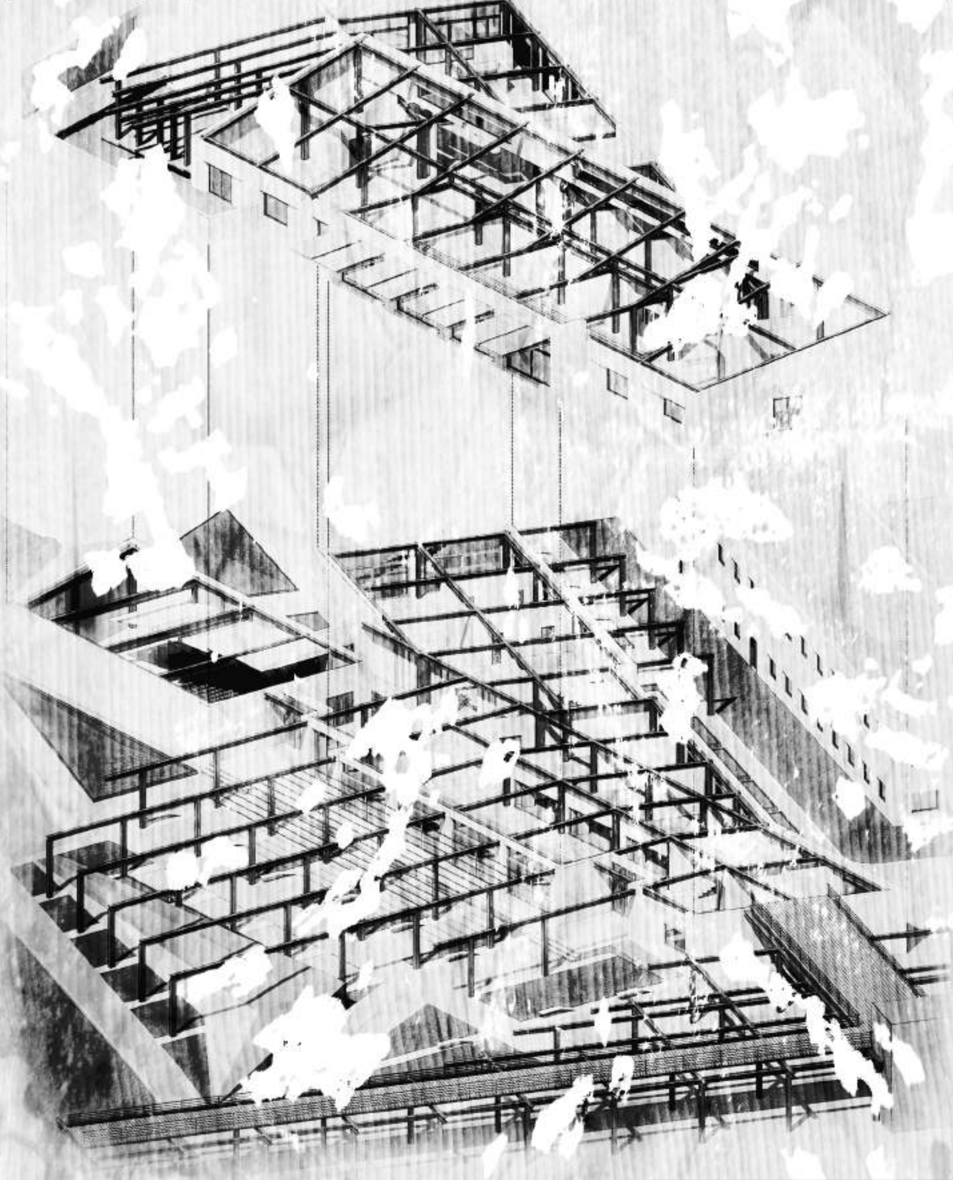
[re]claiming the body politik

ursus energy recovery centre

Warsaw, Ursus | MArch Stage 2 | Sotiria Sarri



technical strategy

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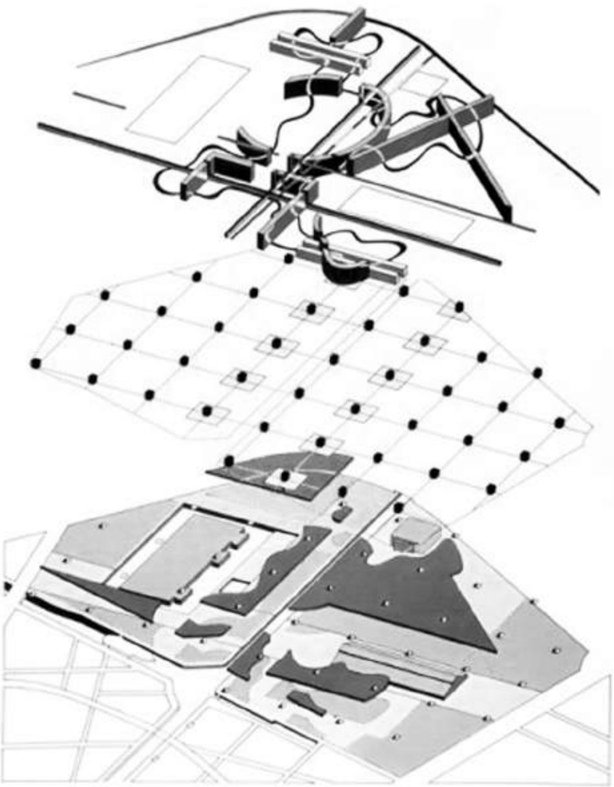


Tschumi's Parc de la Villette, an honest relationship between subject and object, acts as a frame for cultural interactions.

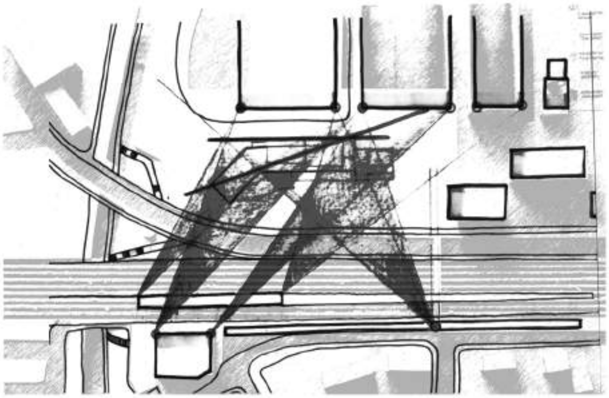
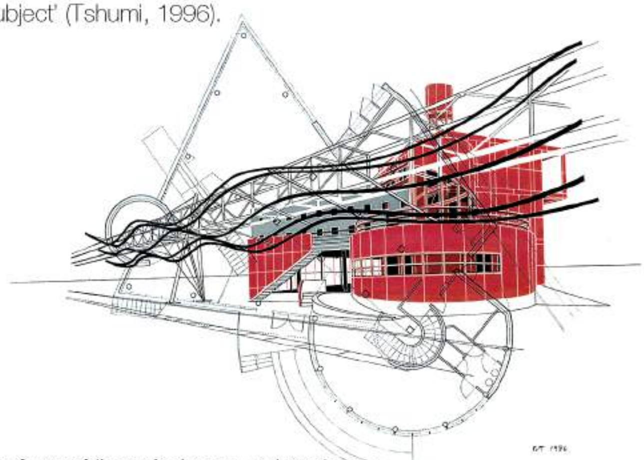


Diagram superimposing visibility axes and revealing structural grids

The concept of sequences, a key theory established by Bernard Tschumi, drives my approach to structure, construction and tectonics as well as design. Tshumi's consideration of **transformational, spatial and programmatic sequence** brings with it structural implications for the building. Sequences of spaces and sequences of events, in other words, the **facilities, resources and utilities of the building, are totally interdependent, fully condition and reinforce each other.**

Superimposition is used as a key device to test the **'in-between'** condition via the juxtaposition of two different **structural grids**. The dualisms between structure (frame), form (space), event (function), body (movement) and fiction (narrative) are blurred using superimposition, collision, distortion and fragmentation.

As with Tschumi's 'Parc de la Villette', the scheme requests from the user a **self critical program of reflection and progression**, one of a **cultural-space narrative**, which will release the subject to 'reinvent him or herself as a new subject' (Tshumi, 1996).



The frame of the park changes and reacts to the functions that it holds within.

_structure

_STRUCTURAL THEORY

Diagrammatic hybrid collage depicting the 'in-between' nature of elements

The concept of structural superimposition and individual customization is vital in assuring that the users project their own meaning onto the building itself. Emanating from my architectural discussion, I believe that **architecture can empower the community by promoting the ability of renewal, mutual exchange and [re]production**, with the latter being a continual updated/proactive ability to change through 'action' upon empty, unused 'voids'.

The standardization and flexibility of the building's components promotes the **'open source urbanism'** concept. A **robust frame**, to which temporal and permanent partitions can be attached, is required. Different configurations of space allow for a continual **physical and visual communication** between the superimposition of spaces. In this way, a **dialogue** between the function and the form of the building is created and the **"in-between"** nature of elements is emphasised.

_STRATEGY SELECTION

Steel Frame Structure

The chosen structural strategy is a **steel frame construction** with areas of **reclaimed brick cladding** and **corten steel**.
The use of steel enables long clear spans necessary for an easily erected structure sitting on an industrial metal dominated site.

The industrial heritage of Ursus and the aluminium factory (ASMET) facing the scheme, means that steel is locally available and that there is skilled labour force available to construct the buildings. Additionally, steel can be **reused** or **recycled** when the building is replaced or modified.

The steel structure is **exposed**, reflecting the principle of openness and visibility implemented throughout the building. Furthermore the building can be easily assimilated within its social and physical context since the workforce available on site is **familiar with the manufacturing of steel components**, the **erection of structures** on-site and the **tectonic connection of elements**.

The use of brick acknowledges the **historic importance** of the material on site and around the city. The material can be locally **recovered from the derelict iron foundry** and there's a highly skilled labour force available for its construction, maintenance and conservation.

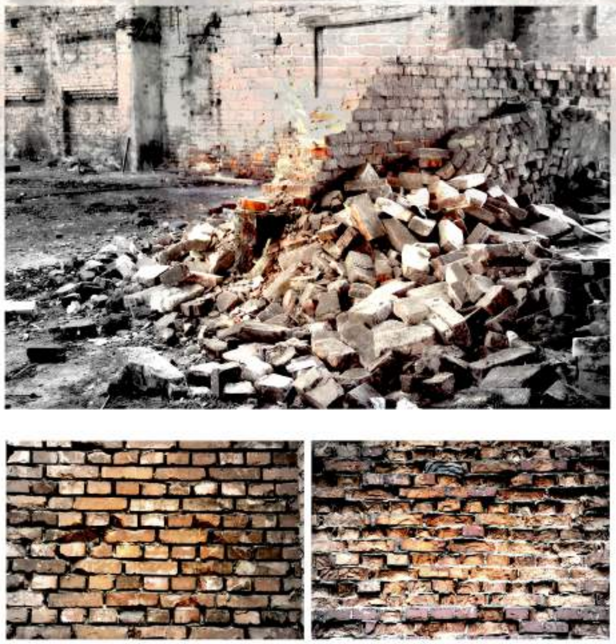
The chosen strategy for the roof is a **metal standing seam system** (e.g. Kalzip) finished with zinc.
The structure is also **visible** to the building's users, just like the steel frame of the walls.

_structure

_STRATEGY DEVELOPMENT

Existing Fabric

As already mentioned, manufacturing skills in Ursus over the years have been primarily focused upon the steel industry and this is where the **existing skills-base remains.** However, many **derelict existing brick buildings** on-site are significantly **decayed** and some parts of them require **removal.** These bricks can be **recovered and utilized** for the building's construction.



Decayed/Damaged brick walls on site that can be reclaimed

Reclaiming Bricks

Brick is a predominent exposed material of the site's derelict buildings. Utilizing reclaimed bricks not only helps the building to **remain in character with its surrounding environment,** but also it seeks to **limit environmental impact.** The process of recycling bricks incurs a **smaller carbon footprint** than using new bricks with their associated production and firing processes. **Energy is saved** in processing and manufacturing when re-claimed bricks are used. Furthermore, bricks are **sourced locally,** promoting a sustainable approach to energy consumption. Such recycling also reduces requirement to **transport** and **dispose of** waste.

