Moulin Rouge

Dance School

TITLE PAGE

"MOULIN ROUGE - a Dance School"
Aalborg University
Architecture and Design
4th semester Master Architecture

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Project period: 01 I 09 I10 - 05 I 01 I 11
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Synopsis

The project takes basis from the 2009 competition regarding designing a Dance School as an extension to the Moulin Rouge in Paris, French.

Placed as an infill in a dense urban context in the center of the city the building serves as a new landmark in the area.

In the project dance have been analysed and terms have been derived that has influenced and inspiret both the external expression of the buildling and the internal organisation.

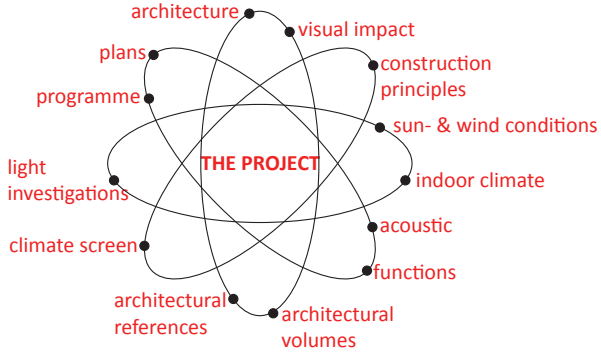
Technical aspects of construction, light investigations and acoustical investigations have been integrated.

CONTENTS


Quick
Quick
Quick
Quick
Travelex
Féerie

METHOD

The project is based on the method Integrated Design Process (IDP), which is developed and used for architectural design at Architecture and Design. The purpose of this methods is to integrate aesthetics, functional aspects, technology and construction when designing a new building [Knudstrup, 2005]. Implementing the architectural and technical aspects early in the design process gives the advantage of using these as decision basis in the project.
The project will be worked through both from an aesthetic and a techinical point of view which should result in a holistic project where techical aspects are integreted throug the process and not just added on in the end.



The project periode is roughly divided into four phases:

1	Analysis Phase	A programme is developed including investigations and studies for the initial programme. A vision and design parameters are summed up.
2	Sketching Phase	Architectural ideas are developed through drawings and modelling in order to reach a design that fulfilles the demands given from the programme.
3	Synthesis Phase	The design is detailed and calculations and verifications for the techical aspects are completed.
4	Presentation Phase	The final presentation included in the report consist of drawings, photos of a physical model and photoshopping.

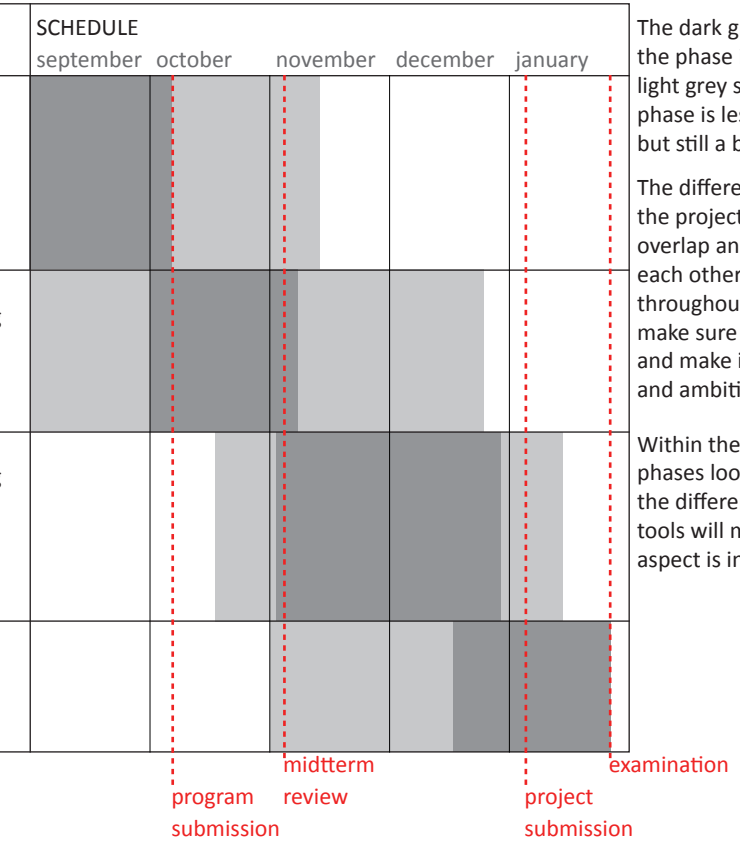
Readers guide

The report is divided into a program, a sketching phase and a presentation section. Further it contains a cd-rom with the competition programme and files used in EcoTect.
References are shown in accordance with the Harvard Method for books [author, year]. Internet pages have been given a designed name. All references are listed at the end of the report.
References for illustrations are also listed at the end of the report according to page number. If a page contain more pictures they are named after placement at the page (for example: illustration 39 top right, for picture at page 39 at the top to the right.)

Tools

In the different phases different tools will be implemented in order to achieve unity between the aesthetic and the technical aspects as shown in the illustration below.

PHASES	TASKS	TOOLS
analysis	research - contextual - thematic - techical	litterature studies internet research writing mapping brainstorming drawing
sketching phase	form development	drawing physical modelling digital modeling eco-tect autoCad
synthesis phase	detailing	drawing physical modelling digital modeling eco-tect autoCad rhino
presentation phase	documentation and presentation	autoCad eco-Tect physical models



The dark grey show when the phase is ongoing. The light grey show when a phase is less prioritized but still a bit in progress.

The different phases in the project period will overlap and influence each other. Deadlines will throughout the project make sure to keep focus and make it a progressive and ambitious project.

Within the different phases loops between the different tasks and tools will make sure every aspect is integrated.

MOTIVATION

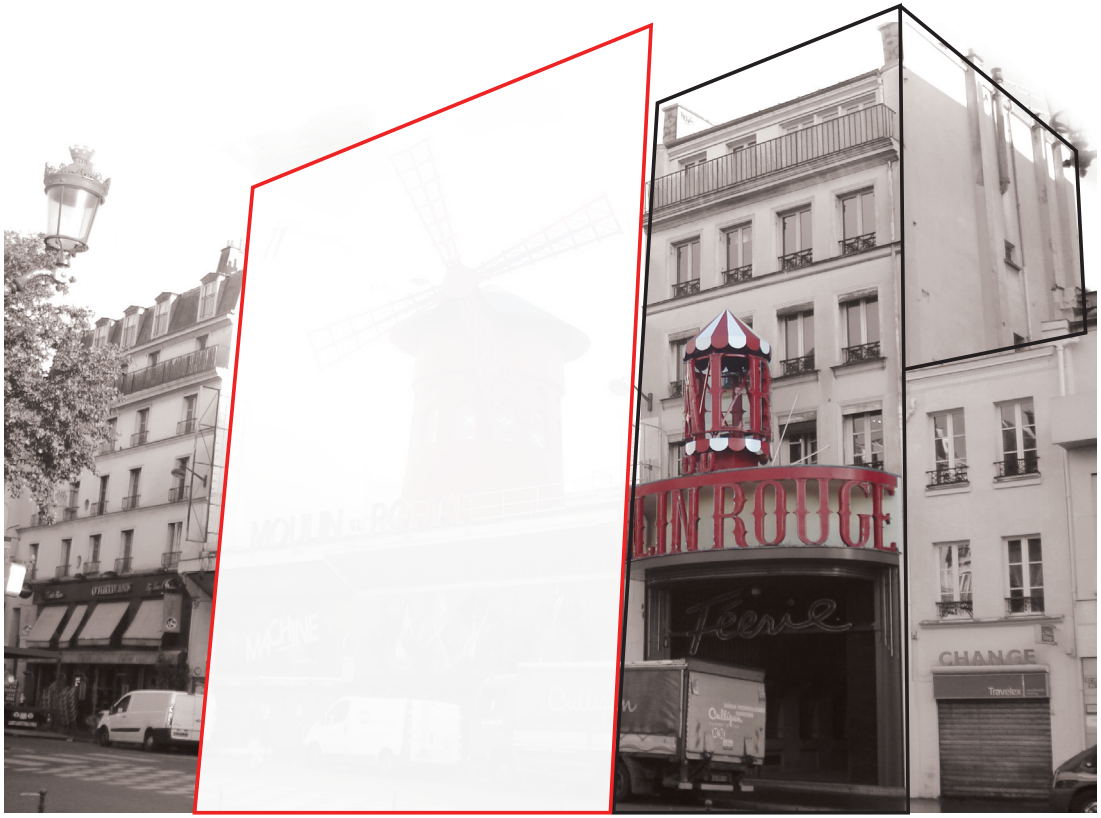
I have always been very fascinated by the movement of the body. It has a language of its own where it is capable of evoking a lot of different feelings just by the movement. For hundreds of years dance has been used in cultures everywhere to interpret the world. The same has architecture which is why they share some of the same concerns.
In my thesis I would like to combine my passion for architecture with my passion for dance, and try out how these two terms can be combined in a shared language. Designing the frame around dancing and explore the relation and the tension between the body and the room.
I chose to take basis in the Moulin Rouge competition. To design a dance school as an extension to the Moulin Rouge was intriguing but also a difficult challenge. I would face a lot of problems that I trough the studies not had tried before; working with an extension to a world-known building, working with an infill in a dense urban situation and showing my creativity in a very limited and fixed site.

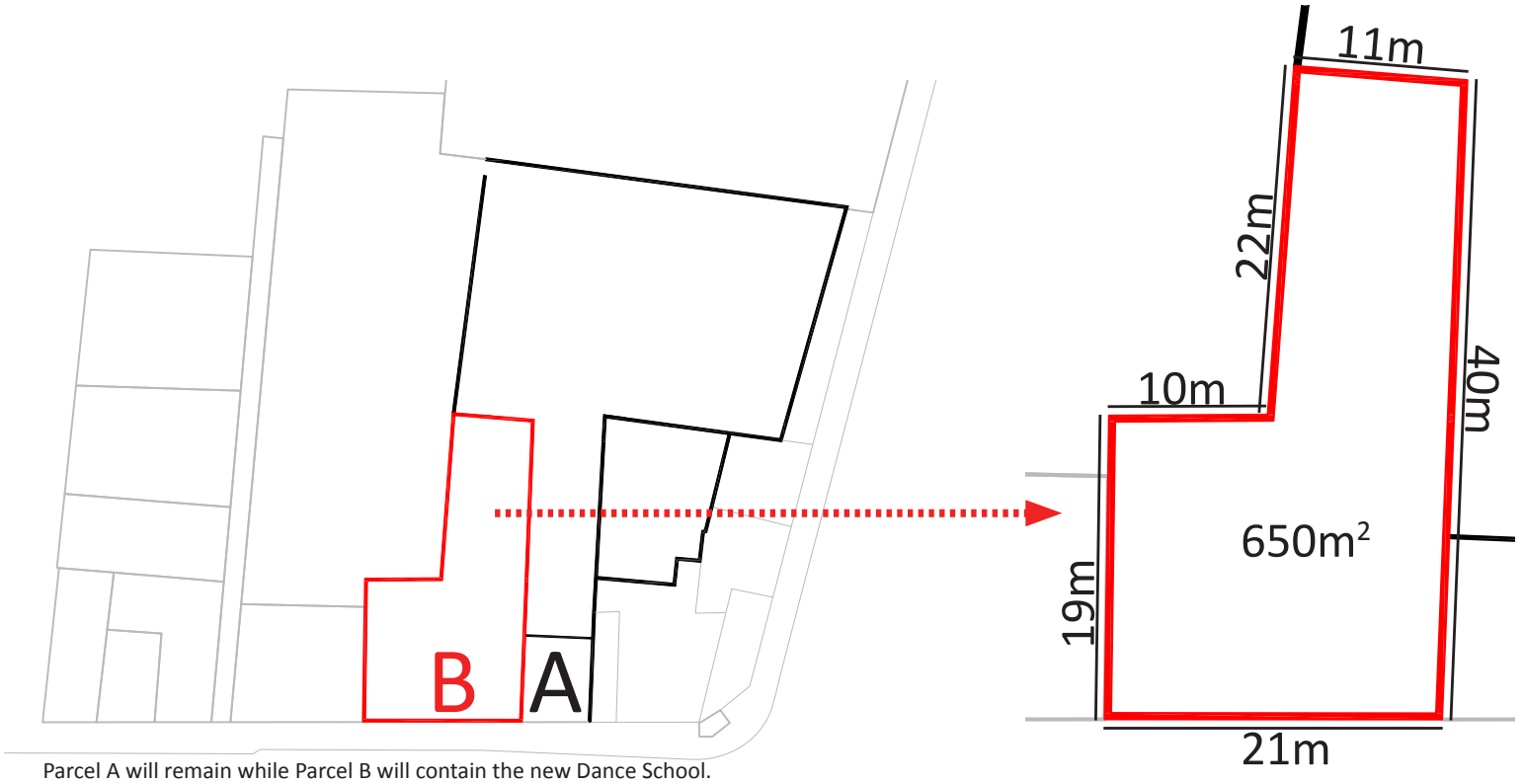
But I would also have to face another kind of problem. Today there are many problems related to our lifestyle; stress and obesity are an increasing issue. This raises the question of what will make people use a dance school? It is very important when designing architecture to sport that it is appealing to the user. It needs to seduce in order to maintain interest. It has to make sport seem attractive and not just a chore, otherwise people very quickly loses interest. The building has to have a welcoming and generating force that contributes the body and the senses to meet with and use the architecture creatively. A building and a room is not only perceived by the eyes but with all senses. Therefore there have to be worked with spatial qualities, light, acoustic, materials, texture and colors in order to appeal to every sense.
In recent time there has been an increasing focus on huge iconic sport architecture, especially to the Olympic Games and sport arenas. The architecture has a huge advertisement value and can sometimes cause bigger urban regeneration of an area. But when creating sport architecture it is not the size but the experiences people get that matters. Both the practitioner, the audience and the passers-by should be focused on.
Combining sport and culture attracts more people and intensity to the building. The more implementing activities, the more people. There is also an economic advantage because the building will be used by more people why again there will be a bigger opportunity for existence of side activities. Activities can take place at the same time and they can prevent dead periods in the building [Wikke, 2010].

The challenge would consist of designing a building that would attract the dancers, give them optimal space for dancing and maintain their interest in dance. The building should also attract visitors to a museum which also should be incorporated in the building. These two functions should hopefully cause mutual inspiration attracting even more people to the building.
At the same time the building should be a landmark in the area reflecting the history of the site. It should have a conspicuous appearance that will attract people to the area like the red mill is doing today.

THE COMPETITION

The Moulin Rouge Dance School is a theoretical, past academic competition provided by Arquitectum in 2009, in search for a reinterpretation of the world-famous cabaret Moulin Rouge in Paris [arquitectum].
The existing building is divided into two sections as shown in the illustrations. Section A is the current main entrance with the red “Moulin Rouge”- sign on the façade. This section contains a theater hall where the dances are preformed. It also contains a foyer and secondary functions and will have to be connected to the new building. Section B is the site for this competition, the future Dance School. It also needs to contain a museum, a bookstore, auditoriums and a cafeteria within the maximum area of 3600m^2 (program on page 12). Section B contains the iconic Red Windmill on the roof. This may either be preserved or can be replaced as long as the monumental character of the entrance to the Dance School is maintained.
The challenge consists of designing a reinterpretation of the cabaret which is very important in the Parisian history and therefore should reflect this. At the same time the Dance School should be modern incorporating the latest tendencies.





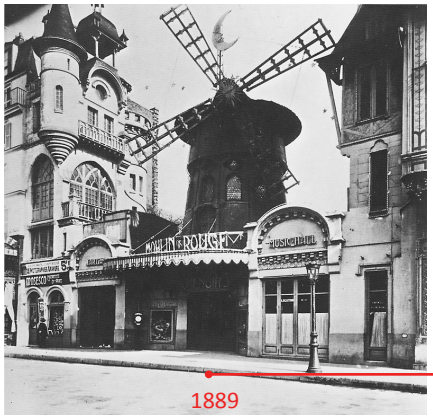
Parcel A will remain while Parcel B will contain the new Dance School.

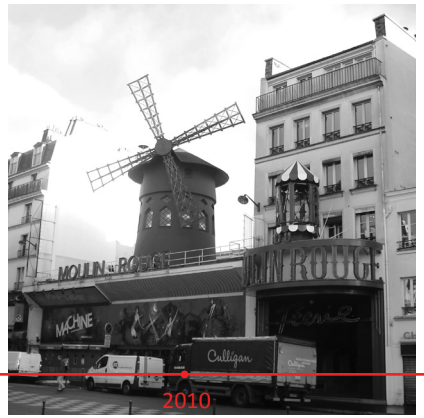
The following programme is given by the competition [programme on enclosed cd].

function	no.	m^2	total m^2	including	light	wiev /connection	height	public/private
DANCE SCHOOL								
training room	3	500	1500		indirect natural light		min. 5m	private
gymnasium	1	250	250		indirect natural light	of the street	min. 5m	private
exterior space	1	100	100	space for social gathering		with the city	2.5 - 3.5m	restricted
dressing room	2	50	100	toiletfacilities			2.5 - 3.5m	private
Total m2			1950					
BOOK STORE								
bookstore	1	50	50	reading area w/10 tables			2.5 - 3.5m	restricted
bathrooms	2	12.5	25				2.5 - 3.5m	restricted
Total m2			75					
AMPHITHEATER								
auditoriums	2	150	300	90 seats per auditorium			2.5 - 3.5m	public
Total m2			300					
MUSEUM								
exhibition space	1	200	200				min. 5m	public
cafeteria	1	150	150	20 tables for four persons	direct natural light	of the street	2.5 - 3.5m	restricted
bathrooms	2	12.5	25				2.5 - 3.5m	public
souvenir store	1	50	50				2.5 - 3.5m	restricted
Total m2			425					
ADMINISTRATION								
entrence hall	1	50	50	reception, metal detecter, ticket office			2.5 - 3.5m	public
administration	1	200	200	offices, sectretary, bathrooms, storage etc.			2.5 - 3.5m	private
Total m2			250					
CIRCULATION								
circulation and walls			max. 600					
TOTAL			MAX. 3600 M^2					

MOULIN ROUGE

Moulin Rouge was built in 1889 as a cabaret in Paris and it is marked by a very iconic red windmill on the roof. Placed in the red-light district of the city it was the birthplace of the can-can dance, a seductive dance by the courtesans to entertain the male clientele. The new music-hall was an extravagant place with huge dance floors, mirrors everywhere and a garden with elephants and donkeys. Ever since the opening it was a huge success, and from a reputation as a 'high-class brothel' it went to a fashionable venue for the French society to see the spectacular shows where the dancers often had excellent dance skills and the choreography always was a bit risqué and provocative. The wild atmosphere was not only on stage but continued all around it [Moulin Rouge].
Through the years Moulin Rouge have been renovated and redecorated several times. The only thing consistens is the red mill (however not the same one). The mill has never had a function but has been a strong symbol of the place and of 'joie de vivre' - the joy of life [Moulin Rouge].
Many notable performers have performed in the Moulin Rouge, including Elton John, Frank Sinatra and Edith Piaf, and six films have been made with the title Moulin Rouge [wiki/moulin].
Today it mostly serves as a tourist destination offering musical dance entertainment, a restaurant and a small museum. Many tourists visit the site every day.





1889 2010 2020?

Throug time Moulin Rouge have been renovated and redesigned several times.

PARIS

Paris is the capital and largest city of France placed in the northern part of the country. With its 2.2 million inhabitants in the inner city, it has the world's highest population density of 20.000 inhabitants per square kilometre. Additional four million live outside the Boulevard Périphérique, which divide the inner city with the Parisienne region [Uffelen, 2009].

Paris has a long history and has always been famed for its cultural and artistic communities and its nightlife. In the beginning of the 20th century artists from all over the world gathered to Paris, from Stravinsky, Picasso, Dali and Hemmingway. Today it still has a huge global influence as one of the world's leading business and cultural centres with influences on politics, education, entertainment, media, fashion, science and art [wiki/Paris].

Paris is one of the most expensive cities to live in and also one of the most popular tourist destinations in the world [wiki/Paris].


Sacré-Cœur


Eiffel Tower


Louvre


Green facade


Arc de Triomphe


La Géode


Notre Dame

Architecture

In 1852 Haussmann introduced a modernisation programme that transformed Paris from a medieval city with narrow winding streets to an urban city with a network of wide avenues that still dominates the layout of Paris today [wiki/Haussmann]. The river Seine is twining through the city leaving two islands. The city is relatively flat but has a couple of prominent hills, the highest being Montmartre with its 130 meter, close to the Moulin Rouge. With Haussmanns transformation of the city entire districts was levelled to the ground and new neighbourhoods was established. A very striking characteristic of the city is therefore the neo-classical buildings of 5-6 stories made of a warm honey-coloured limestone. The region was also rich in gypsum and produced a lot of plaster and stuccos inspired by the Antiques [Ayers, 2004].

Until the mid 20th century limestone remained the favourite facing material in Paris but today the materials of new constructions are dominated by concrete, steel and glass [Ayers, 2004]. Since the 1980th environmental awareness has resulted in a pragmatic use of sustainable construction methods and technology implementation in order to save energy [Uffelen, 2009].

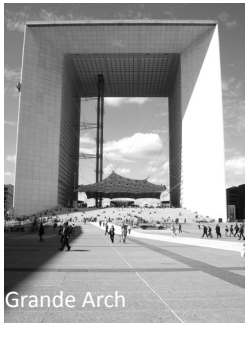
Until 2008 a law required all buildings within the inner city to have a maximum building height of 25 meter why nothing is protruded. In the financial district 'La Défense' just outside the Boulevard Périphérique all the cities high-rises are clustered.

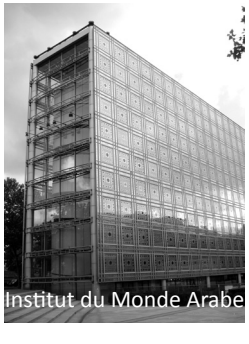
The very dense city leaves no unused areas or buildings why many former industrial areas are re-used, converted into modern functions. Parc de la Villette is an examples of this. An old slaughterhouse has been transformed into a museum and the areas surrounding it is now an experimental park with thirty bright red ornamental buildings of various deconstructivistic shapes spread around [Uffelen, 2009).


Centre Pompidou


Parc de la Villette

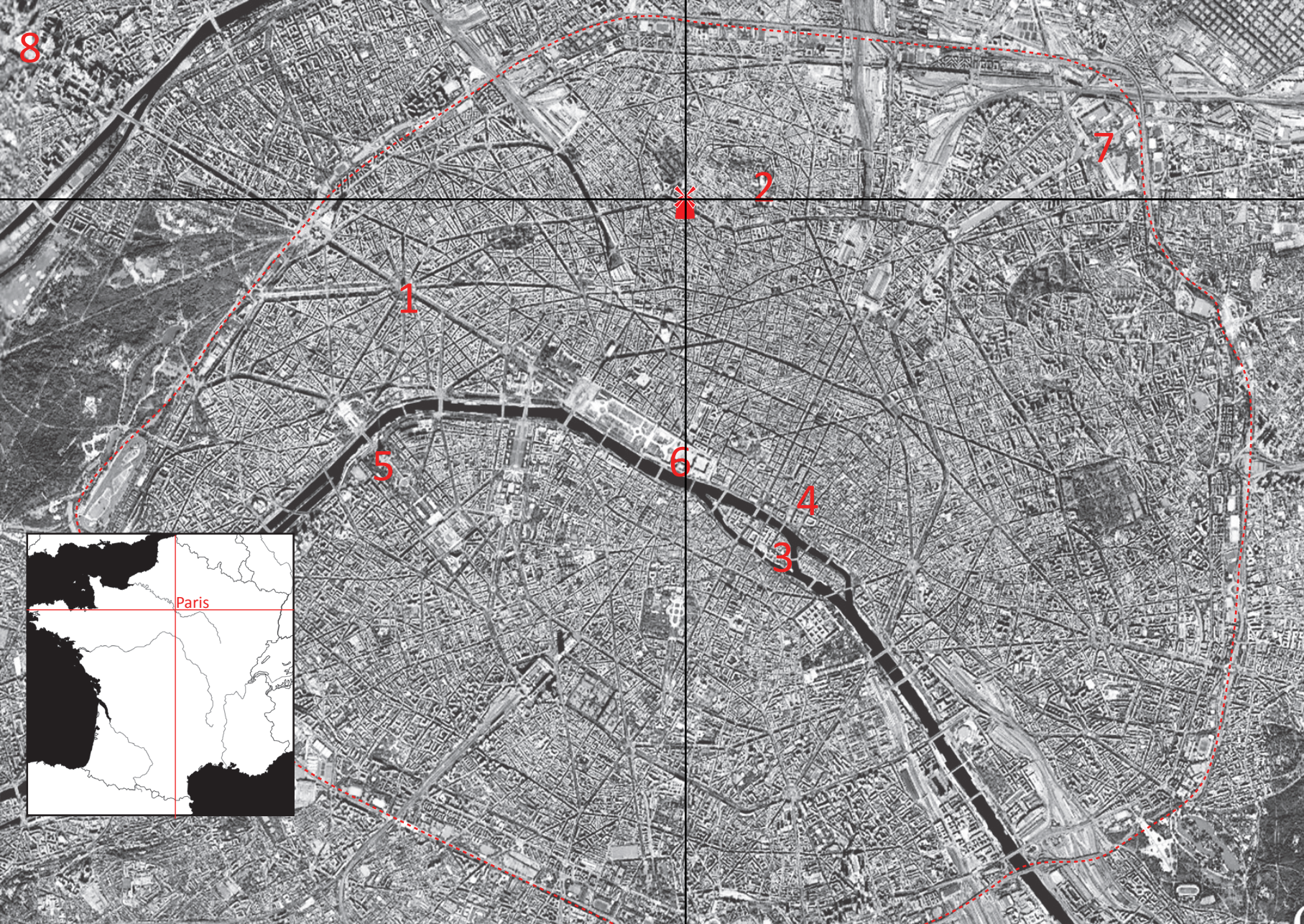

Eiffel tower


Grande Arch


Institut du Monde Arabe


Moulin Rouge


Neo-classical facades


8
7
2
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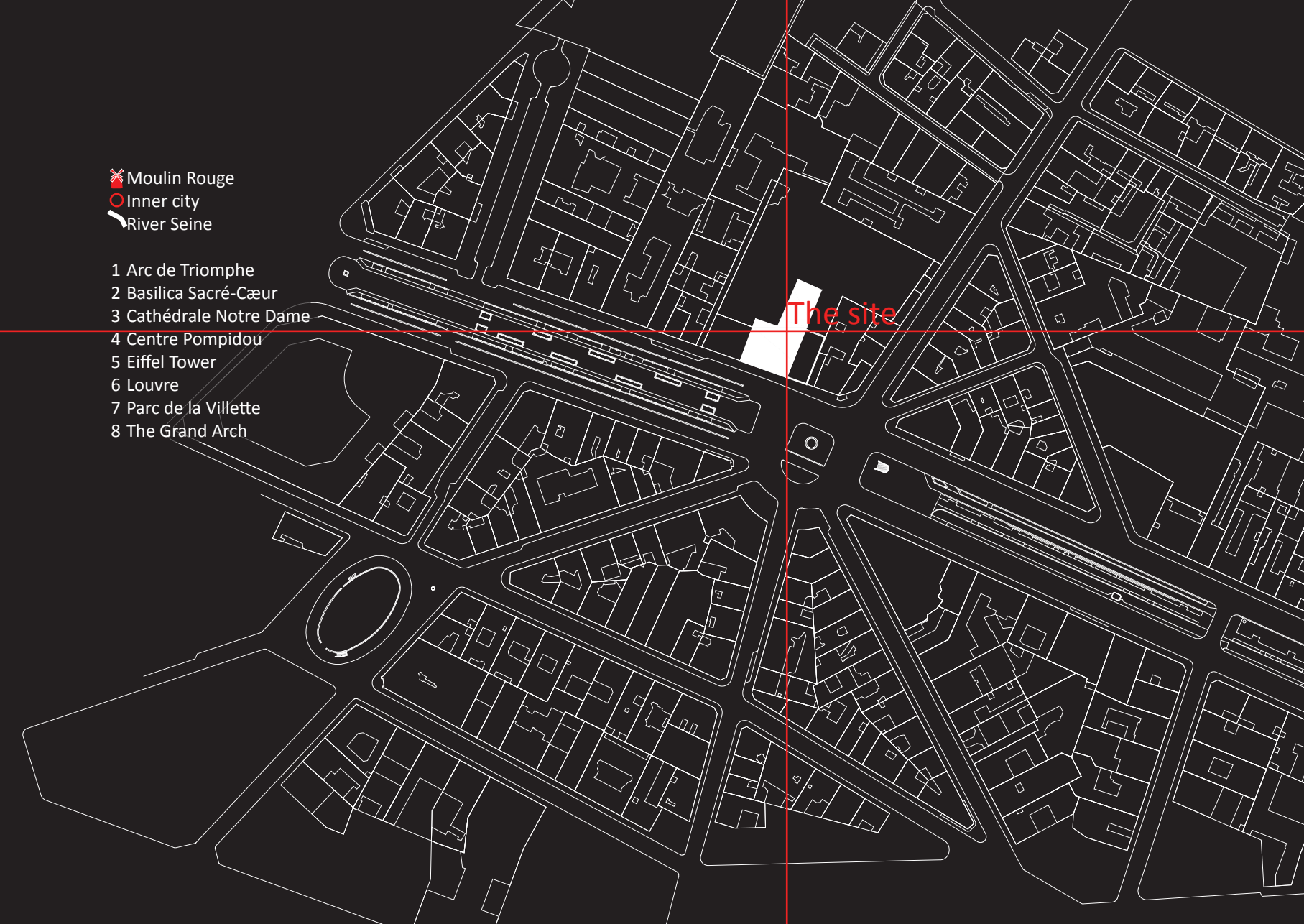
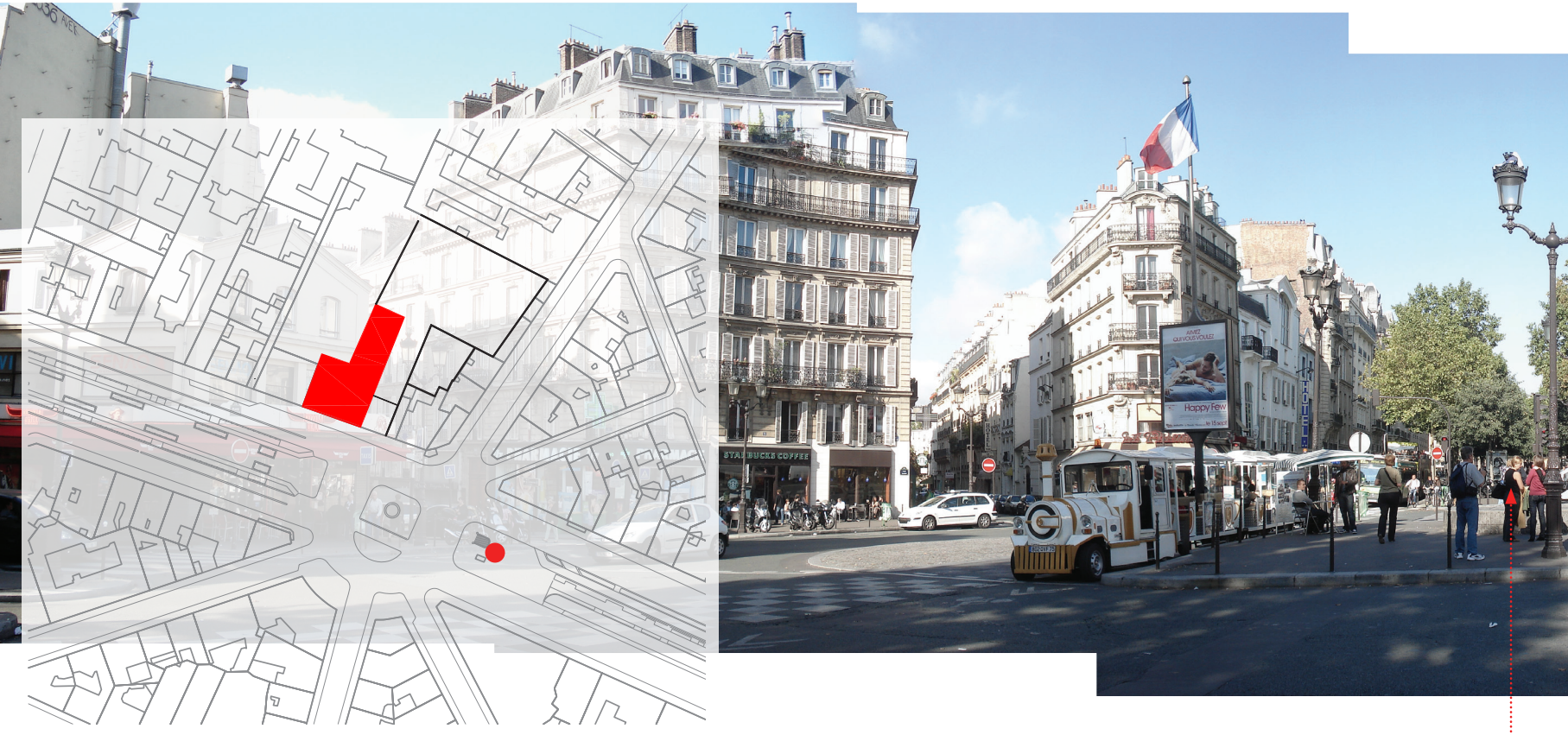
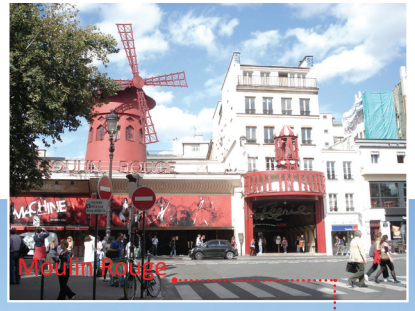
Paris


Moulin Rouge
Inner city
River Seine
1 Arc de Triomphe
2 Basilica Sacré-Cœur
3 Cathédrale Notre Dame
4 Centre Pompidou
5 Eiffel Tower
6 Louvre
7 Parc de la Villette
8 The Grand Arch
The site

THE SITE

The Moulin Rouge is placed at the Place Blanche very central in the city in the district Pigalle.
Six roads emanates in the very crowded and trafficked cross.





