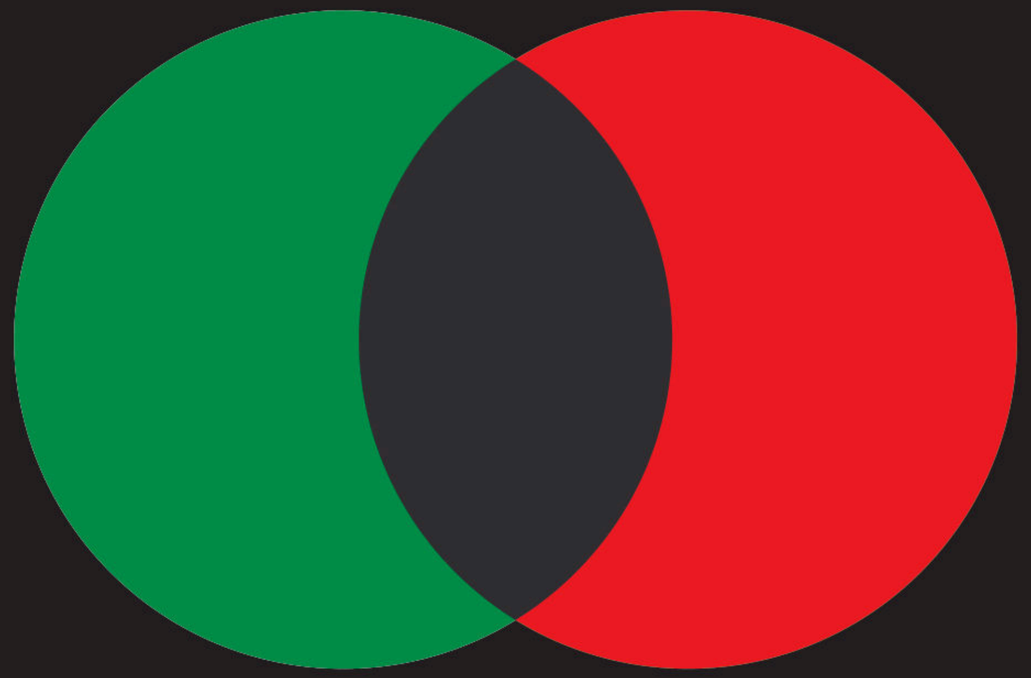
GREEN RE-ARTICULATES RED

Ground and Daylight transformations of the French Communist Party HQ

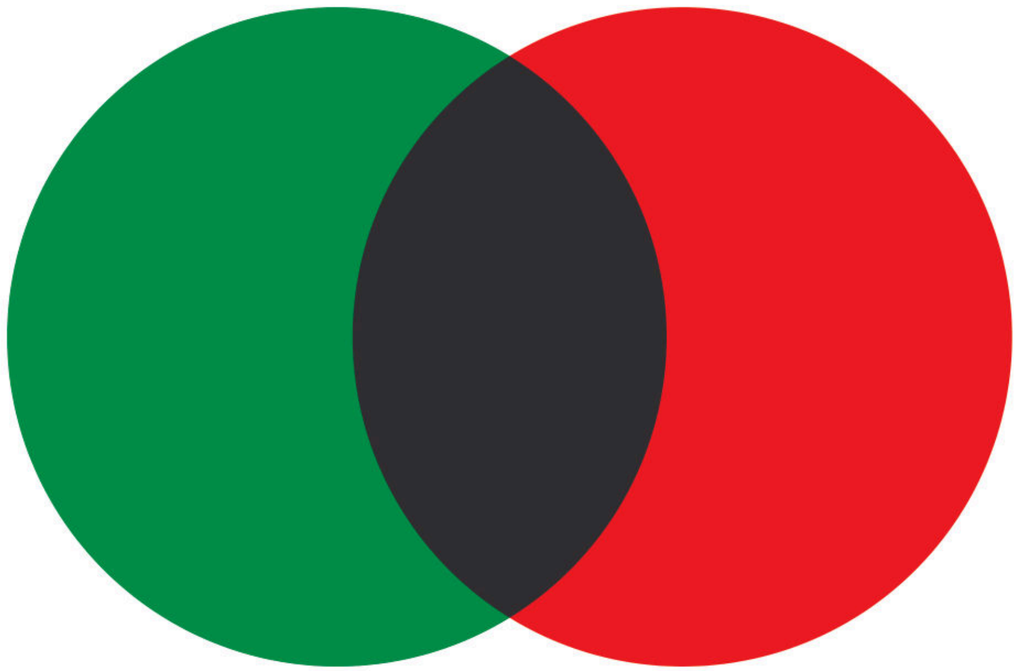


ARTHUR MAMOU-MANI

Fifth Year Diploma Project at The Architectural Association
Diploma Unit 2 - 2007/2008
Tutors : Anne Save de Beaurecueil, Franklin Lee

GREEN RE-ARTICULATES RED

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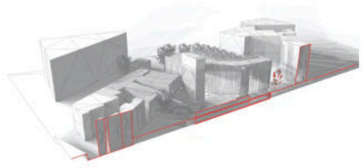
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Green Re-Articulates Red
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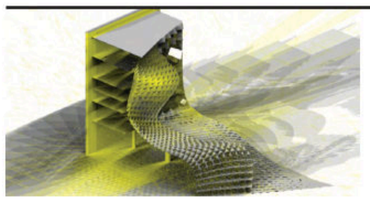
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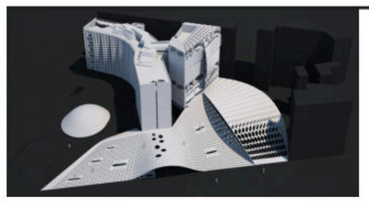
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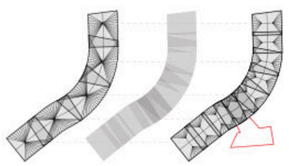
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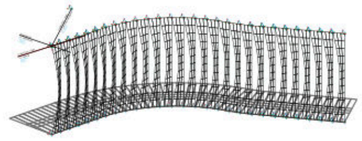
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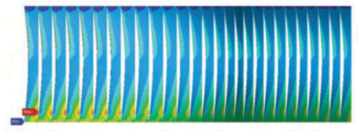
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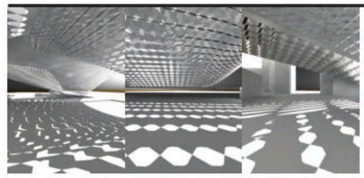
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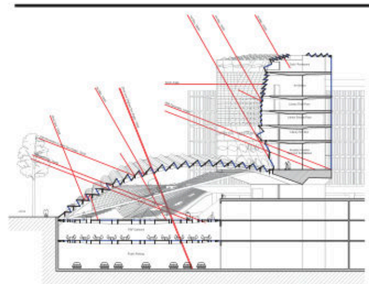
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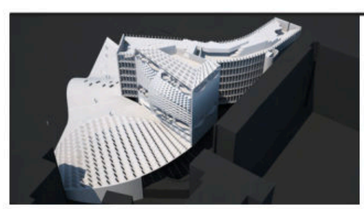
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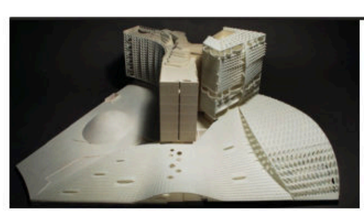
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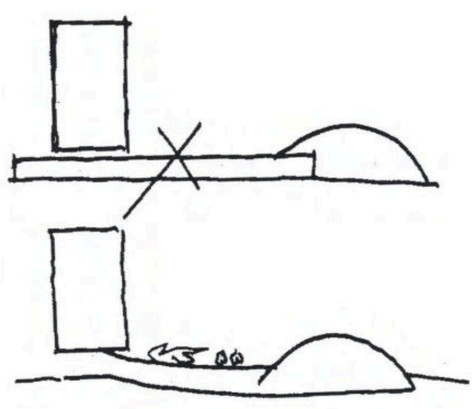
Urban context, relationship with the site and surrounding buildings

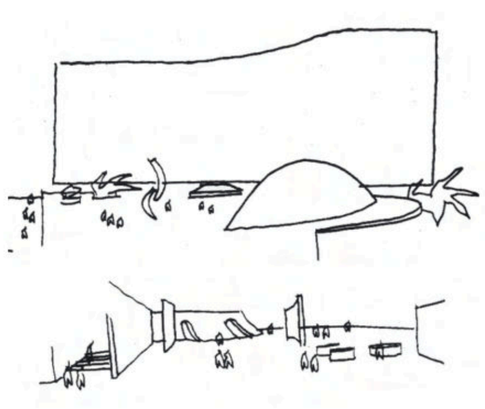


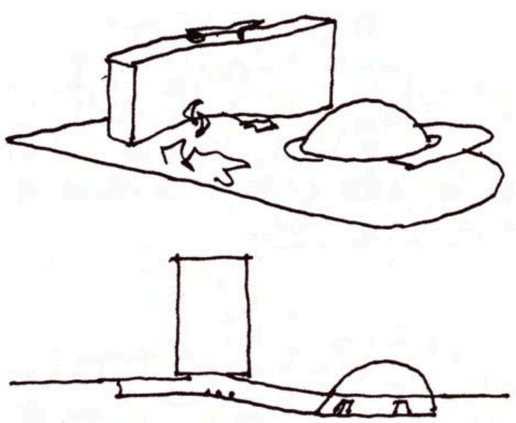
Initial Statement and sketches by Oscar Niemeyer:

Ne pas trop occuper le terrain. Respecter les volumes et les espaces verts, faire la ville respirer un peu et l'architecture libre et créatrice comme le beton demande

"Occupy the site as little as possible,
Make the city breathe a little
and a free and creative Architecture will arrise.
This what concrete asks for."







I. The Historical Context

The Party Communiste Francais (PCF) Headquarters, located in the poor and multi-cultural 19th arrondissement of Paris, was designed in 1970 within three days by Oscar Niemeyer while in exile from the Brazilian dictatorship. The architect celebrated in 2007 his hundredth birthday and now describes this building as the closest to his heart.

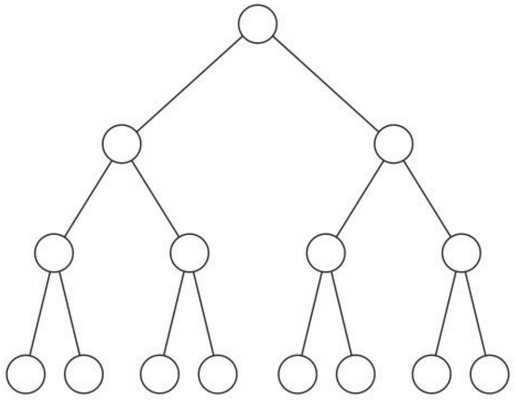
At the time of his first sketches, while the rest of the world was in the midst of the cold war, the PCF was the second most important political party in France scoring 20 percent during the presidential election. Most of French and Parisian philosophers, writers, poets and painters of this period like Jean-Paul Sartre, Albert Camus, Pablo Picasso, Paul Eluard and Andre Breton were members of the party and were donating some of their art pieces to it. In the latest presidential elections, the PCF scored two percent which is ten times less than fourty years ago. Since parties are financed by the state proportionally to their result to elections, the PCF is facing a major crisis that led its leaders to have its wide artistic and real estate asset to be re-evaluated (images 1.). Two levels of the 50 million Euros building will be rented to private companies sharing the PCF's ideology. The cost of the maintenance is so high that the building had to be listed so as to receive subsidies from the state. This procedure freezes any kind of changes to a building that was initially designed by Niemeyer to accommodate "future modifications". **Similarly to its newly listed headquarter, the Stalinian French Party is frozen in its own past.** Communism rhymes in people's head with U.S.S.R.'s infamous Gulags, bureaucracy and dictatorship. Capitalism has now won the war and individualism has also crushed the beautiful idea of solidarity which initially gave birth to an ideology that has proven to be impossible to apply to reality. The tensed political context of 1970 could explain why this building is often qualified as a "bunker" and today this opacity and monolith-like features amplifies the negative historical echo of communism in people's mind. Designed to "make the city breath" with an open park as a base, the site has now been surrounded by fences going against Niemeyer's idea of a democratic building: an Architecture for people. Yet, the PCF building is one of Parisians favourite buildings, the luminous white dome covering the congress room never leaves passer-bys indifferent. The sensuous curves inspired by Brazilian women and Rio's topography bring gentleness and warmth to the neighbouring inhabitants of this poor and grey district.

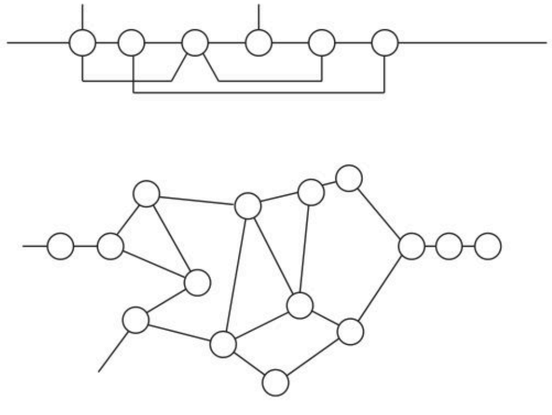
II. The Opportunities

At the end of this year, the PCF will be holding a crucial meeting about its renewal. As a matter of fact, the world has drastically changed since 40 years: ecology is now one of the main concerns, western economy is mainly service driven and delocalise its production force to the south hemisphere where wages are cheap and unions inexistent (Fair Trade image 3). **One could say that the industrial revolution and its resulting working/leading class struggle is now transformed into a southern/northern hemisphere struggle.** Communism that was once state driven and hyper-centralised has been taken over by the internet generation thus changed into a world wide rhizomatic anti-capitalist organisation (images 2.) As a French and Parisian Architecture student in a "voluntary exile" to England sensitive to both Niemeyer's building and ideology I would like to lay down this one hypothesis and develop it throughout my year long project:

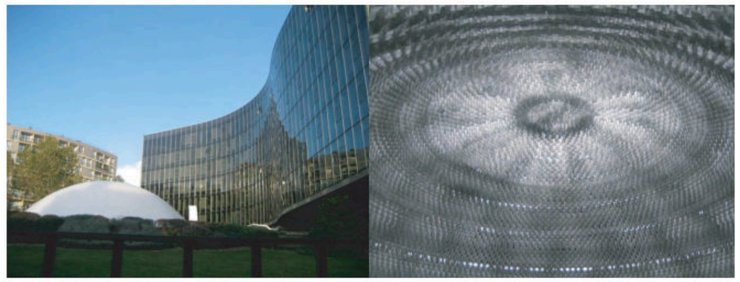
Could Architecture be part of the PCF's renewal ?

In between the act of "Re-Branding" the party and offering a new public ground connecting the party to the people, How can Architecture represent the idea of a new and different communism?





Gilles Deleuze (1925-1995) opposes totalitarian and fascist systems (hierarchical) to groups organized as Rhizomes with "no end and no beginning". **Left:** tree structure **Right:** Networked structure or Rhizome



Monolithic and Articulated
Left: The Monolith on the Pedestal, picture of the PCF Headquarter
Right: The articulated aluminum panels reflecting light within the dome



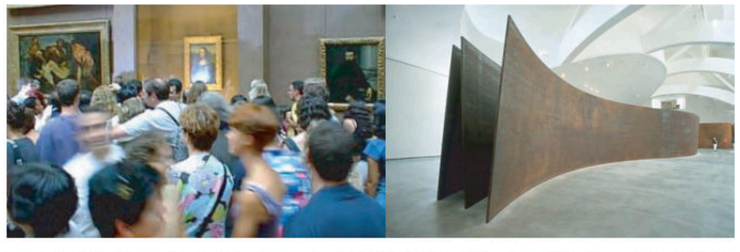
Communism in different forms
Left: "Thank you Kim Jong Il" written by well disciplined crowds during Arirang Festival in communist North Korea.
Right: Anti-Liberal protest in London during the European Social Forum



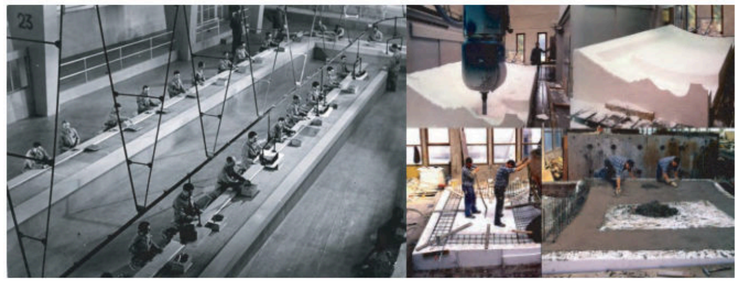
New Opportunities
Left: Existing market on Bd. De La Villette Right: Fair trade label



Politics and Art :
Old and New Posters of propaganda



Emphasizing interaction vs. traditional passive experience when designing a space for art
Left: Trying to see the Mona Lisa in the Louvre
Right: Designing for an art piece, Richard Serra in the Guggenheim Bilbao



Transforming society from industrial to service oriented
Left: Image from Charlie Chaplin "modern times" showing the alienating aspect of mass production
Right: Manufacturing different facade panels for the Zollhof Towers using customized CNC milled Styrofoam as moulds.


1,10 € MERCREDI 14 JUIN 2007 - N° 19 566 - www.lefigaro.fr

LE FIGARO

« Sans la liberté de blâmer, il n'est point d'éloge flatteur » Beaumarchais

Notre supplément Figaroscope

Dossier: les vide-greniers font le plein

Crise financière au PCF

Le Parti communiste, qui n'a totalisé que 1,93% des voix à la présidentielle, ne sera pas remboursé de la totalité de ses frais de campagne. Les législatives devraient aggraver sa situation.

Le siège de la place du Colonel Fabien à Paris est l'un des derniers biens immobiliers du Parti communiste.

Fiscalité, heures sup: le gouvernement finalise ses réformes

Le poids des désastres électoraux

Œuvres d'art : le trésor fantôme ?

« Fabien » monument historique

Le Figaro cover story, "financial Crisis for the PCF", 11th November 2007


EL PAIS

DIARIO INDEPENDIENTE DE LA MAÑANA

Se vende patrimonio comunista

En la ruina, el PC francés explota su sede y se deshace de sus obras de arte

OCTAVI MARTÍ, París

La Monna Lisa de Marcel Duchamps, que fue propiedad del PCF.

El edificio, de Oscar Niemeyer, ha servido ya en varias ocasiones como marco para desfiles de moda

El Pais front page "Communist assets for sell", june 2007


Oscar Niemeyer, meeting the Secreteray of the PCF Georges Marchais in 1977

Bankruptcy for the PCF ?
By Katell PRIGENT LeJDD.fr

The political crisis that faces the PCF could have as a consequence a financial crisis.
Last week. Le Monde was announcing the possibility for the PCF to sell his artistic and real estate assets. The rumour has been denied by the communist leaders who however recognize the "delicate situation" in which they currently are. I am talking about a period that people under twenty. It was in 1969, the PCF candidate to the presidential elections, Jacques Duclos scored 21.27% of the votes. USSR was donating one million dollar yearly. Thirty years late, the candidate Marie-George Buffet has fallen under 2%. And the finances of the Party only rely upon itself.

Mechanically, the political crisis transforms itself into a financial crisis. The accounting results for 2006 have a surplus of 340000 Euros and the Party receives 6 million euros every year from its 90000 subscribers. But the 4.6 million Euros expenses of the presidential campaign have only been reimbursed for 800000 Euros similarly for Robert Hue in 2002 with his score of 3.37%. [...]

According to the status of the PCF, the elected politicians have to give their salary to the party. In 2005, it is more than half the budget that was covered by the salaries of the 12000 communist politicians. Since recent years, this tradition is not respected anymore and they often keep this money to themselves [...]

Last week Le Monde mentioned **the possibility for the PCF to sell not only their artistic assets but also its headquarter** in the 19th arrondissement in Paris. The building on the Place du Colonel Fabien, conceived in 1971 based on Brazilian Architect Oscar Niemeyer was listed as a historical monument last March. Tuesday the Party gathered the press to deny this rumour that seemed quite credible. "We are not on the edge of bankruptcy yet our financial situation is quite tensed" has declared the financial advisor Jean-Louis Frostin.

"I can see your cameras filming the Fabien's cupola, let me reassure you: She is not for sell" said the PCF spokesman Olivier Dartignolles to the journalists. [...] "None of the art pieces that been given to us throughout the year has been evaluated" explained Jean-Louis Frostin

L'humanité (communist newspaper)
Interviews of Oscar Niemeyer
10th january 2007

How can an architect help to transform the world?

O.N. He can fight for a society more fair and more united [...]
A young man that protests in the street against the world's injustice does a better job than mine and the journalists to whom i say that are astounded.

Is your commitment to communism still the same ?

O.N: I am happy, i am still on the same path. I went out of school and my family was from the bourgeoisie. My grand-father was minister of the Supreme Court in Brazil. I immediately understood that things should be changed. The path is the Communist Party. I entered the Party and stayed there till today, following every moment, good or bad that life imposes.

When i speak about Architecture i always say that **life is more important than Architecture, Architecture does not change anything, life can change things much more than it.** I constantly say it to my colleagues or students: it is not enough to come out from school to be a good architect. One should first know men lives, their misery, their suffering to fully produce Architecture, to create. The most important is to be a man that manages to understand life and one must understand that it s essential to change the world. We seek for coherence.

Every Tuesday, we organise in my office a meeting between students, intellectuals, scientists, writers, we exchange philosophical reflexions, political thoughts, on the world, **we want to understand life, change life, change human beings.**

The year 2008 marks the 40th anniversary of the May 68 events. It is also the year Nicolas Sarkozy was elected after saying in one of his speaches that he will end the "spirit of 68". The May 68 protests were initiated by Parisian students against their University's political bureaucracy. What started as a local conflict quickly developed into a nation-wide rebellion against any form of authority. This explosion from the French youth had multiple causes and was quite confusing as to what were the overall aims but **its most interesting by-product happened on an artistic and social level:**

May 68 gave birth to a sense of anti-authoritarianism not only in the social area in which it broke the barrier that allowed my parents to meet but it also made everyone an artist. The youth, helped by the rebellious Beaux-Art students, will create half consciously a series of art interventions using graffiti, posters and slogans amongst which the very popular: Under the Pavestone, the beach.

It is not a surprise that art movements such as the Surrealists and the Situationists happened around the same time and place nor is it a coincidence that Deleuze and Guattari wrote their book Capitalism and Schizophrenia soon after it.
What links all this together is the rejection of hierarchical systems of all kind. It is the desire to discover life through your own means and not through someone else's predefined codes.

May 68 was a far-left movement, yet it rejected the Stalinian authority and the French Communist Party who supported it. One cannot re-design the headquarters without understanding this clash between a communism which came from the people and one which was a tyranny.

The strong poetic and political character of wanting to look beneath the pavestone could be associated to Dali's surreal desire of lifting the sea or the complete enwrapping of urban and natural features by Christo and Jean-Claude.

When dealing with the PCF both as a Party with a heavy past but also as a monolithic building, an Architect which had to design its extension would be tempted to use the same analogy and ***try to lift the drape...***



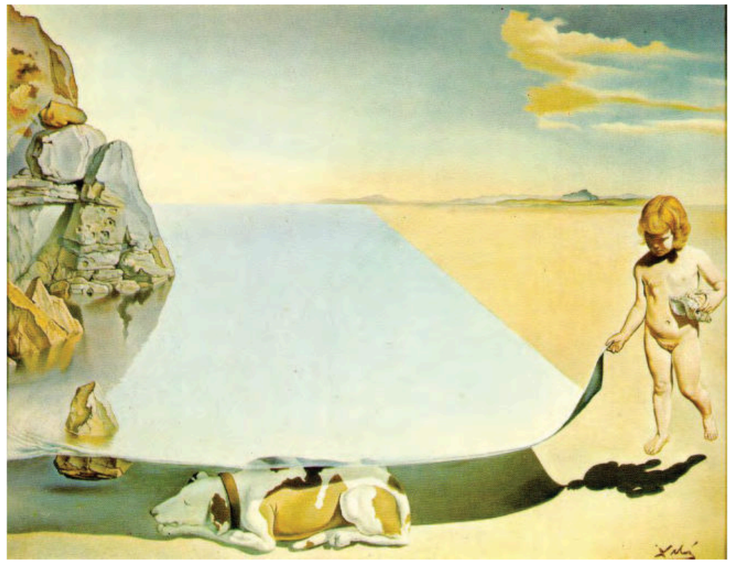








Barricades in Paris during May 1968
© Roger-Viollet



Salvadore Dali
"Myself at the Age of Six when I Thought I Was a Girl Lifting with Extreme Preaution the Skin of the Sea to Observea Dog Sleeping in the Shade of the Water" (1950)



Christo and Jean-Claude
Wrapped Coast, One Million Square Feet, (Little Bay, Australia 1968-69)



Christo and Jean-Claude
Wrapped Reichstag, Berlin, 1971-95

"In this election, we're going to find out if the heritage of May 68 is going to be perpetuated or if it will be liquidated once and forever."

Nicolas Sarkozy, President of France. Paris Campaign Rally, May 1st 2007



Nasser Nasser/AP





Serge Hambourg

"Without the freedom and open-mindedness we gained with May 68 I would have never been able to marry my husband who came from a completely different social background than me.

Chantal Mamou-Mani, my mom, "Si Mai 68 M'Etait Conté"



"Be Young and Shut Up"



"Workers Peasant Unity"



"No to Bureaucracy"



"May 68, Beginning of a Long Lasting Struggle"



"No Dialog with the Police State"



"Stop the deportation of our foreign comrades"



"Participation"



"Back to Normal"

May 68 Poster by Atelier Populaire

View from Boulevard de La Villette - The Monolith on its Pedestal

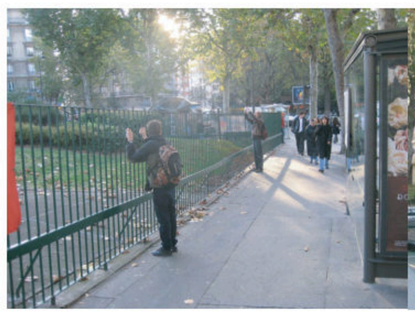
Niemeyer's intention of having a democratic park which would be connected to the city is completely lost as a barrier prevents anyone from entering, leaving a small gated entrance which few people use.

View from Rear - The Overheated Facade

Nyimeyer's intention of "not occupying the site too much" led to a dead space at the rear of the building.
The teinted southern facade is also overexposed to solar radiation.



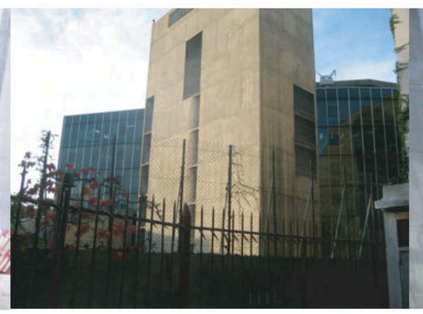


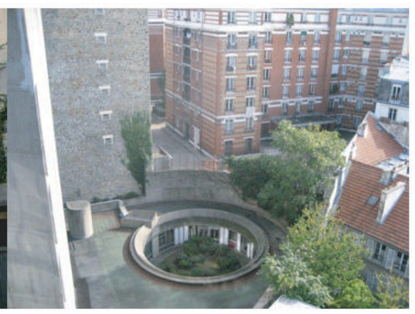












Currently, as there is only one entrance controlled by an interphone, passer-bys do not realise that they could get in therefore starring at the building the fences.

The circulation only occurs between this one entrance and the main entrance on the ground level leaving other spaces unused.

The staircase above is the only access the rear of the building.
Its access from the street is locked and even though it is possible to go there, no one does it and it remains completely empty.

The neighbouring building inhabitants could have access to this area but they are separated from it by a wall.