Reclaiming the bricks_Process

1. A club hammer and bolster chisel is used to cut into the mortar bed between the bricks.
2. Using the bolster the brick is tapped harply with the hammer and the mortar come off.
3. Final cleaning off is done with a wire brush.
4. The cleaned bricks are stacked and ready for reuse.

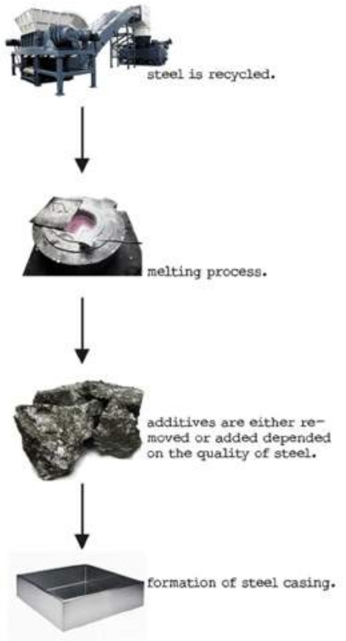
_structure

_STRATEGY DEVELOPMENT

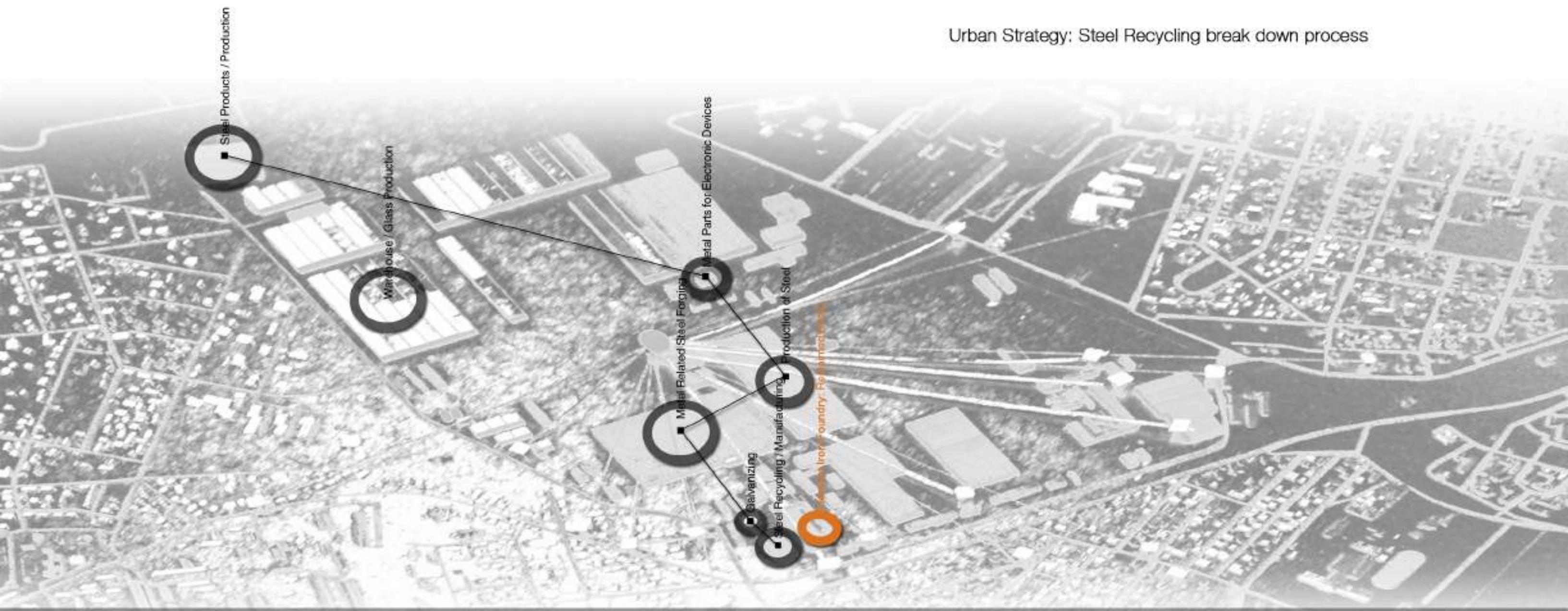
Source

Warsaw, after becoming a major industrial centre, has a large **resource of steel**. Due to bankruptsy, today the Arcelor Warszawa Steel Mill (formerly Huta Warszawa) is the only major factory remaining.
However, on site there are many companies dealing with **steel recycling, manufacturing, distribution, forging and galvanizing.**

Reconsidering Ursus as a **self-sufficient district**, the urban strategy proposes the recycling of steel on site from existing actors in order to produce **new construction materials** or be utilized as a **first source in the development of innovative technologies.**



Urban Strategy: Steel Recycling break down process



_structure

_MODULARITY

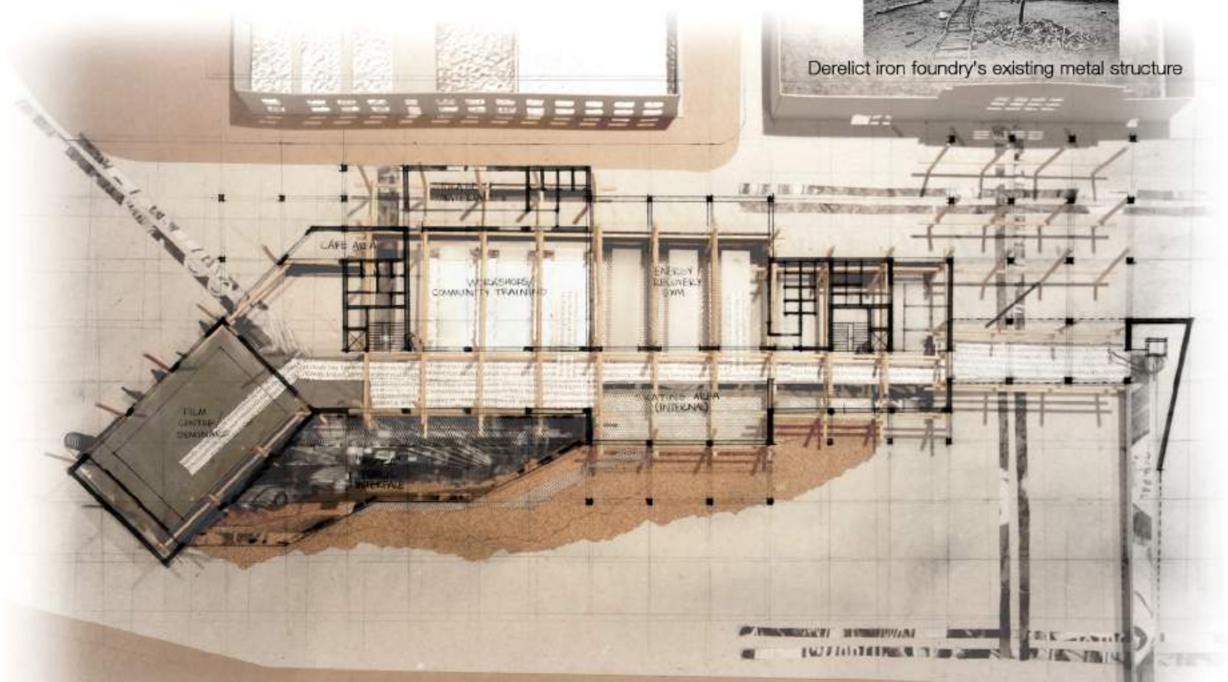
EXISTING SITE CONDITIONS

Military industrial buildings, such as the derelict iron foundry surrounding the scheme, where typically constructed following pattern books; an early example of standardization. The dimensions, orientation and alignment of the building's surrounding the site, exhibits a distinct **modular gridiron pattern** of approximatelly 6 metres. This instantaneously establishes the building's **structural language**, **rhythm** and the **vertical grid**, which is informed by the derelict's internal structural columns. Furthermore, the **diagonal grid**, which is formed by the analysis of visual axes on site, breaks the building's modularity, openning up to the main courtyard space and enabling a **transformative facade.**

STANDARDISATION

The standardized dimensions of the building's fabric, means that the structural intervention of the proposed framework could over time expand to the surrounding buildings to regenerate them. It also ensures the **reversibility of the scheme** and the **recyclability** of most of its materials.

Derelict iron foundry's existing metal structure



Developmental model at 1:200 scale testing the building's structure and relationship with existing buildings

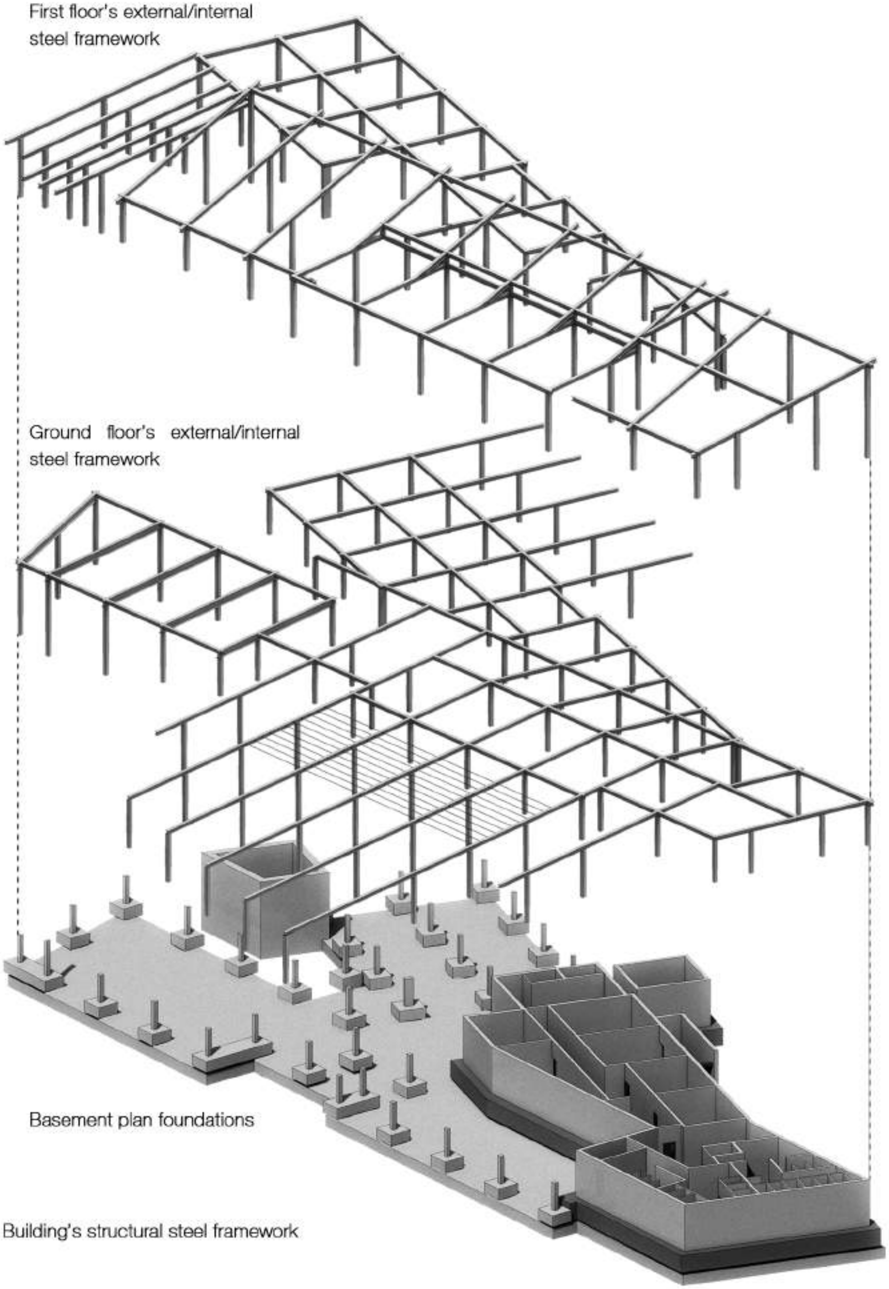
_structure

_STEEL FRAMEWORK

The structural design is initially generated from the **modularity** of the derelict building's internal structure.
The new framework provides a structure to be infilled with **temporal workshops**, **recreation** and **exhibition spaces** from the inside out.