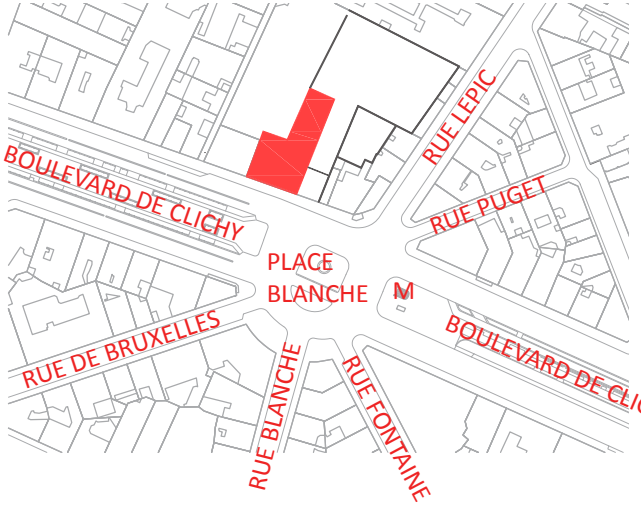
Moulin Rouge

Boulevard de Clichy

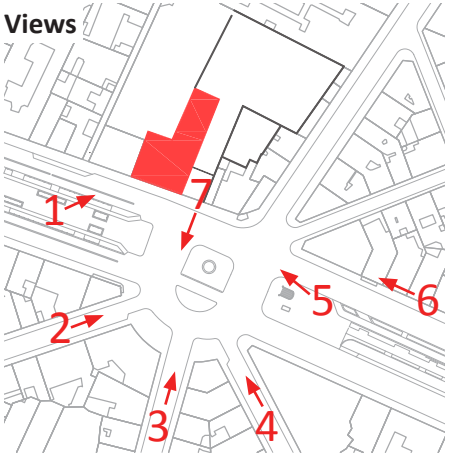
Typology
The area around the Moulin Rouge is dominated by neo-classical buildings of 3-7 stories with facades flush like dense urban blocks leaving only very small courtyards.

Infrastructure
The Moulin Rouge is placed on the wide Boulevard de Clichy at a big star cross where five other roads emanate. There is a constant and chaotic flow of cars, busses and bicycles. Cars and tourist busses are parking everywhere. In the middle of the boulevard a broad field with benches and big trees are securing the pedestrians a more slow and protected site which is used for walking, running, relaxing and dog-walking.
The metro station Blanche is also placed here.

Functions
Being in the 'red-light district' of the city Boulevard de Clichy is dominated by shops, shows and cinemas for adults. Cafés, restaurants and hostels are also highly represented, all at the ground level with dwellings placed above. At night the district is shining and flashing in neon signs which almost take focus from the – also shining – Moulin Rouge.



Views



Big threes on the Boulevard are hiding Moulin Rouge. But close up it is visible.

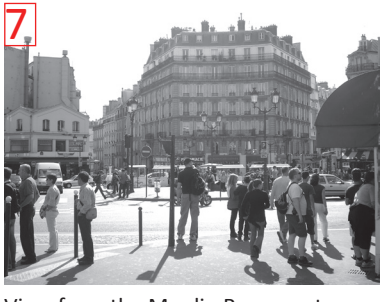
From Rue de Bruxelles Moulin Rouge is not visible.

A good sight of Moulin Rouge is provided from south of the Rue Blanche.

The red mill is focus point when comming from Rue Fontaine.

From the Metro station Blanche Moulin Rouge is very visible.

Moulin Rouge is visible from the east of the Boulevard but is blending in with a lot of colourfull signs on the cafées and shops along the street.

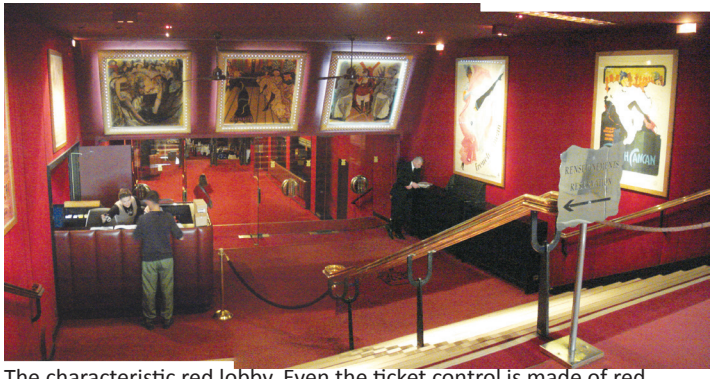


View from the Moulin Rouge out on the Place Blanche.

The existing building

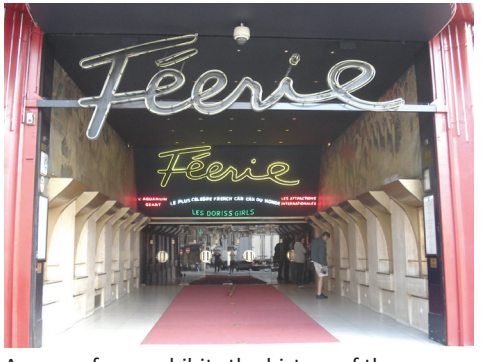
The existing building contain foyer, theater hall and a many secundary functions. From the entrance an open pre-foyer contain a small exhibition of the history of Moulin Rouge. From here people are being lead into the foyer, a wide, elongated room of different levels, pass the ticket controll and wardrobe and down to the theater hall which is also being used as resturant. The lobby and theater hall is very characteristic with a red carpet on the floor and red walls and ceiling. Gold is a the only other color used on handrails, stairs, signs and frames. This leaves an exclusive and seductive atmosphere.

It will be obvoius to connect the new Dance School to the existing building as the dancers will preform at the stage there. Also the new museum should be connected to the existing building as it will exhibit the history of the Moulin Rouge.



The characteristic red lobby. Even the ticket control is made of red leather. Posters of old shows decorates the walls.

The entrence of the Moulin Rouge.



An open foyer exhibits the history of the Moulin Rouge.

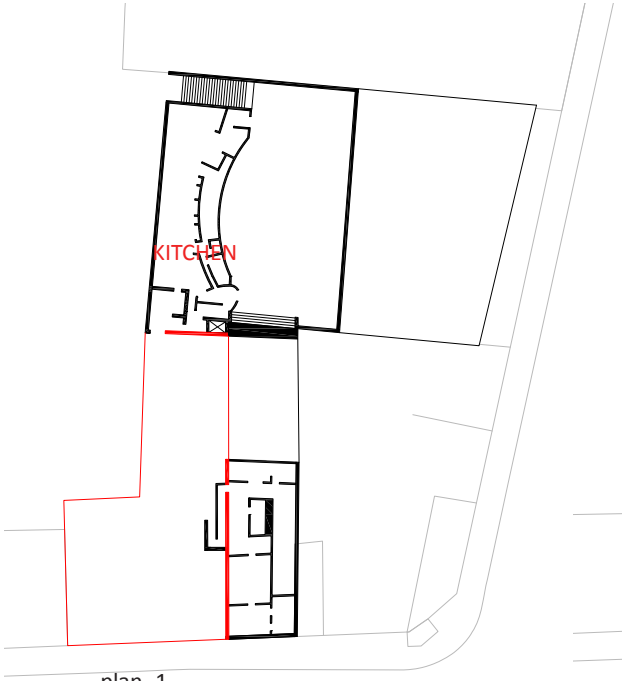
The stage is placed as a continuation of the foyer.

Inside the theater hall.

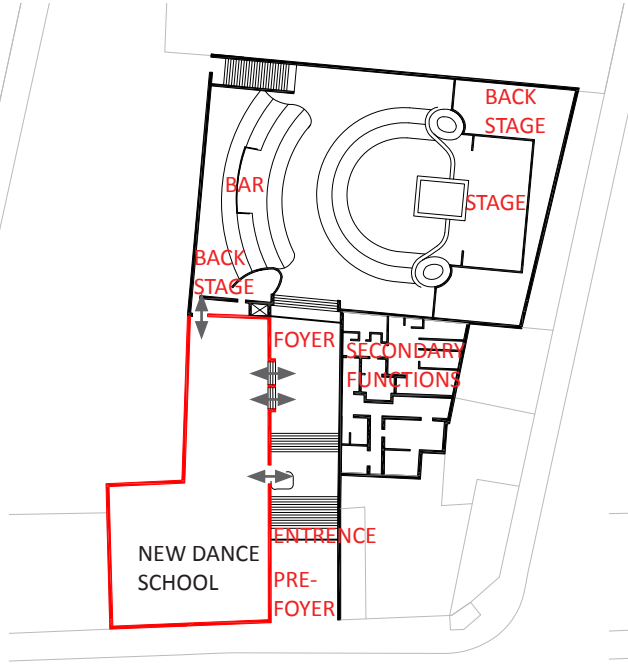
In the basement technical rooms are placed under the foyer. Stairs are leading down via the new Dance School.

At ground level there are four internal connections between the existing building and the new Dance School. Three of them connects to the elongated foyer while the last leads direct to the back of the theater hall.

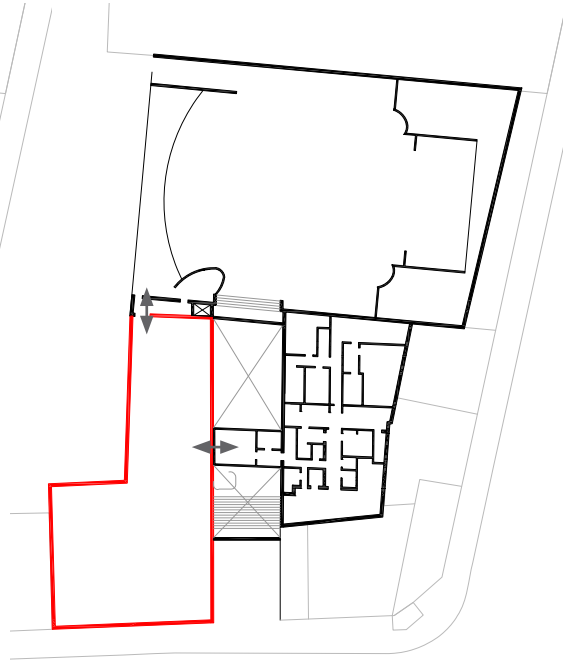
On the first floor a corridor above the foyer connect the Dance School to the secondary functions. There is also a connection to the back of the theater hall above the one at ground level.



plan -1
1:1000

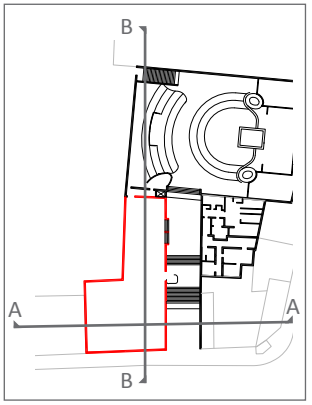


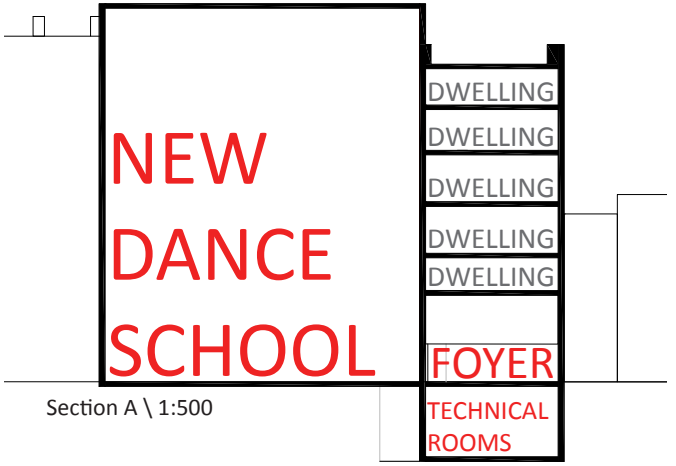
ground plan
1:1000



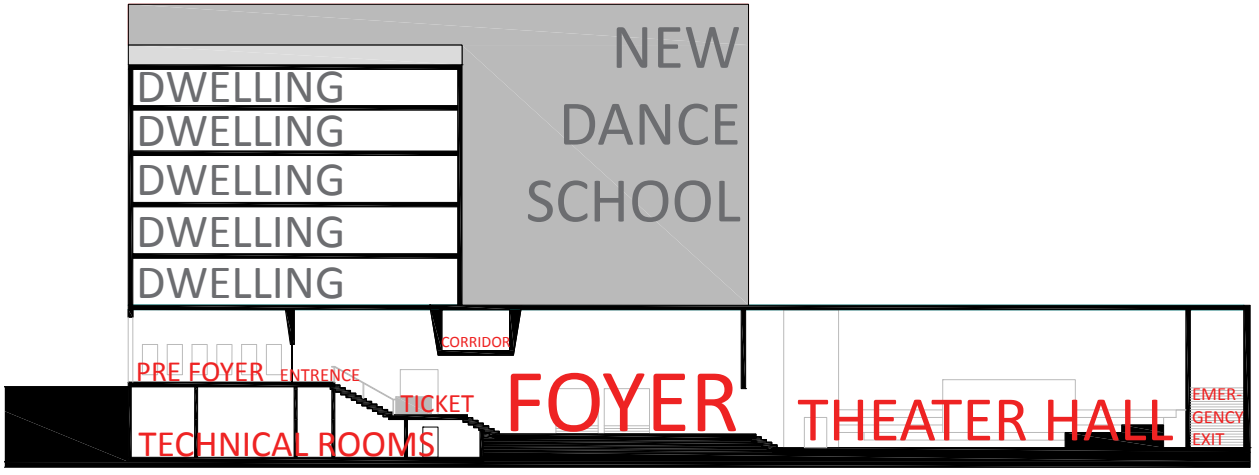
plan 1
1:1000

Sections throug the building show the different levels from the entrance through the foyer down to the theater hall.





Section A \ 1:500



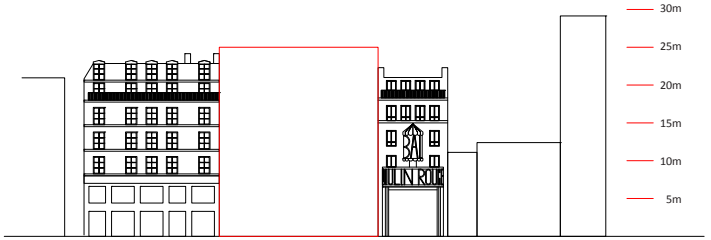
Section B \ 1:500

Height

The programme sets a limitation of 25 meter in height. This means the new structure will not protude the surrounding buildings but will in scale adapt to the context if all 25meter are utilized.

The buildings to the left all have a height of 20-22meter but the ones to the right are more various in height, between 10-30meter.

Every building in the block contains cafés on ground level why they are dominated by big window openings. On the upper floors housing have the traditional neo-classic facades of lime stone, marked horizontal divisions, windows and small terracces on the top floor.



Facade
1:1000

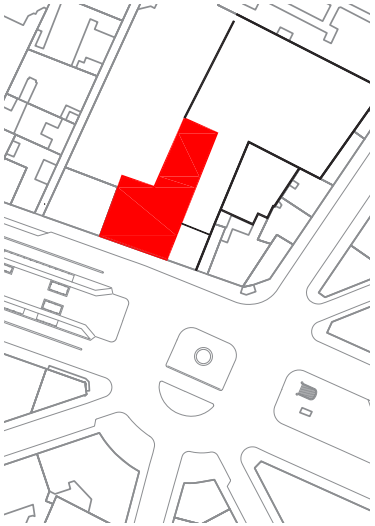
Edges

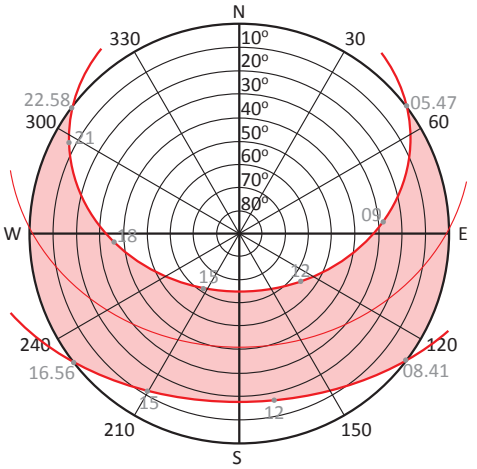
All the facades of the parcels are flush like an urban block. Nothing is protuding or pulled back at the ground level. On the second and third level big signs and the 'Moulin Rouge' entrance are prutuding.
When walking the facades are percieved as one continuous building. No gaps occurs, only the existing parcel of Moulin Rouge opens up inside revealing an inner courtyard with a small exhibition.

Plan showing the edges
1:2000

THE CLIMATE

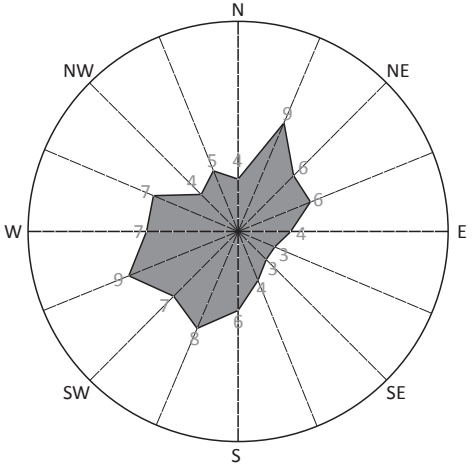
Paris has a typical oceanic climate – mild and moderately wet.
In the summer the weather is usually warm and pleasant with average temperatures between 15 – 25°. In winter it is cool but generally above freezing why snowfall is rare. It is not a very rainy city but throughout the year sudden showers appears [wiki/paris].





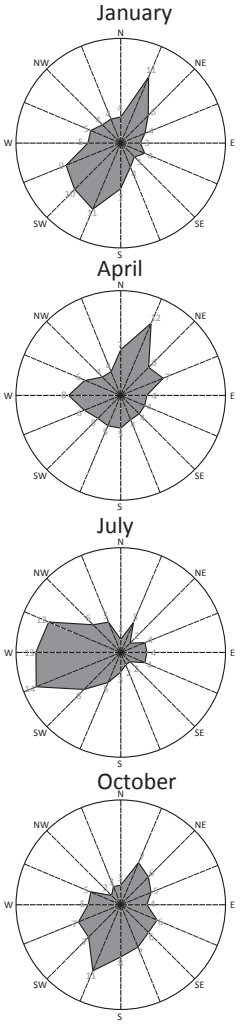
The sun path show that Paris has long sunny days in the summer and shorter days in the winter with sunset around 5 pm [gaisma].

The facade of the Dance School points towards south-west, perfect to let direct sun into the building in the daytime and evening.



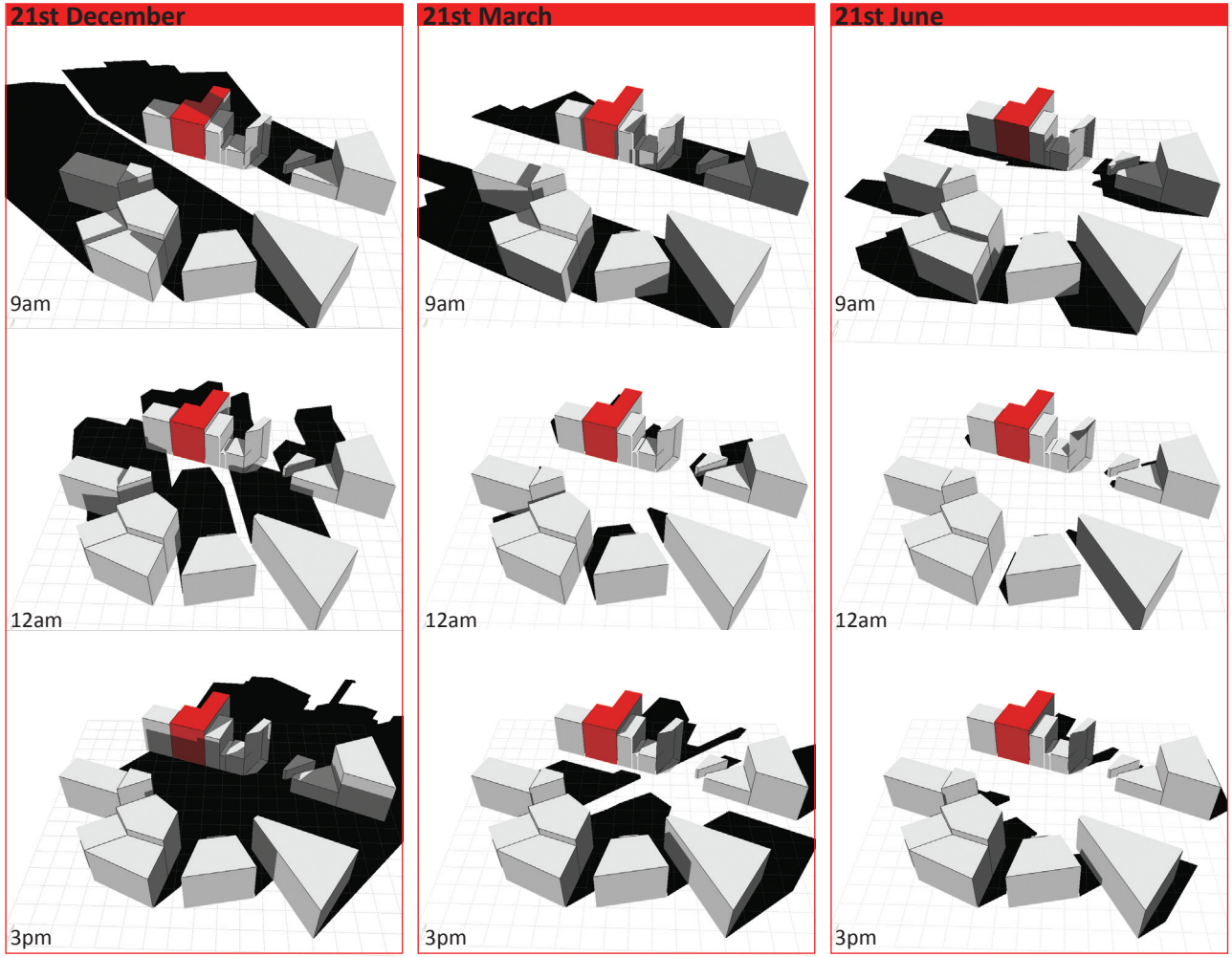
The windrose show the average wind direction and speed over the year. More specific wind roses are showen in the side, one representing each season [windfinder].

The wind direction changes a lot over the year. In winter the dominating wind comes from southwest and northeast, and in the summer the western wind is most dominating.



Shadow investigations
Due to the location at a big, open square there are not many problems related to shading of the building.
During winther it is only late in the afternoon the buildings from opposite the street will shade the Dance School.
During summer the only time shadows will occur is early in the morning.

It is therefore very exposed to the sun most times of the day and year. This means that the sunlight can be used to light up the building and it can create interesting shadows inside the dance studios.
But at the same time problems of overheating in the summer can occur.
The task will be how to distribute the light deep into the building, to take advantage of the winter sun but to avoid the heat from the summer sun.



Summary and design parameters

Sensing the place is very important in order to integrate the new Dance School in the context. The extension of the Moulin Rouge will be an infill in a dense urban context of typical Parisian neo-classical architecture. Being in the ‘red light district’ of the city the atmosphere is a bit sleazy and the Moulin Rouge stands as a landmark in the area. The speed in the area is fast; cars, busses, bicycles and people are passing everywhere.

The new Dance School should respect the existing structures and adapt to it´s surroundings but at the same time it should stand out marking the new function. This function should be showed in the building/facade in one way or another.

It should reflect and become part of the history of the site.

It should connect to the existing structure containing theater hall and foyer, and make it a natural continuation.

Some striking contrasts are:
Fast - slow
Dynamic - static
Open - closed
Introvert - extrovert
Day - night
Compression - dispersal

EXTENSIONS

Extensions are a very topic issue today in architecture. Old buildings are being restored because of cost, historic preservation and taste, and often extensions come together with renovations or improvements of the existing building. Often the existing buildings are not optimal in relation to the function and natural light why the task often involve reorganizing the structure, opening it up to make it more spatial and light. Many prestigious buildings does over time get problems with space and outdated technical systems why the solution often is renovations maybe including an extension. An example of this is the Palau de Música in Barcelona from 1905 [wiki/palau]. The concert hall needed more space to foyer, library, dressing rooms and archive but also technically improvements and renovations of the existing structure. In 1989 the architect Oscar Tusquets made the renovations and added an extension next to the original building. The extension adapts to the existing structure in scale and by using the same material and color why they are melting together in a harmonious composition even though they have very different languages. The existing structure was built in typical Catalan modernism of curving, dynamic shapes richly decorated with colored organic motives. In contrast to this the new extension is a very simple, straight and unornamented structure. It does not try to stell focus from the original structure but it gives a soft and clean addition to the very ostentatious facade of the old building.

There are many different kinds of extensions, from the small parasit, digging underground or building above the existing structure, or next to the existing building as an infill which is the case of this project. An extension always raises a lot of questions - should it be modest or spectacular, purely conceptual or willfully contradictory? An extension

Palau de la Musica in Barcelona is an example of how an older building and a new etension from different time periods can contrast and compliment each other.

can easily dominate the old structure, reducing its cultural value. On the other hand, an extension can also give all the attention to the old building. The goal must be to create a junction between the old and the new structure which compliments each other and give space to both parts.
Many extensions today are modern but not aggressively different from the original structure. They use steel and glass which gives the extension a light-filled expression of today's sensibility in contrast to the often darker, heavier and more protected environment sought in earlier times. Another tendency today is to use strong colors on the extension, making it clearly stand out as a new structure.
Another discussion is whether the new building should be able to function as a single entity or only work in combination with the existing structure. Attention must be paid to the transition between the old and the new structure.

It is a difficult challenge to make an extension to a building like the Moulin Rouge which has a unique expression and a world-known history. A site which is visited by hundreds of Parisians and tourists visit the site every day, day and night, whom have a strong opinion of the place.
The existing red mill can either be preserved in order to maintain the historic atmosphere or it can be removed and possibly be translated into a new structure. This raises the very important discussion whether or not it is right to remove the mill, which has given the name to the place. What will then constitute the 'Moulin Rouge'? But with a new function what will give the right to preserve the mill? And if it is to be preserved, will it only be of nostalgic reasons and is that enough to justify its presence?
If the choice is to remove it that raises another question; should the new structure be as iconic and noisy as the red mill or is it more right to make a simpler structure which will not demand all the attention in the area? According to the competition program they are seeking a new building with just as much icon value as the red mill, the question is how.

No matter which solution the extension should be an integrated part of the Parisian context. That can be achieved in many different ways, often by preserving or interpreting some of the characteristic features.
Another important aspect of this project is to make the dance visible somehow, to make it connect with the function – dancing.

"A good extension will revitalize and enrich the existing building in the round." [p.15, Mornement, 2007]

DANCE

In all human cultures dance is a very important way of expression because humans use dance to interpret the world. To dance at special occasions is known all over the world from the aboriginals in Australia to our ancestor in the Nordic countries. Folk song dance was emerged in France in the Middle Ages and quickly spread to all over Europe. In the 15th century ballet was developed by the French and Italian renaissance courts, a more artistic and refined dance of slow and complicated movements. The first dance schools and stages was developed and ballet began to be performed on stages accompanied by live classical music. In the beginning ballet was based on myths and legends but after the great depression in the 1920th and 1930th it became more problematized and engaged in society.
After the French revolution in 1789 dance becomes more unrestrained and wild with quicker movements. Waltz and quadrille emerges, and in 20th century dance was influenced by America which introduced one- and two-step, foxtrot, swing and rock and roll. Also Latin America contributed to the different dance styles with tango, samba and rumba [Wikke, 2010].

In the new Dance School at the Moulin Rouge modern dance and can-can will be taught and performed. Can-can was developed in the Moulin Rouge which is why it has a strong connection to the place. When first developed it was thought of as an extremely inappropriate dance. The dancers used extravagant underwear which they revealed during high kicks and by throwing their skirts over their backs. The word can-can means 'scandal' which it did produce when first performed. It still has an erotic buzz but today it is considered an acceptable art of dance. It is a very demanding and tiring dance to perform and often including screaming [wiki/cancan].

Can-can dance which was developed in the Moulin Rouge. An erotic dance to curtisise the men by lifting up the dress revealing the underwear.

Modern dance is a concept developed in the early 20th century by the French musician and singer Francois Delsarte, as a rebel against the rigid constraints of ballet [Wikke, 2010]. He wanted to express the inner feelings of the performer through movement and used the body as a form of expression. He formulated the 'Law of Trinity' – the connections of the physical, the emotional and the intellectual, or the physical limbs, the torso and the head. This dance was further developed and the Hungarian dancer and choreographer Rudolf van Laban, who was very interested in the movement in relation to the surrounding room, created a choreographic system 'Labanotation' [Beck, 1998] – a language for interpreting, describing and visualizing all ways of movement which still is used.

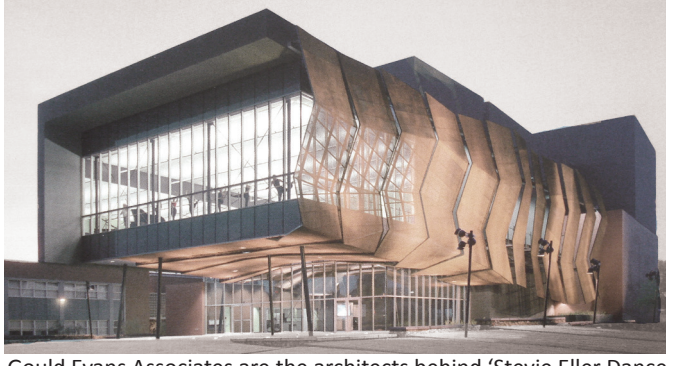
Modern dance is a free dance where the dancers feelings and mood are expressed in a creative, individual way.

ARCHITECTURE + DANCE

Dance is an art of choreographed movements with the purpose of entertaining. Architecture is the shelter around it. Offhand they might not seem to have much in common but they do actually share some of the same concerns why this chapter seeks to draw parallels and inspirations between the two different fields.
Both dance and architecture are ways to interpret the world and the culture. Ways to portray humankind just like art, literature etc. That is why they both create important cultural value.
Dance is an art form that, just like music and any other kind of art, can give mutual inspiration to architecture. Movements and rhythms can be translated and form basis to any design.
Architecture and dance share a vocabulary because they share space.

The relation between dance and architecture and the way they portrait the culture is clearly expressed in the dance schools. In the 18th century when the first dance schools was built they were huge, heavy and much introverted buildings because ballet was a very strict and refined dance art only for the aristocrats. Both dance and architecture have developed much since then which is expressed by contemporary dance schools which are much more light, welcoming and addressed to everybody.
There are many different ways of visualizing 'dance' in the facade. Some of the dance schools have the dance studios behind a huge glass facade showing the dance directly. Others show the movement by shadows in a more blurred facade (an example of this is the Laban Dance School, see p. 38). Another way to show 'dance' is in a dynamic construction giving the impression that the construction is dancing.
But it is not only dance schools that have a relationship with dance. Some architects have found inspiration from the movement of dance even though

Denmark was one of the first contries to make a building dedicated to dance. In 1748 the ballet school was founded in a heavy, momumental and static building [wiki/denmark].



Gould Evans Associates are the architects behind 'Stevie Eller Dance Theatre'. They wanted to express the physical expression of dance and movement in the architecture showed in the dancing light screens in the facade [gouldevans].

the building has a different function. An example is the ‘dancing building’ of Frank Gehry in Prague, also known as the Fred and Ginger building; the nickname is a direct indicator of what it looks like and from where it has an obvious inspiration – dancing. It looks like two dancing bodies, one leaning towards the other. Both the organic shape and construction but also the transparent glass façade is emphasizing this light movement.

Dance and architecture are both geometrical structures, but where architecture only consists of one structure, dance consists of many put together in a choreography why time becomes a forth dimension.
In architecture this choreographed movement can be expresses as a repetition of elements in the facade, twisting and rotating like the dancers. In that way it can for example start from something soft and static and turn to a more expressive and dynamic shape and in that way the similarity to a dance choreography arises.

But a building can also look like one of the structures in the dance - like freezing a moment in the dance and use that as an interpretation in the architecture.
An example of this is another of Frank Gehrys buildings, the Bard Theater in New York. The theater have a similarity to a still-picture taken from a dance, as it look like it any second will fly away or land, just like a picture of dancing bodies. Frank Gehry have achieved that by using steel plates formed as they look like light fabric carried by the wind.

There are many parallels and similarities when studying the relation between dance and architecture. A common characteristic is the illusion of something very light and elegant that in reality is very demanding and complex to achieve. Strength, suppleness and balance is pushed to the limit to see what is possible whether it regards the body or the construction.

There is an obvious simiarity between Frank Gehry’s building ‘Fred and Ginger’ and two dancing bodies.

A repetition and twisting of the same element in the facade can from a static expression turn into a very dynamic shape like a coreagraphed movement.

The Bard Theater and a still-picture from a dance have a sheared illusion of something very light and floating in motion.

DANCE SCHOOL

Dance is being practiced on all levels ranging from high educations of master degrees down to once-a-week training classes. Many of the once-a-week training take place in the evenings in buildings or rooms with other functions in the daytime or buildings transformed to the use of dance schools. Greater dance institutions with educations have their own buildings, many of them transformed from buildings with other functions. But with an increased focus on the importance of the sensuous qualities which often lack in these buildings, many new dance studios have been built which both stimulates the body and the mind.

The dance schools contain, besides dance studios, secondary functions as changing rooms, shower, administration and open spaces where students can stay before and after classes. Other functions vary according to each school, type of dancing and institution.

In the dance studios movements are being choreographed in relation to the dimensions of the room why no specific room shape relate to dance studios. But the room directs the movements of the dancer and supports the activity via surface, space and atmosphere. It should give space and not be too dictating and intrusive. The atmosphere of the room and the physical and perceptive correlation between body and room, both visual and tactile, is of very big importance.
Beside the demands given from the competition program there are a number of requirements relating to the dance studios given from the book 'Architecture, Body, Room' [Wikke, 2010];

1 The room should be minimum 4 meter high so it is high enough for jumps and lifts.
2 The room should have a direction.
3 A smooth floor with a degree of flexibility to absorb the impact of intensive dance exercises.
4 A barre should be fixed to the wall at waist height (could also be movable).
5 Mirrors from floor to ceiling on at least one wall.
6 A good acoustic and sound system as dance is performed to music.
7 The room should be light and evocative.

Secondary rooms as changing rooms, showers etc. are often being de-emphasized into pure rational, functional rooms. But they have a great social value and a great importance of the overall perception. When designing the building these rooms should have focused attention to in order to create attractive frames.