Unexpected Events happening during visit

- Monday 22nd October at 11h00
- Friday 4th January 2008 at 17h00
- Tree base
- Limit of parcels
- Wall of separation between parcels
- Insalubrious building Parcel limit
- Entrances
- Shop
- Public building and Public Education
- Registered Association
- Parc / Sport 1° Accessibility
- Religious building
- Public Transport Stop
- Fully Accessible Ground
- Temporary Structures
- Particular Event that happened during visit
- Car Parking Authorized
- Extension Project Proposed Area of interventio
- Area of intervention 2
- Area of intervention 3
- Area of intervention 4
- Fences
- Car 1° Accessibility
- Car 2° Accessibility
- Train
- Pedestrians 1° Accessibility
- Pedestrians 2° Accessibility
- Pedestrians Accumulation
- Bicycle

The remarquable view over Paris on the PCF's roof and the Insalubrious neighbouring building two of the most important contextual factors which should influence the design:
- Similarly to the ground, the roof is unused yet designed to be Public.
- If destroyed, the neighbouring buildings will leave an empty site which could be an opportunity to give the PCF back its original Architectural intentions



From the roof towards South



From the roof towards South looking down
Insalubrious buildings in red



110-114 Boulevard de La Villette



Place du Colonel Fabien From the roof

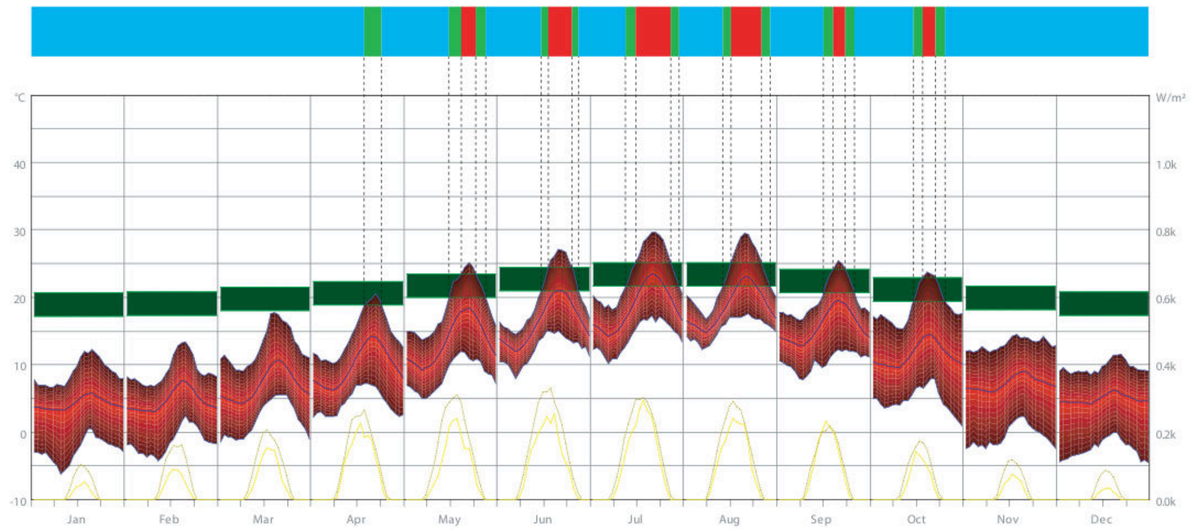
The graph on the right (Monthly Diurnal Average) is showing the average temperatures in relation to direct and diffuse radiations and comfort zones. Paris average temperatures are mainly located under the comfort zone between October and April (blue zone). Direct Solar radiation could help heating up a building but is not convenient for usual activities within the building and the use of too much glass could result in great heat loss.

Between the month of April and October a great proportion of the average temperature are located above the comfort zone. During this period the direct solar rays should be blocked, mainly in the middle of the day. Below are the extremes - Brightest day, most overcast day, hottest day and coldest day.

The brightest day (the one with the most direct solar radiation) is not the hottest day. Still the temperatures reach 27°C that day. During the hottest day the solar radiation reaches 0.5 kW/m² while in the brightest day, the radiations reaches 0.75 kW/m². Reducing the amount of direct radiation will help cooling the building but also allowing cross ventilation.

On the contrary Wind should be stopped during the most overcast and coldest day as it reaches very high values.

MONTHLY DIURNAL AVERAGES - Paris



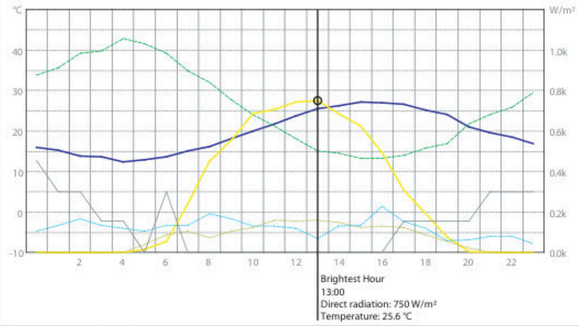
LEGEND

Temperature
Rel.Humidity
Wind Speed

Direct Solar
Diffuse Solar
Cloud Cover

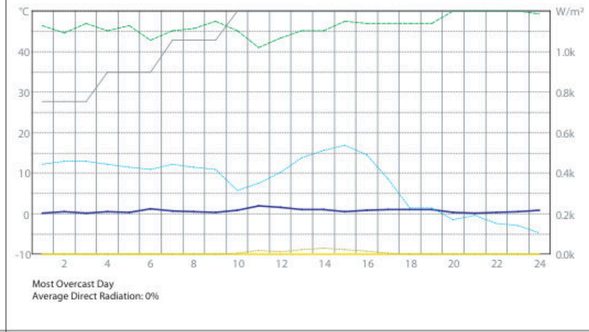
Comfort: Thermal Neutrality
Average diurnal temperature below the confort zone - Heat required
Average diurnal temperature in the confort zone - No intervention
Average diurnal temperature above the confort zone - Cooling required

DAILY CONDITIONS - 25th June - Brightest Day



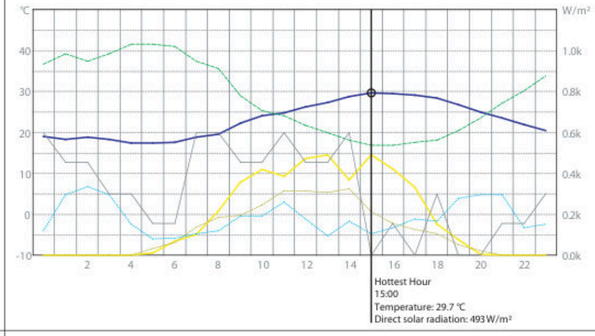
Brightest Hour
13:00
Direct radiation: 750 W/m²
Temperature: 25.6 °C

DAILY CONDITIONS - 6th January - Most Overcast Day



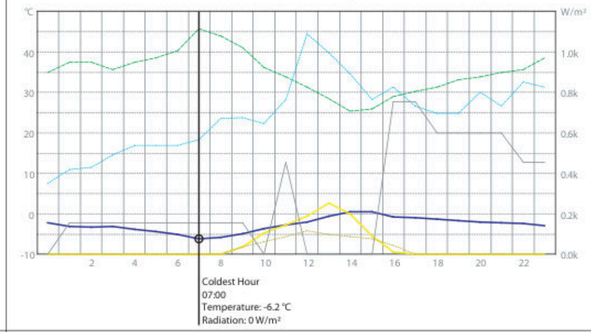
Most Overcast Day
Average Direct Radiation: 0%

DAILY CONDITIONS - 12th July - Hottest Day



Hottest Hour
15:00
Temperature: 29.7 °C
Direct solar radiation: 493 W/m²

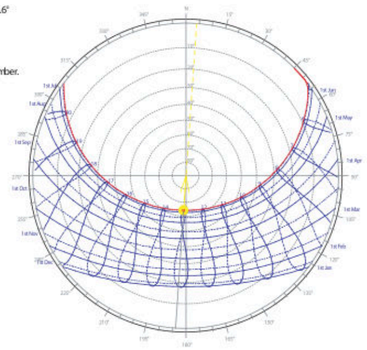
DAILY CONDITIONS - 21st January - Coldest Day



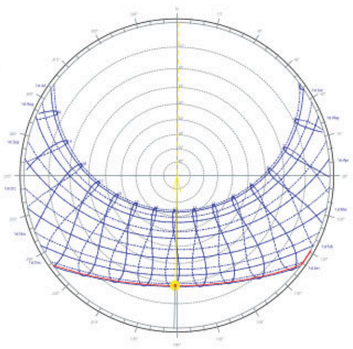
Coldest Hour
07:00
Temperature: -6.2 °C
Radiation: 0 W/m²

Stereographic Diagrams

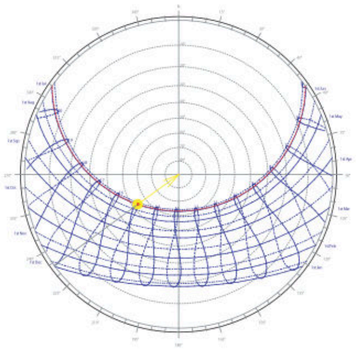
Location: 48.8°, 2.4°
Sun Position: -176.2°, 64.6°
HSA: -176.2°
VSA: 115.4°
Time: 13:00
Date: 25th Jun
Dotted lines: July-December.



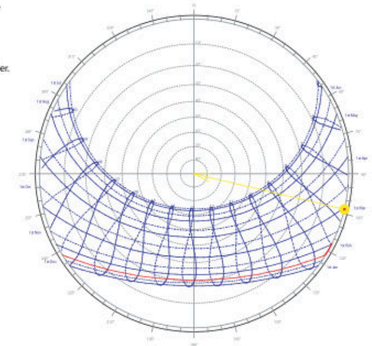
Location: 48.8°, 2.4°
Sun Position: -178.9°, 18.5°
HSA: -178.9°
VSA: 161.5°
Time: 13:00
Date: 6th Jan
Dotted lines: July-December.



Location: 48.8°, 2.4°
Sun Position: -126.2°, 53.7°
HSA: -126.2°
VSA: 113.4°
Time: 15:00
Date: 12th Jul
Dotted lines: July-December.

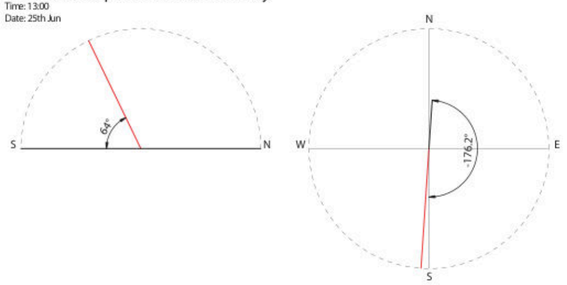


Location: 48.8°, 2.4°
Sun Position: 103.4°, -15.4°
HSA: 103.4°
VSA: -130.1°
Time: 07:00
Date: 21st Jan
Dotted lines: July-December.

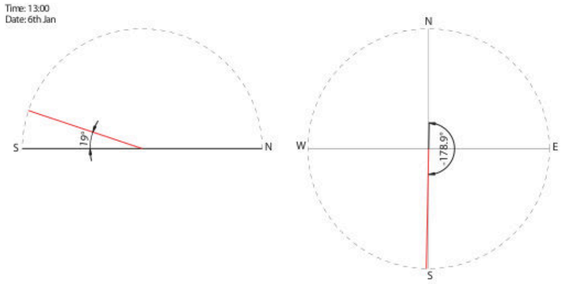


Elevation and planar view of Solar Ray

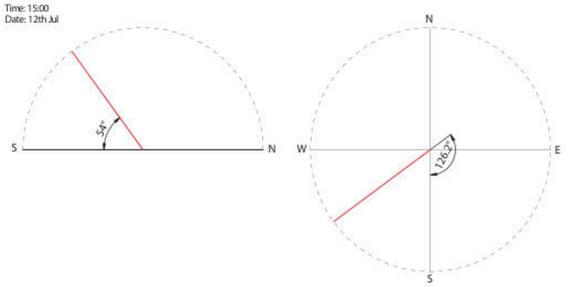
Time: 13:00
Date: 25th Jun



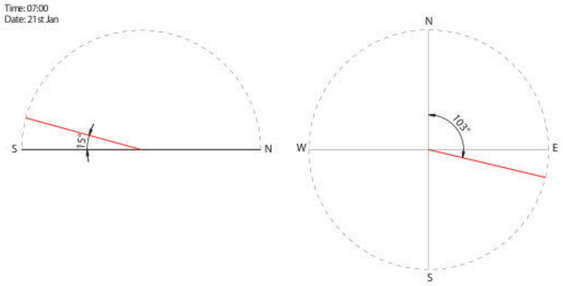
Time: 13:00
Date: 6th Jan



Time: 15:00
Date: 12th Jul



Time: 07:00
Date: 21st Jan

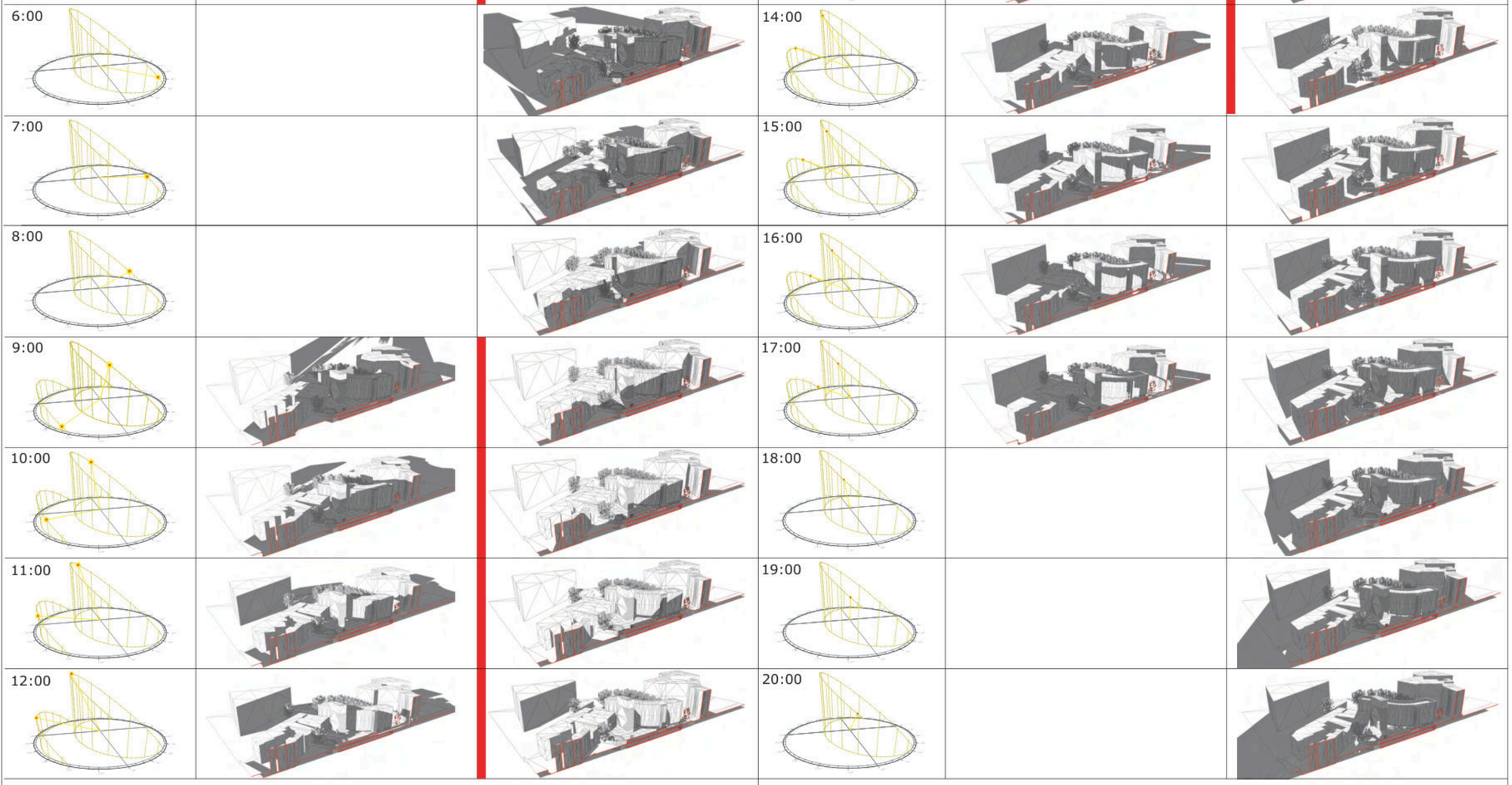


Daily Sun-path Diagram
21st January - 12th July

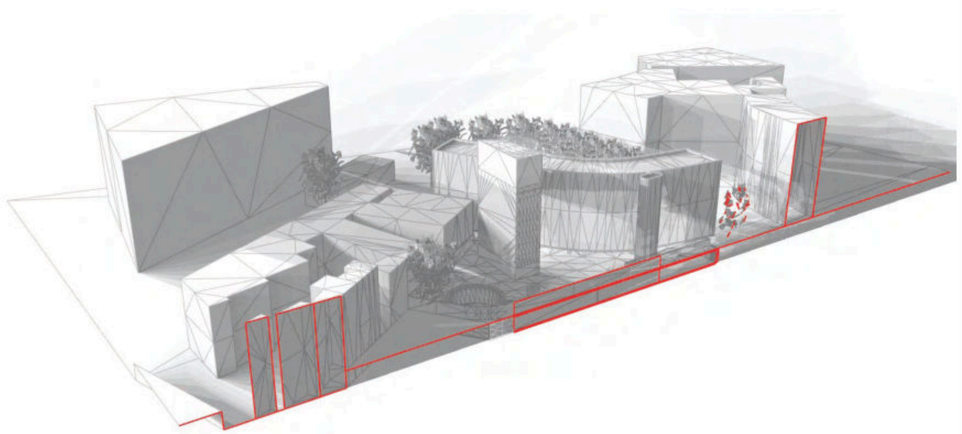
Shadow Mapping
21st January (Coldest Day)

Shadow Mapping
12th July (Hottest Day)

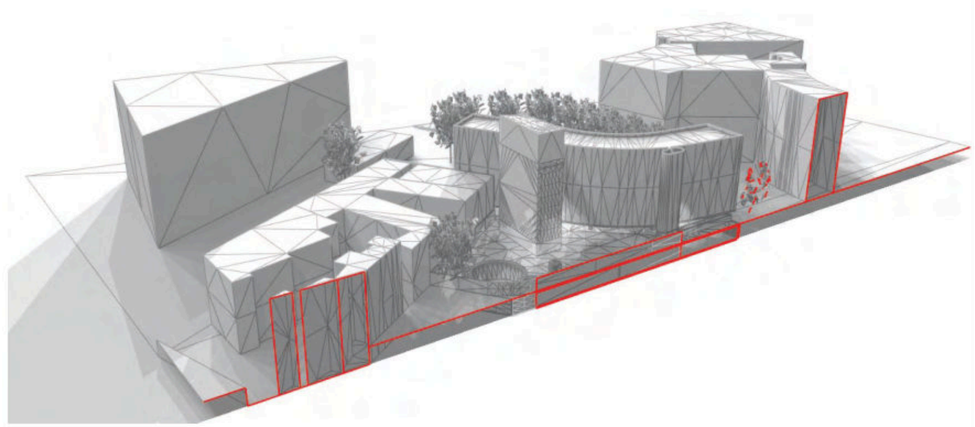
Red area defines hours of the day where the South-East facade is overexposed to direct solar radiation



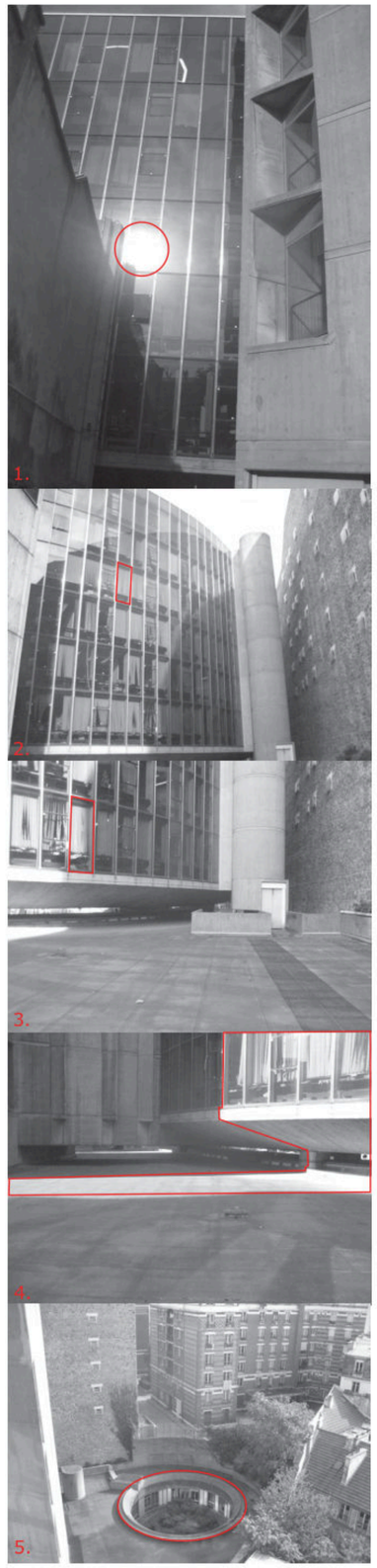
Shadow Mapping
21st January from 9:00 to 17:00



Shadow Mapping
12th July from 6:00 to 20:00



Pictures of the Eastern Side of the Building:
Taken on Monday 22nd October 2007 at 11:00.
1. Direct Sun on the facade
2. 3. The sun hits the facade, the users added curtains.
4. Protection from the central core
5. Protection from the surrounding walls



Environmental Measurements in the PCF - Thursday 24th January 2008 from 8h40 to 18h00 2008

View From Office 1

The Dome provides Reflexion to the entire building. It is a light in itself. It raises the question of light diffusion through global shapes.



View Of Office 1

On the left of the image, the door leads to another office. Those circulations are rarely used and could be a good opportunity for creating a buffer zone.



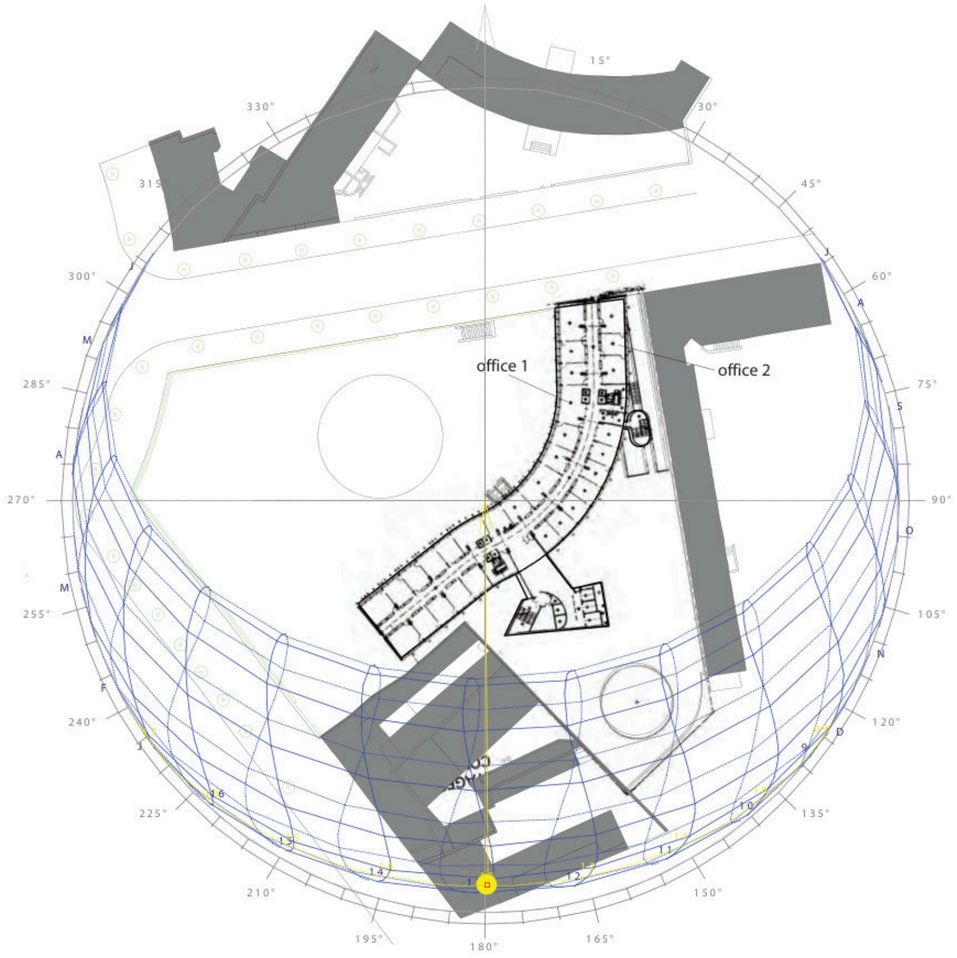
Left:
View Of Office 1

The Ceiling is tilted to follow the structure. On the left is one of the movable and integrated furniture the Niemeyer designed.

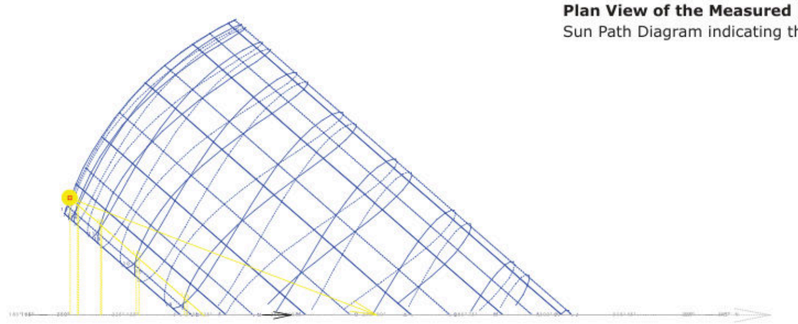
Right:
View of Office 2



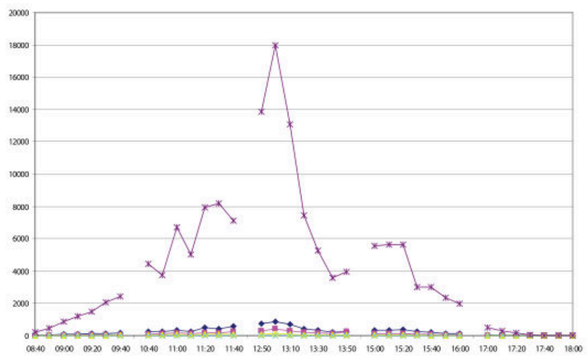


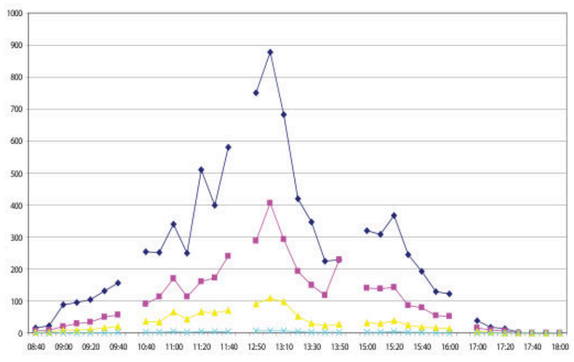


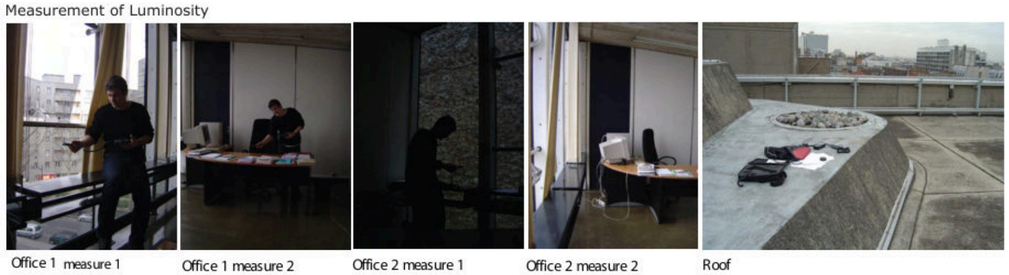
Plan View of the Measured Level
Sun Path Diagram indicating the 24th January



Measurement of Luminosity

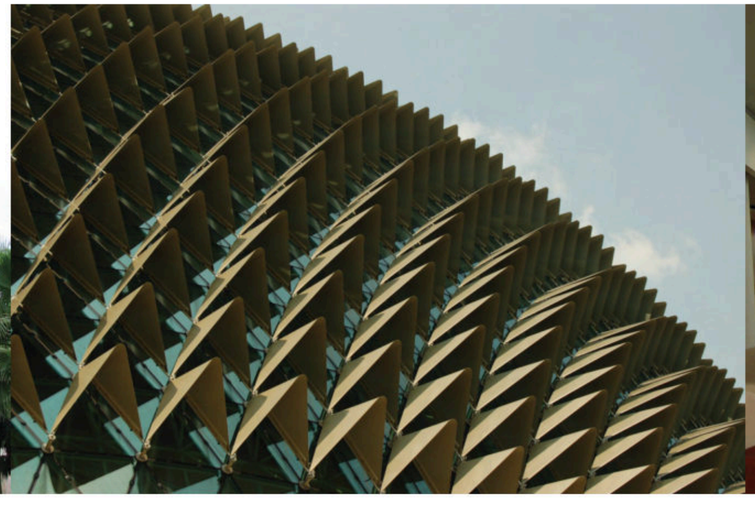
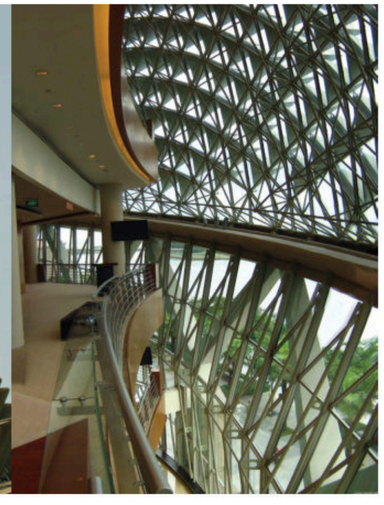






Office 1 measure 1 | Office 1 measure 2 | Office 2 measure 1 | Office 2 measure 2 | Roof

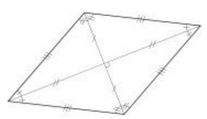


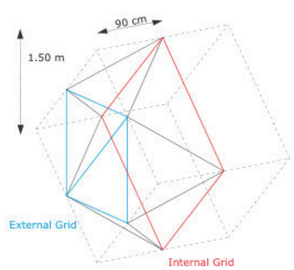
Studying the Structure
"The steel structure is a double-layered space frame with two directions of its triangular external grid following exactly a predefined network of rhombi with constant edge lengths of 1.5m and a third direction of lines of varying length, which enable adapting the grid to the free-form surface."
Source:
The Geometrical Processing of the Free-form Envelopes for The Esplanade Theatres in Singapore
(Sanchez-Alvarez J.)