This framework, on the left extends back to physically merge with the aluminium factory which programmatically supports the workshops, while on the right side, it forms a regeneration platform for the transformation of the derelict iron foundry into a research centre for renewable technologies.

The connections to the front and rear of the building are **lightweight walkways**, which have minimal impact to the whole structure.

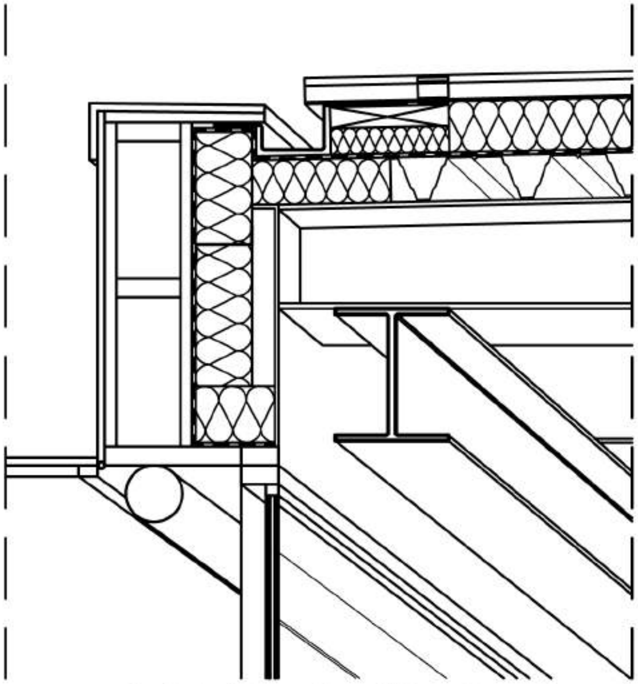


Building's structural steel framework

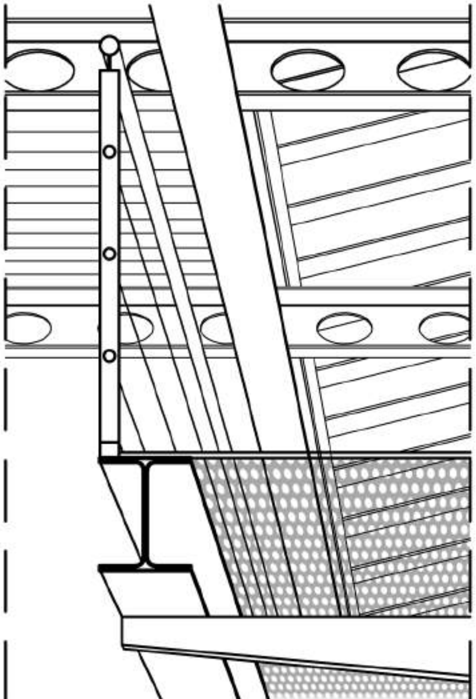
_structure

_STEEL FRAMEWORK_BUILDING DETAILS

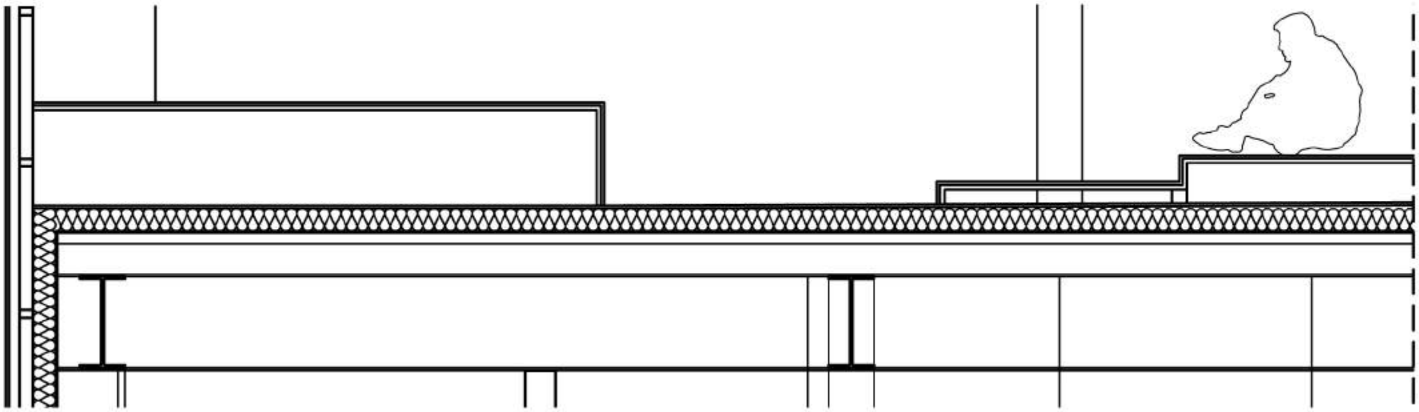
The following drawings illustrate some typical details for the steel frame constructed inside the building.



1:20 structural facade detail with metal beam HEB 350. The steel framework is visible and offset from the building's facade to allow for maintenance



1:20 Structural detail of the perforated metal walkway. The lightweight perforated metal walkway, has a minimal impact to the whole structure and the cellular beams utilized save weight of up to 30%.



1:50 film centre's steel structure with metal beam HEB 600

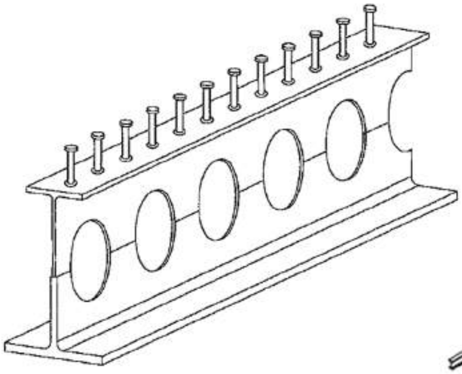
_structure

_STEEL FRAMEWORK

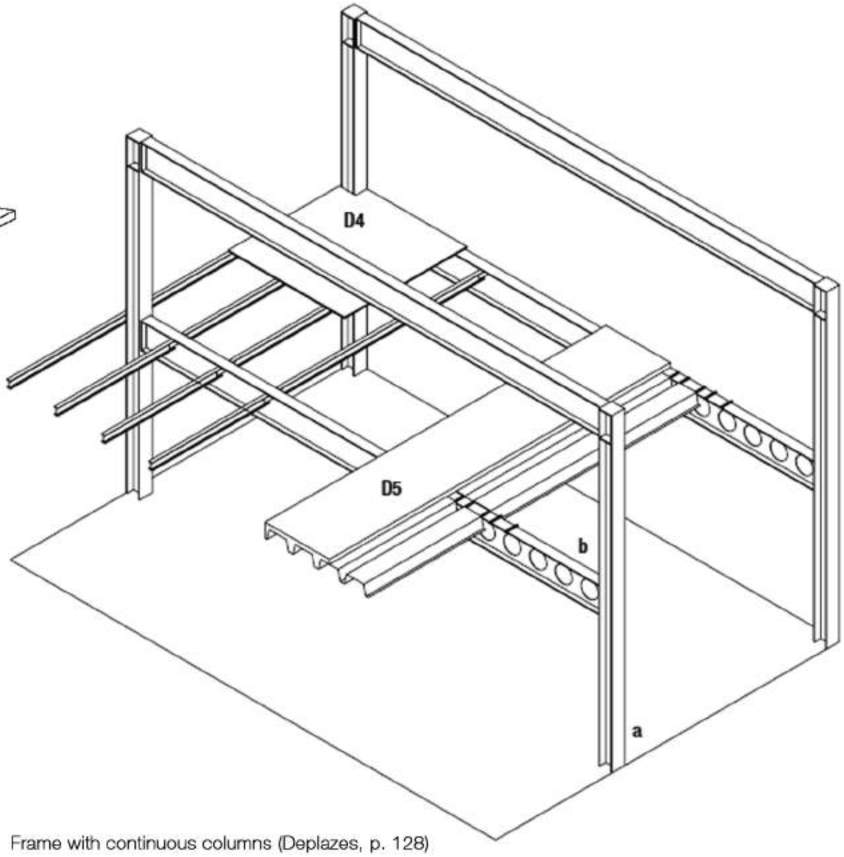
The loadbearing structure consists of **a series of frames with continuous columns**. The steel framework is **offset** from the building's facade, in order to be visible to the users and facilitate maintenance.

Holes are required in the beams to accommodate services transverse to the frame.The services are distributed over the full length of the **cellular beam**. An advatage of such perforated beams is the saving in weight of **up to 30%**.
A ribbed slab is also situated, comprising of trapezoidal profile metal sheets suspended between the main beams plus a concrete infill/ topping. Studs welded to the beams beforehand guarantee the composite action between floor and primary structure.

The following drawings illustrate some typical details for the steel frame constructed inside the building.



Cellular beam: Example with different top and bottom flanges to save weight (Deplazes, p. 129)



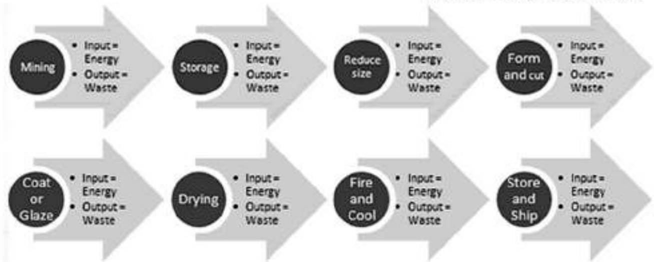
Frame with continuous columns (Deplazes, p. 128)

_structure

_SUSTAINABILITY

The building, **promoting and showcasing a model for a sustainable way of living**, adopts sources of renewable energy and works (for its bigger part) with **local skills and processes** to achieve a social and environmental sustainability. Parts of the intervention (bridge's structural panels, workshops and energy cycling recovery) are **adaptable** increasing the **longetivity** of its lifespan and the ecological value of the embodied materials. As proposed in the urban strategy, the building also uses, wherever possible **recycled and reclaimed materials**, such as metals and bricks. This offsets the ecological expense of any new energy-intensive materials (such as concrete being utilized for foundations, flooring and foundations), which cannot be reclaimed.

Manufactured Bricks



Reclaimed Bricks

_construction

_CONSTRUCTION STRATEGY SELECTION

"We are not dealing anymore with the technology of construction, but with the construction of technology".

Paul Virilio

Diagrammatic hybrid collage illustrating the building's main construction materials, cor-ten steel and reclaimed brick

The building's construction consists of a steel frame structure with reclaimed brick, cor-ten steel and glass skin.