In the book “architecture, body and room” (Arkitektur, krop og rum)[Wikke, 2010] they sum up the most important fields when designing an interaction between architecture, body and room to achieve frames with a high value of aesthetics and sensuous qualities. They have divided these into three main categories:

1 Interplay with the context
2 Innovation of the functional and spatial organization
3 The aesthetics and a deliberate and creative use of the bodily and the human’s ability to sensory perception.

The following case studies will show how these categories are being expressed and through them explain the importance of the three categories. Later, at the end of the project, the three categories will be used to put the project into perspective.

“it is a building which champions the idea that intelligence, creativity, imagination and art make life better.” [Rowan More, p. 145, Wikke, 2010].

Case studies – Laban Dance school

Place: London
Architect: Herzog and de Meuron
Year: 2005

Laban Dance School is placed in London and is the biggest and leading institution of modern dance in the world, offering a variety of educations within the field of dance. Architects Herzog and de Meuron worked in collaboration with the visual artist Michael Craig-Martin [guardian].
It is a new landmark that adds a poetic construction of a delicate colored slightly convex façade in the raw industrial suburban context. The building is an inspiration and accelerator to a positive transformation of the area both physically and socially.
A characteristic garden of waving, topographic formed landscape in front of the complex, emphasize the geometric shape of the building. The garden functions as a pre-space to the building where people can walk, exercise, play and relax as a continuation of the program inside the building.
The foyer contains a café and studios to pilates and health which is also used by the locals.
The building is organized as a ‘township’ with avenues, corridors, courtyards, internal stairs and a view to the outside. The rooms are reflecting the floating movement of the dance encouraging people to

meet. Dance studios, a theater, auditoriums, a clinic, a library and a café are scattered around randomly on the two stories to make natural interaction and communication. The thirteen dance studios are all designed differently, they all have a unique size, height, shape and color given by the façade but what they all have in common are simplicity and calmness. Opposite all the spaces in between have a different atmosphere and texture. Light and graphically or colored initiatives gives a constant new sense of space and identity to the different areas. Light and reflections have been a focal point throughout the entire project. The tall, narrow and reflecting glass elements in the curved façade are placed with slightly offset angels to the next element which creates an effect like a film-strip when the dancers are moving behind the façade.

From the entrance a heavy, dark concrete stair is contrasting the otherwise light and soft foyer of glass and pink. The stair is extended as a wall dividing the private recreational area with a corridor leading to the public café and clinic.

Everywhere in the big foyer contrasting materials, colors and surfaces adds sensuous qualities to the room.

The stair-elongated wall, with its rough textured concrete, a glass-wall, a wall with graphic drawings, light concrete on floor and ceiling and a smooth barre of wood twists along the walls. All accentuated by the strong light coming in from the end of the room. The sensuous qualities is present everywhere.

Case studies – Canada's National Ballet School

Place: Toronto
Architect: KPMB and GBCA architects (new extensions)
Year: 2005

Canada's National Ballet School is a very good example of a dance school with excellent integration in the context. The school offers higher education and contains both classrooms, a theater stage, dance studios and dormitories for the students. The complex consists of a mix of old and new buildings - three old structures of different styles (one new-gothic, one neo-classic and one historisistic) is connected with six new buildings in an architectonic alliance that adds a specific soft atmosphere to the complex.
In between the historic and the new buildings a spatial triple-storie high foyer and café area (the 'town square') connects the different functions. Everywhere there are visual connections; platforms, balconies and stairs are trucked into the foyer area, making it a very open and inviting structure. There is a good internal connection between the dance studios, classrooms and stage, as well as a good visual connection between inside and outside. The students feel that they "are a part of the life in the city and that their dance have been an integrated part of the neighborhood" [own translation, Wikke, 2010, p. 63]. Corridors and stairs are also very spatial and are used as warm up and recreational area.
The materials and qualities of the old and new structures complement each other emphasizing them constant.

The infill of new structures is integrated with the three existing buildings in a harmonious composition. The new buildings have a open, simple elegance which contrasts the older, more closed and introverted buildings.

In the foyer a deliberate emphazising of the old and the new structures integrats them into a unity in the composition.

Summary

The case studies show two very different examples of how to achieve a functional dance school with a high degree of sensuous qualities that adds a specific atmosphere to the place. Laban Dance School focus on stimulating all the senses with interaction of light, color and materials. Canada's National Ballet School achieves the sensuous qualities by uniting of old and new structures.

From the studies of dance schools and the tendencies that according to the book "architecture, body and room" needs to be fulfilled they mentioned three main categories; interaction with the context, innovation of the functional and spatial organization and a deliberate and creative use of the bodily and human's ability to sensory perception.

The two cases both achieve all three of the mentioned categories. They have an excellent interaction with the context whether it is in the form of an infill between existing, historic structures or as a new structure that functions as a new and poetic landmark in a rough industrial suburb. Both of them also have an innovative and functional spatial organization where they both focus on visual connections and meeting points.
The sensory perception is also achieved in very different ways which shows that there are more ways to achieve this as it needs an individual interpretation of each project.

Achieving the three cathegories makes the perception of the building a holistic experience. They are getting around the design from zoom out to zoom in making sure that the building is integrated into the context and have spatial, functional and sensuoury qualities.

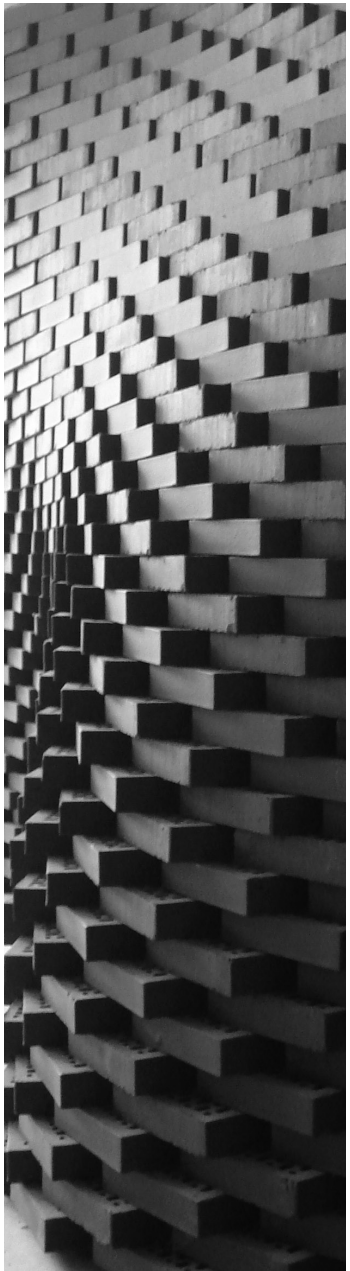
In the design phase of this project the three categories will function as guidelines in order to make sure to get around all of them.

THE SENSES

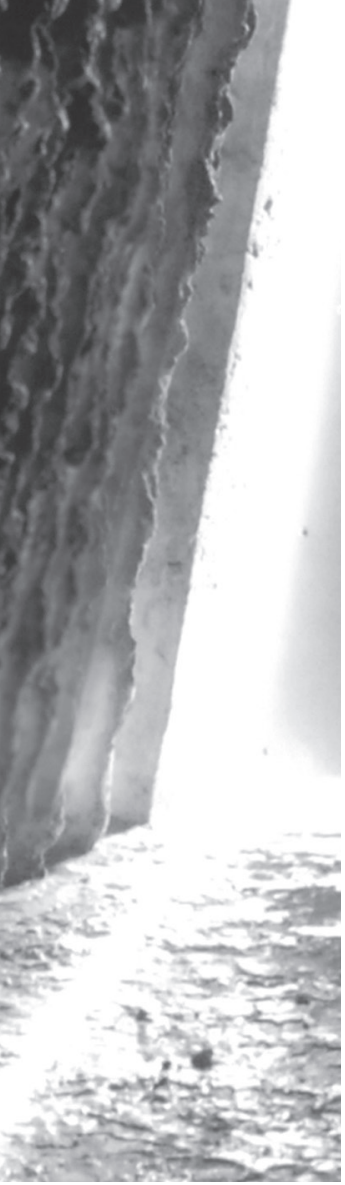
As seen from the studies of dance schools, an important issue is to stimulate all senses in order to make the building seduce the users and observers. A special atmosphere and sensuous qualities in the architecture are crucial to obtain in order to challenge the body and mind to optimal collaboration. It should fascinate, and stimulate the desire to move the body, but at the same time give a feeling of security and harmony – not just once but repeatedly. Humans always get stimulated both by other human beings and by the physical surroundings. We develop through senses, feelings and thoughts why these constantly should be evoked and challenged.

The senses are a very complex topic defined as the "physiological capacities within organisms that provide inputs for perception" [Gibson, 1968]. No defining theory describes and categories the senses as there are many different definitions of what constitute a sense. They are studied in a variety of fields and through them defined in different ways [wiki/sense].

Based on the theory of the American psychologist James Gibson the senses are divided into five categories; the visual, the kinesthetic, the sense of feeling, the auditory and the sense of taste and smell [Gibson, 1968]. They all collaborate and inform each other, why they are closely connected into a synaesthesia. The eyes, ears, nose, mouth and skin can orient, explore and investigate, and often information is picked up by a combination of perceptual systems. When humans see a surface of a material they instantly feel the weight, density, temperature and humidity. In the following the senses will from Gibsons definition be described in relation to architecture and how it can affect and can be used to stimulate the senses.



"Every touching experience of architecture is multisensory; qualities of matter, space and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle." [Juhani Pallasmaa, p. 255-256, Wikke, 2010].



The Visual: Light, colors and graphic effects.

Light is very emotional and sensuous and can be used to communicate a specific atmosphere. It makes humans capable of sensing the structure and character of a room, its surface and tactile characteristics. A combination of natural and artificial light can create changing and specific atmospheres. When using of the sun and cycle of the daylight an active dialog can be created between the building and city/nature throughout the day and the architecture becomes related to time.
Colors are very individually perceived and dependent on the light and the surroundings. Colors can expose or tone down a specific form or character of the room. Colors are also about contrasts; light/dark colors, cold/warm colors, matt/shiny and plain contra patterned.

The kinesthetic sense: The orientation of the body in the room.

People can read the movements of others and movements of objects in the room. A standing body percepts the surroundings differently than if it was in movement. The kinesthetic sense and sense of balance therefore are very important when designing rooms to sport. They are stimulated through gravity and the rotation and movement of the body in all directions. A sense of balance and grounding is important – the body and mind have to collaborate and be in interrelated equilibrium.
Humans select stimulations and can focus on a section of time as well as of a section of room and through that the visual system help constructing a consecutive model of scenery. This ‘attention mechanism’ exists for all senses and can be used to put something in focus – for instance the orientation towards the entrance of a building can be perceived faster. The architect can create a ‘moments of attentions’ in natural sequences so the user can focus, feel guided and have peace to experience the building.

The Sense of feeling: The tactile and haptic system.

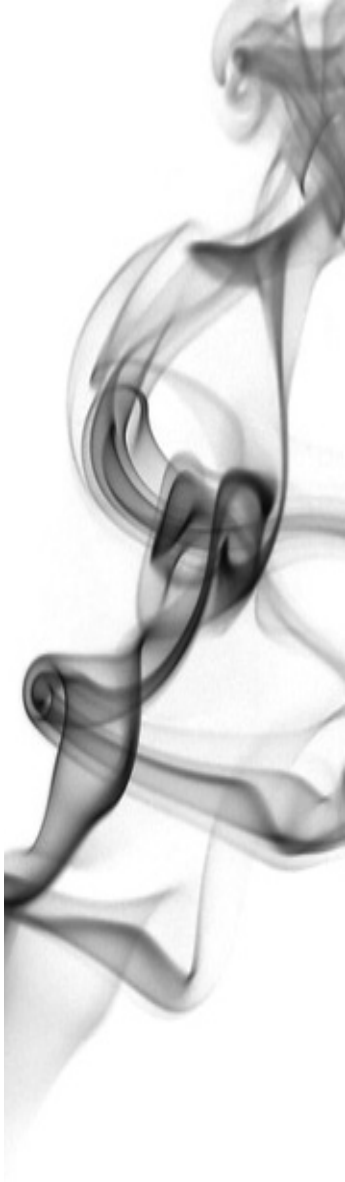
Every sense experience is fundamental related to the haptic - to touch the world. Inputs are given from skin, muscles and joints. The tactile and haptic senses are challenged through dance where the body is in close contact especially with the floor which requires material qualities of the surroundings. Memory is close related to the haptic and the bodily experience.
Many great architect, like Alvar Aalto and Steven Holl, hails the haptic dimension of architecture; the feeling of the materiality, as an essential part of architecture [Wikke, 2010].

The auditory: acoustic in the room

Acoustic perception is often unconscious experiences but it has a fundamental impact on the perception. Sound measures the room and makes the scale understandable why the dimensions of the room are very important. It helps a dancer in movement to define the room. Every building and every room have specific acoustics of intimacy or monumentality, invitation or rejection, hospitality or hostility. Sound should be different between rooms to strengthen the different characteristics and functions of the rooms. The sound is very dependent of the shape of the room, the amount of people in the room, their activities and the materials on the surfaces.

The sense of taste and smell:

The smell, especially in a room for physical activity, constitutes an important aspect of the way one perceive the room. Humans define other people and their surroundings with the sense of smell. Also smell can help reconstruct memories of previous experiences, even forgotten experiences can be remembered.
Rooms for physical activities, such as dance, involve close contact with the surface of the floor. If it smells old and acidic that would overshadow all other senses and affect the holistic perception even though everything else is of very high sensuous qualities.

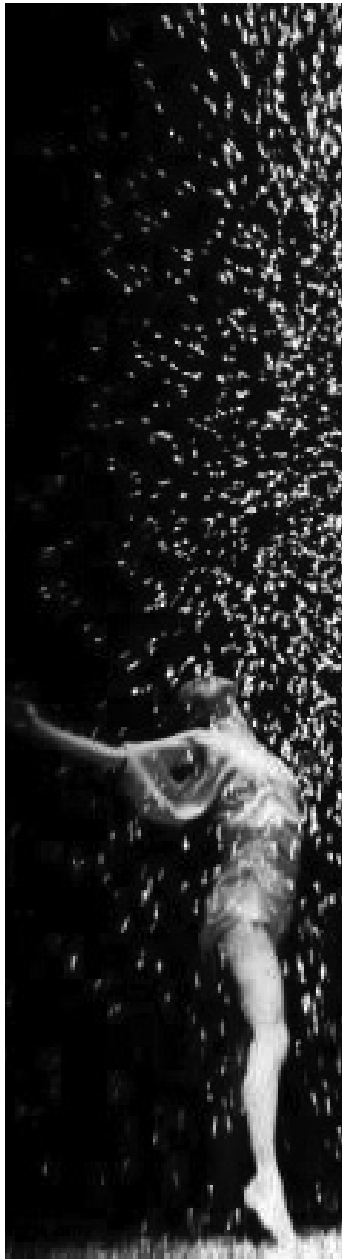


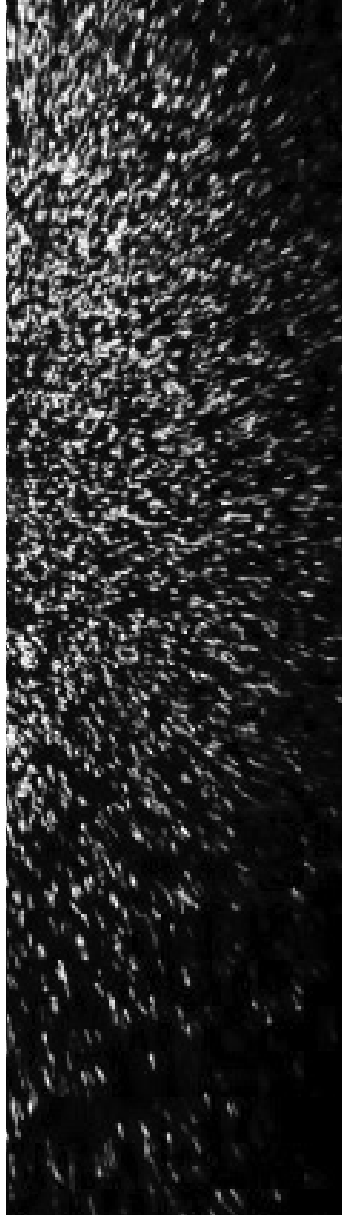
Summary

James Gibsons division of five senses can all be used in relation to architecture.
The visual sense makes humans capable of seeing the building and the room, the structure and tactile qualities. Light can be used to set a specific atmosphere emphasizing things. The kinesthetic sense is especially important when designing room for dance, as it is defined as the body's orientation in a room - the grounding and the balance. The sense of feeling is also very important in this context as the dancers will be in physical contact with different surfaces. The acoustic perception is important as the dancers need a precise rendering of the music. And finally the smell in a room can overcome all other senses especially if the room smells bad.

In the process of designing the Dance School experiments should be made in order to achieve sensuous qualities in the architecture. There are no definitions of how to achieve sensuous qualities why these studies of the different senses are important to remember so every sense will be stimulated.
The building will house many different people, both dancers, guests of the museum and staff. They all need to be taken into consideration - how they will interact and by which senses they will experience each other.

Some of the senses also require a more technical point of view, for example light and acoustic why these will be further analyzed in the next chapter.





LIGHT

As a continuation of studying the senses it is important to take a more technical aspect of it into consideration. To be able to achieve good conditions for light it is important to experiment with the daylight, geometry and materials why this will be explored and testet through the project. Focus will also be on incorporating good acoustical qualities why this also will be testet and calculated in relation to different room geometries and materials, further described in the following chapther.

Light

Light influences health, comfort and productivity which are all very important factors when designing a dance studio. The visual perception of the room, the aesthetic qualities and atmospheres can all be measured by the eye. But there are also factors like regulation of the biological clock and the stimulating the production of the cortisol which are controlled by the circadian canal.

Experiments have been made regarding how light and darkness affects humans. They have shown that a dark room made the production of melatonin increase and made the subject tired. On the other hand an intense light can increase the production of the stress hormone cortisol [Wikke, 2010]. The mental state is very sensitive towards the physical surroundings, often unconsciously. In a building dedicated to dance activity, it is very important that the dancer is very concentrated and does not get blinded or irritated by reflections etc. The light have to be consistent to the use.

Daylight can enter the room both as direct and indirect light. The direct light will cast a sharp sunbeam that highlights the surface it touches and will be reflected through the interior as indirect lighting in the room. The materials have a big influence of how and how much light will be reflected. It can also be used to distribute the light further into the building. The indirect light will be seen as blurred and undefined.

The brightness of the lights is described as the illuminance, measured in lux. The daylight factor describes the amount of natural light, direct and reflected, which hits a certain point in the room. That can be used to determine the lighting conditions.

Many factors influence the daylight factor. The placement and orientation on the site, shadows from other buildings and trees, sizes and placement of the windows and also the depth of the room are the most important factors to take into considerations in the design phase.

To achieve visual comfort some points needs to be achieved;

1 Enough light
2 No glare
3 No mirrored reflections
4 Limited luminance contrasts
5 Representation and discrimination of colors

Daylight can affect the perception of the room as being light or heavy and open or closed. The materials have a huge effect on how the room is perceived and how the light interacts with it, why light and materials should be worked on simultaneously in the process. Light can accentuate the surface and texture of the interior spaces. In order to simulate light inside the building, Eco-Tect will be used during the design process to make sure the intensity of the natural light is consistent with the wanted amount.

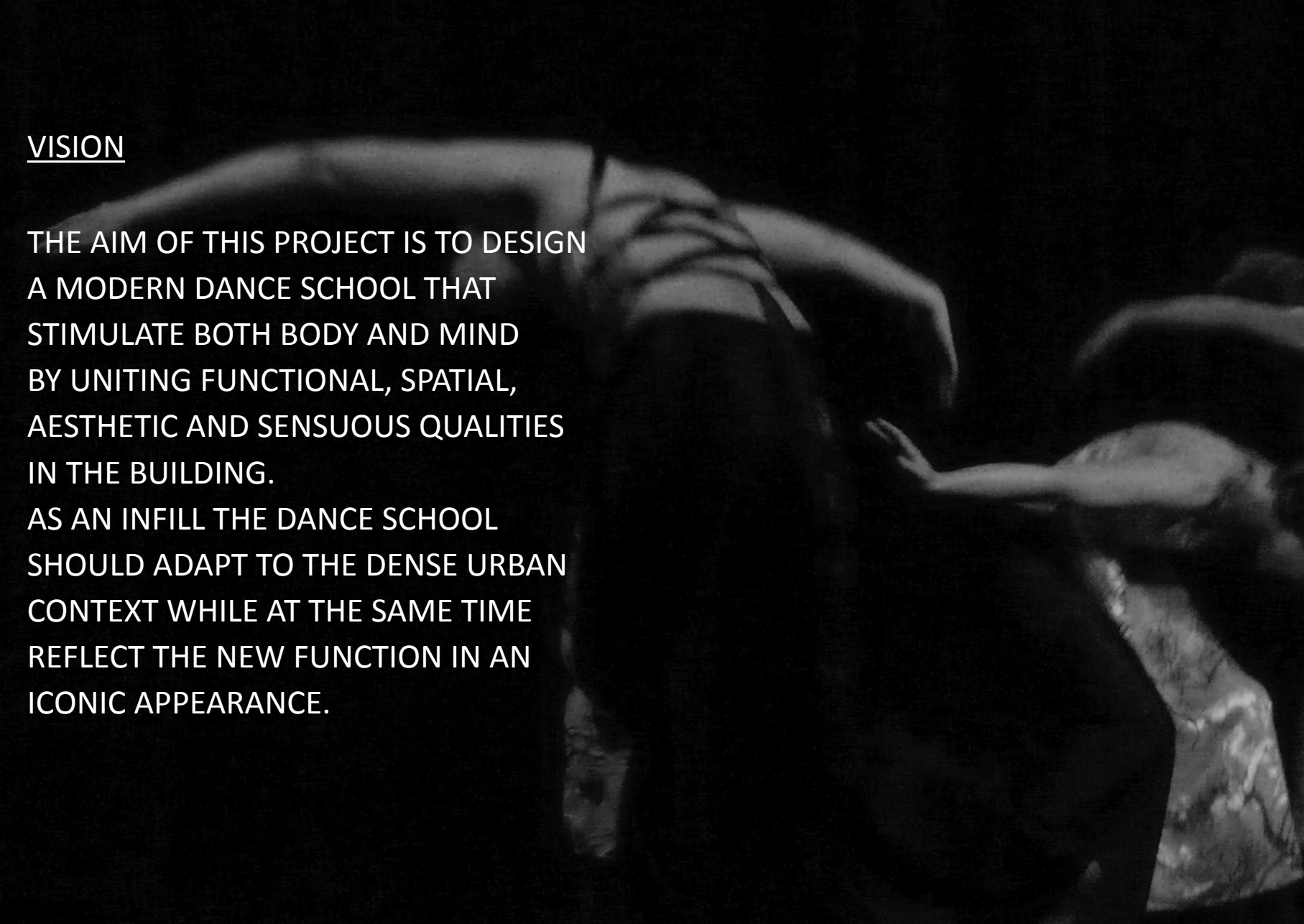
ACOUSTIC

Opposed to for example seeing, where humans can close their eyes if they do not want to see something, hearing is not avoidable. We cannot close our ears why we have to relate to sound all the time including at night.
Sound can both be a calming and a stressing factor and it can be perceived as pleasant or noisy. How people react to sounds is very independently and different; a heavy rock concert can by some people be amazing while other think of it as noisy. A poor acoustic can make humans tired and annoyed, but worse it can also damage the hearing, induce tinnitus or reduce the hearing capability [Kirkegaard, 2004].
Whether a sound is perceived as pleasant or noisy depends on many factors, for example contents of frequency, time variations, duration, sound source and spirits of the person.
Acoustic covers both building acoustic (sound insulation) and architectural acoustic (sound control) but in this project focus will be on architectural acoustic, defined as the way sound behaves in an enclosed space [Kirkegaard, 2004].
Size and shape of the room and the materials used are decisive of behavior of sound why this has to be developed as an integrated part of the form development. The acoustic should be optimized according to the use of the room as different functions have different acoustical requirements.
In a dance studio a clear acoustic communication is needed in order to hear speech and music. This means that a low reverberation time is required. A high suppression of sound will increase the accuracy of rhythmic music, which is crucial for the dancers, and it will in general reduce the background noise.
Secondary rooms such as changing rooms often consist of hard surfaces because of humidity from the showers why they often can have a ringing acoustic. In that case the reverberation time needs to be reduced which can be done for example by implementing sound absorbing materials.
But every room needs attention towards the acoustical qualities because the shape of the room and the materials are crucial to the way sound behaves.

The different acoustic conditions that define quality of acoustic are:

1 the direct and reflecting dispersion of sound from a source to a receiver
2 the beginning and dying of the sound (echo)
3 acoustic reflections (echo, flutter echo)
4 sound proofing and background noise

These can be described by three methods; wave theoretical architectural acoustic (the natural frequency), the geometric architectural acoustic (graphic method to avoid echo, flutter echo and dead zones) and statistic architectural acoustic (sound absorption and reverberation time).
Eco-Tect is a computer program which can simulate acoustics in simple 3 dimensional volumes. During the design process it will be used as form generator to make sure the acoustic is consistent with the function in the room.

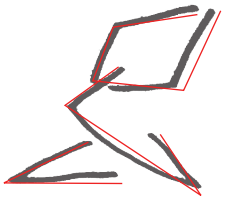


VISION

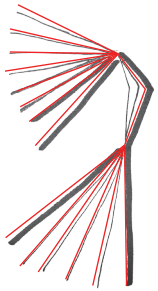
THE AIM OF THIS PROJECT IS TO DESIGN A MODERN DANCE SCHOOL THAT STIMULATE BOTH BODY AND MIND BY UNITING FUNCTIONAL, SPATIAL, AESTHETIC AND SENSUOUS QUALITIES IN THE BUILDING.
AS AN INFILL THE DANCE SCHOOL SHOULD ADAPT TO THE DENSE URBAN CONTEXT WHILE AT THE SAME TIME REFLECT THE NEW FUNCTION IN AN ICONIC APPEARANCE.

DESIGN PARAMETERS

Based on analysis and studies in the program design criteria's have been listed. These will function as guidelines in the following form finding process.
In order to reflect the function of the new building, terms from dance have been derived. By analyzing the structures and movements of the body some common parameters show: geometric structures, organic choreography, overlapping, openness and closeness.
These are terms that can be related to architecture and will be used as guide lines when designing both the external expression and the internal organization of the building.

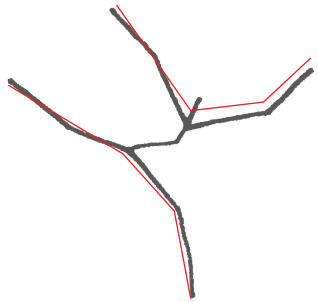


GEOMETRIC STRUCTURES



ORGANIC COREOGRAPHY

OVERLAPPING



OPEN

CLOSED

THE CONTEXT

The Dance School needs to have a conspicuous expression, as there are many visitors at the site. It should reflect the history in one way or another.
As an infill it should adapt to the surrounding buildings and be an integrated part of the bigger building complex.
The Dance School should have different characters day and night in order to reflect the changing character of the context.

SPATIAL ORGANISATION

The building should provide separable zones and paths to the private and the public parts of the building. The organization should be very clear and have visual connections that will hold together and inspire the different functions.
The Dance School should inspire social interactions.

SENSUOUS QUALITIES

The building should incorporate sensuous qualities that stimulate all the senses through the instinctive impression of a building. The spatial percepition, light, colors, sounds and odors all relate to the immediate feeling one gets when entering a room.

DESIGN PROCESS

The vision and design parameters form the basis of this project from where the form finding process takes its departure.
The following part of the report will describe the process of the integrated form finding.
Initially the form finding was concentrated about aspects of organization of the functions, flow, placing on the site and facade expressions that will be examined through sketching and physical modeling.
In the further detailing more technical aspects will be incorporated into the design. Detailed studies of construction considerations, calculations of light and acoustic will help influence the buildings form expression.

For an easier understanding of the form development, the report describes the procedure in a linear process even though in reality an iterative process where all parameters kept influencing each other has been developed.

FUNCTIONS

To give a more clean picture of the room program the functions have been divided by size and degrees of privacy. The Dance School will be a dominate part of the building. This, and the administration, is the only private zones in the building.

PUBLIC
600m²

350m²
RESTRICTED

PRIVATE
2150m²

changing rooms

<600m²
CIRCULATION

THE MILL

One of the first and very important questions is whether or not to keep the mill in the facade as a symbol of Moulin Rouge and the history of the site. According to the competition programme there are no preferences whether to keep it or not as long as the facade will remain having a signaling expression.

The mill has never had a function or any direct reference to either Moulin Rouge or dance. But through the years it has become a symbol of the place and the spirit.
Previously the entrance to the Moulin Rouge was underneath the red mill but after several reorganizations the entrance is now through the adjacent building - which also contains the foyer and the theater stage. This means that the building, on which the red mill is placed, now do not have a direct connection to the Moulin Rouge. Among other things it now contains a cafe (not related to the Moulin Rouge) and secondary functions which the public never will see.
But the mill has a very strong symbolic value, people gather here to see the spectacular facade.

There are two choices - either to keep the mill or to remove it. If keeping it in the facade it would preoccupy the whole facade because of its size and strong expression. The mill would keep its strong identity and it would be the main history of the new building. But it would also downgrade the importance of the Dance School because this would be less visible. Even if the plans surrounded the mill letting the dancers be visible in the facade as well, because of the size and strong form expression of the mill it would still take up all focus. The Dance School automatically would be a secondary function.

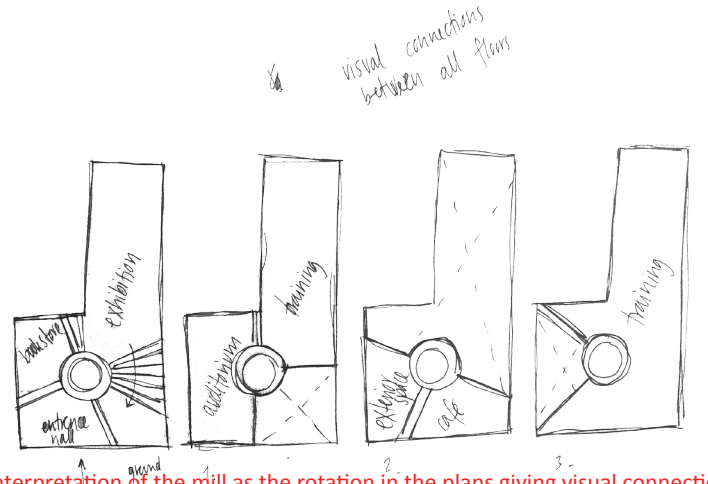
The other choice is to remove the mill and design a new expression to the building. This would give the Dance School the expose as it should; given it is the main function of the building. But it would also mean that the site would lose a historic element that through the years has achieved an important status.

Looking deeper into the program of the competition they want to expose the new Dance School. They also want to give visitors an unexpected surprise when visiting the place.
Seen from the analysis of other dance schools it is showed how the dancers prefer clean and simple rooms in order for them to concentrate and give all focus to the body. They also highlight the advantaged of a placement within the city in order to open up for the view. The dancers can get a lot of energy from the cityscape and vice versa.

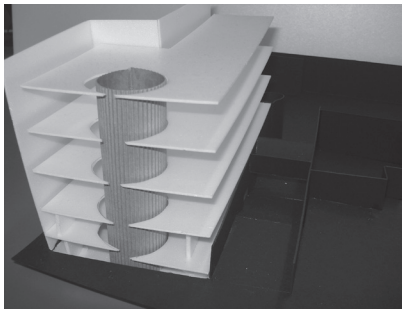
Through sketching and physical modeling the possibilities of both choices have been explored. But the conflicting wishes to keep the historic symbol and to expose the dance was not reconcilable.
Hence the further process of trying to find other solutions for keeping the symbolic value while expose the dance.
It ended up with the idea to remove the mill from the roof and place it inside the building as a part of the museum. In that way it will function as main attraction in the museum and hopefully attract more people to come inside the museum instead of already having exposed it in the facade. At the same time it would allow people to come closer to it, whereas in the facade it would always be at distance.
This solution will at the same time allow the Dance School to be exposed in the facade. This will mean that the Dance School now will tell the

history of the building letting the red mill be the secondary function.

The new structure would still need a strong architectonic expression in one way or another.
Below a selection of reinterpretaions of the mill is shown as drawings and pictures of models.

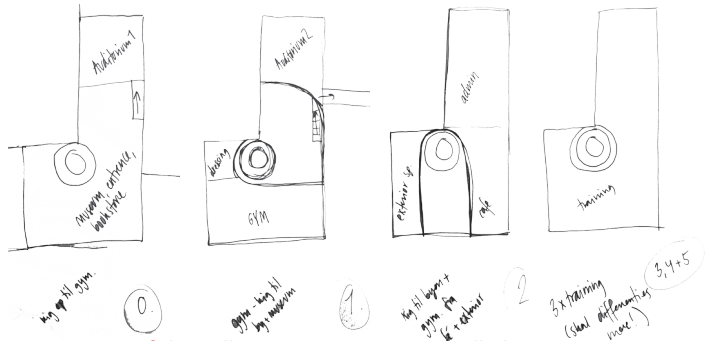


Reinterpretation of the mill as the rotation in the plans giving visual connections between the levels.



The mill will occupy a dominating part of the facade and the dance will be a secondary function.

The mill translated into a stair as the vertical link to all functions.

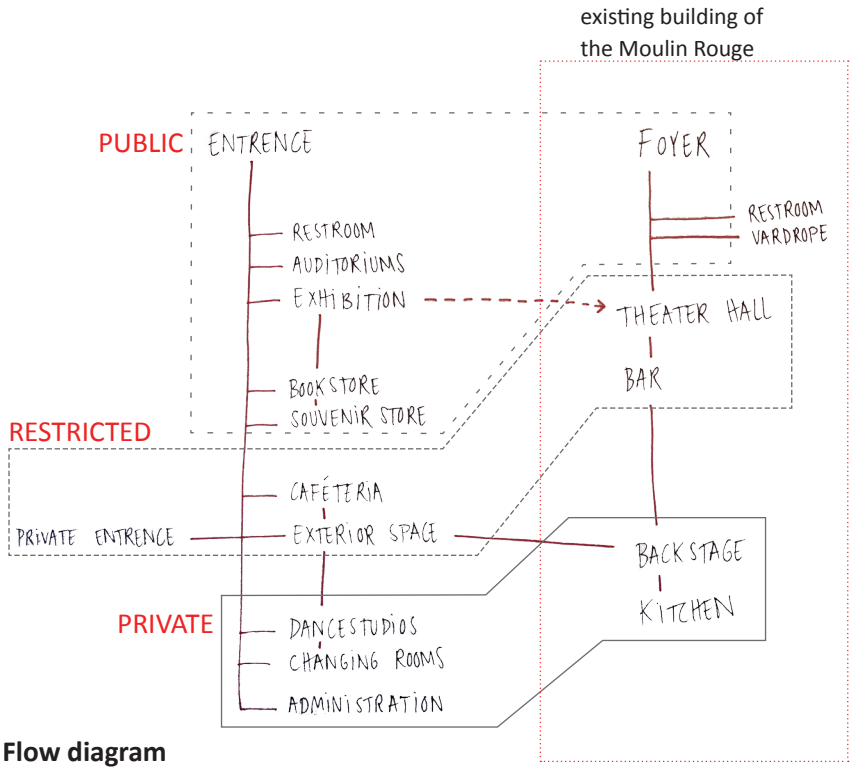


Reinterpretation of the mill into a stair connection all plans.