>> In geometry, a rhombus (or homb; plural rhombi) is a quadrilateral in which all of the sides are of equal length. The diagonals of a rhombus are perpendicular to each other.
See on the right for geometrical rules of a Rhombus

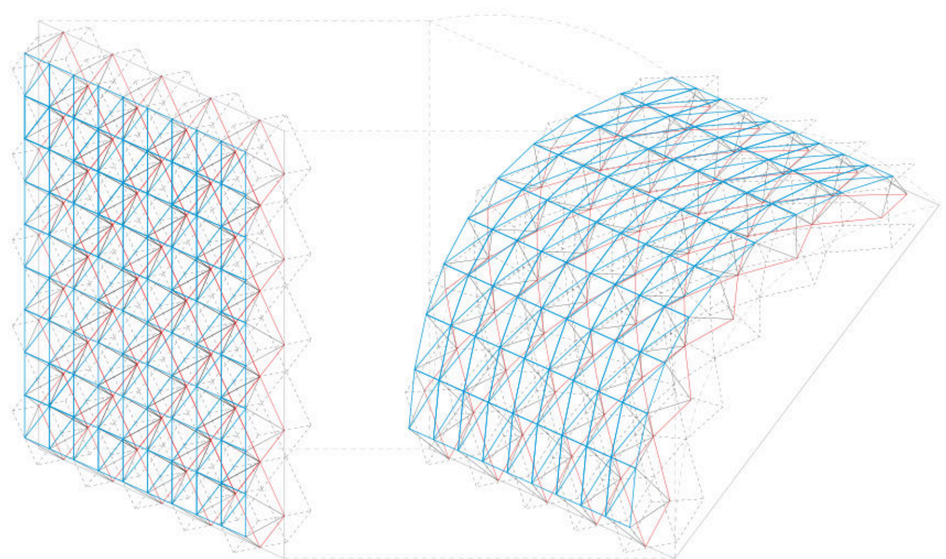
The geometrical rules defining of a Rhombus



Half a Cube-Octahedron+Diagonal

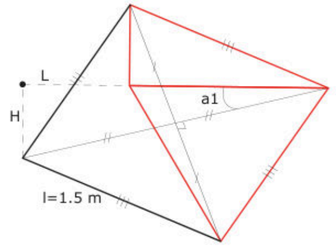


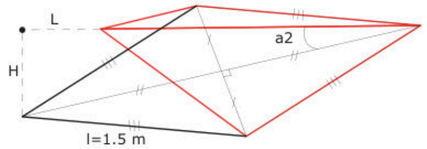
Square-On-Diagonal Double-Layered Grid and its polyhedral components



Sunshades geometry

Two examples of module variation keeping the geometrical constraints
H represents the height of the sunshade device, it is normal to the surface defined by the rhombus
L is the maximum length that can reach the device, at length L, it would cover entirely the glazing

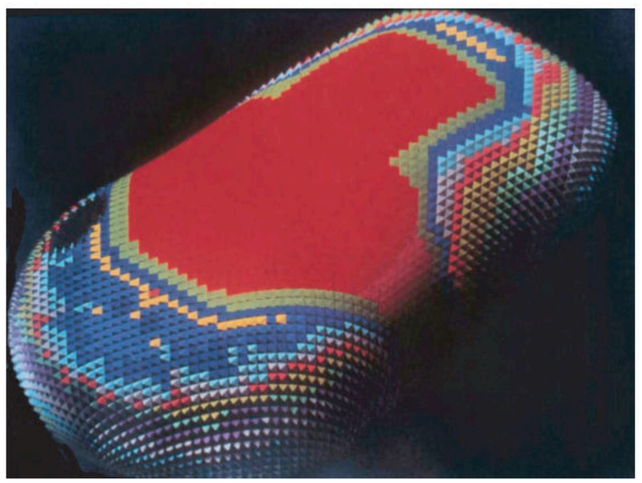




Colour Coding of the Sunshades
Source
http://www.merotsk.de/uploads/tx_cwtcartoongallery/esplanade_theatres_in_singapore.pdf

According to the degree of horizontality or of verticality of glazing, a certain type of component is selected.

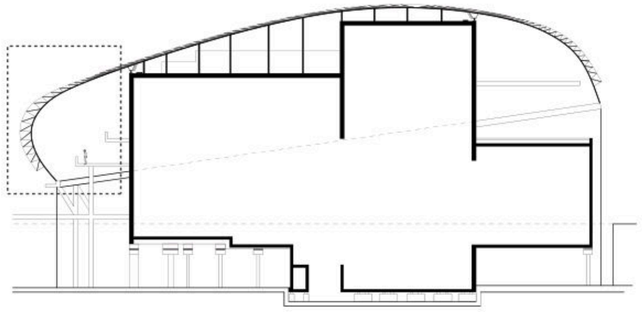
Not all the components are different, the same colours represent similar components.
"Except for special edge elements, the two domes required no more than twenty five different rhombic patterns"



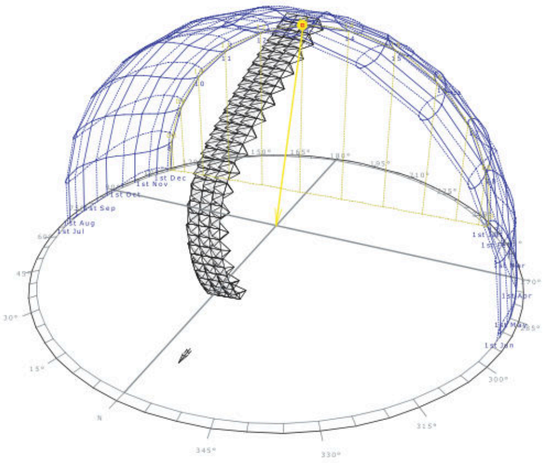
Prorotype of the structure



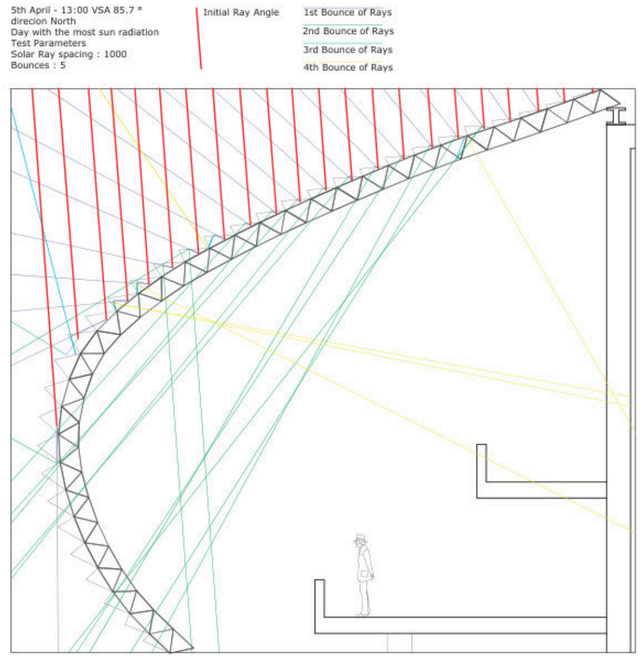
North to South Section through the Lyrical theatre



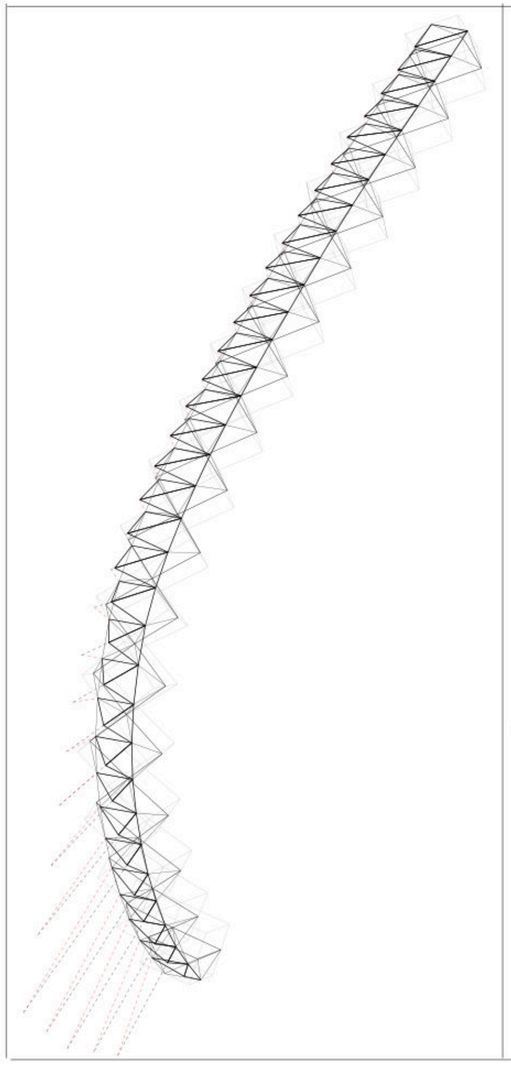
Northen fragment of the structure within Singapore's daily and annual sunpath
The sun angle represented here is the 5th April at 13:00



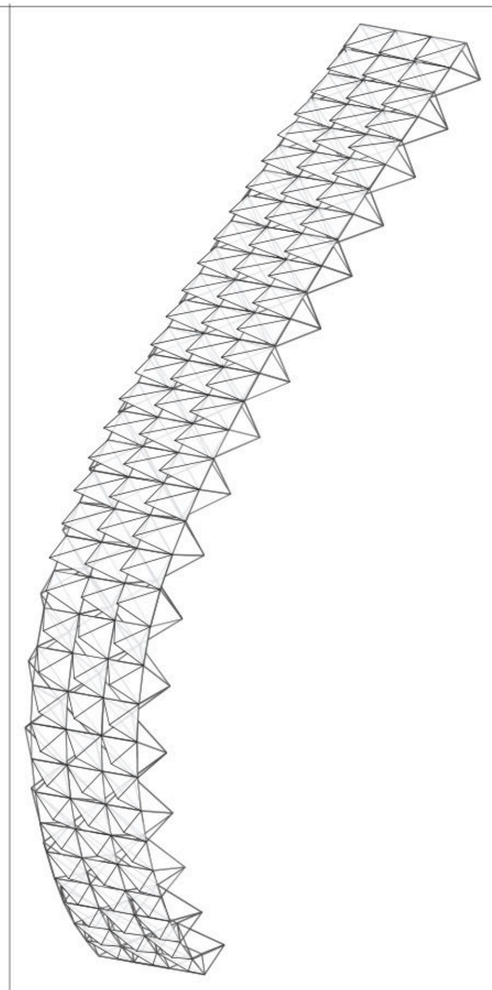
Section through the system and tested 3D sun angles



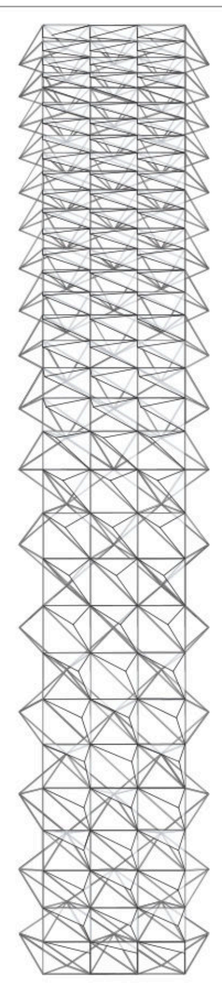
Axonometric View showing the construction lines



Axonometric View



North Elevation



Architect's Statement

The Point of this study is to Test the Structure with solar ray analysis and compare the results to the architect's statement:

Extract from Atelier One's Website :
Design Sun Time: 1200-1300 hrs
Sun Altitude Angle: 68 N

"This part of the facade is exposed to the highest angle sunlight only, it incorporates the transitional zone from roof to wall.

Shading overhangs are short in the wall section and extend as curve turns towards the horizontal. Views from the interior are virtually uninterrupted. Some inter-reflection between shading elements contributes at lower angles to the diffuse light internally.

The effective shading coefficient will exceed those of either horizontal or vertical shading devices and an SC of less than 0.3 should be achieved (subject to detailed calculation)"
Atelier One

Key Points:

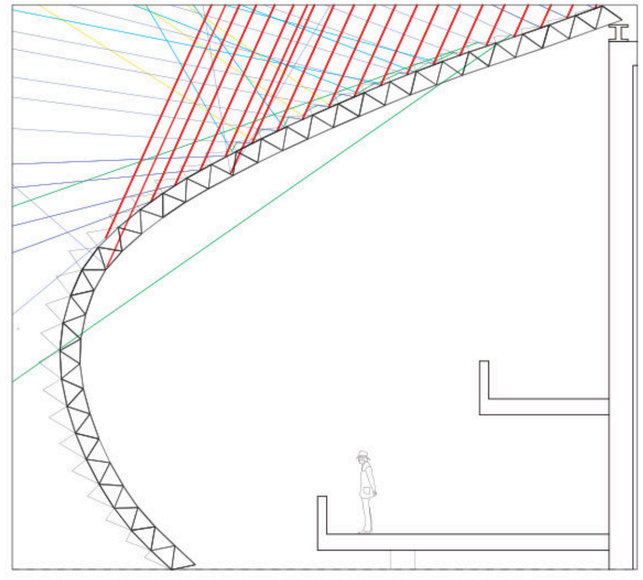
- A set angle and attitude of the sun is being used for the design (highest angle, 1200-1300 hrs)

- A relationship is instaured between the angle of the glazing and the length of the overhangs.

-Inter-reflections between shading elements creates diffuse internal light at lower anlgles

- Visibility is one of the paramters

- 30% of the glazing is still exposed to the sun

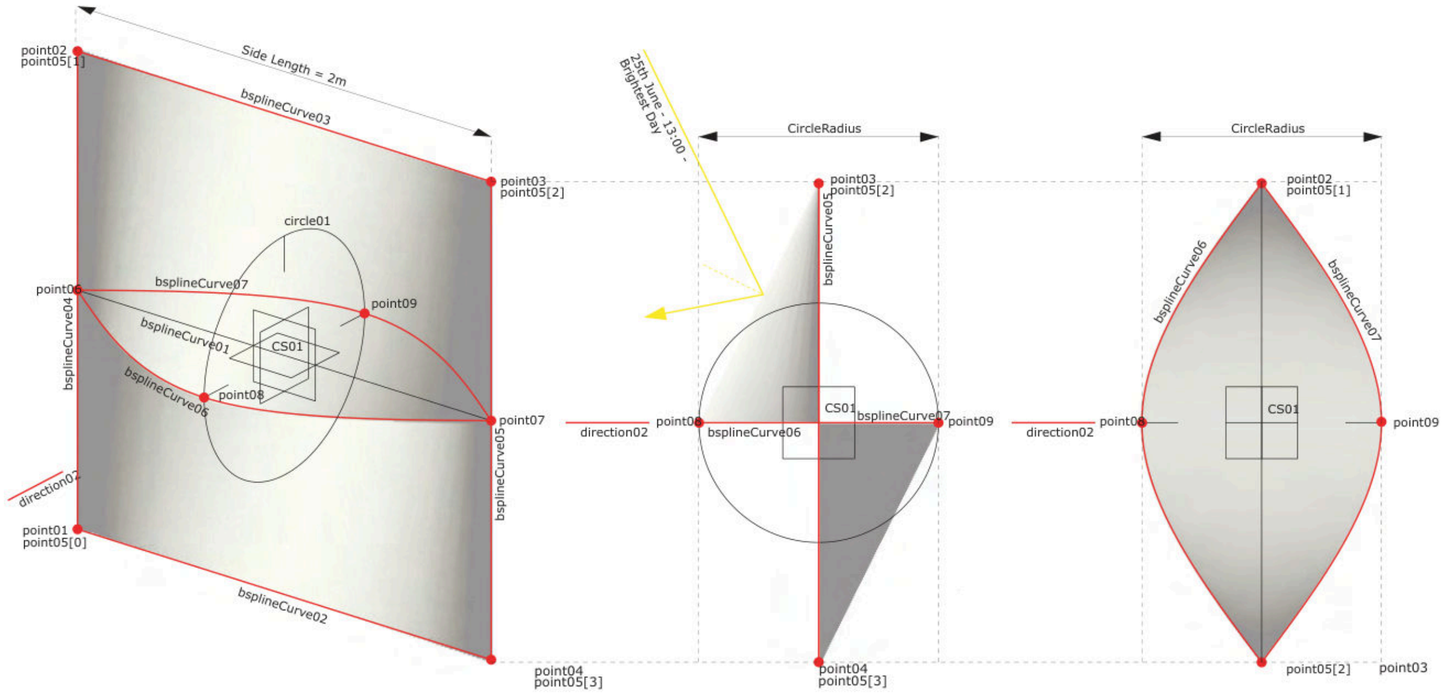


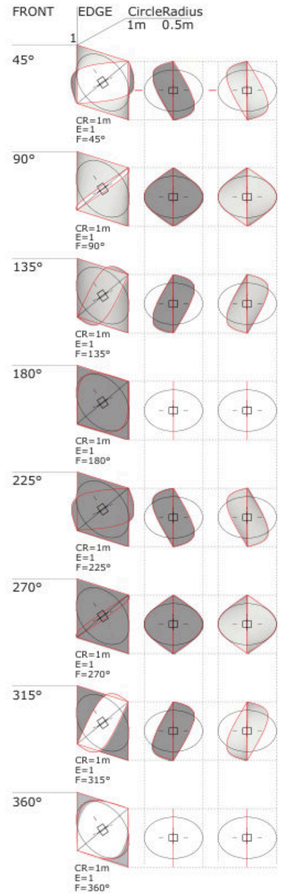
Conclusions from the Analysis:

The Northern part of the building is only threatened by rays hitting the upper surface of the structure.
No inter-reflections occur within the lower part but it does happen on the upper part. The structure should be tested with lower sun ray angles.
A Study should be done about the relationship between the floors and the structure.

Component Geometrical and Symbolic View

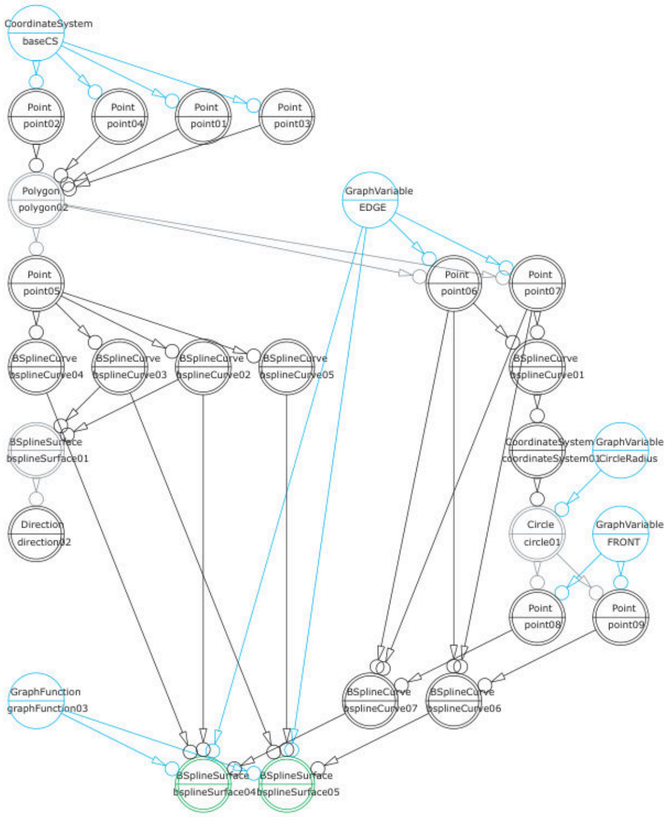
Variables:
CircleRadius (Radius of Circle01) = 0.5
EDGE (TValue of point06 and point07) = 0.875 (Neutral)
FRONT= 90°
Fixed Value:
Side Length=2m





Color Coding:

- Variables and Base C.S.
- Hidden Features
- Construction Features
- Active Features



G.C. Script

```
transaction modelBased "COMPONENT"

{

feature CircleRadius GC.GraphVariable
   {Value                = 0.5;
      LimitValueToRange  = true;
      RangeMinimum       = 0;
      RangeMaximum       = 1;
      RangeStepSize      = 0.0;}

feature EDGE GC.GraphVariable
   {Value                = 0.875;
      LimitValueToRange  = true;
      RangeMinimum       = 0.5;
      RangeMaximum       = 1;
      RangeStepSize      = 0.0;}

feature FRONT GC.GraphVariable
   {Value                = 90;
      LimitValueToRange  = true;
      RangeMaximum       = 360.0;
      RangeStepSize      = 0.0;}

feature bsplineCurve01 GC.BSplineCurve
   {Points               = {point06,point07};
      ConstructionsVisible = true;
      IsConstruction     = false;}

feature bsplineCurve02 GC.BSplineCurve
   {  Points             = {point05[0],point05[1]};
      IsConstruction     = false;}

feature bsplineCurve03 GC.BSplineCurve
   {Points               = {point05[3],point05[2]};
      IsConstruction     = false;}

feature bsplineCurve04 GC.BSplineCurve
   {  Points             = {point05[3],point05[0]};
      IsConstruction     = false;}

feature bsplineCurve05 GC.BSplineCurve
   {Points               = {point05[2],point05[1]};
      IsConstruction     = false;}

feature bsplineCurve06 GC.BSplineCurve
   {Points               = {point06,point09,point07};
      IsConstruction     = false;}

feature bsplineCurve07 GC.BSplineCurve
   {Points               = {point06,point08,point07};
      IsConstruction     = false;}

feature bsplineSurface01 GC.BSplineSurface
   {Curves               = {bsplineCurve02,bsplineCurve03};
      IsConstruction     = true;
      Visible            = false;}

feature bsplineSurface04 GC.BSplineSurface
   {Function             = graphFunction03;
      FunctionArguments =
{bsplineCurve07,bsplineCurve04,bsplineCurve02,EDGE};}

feature bsplineSurface05 GC.BSplineSurface
   {  Function           = graphFunction03;
      FunctionArguments  =
{bsplineCurve06,bsplineCurve05,bsplineCurve03,EDGE};}

feature circle01 GC.Circle
   {CenterPoint          = coordinateSystem01;
      Radius             = CircleRadius;
      Support            = coordinateSystem01.YZPlane;
      ConstructionsVisible = true;
      IsConstruction     = true;
      Visible            = false;}

feature coordinateSystem01 GC.CoordinateSystem
   {Curve                = bsplineCurve01;
      T                  = .5;
      HandlesVisible     = true;
      IsConstruction     = true;}

feature direction02 GC.Direction
   {Surface              = bsplineSurface01;
      U                  = .5;
      V                  = .5;}

feature graphFunction03 GC.GraphFunction
   {Definition =
function (BSplineCurve MidCurve, BSplineCurve VertCurve,
BSplineCurve HorCurve, double EDGE)
{BSplineSurface myLOFT;
      if (EDGE<.75)
{myLOFT = new BSplineSurface (this);
myLOFT.LoftCurves({VertCurve, MidCurve});}
else
{myLOFT = new BSplineSurface (this);
myLOFT.LoftCurves({HorCurve, MidCurve});};};}

feature point01 GC.Point
   {CoordinateSystem     = baseCS;
      XTranslation       = 1;
      YTranslation       = 0;
      ZTranslation       = <free> (0);
      HandlesVisible     = true;
      IsConstruction     = false;
      Visible            = true;}

feature point02 GC.Point
   {CoordinateSystem     = baseCS;
      XTranslation       = 3;
      YTranslation       = 0;
      ZTranslation       = <free> (0);
      IsConstruction     = false;
      Visible            = true;}

feature point03 GC.Point
   {CoordinateSystem     = baseCS;
      XTranslation       = 3;
      YTranslation       = 0;
      ZTranslation       = 2;
      IsConstruction     = false;
      Visible            = true;}

feature point04 GC.Point
   {CoordinateSystem     = baseCS;
      XTranslation       = 1;
      YTranslation       = 0;
      ZTranslation       = 2;
      IsConstruction     = false;
      Visible            = true;}

feature point05 GC.Point
   {Curve                = polygon02;
      T                  = Series(0,1,.25);
      SymbolXY           = {100, 104};
      HandlesVisible     = true;
      IsConstruction     = false;}

feature point06 GC.Point
   {Curve                = polygon02;
      T                  = EDGE;
      HandlesVisible     = true;
      IsConstruction     = true;}

feature point07 GC.Point
   {Curve                = polygon02;
      T                  = EDGE- .5;
      HandlesVisible     = true;
      IsConstruction     = true;}

feature point08 GC.Point
   {Curve                = circle01;
      T                  = FRONT*(0.5/180);
      HandlesVisible     = true;
      IsConstruction     = true;}

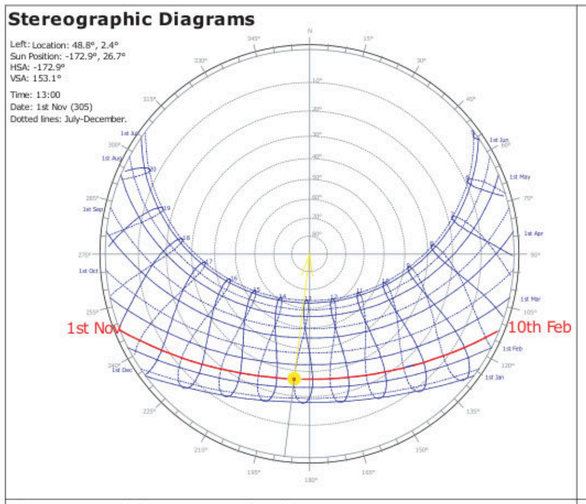
feature point09 GC.Point
   {Curve                = circle01;
      T                  = (FRONT*(0.5/180))+0.5;
      IsConstruction     = true;}

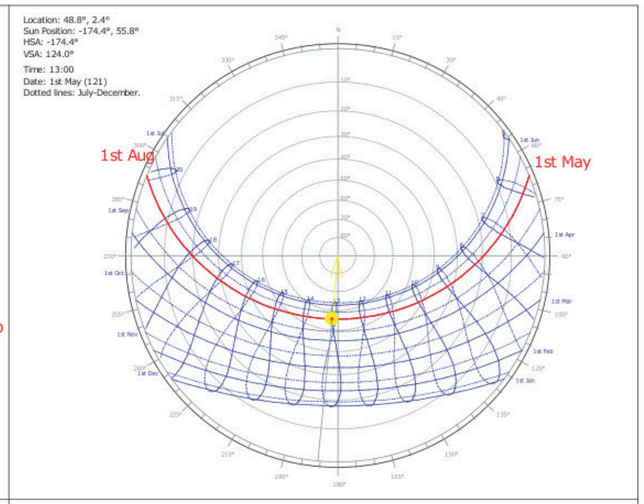
feature polygon02 GC.Polygon
   {Vertices             =
{point04,point03,point02,point01};
      IsConstruction     = false;
      Visible            = false;}

}
```

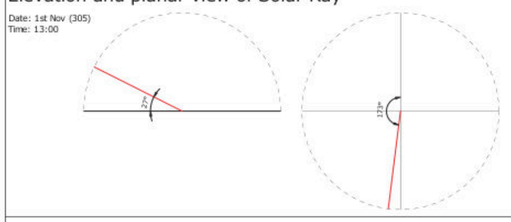
SEE MONTHLY DIURNAL AVERAGES - PARIS to understand the study that follows -
1st November is the beginning of the first month which average temperatures are always below the comfort zone. The angle of the solar rays that corresponds to November 1st daily solar path is the same than the one for February 10th. One would want an constant angle from the 1st November to the 1st May. One has to decide which months of the year could be qualified as overly warm.
To do so, one should look at several sun path angles within those months and compare them to extract different scenarios to the most extreme protection (no sun during hot months) to the most permissive solution (let the sun from October and April)