As already mentioned, the materials have been chosen for a number of reasons including:

-Availability of **skilled workforce**, including the social significance of steelwork in Ursus, given its **industrial history**

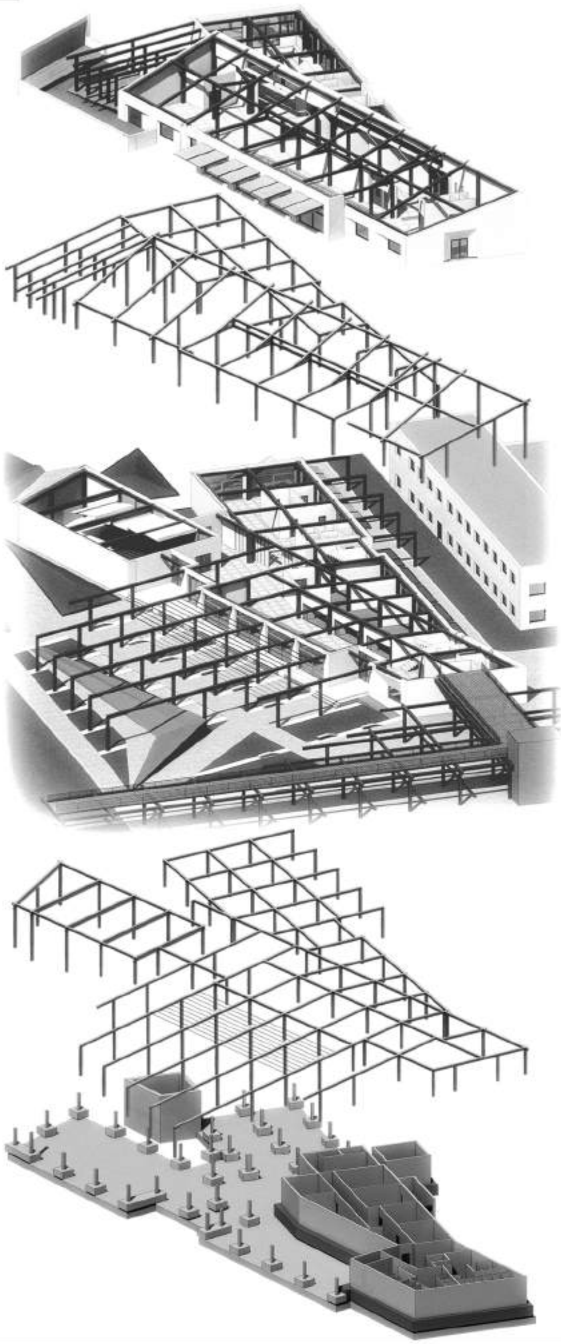
-Availability of **local materials/products**

-Acknowledgement of **historic/cultural significance of context**, including historic brick buildings adjacent to the proposal

-The energy recovery and steel-related workshop and community training facilities are visually reinforced via the **exposure of the services** and the **steel frame structure**

-Materials can be **recycled or reused** when the building is replaced or modified.

_CONSTRUCTION SEQUENCE



G. External Works

1. Site works [Embankment fill, Landscape planting installation (StabiliGrid System), Installation of Cor-ten steel stripes]
2. Drainage
3. External services

F. Services

1. Sanitary applications
2. Disposal installation
3. Mechanical installation
4. Geothermic installation
5. Electrical installation
6. Lift installation

E. Internal Finishes

1. Wall finishes
2. Floor finishes
3. Ceiling finishes

D. Superstructure

1. Metal frame
2. Upper floors
3. Roof (Kalzip roof)
4. Stairs
5. External walls (after reclamation and cleaning of bricks)
6. Windows and external doors
7. Internal walls and partitions
8. Internal doors

C. Substructure

B. Excavation Works

1. Laying the foundations
2. Rehau ground-air heat exchange system's installation
3. Geothermic installation works begin

A. Site Reconnaissance and Clearing of Site

_ADAPTABILITY_DECONSTRUCTION

Adaptability

The structural strategy allows the building's occupants to adapt their space according to climatic and economic requirements. The internal finish of the frame can be changed according to the requirements of the workshop/gym units. The intend of doing that is to **return autonomy and control back to manufacturers and traders, as well as to activate and educate the local community.**

Panel System

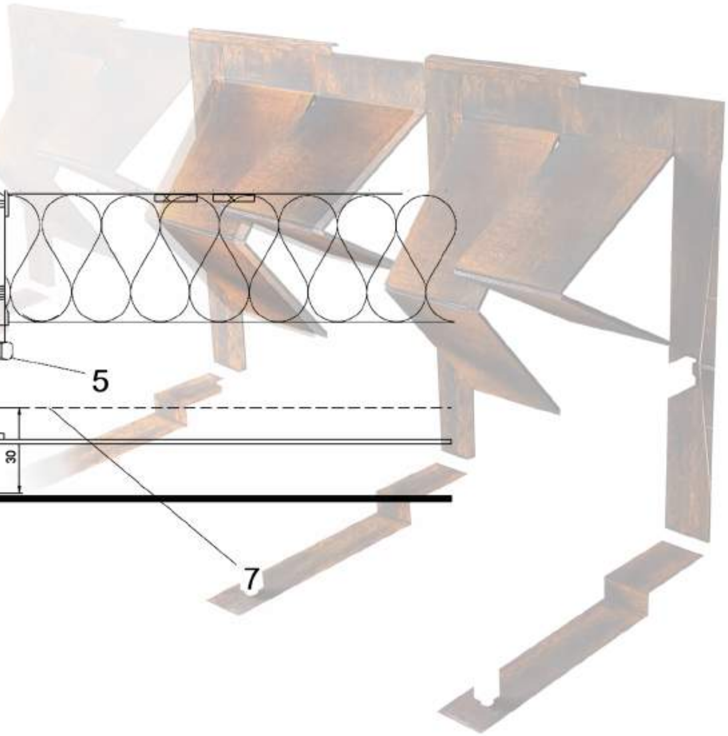
The following detail illustrates the simple system for fitting the panels into the steel structure. The pre-fab cor-ten steel panels are adjusted in the facade's structure and welded together, leaving a small gap for aesthetic reasons 'in-between'. In the areas were screws are placed, **galvanized elements** are utilized in order to avoid electrochemical corrosion.

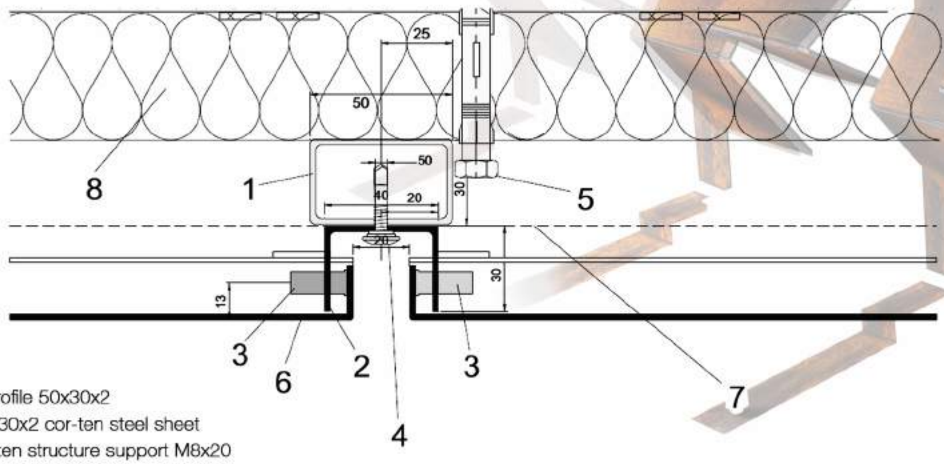
Sustainability

In order to reduce environmental impact, the beam sections will be **bolted together** rather than welded, wherever possible. The use of bolted joints and flexible cor-ten steel panels along some parts of the building's facade, allows future **reuse/ reappropriation** of the building's components.

Deconstruction

The steel junctions almost all use standard steel bolt fixings, provided from the **aluminium factory** on the rear of the site, allowing for future adaptability. These skills in fixing are very **familiar** and **fast for the local workforce to implement.**





1. galvanized profile 50x30x2
2. U-profile 30x30x2 cor-ten steel sheet
3. Stainles cor-ten structure support M8x20
6. Cor-ten steel sheets
7. Waterproofing membrane
8. Insulation

_LANDSCAPE CONSTRUCTION SYSTEM

Recycled-pe pervious pavement grid system

Stabiligrid is an economical, easy-to-install, load bearing pervious-pavement lattice grid. It is an environmentally sound alternative to pavement, effectivelly reducing storm-water runoff and allowing the underground soil to absorb and process environmental toxins, such as cadmium, copper, lead and zinc, and preventing the contamination of ground water. Stabiligrid also reduces soil erosion, preserving vegetation and natural habitats.

It is lightweight but highly durable, and may be adjusted to fit existing contours using standard tools, such as an angle grinder or circular saw. The grids are typically laid on a 1 to 4 inch gravel base, depending on the porosity of the substrate below. The grid can be backfilled with gravel, sand, or top soil for vegetated surfaces. The grid reduces both storm-water runoff and the urban heat island effect.

Since landscape is both an important functional and aesthetic part of the scheme, stabiligrid is an ideal solution for its low-cost and fast construction. Through landscaping the external area with stabiligrid system, a microclimate and a natural cooling of the air is achieved.

Application methods

_construction

_SKY COURTS / Höweler + Yoon Architecture

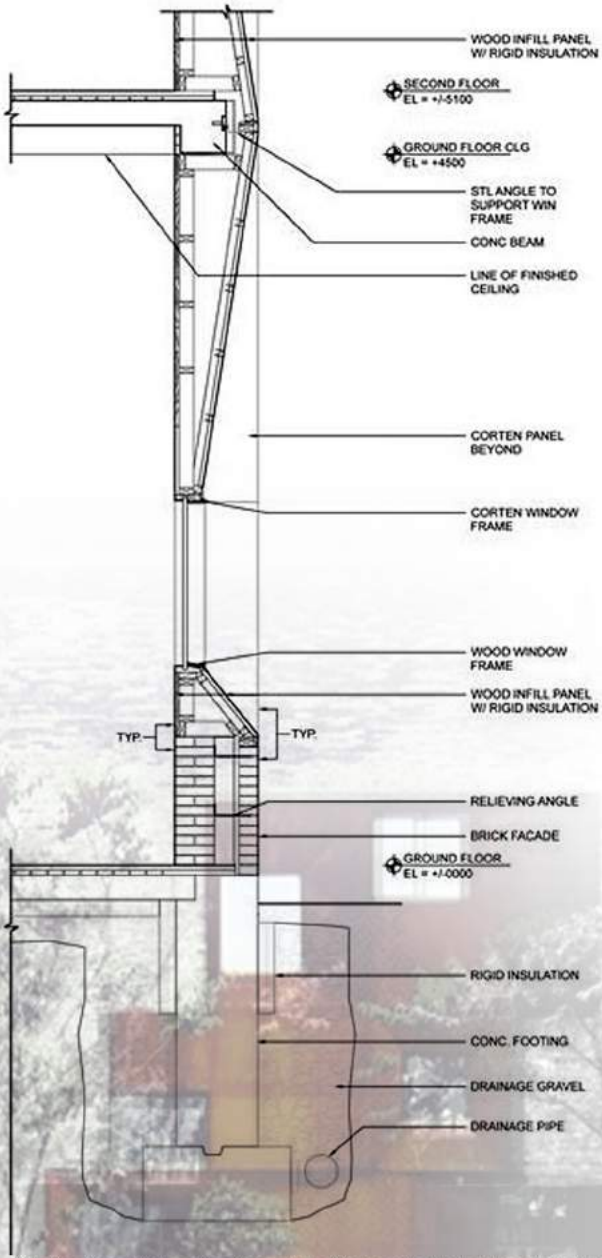
Similarly to my proposal, this scheme becomes a **network of spaces** linked together by **multiple paths**, producing an exhibition hall that is at once open and sub-divided. The sequence through these precincts creates a **series of layered spaces** where one can view from one courtyard to another and another—seeing from inside to outside to inside again.

The brickwork is detailed to emphasize the tectonics of the brick as a building module as well as the oblique geometries of the building.

The windows and exterior doors are **clustered** on the facades to create a larger figural composition. Using economical and typical window and door sizes, these apertures are packed together using **facetted Corten steel 'window surrounds.'**

The figural surrounds negotiate between the scale of a window and the scale of the large exhibition hall, providing an intermediate scale that approaches the **tactility** found at the level of the masonry detailing.

Construction facade materials: Brick and corten steel



Construction detail section through the Corten steel 'window surrounds' _construction

_CDM CONSIDERATIONS

[approaching the site from the bridge]

The new connection facilitates movement to and from the train station into the scheme. The scaffolding used for its construction will act as a first step for the regeneration of the derelict iron foundry surrounding the site.
It is designed to work as a structural continuation of the derelict building and providing the platform for its regeneration.

_CDM CONSIDERATIONS

CDM in construction:

The project must have a **CDM coordinator** appointed from the very beginning and workers must be properly trained, equipped with appropriate **PPE** and informed on hazards and risks on site.