FLOW

The two main functions in the building are the private Dance School and the public museum.
Because of the huge amount of curious visitors the zones and paths between the private and the public functions should be separate. This will give the dancers some privacy and the possibility to concentrate fully on the dance. But visual connections should still give the public a possibility to see the dancing as this is the main function of the building as it is closely related to the Moulin Rouge as this has always been a place to perform dance. Visual connections to the dancers will give an extra dimension to the museum because the guests will get an insight in the practice of the dance and hopefully inspire to see a show inside the theater one day.

Small adjustments have been made to the original program given by the competition. The book store and souvenir store are to be a restricted functions meaning that not everybody in the museum have access. It is assumed that it will only increase the sale much more when making these functions public. The museum, book store and souvenir store should be placed in connection to each other so the guests of the museum naturally will visit these.



Flow diagram

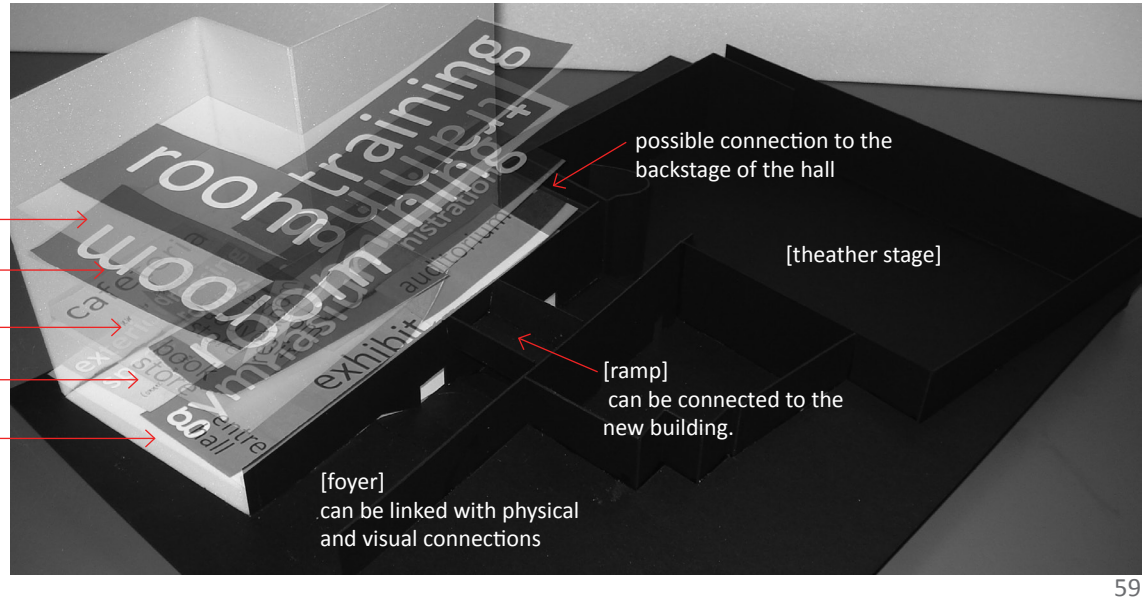
ORGANISATION

In order to get an understanding of the scale and the different functions a 1:200 model was made. Through this different potentials were explored of how to distribute the functions, how to connect them, and where the building can be connected to the existing building either physical or visual.

The new museum will tell the history of the Moulin Rouge and is hereby directly linked to the adjacent building. It is obvious to place the museum as a mirror to that in order to make connections, both physical and visual, to the foyer. In that way the guests can get a glimpse of the real foyer and the atmosphere and not just experience it through the exhibition.
A ramp crossing the existing foyer would connect to the new building.

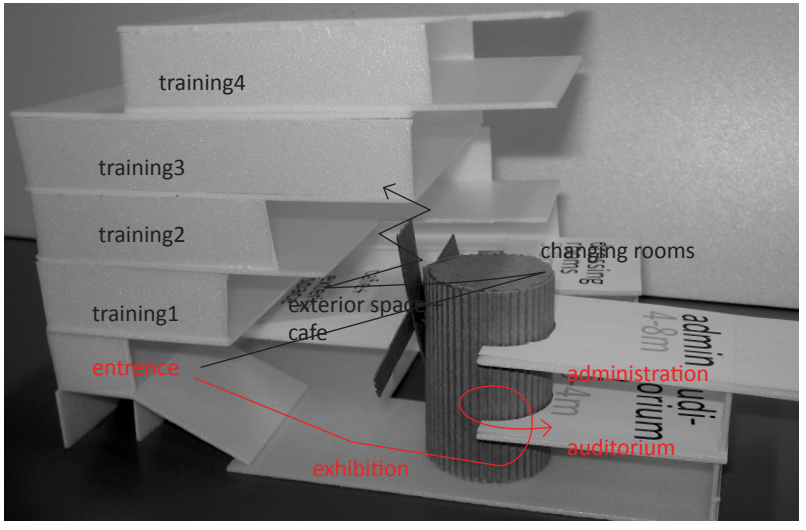
There is also a possibility of connecting it at the northern end of the building to the backstage of the theater hall.
By placing the museum as a longitudinal room directing away from the city it will have the possibility of being an introverted and secluded function which will reflect the Moulin Rouge.

The dance studios are placed at the south facade to make a direct connection to the city. Four training studios, the exterior space, cafe and changing rooms are placed from first level an upward and will in this way give the dancers their own zone in the building. This is pulled forward to the facade exposing it.
This division is reflecting the city, of having public function at ground level and private function above.



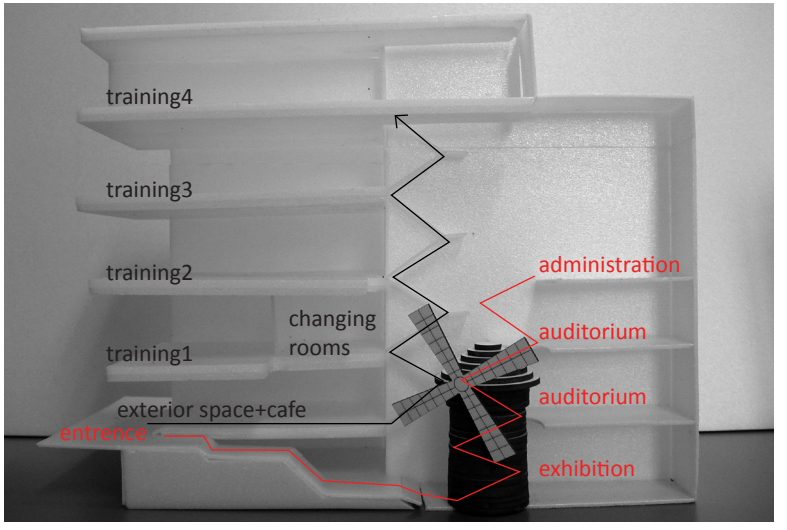
Because of the wish to place the mill in the museum, the next step was to explore the potentials and problems related to this. In the initial form finding and distributing of the functions the mill functioned as a stair connecting the public functions. In this way it would function both as historical, physical and visual connection.

By placing the mill inside the museum it will occupy a lot of space especially in height. This is giving problems of distributing all function within the relatively small space given for the project.
The mill is a big structure placed in a relatively narrow room and needs more space around it. On the initial interior models the mill is to enclosed.

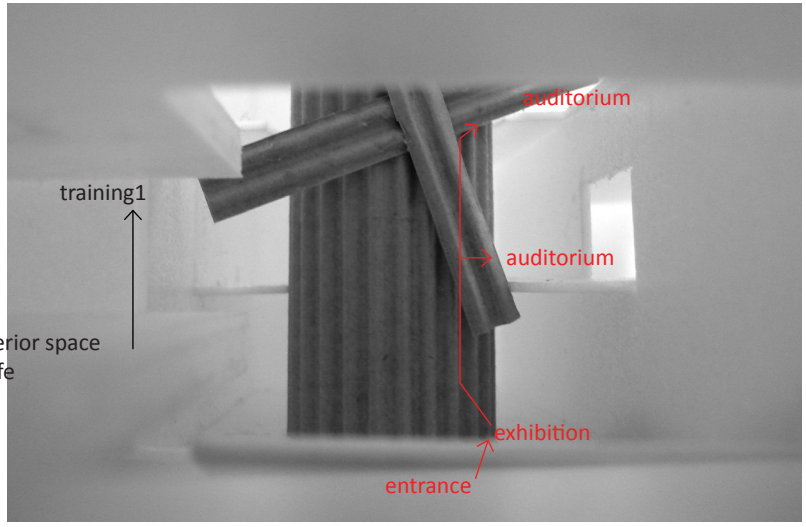


An initial model of the distribution of the functions. Separated entrances to the private and the public and clear division of the paths and zones.

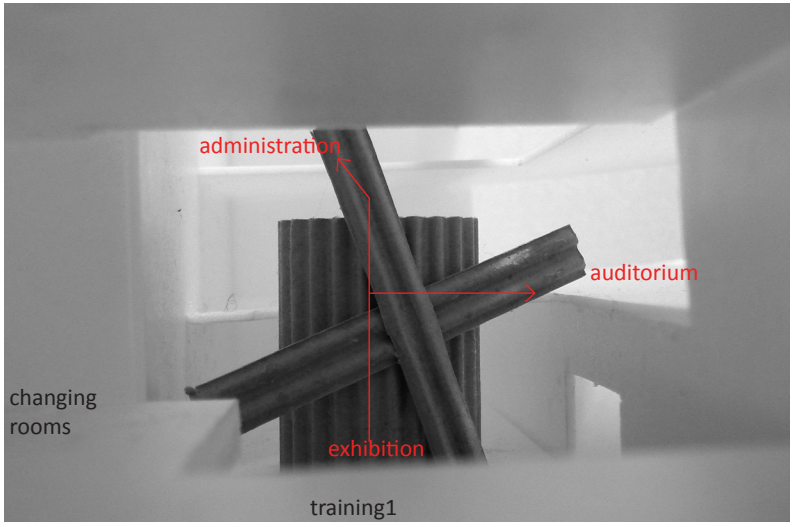
From a narrow entrance the public lead down to the mill where the room opens up to become a triple-high atrium with visual connections to the dance activities.



The volume and rooms have been more defined. The section model show a clear division between public and private functions but with visual connections everywhere. The mill has been given more space but it is still be encircled and it deserves more space.



From the entrance the mill is clearly in focus, leading the guests down to the museum where the room will open up to become a triple-storie high atrium..



From the training rooms the red mill is very visible always reminding the dancers of the place. They also have a view towards the auditoriums and the museum from where the guests can watch the dance from a distance.

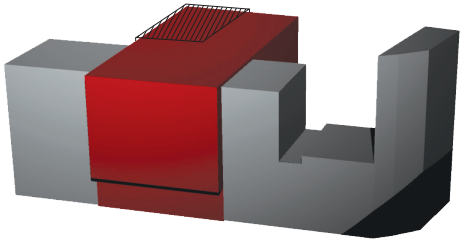
PLACEMENT ON THE SITE

Seen from the internal organization the building has problems staying within the limits of the site. The functions will occupy every square meter of the given space. It is desired to place the mill inside the building and to have a triple-high room with visual connections, in order to achieve spatial quality. Hence the building will have to expand beyond the limitations given from the program.
This can be done either in height or by cantilevering above the rooftops at the back of the building.

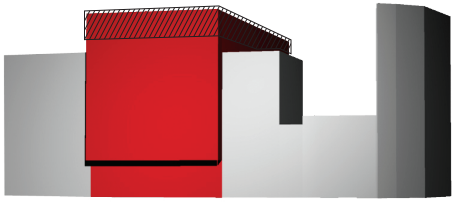
From the program a height restriction of 25meter is required for the building, where the adjacent buildings are 22-23meter in height. Staying inside the limitation the building will adapt to the scale of the context. But because a close building in the context is 30meter high the new dance school would not be the only building protruding the 25meter.

Is it is decided that the interior qualities are attached greater importance than staying below the 25meter as this will result in a compression of all rooms. By protruding just one level, which means still staying underneath 30meter, the building will attain much better spatial qualities.

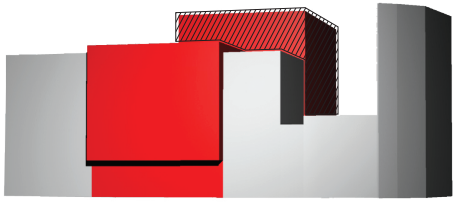
During the process it was decided to add a cantilever above the existing building of the Moulin Rouge. In this way the building will have more than one visible facade and it solved a lot of problems relating to the internal organization and circulation. At the same time it will be seen more connected to the Moulin Rouge as the extension is surrounding it.



Adding a cantilever behind the building will result in staying within the limits but the rooms will be surrounded by other buildings and have no view or direct sunlight.



The building protruding one level will exceed the limit of 25meter but will make the building more visible.



Adding a cantilever above the existing foyer of the Moulin Rouge will result in much more exposing of the building as more facades will be visible.

Edges

The building is an infill, placed in a bigger complex with only one facade free of other building. The surrounding facades are flush. This means that anything breaking that order either by protuding forward or backward will be noticed because it is changing the layout of the complex. This can be used to make the Dance School much more conspicuous.

When pulling back the building will create a small square to the front, which is often used to give a building a hierarchy because many people can gather here and you get another perspective of the building. But when it comes to infill architecture it will have the opposite effect as the building will be hiding behind the surrounding buildings and hereby be less visible.

If the building is protruding the surrounding buildings it will be more noticeable in the context. But if the protruding is continuing at ground level it will occupy much of the pavement.

Hence the optimal solution will be to take the qualities from each, by having a building that on ground level, is pulled back creating an opening to the pavement and to letting people stop for a while. Then it should be pulled forward on the upper floors in order to reach out to the city.

Plane facade
- adapts to the context
- same hierarchi
- the least conspiecuous

Facade pulled back
- create a small plaza
- depth in the facade creats a break in the facade

Protuding facade
- the most conspicuous of the above
- occupy much af the pavement

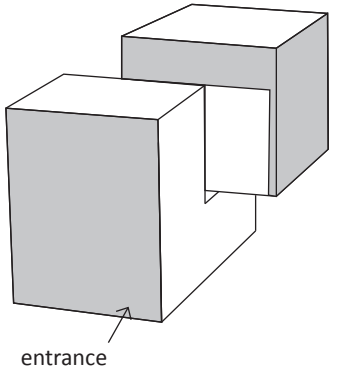
Combining the qualities
- pulled back at ground level
- protuding at upper levels
- variation of the depths in the facade

THE FACADES

The challenge of designing the facade consists in finding an expression that meets all the sometimes conflicting visions, listed on the next page. The building should clearly stand out as a landmark of the area and reflect the history of the Moulin Rouge. At the same time it is desired to portray the Dance School as a serious and artistic form of art.
The building should also relate to the context and should change it's character at night.

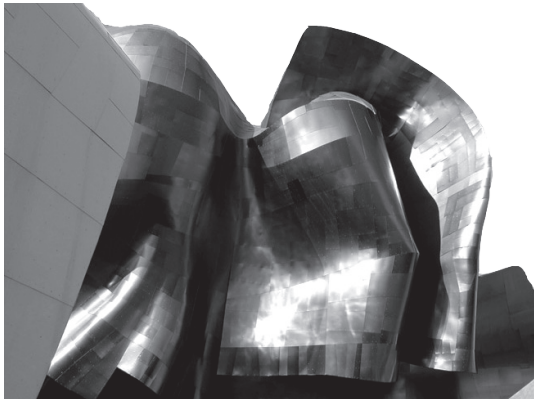
The form finding has included sketching, physical modeling and photo shopping. Developing the expression of the facade has been a continuing process throughout the project, as more parameters kept influencing the appearance.
The facade studies have been completed simultaneously while working with the spatial distribution and the edges as they are close connected. Later in the process construction and light simulations inside the building will also have an impact on the design of the facade.

In the beginning of the process only one facade would be visible, that is why the form development has concentrated on this. During the process the cantilever was added resulting in more visible surfaces. This made the challenge of developing the facade expression more complicated as more parameters were added - the building should be perceived as one coherent building that is why the facade expression should be able to have multiple directions towards very different surroundings, and contain various functions.
The remaining facades are either surrounded by other buildings or facing an impassable courtyard of rooftops. These will only function as light-intake and will be blocked from view as it would be a very dirty and uninspiring view. That would only disturb the experience when being in the museum and the dance studios where the view should be concentrated to the street.
This has resulted in facades that are either very extroverted or introverted and creates a challenge to find a shared language between the two.



The grey marks the visible facades, the primary facades. The rest of the facades will not be visble due to surrounding buildings, but the intention is to find a facade expresion that will make the building be percieved as a coherent volume.

Vision for the facade expression

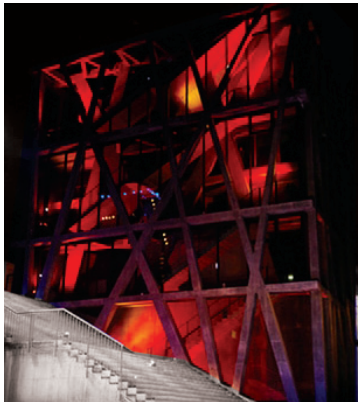


HAVE SIGNALLING AND SULPTURAL VALUE

REFLECT THE HISTORY OF MOULIN ROUGE

HAVE A REFERENCE TO DANCE AS AN AMBITIOUS AND ARTISTIC FORM OF ART.

TRANSPARANT AND TRANSLUCENT MATERIALS



CHANGE CHARACTER AT NIGHT

BOTH 2- AND 3-DIMENSIONAL.

"Many visitors will come wanting to be surpriced" [competition]

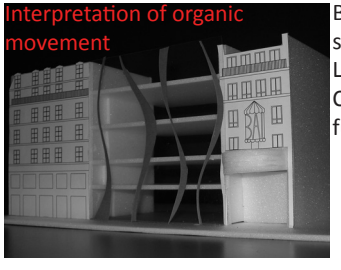
The starting point of the form development of the facade expression was a workshop. Here different categories derived from dance and movement were explored through sketching and physical models. A selection of the outputs is shown and discussed and some of the qualities will be further developed.

First workshop
The four categories were derived from dance or terms of movement.

1. Interpretation of ‘Dance’
2. Interpretation of ‘movement’
3. ‘Changeable expression’
4. ‘Light, floating expression’

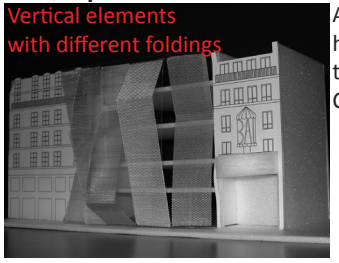
1. Interpretation of ‘Dance’

Sculptural expression.
Conspicuous.

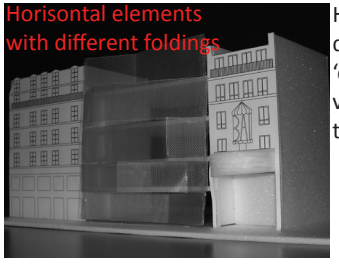


Big exposure of the dance studios.
Less conspicuous.
Could contain other public functions.

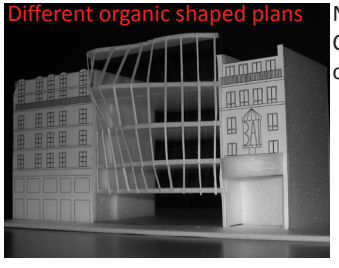
2. Interpretation of ‘movement’



Ascending elements have a clear reference to moving structures.
Conspicuous.

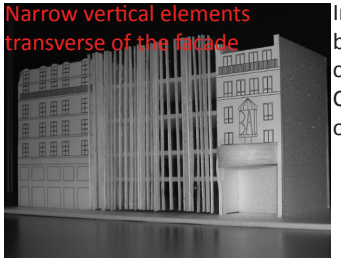


Horisontal elements does not reflect ‘dance’ as much as vertical but refer more to other functions.

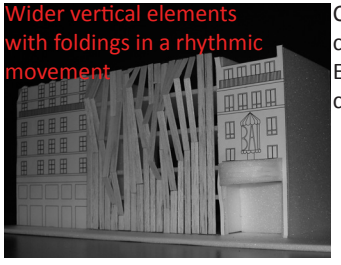


Non conspicuous.
Could contain many other functions.

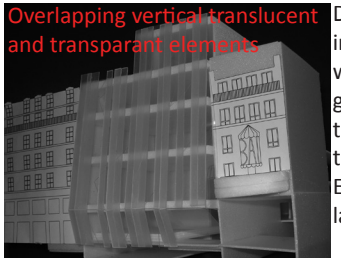
3. ‘changable expression’



Interesting play between opan and close.
Could contain many other functions.

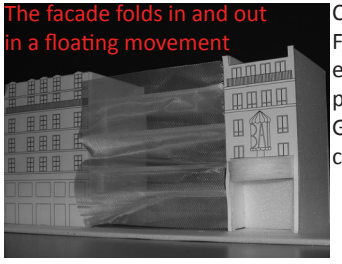


Clear reference to a coreography.
Elegant and conspicuous.

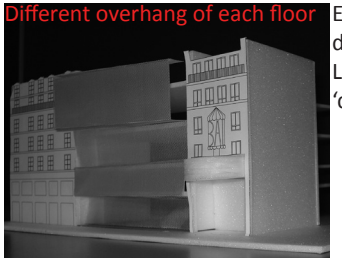


Displays the dancers in a play of movement with an ever changing graduation between transparancy and translucentcy.
Elegant and poetic but lack sculptural value.

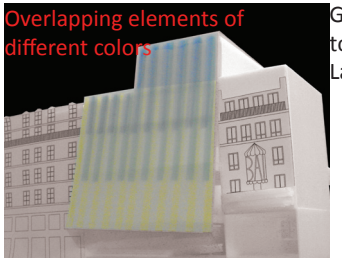
4. ‘light floating expression’



Conspicuous.
Folds in at the entrence inviting people to come in.
Gives a reference to a curtain.



Exposure of all the dance studios.
Lack a reference to ‘dance’.



Graduation from light to dark colors.
Lack sculptural value.

The workshop resulted in a desire to further investigate the following terms:

Vertical and diagonal elements.

The horizontal and organic shapes do not have as clear a reference to dance and movement as the vertical elements.

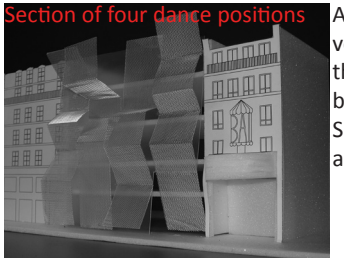
Three-dimensional.

The plain facades do not have as conspicuous qualities. The three-dimensional will make the facade protrude the adjacent buildings.

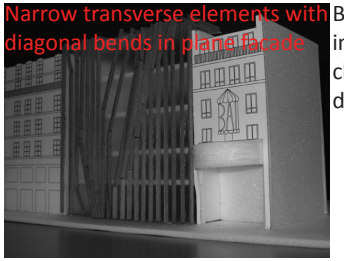
Rhythmic composition.

By repeating the elements but changing shape, rotation or bending an interesting facade can be achieved.

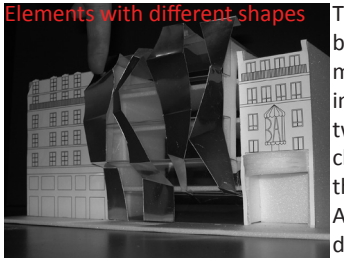
In a second workshop these was further developed (a small section are shown on this page).
This will result in a fascinaton of an abstraction of dancing bodies. Elements of the facade are choreographed into changing shapes of bendings and overlapping silhouettes which echo the outline of a dancer. This will achieve the desired conspicuous expression while at the same time reflect the function of the building.



A combination of the vertical elements and the scale of the human body.
Spectacular facade but almost too noisy.



Bending structures in achieve an ever changing degree of dense and scattered.



The elements have been made much more dynamic when implementing diagonal twists in the surface changing the shapes of the elements.
An abstraction of dancing structures.

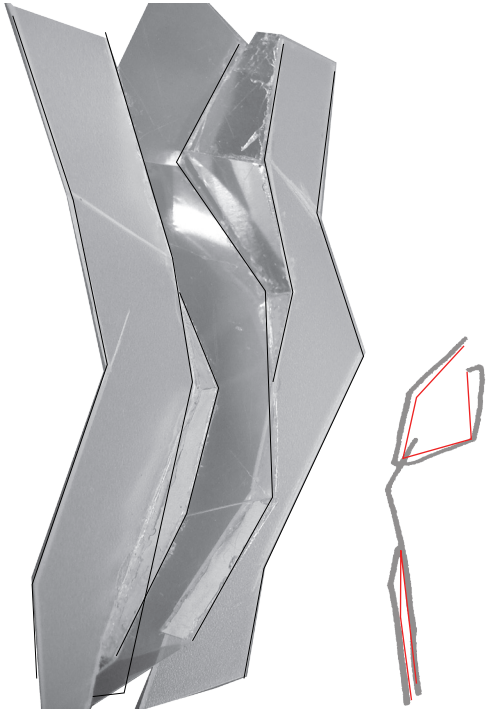
Further development of the facade now changes from working with the overall structure to working more in detail with the elements. This will explore possibilities of shaping the different elements and how they can be joined and placed according to each other.
At the same time materials and the construction for the facade is studied more deeply and will also influence the shaping [‘construction of the facade’ , page 82].

The materials should be light, transparent and translucent. This will give the building a light expression and show the dance activity in the facade either directly or as shadows.

Simultaneously with developing the facade light investigations have been made in order to explore problems and potentials regarding natural daylight into the building while at the same time avoid annoying reflections and overheating [‘light’, page 90]. This concludes that the facade should have maximum 50% closed materials in order to get a sufficient light. With transparant glass elements problems of overheating and annoying reflective light is relevant why the facade should either implement shading elements or a dominate part should be translucent elements. When implementing shading elements the expression of the building changes too much. Hence, the facade should mainly consist of translucent elements that filters the light and only reveal the shadows from the dancers.

Elements that have various shapes, bending and folding both in the surface and in space.

This shape is too static. The proportion is too narrow compared to the height.



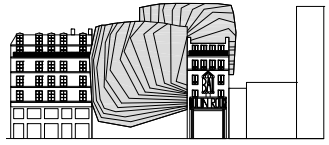
By giving the elements a sharper bend and by adding those together in a deeper three-dimensional grid the facade will be perceived more dynamic and interesting.

Having found some guidelines to the elements the next step was to find an overall grid to implement the element. This happens simultaneously with the construction of the facade [‘construction of the facade’, page 82]. Through sketching, physical modeling and digital modeling the overall shape, direction of the movement and proportions are explored.

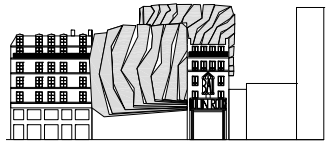
The facade will be a wrap that captures the building, adapting to the context and functions within. At the primary facade it will have a very dynamic and three dimensional grid with elements of different shapes of bending that protrudes back and forward from each other. This will reflect the energy from the dancers and the city in which it is placed in between.
At the north facade the grid will become a two dimensional rigid system of same sizes elements divided by a horizontal grid. Here it will reflect the clean and introverted function of the museum and the encaptured context of surrounding buildings.
In the east and west elevations the gradual transition between the two extremes is visible.
At night the facade will change character into an illuminated red structure.

A harmonious proportion of the elements are achieved by having ten vertical bands.
The elements should protrude 1.5-3.5m above the street - enough to make an appearance without projecting onto the entire pavement. It is framing the sign from the Moulin Rouge.

The angle should not be more than 140^0 as this will be too pointy and sharp but will also be perceived as dangerous. At the same time the elements should protrude within two meter to achieve a certain depth in the facade.

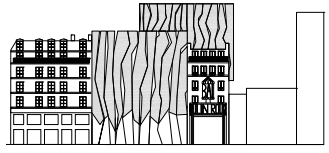


The movement origins from the Moulin Rouge in a circle momement that surrounds the existing building. Reference to the rotating mill and a clear connection to the Moulin Rouge.

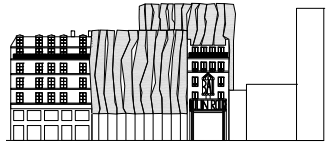


The movement origins from the Moulin Rouge and strive upward.

Large scale pattern - the elements become slightly too wide.

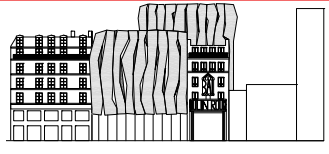


The dynamic pattern start at the ground from a two-dimensional transparant grid that becomes three-dimensional and translucent.



Transparant rigid elements at ground floor, three dimensional dancing translucent elements above.

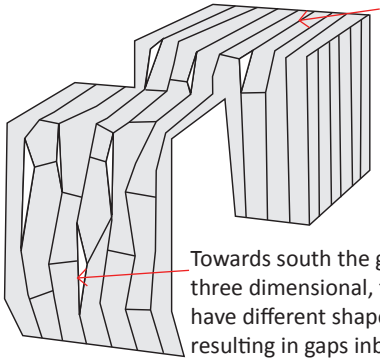
Small scale pattern - the band elements are a bit too slim.



Harmoneous proportions of the elements.

Gaps between the translucent elements have either a transparant material or reflecting material.

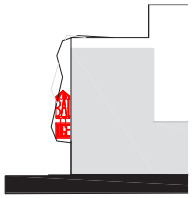
Selection of digital modelling of the facade grid.



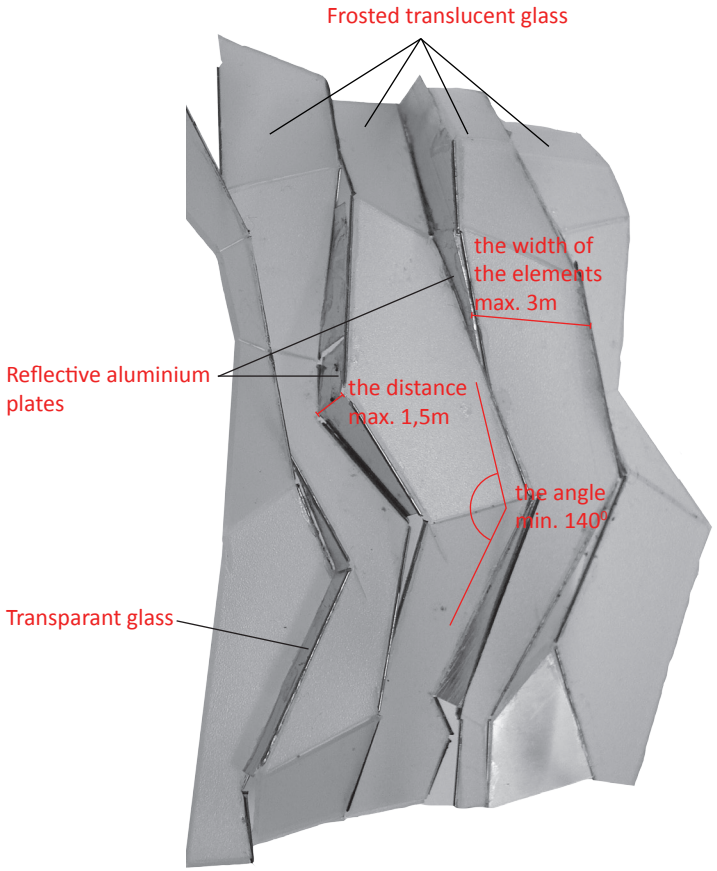
Towards north the grid consists of two dimensional, rigid elements of the same size.

Towards south the grid becomes three dimensional, the elements have different shapes and bendings resulting in gaps inbetween.

Principle of the facade grid showing how it gradually turns from a rigid two dimensional system to a more free, dynamic three dimensional shape.



Seen from the east the facade is protuding between 1,5 and 3,5meter.