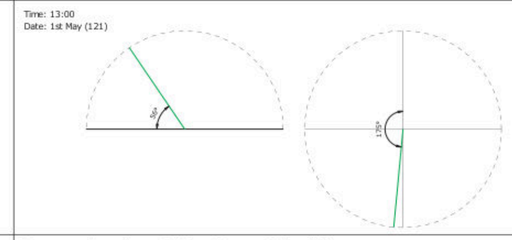
Stereographic Diagrams

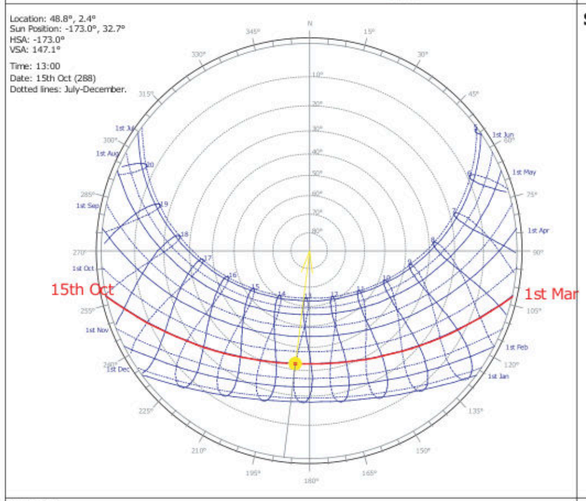


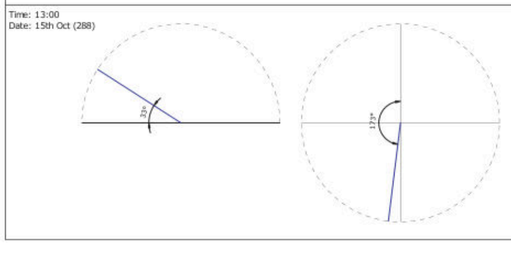


Elevation and planar view of Solar Ray



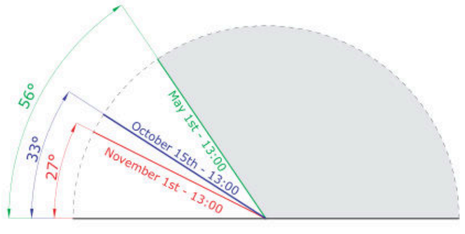




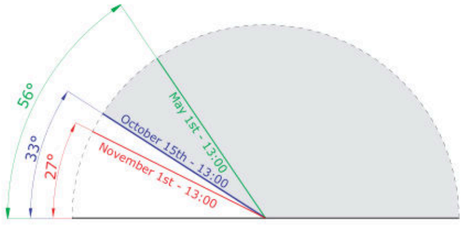


Scenarios for Solar Rays Blocking

1. "Warmer" Scemario - Blocking beyond May 1st



2. "Colder" Scenario - Blocking beyond October 15th



Solar Path Diagram for Transitional Monthes

"Warmer" Scenario 1st May

Location: 48.8°, 2.4° (15°) PARIS
Date/Day: 1/5 (Day 121 of 365).
Equation: 2.951 minutes
Declination: 14.743°
Sunrise: 05:37
Sunset: 19:57

	LOCAL	SOLAR	AZI	ALT
1.	06:00	05:12	71.47	3.47
2.	06:30	05:42	76.98	8.22
3.	07:00	06:12	82.46	13.08
4.	07:30	06:42	87.99	18
5.	08:00	07:12	93.67	22.94
6.	08:30	07:42	99.58	27.85
7.	09:00	08:12	105.87	32.66
8.	09:30	08:42	112.65	37.33
9.	10:00	09:12	120.11	41.75
10.	10:30	09:42	128.43	45.83
11.	11:00	10:12	137.78	49.44
12.	11:30	10:42	148.29	52.42
13.	12:00	11:12	159.94	54.58
14.	12:30	11:42	172.49	55.75
15.	13:00	12:12	174.1	55.85
16.	13:30	12:42	161.94	54.84
17.	14:00	13:12	150.11	52.83
18.	14:30	13:42	139.41	49.98
19.	15:00	14:12	129.88	46.46
20.	15:30	14:42	121.41	42.44
21.	16:00	15:12	113.82	38.07
22.	16:30	15:42	106.93	33.44
23.	17:00	16:12	100.58	28.64
24.	17:30	16:42	94.61	23.75
25.	18:00	17:12	88.91	18.81
26.	18:30	17:42	83.36	13.88
27.	19:00	18:12	77.88	9.01
28.	19:30	18:42	72.38	4.24

"Colder" Scenario 15th October

Location: 48.8°, 2.4° (15Â°).
Date/Day: 15/10 (Day 288 of 365).
Equation: 14.259 minutes
Declination: -8.269°
Sunrise: 07:14
Sunset: 17:57

	LOCAL	SOLAR	AZI	ALT
1.	07:30	06:53	105.57	2.5
2.	08:00	07:23	111.35	7.18
3.	08:30	07:53	117.33	11.68
4.	09:00	08:23	123.59	15.94
5.	09:30	08:53	130.2	19.89
6.	10:00	09:23	137.2	23.46
7.	10:30	09:53	144.64	26.57
8.	11:00	10:23	152.51	29.15
9.	11:30	10:53	160.79	31.11
10.	12:00	11:23	169.4	32.38
11.	12:30	11:53	178.19	32.91
12.	13:00	12:23	172.98	32.69
13.	13:30	12:53	164.28	31.72
14.	14:00	13:23	155.86	30.03
15.	14:30	13:53	147.81	27.7
16.	15:00	14:23	140.19	24.79
17.	15:30	14:53	133.02	21.4
18.	16:00	15:23	126.25	17.6
19.	16:30	15:53	119.86	13.46
20.	17:00	16:23	113.77	9.05
21.	17:30	16:53	107.91	4.43

Solar Path Diagram for Extreme Temperatures

Data for the Hottest Day - 12th July

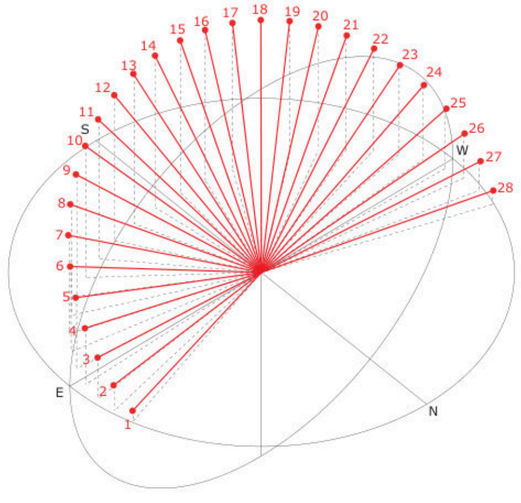
Location: 48.8°, 2.4° (15°).
Date/Day: 12/7 (Day 193 of 365).
Equation: -5.47 minutes
Declination: 22.123°
Sunrise: 05:05
Sunset: 20:46

LOCAL	SOLAR	AZI	ALT
05:30	04:34	59.73	3.44
06:00	05:04	65.15	7.82
06:30	05:34	70.47	12.39
07:00	06:04	75.73	17.12
07:30	06:34	81.03	21.96
08:00	07:04	86.43	26.86
08:30	07:34	92.04	31.8
09:00	08:04	97.98	36.72
09:30	08:34	104.41	41.57
10:00	09:04	111.52	46.26
10:30	09:34	119.58	50.72
11:00	10:04	128.88	54.81
11:30	10:34	139.76	58.34
12:00	11:04	152.44	61.11
12:30	11:34	166.79	62.83
13:00	12:04	177.87	63.31
13:30	12:34	162.7	62.47
14:00	13:04	148.76	60.44
14:30	13:34	136.59	57.44
15:00	14:04	126.17	53.73
15:30	14:34	117.25	49.52
16:00	15:04	109.48	44.99
16:30	15:34	102.58	40.24
17:00	16:04	96.3	35.37
17:30	16:34	90.47	30.44
18:00	17:04	84.93	25.51
18:30	17:34	79.56	20.62
19:00	18:04	74.28	15.8
19:30	18:34	69.01	11.12
20:00	19:04	63.67	6.59
20:30	19:34	58.21	2.28

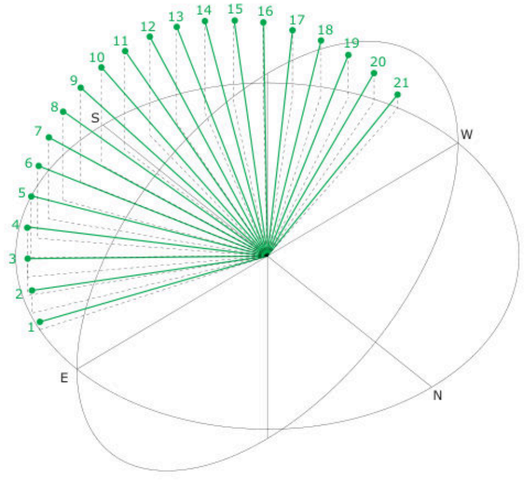
Data for the Coldest Day - 21st January

Location: 48.8Â°, 2.4Â° (15Â°).
Date/Day: 21/1 (Day 21 of 365).
Equation: -11.181 minutes
Declination: -20.268Â°
Sunrise: 08:41
Sunset: 17:21

LOCAL	SOLAR	AZI	ALT
09:00	07:58	125.27	2.56
09:30	08:28	131.16	6.44
10:00	08:58	137.3	9.98
10:30	09:28	143.73	13.12
11:00	09:58	150.44	15.8
11:30	10:28	157.44	17.97
12:00	10:58	164.67	19.58
12:30	11:28	172.09	20.57
13:00	11:58	179.6	20.93
13:30	12:28	172.88	20.64
14:00	12:58	165.45	19.71
14:30	13:28	158.19	18.17
15:00	13:58	151.17	16.06
15:30	14:28	144.42	13.42
16:00	14:58	137.97	10.33
16:30	15:28	131.79	6.83



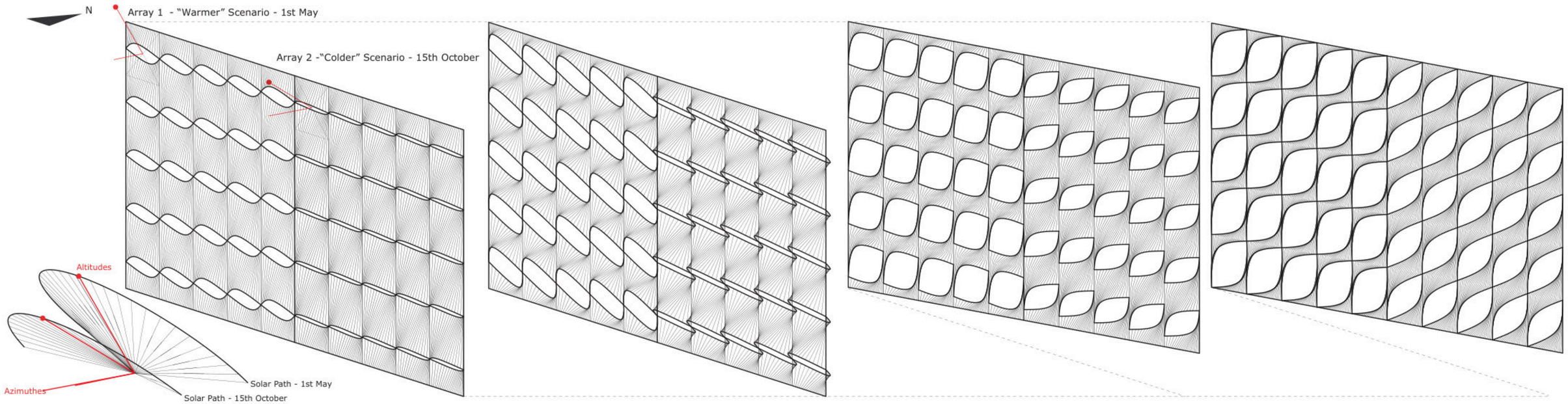
1. "Warmer" Scenario 1st May -
Solar Path Diagram - Perspective



2. "Colder" Scenario 15th October -
Solar Path Diagram - Perspective

Constraining components to an external agent

The solar rays are all parallel therefore a simple array of sun-shading components would not need to have differences.
We shall look at more intricate cases in which the base surface is curved. This requires the intelligence of computation.

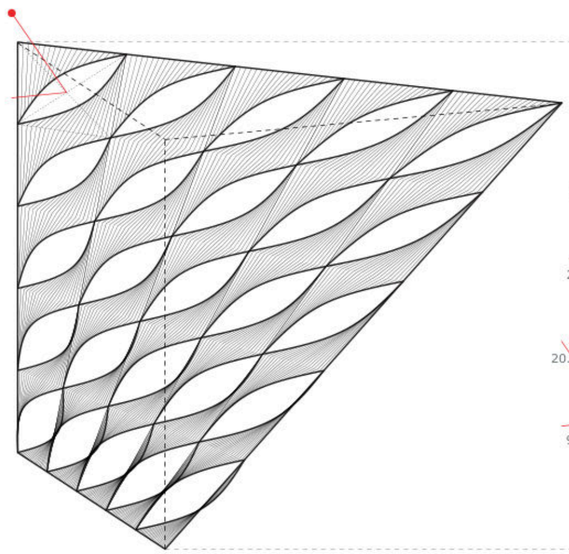


Array 1 and 2
CircleRadius= 0.5 m
EDGE=0.875 (neutral)
FRONT= May (55.95)
TIMEDEC (Time of the Day)=0.5 (12:45)

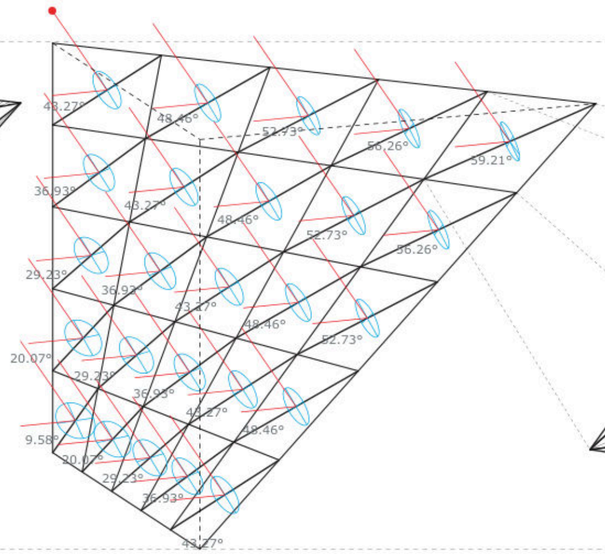
Array 1 and 2
CircleRadius= 1 m
Changing CircleRadius which is the variable representing the length of the opening has no implication on the angle of aperture.

Array 1 and 2
CircleRadius= 0.5 m
EDGE=0.95
There is no continuity between the threads composing the components

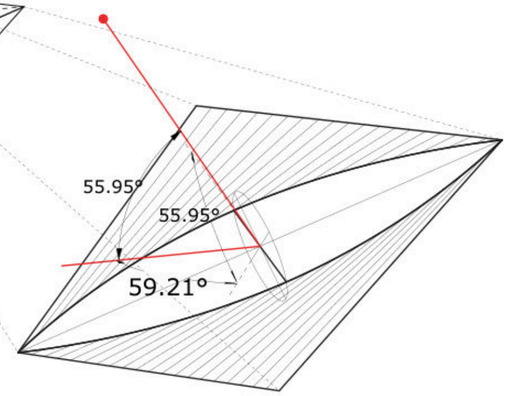
Array 1 and 2
CircleRadius= 0.5 m
EDGE=1
A precise relationship has to be found between the EDGE variable and the azimuth+global form position



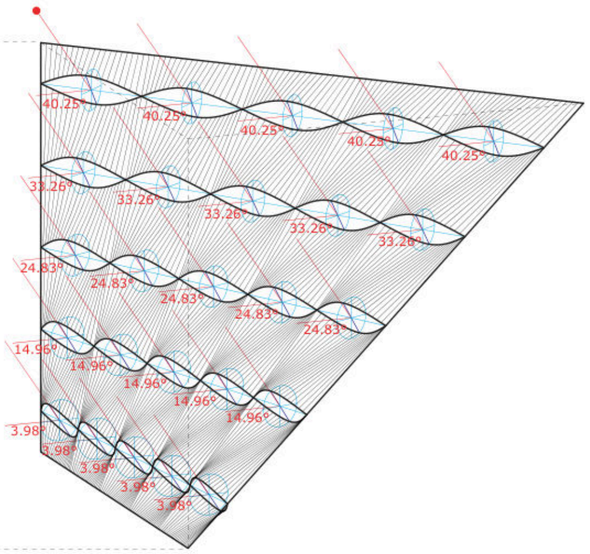
Array 1
CircleRadius= 1 m
EDGE=1 (45Deg)
FRONT= May (55.95)
TIMEDEC (Time of the Day)=0.5 (12:45)



Array 1
Construction Lines showing the difference between the angles (see zoomed axo)



Zoomed Axonometry
The only angle varying is the one located at the center of the polygon's diagonal line, which sides are the sun's azimuth and the the normal to the polygon at the center of its diagonal.

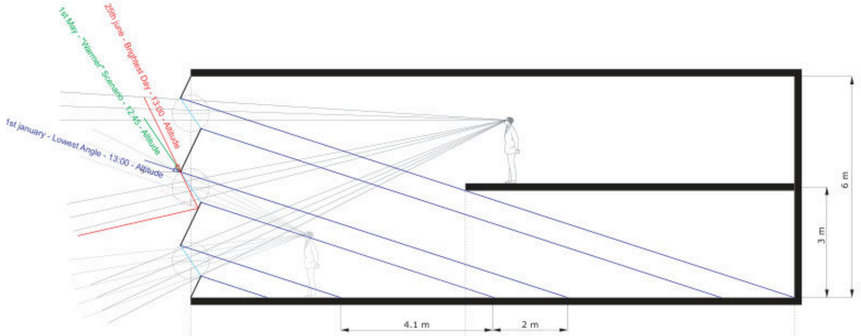


Array 1
CircleRadius= 1 m
EDGE=0.875 (Neutral)
FRONT= May (55.95)
TIMEDEC (Time of the Day)=0.5 (12:45)

Setup:
The Components are being assembled into clusters of three by three, forming a facade of 6m by 6m.
This cluster forms the opened area of a box which depth relates to the component's impact on the sun ray angles.

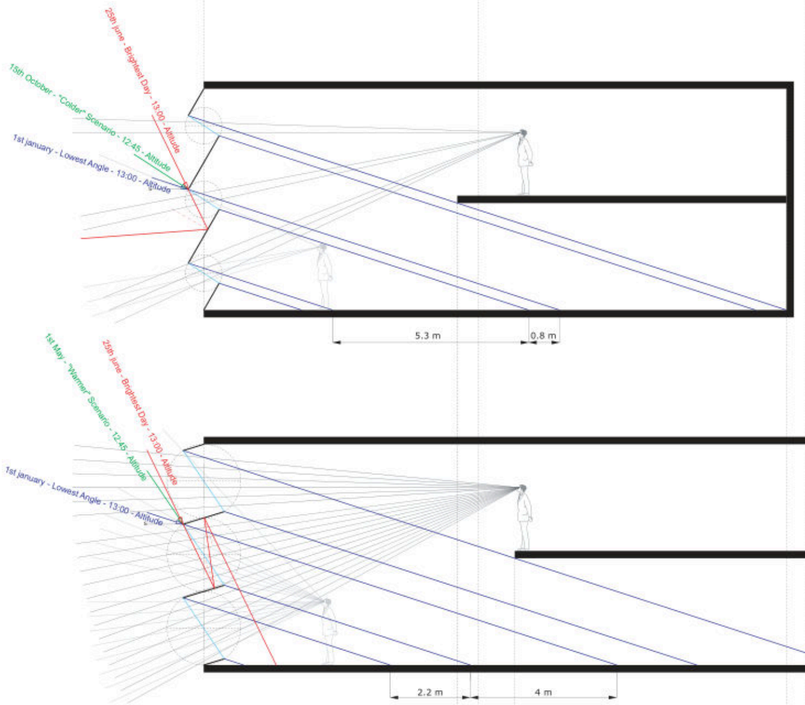
Section 1.

Circle Radius = 0.5 m
FRONT = 56°
EDGE = 0.875



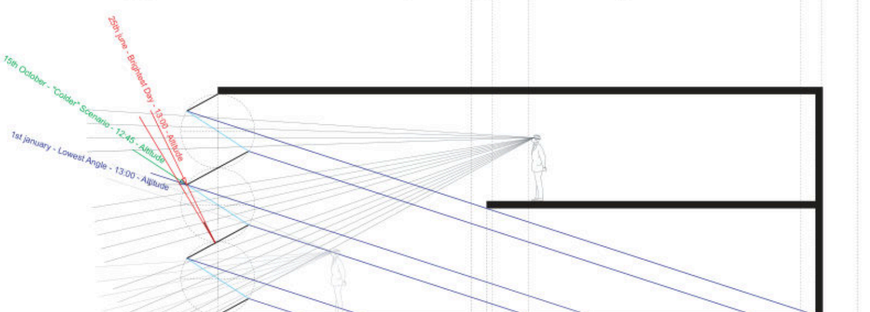
Section 2.

Circle Radius = 0.5 m
FRONT = 33°
EDGE = 0.875



Section 3.

Circle Radius = 1 m
FRONT = 56°
EDGE = 0.875



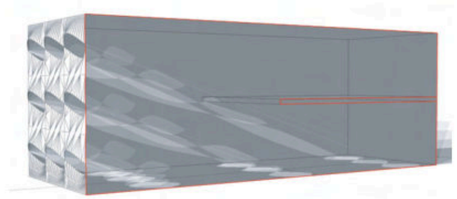
Section 4.

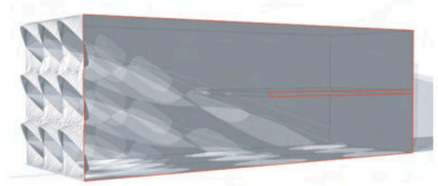
Circle Radius = 1 m
FRONT = 33°
EDGE = 0.875

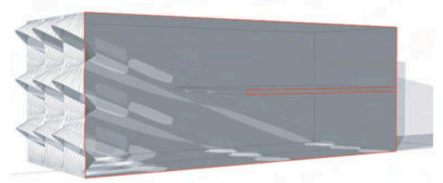
Sections - Depth of spaces and Mezzanines
It depends on the point reached on the floor by the 1st January Solar Ray.
The Lengths of Mezzanines are always similar what changes is the depth of the spaces:
Going from 15.8 m where the FRONT angle and the CircleRadius parameters are the lowest to 17.4 m when those two parameters are the greatest.

Section 1. Total Length : 16.4 m
Section 1. Mezzanine : 8.9 m
Section 2. Total Length : 15.8 m
Section 2. Mezzanine : 8.9 cm
Section 3. Total Length : 17.4 m
Section 3. Mezzanine : 8.9 cm
Section 4. Total Length : 16.2 m
Section 4. Mezzanine : 8.9 cm

1st January - Overlay of Shadows from 9:00 till 13:00

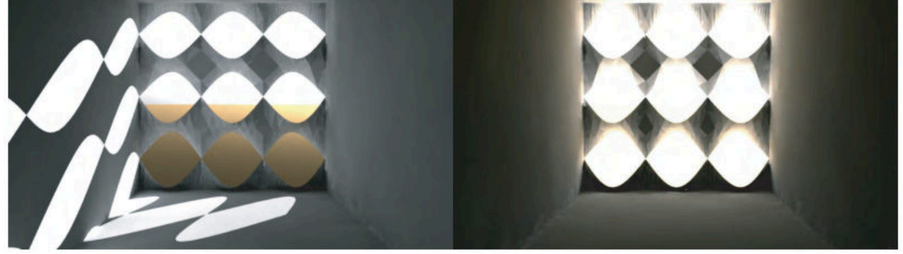


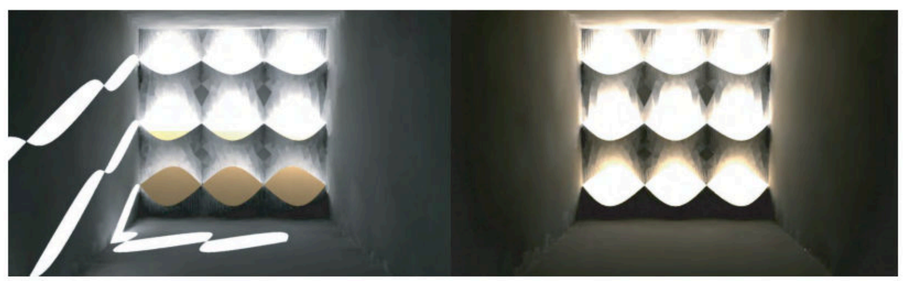




Radiance rendering for 1st January - 13:00
Day with the lowest sun Angle







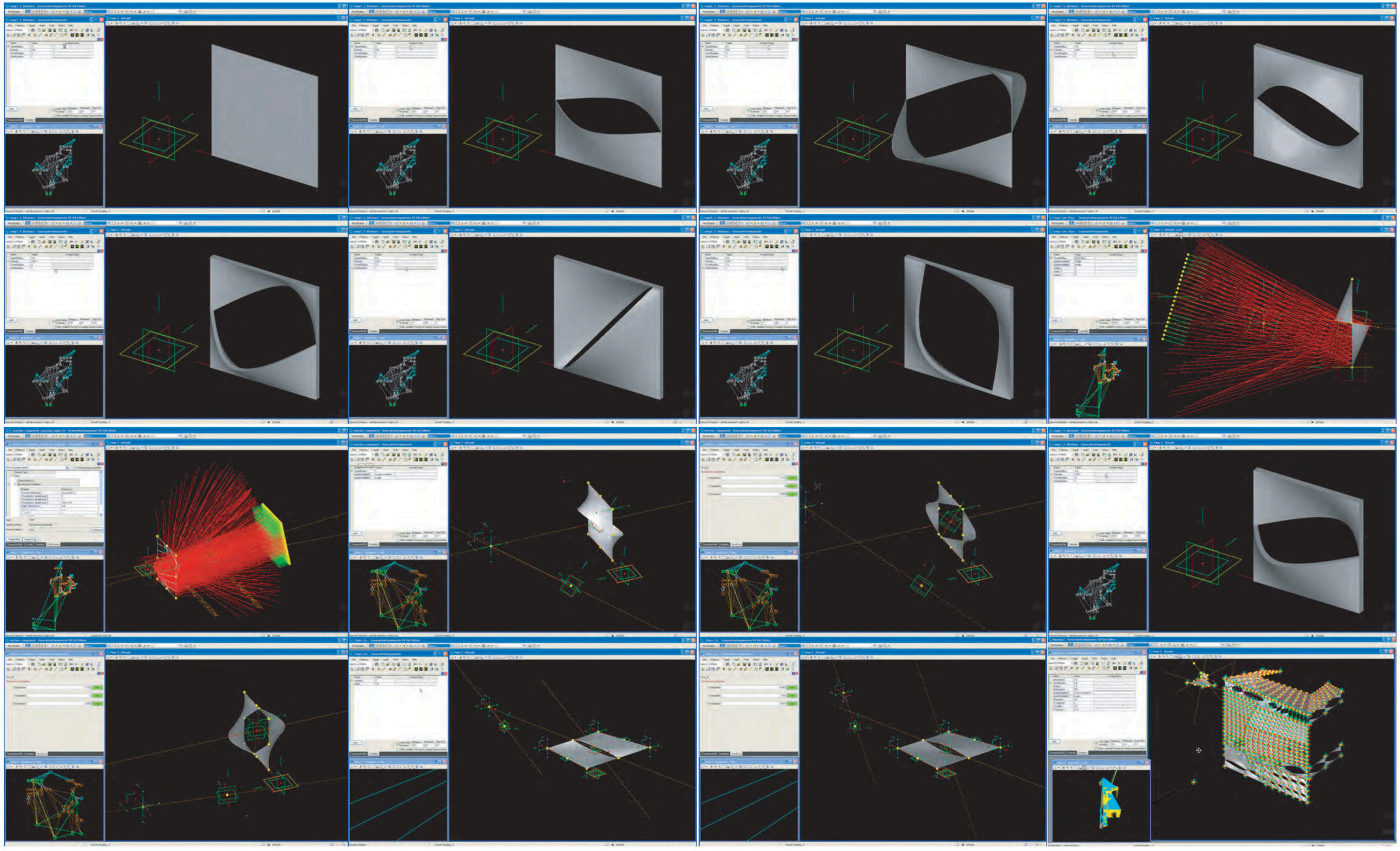
Radiance rendering for 25th June - 13:00
Brightest Day

Conclusions:

Success:
-The back wall is never exposed to direct solar rays while remaining as close to it as possible.
-No Direct Solar rays enter during the whole day between the period that the specific constrained components has been set to.
-When CircleRadius increases it allows more diffuse lightning inside and increases the area of transparency.