Special care must be taken around **excavations** for the foundations and when working at **height**, such as assembling the steel frame or working on the roof.

CDM in maintenance:

Site

No major risks are associated with the building in use. For maintenance work at high level, **safety harnesses** and **appropriate scaffolding** should be available.

The site and building are structured to keep **noisy, heavy industry to the north** and smaller scale **recreational productivity to the south.**
Deliveries take place to the rear of the site, next to the aluminium factory, and can be moved directly into storage to avoid public's interaction and materials in transit.

After construction work is complete, access is provided via **external stairs** to the plant rooms for **maintenance and cleaning works.**

Awareness

Functioning as a community training and recreational centre, part of the building's responsibilities should be not to only **practice**, but also **educate the workforce** in health & safety best-practice and procedures. Provision for **first-aid facilities**, locker rooms and a full-time site manager are located in the administration area. **Protective clothing** should be warn at all times during the construction, maintenance or reconfiguartion of the building.

_construction

_CLIMATIC CONSIDERATIONS

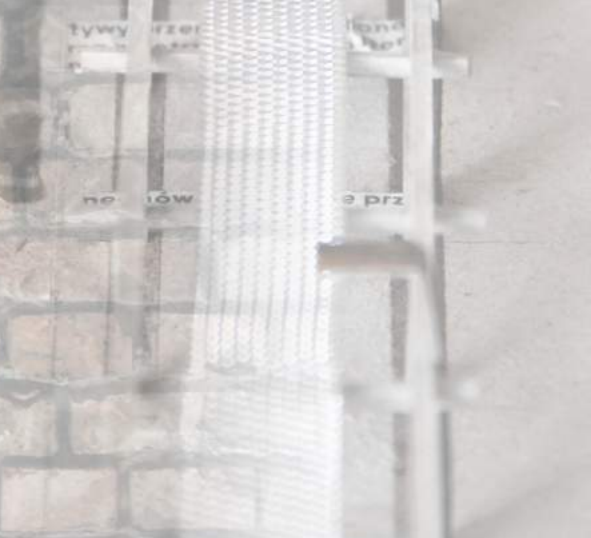
Temperature

Ursus has an average annual temperature variation between -6°C and 24°C. Therefore, **movement joints** have been encorporated in the junctions between steels, and especially between the steel and brickwork to allow for **thermal expansion and contraction.** The design of the roof is also affected from the high levels of snowfall, which has a deeper gutter and parapet to gather the levels of snow being concentrated.
Furthermore, the **materiality of the building** has been adapted to suit the fore mentioned conditions. The **perforated steel walkways** along the bridge and the cor-ten steel stripes of the landscape allow snow to drain through to the **drainage** channel, making the walkways accessible at all times.

Weathering

Since most of the materials are recycled and reclaimed, they can be considered as **pre-weathered**. The **imperfections** of the materials are left evident to **celebrate the recycling, reuse process** and to **merge harmonically** with the existing industrial landscape.
COR-TEN steel has enhanced **better atmospheric corrosion resistance** when compared with ordinary carbon steel. However, since the site is exposed to various weather conditions, a **high grade antioxidant primer coating** is applied to protect against further atmospheric corrosion in Ursus's industrial climate.

Collage of layering recycled preweathered materials used in the building's construction
_Cor-ten Steel and Brick



The perforated steel walkway along the bridge makes it accessible at all times

_environmental

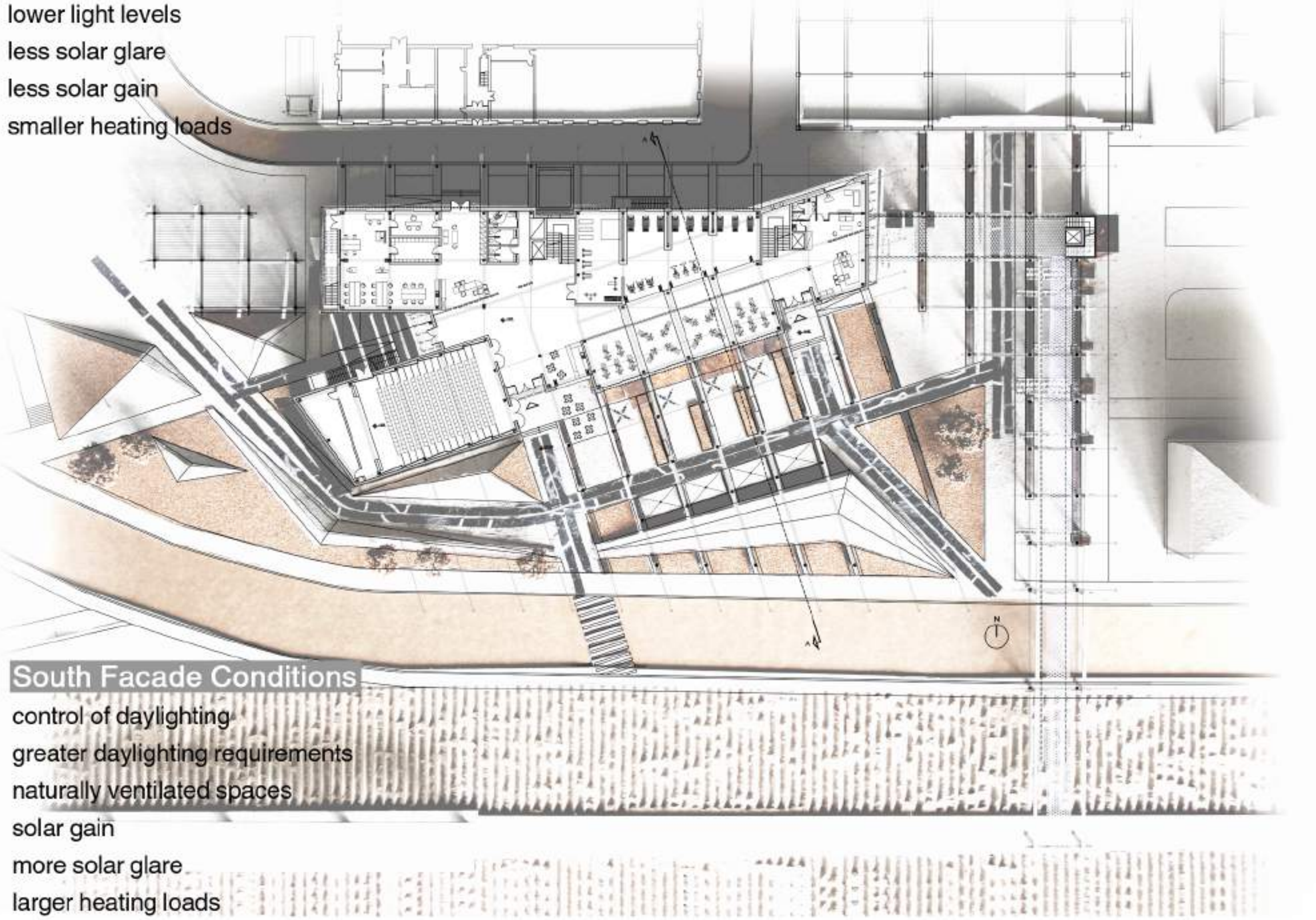
_ENVIRONMENTAL STRATEGY SELECTION

The building's spatial programme is heavily influenced by environmental considerations such as daylighting conditions. This is because the building utilizes **passive strategies** for heating, cooling and ventilation to minimize its energy consumption.

The North and South Elevations of the scheme are substantially open, using glazing and external screens to enclose space. Both visible elevations are clad with a series of modular perforated "cassettes" or panels. These subdivide the elevations into panels that are 3,75m high, 2,5m wide. They are made of 20mm thick COR-TEN steel that is perforated in the broad face to **permit light and air to pass through**. The **'agora'**, the main public interface area, is placed in the **south east part** of the site for maximum environmental gains.

North Facade Conditions

lower light levels
less solar glare
less solar gain
smaller heating loads



South Facade Conditions

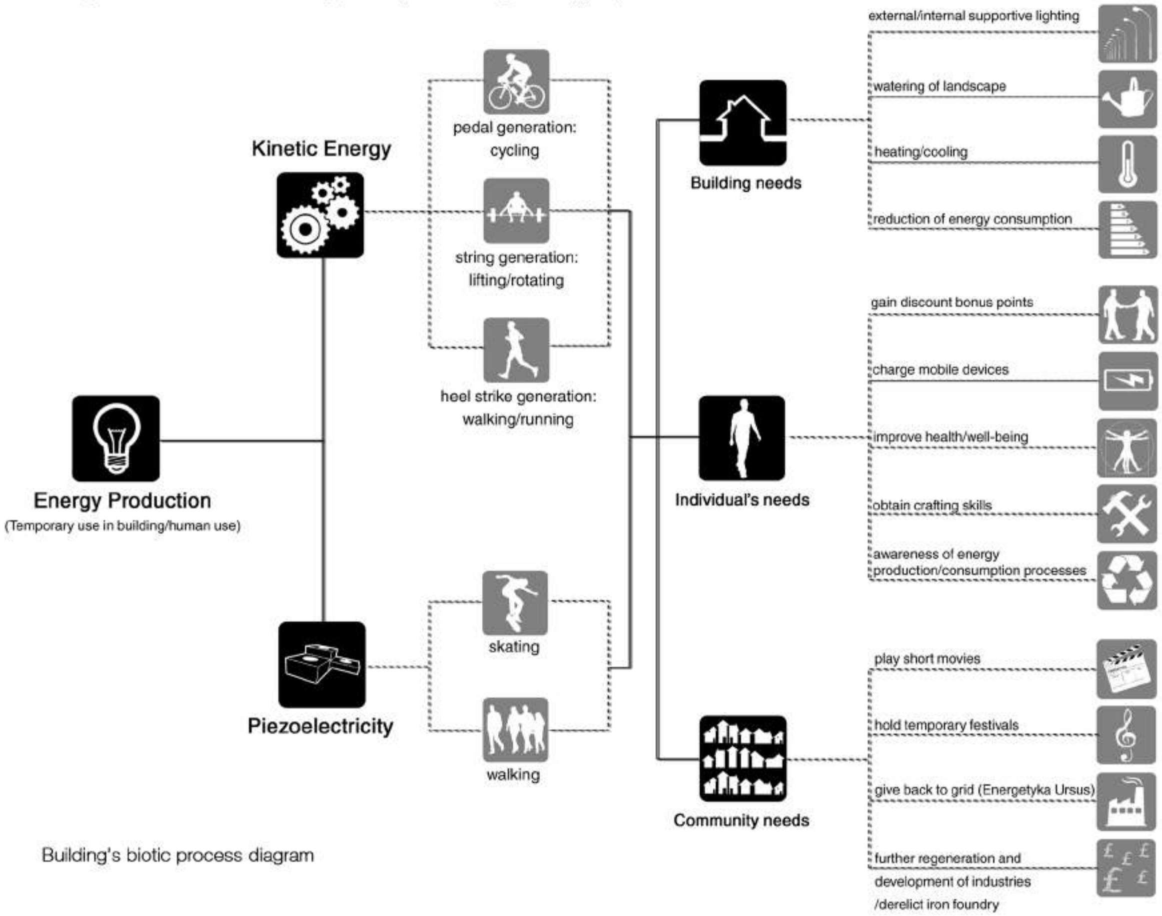
control of daylighting
greater daylighting requirements
naturally ventilated spaces
solar gain
more solar glare
larger heating loads

_environmental

_ENERGY STRATEGY

Heating and Power

The building, being an **energy recovery centre**, aims to **consume as less energy as possible**. Through the energy recovery gym and cycling units along with the proposed external and internal piezoelectric paths and photovoltaic panels, the scheme **covers 70% of its own energy needs.** Due to the use of geothermal energy, there are great gains in energy consumption as well. The building provides supportively with energy its own power loop, while it gives back to the grid as the capacity of its spaces increase. Furthermore, the project's **bioclimatic design**, with big openings on the south and smaller on the north, also saves energy.
The scheme also has the **ability to power temporary community events/festivals and the projection of short movies in the film centres.** The power provision to the site is **oversized**, allowing for the **building's future expansion and connection** into the derelict iron foundry as the renewable energy companies begin to appropriate it.