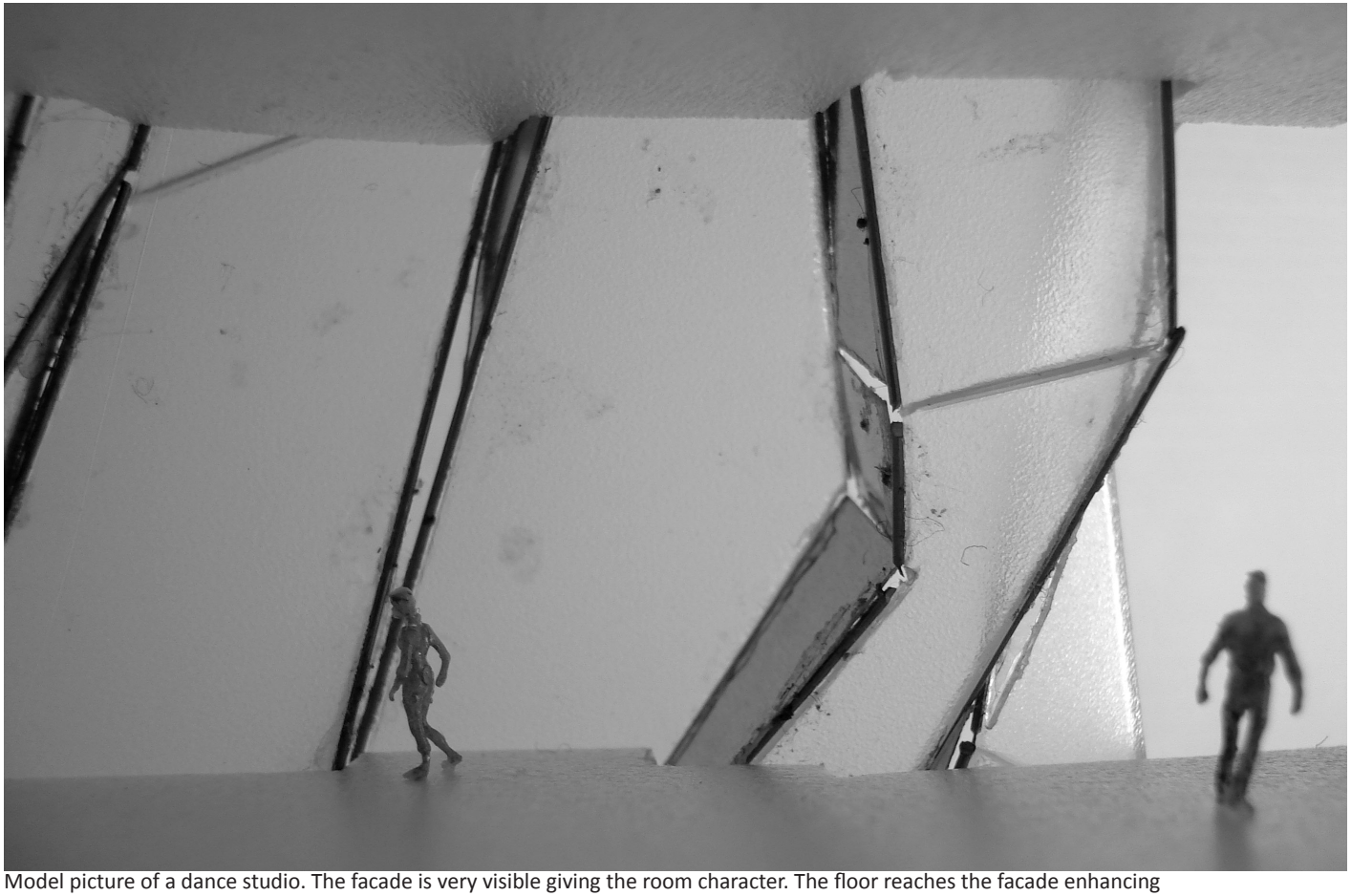
The facade will consist of elements that are abstracts of dancing bodies. The elements will have different shapes and be displaced from each other in a three-dimensional grid, bending and changing shapes. This will result in an ever-changing facade with only very few repetitions in the elements.
From the front, one can only see the translucent elements and the lattice grid. When seeing the facade from the side the depth, the reflecting steel and transparent glass elements reveal.

The elements will primarily consist of translucent material but would be interrupted by transparent elements, giving the city a view to the dancers and vice versa. In between the elements a lattice grid will hold them together.

The width of the elements is 3 meter maximum with a depth of 1,5 meter maximum to the next element. The elements shall have a minimum angle of 140^0 in the depth in order to avoid sharp and pointy edges.

The facade illuminated with a red light.

At night the facade will be back-lit by red LED lights which will be incorporated into the facade. This will light every translucent element and the building will change character. It will be perceived as a lighting, floating structure embracing the Moulin Rouge which is why it at night will have a more direct connection to this.
The lattice grid will stand out more clearly by night as a dramatic structure.



Model picture of a dance studio. The facade is very visible giving the room character. The floor reaches the facade enhancing the dramatic and conspicuous appearance.

THE MUSEUM

Working with the facade has mainly concerned the primary visible facades. The museum is secluded from the south facade placed in the northern part of the building where the facades will not be visible from the outside and the these facades should somehow be connected. This part of the building is enclosed by other buildings at the lowest 10 meter where above the facade is free.

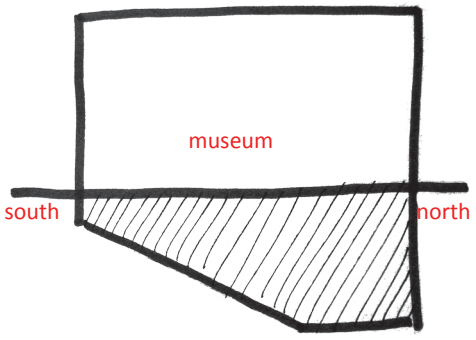
The room should have a clean and simple expression that does not take the focus away from the mill. It should enhance the atmosphere of an subtle ceremonial setting of the red mill.

Light studies in a 1:100 model have been made. Here different solutions have been tested, of a clear division between the enclosed part and the free part and of a gradual transition between the two types of facades.

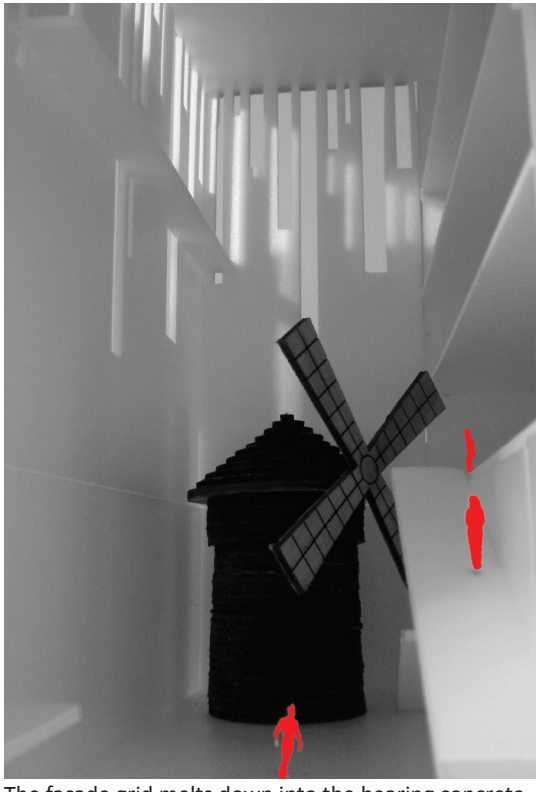
Pictures from the light studies are shown on the next page.
The clear division will make the room seem like it is split in two. This will make the lowest part seem very closed and dark encapturing the mill. The other two solutions are merging of the two structures, where the lattice grid gradually becomes the concrete structure. The room is perceived more as a whole. The horizontal windows will enhance the decks in the room and the auditoriums and the administration will have more regular horizontal windows. This will from the outside conflict with the vertically elements in the south facade. The solution with vertical merging will enhance the almost ceremonial appearance as is desired, but here the religious reference is too clear. It should be more softened down.

As none of the solutions from the light studies are desired, the choice has been to continue the lattice grid of translucent elements all the way down to the floor in the museum. It should have a gradually transition between opaque elements at the enclosed part of the walls gradually changes to more translucent elements letting in diffuse light closer to the roof. This will make the roof seem lighter and floating above to enhance the ceremonial appearance.

Concrete columns will carry the upper floor. These can be placed either on the inside or outside of the facade. It is desired to make the facade and roof wrap seem like it is enveloping the building why these should be placed on the inside. Here they will be visible and contrast the light glass elements.



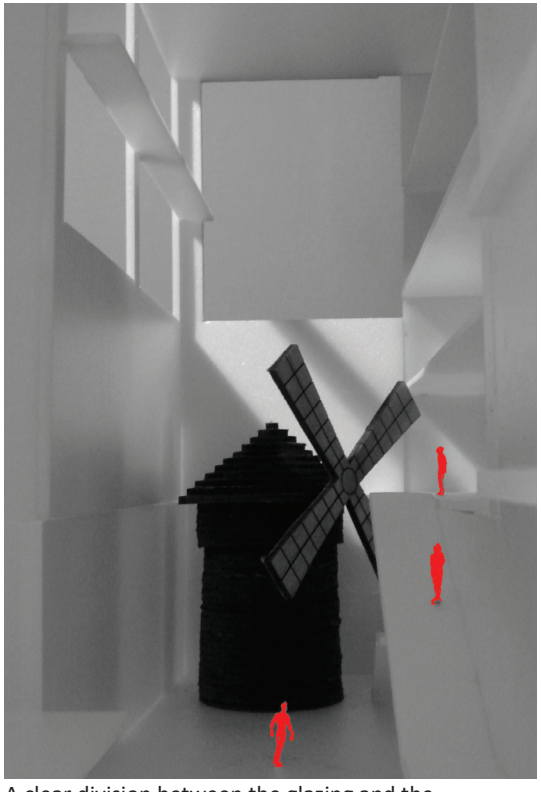
The diagram show how the lowest part of the museum is surrounded by other buildings.



The facade grid melts down into the bearing concrete in a vertical direction.

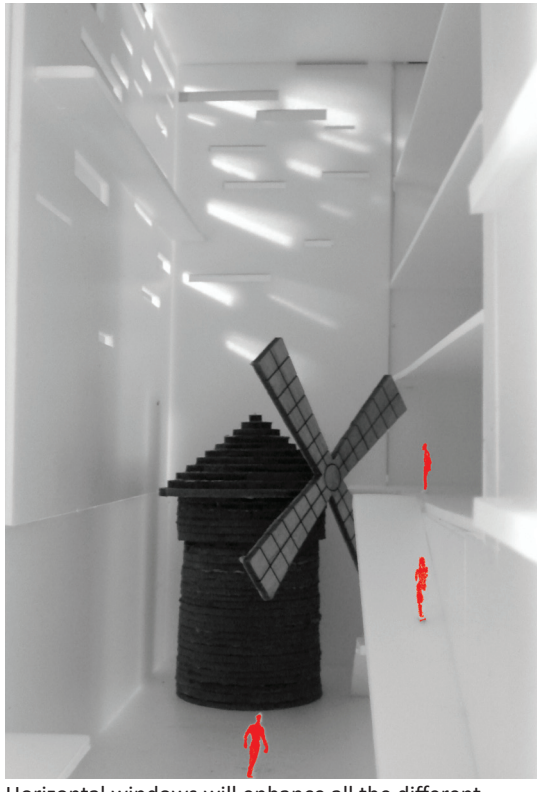
This enhance the ceremonial appearance and could be considered more of a church.

The graduation from closed to open is seen as a quality blurring the edge.



A clear division between the glazing and the encaptured part, where the room is surrounded by other buildings.

This splits the room in two and makes the lowest part seem more enclosed and narrow which is not desired.

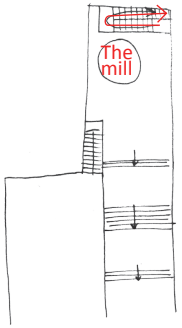


Horizontal windows will enhance all the different decks and the walkway. The direction is conflicting with the verticality of the rest of the facade though the auditoriums and administration will have more regular windows.

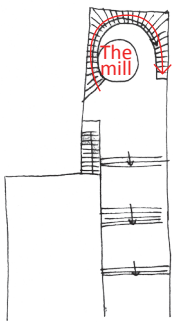
Circulation
From the museum the guests shall be able to reach the bookstore placed in the cantilever on the second floor and the auditoriums further above. The workers in the museums should have access to the administration above the auditoriums.
Preferably they should have their own access in order not to be dependent on each other but because of the very narrow room it should not compromise the spatial qualities.

In spite of the narrow room it has been possible to find a solution to separate the public and the private flow, at the same time secure a circle-path for the public. In that way the guests of the museum will have the choice from the entrance either to go straight down to the mill and continue to the bookstore and auditoriums. From here they can return to the entrance without having to go down to the mill again. All the time they have the view to the dancers.

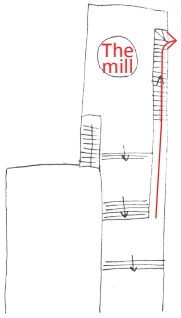
The workers of the museum can follow the same path or take their own private stair placed at the back of the museum inside the existing building. A structure will be continued up and will contain lift and stairs.



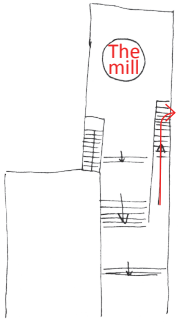
The stairs in the background of the mill will disturb the mill and take too much focus.



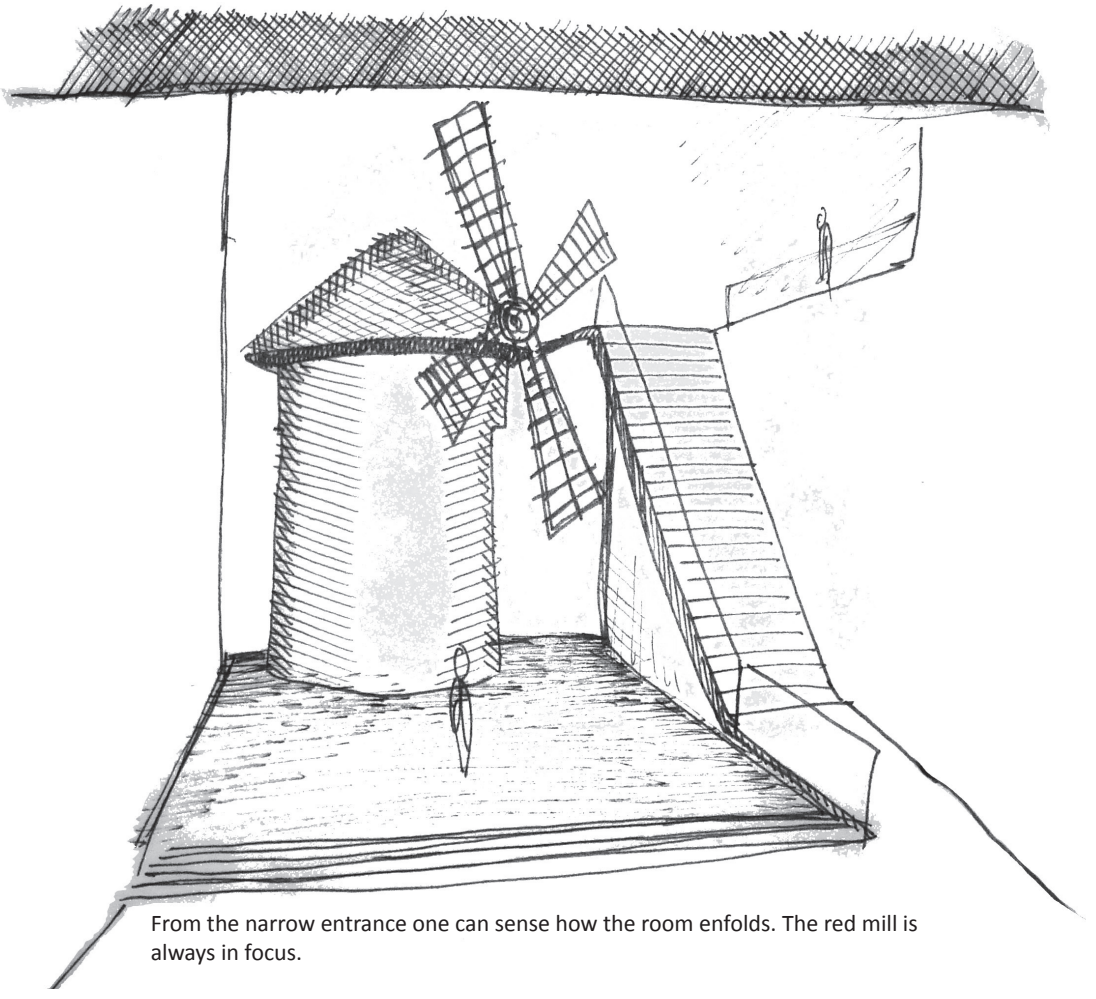
The stairs surrounding the mill will be a huge installation and will totally encapture the mill.



From the entrance there is a possibility to go straight to the bookstore and auditoriums. This will squeeze the mill leaving not much space around



The stair is pulled back giving the mill the space it deserves.



From the narrow entrance one can sense how the room enfolds. The red mill is always in focus.

CONSTRUCTION

The building will contain two primary functions, the Dance School and the museum, which will be in one cohesive building. The paths between the public and the private are clearly divided but visual connections are holding together and inspiring the two functions everywhere.
This results in a lot of glass, transparency and translucency in the building which provides the feeling that there are no limits and boundaries between the Dance School and the museum.

The training rooms, placed towards the south facade, should be open and flexible in use without any disturbances from load carrying structures. This means that the decks have to span 21m, the width of the building so they can be supported by columns in each side. Because the building is an infill between two other buildings these will function as stabilizers.
This is resulting in a facade that only has to carry itself and be able to take forces from the wind.

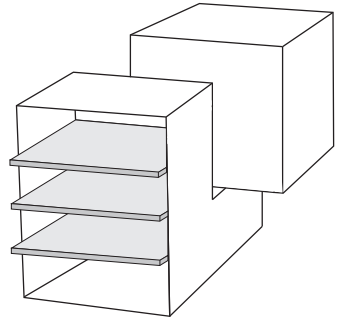
From the inside the building should be perceived as clean and simple in order to highlight the functions - the dancing and the mill. The structure should not have a lot of visible detailing but should frame the activities beautifully without taking away the focus.
The deck could either be constructed of a steel lattice, beams or concrete slabs.
A steel lattice construction can easily get a cold high-tech expression with visible trusses and joints. This would make the structure very noticeable and can make the room noisier than what is desired.
Beams and slabs of concrete have a more clean and simple expression which do not take focus from the dance or the things exhibited.
The desired plans in the dance studios are edged and cantilevered above the street. The floors should reach the facade so the boundary between the city and the

The 21st century museum in Kanazawa of Sanaa is an example of the exhibition rooms in the museum with a clean and simple expression, emphazising the art.

The exhibition rooms are very plain and does not disturbe or takes focus from the art. The only detailing in the room is the ceiling with skylight provideing a natural diffuse light.

dancers will be as minimal as possible. Because of a desire for a very light facade no load carrying structures should hold the cantilevers. This results in in situ constructed slabs which can be made in the desired shape.
The decks should be as thin as possible why cobiax slabs are chosen [appendix 1.a][cobiax]. This is an in situ deck construction which incorporates balloons to make it as light as possible and which will make the height of the deck 600mm. The dimension is derived from comparing to a reference project with the same span length [appendix 1.a].
By chosing these decks is gives a large degree of freedom of the expression of the ceiling in the dance studios.

The decks will be supported by concrete columns in each side. The ventilation system will run vertically between the columns and both columns and ventilation will be hid behind the mirrors on the walls. The columns will have a dimension of 240/360mm and be placed for each 5 meter [appendix 1.b].



The deck cantilevers 2m above the street. In situ cast deck will result in no carrying structures being in the facade.

type	dimension	expression
Cobiax deck	600mm	- freedom in the shape of the deck - freedom in the expression of the ceiling - slimmest solution
KB profile beam	1020/220	- the thickest solution - east-west direction of the beams - needs support under the cantilever
TTD deck	780/2400	- can hide technical equipment - east-west direction of the ribbs - needs support under the cantilever

Diagram comparring the cobiax deck with a TT deck and a beam construction.

The cobiax deck have many advantages besides the freedom in the shape - it is also the slimmest possibility of the three.

The dimension from the beam is from “dimensionering med diagrammer” [Ahler, 2002]. The dimension of the deck is from the website of Spændcom [spaendcom].

Construction of the cantilever

Another challenge of the construction of the building is the cantilever above the foyer of the existing Moulin Rouge building. This cantilevers 10m in 5 levels.

Most of the cantilever is hid behind other buildings, only the west facade and a small part of the facade towards the south will be visible. The bottom of the cantilever is not visible from any angle because taller buildings surround it, why columns underneath can support the building. These will lead the forces down through the building underneath.

If the bottom of the cantilever would have been visible it would have needed another solution for the construction. Then it should have been emphasized as a cantilever and not have had supporting columns underneath.

But because it will not be visible from anywhere there is no need to make it more complicated, why supporting columns underneath will be carrying the cantilever.

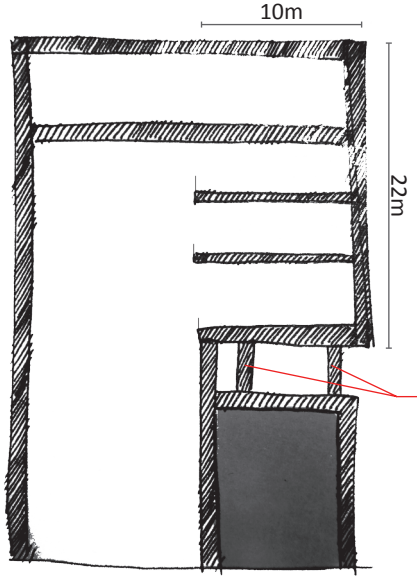
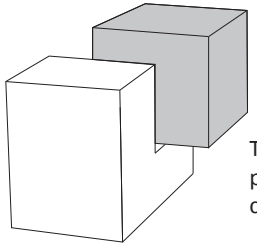


Diagram of the section. Coloumns are leading the forces down through the building underneath.

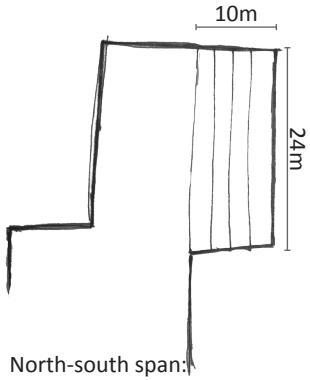


The grey marks the placement of the cantilever.

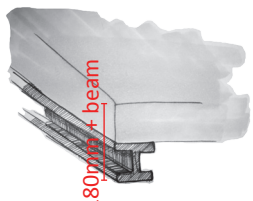
The decks in the cantilever will be made of precast slabs as slim as possible. They can span two directions depending on where the load carrying structures should be placed - either north/south or east/west. This will result in a big difference of the height of the decks due to the very different span length. It will also have an impact of the perception in the museum whether or not load carrying structures would be visible.

The cantilever contains more sedentary functions such as administration and auditoriums. Here the facade is a two dimensional and rigid structure why load carrying concrete columns can be placed on the internal side of the facade.
This results of decks with only 180mm slabs [appendix 1.d] but it will also cause concrete columns inside the museum.

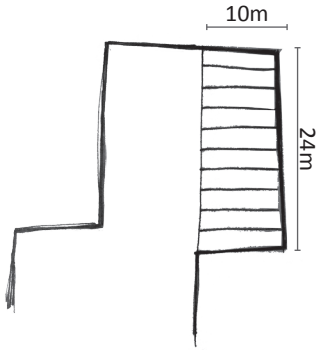
In order to minimize the height of the construction the slabs will be placed on console profiles. Three concrete columns in each side will support the decks [appendix 1.b].



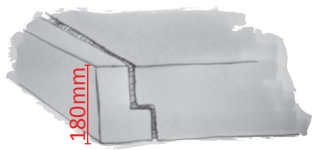
North-south span:
TT600mm deck
Coloumns south and north will result in a free deck towards the museum but will be much thicker.



Traditional way of placing a slab on a I-beam profile.



East-west span:
PX180mm deck
The slabs can be much slimmer but will be supported by transverse beams and coloumns which will be visible from the museum.



Slabs held on console-profiles will minimize the height of the deck construction as this will be visible from the museum.

Construction of the facade

The facade should be constructed of a self carrying lattice shell so it wrappes the building like a skin. The distance between the city and the dance studios will be minimized and it will be perceived as a thin skin surrounding the building.

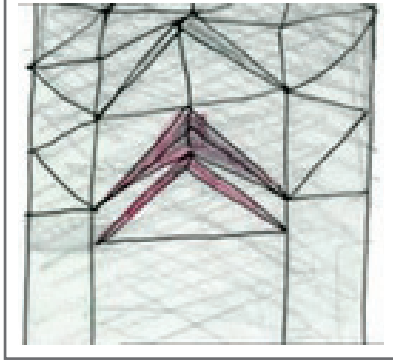
A lattice shell has the ability to be formed in almost any desired shape and can function both as a facade and as a roof. It is often used to optimize geometric forms like spheres and cylinders but the shape does not have the need for any easily describes mathematical term.
The lattice shell can be used to the very complex facade and roof of this project. It will be an irregular mesh of hinged bars fixing the translucent window elements.

Determining a shell surface is always problematic and needs an individual approach for every project. It needs to be able to take compressive, tensile and shear stresses acting in the plane of the surface. It should also be able to persist buckling and surface instability [structures].
Because of the three dimensionality of the lattice shell in this project it can optimize problems related to local buckling and instability.

The lattice shell can be shaped in the desired facade expression for this project, with it's abstractions of dancing structures. The illusion of something very light and easy in dance will be repeated in the facade even though both the dance and the facade will be very complex and demanding to achieve.

An example of a lattice shell facade is seen in the Citroën showroom in Paris [worlsarchitecture]. A glass latticework of chevrons reflects the building's Citroën identity. The lattice grid is stretched between the two adjacent buildings and functions as a vertical carrying element. This facade solution makes the whole structure very transparent and light and the Citroën reference is very clearly emphasized.

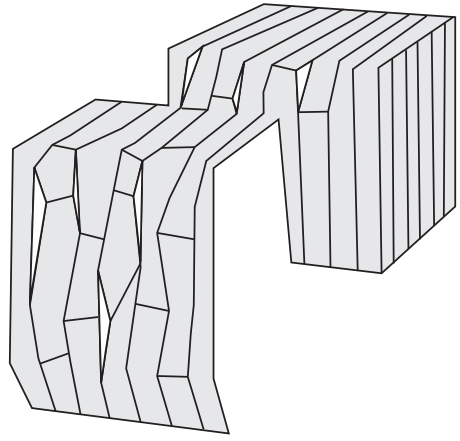
The lattice shell can be shaped to have a reference to dancing structures as it is desired in this project. The similarity is seen in the grids possibility to have almost any shape and still make it seem light and easy even though it has been very complex to achieve.



The lattice shell is constructed as a grid system where vertical, horizontal and diagonal bars are carrying and stabilizing the structure.

The facade and roof will be fixed to the adjacent buildings.
It will be a wrap that captures the building adapting to the context and functions within [facades, page 71].

Dimensioning of the lattice grid
In order to get an understanding of the dimensions of the facade grid a calculation of the worst case bar in the latticework have been calculated [appendix 1.e]. This shows that a round bar of 114mm is enough to carry the facade. This has been calculated with regards to wind loads. The facade becomes a roof structure as well. Here wind forces are not relevant but snow can occur. As snow has a much lower force than wind it is assumed that the lattice grid can have the same dimensions in the roof in order for the structure to have a homogeneous appearance with the same dimensions of the grid all over.



Principle of the facade grid showing how it gradually turns from a rigid two dimensional system to a more free, dynamic three dimensional shape.

Materiality

The translucent elements are fixed to a stainless steel grid of round bars placed between the glass making it visible both from the inside and the outside. The lattice grid has a smooth and reflective surface from the outside but will be sealed from the inside in order to avoid cold bridges.

The glass elements will consist of frosted white glass which has a matt and rough surface. It will avoid reflecting the surroundings but instead give focus to the dancers showing the shadows in the facade.
These will filter the light giving a homogeneous and diffuse light inside the building.
The tactility, luster and color will contrast the high reflective and smooth steel plates placed to fill out the gap between the translucent elements.

The north facade in the museum is composed of a gradual transition from opaque elements near the floor to more transparent glass elements closer to the ceiling.
This blurs the transition between the enclosed part and the free part that filters the light.

The building will adapt to the context regarding buildings scale, color and division between public functions at the ground level and private functions above. But it will contrast the historic and heavy limestone buildings with a new, light and dynamic facade composition.

An example of the translucent elements is seen in Peter Zumpthors Kunsthaus Bregenz [Schittich, 2007]. It consists of frosted glass shingles that do not reflect the surroundings but creates interest in the structure and details which are more visible.

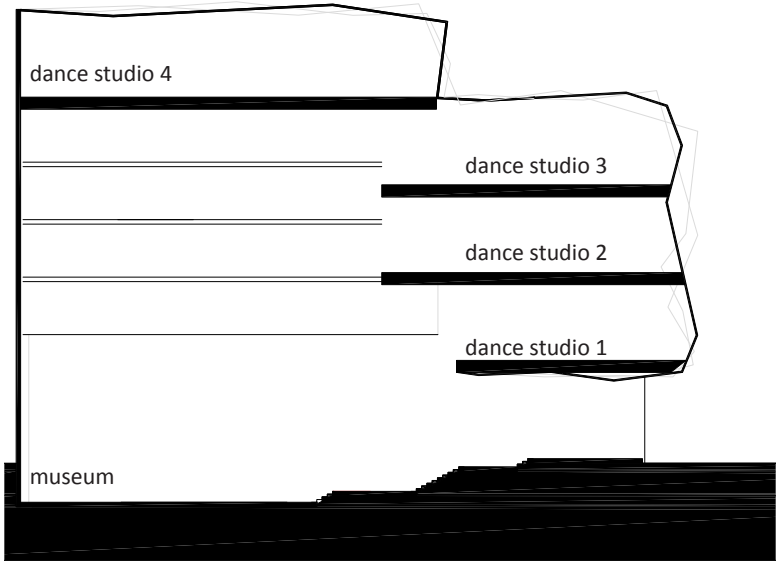
Night
The neighborhood has very different characters between day and night where signs and light pulsate at night, making it a vibrant and lively area.

The Dance School will reflect these different characters. During the day the facade will be animated through the form and the shadows from the dancers. The protruding elements in the facade will give a changeable pattern of shadows throughout the day. This also strengthens the character.
By night it will be lit by LED light integrated in the facade structure. These will back-light the translucent elements with a sharp red light giving it a spectacular and weightless character. The lattice grid will stand out more as the only thing the light cannot penetrate.
It will enhance the spectacular show atmosphere of the Moulin Rouge and function as part of the setting for the show.

Behind the facade the red mill in the museum will be illuminated and visible from outside adding to the history of the Moulin Rouge.

Light in the facade
The translucent facade of the Nelson-Atkin museum is back-lit [nelson]. This gives the building another character by night.

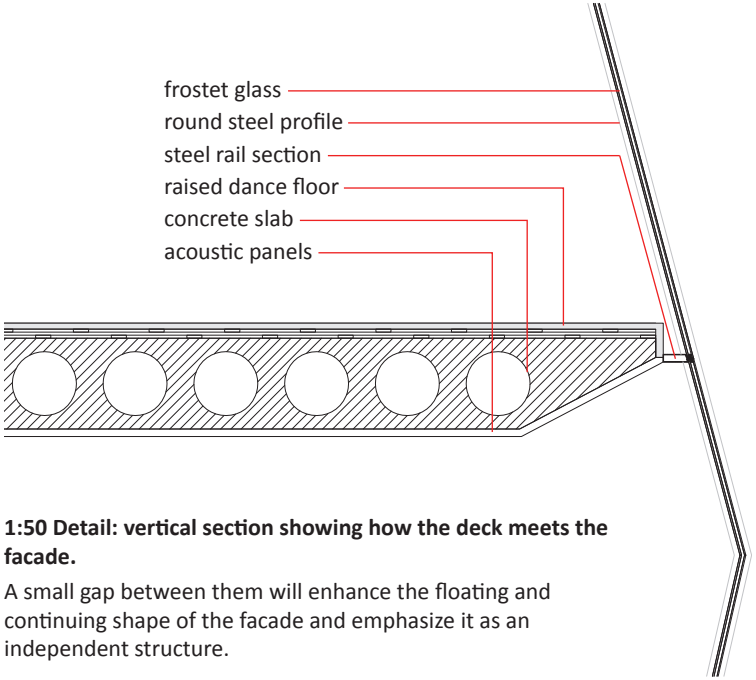
In the section the dynamic shape of the lattice shell is clear. The movement starts as an almost two-dimensional structure at the ceiling of the entrance to the building. From here it bursts out into a three-dimensional dynamic shape. It constitutes as a roof above dance studio 3 and rises up enclosing the upper studio 4.
The decks in the dance studios are pulled forward to reach the facade so there are no visible connection in between. This will make the distance between the city and the dance school as little as possible.



The floor slab is pulled back a little, so one can sense the continuation of the facade. If it was pulled all the way to the facade the movement would stop.

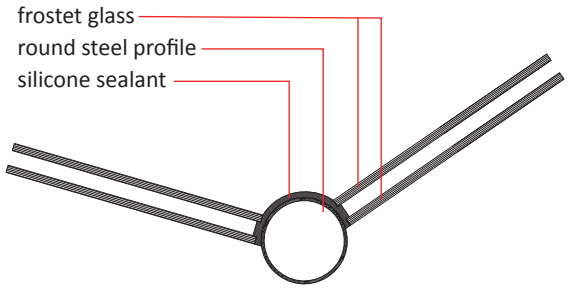
The latticework will consist of steel bars with a dimension of 114mm in diameter. The choice of having round bars allows the glass elements to be fixed at any angle.
The bars are placed between the elements making them visible both from the inside and the outside. This will make the elements seem more divided and will emphasize each element.

In order to avoid cold bridges the steel profiles will be sealed at the inside. The steel will be visible from the outside but will have a black covering on the inside which will make the profiles in sharp contrast to the white translucent elements.



1:50 Detail: vertical section showing how the deck meets the facade.

A small gap between them will enhance the floating and continuing shape of the facade and emphasize it as an independent structure.



1:10 Detail: horizontal section of the facade

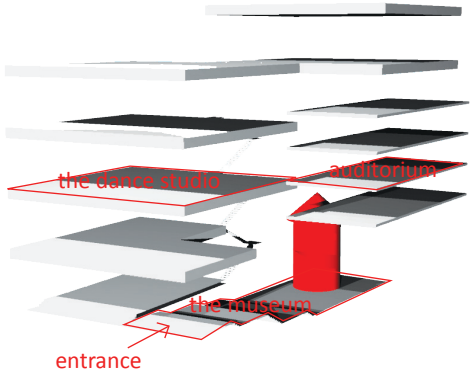
The elements will be fixed to a grid of smooth circular aluminum bars with a silicone sealant.

The lattice grid is visible both from the inside and the outside as it is placed in between the glass elements, but will be sealed on the inside to avoid cold bridges.

LIGHT

The building consists of a lot of transparent materials which will contribute to a very light and friendly atmosphere and give visual connections. Seen from the studies of the senses light have a very strong impact on the atmosphere of the room [‘senses’, page 42]. By using the daylight actively the architecture can be related to the passing of time and it can make humans sense the surfaces and the tactile qualities. But it can also produce problems such as overheating especially in a building turned towards south without any natural shades from the surroundings.

Three rooms in the building have been detailed according to the light - a dance studio, the museum and an auditorium in the cantilever. They all have very different light intake why EcoTect and physical models will be used to find solutions for any problems both from a technical and an aesthetic point of view.



The dance studios

The dancers in the dance studio should have the feeling that they are in the middle of the city with a view out to the street. From the initial studies of other dance schools it is clear how much energy the life of the city can give to the dancers and vice versa. But to this project, where the dance studios will be turned towards south there will be a lot of problems related to overheating and annoying glares and reflections of the light.
The challenge will then be how to shade the direct light but still get a sufficient daylight level by using natural light. At the same time the dancers should have a view of the city and the people from the outside should sense the dance activity in one way or another.