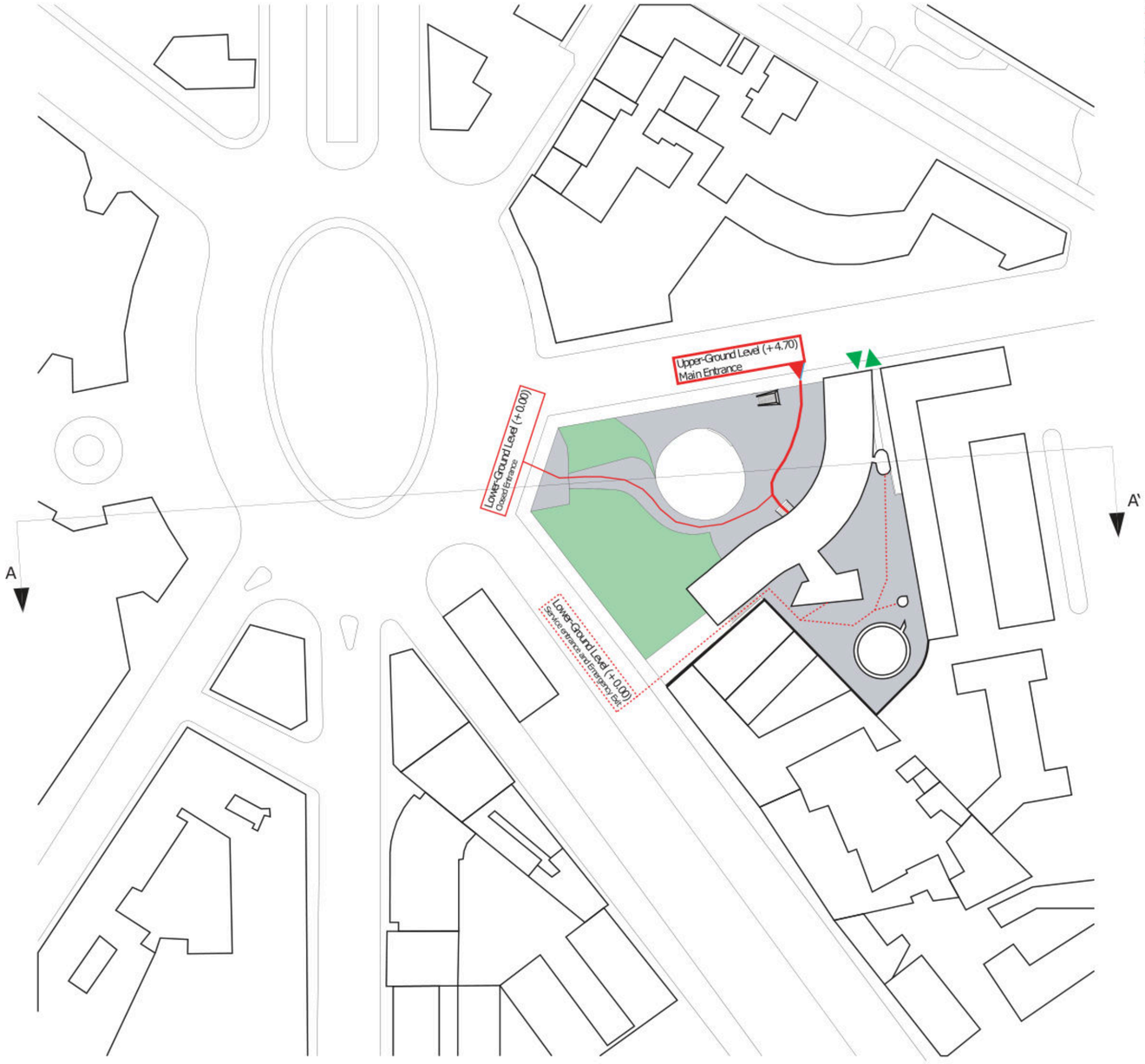
Failure:
Not enough light enters within the room. This should be quantitatively tested with Lux and Program.

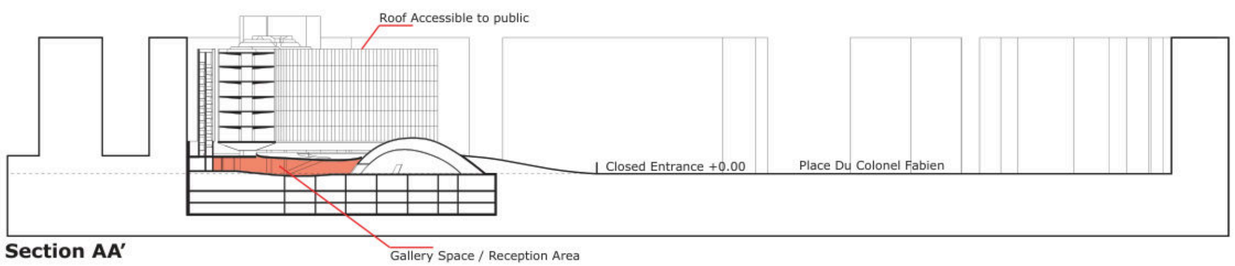
Below is a sequence showing live changes of the sun-shading component in G.C.
A script was written in C+ to calculate bouncing solar rays with the help of Ying Chen from Buro Happold.



Right : Analysis of the different circulation types and paths available throughout the building and from the street.

Below : Plan and Section through the site

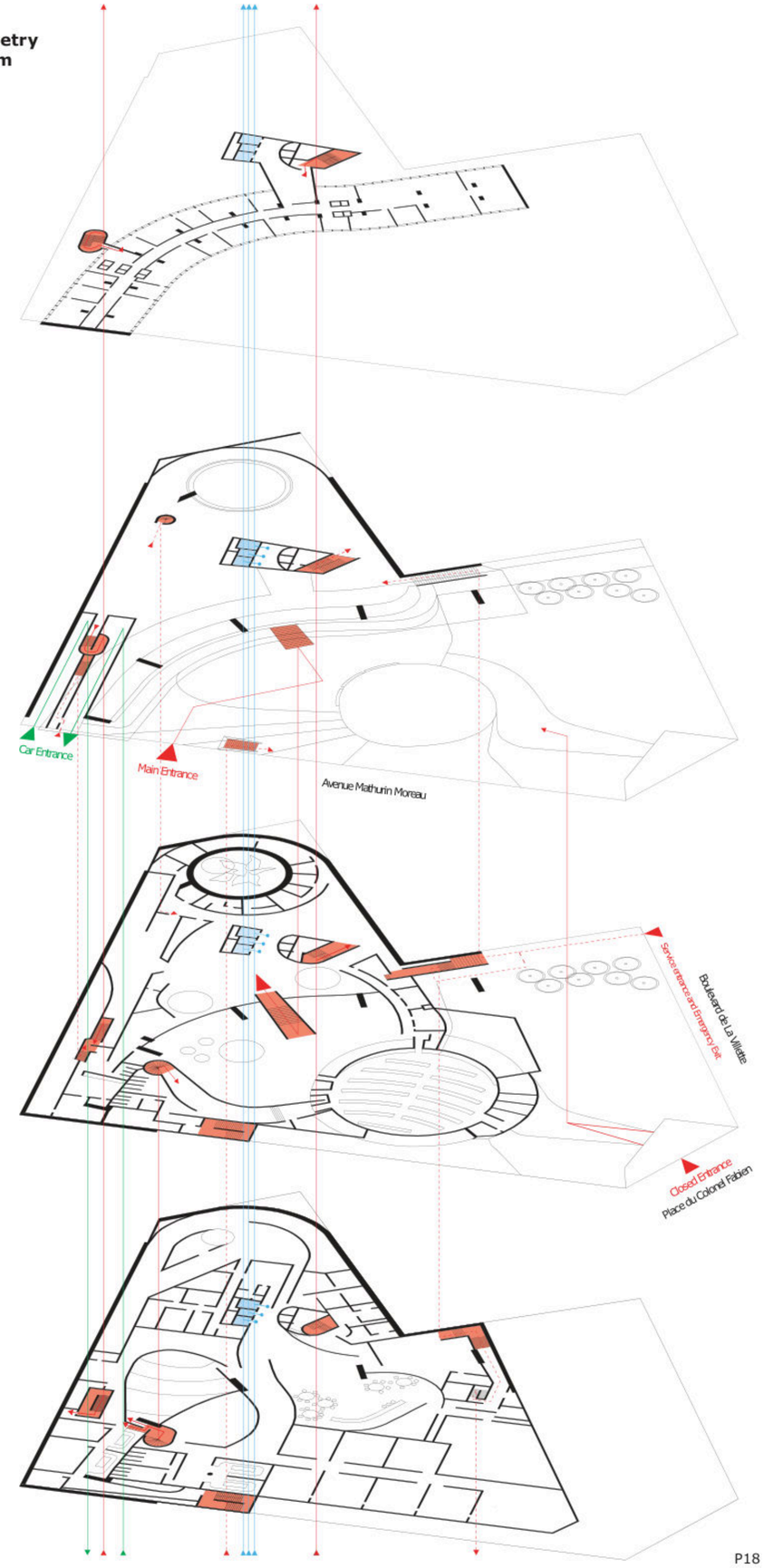




Section AA'

Exploded Plan Axonometry and Circulation Diagram Legend

- Staircases
- Emergency Staircases
- Lifts
- Car access



1. Separated Artificial Grounds

Separating the building from the ground using pilotis was a paradigm of modernist Architecture. Yet Niemeyer builds his building as extension of the ground, what is then elevated is often used as a roof to connect buildings between them. This unusual type is called "Marquise".

1.1. Elevated floors_Marquise

1.1.1. Arcade
1.1.2. Unaccessible Marquise_Roof
1.1.3. Walkable Marquise(s)_Roof

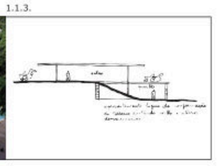
1.1.1.



1.1.2.



1.1.3.



1.1.2.







1.1.3.

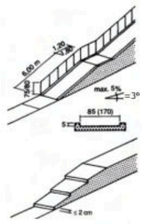


1.2 Elevated Solids



2. Ramps, Staircases and Stramps

Ramps are not classified within the elevated ground category since they touch the ground on both ends thus being in between the artificial elevated ground and the artificial ground



2.1. Linking Building to the City







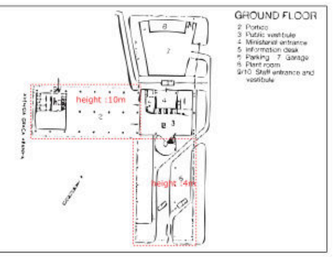
2.2. Linking Two Parts of a City







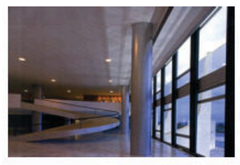




1936 - 1943 : Ministry of Education and health, Rio de Janeiro

2.3. Linking parts of the building within it









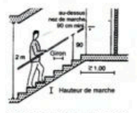












③ Pente normale favorable 17/29 ; longueur de pas : 2 hauteurs de marche + 1 giron = 62,5 cm env.

2.5. Links parts of the building outside it

2.5.1. Covered
2.5.2. Un-covered

2.5.1. Covered





2.5.2. Un-covered





2.4. Stramps and Staircases

2.4.1. Open
2.4.2. Enclosed within a volume
2.4.3. Linked to the city
2.4.4. Linking two parts of a building within it
2.4.5. Linking two parts of a building outside it
2.4.6. Linking two parts of a city

2.4.12.4.4.





2.4.3.2.4.2.

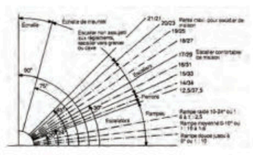


3. Grounds

Grounds whether artificial or natural, could be defined as surfaces connected in their entirety to the earth (Local groundl level)

3.1. Artificial Sloping Grounds

3.1.1. Appropriate for Walking
3.1.1.1. Within the City
3.1.1.2. Within the building
3.1.1.3. Linked to the City
3.1.1.4. Inhabitable Bifurcation
3.1.1.5. Entirely Paved
3.1.1.6. Partly Paved
Partly"Natural"
3.1.1.7. Entirely "Natural"
3.1.1.7. Stramps and Staircases



3.1.1.33.1.1.5.



1950 - 1970 : Cathedrale, Brazilia, Brazil

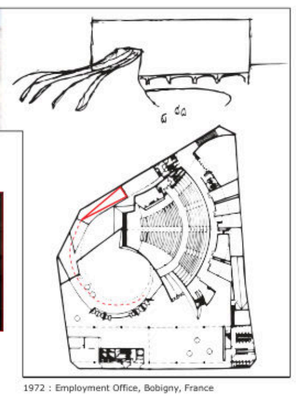
3.1.1.2.



1953 : Bienal Fundation, Sao Paolo, Brazil

3.1.1.33.1.1.43.1.1.5.





1972 : Employment Office, Bobigny, France

1998-2002 : Greather Authority London (London City Hall) by Norman Foster

3.1.1.6.3.1.1.3.

1986-1995 : Museu Brasileiro de Escultura by Paulo Mendes da Rocha

3.1.1.2.

3.1.1.23.1.1.7.

3.1.1.33.1.1.4.

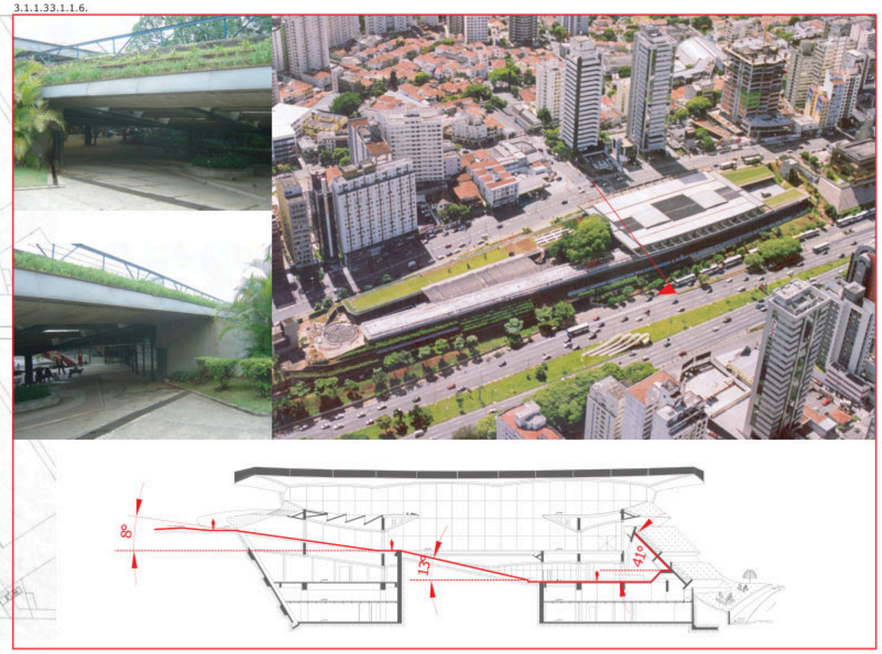
1953 : Temporary Pavilion for the fourth bicentenary exhibition, Sao Paulo, Brazil

3.1.1.5. 3.1.1.3. 3.1.1.2.



1952 : Edificio Copan, Sao Paolo

3.1.1.33.1.1.6.



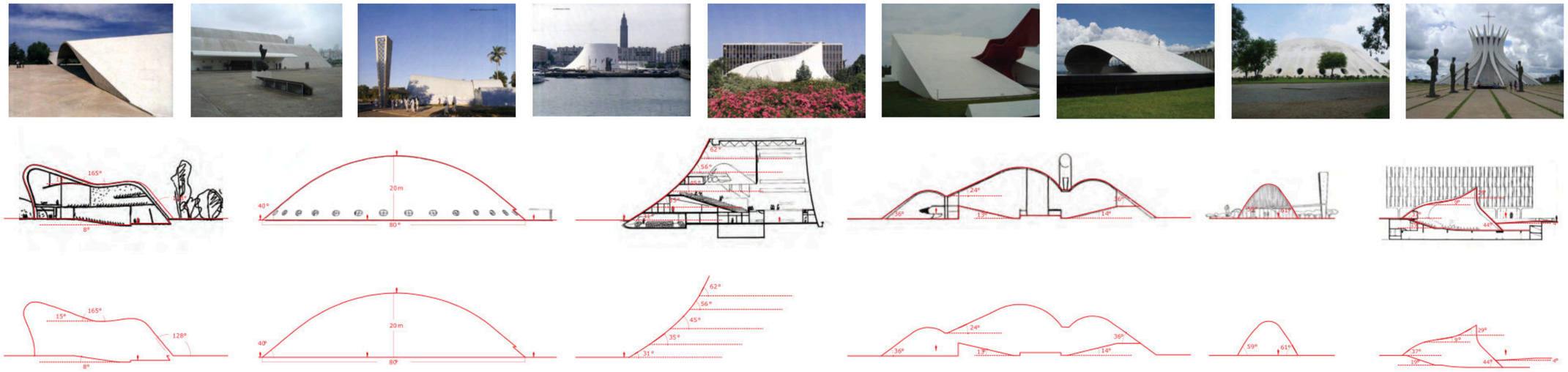
3.1.2. Appropriate for seating_laying down



4.1.3. For Cars



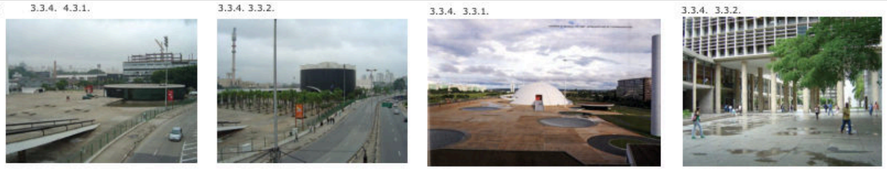
3.2. Artificial Unaccessible Grounds



3.3. Natural and Artificial Flat Grounds

- 3.3.1. Fully Paved
- 3.3.2. Partly Paved, Partly Natural
- 3.3.3. Fully Natural
- 3.3.4. Link to the City

3.3.4. 4.3.1. 3.3.4. 3.3.2. 3.3.4. 3.3.1. 3.3.4. 3.3.2.



5. Limits/Barriers/Guides

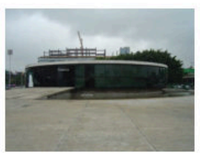
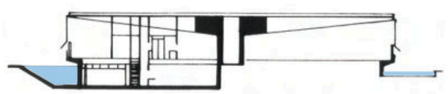
Barriers are a big issue for any so-called "public" Architectural project. Since the notion of "Ground" in Architecture goes hand in hand with the one of "Democratic Space", barriers could be seen as the enemy of democracy. Barriers not only block the access to a space but also force to take a specific path or entrance. If steel barriers or walls are often ugly and aggressive, water or highly angled slopes can diminish their harshness. They can also help to guide people to specific view points.

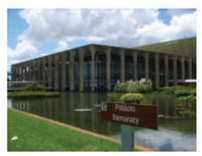
5.1. Steel Fences





5.2. Water









5.3. Elevated Floors




5.4. Vegetation

Vegetation, in the case of the PCF, not only prevents from people accessing special areas but it also hides unwanted features such as air conditioning vents.

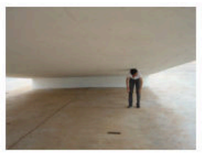


5.5. Steep Slope (see 4.2)



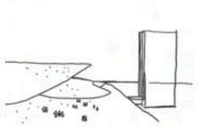


5.6. Height limitations


5.6. Temporary Barriers due to unexpected events or changes.

From the initial ambition of having a barrier free building, Niemeyer disregarded some basic principles such as balustrades.






5.7. Fragile or Subtle Barriers





6. Articulating Accessibility

Working with the ground requires a reflexion on structural / porosity / interconnectivity / light reflection issues.

Architect is not Oscar Niemeyer

6.1 Structure

Elements of accessibility imply very specific structures. In most cases, an external element supports the weight of the ramps. A specific case that has not been encountered is when the ramp would itself be structural.











6.2 Inter-connections

Connections between two Architectural elements related to accessibility either imply structure, light, porosity or accessibility itself.





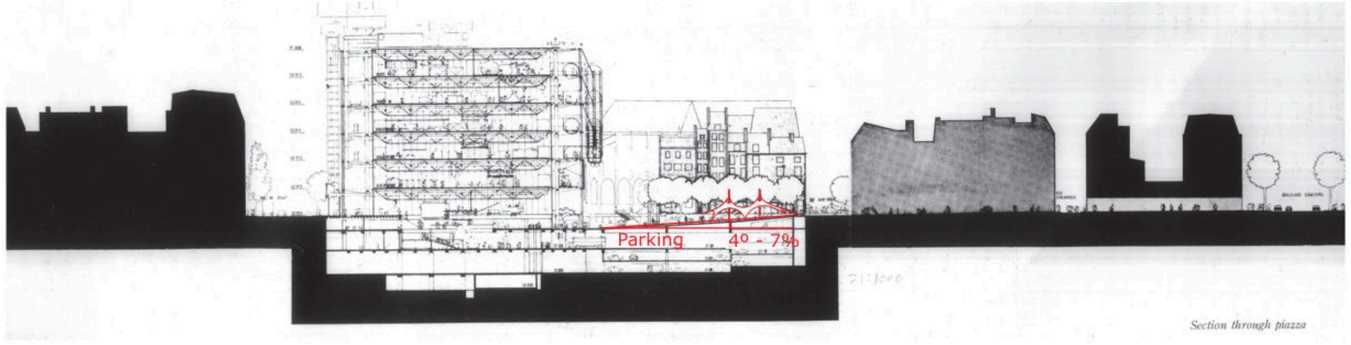

6.3. Security

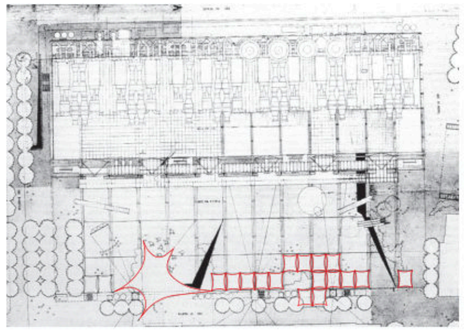
Accessibility in Architecture is a domain that is constrained by legal issues: Handicapped people, firemen, security. All this has often not been taken in consideration by Oscar Niemeyer thus leading to a negative transformation of the initial concept.

6.4. Porosity

Smooth and continuous surfaces used for accessibility are often associated with dark spaces. Oscar Niemeyer used several modular methods to provide natural light within the building.







History

Ordered by French president George Pompidou, the centre that carried his name to posterity was built in place of a large open-air Parking lot in the middle of the Latin Quarter in Paris. The jury of the international competition was chaired by Jean Prouvé and had amongst its member **Oscar Niemeyer** who was by then in exile from Brazil's dictatorship. Niemeyer did not like at first the winning proposal of Renzo Piano and Richard Rogers because of its brutality but was convinced later on by Prouvé.

The main point of the proposal was a gigantic inclined plaza occupying half of the site and that would be the location of multiple barrier-less events. Two years before that, the student rioted against the government during the event of Mai 68. The winners, themselves were both in their thirties.

Scale

The plaza was designed to be as wide and long as the museum itself in order to accommodate popular events or happenings outside the enclosed boundaries of the galleries. The scale of this plaza creates an area that one cannot ignore, the slope itself pushes the passer-bys to become viewers.

Texture

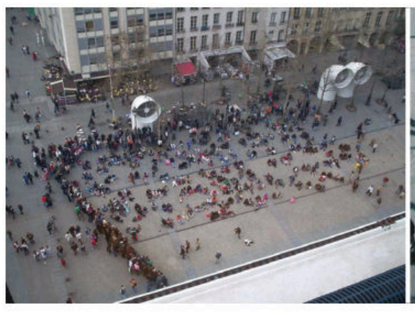
The plaza is subdivided into tiles of 8 meters by 13 meters and is distributed by large boat-like parking exhaust, all those features increase the perception of scale. The few greenery of this plaza is bound to the edge and is used to separate the linear and the more meandering flows.

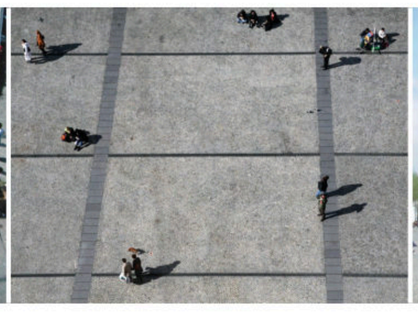
Usage

The plaza covers and hides a gigantic parking lot. The only indications of this are extravagant exhaust vents. On the gentle slope forming the plaza, the architects (Renzo Piano and Richard Rogers) planned tent-like structures to accommodate events or simply to protect from rain. This architecture probably became unnecessary and too fragile to stay.

Should such a democratic ground have more architectural elements or is its flatness enough?

Is its neutrality the reason of its success?



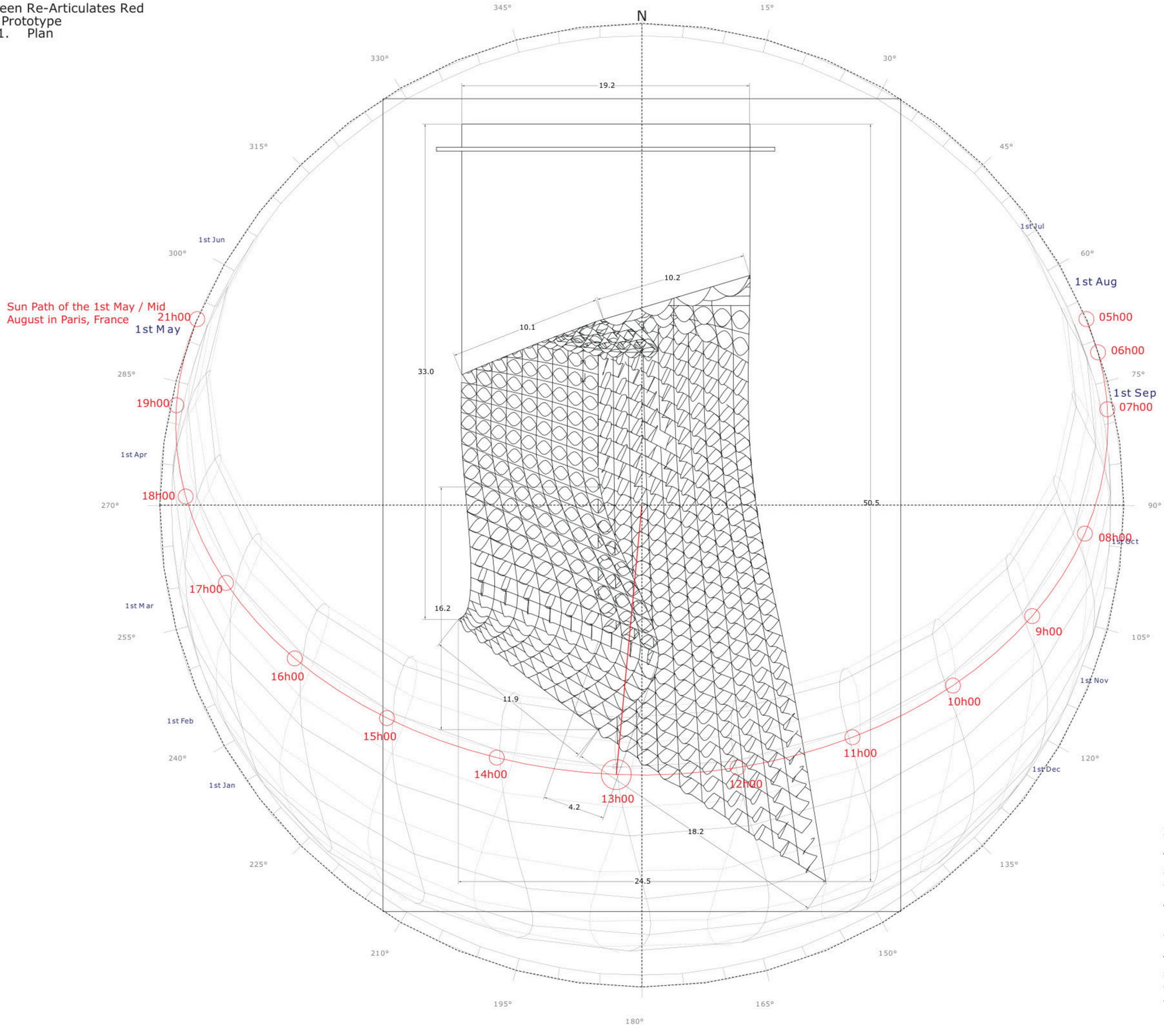






A Feeling of Democracy - A Political Space

The scale, dimension and neutrality of the plaza highlight the events and organization of people enabling both large scale formations as well as intimate activities. In either case, the plaza awakes a sense of democracy and publicness to the person that pass by it. It makes one feel that he is part of something greater than himself. It is therefore a very strong political ground as the Roman forum use to be.



Initial Prototype

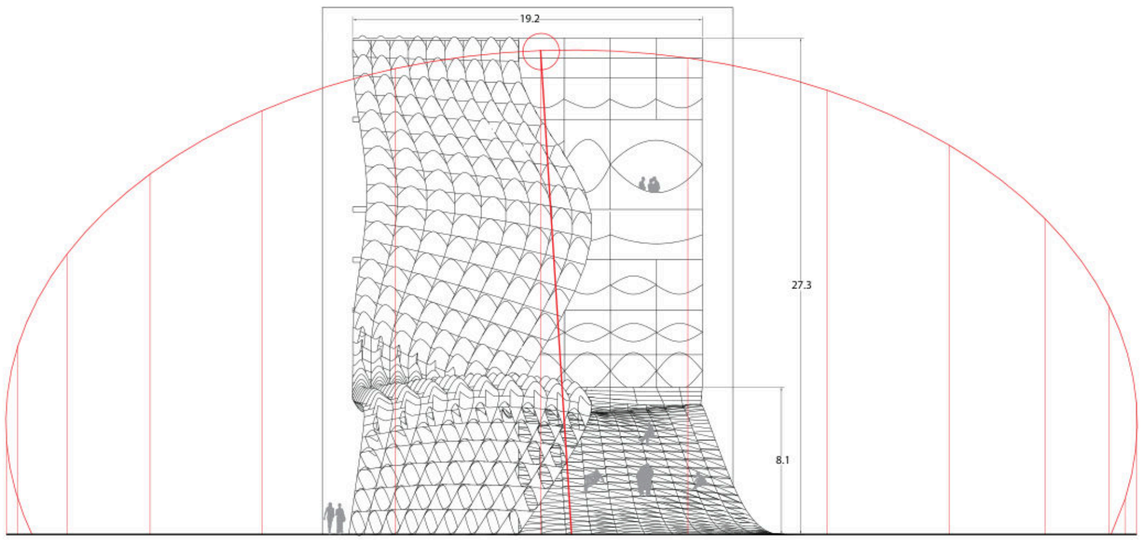
The plan shows the relationship between the component and the surface it stands on. It responds to two factors:
The Sun and its location (angle of the polygon it stands on).