Building's biotic process diagram

_ENERGY STRATEGY_A SCENARIO

Spatial areas in total

Administration	206 m^2
Energy recovery gym	388m^2
Workshops	236 m^2
Film Centre	300m^2
Media Library/Resource space	228m^2
Media Gallery	230 m^2
Cafe/Kitchen/Eatery	45 m^2
Changing Rooms (Male/Female)	111 m^2
W.C.	80 m^2
Circulation	833 m^2
Plant room	166 m^2

According to *"HVAC Equations, data and rules of thumb"*, (Arthur A. Bell, JR. second edition 2008), the following calculations have been made:

- Calculation for cooling and ventilation power supply:

Energy recovery gym = 388 m² x 250 W/m² = 97.000 W
Changing Rooms = 111 m² x 126 W/m² =13.986 W
Administration = 206 m² x 126 W/m² = 25.956 W
Circulation = 833 m² x 160 W/m² =133.280 W
Workshops = 236 m² x 126 W/m² = 29.736 W
Cafe- Kitchen/Eatery = 45 m² x 160 W/m² = 7.200 W
Film Centre = 240 seats x 180 W/seat = 43.200 W
Media Library = 228 m² x 126 W/m² = 28.728 W
Media Gallery = 230 m² x 126 W/m² = 28.980 W

TOTAL: 408 KW

Due to the use of geothermal energy though, the total demand for cooling and ventilation is reduced in:
408/4,5=**90 KW.**

- Similarly, the calculation for heating's power supply:

Energy recovery gym = 388 m²
Changing Rooms (Male/Female) = 111 m²
Administration = 206 m²
Circulation = 833 m²
Workshops = 236 m²
Cafe- Kitchen/Eatery = 45 m²
Film Centre = 300 m²
Media Library/Resource space=228 m²
Media Gallery = 230 m²

TOTAL SPACES = 2.577 m² x 160 W/m² = 412 KW
Due to the use of geothermal energy though, the total demand for cooling and ventilation is reduced in:
412/4,5 = **92 KW**

_ENERGY STRATEGY_A SCENARIO

- Calculation for lighting's power supply:

Energy recovery gym = 388 m² x 9,6 W/m² = 3.725 W
Changing Rooms = 111 m² x 6,4 W/m² = 710 W
Administration = 206 m² x 16 W/m² = 3.296 W
Circulation = 833 m² x 6,4 W/m² = 5.331 W
Workshops = 236 m² x 16 W/m² = 3.776 W
W.C.= 80 m² x 6,4 W/m² = 512 W
Cafe- Kitchen/Eatery = 45 m² x 8 W/m² = 360 W
Film Centre =300 m² x 3,2 W/m² = 960 W
Media Library = 228 m² x 16 W/m² = 3.648 W
Media Gallery = 230 m² x 6,4 W/m² =1.472 W
Plant room =166 m² x 6,4 W/m² = 1.062 W

TOTAL: 25 KW

TOTAL Power Supply: 90+92+25=207 KW

Taking into consideration that the building will operate two days a week for 12 hours and for 5 days for 6 hours, the total annual energy need will be:

[(2x12x207x0,60)+(5x6x207x0,60)]/7x365=

350.000 KWh

*(*0,60 is the reduction factor taking in mind that not all building's systems will function at the same time and also that the environmental conditions will vary)*

_environmental

_ENERGY STRATEGY_A SCENARIO

Calculation of building's energy production:

A. Photovoltaic Panels

The installation of PV panels requires a 30 degrees inclination of the 650 m² roof's surface. The coverage therefore is:

650 x 1,30 (due to slope) = 845 m²

Number of PV Panels: 845m²/1,5 = 563 panels

Power=563 panels x 250W/panel = 140 KW

In total the annual energy production from the PV panels is:

135.000 KWh

B. Piezoelectric Tiles

Assuming that at a first stage 50 piezoelectric tiles will be placed in the building's interior, between the main circulation corridor and the film centre's foyer, as well as 100 tiles in strategically defined areas of the external space for their maximum performance.

As already identified and analyzed in the urban strategy, the energy production is associated with weight and it is calculated at the rate of 6W/footstep.

The building's concentration of people is calculated as following:

Energy recovery gym =388 m² x 5 = 78 people

Administration = 3 people

Circulation- Cafe- Kitchen/Eatery =833 m² + 45 m² /1,10 = 798 people

Workshops = 236 m²/5 = 47 people

Film Centre = 240 people

Media Library = 228 m² /1,10 = 207 people

Media Gallery = 230 m² /1,10 = 209 people

TOTAL max number of people:

1.582 people

Supposing that the building will accommodate two days per week 1.000 people, while rest five 500 people, and that every individual will step on the 35% of the tiles, then:

Energy production: (2 days x 1.000 people x 150 piezoelectric tiles x 6W x 1h x 35%) + (5 days x 500 people x 150 piezoelectric tiles x 6W x 1h x 35%) /7 x 365 =

73.000 KWh.

Calculation of building's energy production:

C. Pedalling and fitness devices

There is provision for 16 energy recovery bicycles externally, in the public interface area and for 24 internally, in the energy recovery gym. Furthermore, 20 additional points are provided for exercise and production of electric energy via assorted weights, wheel rotating, treadmill running and piezoelectric matress exercise.

In total: 16+24+20 = **60 exercise points**

An average adult who works out every day can put out between **100 and 150 Watts** of power for an hour. Kids under 12 can put out **50 to 100 Watts** of power for an hour. Someone who is a competitive cycler can put out up to **500 Watts** *(http://www.pedalpowergenerator.com/index.html).*

Therefore, if we assume that the building will operate for two days twelve hours and for five days per six hours and that from the 60 exercise points, 40 will be used by adults, 10 from kids and 10 from competitive adults, therefore:

Adults: (2 x 12 x 40 x 150 W/h) + (5 x 6 x 40 x 150 W/h) = 324.000 W = 324 KWh
Kids: (2 x 12 x 10 x 100 W/h) + (5 x 6 x 10 x 100 W/h)= 54.000 W= 54 KWh
Competitive adults: (2 x 12 x 10 x 500 W/h) + (5 x 6 x 10 x 500 W/h)= 270.000 W= 270 KWh

TOTAL per week:324 + 54 + 270 = 648 KWh

TOTAL per year: 33.789 = 34.000 KWh

In total the combined calculated electrical energy production per year from the PV panels, the piezoelectric tiles and the pedalling/fitness devices is: 135.000+73.000+34.000=

242.000 KWh

Therefore, at a **first stage**, the building covers approximatelly <u>70% of its energy needs</u>.

_environmental

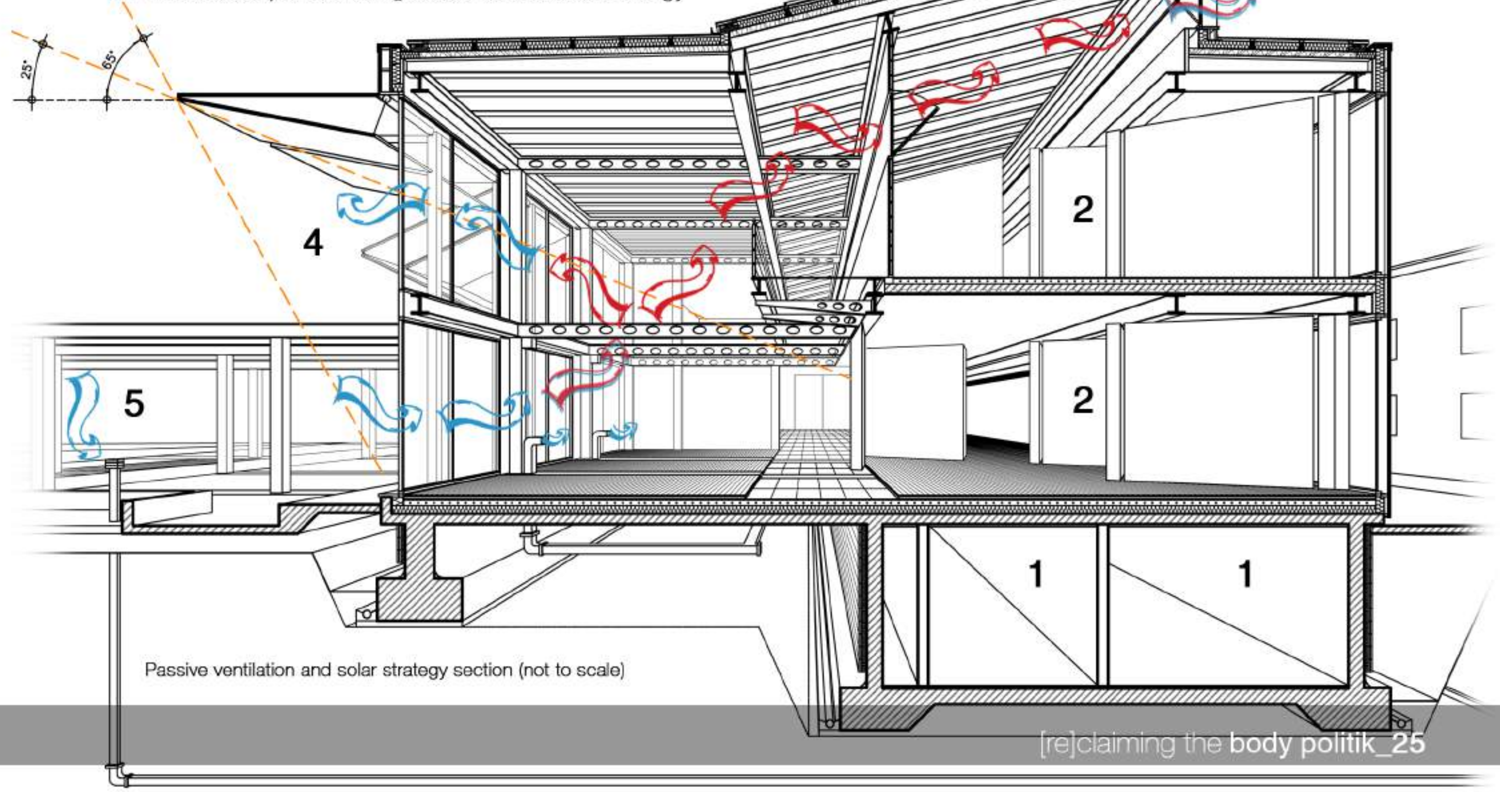
_PASSIVE STRATEGY

The indoor is shaded from the facade's perforated cor-ten steel panels, controlling therefore its daylighting

The building utilises **passive technologies** as a primary response to environmental control. The following section illustrates how **daylighting** and **airflow** are being manipulated to regulate the indoor environment.

The perforated metal panels act as a **solar screen** during summer.

1. Rooms requiring mechanincal ventilation located in areas of **lower air flow**
2. Shallow rooms to north allow **single sided ventilation**
3. **Passive Stack ventilation** through openings to the north
4. South facing facade achieves **solar gain**, heat disperses through masonry and cor-ten steel areas
5. South-east prevailing wind drives **ventilation through the building**
6. **Photovoltaic panels** facing south, absorb **solar energy**



Passive ventilation and solar strategy section (not to scale)

_VENTILATION STRATEGY

REHAU ECOAIR™ Ground - Air Heat Exchange System

The system takes advantage of the more moderate and relatively constant ground temperatures to precondition incoming fresh air, **reducing heating and cooling costs**. It also filters the air and can **lower the relative humidity.**

As incoming air passes through the underground pipes, it is pre-warmed with ground heat in winter and pre-cooled with cooler ground temperatures in summer.

The system requires only a **small amount of electrical power** to operate an air intake fan and provides significant **energy cost savings**, especially when used in conjunction with heat or energy recovery ventilators.

The whole building anavoidably requires mechanical ventilation. A **parallel ductwork** provides the higher air-changes required in separate spaces. However, the film centre requires its own air-handling unit of 20m², situated on the basement. Air is circulated as part of a heating, ventilating, and air-conditioning **(HVAC) system**, which is feeded from the geothermal heat pump. Furthermore, **fan coil** units work supportively during peak temperatures.