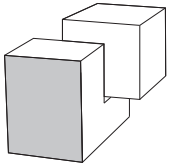
Only the facades towards south and north can be used for light intake. The northern facade will not be visible from anywhere except very few private housing and the view should be blocked because of the very uninspiring and dirty courtyard of rooftops.
The view from the dance studios should be concentrated towards the red mill in the museum and out to the city, so the dancers will be very aware of the placement in the transition zone between the city and the Moulin Rouge.

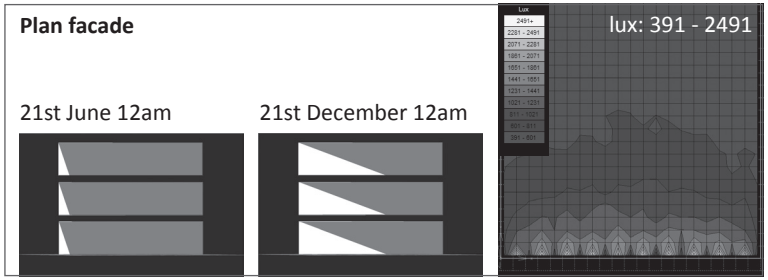
Different tests and analyses have been made to show potentials and problems related to the light distribution and architectonic expression both from the inside and the outside of the dance studios.
First it is tested how much they are shadowing to each other and how much difference it makes to place the dance studios respectively above each other, as terassering or as cantilevers.

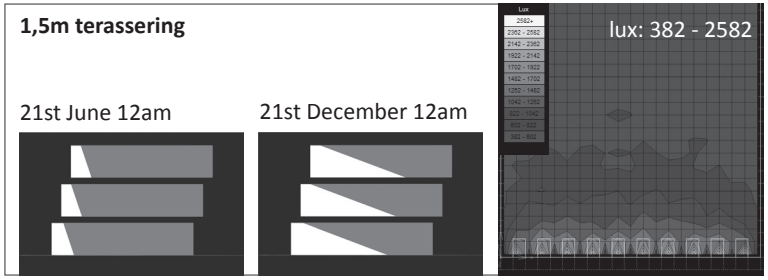
South facade
Three dance studios are placed above each other in the southern facade. The 22m deep rooms can have problems getting daylight deep into the room why the test show how deep into the room the direct light will get, both winter and summer, and how it will affect the luminance level and light distribution.

Different placements in proportion to each other have a great difference of the architectural expression of the building. The terrassering solution clearly gets most daylight but due to the architectonic expression, where it is leaning back hiding behind the surrounding buildings, that option is eliminated. This will not have the signaling effect as it should but more of a laid-back attitude. It is also the option which could have most problems of overheating in the summertime.
Due to problems of overheating in the summer, the option which cantilevers will shade the sun at the middle of the day when the light is strongest. But it also has the smallest luminance level why this solution would need much more windows to reach a sufficient daylight level.

Seen from the luminance level none of the solutions reaches a lux level above 400 lux. This is not considered a problem as there was no light intake in the northern facade and the south facade only consisted of 50% windows. The desired expression of the building should be to have a more open and transparent facade than in the tests carried out. There will be more openings and intake of light from the north in the actual building.





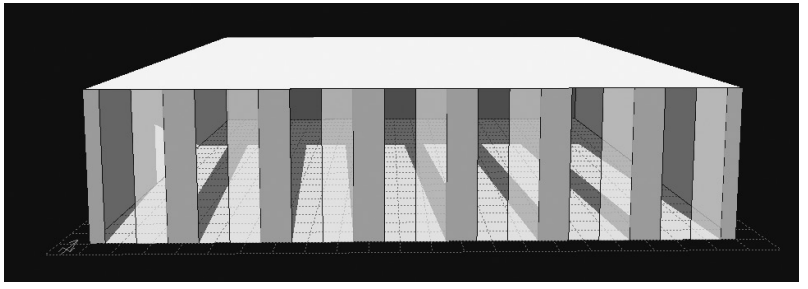


The tests have been conducted in EcoTect with a south facade consisting of 50% windows as the only source of light in the room. The luminance level is measured in the lowest of the dance studios.

The next step has been to test how transparent and translucent the facade can be and still reach a sufficient luminance level with an even distribution of the light without sharp transitions or dark corners. Different percentages of respectively transparent, translucent and closed materials were tested In EcoTect [see opposite page].

The test concluded that even with a facade consisting of 50% translucent materials and no transparent elements the luminance level reached 350lux in the darkest corner. With a desired expression that consists of less closed material than this, this concludes that there are no problems related to obtaining a sufficient daylight no matter if the facade consists of transparent elements, translucent elements or a combination of these. When using translucent materials the deviation of the lux level is not nearly as big as when having transparent elements. But still there is not much difference between the darkest corners when having only transparent compared to only translucent materials. This shows that the translucent elements are almost as efficient as the transparant elements to distribute the light deep into the room but the very high luminance level at the south facade will be avoided.

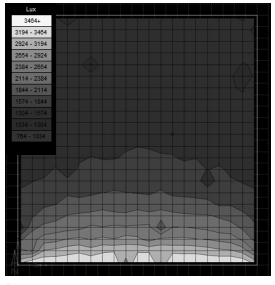
The problem will then exist in the possibility of overheating, reflections and glares when having too much transparent elements.



Perspective front view of the dance studio built in EcoTect with 33% transparent and 33% translucent windows.

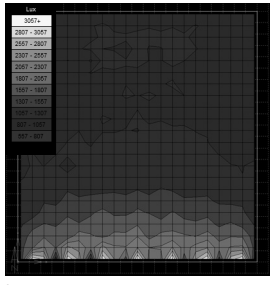
The tests have been conducted to verify the luminance level of different grades of transparency and translucency in the facade. The test has been conducted with the same size window in the north facade and the same materials used on all surfaces. The walls towards East and West consist of mirror with a high level of reflectance. The ceiling is put to be an acoustic absorbing ceiling, as it is assumed that the room will need some acoustical regulations, and the floor is put to be a light fabric with a reflectance of 0,5. These all have an influence of the luminance level and might be changed later in the process.

100% window



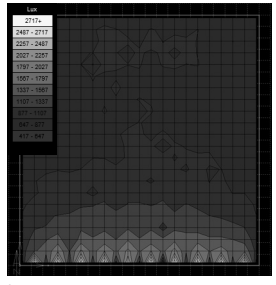
lux: 764-3464
average: 1745

75% window



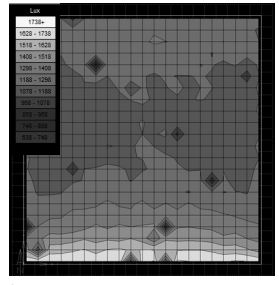
lux: 557-3057
average: 1232

50% window



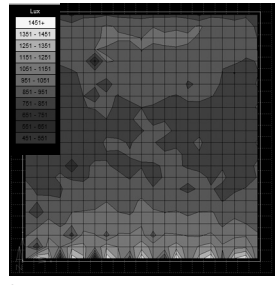
lux: 417-2717
average: 966

100% translucent



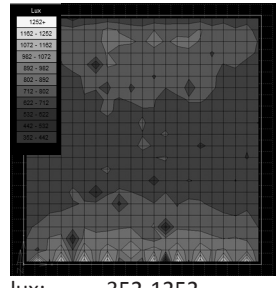
lux: 638-1738
average: 1250

75% translucent



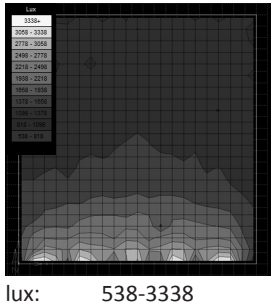
lux: 451-1451
average: 899

50% translucent



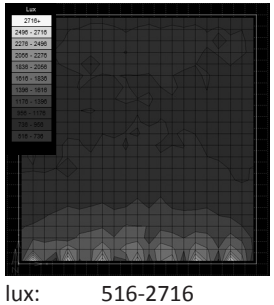
lux: 352-1252
average: 726

75% window
25% translucent



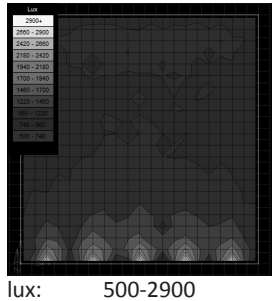
lux: 538-3338
average: 1503

33% window
33% translucent



lux: 516-2716
average: 1069

25% window
50% translucent



lux: 500-2900
average: 1066

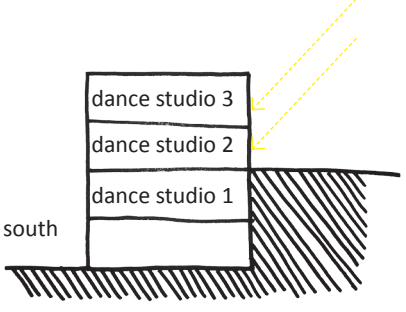
North facade

The northern facade is free of other buildings from second level and upward, shown on the diagram below. These facades should therefore also be designed to let light into the building.
However as there are only dirty and uninspiring roofs the view should be blocked.

Different solutions have been tested in EcoTect - placing a high horizontal window, the facade as one translucent window, placing a light shaft and by terassering the decks to open up to roof windows. In all tests the south facade has the same window area of 50% and all the surfaces have the same materials in the tests.

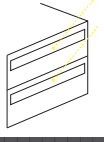
The most efficient solution will be to have terrassing decks. This would also change the spatial perception a lot when direct sunlight would penetrate the room. But this would also decrease the dimensions of the room which is not desirable.

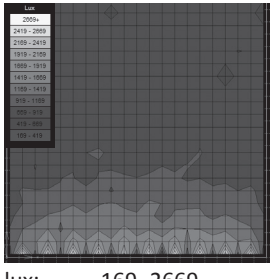
The second most efficient solution is placing a light shaft which will result in much daylight being reflected down to the dance studios.
However, having a lot of reflective materials on the walls, some with windows and some with mirrors, can give acoustical problems why this wall (besides the roof) is the only plane wall to adjust in relation to that. Therefore the acoustical calculations might affect the final decision of this facade. Acoustical tests and considerations will be explained later in the report ['acoustic', page 95].



Section of the dance studios showing how other buildings surround the lowest of the dance studios.

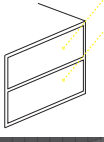
Vindow placed high

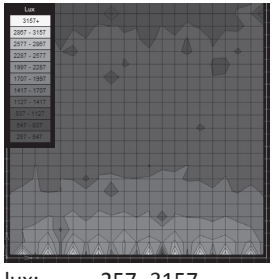




lux: 169 -2669
average: 727

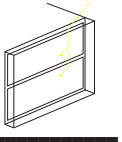
Translucent facade

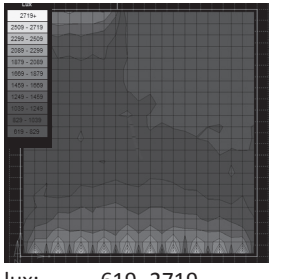




lux: 257 -3157
average: 1017

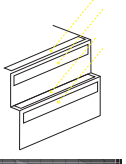
Light shaft

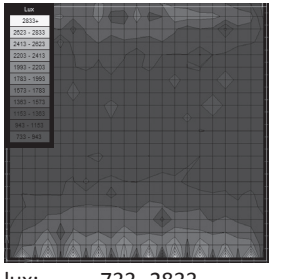




lux: 619 -2719
average: 1026

Terassering





lux: 733 -2833
average: 1272

The auditorium

The building twists around, above and behind the existing building emphasizing the connection to the Moulin Rouge. In this way more of the building than only the facade towards south will be visible.
The building will make a frame around the existing Moulin Rouge and making the extension visible from angles where the exposed south facade is not.

In order to make that part of the building more visible it is decided to pull it out from the building in front, the Moulin Rouge. In this way it is not perceived as a continuation of that building but will appear as a separate building.
This also has an effect on the luminance level and the view from inside the rooms. Even though the luminance level would be sufficient without protruding the cantilever this gives a much better view of the city.

The cantilever contains both a dance studio, auditoriums and administration and is hereby a mix of private and public functions.

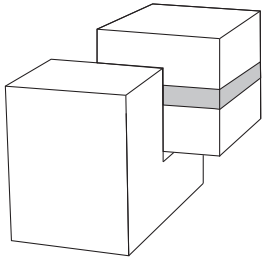
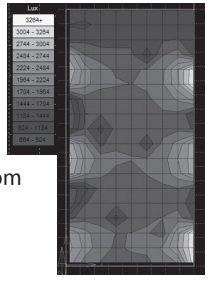


Diagram showing the placement of the auditorium in the cantilever.

Plane facade

The cantilever in same plane as the building in front will be perceived as a part of that building and not belonging to the dance studio.



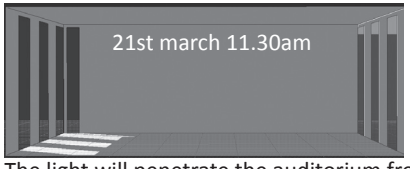
The light will penetrate the auditorium from around 10.45am to 1pm every day.

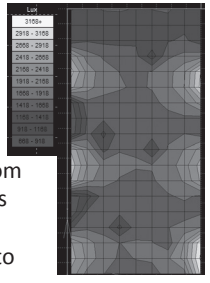
The view of the city is very poor.

With a luminance level above 660 there is no problem getting enough sunlight into the room.

1m cantilever

By pulling the building a bit out from the building in front and revealing the corner of the building it is much more visible and protruding.





The light will penetrate the auditorium from around 10.30am to 3.30pm every day. This gives additional almost 3 hours of direct sunlight inside the auditorium compared to the above model.

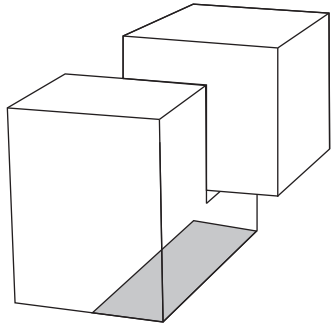
Another and perhaps more important fact is the much better view towards the square in front of the building, that this solution provides.

The museum

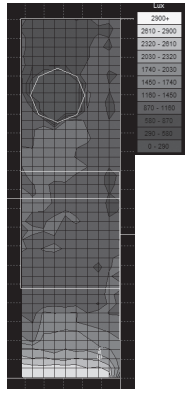
The Moulin Rouge is all about the show and the expectations of something big and spectacular. This staging wants to be continued throughout the museum and the red mill. This will be the main attraction in the museum and the room is focusing of this by the way people are being lead from a narrow entrance down to the mill where the room opens op in width and especially in height to give this almost ceremonial atmosphere.
The red mill will both function as a visual and historic connection.

The character of the room should enhance this setting. The frames should be simple and clean without many disturbances that will take focus from the mill. All the facades are introverted as none of them will be visible from the outside, except the entrance. Therefore the windows can be concentrated only to enhance this atmosphere and of course to make sure to have enough daylight.

The luminance level was tested in the museum with light coming only from the dance studios and the entrance. This should reveal any problems of the received daylight but it showed a luminance level of almost 600 lux in the back of the museum. This showed that there is no problem related to getting a sufficient daylight level why the light intake could be designed according to the architectonic qualities and perception of the room.
This was done by light tests in a physical model in 1:100 [‘museum’, page 75] and was done in colaboration with working with the facade.



The museum is placed as an elongated room with direct light comming in from the south.



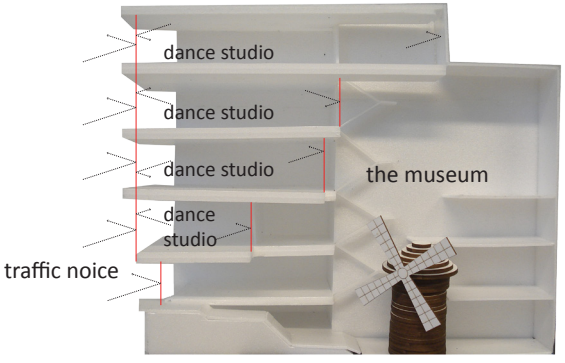
The luminance level in the museum is 580lux at the rear end. The dark circle with no light is the mill.

In the calculation the south facade consisted of 50% window and 50% closed material. No other light intake was incorporated.

ACOUSTIC

The building has a very open and transparent expression with visual connections between the city and the dance studios and between the dance studios and the museum.
The dance studios needs to be acoustically insulated so that it is possible to hear loud music in all of the training studios at the same time without disturbing each other or the museum. The building also needs to be insulated from the noise from the much trafficked context.

The greater mass or weight of a material the less sound energy will be transmitted [Schittich, 2007]. This means that glass provides very poor acoustical insulation but there are several options that can prevent the sound distribution. Special acoustic glass can insulate from noise [acousticglass]. Another solution can be to make a double layer of glass with different thickness. This will increase the transmission loss much, and was for example used in Casa de Musicá in Porto [casamusica] which had some of the same acoustical challenges of obtaining insulation from traffic noise, using a glass facade. Because of the desired expression of as little boundary as possible the choise has been to have one layer of acoustic glass in the facade.
But between the dance studios and the museum there is a natural transition zone which cause the need for two layers of glass.



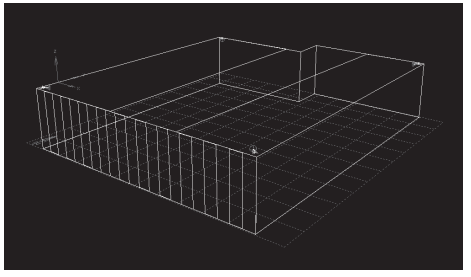
The building needs to be sound proof in order to insulate from noise from the city and between the dance studios and the museum. This will be done by using acoustic glass in the facade and by implementing a double layer of glas between the dance studios and the museum.

In casá de Música the noise from traffic was measured to 75dB. By adding a double layer of corrugated glass in the facade, one of 20mm and the other of 12mm, it succeeded in reducing the traffic noise to 5dB inside the building [casamusica].

The dance studios

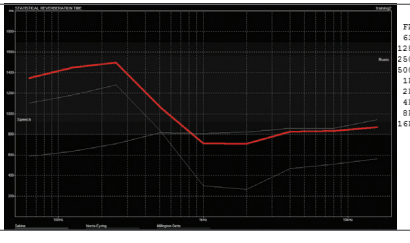
In the dance studios the reverberation time should be optimal for music because the dancers need to hear the rhythms very clearly. The reverberation time should be around 1,0s.
Many of the surface materials are already determined inside the dance studio. The facade towards south consists mostly of glass which is a hard surface that reflects the sound in random directions. The room also needs at least one, preferable two, walls of mirror which acoustically have the same function as the glass. The problem of too many hard surfaces reflecting all the sound can easily arise.
The floor needs specific dance flooring, a soft vinyl which will function as sound absorber.
Only the surface materials on the northern facade and the ceiling can be changes. The northern facade also needs to function as light intake and from light investigations it was seen that implementing a light shaft was a very good solution. This means having a transparent wall which is adding another hard surface to the room.

To find out if this provides acoustical problems Eco-Tect is used to calculate the reveberation time. Initially it is tested with mirrors on both the east and the west wall in the entire height of the room and having acoustical panels in the ceiling. This results in a reverberation time of 0,71 - 1,50s which has too big a deviation.
After a couple of iterations and changing of materials a reverberation time of 0,94 - 1,15s was achieved. This was achieved only by changing the ceiling material into 2/3 acoustical panels and 1/3 of suspended plaster.
In this way the light shaft in the northern wall could be retained.



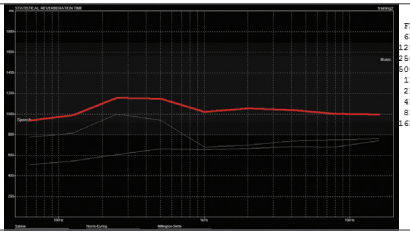
Perspective view of the model in EcoTect.

Original model
RT: 0,71 - 1,50s
ceiling:
acoustical panels



FREQ.	TOT. ABS.	SABINE RT(60)
63Hz:	293.513	1.35
125Hz:	271.917	1.45
250Hz:	262.971	1.50
500Hz:	369.002	1.07
1kHz:	553.545	0.71
2kHz:	550.883	0.71
4kHz:	465.170	0.83
8kHz:	436.216	0.84
16kHz:	414.292	0.87

Solution model
RT: 0,94 - 1,15s
ceiling:
2/3 acoustical panels,
1/3 suspended plaster



FREQ.	TOT. ABS.	SABINE RT(60)
63Hz:	422.175	0.94
125Hz:	400.579	0.99
250Hz:	340.885	1.16
500Hz:	342.967	1.15
1kHz:	383.656	1.02
2kHz:	366.177	1.06
4kHz:	362.574	1.04
8kHz:	348.313	1.00
16kHz:	349.355	1.00

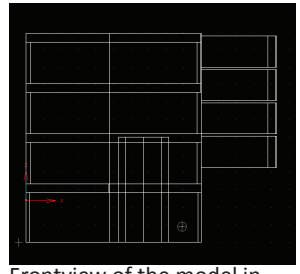
The museum

From the narrow entrance the museums guests are being lead down to the mill where the room opens op to become a very high and impressive atrium. This whole setting is part of giving the spectacular atmosphere of the Moulin Rouge which should also be emphasized through the acoustics.

The museum room should have a bit of an echoing effect which can strengthen the ceremonial identity of the room. But without it being annoying, as people should still be able to talk silently to each other. This could be compared to the sound in a church which also often has a room that is rising upwards. Churches have a high reverberation time and hence the echoing effect that people combine with being in a very high room. This gives a feeling of being very small and put up an atmosphere of something big. In this case, the museum of Moulin Rouge should have some of the same magnificent and spectacular atmosphere of the theater itself.

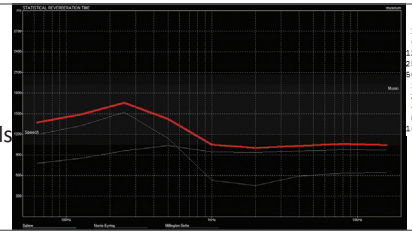
In order for the acoustic to help set this atmosphere the reverbeation time should be around 1,5s. The first model was completed in Eco-Tect with concrete on the walls, a floor made of timber and an acoustical ceiling as it was assumed that the room would need some acoustical regulations. A simplified model of the mill in the museum was also build as this would have an impact on the reverberation time.

The first model resulted in a reverberation time between 1,01 - 1,66s. The deviation was too big and too much sound absorbing materials was being added, as the reverberation time should be increased for most frequences. After some iteration of changing materials on the surfaces this resulted in a reverberation time of 1,26 - 1,57s.
The materials changed was having a suspended timber floor and adding plywood panels in the ceiling.



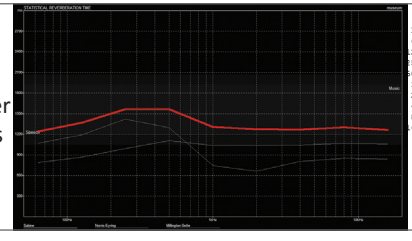
Frontview of the model in EcoTect.

Original model
RT: 1,01 - 1,66s
walls: concrete
floor: timber
ceiling: acoustical panels



FREQ.	TOT. ABS.	SABINE RT(60)
63Hz:	2272.809	1.37
125Hz:	2094.292	1.49
250Hz:	1874.488	1.66
500Hz:	2188.334	1.42
1kHz:	2961.103	1.05
2kHz:	3090.914	1.01
4kHz:	3004.458	1.03
8kHz:	2897.281	1.06
16kHz:	2941.594	1.04

solution model
RT: 1,26 - 1,57
walls: concrete
floor: suspended timber
ceiling: plywood panels



FREQ.	TOT. ABS.	SABINE RT(60)
63Hz:	2507.108	1.24
125Hz:	2283.793	1.37
250Hz:	1983.456	1.57
500Hz:	1986.517	1.57
1kHz:	2378.984	1.31
2kHz:	2431.574	1.28
4kHz:	2432.359	1.27
8kHz:	2341.083	1.30
16kHz:	2415.973	1.26

FINAL SOLUTION

The concept fuses dance and architecture with an interpretation of dancing bodies into a series of vertical elements.

The abstraction of dancing bodies is present everywhere in the building and has influenced both the exterior expression and the spatial organization.

The movement in the building is choreography of moving up and down, turning and changing between being in an open and an enclosed volume. The mind is constant aware of the placement in the room.

The skin of the building is also seen as choreography of structures changing and adapting to the context and the functions within.
The energy from the city and the dancers are resulting in an expressive three-dimensional facade. Where the context and the functions are more introverted and secluded the facade becomes two-dimensional and rigid. A graduation between the rigid and the dynamic part of the facades gives a floating choreography in between.

Dance and architecture are fused

Organization
The two primarily functions; the Dance School and the museum are clearly divided in the building. Each has their own separate zoning and circulation.

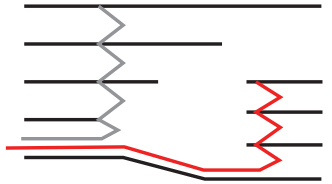
The private Dance School is placed towards the south facade visible to the city. The public museum is placed at ground floor and is a secluded function dragged away from the city. This reflects Paris' way of placing private functions above the public. It also gives the introverted functions (the museum) tranquil frames while the active functions (the dance studios) are reflected in the expressive facade.

A big atrium is the center point of the building to where all functions and circulation are placed. This inspires social interactions and visual connections even though all paths between public and private are separate. The clear zoning will ensure privacy for the dancers in the very attractive and crowded context.

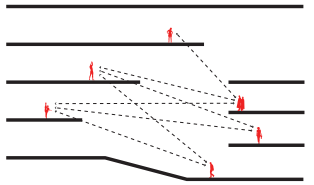
The red mill is placed in the museum and function as visual and historic link. It is visible from almost every function in the very transparent building and from the outside attracting people inside the museum.

Functions
Two main functions, a private Dance School and a public museum.

Organization
The Dance School is directed towards the city while the museum approaches the Moulin Rouge.



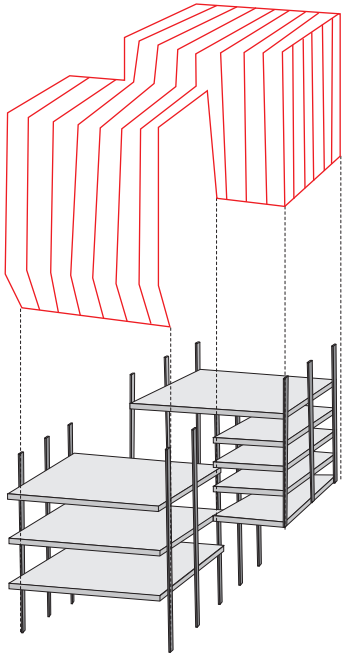
Circulation
The circulation is divided - the paths of the dancers are shown in grey and the paths of the guests of the museum are shown in red.



Visual connections
A central atrium and exhibition room provides visual connections between the two functions.

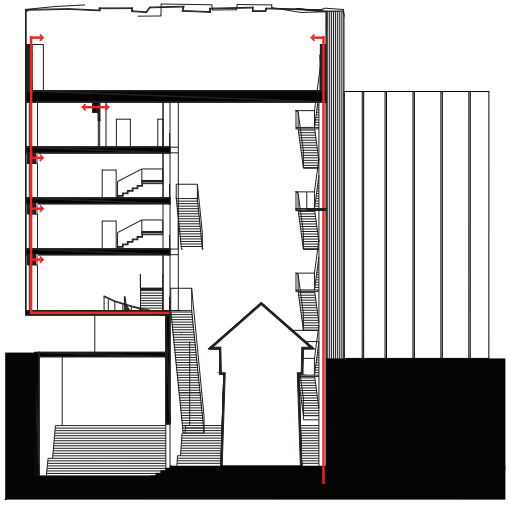
Structural system

The building is made of a deck and column construction and a self supporting lattice shell as facade and roof.
The lattice shell is constructed of round steel profiles and frosted glass elements of different sizes and shapes.
The decks will be in situ cast slabs made of a balloon method to minimize the thickness and the weight of the slabs. These will distribute the loads to columns in each side.
The building is an infill which means that the surroundings buildings functions as stabilizers



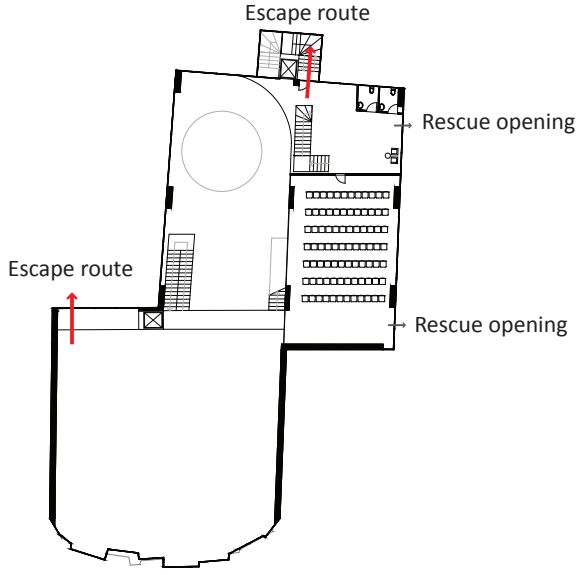
Ventilation

The ventilation system runs vertical in the building hid in the walls and concrete columns which results in slimmer decks.
The technical room is placed in the basement.



Fire

The circulation inside the building functions as escape routes. An extra escape route is placed to the north of the dance studios from where there will be a direct access to the outside.
Rescue openings will be placed in the cantilever to ensure several escape routes.



PRESENTATION -
THE MOULIN ROUGE DANCE SCHOOL

As an expressive icon the facade of the Dance School attracts attention and become the new symbol of the Moulin Rouge.
As a stage curtain, slightly opened, it raises the expectations of the coming show inside the Moulin Rouge.

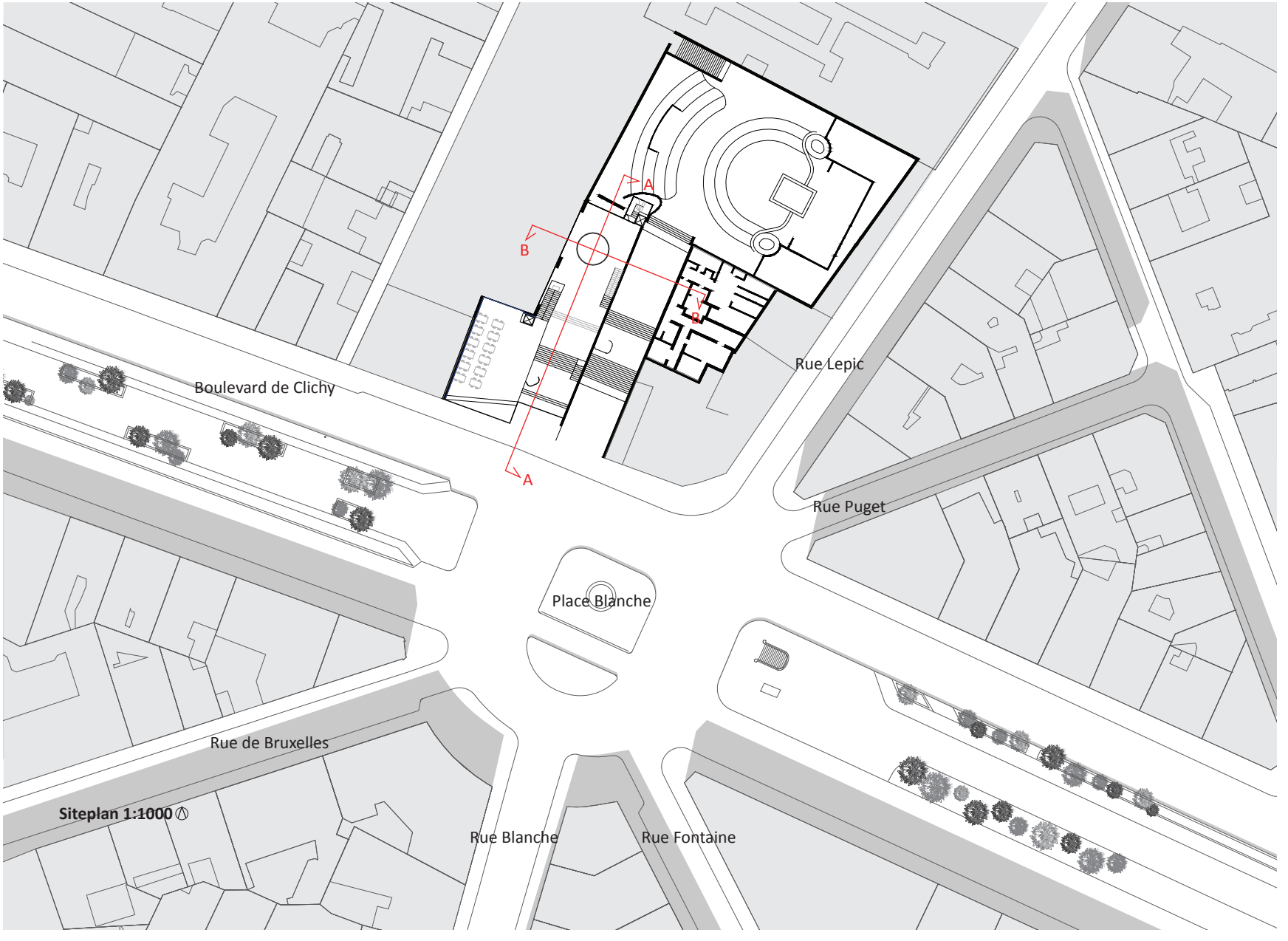

BAL
MOULIN ROUGE
Féerie

The Dance School introduces a light and contemporary structure that clings around the Moulin Rouge emphasizing the connection.
The dynamic structure of the building is activating the street. The frosted glass and high reflective steel gives an interesting play of matt and reflective surfaces and the depth of the facade contribute to an ever changing play of shadows. Further, the facade reveals shadows from the dancers behind the facade exciting the curiosity of the passersby.
The building has achieved a powerful and yet balanced appearance in its context.