This plan also shows the two surfaces dedicated to two different functions : **Stairs and Sun Protection.**

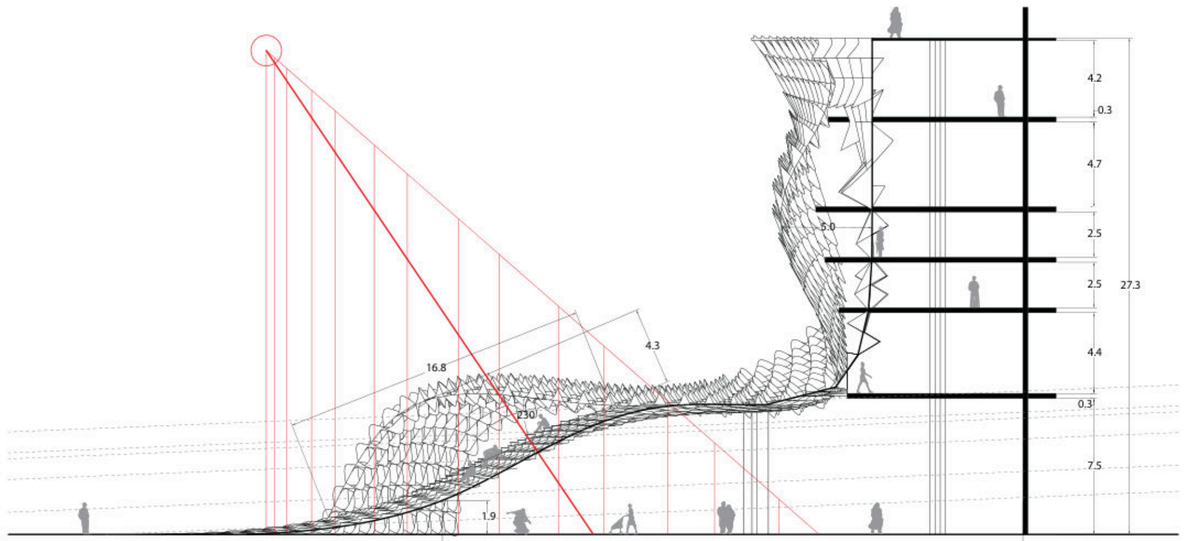
The Design follows two main rules :

-One component and the surface it seats on responds to the sun ray of the 1st May/1st September.
-One component and the surface it seats on is fully accessible for people to walk on.

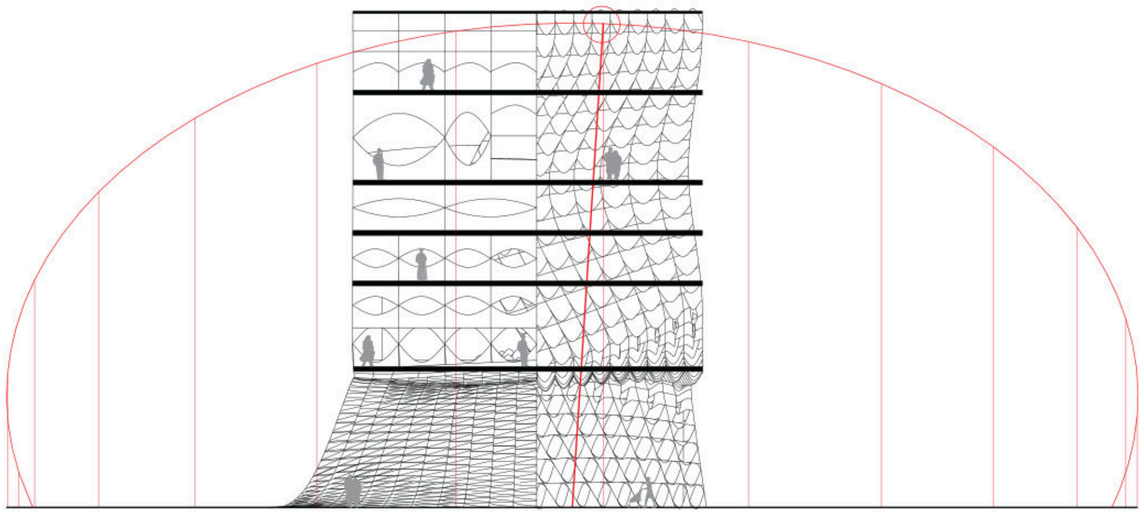
The global shape is composed of blown-up versions of a small component :
Lofting two curves defines ruled surfaces that are on one side curved and on the other straight.
The components sit on a grid defined by the isocurves of those surfaces.



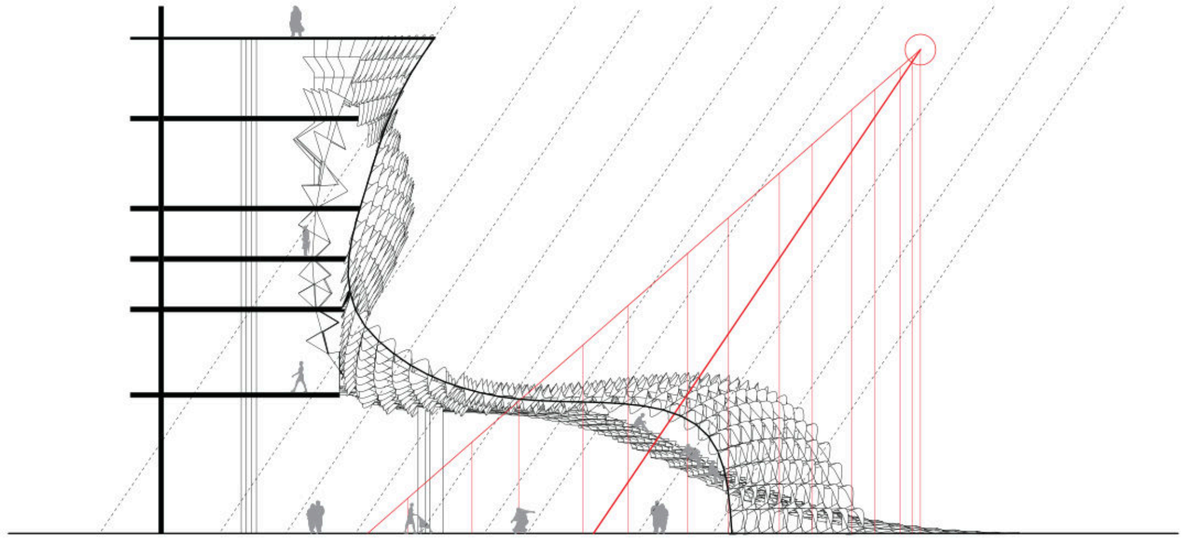
Front Elevation



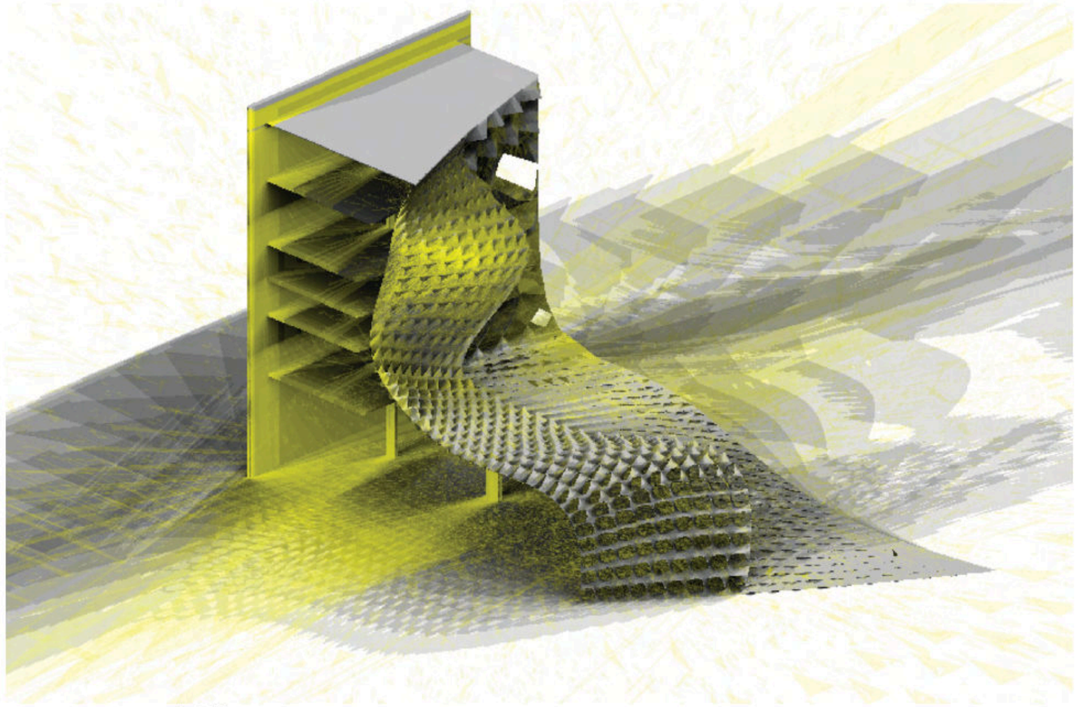
"Accessible" Side Elevation



Back Elevation



"Sun" Side Elevation



1) Axonometry of the Prototype

Set up:
1st May from 08h00 till 19h00

Action:
Range of Shadows and Reflexions

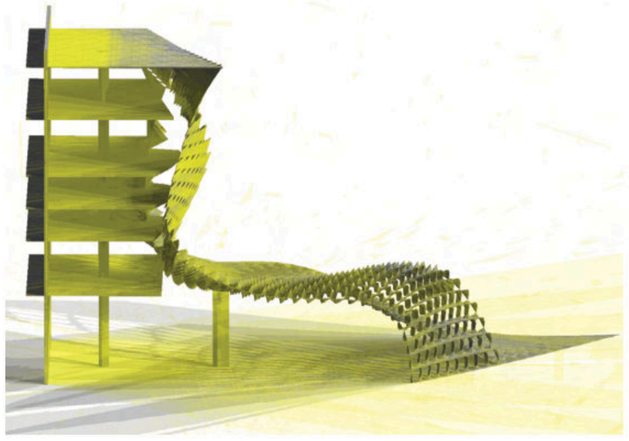
Conclusions:

Shadow:
A very low quantity of direct light enters the prototype during the whole day.
Direct light patches can be observed in the morning and in the afternoon.

Reflexion:
Light is being diffused within the prototype.

Next step for the project:
Set up the global shape according to specific hour constraints during the 1stMay/1st September.

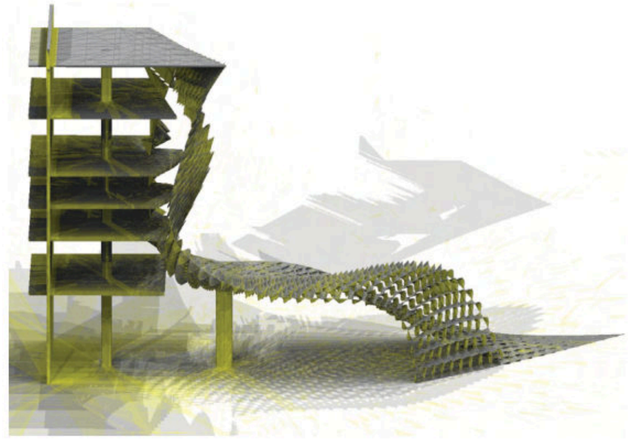
1st January



1st May

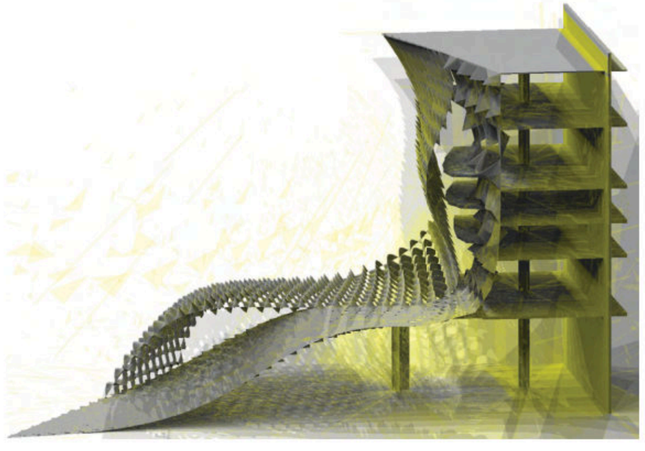


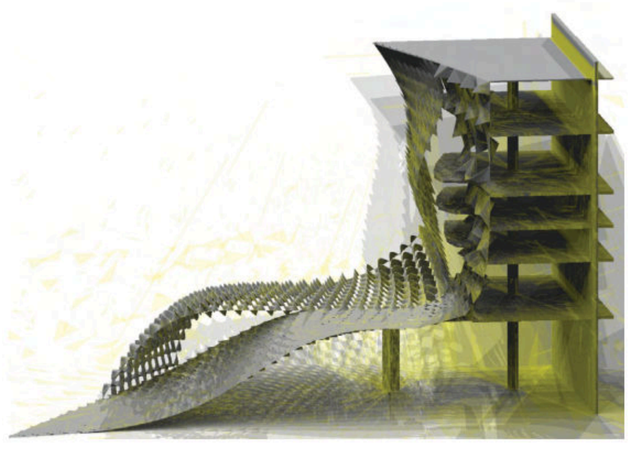
1st July



Side View towards the "Sun" surface







Side View towards teh "stairs" surface

2) Simulating the prototype at key days of the year

Set up :
1st January from 08h00 till 19h00 (Lowest angle)
1st May from 08h00 till 19h00 (Set up)
1st July from 08h00 till 19h00 (brightest day)

Action:
Range of Shadows and Reflexions

Conclusions:

Shadow:
1st January:
- Wide and long light patches can be observed during the whole day..
- Light is diffused everywhere in the prototype and on the surface itself

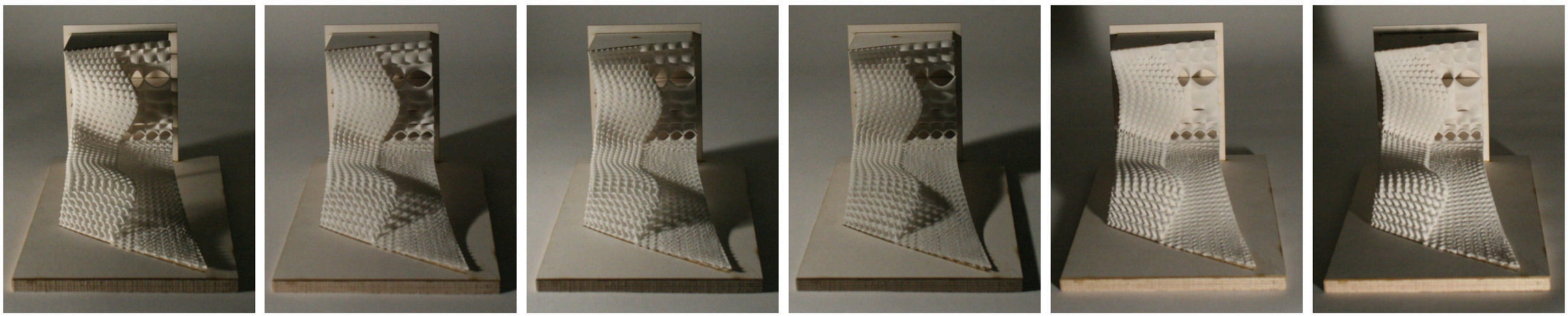
1st May and 1st July ;
-Direct light patches are much smaller but more numerous, they get larger in the afternoon. Spaces look much darker.
- Light is less diffused within the space

Next step for the project:
Test the impact of translucency.
Define which area is never touched by direct light for the display of paintings

The purpose of this study is to look at the light and shadow conditions of the "global shape".
The "global shape" is generated from blown up components, they provide shading to a larger area.

Front Views

1. 2. 3. 4. 5. 6.



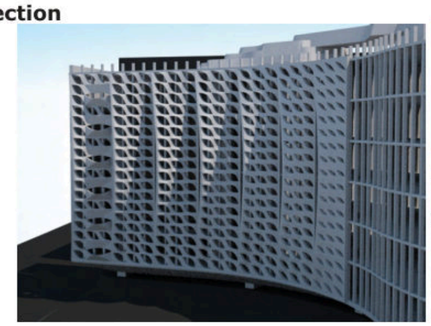
Buffer Zone + Front Facade Protection

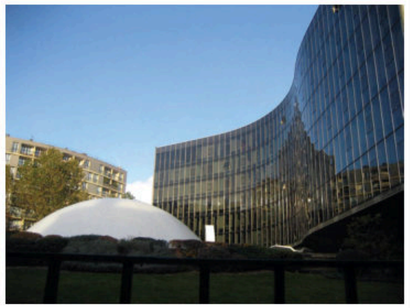
Programmatic Openess:
- Private / Shared Space for members of Party

Type of Spaces:
- Circulatory and common spaces for workers

Type of Light:
- Direct: Sept.-May / Diffused : May - Sept.
- Direct after 16h00 all year

Type of Component:
- Fabric / Steel glass
- Terrasses: Fabric/Resin/Glass/Steel





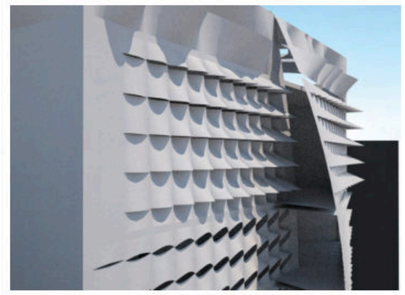
"Precious" Art Gallery

Programmatic Openess:
- Highly secured and controlled space

Type of Spaces:
- Maximum amount of flat smooth walls.

Type of Component:
- Component: Fabric and Plywood, block every Sun-Ray

Type of light:
- Diffused light all year long





Fair Trade and Local Product Market

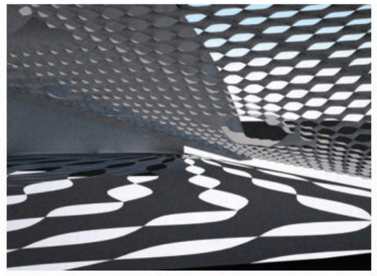
Programmatic Openess:
- Completely Public and open

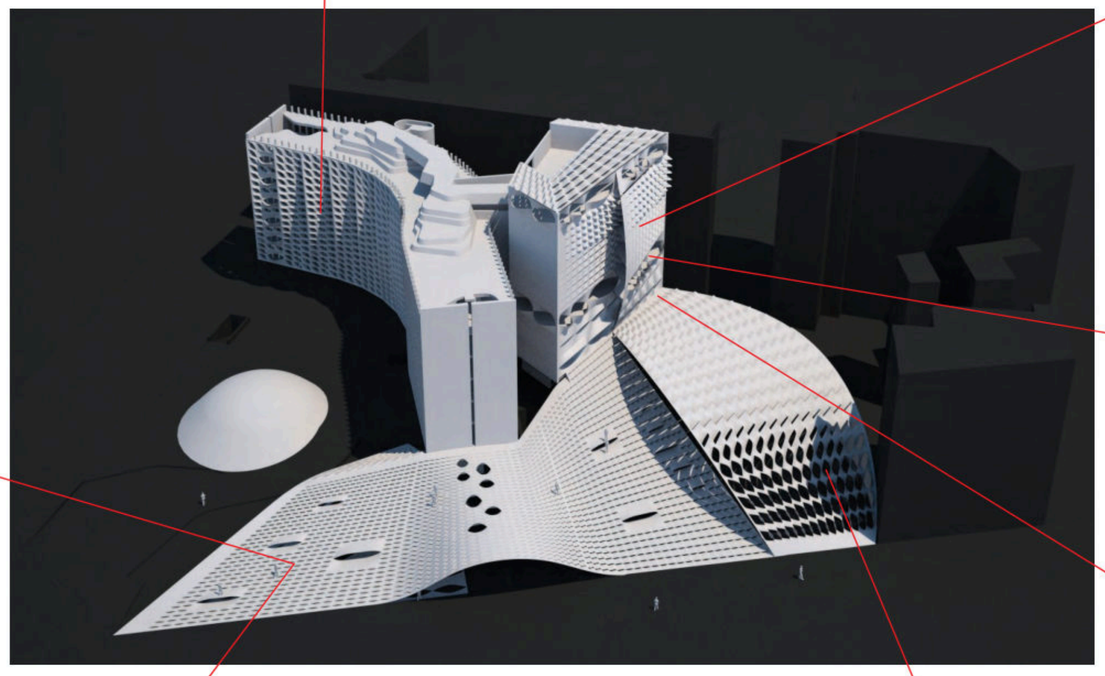
Type of Spaces:
- Spaces Covered but not enclosed, Needs to be protected from direct light when temperature is warm because of fresh products.

Type of light:
Direct : September to May, Diffused May to September

Type of Component:
- Canopy : Concrete/Resin and Steel, open.
- Floor: Steel/Glass Flat Component







Public "Green and Red" Library



1.



2.

Programmatic Openess:
- Open to everyone until late at night.

Type of Spaces:
- A "calm" library with little views outside and a controlled (1) sun-light.
- A "noisy" library with balconies and views (2)

Type of light:
- Two floors with direct light from September to May and diffuse light from May to September.
- One floor with direct light limited in depth

Type of Component:
-"Calm" Library: Fabric and steel.
"Noisy" Library: Resin and steel.

Entrance to the Extension



Type of Component:
Door, Resin and Steel

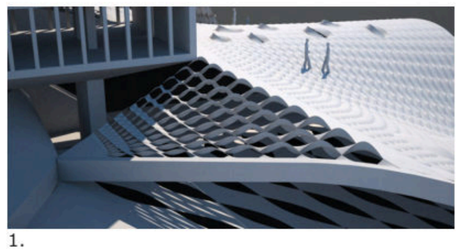
Democratic Ground

Programmatic Openess:
- Completely Public and Open

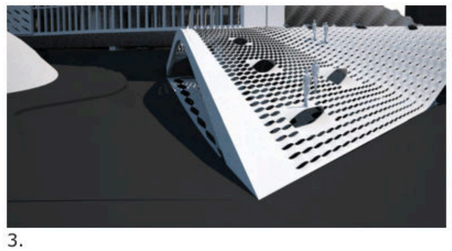
Type of Spaces:
- Staircase with stages or flat islands guiding the flow and the activities.

Type of Light:
Shaded or Direct

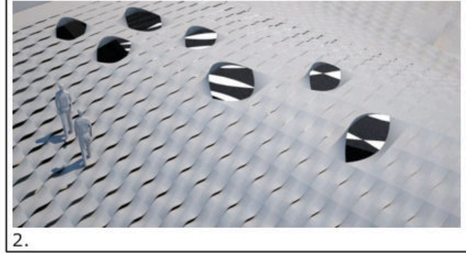
Type of Component:
- Stairs : Resin/Steel
- Barrier (1): Fabric/Steel
- Tree openings (2) : Resin/Steel, vertical opening
- Handicap Ramp (3): Resin/Steel, Flat
- Bench/Stage (4 and 5): Resin/Steel



1.



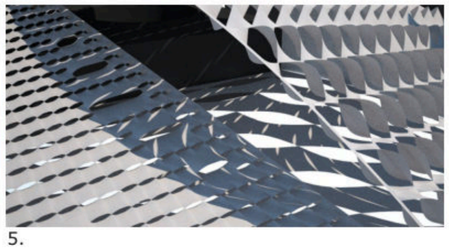
3.



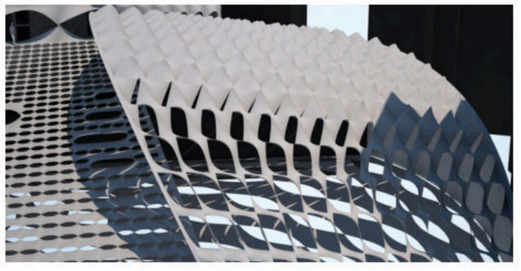
2.



4.



5.



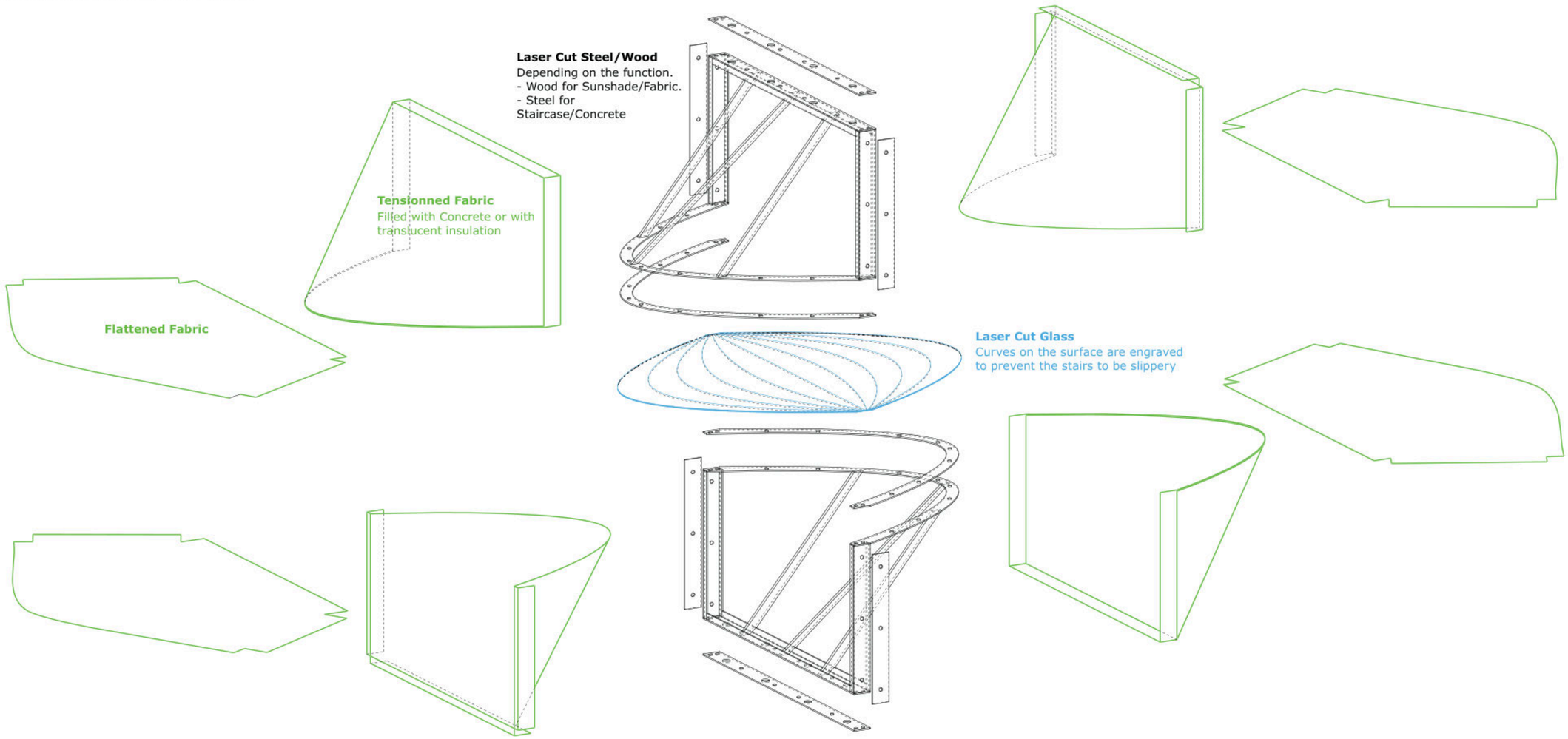
Sculpture Covered Yard

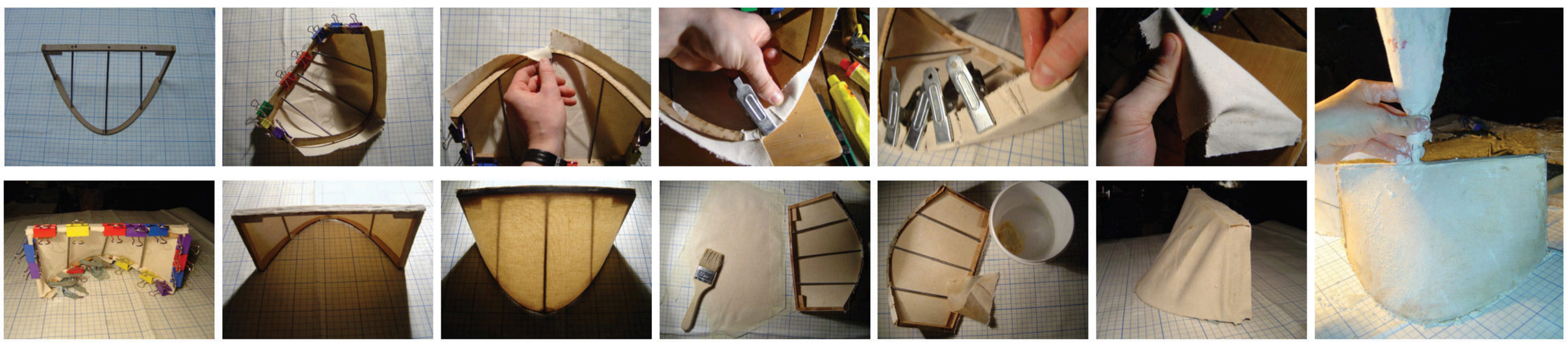
Programmatic Openess:
- Public during the day and at night for special events.