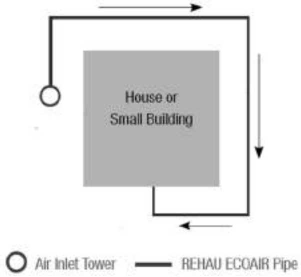
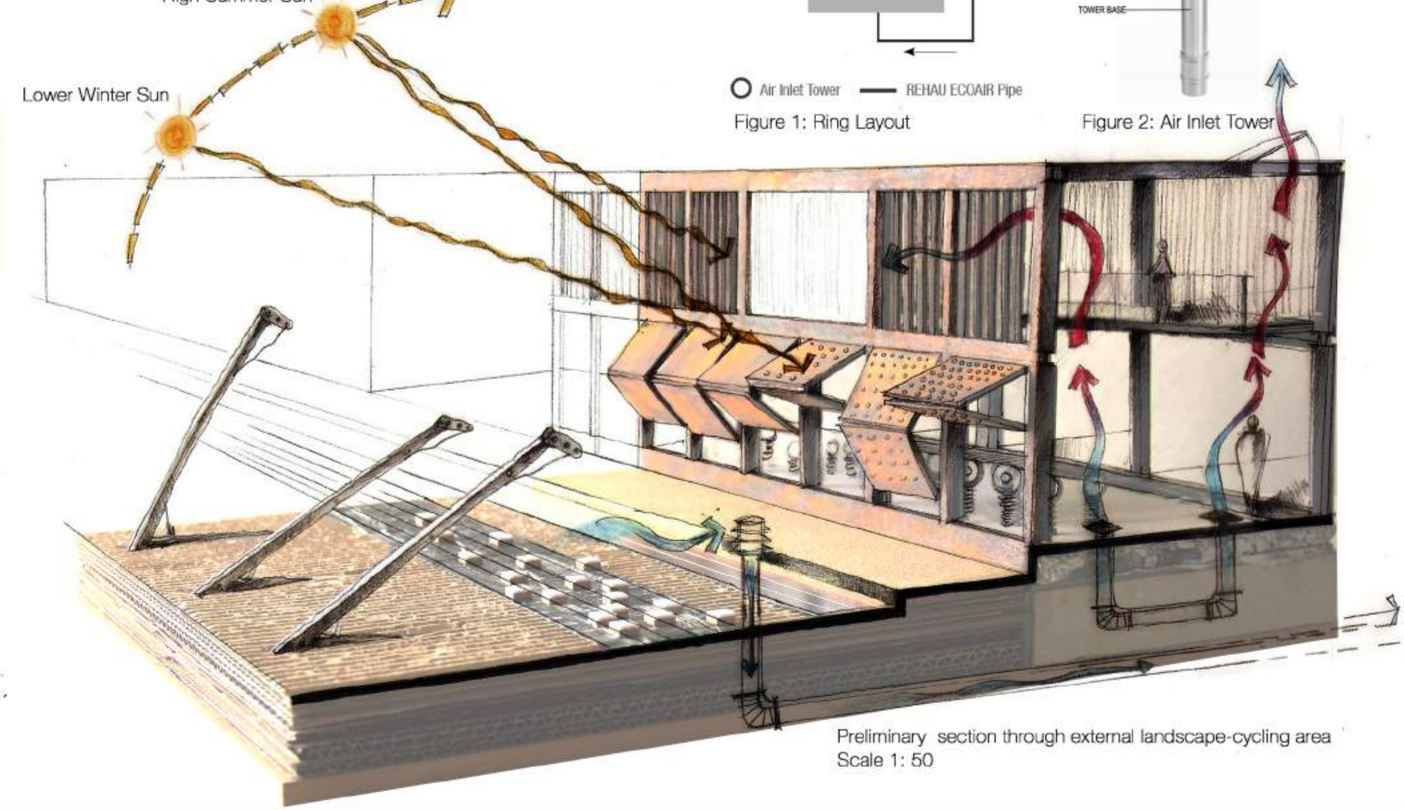


Figure 1: Ring Layout

Figure 2: Air Inlet Tower



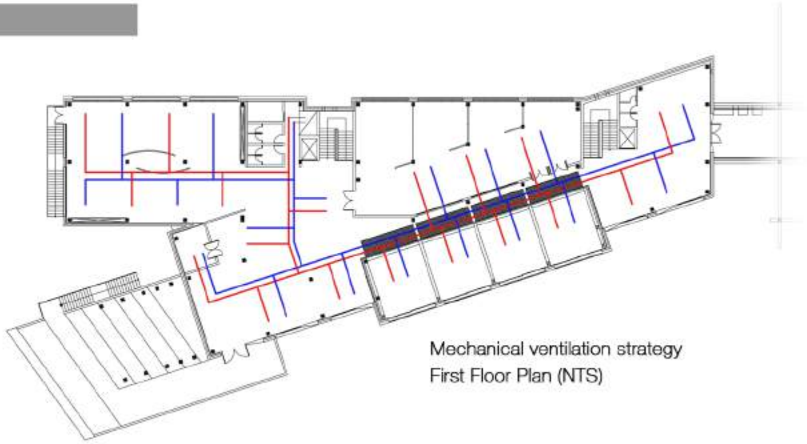
Preliminary section through external landscape-cycling area
Scale 1: 50

_environmental

_MECHANICAL STRATEGY

Ventilation

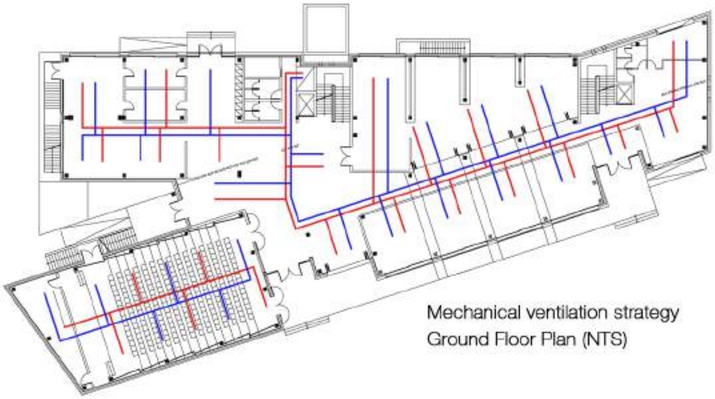
The building unavoidably requires mechanical ventilation, which is situated on the roof of the building. The water which is used to regulate the air in the right temperature is being cooled or heated depending on the weather conditions using the **central geothermal pump** situated on the basement. **Parallel ductwork**, running straight on top of the ceiling, provides the higher air-changes provided in these spaces.



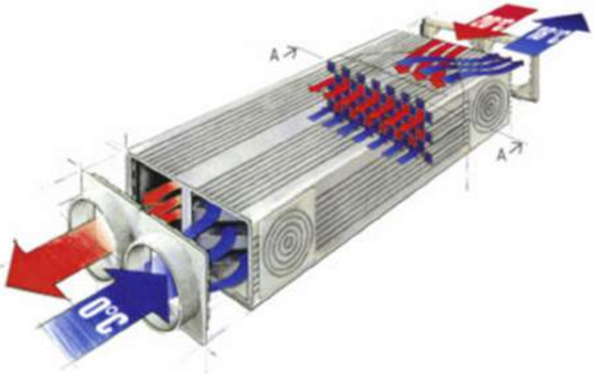
Mechanical ventilation strategy
First Floor Plan (NTS)

Electrical Connections

Every space within the building has its own **separate electrical system installation** to facilitate maintenance, possible updates and repairs. A **perimeter system** runs around the floors and ceiling channels, as required, for **flexible connections**.



Mechanical ventilation strategy
Ground Floor Plan (NTS)



Heat exchange diagram
(http://www.paulventilation.co.uk/)

KEY
- fresh air in
- stale warm air

Mechanical ventilation strategy
Basement Plan (NTS)

_environmental

_HEATING STRATEGY

Underfloor Heating

Underfloor heating is suitable for the ground and first floor of the building since it does not affect internal partitions. It is combined with **geothermal energy** and the pipes can be heated using a compatible **electric boiler**. Underfloor heating is chosen because of its flexibility as it can be localised at specific loops according to the requirements of the space and controlled by a building management system.

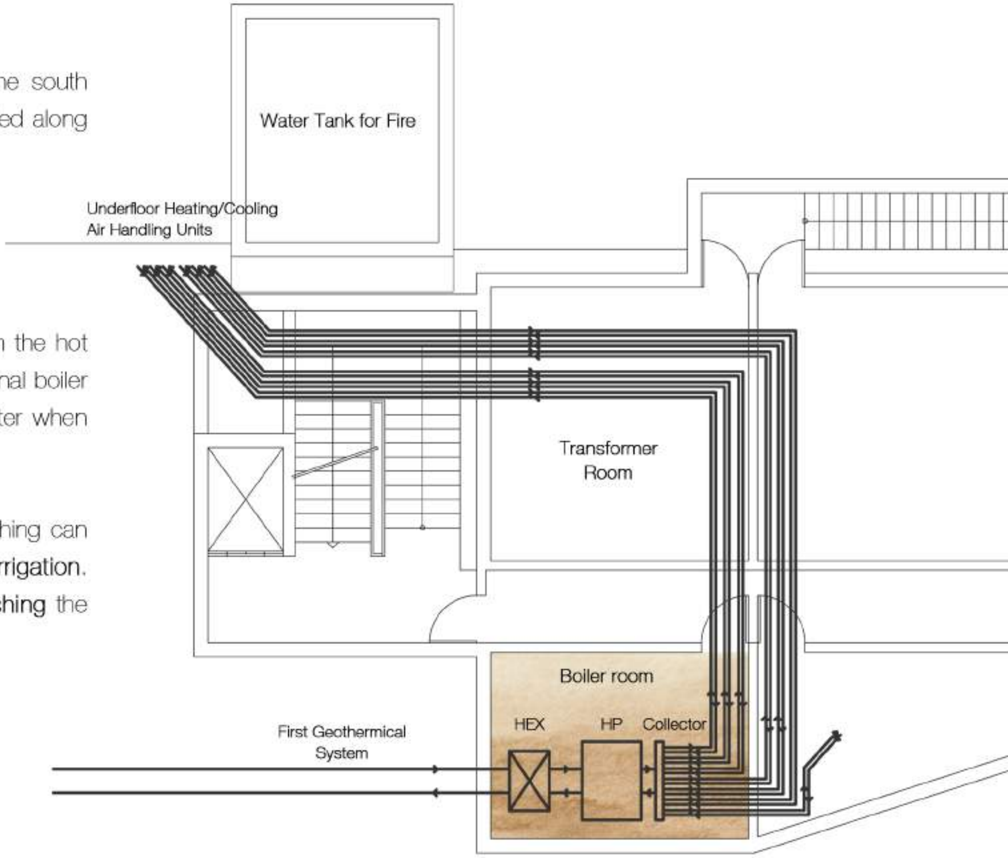
To compensate for the glazed openings on the south facade, **perimeter heating channels** are provided along the ground floor.

Water heating

A **solar water heating system** is used to warm the hot water required for the user's needs. A conventional boiler or makes the water hotter, or provides hot water when solar energy is unavailable.

Rainwater and **wastewater** generated from bathing can be **recycled on-site** and used as **landscape irrigation**. **Greywater** is also collected and reused for **flushing** the toilets.

Basement Plan (NTS)
Diagram depicting heating-cooling strategy



Detailed diagram depicting heating-cooling circulation

_FABRIC U-VALUES

U-Value Calculations

-The specifications for the windows is a triple-glazed Thermo Plastic Spacer (TPS) system. This system includes a 16mm cavity and has a U-Value of 1,50 W/m²K.