MOULIN ROUGE
Féerie
Quick
Quick
Quick

Siteplan

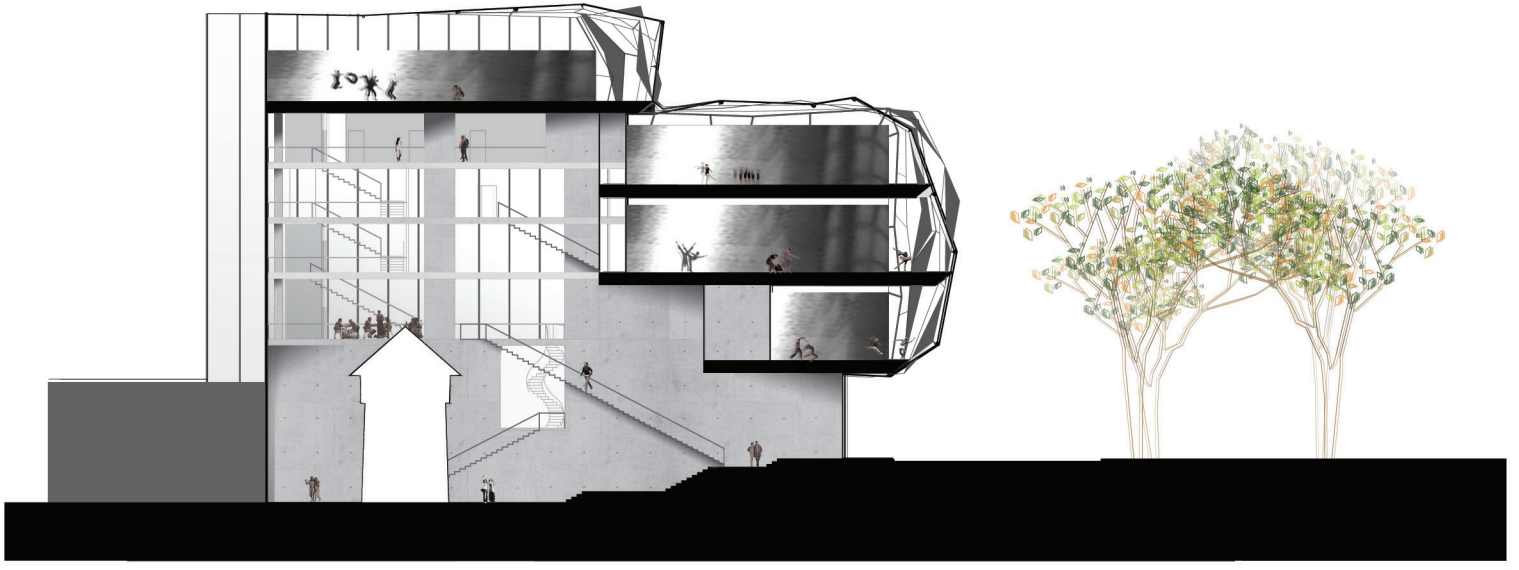
The Dance School is placed at the Place Blance, a heavily trafficked and busy area. It is turning towards the plaza as an infill between two other buildings, one of them containing the Moulin Rouge.
From the place the foyer and museum is very visible revealing the red mill inside. The life inside the Dance School is exhibited to the public passing by.
The entrance is a bit secluded inviting people inside.


A
B
B
A
Boulevard de Clichy
Rue Lepic
Rue Puget
Place Blanche
Rue de Bruxelles
Siteplan 1:1000
Rue Blanche
Rue Fontaine

Sections

In the sections of the building the tall and impressive museum room is very visible. The guests of the museum are being led from a relative narrow and humble foyer down to the museum where the room opens up leaving an impressive and ceremonial appearance.

Section b 1:500



Section a 1:500

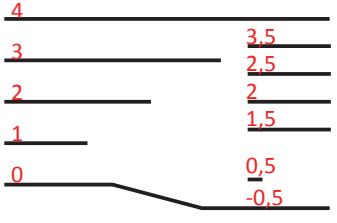
Plans

Already at the entrance the building is divided through a public entrance, for guests and staff of the museum and a private entrance dedicated the dancers. The separated zonings and circulation is clear and apparent - no paths are crossing but visual connections are everywhere binding together and inspiring each other.

The museum room functions as central room from where all circulation originates. This enhance the transparency of the building, even the circulation is much present even though it is divided.

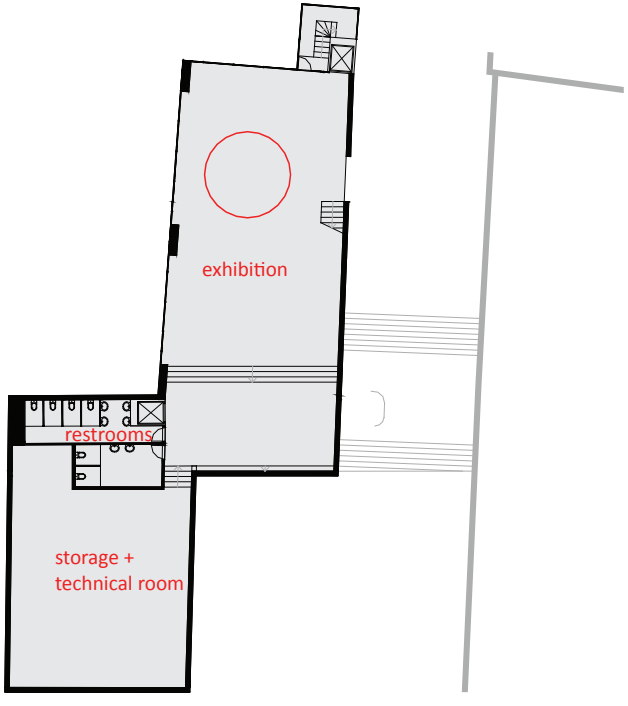
From the entrance the **guests of the museum** are being led down to the exhibition room. From here they have access to the bookstore and auditorium placed in the cantilever.

The **dancers** are being led up to the changing room and four dance studios through the exterior space and cafe at ground level. This enhances social interactions as they will have to go through this area, which function as a place to gather and hang out both on daily basis and at celebrations. The room is full of dancers and activity which will make the building seem very lively.

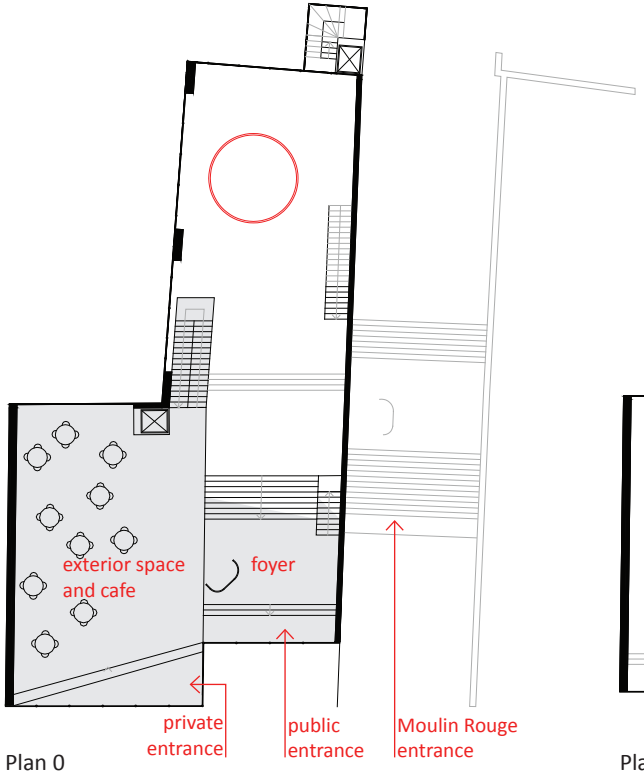


The plan divides separate zonings for the museum and the Dance School, shown in this diagram of a section.

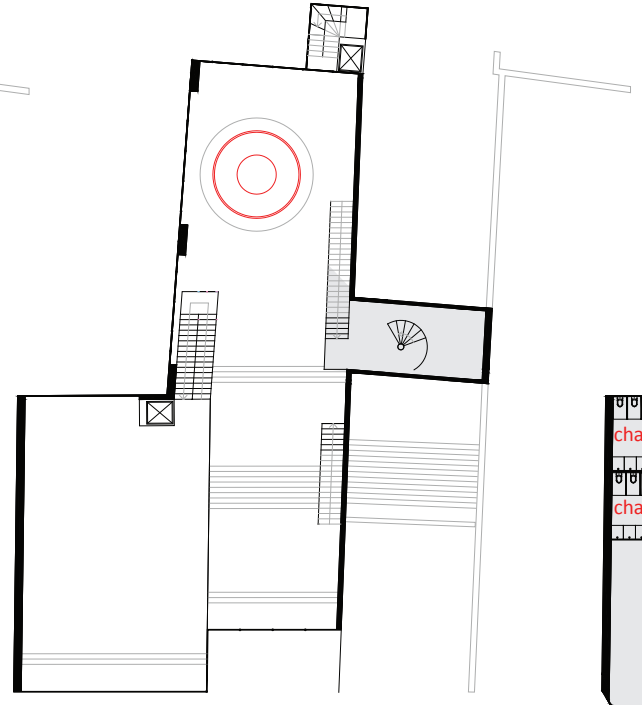
The split-levels with half numbers are dedicated the museum. Only the ground floor and 2nd level they share.



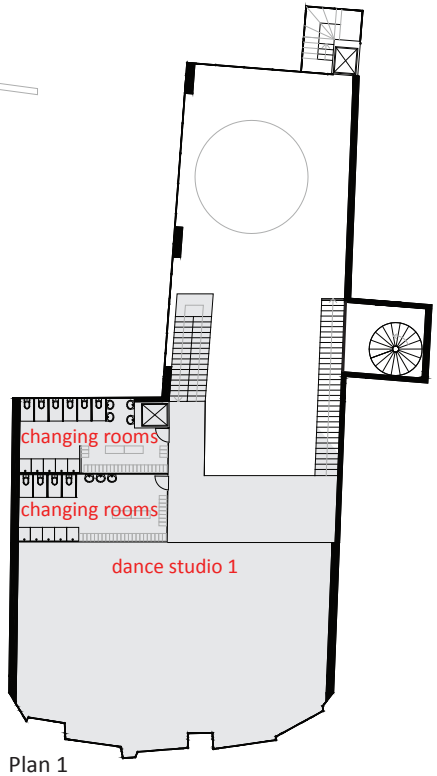
Plan -0,5
1:500



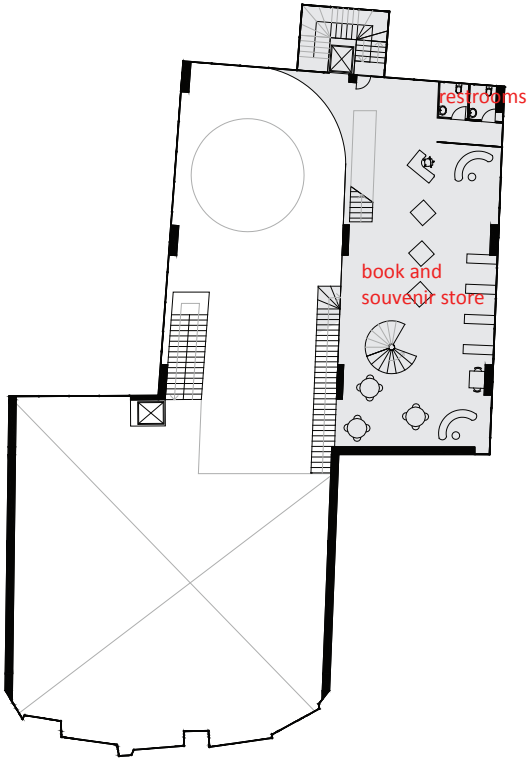
Plan 0
1:500



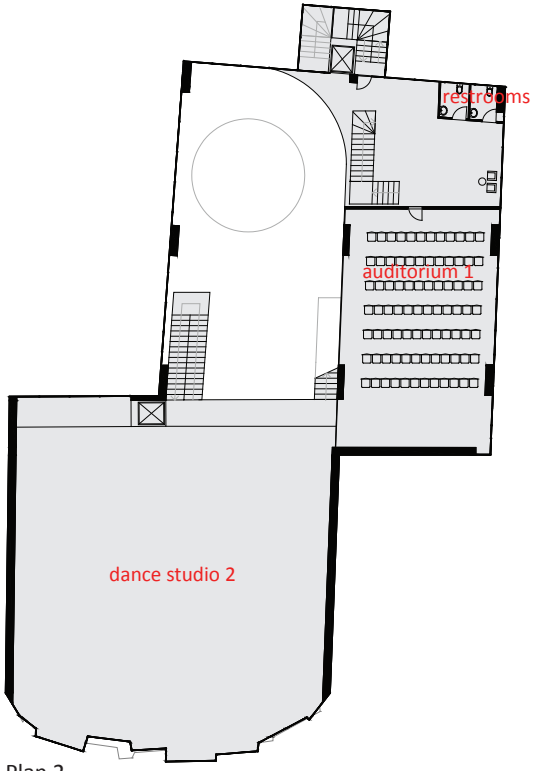
Plan 0,5
1:500



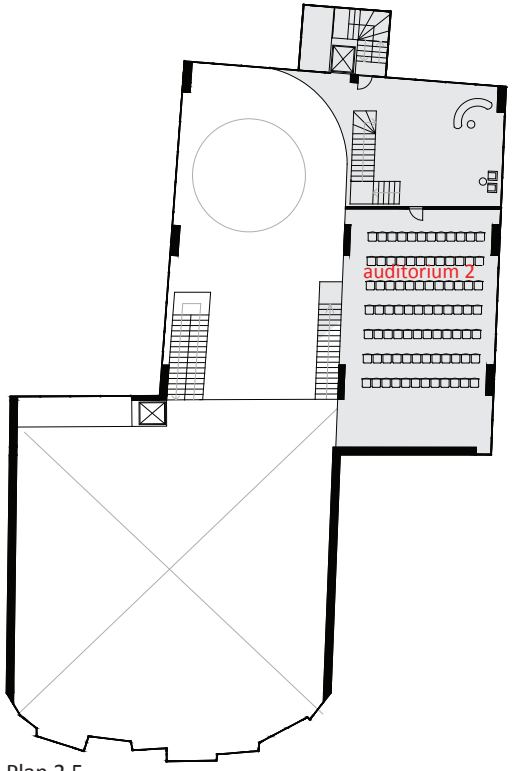
Plan 1
1:500



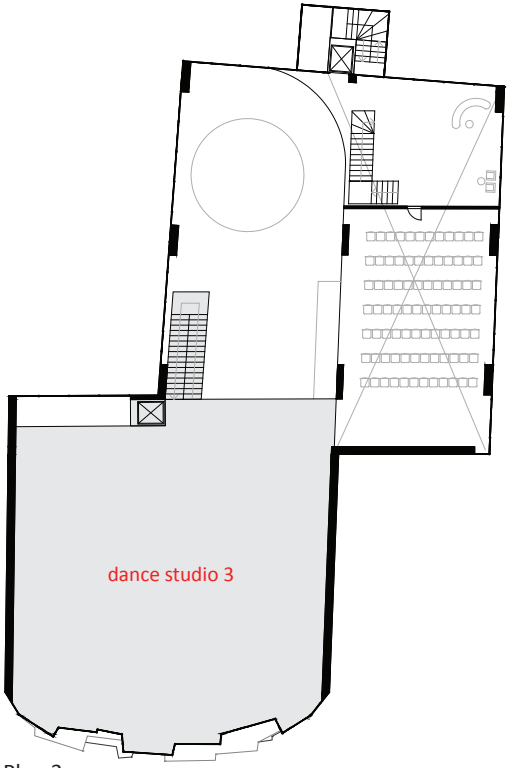
Plan 1,5
1:500



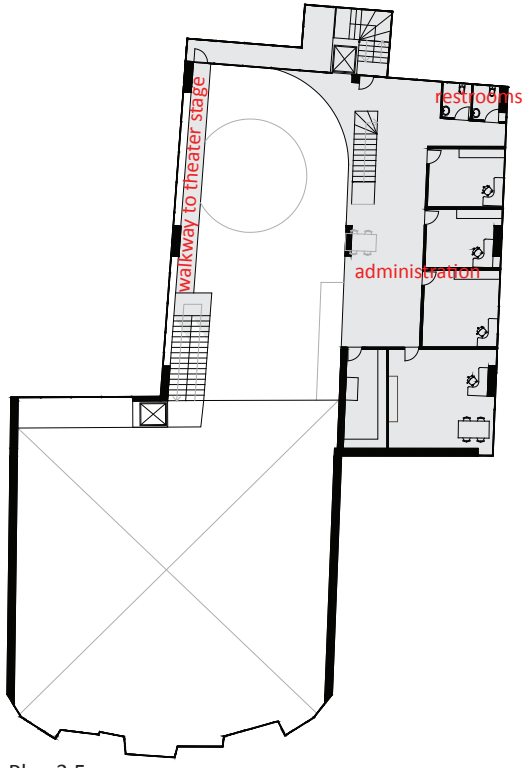
Plan 2
1:500



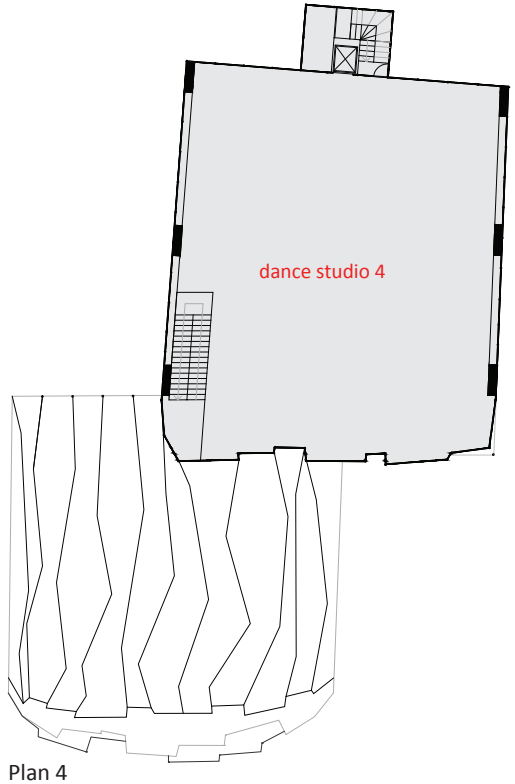
Plan 2,5
1:500



Plan 3
1:500

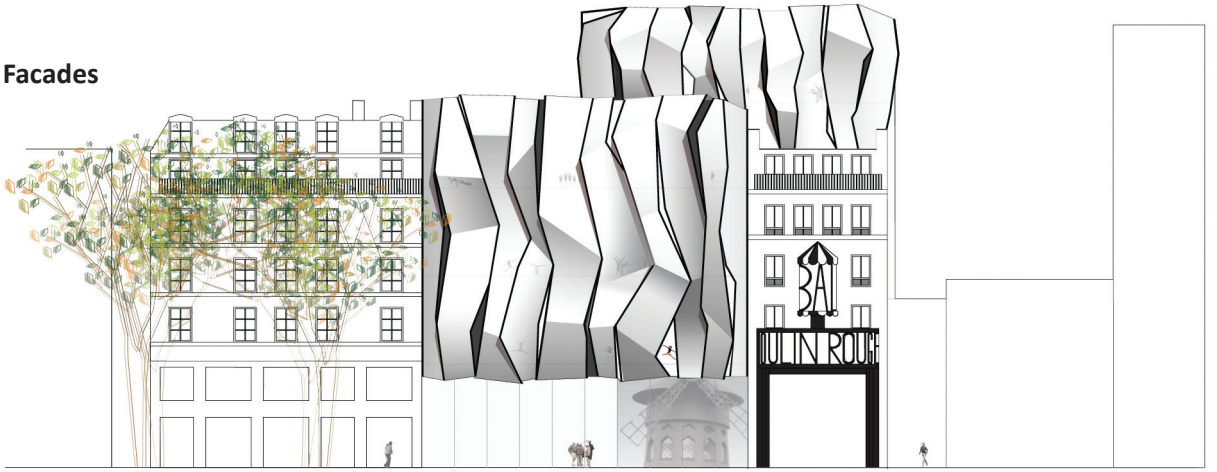


Plan 3,5
1:500

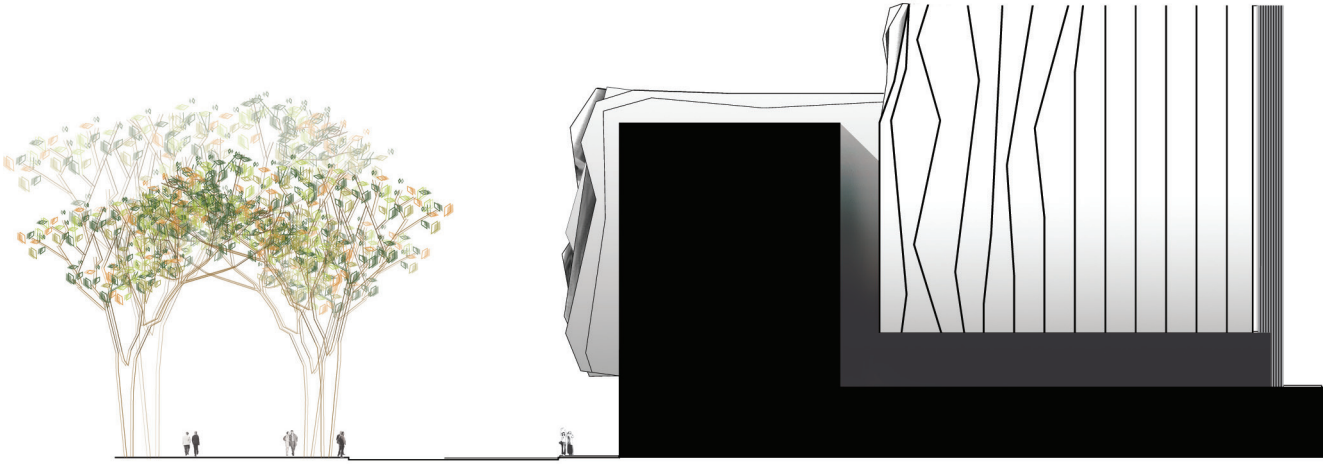


Plan 4
1:500

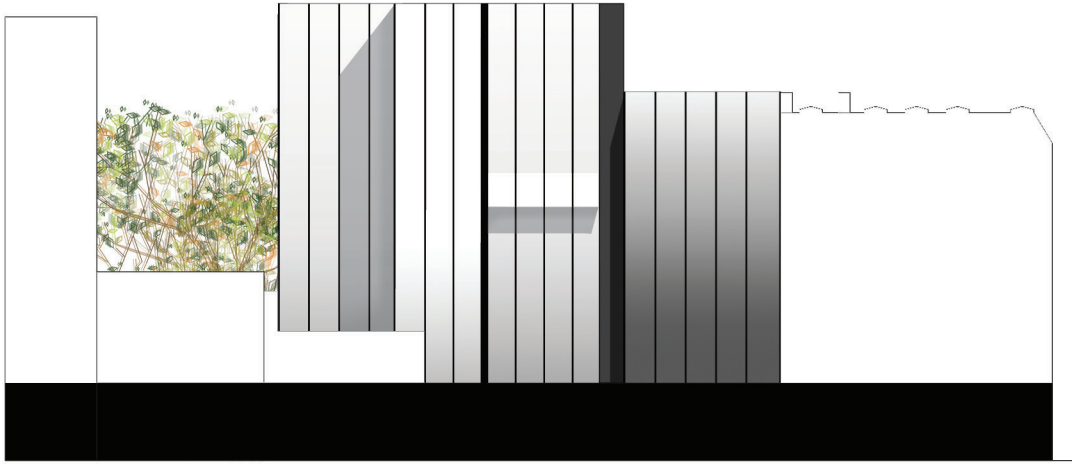
Facades



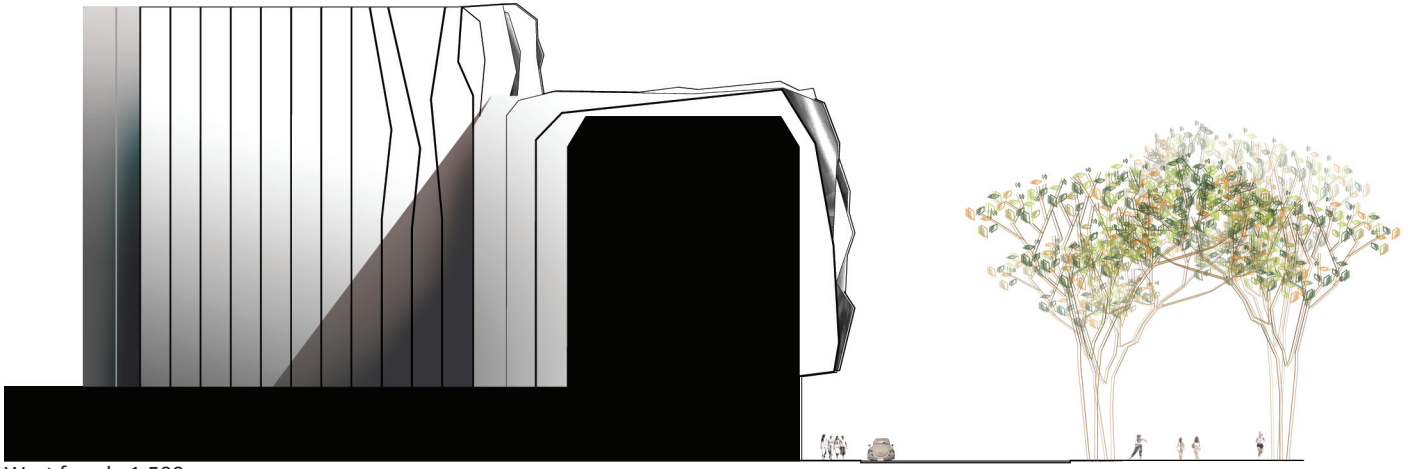
South facade 1:500



East facade 1:500



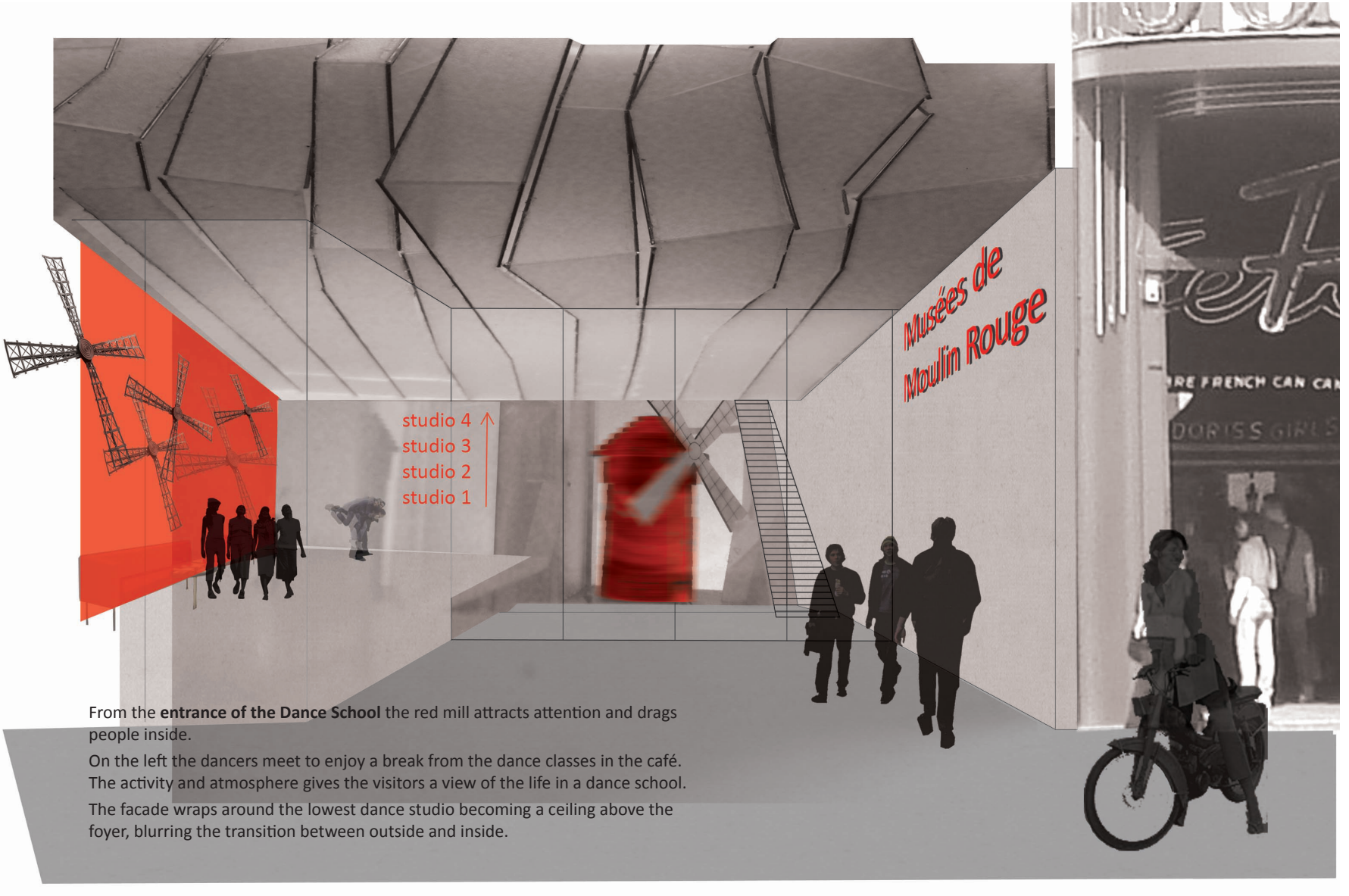
North facade 1:500



West facade 1:500

The central fullheigh atrium lets the visitors of the museum get a full view of the old mill.

From the book store the visitor are amazed by the dramatic movements of the dancers and the dynamic facade behind them.



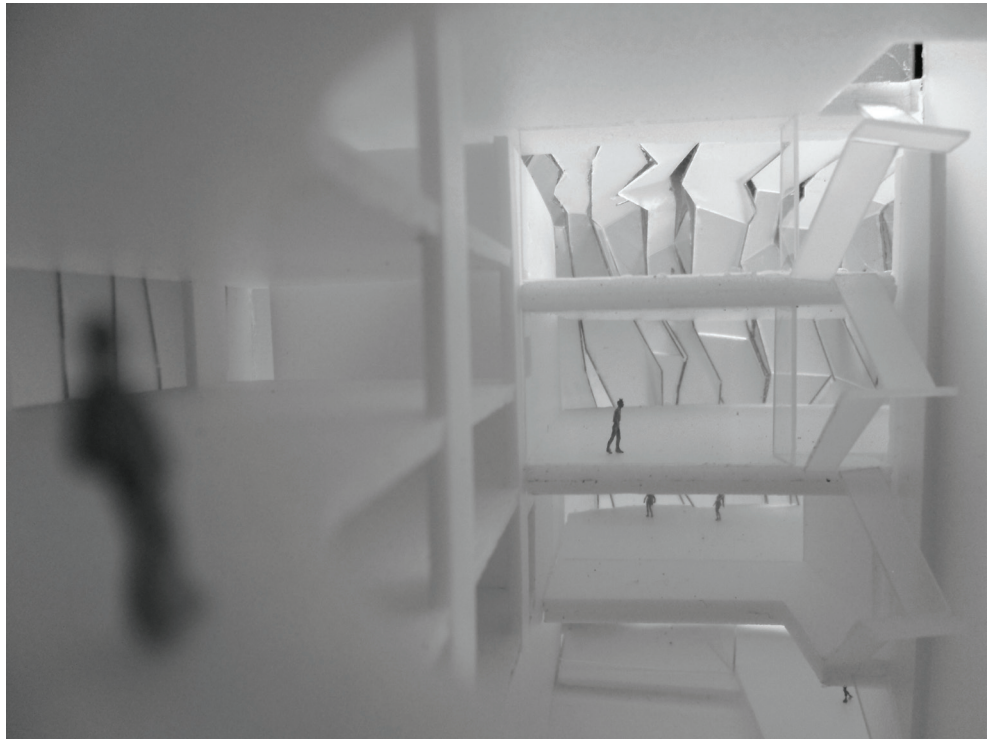
From the **entrance of the Dance School** the red mill attracts attention and drags people inside.

On the left the dancers meet to enjoy a break from the dance classes in the café. The activity and atmosphere gives the visitors a view of the life in a dance school.

The facade wraps around the lowest dance studio becoming a ceiling above the foyer, blurring the transition between outside and inside.

The mill is let by the natural soft light from the surrounding translucent walls. The walls gradually shift from opaque at the floor height to translucent at the ceiling.

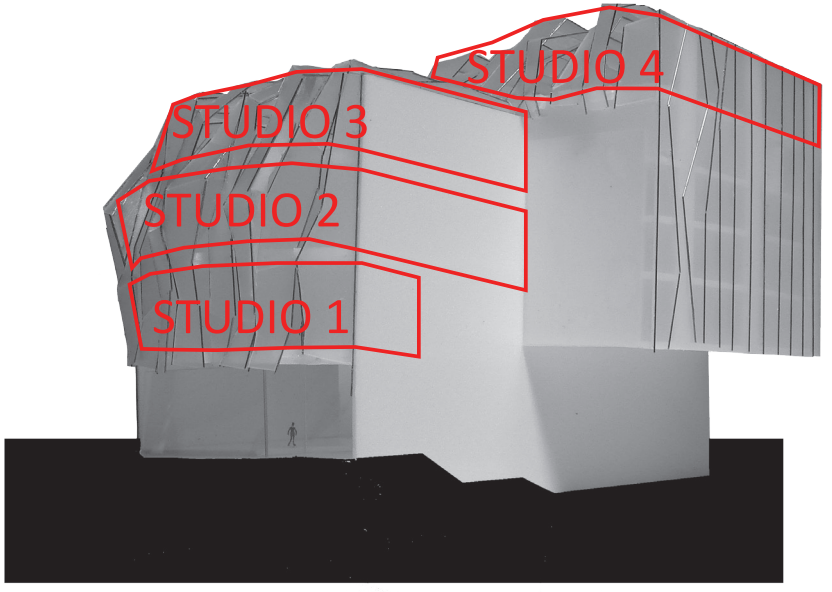
With the mill in the background, the visitors feel the great central atrium allowing visual contact to the activities in the dance studios. The dancers are exhibited but the distance to the audience prevents the disturbances.



The dramatic facade construction becomes the canvas of dynamic movement in the dance studios. To the east of the building the facade is reflecting the more calm activities giving a quiet atmosphere but the structure and materials is giving the facades a coherent appearance.

The dance studios

The four dance studios have each their own character and qualities in order to distingush the rooms. Common for them all is the very present facade that enhances the creativity and movement of the dancers. Besides giving character and aesthetic to the rooms the facade ensures privacy of the dancers and gives a soft, diffuse light.