Type of Spaces:
- Spaces Covered but not enclosed

Type of Component:
- Component: Fabric and Steel

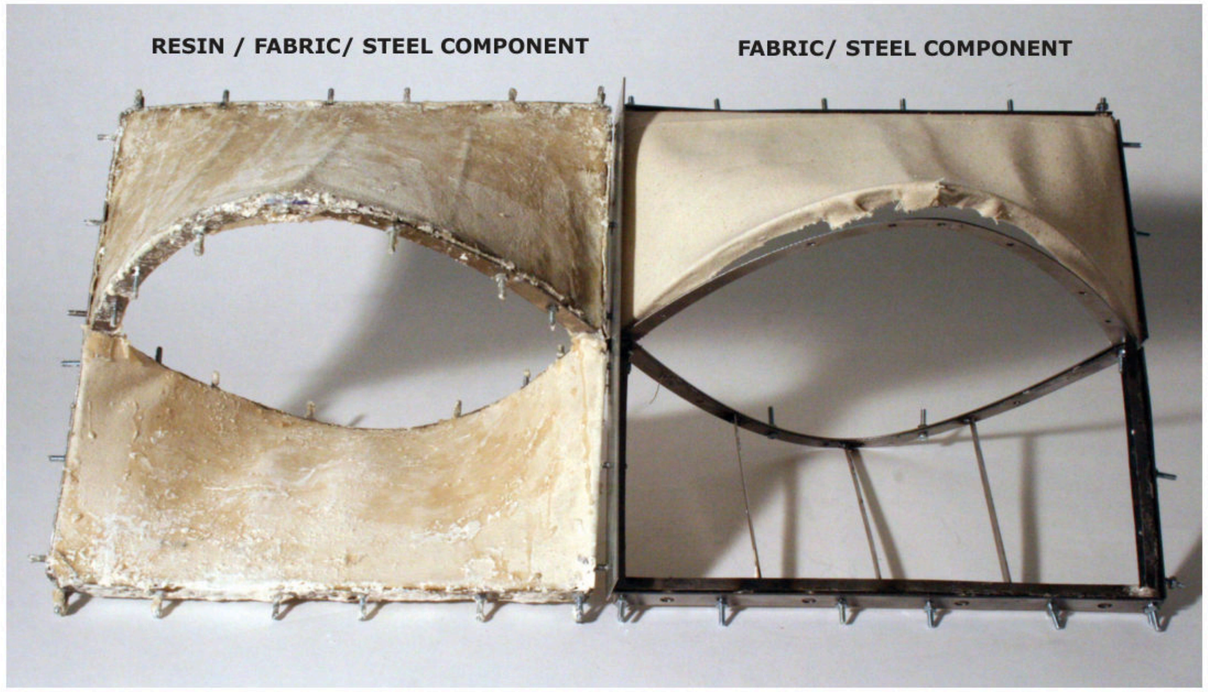
Type of Light:
- Direct from September to May, Diffused from May to September.

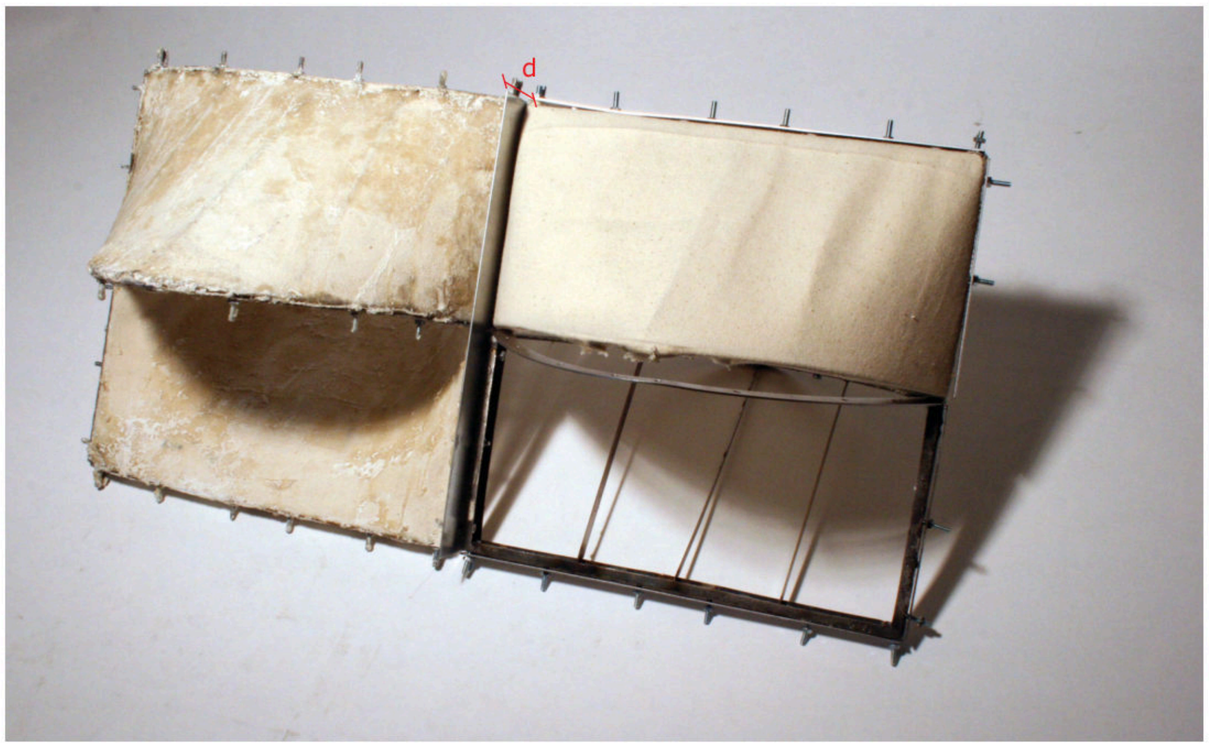

Laser Cut Steel/Wood
Depending on the function.
- Wood for Sunshade/Fabric.
- Steel for
Staircase/Concrete
Tensionned Fabric
Filled with Concrete or with translucent insulation
Flattened Fabric
Laser Cut Glass
Curves on the surface are engraved to prevent the stairs to be slippery



These two components were laser-cut from steel and assembled using nuts and bolts.
Fabric was stretched on the frame and the bolts were placed before pouring the resin with a syringe.

MAIN PROBLEM:
Nuts and Bolts are covered with by resin. The assembly of components would be irreversible.

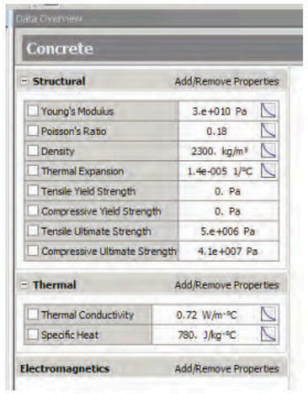




Distance d would vary according to the amount of stress found locally







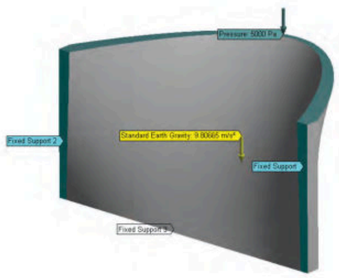
Concrete is the material assigned to the module.

Compressive ultimate strengh:
5.e+006 Pa

Tensile Ultimate Strengh:
5.e+006 Pa

1. Axonometry of Test Set-up

The Tested Part is the concrete element of staircase component. Continuous pressure is therefore applied on the top part.



The stress on the top surface is constant every where since it is the surface on which people walk.
To calculate the pressure in Pascals:

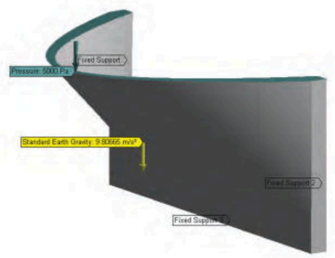
P=F / A

where P is pressure, F is Force and A is Area

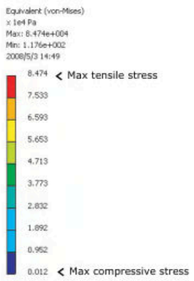
F=N / A

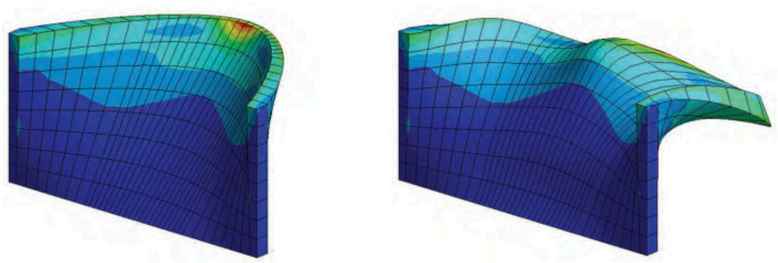
500kg is being used as a safety weight.

After calculation, a pressure of 5000Pa is applied

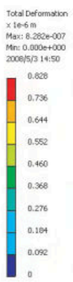


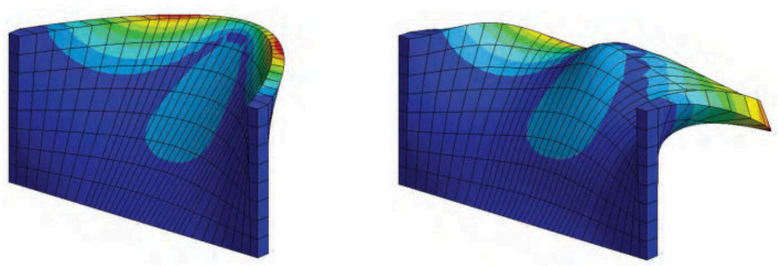
1. Equivalent Von-Mises Stress



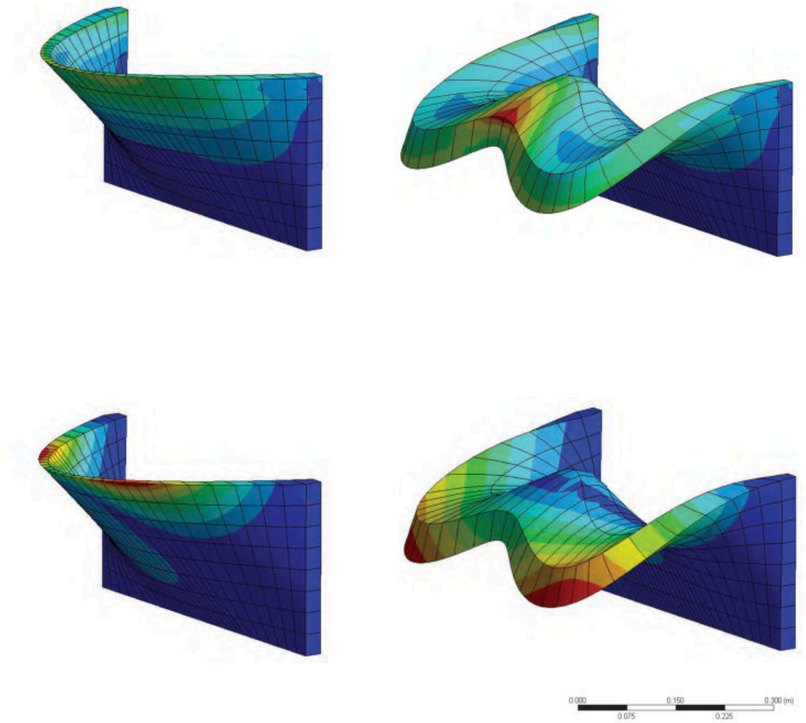


2. Total Deformation



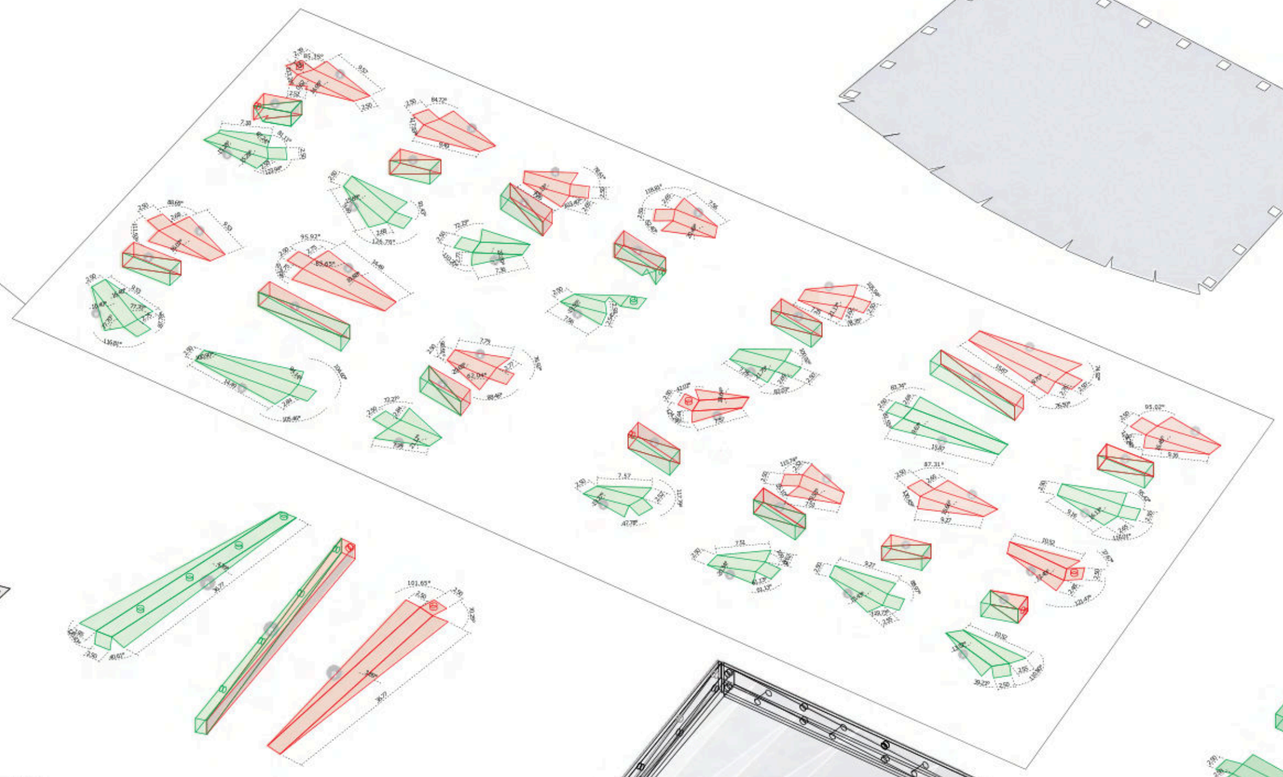


Exageration of the deformation *5

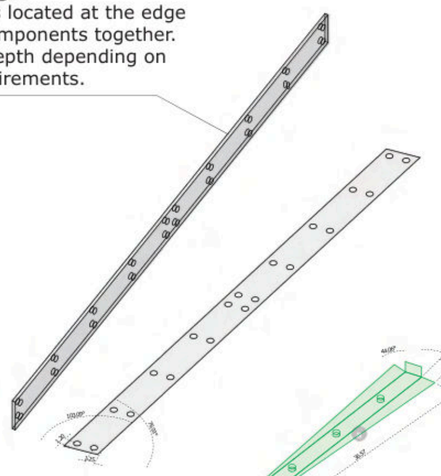


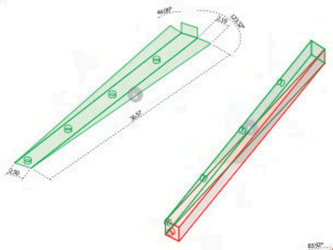
Central Opening:
Its complex geometry makes it very difficult to build as it would have to be made of many different parts
A smarter way would be to replace it with a tubular profile.

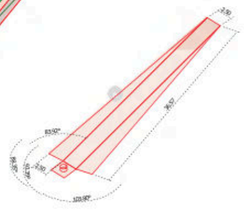
Structural Edge
Steel members located at the edge connect the components together. They vary in depth depending on structural requirements.

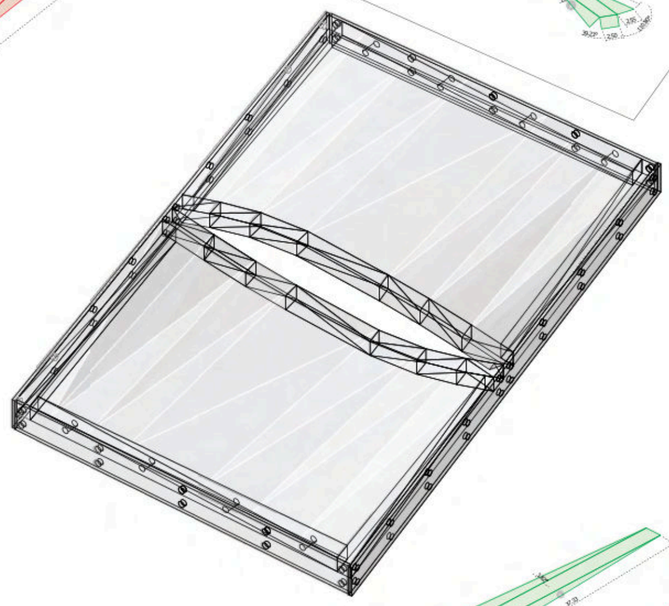


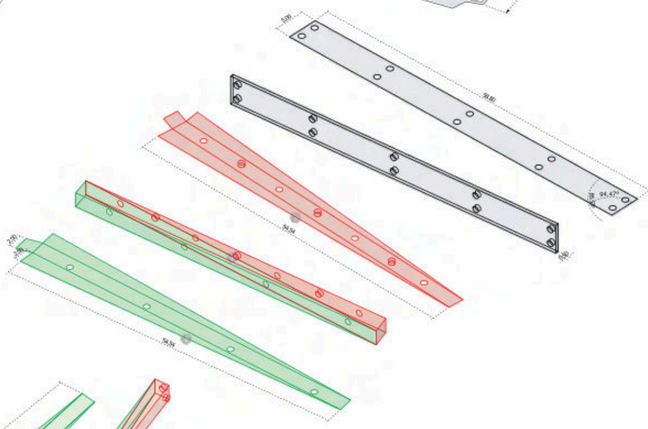


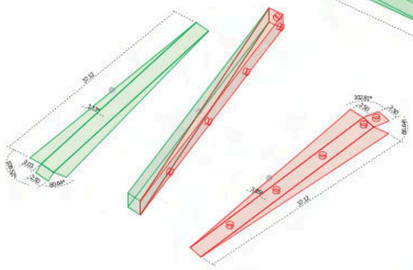


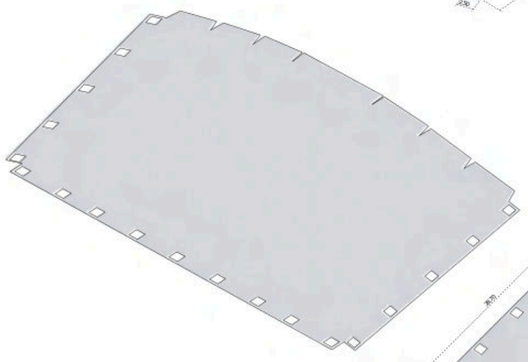


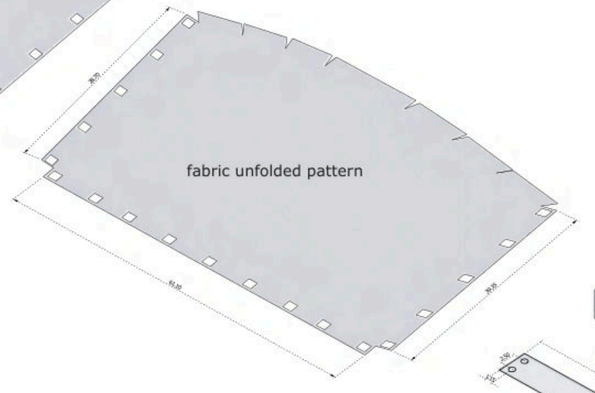


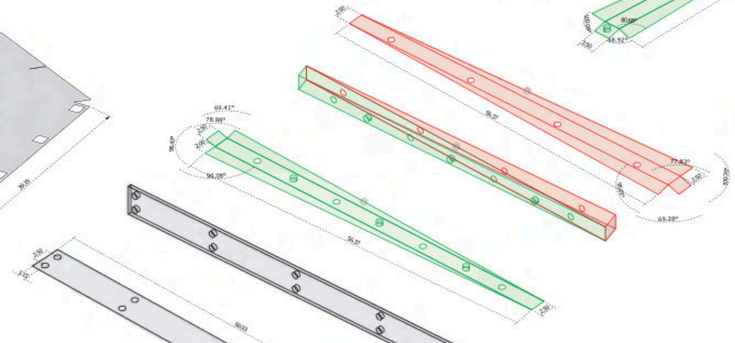


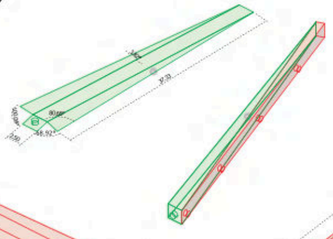


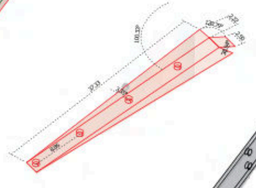


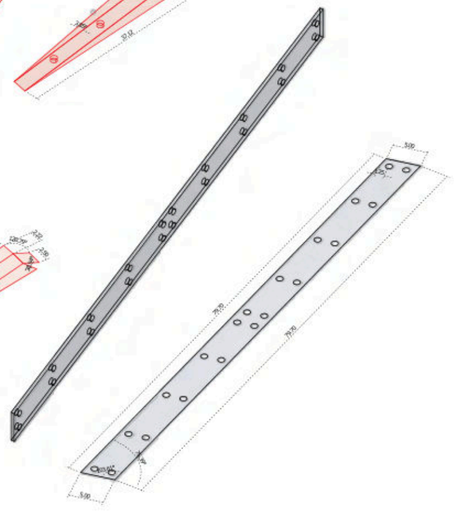






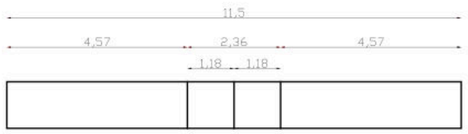


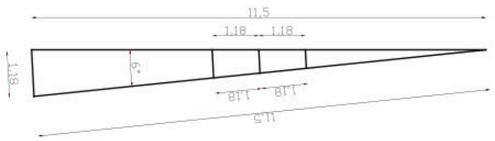


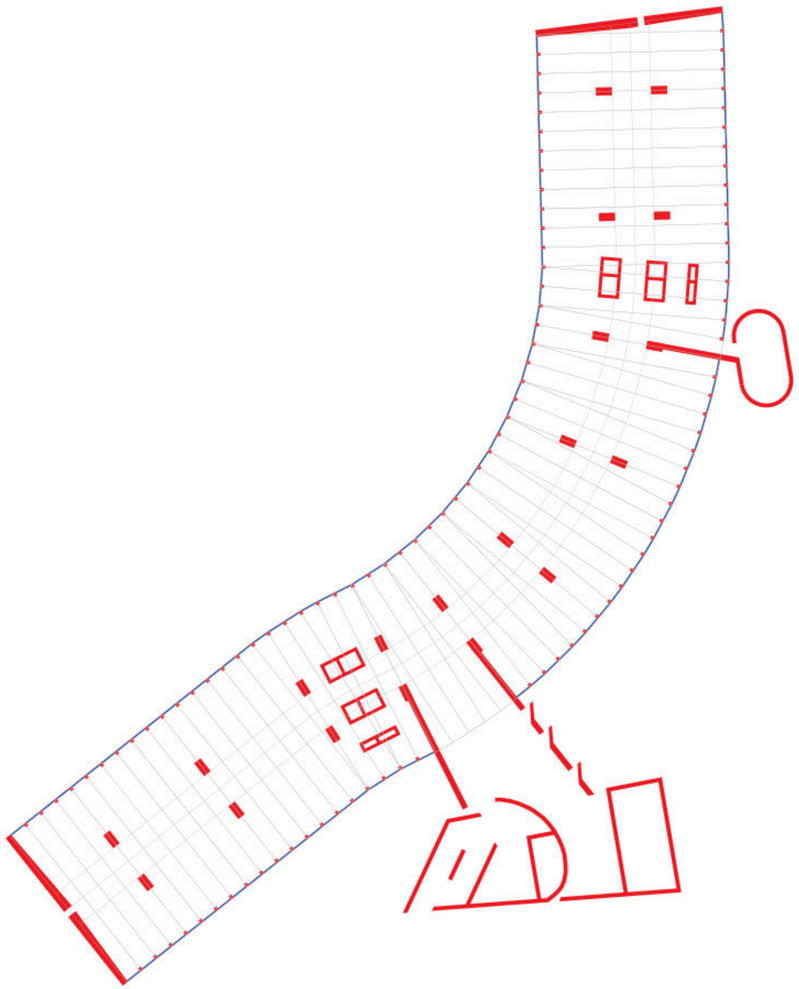


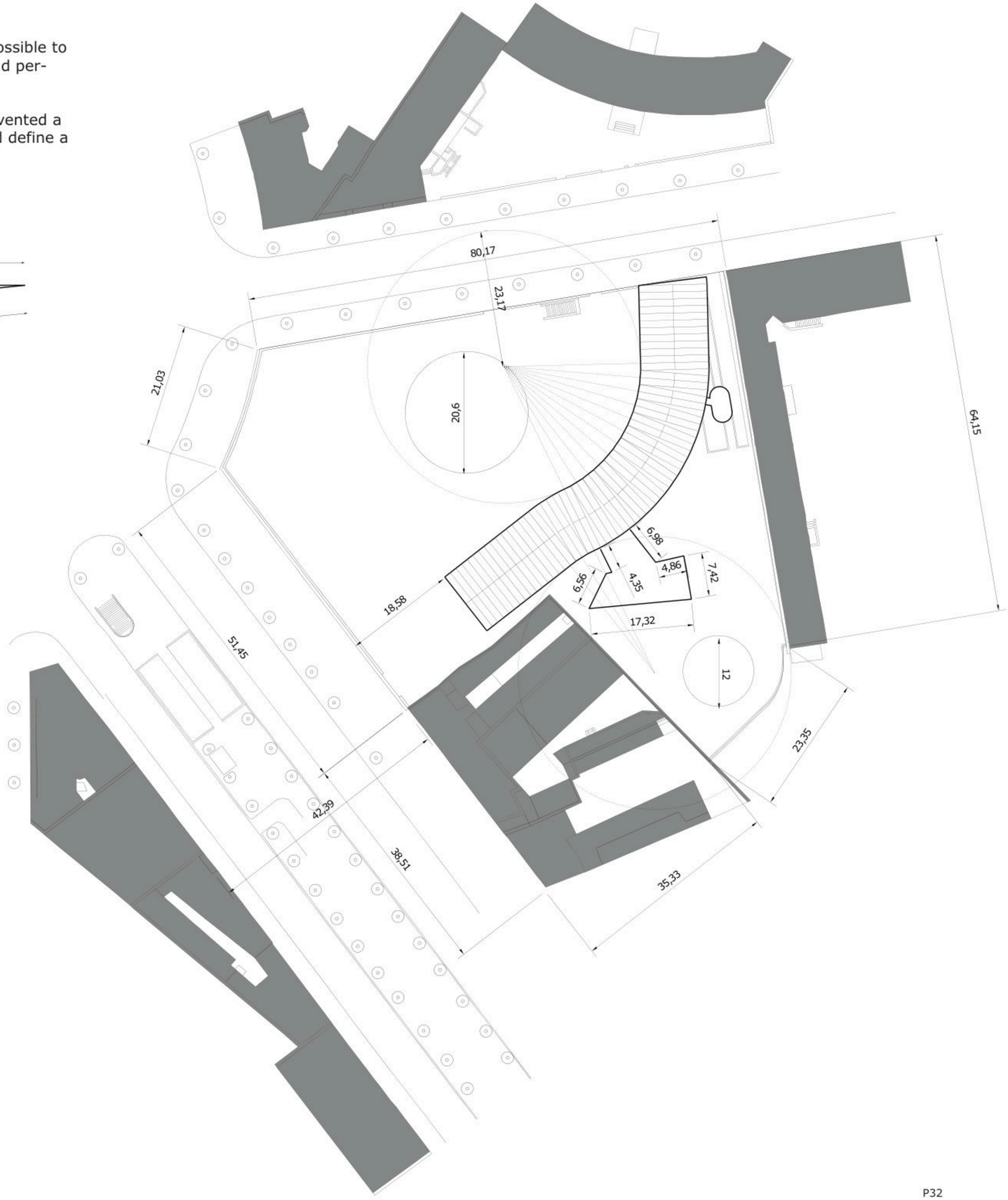
The first sketch of Oscar Niemeyer defined a curved building that would go as close as possible to the neighbouring building in order to make as much space as possible for a front park and perspective but also to hide the existing wall.