The brick walls have been calculated to have a U-value of 0.21 W/m²K, as outlined above:

Material	Thickness	Thermal Conductivity	Thermal Resistance
Inside wall surface	n/a	n/a	0.12
Gypsum plaster	0.013	0.18	0.072
Cavity air space	0.04	n/a	0.18
ROCKWOOL® Cavity	0.15	0.037	4.05
Cavity air space	0.04	n/a	0.18
Brick outer leaf	0.14	0.84	0.166
Total Thermal Resistance			**4.76**
Total U-Value			**0.21 W/m²K**

-The cor-ten steel walls have been calculated to have a U-value of 0.22 W/m²K, as outlined above:

Material	Thickness	Thermal Conductivity	Thermal Resistance
Inside wall surface	n/a	n/a	0.12
Gypsum plaster	0.013	0.18	0.072
Cavity air space	0.04	n/a	0.18
ROCKWOOL® Cavity	0.15	0.037	4.05
Outside wall surface	n/a	n/a	0.06
Total Thermal Resistance			**4.48**
Total U-Value			**0.22 W/m²K**

Despite the highly insulated nature of the spaces, Ursus's climatic variety means that mechanical ventilation is required throughout the winter to maintain the space at 20°C.

-The kalzip roof system is calculated to have a U-Value of 0.14 W/m²K, as outlined above:

Material	Thickness	Thermal Conductivity	Thermal Resistance
Inside wall surface	n/a	n/a	0.12
Cavity air space (structural deck)	0.12	n/a	0.18
ROCKWOOL® Cladding Roll	0.12	0.040	3.00
Kalzip roof system	n/a	n/a	4.00
Total Thermal Resistance			**7.30**
Total U-Value			**0.14 W/m²K**

-Finally, the floor has a U-Value of 0.196 W/m²K, as calculated below:

Material	Thickness	Thermal Conductivity	Thermal Resistance
Reclaimed rail tracks	0.08	0.18	0.44
Lean concrete	0.10	0.41	0.24
ROCKWOOL® ROCKFLOOR®	0.15	0.038	3.94
Reinforced concrete	0.20	0.41	0.48
Total Thermal Resistance			**5.10**
Total U-Value			**0.196 W/m²K**

_environmental

_ACOUSTIC SEPARATION

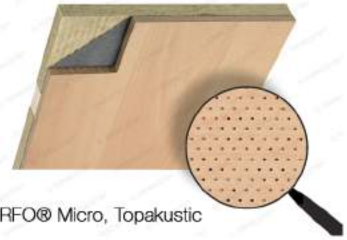
The building's acoustic study aims to ensure the **optimum acoustics** for every space. Both the internal and external film centre challenges the space's acoustics. Taking into consideration that the film centre's volume is approxiamtelly 950-1000m3, it has been analyzed that it has a **reverberation time of 0,82s**, given an occupancy of 240 people, an appropriate level for this time of space. However for this to be met the following oultined criteria should be followed:

-the seats should be covered with fabric

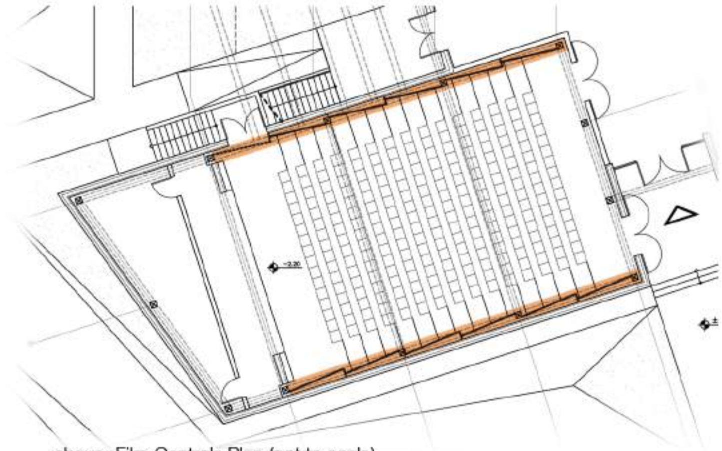
-reflective plasterboard surfaces should be placed in the stage/screen's surrounding space

-MDF wooden (perforated) panels should cover the ampitheatre's surrounding walls, such as TOPPERFO®, and Ideatec® with an absorption coefficient equivalent with 0,70.

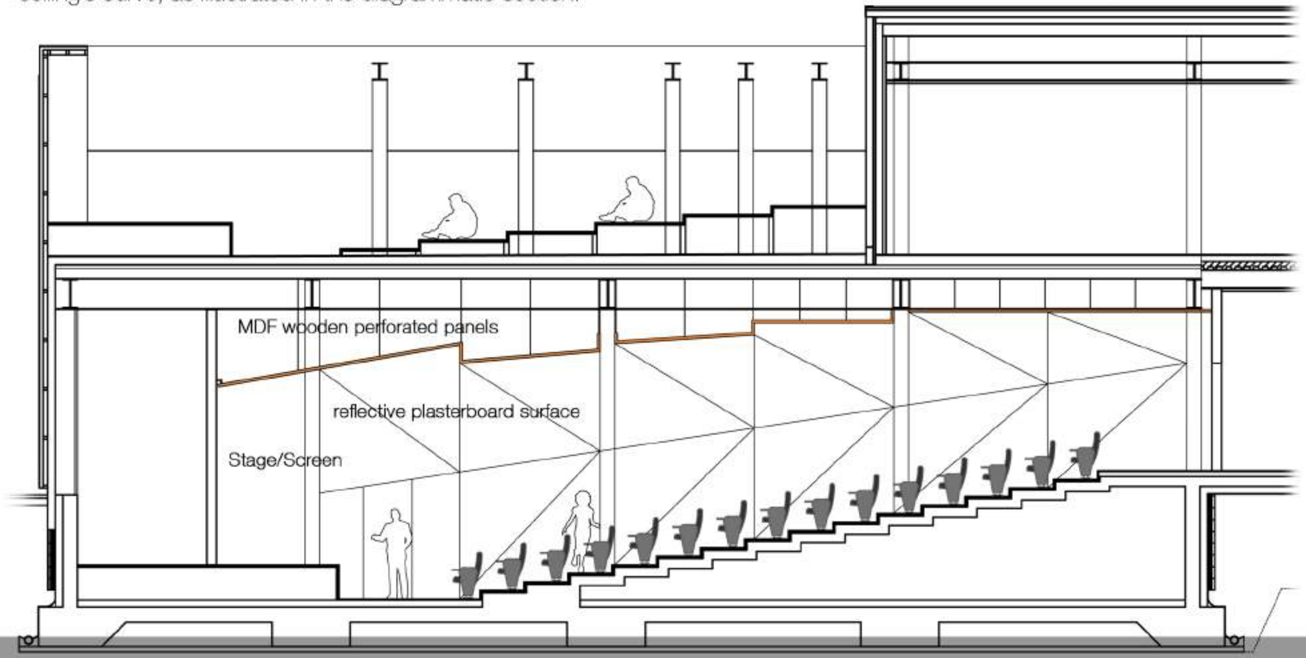
- In the ceiling's construction, a simple plasterboard (not perforated) is attached to the metal structure following the ceiling's curve, as illustrated in the diagrammatic section.



Acoustic Panel TOPPERFO® Micro, Topakustic



above: Film Centre's Plan (not to scale)
below: Section through internal and external ampitheatre (not to scale)



_environmental

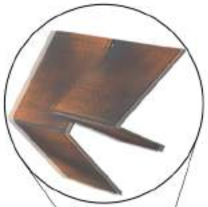
_ACOUSTIC SEPARATION

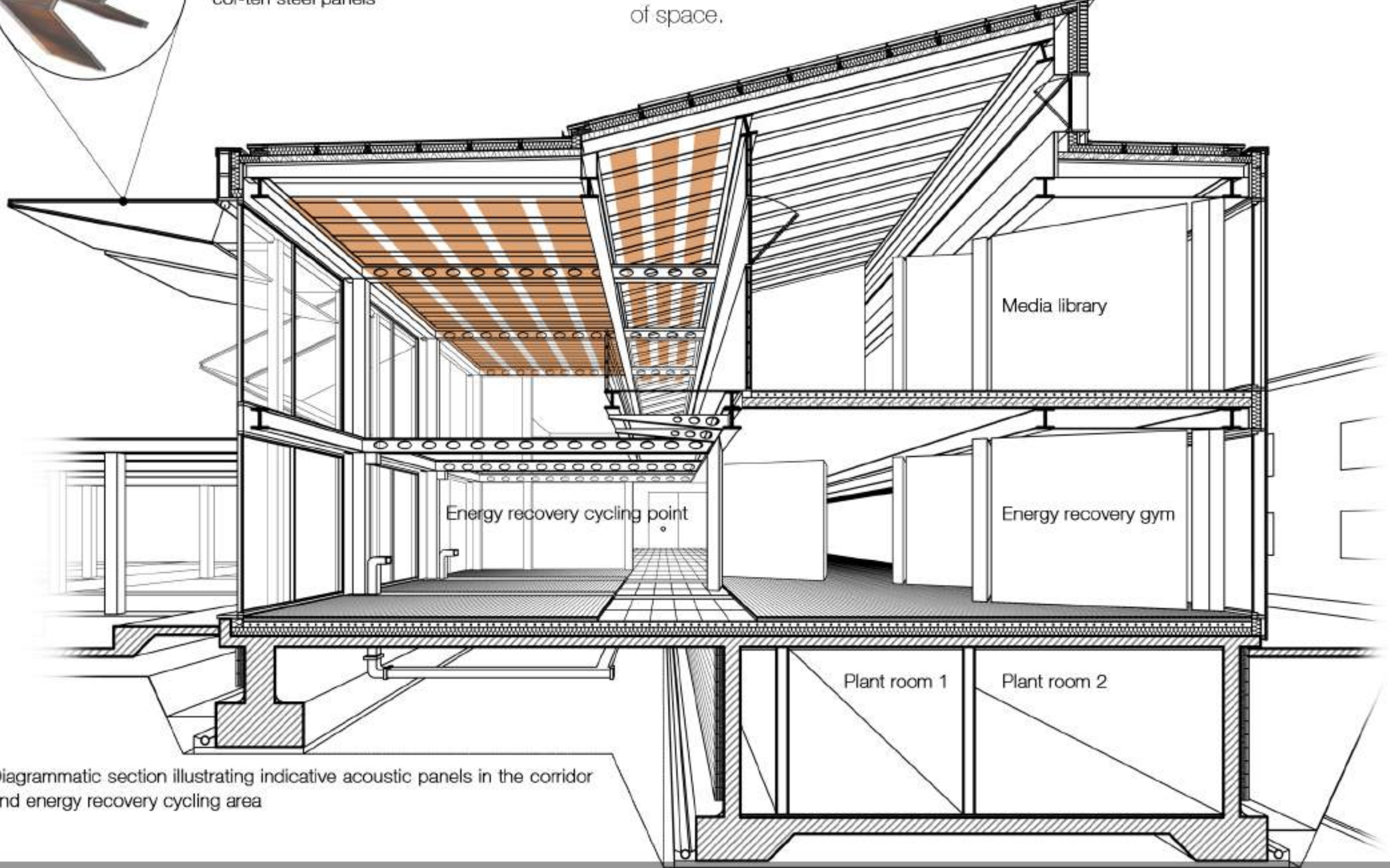
Due to the close proximity to the **train station**, the openable facades of the building have been designed as far as possible to allow for **landscaped space** in order to isolate the railway sound.

The transport of sound through the structure should be controlled throughout the whole building as well, especially in the community training/workshop area, cafe/eatery and energy recovery gym where there's a big gathering of people.

As indicated in the following section, functional zones should be provided with **surface or sub-surface materials** that dampen impact sounds and isolating cavities to interrupt the structural transmission of sound. The penetration of low-frequency sound is lessened by **structural mass**, of middle frequencies by **diffusing and absorbing surfaces**, and of high-frequency sound by the **elimination of small scale air gaps** in doors, windows and partition walls.

Finally, the structural strategy of the facade's cor-ten steel panel system, allows the building's occupants to **adapt the space** according to their requirements and the space's environmental conditions. This does however, challenge the acoustic properties of space.





Diagrammatic section illustrating indicative acoustic panels in the corridor and energy recovery cycling area

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