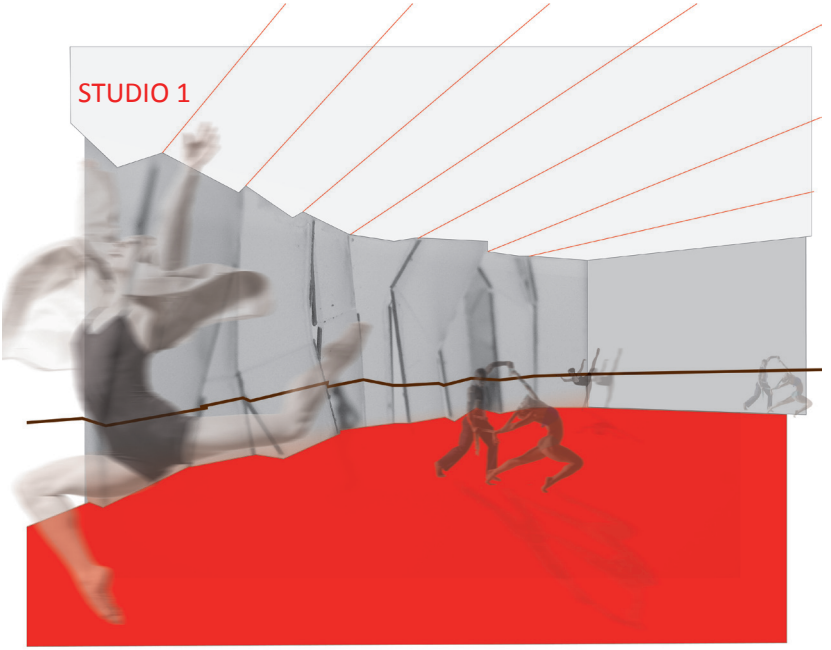


studio 1:
The smallest and most exposed dance studio. This is close to the city, the mill and the changing rooms and will primarily be used to warm-up and advanced training.
The red flooring and the closeness of the red mill will always remind the dancers of the connection to the Moulin Rouge.

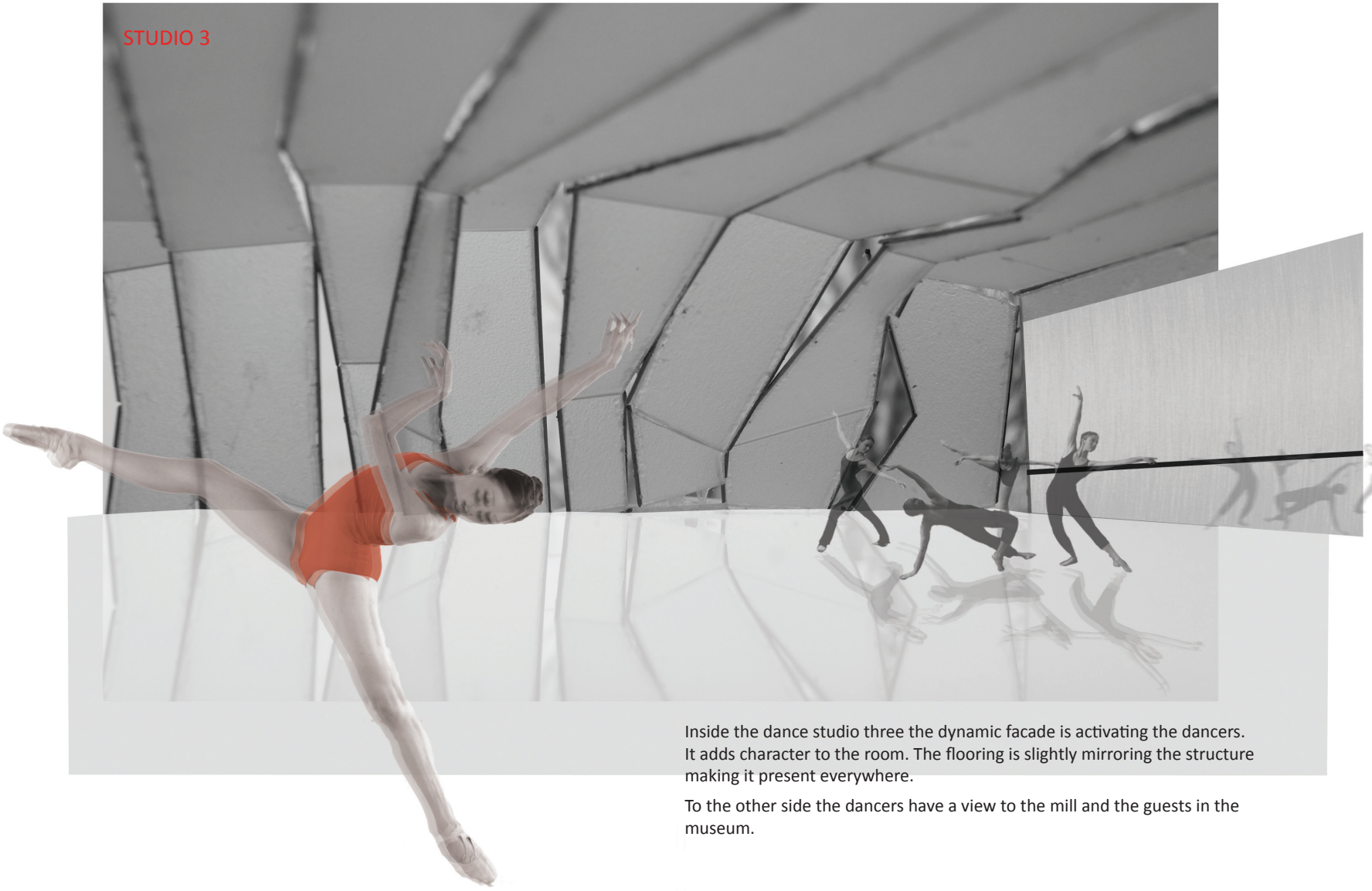
studio 2:
Studio two is one of the three biggest dance studios and is characterized by a much visible connection to the museum.
From here the dancers have direct access to the two auditoriums for theoretic lessons. Also there is a walkway crossing the museum with access to the backstage of the theater hall.
This function as central to the internal circulation.

studio 3:
This dance studio is more private than the two below but still has visual connection to the museum.
In the studio the facade wraps around and becomes the ceiling. It creates an extravagant and characteristic feeling that freezes with the movement of the dancers.

studio 4:
The private sky-studio is secluded from the city and stirring guests of the museum. This will be used to private training and is characterized with the facade becoming the roof structure. The dancers will feel like dancing under the sky because of the isolation, the light roof structure and white flooring reflecting it.



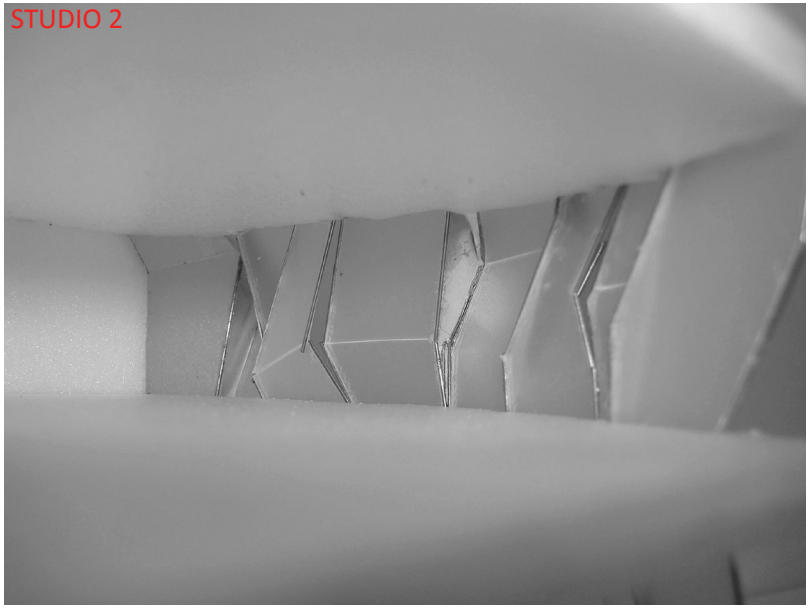
STUDIO 3



Inside the dance studio three the dynamic facade is activating the dancers. It adds character to the room. The flooring is slightly mirroring the structure making it present everywhere.

To the other side the dancers have a view to the mill and the guests in the museum.

STUDIO 2



Studio two will primarily be used in combination with theoretical lessons because of the placement next to the auditoriums.

STUDIO 4

Studio four is isolated from visual connections inside the building which is why private training can be performed here.

REFLECTION

The aim of this thesis project has been to design a dance school as an extension to the Moulin Rouge in Paris. The intention was to focus on how architecture can make frames to movement and how it should stimulate both body and mind.

The reference to dance is not literally but it has been a strong influence and inspiration to the structures and volumes of the project. Parallel terms, used in both dance and architecture, have formed guide lines in the design. Contrasts between open and closed structures, overlapping and rhythmic composition have been used throughout the design both for the exterior expression of the building and the interior organization and spatial perceptions. This have induced changing heights of the plans and visible circulation which means that people always have to relate to the placement of the body in the room.

The context

The building introduces a very light and contemporary structure that contrasts the neo-classical limestone buildings. The Dance School protrudes the adjacent buildings and is very conspicuous in the context. But at the same time the building adapts to the site of the infill and the considerable scale, and has achieved a balance between humbleness to the context and an iconic appearance.

The outer shell of the building is a lattice shell in a choreography that forms and relates to the context and the functions within. This means that when the context and the functions consist of very energetic activities this is reflected into the facade. All the energy embodied here is transformed and crystallized into the facade so the building has a dynamic and expressive expression. When the context and the functions are more secluded and introverted, the facades gradually become very rigid and two-dimensional. The same materials and dimensions of the grid make the building perceived as a whole.
The white frosted glass elements introduce a lightness and elegance to the building. It reveals the shadows from the dancers behind which will animate the facade.

Some would argue that it is ashamed to remove the red mill and hereby a historic landmark from the city. The intention with the new placement of the mill, inside the museum, is to attract more people inside the museum whereas most probably only would look at the building from the outside if kept in the facade. Given its important status it will be main attraction of the museum. But more important; the building should tell the story of the contemporary function, the Dance School, instead of only the nostalgic history of the Moulin Rouge.
When removing such an important structure the new building will have to give something back to the place. It has been an important factor to make the building communicate the new function and show the dance activity in the facade. The challenge of a very sun-exposed facade resulted in showing only the shadows from the dancers. The facade itself should communicate the dancing which has been achieved by the reinterpretations of bodies in movement that have influenced the expression of the facade.

The facade gives something back to the area with its ever changing expression. The depth and different materiality of the facade, results in an ever changing pattern of shadows and reflections.

The facade has achieved the conspicuous expression as was desired. It is a dramatic facade that will function as a landmark in the context and give a lot of tension and energy both to the city and the dance studios.

During the day the building will be a light, white translucent structure with visible steel profiles. The facade has different materialities that shifts between the smooth and high-reflectance steel plates and frosted glass. At night the building will be lit with a red light on all the glass elements which will change the expression. Here it has a much stronger connection to the Moulin Rouge as the red light embraces the building and signaling the show time inside the theater. By night it functions more a setting to the theater shows.

This facade solution meets all the visions as was listed [‘the facades’, page 65]. But at the same time this solution is a concept to the desired facade expression. Given the relatively short period of the project there was not time to develop the structure. This is a very complex and time-consuming process. The structure can be optimized much according to the shaping, bending and depth of each element.

Internal organization

The two different functions have their own zone and circulation inside the building. The separation is very clear but visual connections are everywhere binding the functions together and inspire each other. The public museum is a longitudinal room that is mirroring the foyer of the Moulin Rouge and opening up to visual connections. The guests of the museum will from here be able to see the foyer and theater stage and it will also allow the gusts of the shows inside the Moulin Rouge to get a glimpse of the red mill in the museum.

Because of the very crowded context and hopefully many visitors in the museum the much divided zonings have been needed. This will secure a certain distance between the dancers and the guests of the museum which otherwise would be distracting to the dancers. The very transparent building will still make sure that every activity can be followed. But it is also a way to keep some of the mystery from the Moulin Rouge always to have a certain distance.

The spatial organization has likewise found inspiration from dance. The circulation is a choreographed movement of moving up and down, turns and shifts between open and closed spatialities. One always has to relate to the placement in the room.

All circulation is very visible placed in the atrium which functions as central room.
In the dancers domain of the building the circulation and placement of exterior space and changing rooms secure social interactions. From their own entrance they have a big exterior space and café where they can hang out before and after classes and at celebrations etc. This is very exposed to the city and the museum and the dancers will feel as a part of the city life. At first floor all changing rooms are placed and the smaller dance studio to warm-up. From here the stairs are leading up to the other dance studios and the auditoriums.
All the time they have visual connections to the red mill which will

keep reminding them of the history of the place. This will make it a bit nostalgic but hopefully give the dancers a lot of energy and motivation to train to hopefully one day perform on the theater stage. The red mill will be the goal.

The visitors of the museum will also have changing spatial experiences. From the narrow and humble entrance the room opens up to the big atrium with an almost ceremonial atmosphere. The mill is clearly the main attraction and stand in a simple frame without much distraction. Not until the visitors are all the way at the mill the other functions reveals - the book store, auditorium, administration and dance studios. The visual connections to the dance studios will give the guests a more authentic experience of the Moulin Rouge and will give character to the room.
From the mill the gusts are being led naturally up the stairs to the bookstore from where there are further connection to the auditoriums and administration. From here they can take the stair directly down to the entrance.

Working with a defined footprint of an infill gives a lot of restrictions and limitations of the volume. This is especially been expressed in the museum room which is a much narrow room. Due to surrounding buildings it was not possible to make the room wider. This has been a challenge to achieve spatial qualities and to give the mill the spatialities that a big structure like that requires.
Because of that it has been important to keep the room very simple and light and avoid stairs and corridors that would occupy a lot of space. The choice of translucent glass elements with a smooth and reflective surface on the inside will make the room seem bigger than if the walls have been of heavy concrete. The stairs have been limited as much as possible while still remain the circle circulation of two independent stairs connecting the bookstore with the museum.

Sensuous qualities
Another aspect of the vision was to incorporate sensuous qualities within the building.
As seen in the initial studies of other dance schools, sensuous qualities are an intangible term that needs an individualistic approach for each project. It is a way to enhance the aesthetic in a building which is closely related to the immediate feeling one gets when entering. In this project investigation of spatial qualities, volumes, materials, textures, light, shadows and acoustic have been incorporated in the design phase to enhance the aesthetic and the desired atmospheres.

The dance studios should have frames that enhance creativity and movement. At the same time the rooms should be simple, light and friendly in order for the dancers to fully concentrate. Especially the facade have been worked as the element giving character to the room while the rest of the volume and surfaces are very clean in order to highlight the facade. This is a dramatic structure from the outside but from the inside it creates a dynamic and interesting blocking of the city that allows the dancers not to be disturbed from the heavily trafficked and crowded context. Further the facade will contribute a soft diffuse light. The facade expression will stimulate the desire to move inside the dance studios and make it an attractive Dance School that offers optimal rooms to movement.

This facade achieves a fusion of architecture and dance as was the main criteria listed in the beginning of the design process [design criteria, page 52]. Everywhere the facade will add character to the rooms inside the building either in a much expressive or a humble appearance.

The much transparent building enhances the open and welcoming feeling one gets when entering the building. From the outside many elements are strengthening the curiosity of the passers by - the mill is revealed in the museum and the facade seems like a light curtain revealing the shadows from the dancers. This will attract people inside the building from where the impressive museum reveals.

The materiality and the light enhance this ceremonial appearance with the translucent elements that gradually let in more light upwards. The mill is visible from everywhere in the building; both dancers and guests of the museum will always be reminded of the historic place. This adds a nostalgic and inspiring atmosphere to the whole building.

The museum stands in contrast to the foyer and theater stage in the Moulin Rouge. This consists of red, heavy and enclosed volumes which at the same time is seductive and intimidating. The museum is light and welcoming to everybody.

Everywhere in the project sensuous qualities have been incorporated with the use of contrasting volumes, perceptions of spatialities and contrasting materiality. Throughout the project the deliberate use of aesthetic elements have contributed the desires atmospheres in the building.

REFERENCES

Litterature:

[Ahler, 2002] Ahler, Knud (2002): 'dimensionering med diagrammer', 2nd edition, Nyt nordisk forlag

[Ayers, 2004] Ayers, Andrew (2004): ' The Architecture of Paris', Menges

[Bech, 1998] Bech Jill & Reiser, Joseph (1998]: 'Moving notation', Harwood Academic Publishers

[Gibson, 1968] Gibson, James (1968): 'The Senses Considered as Perceptual Systems', Houghton Mifflin

[Kirkegaard, 2004]. Kirkegaard, Poul Henning (2004): 'Structural Dynamics, Vol. 10, Building and Room Acoustics', Aalborg Universits Tekniske Forlag.

[Knudstrup, 2005] Knudstrup, Mary-Ann (2004): 'Integrated Design Process in PBL', Aalborg Universitets Forlag.

[Pessis, 1990] Pessis, Jacgues & Crépineau, Jacques (1990): 'the Moulin Rouge', St. Martin's Press

[Pallasmaa, 2005] Pallasmaa, Juhani (2005): ' the eye of the skin', Academy Press.

[Mornement, 2007] Mornement, Adam (2007): 'Extensions', Laurence King Publishing

[Schittich, 2007] schittich, Christian et al.: 'Glass Construction Manual', Birhhäuser

[ståbi] Jensen, Bjarke Chr. (2007): ' teknisk ståbi', 19th edition, Nyt teknisk forlag

[Uffelen, 2009] Uffelen, Chris van & Golser, Markus (2009): 'Paris, the Architecture Guide', Braun Publishing

[Wikke, 2010] Wikke, Helle Bøcken & Skousbøll, Karin (2010): ' Arkitektur, krop, rum', Kunstakademiets Arkitektskoles Forlag

Webpages:

[acousticglass] http://www.thelondonglass.co.uk/acoustic_glass.asp
[arquitectum] http://arquitectum.com/
[casamusica] www.sea-acustica.es/Sevilla02/rba02012.pdf
[cobiax] http://www.cobiax.com.au/
[gaisma] http://www.gaisma.com/en/
[gouldevans] www.gouldevans.com
[guardian] www.guardian.co.uk/artanddesign/2003/jan/27/architecture.artsfeatures
[kunsthaus] www.kunsthaus-bregenz.at/ehtml/k_arch.htm
[nelson] http://www.stevenholl.com/project-detail.php?id=19
[Spaendcom] http://www.spaencom.dk/
[wiki /cancan] http://en.wikipedia.org/wiki/Can-can
[wiki/denmark] http://en.wikipedia.org/wiki/Royal_Danish_Ballet
[wiki /hausmann] http://en.wikipedia.org/wiki/Haussmann's_renovation_of_Paris
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[wiki/ palau] http://en.wikipedia.org/wiki/Palau_de_la_M%C3%BAsica_Catalana
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[wiki /sense] http://en.wikipedia.org/wiki/Sense
[windfinder] http://www.windfinder.com/windstats/windstatistic_paris-montsouris.htm
[worldarchitecture] www.worldarchitecturenews.com/index.php?fuseaction=wanappln.projectview&upload_id=2057

Other:

[competition] Competition programme on the attached CD

ILLUSTRATIONS

If nothing else is listed the illustration is own production

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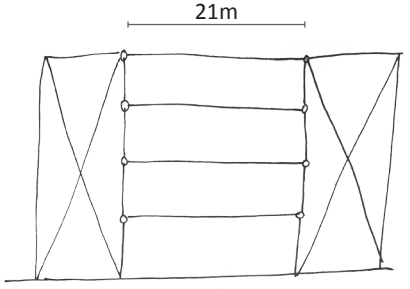
p. 132	www.cobiaz.com.au/
p. 133	www.cobiax.com.au/
p. 134	diagram from [ahler, 2002]
p. 135	diagram from [ahler, 2002]
p. 136	www.spaendcom.dk

APPENDIKS 1.A - COBIAX DECK CONSTRUCTION IN THE DANCE STUDIOS

Cobiax deck construction is an in situ cast deck which can have the desired shape without support in the facade. It is a patented type of deck constuction which uses balloons in the decks to minimise the weight and makes the slabs much slimmer than precast concrete slabs.
The decks are planar why technical requirements and acoustic initiatives not can be incorporated into the slabs. The ventilation will hence be placed vertical in the walls. This also gives a freedom in designing the ceiling where no ribbs or kasettes will deside the expression.



The structural system.
A deck and coloumn construction wit ha span of 21m leading the vertical loads down throug the coloumn. The surrounding buildings function as stabilisers.

Project example

cobiax®

Warehouse Gerriets, Umkirch

Owner: Gerriets Group GmbH Co. & KG

Architect: OAI Haller Architekten, Freiburg

Structural Eng.: Müller + Klein, Freiburg

Approving Eng.: Dr. –Ing. Ralf Egner, Kirchzarten

Execution details

Product:	CBCM
Surface:	~ 800 m²
Max. span:	20,50 m
Slab thickness:	60 cm

From a reference project with same span lenght it is seen that the deck will be 60cm high.

cobiax®

Lightweight solutions in concrete

...for slim slabs & large spans

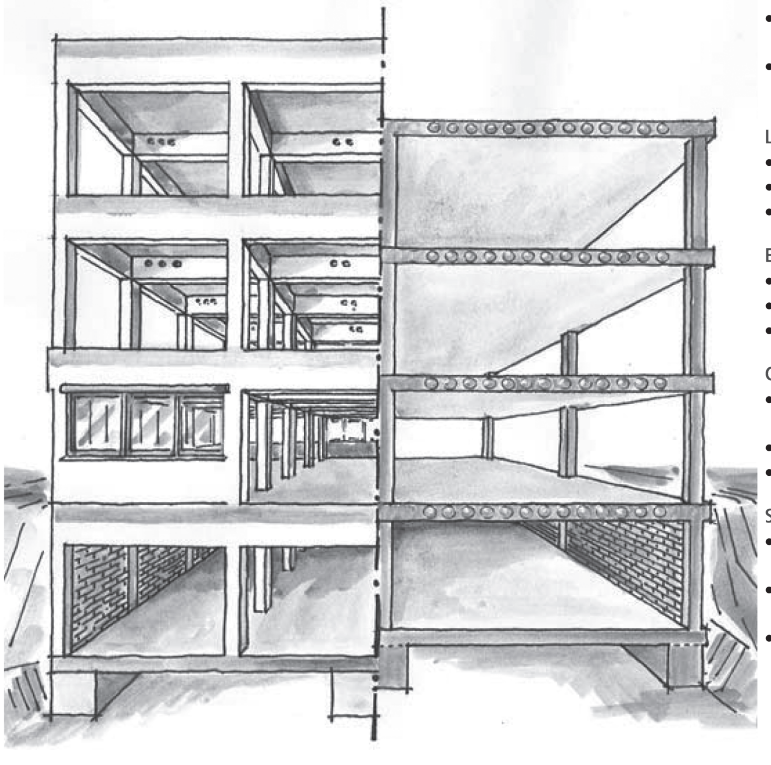
www.cobiax.com

Benefits of the Cobiax flat slab technology

The numerous advantages of the Cobiax technology lead to an increased value for all stakeholders involved in the design and execution process of concrete structures for buildings.

Resource efficiency leads to increased static performance, economic costing and sustainable building structures.

conventional system | optimized with Cobiax



Weight reduction
- Up to 35% lighter than solid flat slabs
- Up to 15% less load acting on foundations
- Increased freedom for structural conception

Large spans
- Up to 20 m spans
- Flat soffits with no obstructing beams
- Up to 40% less columns

Earthquake safety
- Reduction of the accelerated mass
- Eased earthquake design verification
- Reduced damage risks

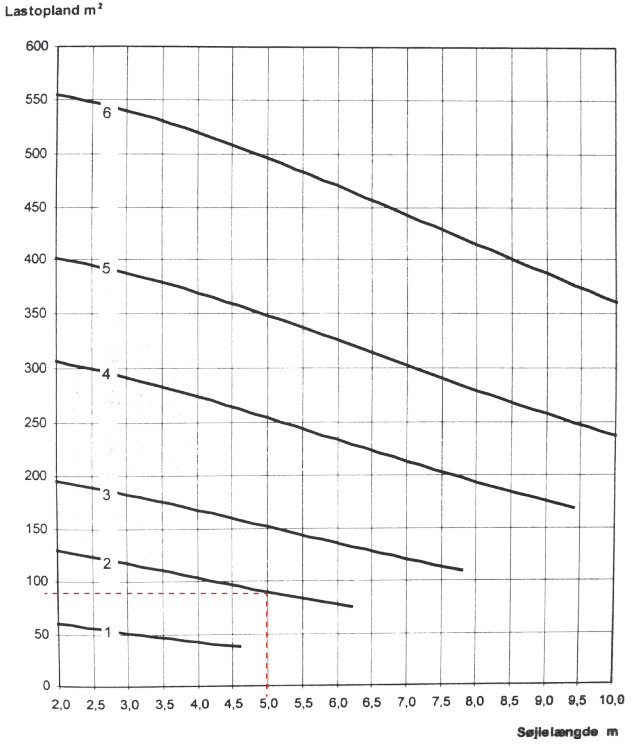
Cost effectiveness
- Concrete and reinforcement steel savings
- Reduced floor-to-floor height
- Eased retrofitting of building

Sustainability
- Resource efficiency trough building materials savings
- CO_2 emission reductions trough concrete volume optimization
- Use of recycled material for Cobiax products

APPENDIKS 1.B - COLOUMNS IN THE DANCE STUDIO

X - akse	Y - akse		Tungt erhverv - last
Søjlelængde	Lastopland	Rektangulære tværsnit	Søjler
m	Etage - m^2	Styrkeklasse B30	Beton

1	2	3	4	5	6
180 / 240	240 / 360	300 / 420	360 / 540	420 / 600	480 / 720

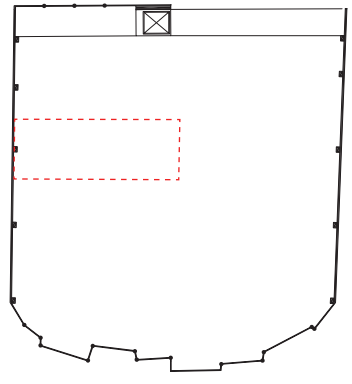


The columns in the dance studio are dimensioned according the 'Dimensionering med Diagrammer' [Ahler, 2002]. The choice has been to have columns for each 5meter with a dimension of 240/2600mm. These will be hid behind a mirror spanning the length of the room which is why the profiles should be as slim as possible.

Coloumn dimensions

type	distance	load	dimension
rectangular	5m	$51m^2$	240/360mm
concrete	10m	$105m^2$	300/420mm

Diagram showing the dimensions of rectangular concrete coloumns with different distances. The grey marks the chosen columns. The dimensions are from "dimensionering med diagrammer" [Ahler, 2002].



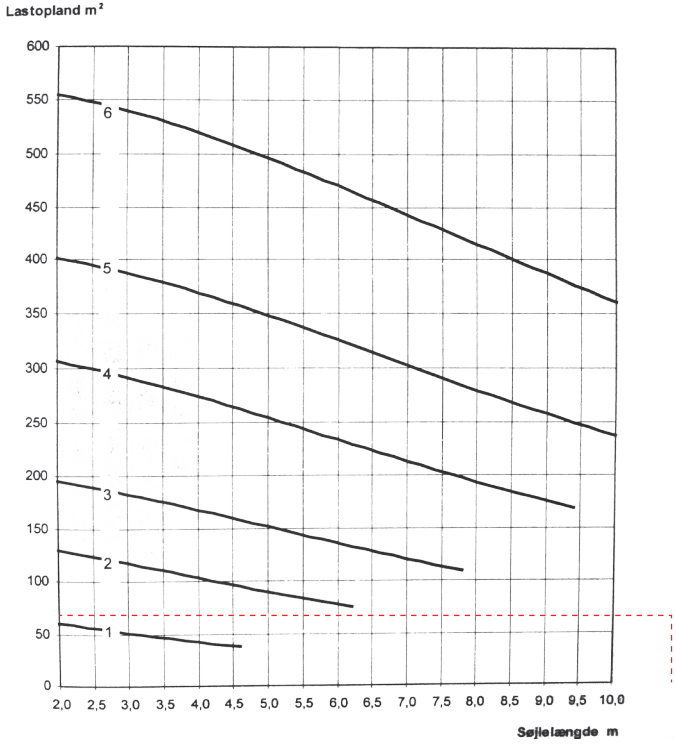
240/360mm concrete column placed for every 5m.

Red marks the load of one column.

APPENDIKS 1.C - COLOUMNS IN THE MUSEUM

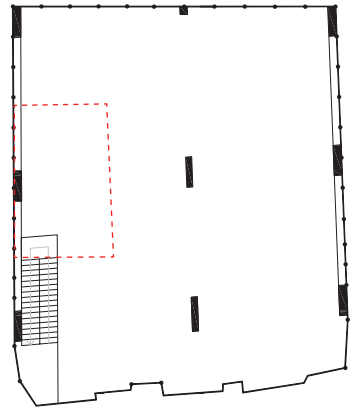
X - akse	Y - akse		Tungt erhverv - last
Søjlelængde	Lastopland	Rektangulære tværsnit	Søjler
m	Etage - m^2	Styrkeklasse B30	Beton

1	2	3	4	5	6
180 / 240	240 / 360	300 / 420	360 / 540	420 / 600	480 / 720



This diagram shows that the columns in the museum can be slimmer than what was assumed initially.
The columns will be placed as shown on the diagram below and have a dimension of 480/720mm.
The diagram only shows columns of up to 10meter. The columns in the museum will be higher why this only is an assumption of the actually dimension.
The columns in the museum have been dimensioned after the plans have been printed why the real dimension of the columns are not incorporated on these. This shows that the columns can be slimmer than the ones shown on the plans.

type	distance	load	dimension
rectangular concrete	10m	$62m^2$	480/720mm



240/360mm concrete column placed for every 10m.

Red marks the load of one column.

APPENDIKS 1.D - DECK IN THE CANTILEVER

Bæreevnetabel - PX 18/120

Bæreevner udover egenvægt i kN/m² ifl. EC2, 2. udg. 2005

Fuld forspændingskraft

Egenvægt pr plade ekskl fugebeton i kN				12,6	14,7	16,8	18,9	21,0	23,1	25,2	27,3	29,4	31,5	33,6	35,7	37,8	39,9
	Spændvidde			3,6	4,2	4,8	5,4	6,0	6,6	7,2	7,8	8,4	9,0	9,6	10,2	10,8	11,4
5 L9,3+3 L12,5	M_{Rd}	105,88 kNm	$q_{,Rd}$	-	37,0	27,6	21,2	16,6	**13,2**	**10,6**	**8,6**	**7,0**	**5,7**	**4,6**	**3,7**	-	-
	V_{Rd}	70,26 kN	$q_{,vRd}$	-	**24,8**	**21,4**	**18,6**	**16,5**	14,7	13,2	12,0	10,9	10,0	9,2	8,4	-	-
	MmREI60	91,85 kNm	qmREI60	-	31,7	23,5	18,0	14,0	11,0	8,8	**7,0**	**5,6**	**4,5**	**3,6**	**2,8**	-	-
	MmÅbnFak0,02	68,51 kNm	$q_{mAbnFAk0.02}$	-	22,9	16,8	12,6	**9,6**	**7,4**	**5,8**	**4,5**	**3,4**	**2,6**	**1,9**	**1,3**	-	-
	MmÅbnFak0,04	81,02 kNm	$q_{mAbnFAk0.04}$	-	27,6	20,4	15,5	12,0	9,4	**7,4**	**5,8**	**4,6**	**3,6**	**2,8**	**2,2**	-	-
	MmÅbnFak0,06	90,42 kNm	$q_{mAbnFAk0.06}$	-	31,1	23,1	17,6	13,7	10,8	8,6	**6,9**	**5,5**	**4,4**	**3,5**	**2,8**	-	-
	V_{vBrand}	47,20 kN	q_{vBrand}	-	15,7	13,3	11,5	10,1	8,9	7,9	7,0	6,3	5,7	5,2	4,7	-	-
	MmREI120	35,95 kNm	qmREI120	-	**10,5**	**7,4**	**5,2**	**3,6**	**2,5**	**1,6**	-	-	-	-	-	-	-
	Mrev	92,76 kNm	q,rev	-	32,0	23,8	18,2	14,1	11,2	8,9	7,1	5,7	4,6	3,7	2,9	-	-
	Mbal	42,41 kNm	q,bal	-	13,0	9,2	6,7	4,8	3,5	2,4	1,6	1,0	0,5	0,0	-0,3	-	-
	flev i mm		f_{lev}	-	11,1	13,6	16,0	18,1	19,6	20,4	20,3	18,8	15,9	11,1	4,1	-	-
	fe1 i mm		f_{e1}	-	0,3	0,5	0,9	1,3	1,9	2,7	3,8	5,1	6,7	8,7	11,0	-	-
	Egensvingning	Hz	$f_{,1}$	-	17	14	13	11	10	9	8	7	6	6	5	-	-

Table from spændcom. The red marking indicates the chosen deck which can span 10m [spaendcom].

APPENDIKS 1.E - CALCULATION OF THE FACADE

The dimension of the truss which has the biggest span in the latticework is calculated. It is calculated like a beam with an even distributed load, this being the wind load.
The truss will be round in order for glass elements to be fixed at any angle.

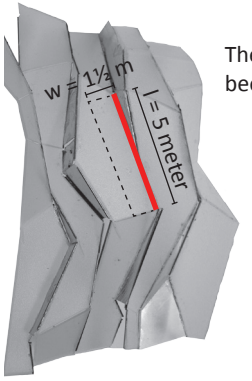
Geometry of the element:
Height: 5m
Span (width): 1,5m
Wind load: 1,0kN

The assumption: round profile with a diameter of 114mm.
Inertia: 234 x 106 mm4 [ståbi].

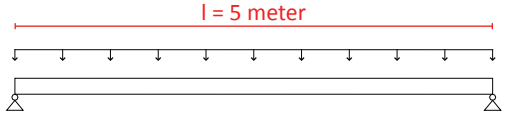
Payload, q: wind load x width
1,0kN x 1,5m =1,5kN/m
Moment, M: ½ x q x l^2
½ x 1,5kN/m x $(5m)^2$
18,75kNm
Tension: (M/l) x y
(18,75 x 106) / (234 x 106) x 50
400 kN/mm^2

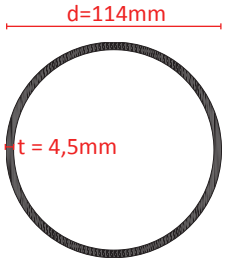
This meets the requirement of a yield point less than 450 kN/mm^2, with a choice of steel of strength class S355. [ståbi]

If it did not succeed the choice could have been of a bigger strength class, a bigger diameter of the profile or a bigger inner diameter (t).



The truss which have been dimensioned.





Assumption of a round profile of 114mm