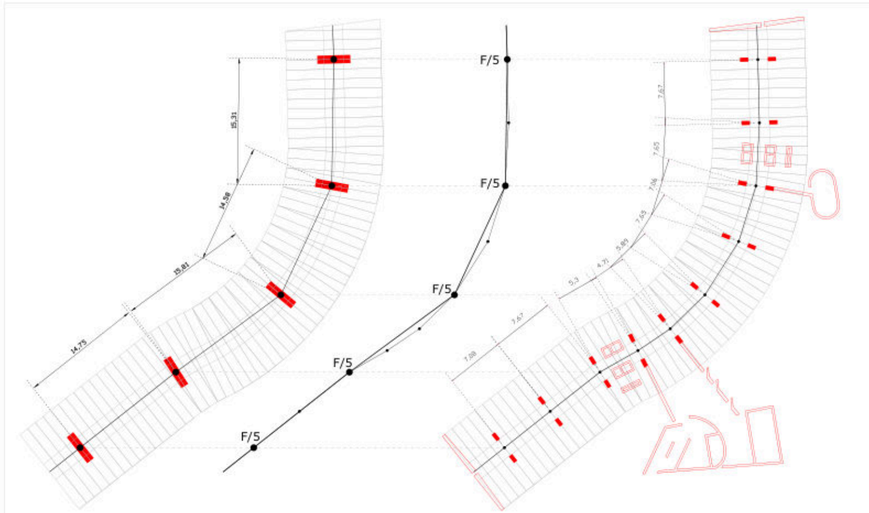
To achieve this curvature and allow all the glass panels to be flat, the architect's team invented a system composed of two modules. When arranged in specific ways, those modules would define a certain curvature.











Ground Floor

Common Floor

Measuring the distance between columns and counting their relations

Initial Statement:
Each Column is being linked by a segment. The differ ence between the curved lined between columns and the straight ones is less than 1m as shown in the middle diagram.

Conclusions:

- The Distance between the large columns and between the smaller columns is never

equal.

- The subdivision of forces between large columns and smaller columns is not

equal.

- A larger amount of sub-columns might be explained by a need to support the link between core and building

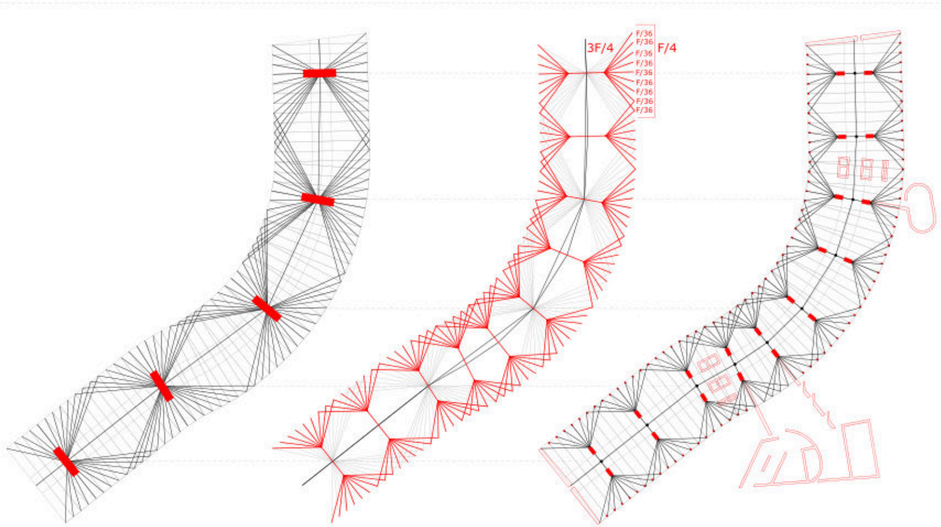
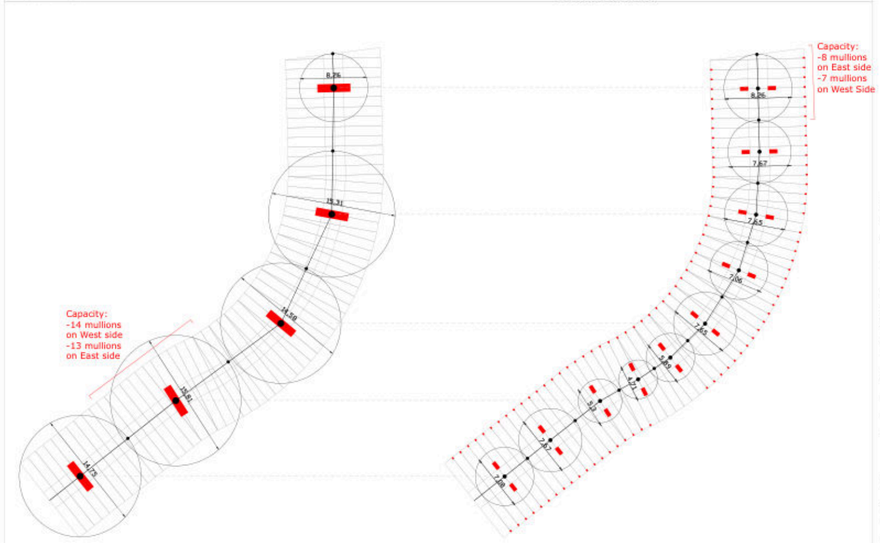


Diagram showing the division of forces between mullions, small columns and large columns.

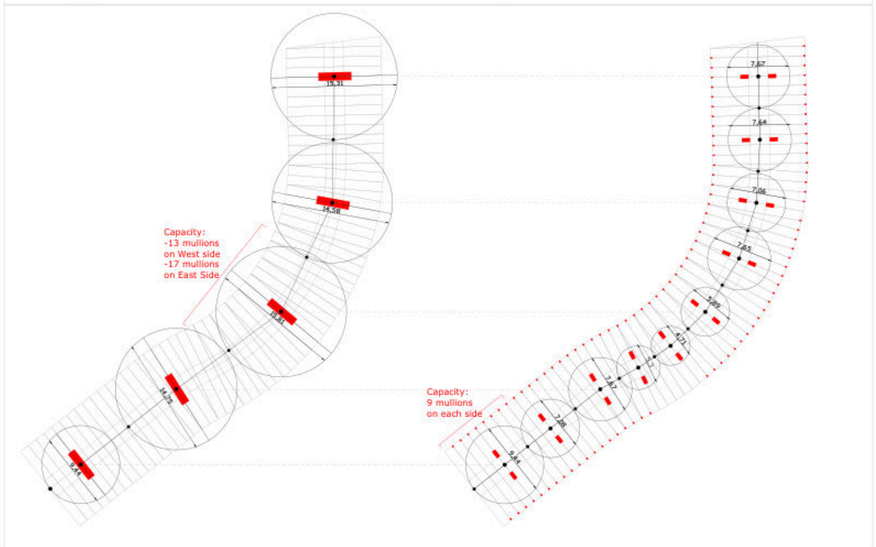


Finding the maximum structural capacity of each columns

The circles have for center point the middle of the columns and for radius the mid point of the line that connects two sets of columns towards NORTH

Largest Circle Diameter
- for large Columns: 15.81 m
- for small Columns: 8.26 meters

Maximum Number of mullions supported by a single column:
- Large columns : 14
- Small columns : 8



The circles have for center point the middle of the columns and for radius the mid point of the line that connects two sets of columns towards SOUTH

Largest Circle Diameter
- for large Columns: 15.81 m
- for small Columns: 9.44 m

Maximum Number of mullions supported by a single column:
- Large columns : 17
- Small columns : 9

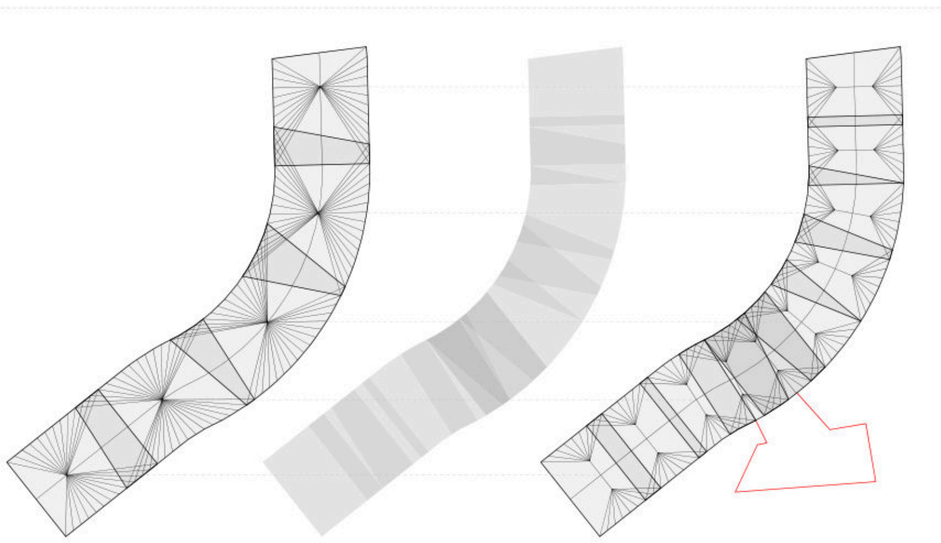
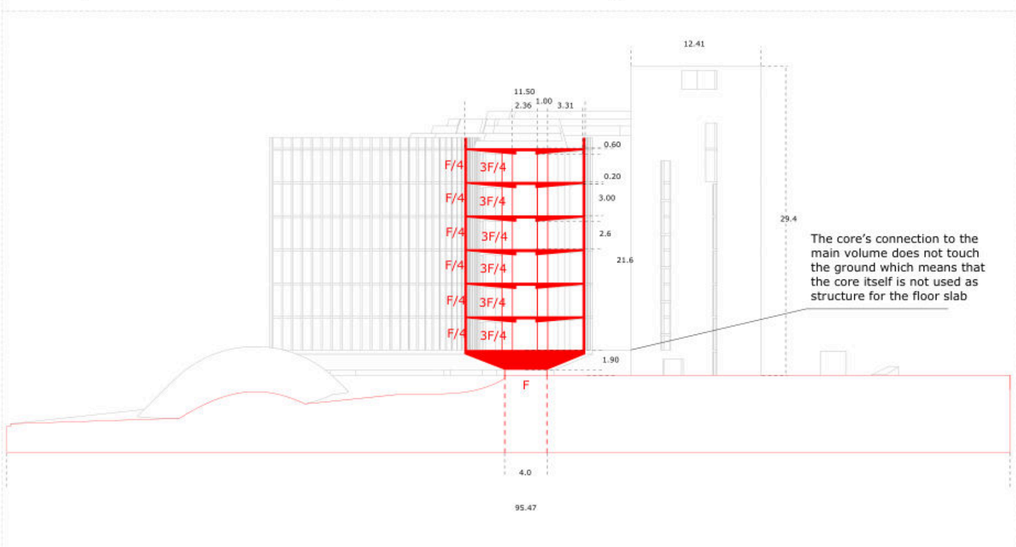


Diagram showing the supported areas and their overlaps- One can notice the structural redundancies where the core is.

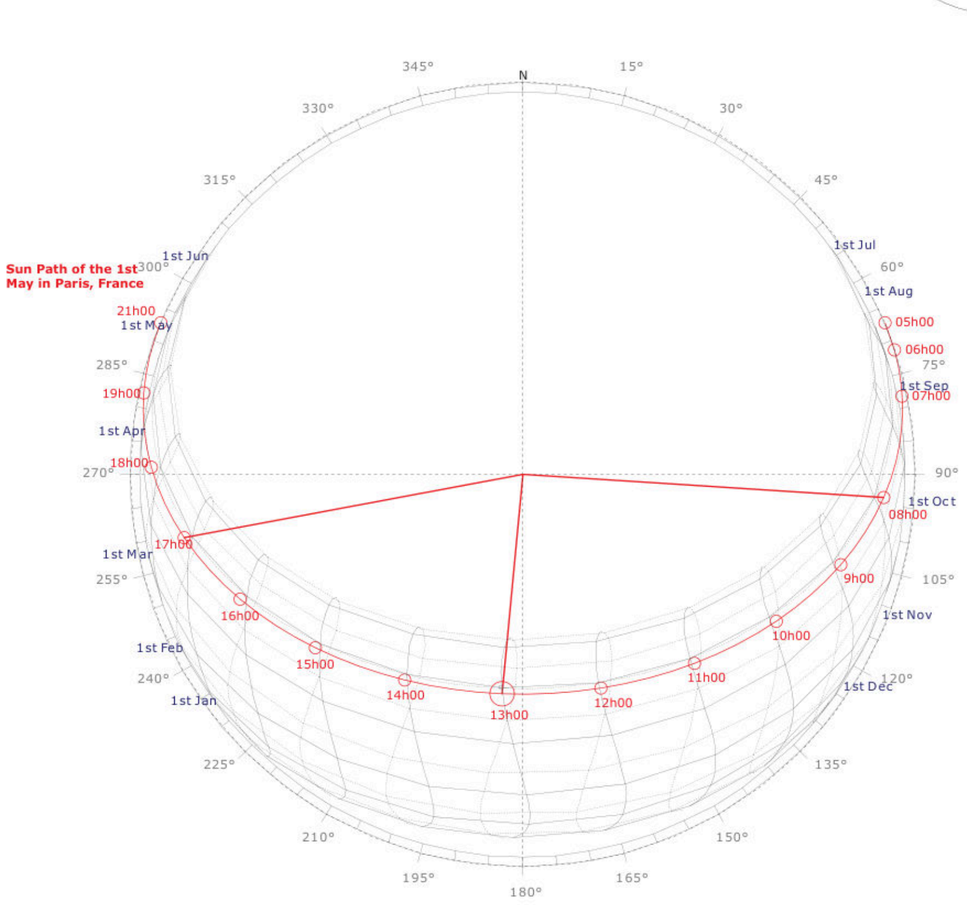


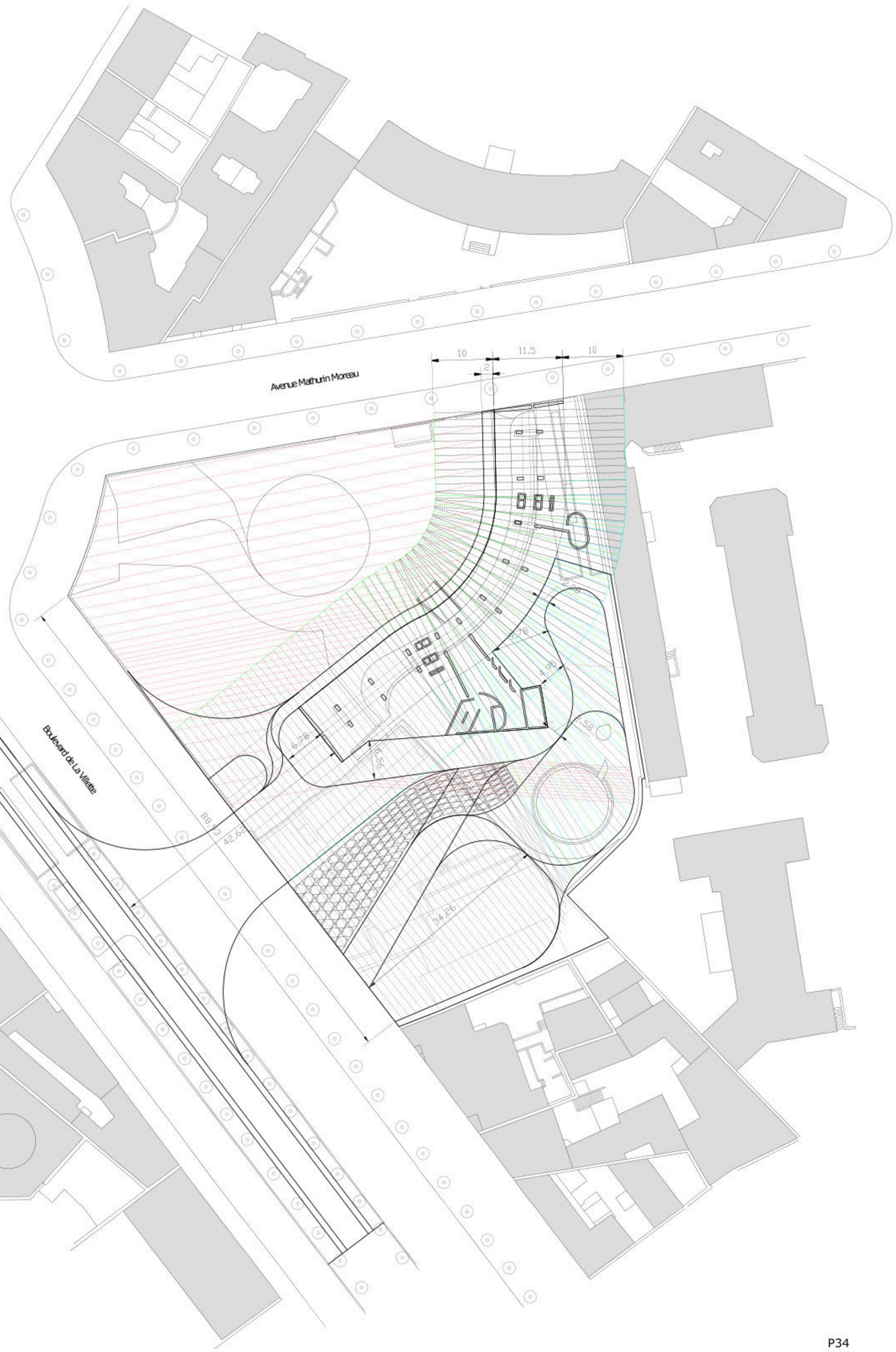
Section showing the distribution of forces.
The floor plates are not cantilevering since the mullions take a small part of the forces. There is a larger slab thickness when standing on the 1.00m columns than at on the edge when its supported by the mullions.

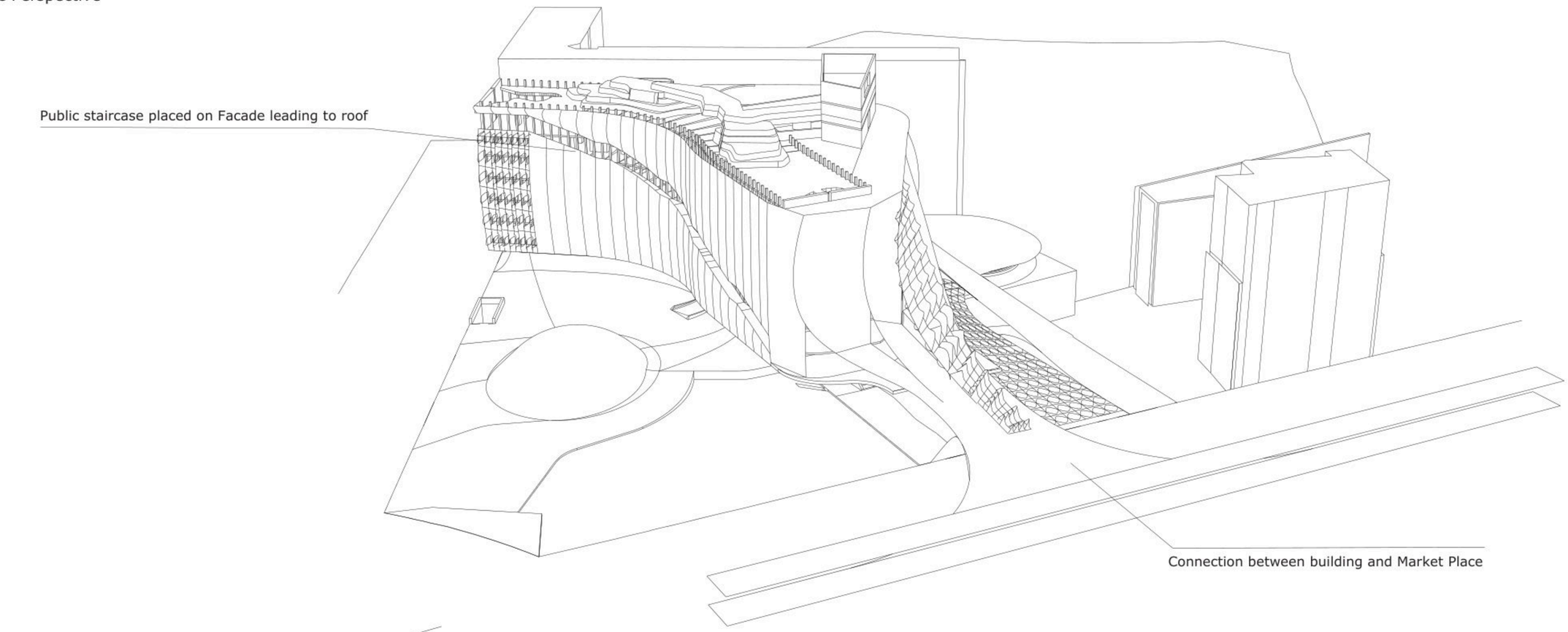
This Schematic Plan view compiles most of the site constraints such as:

- Sun (As an evolution from last prototype, the global is defined by an hourly constraint not to let in light from 9h00 till 18h00 which are the hottest hours)
- Existing building and existing structure (The curvature module that defined the mullion will be extended and kept.)
- Trees

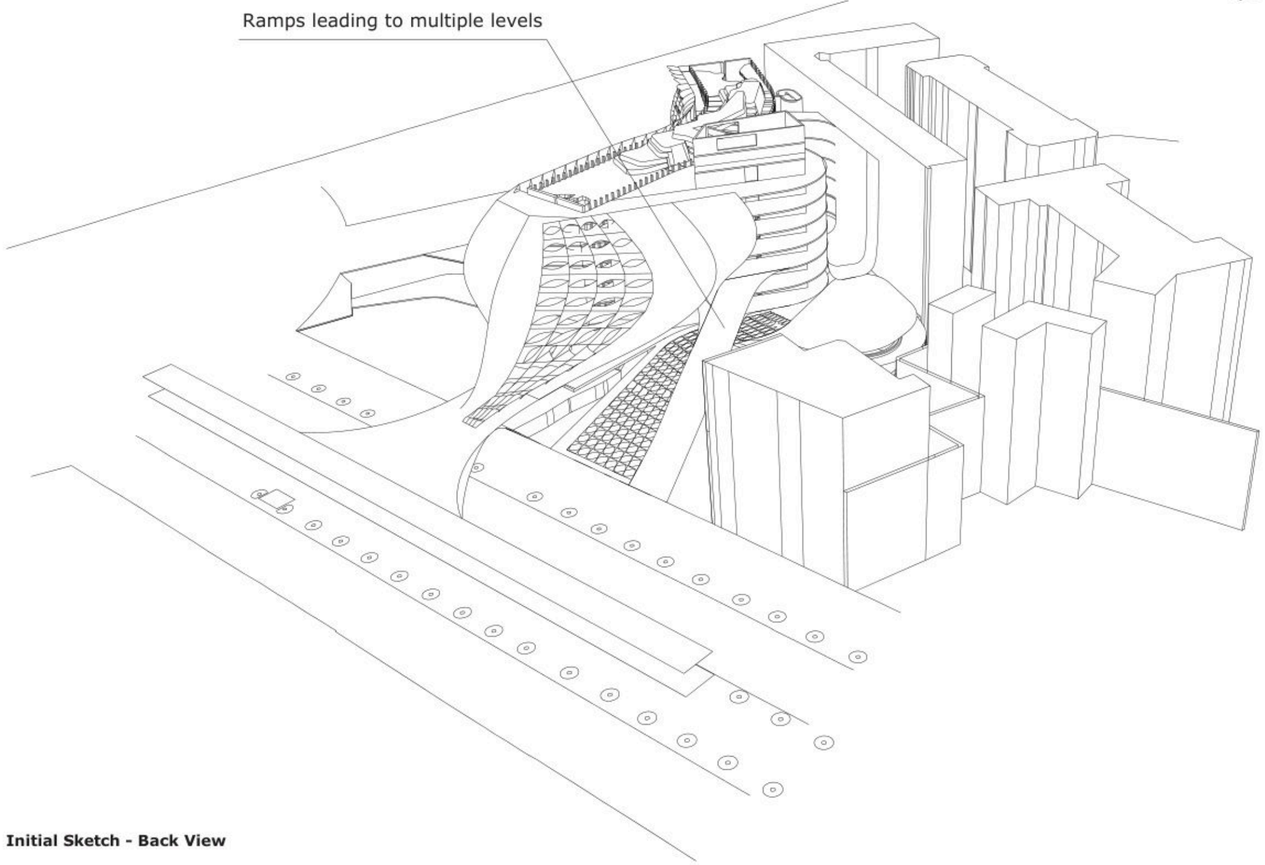








Initial Sketch - Front View



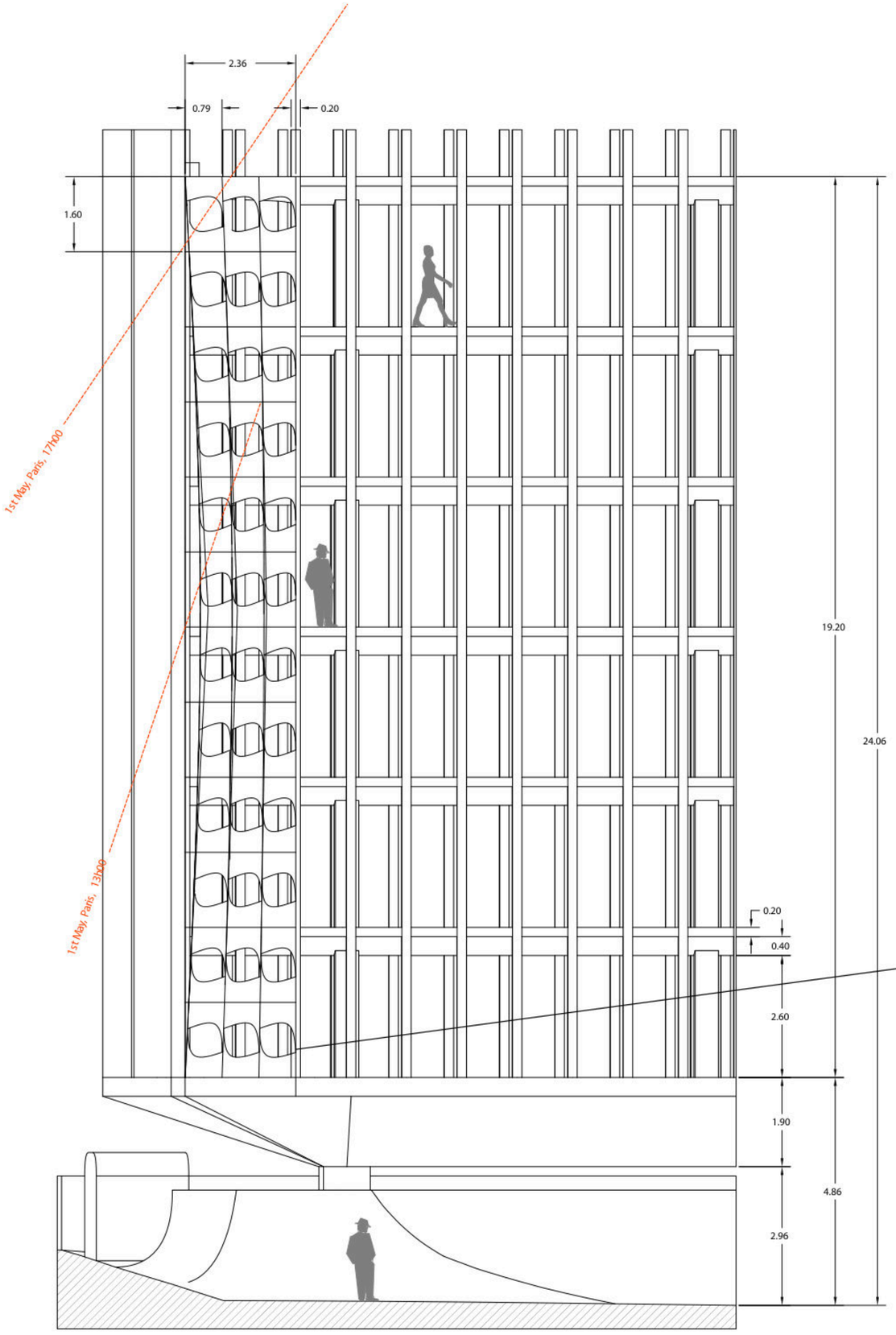
Initial Sketch - Back View

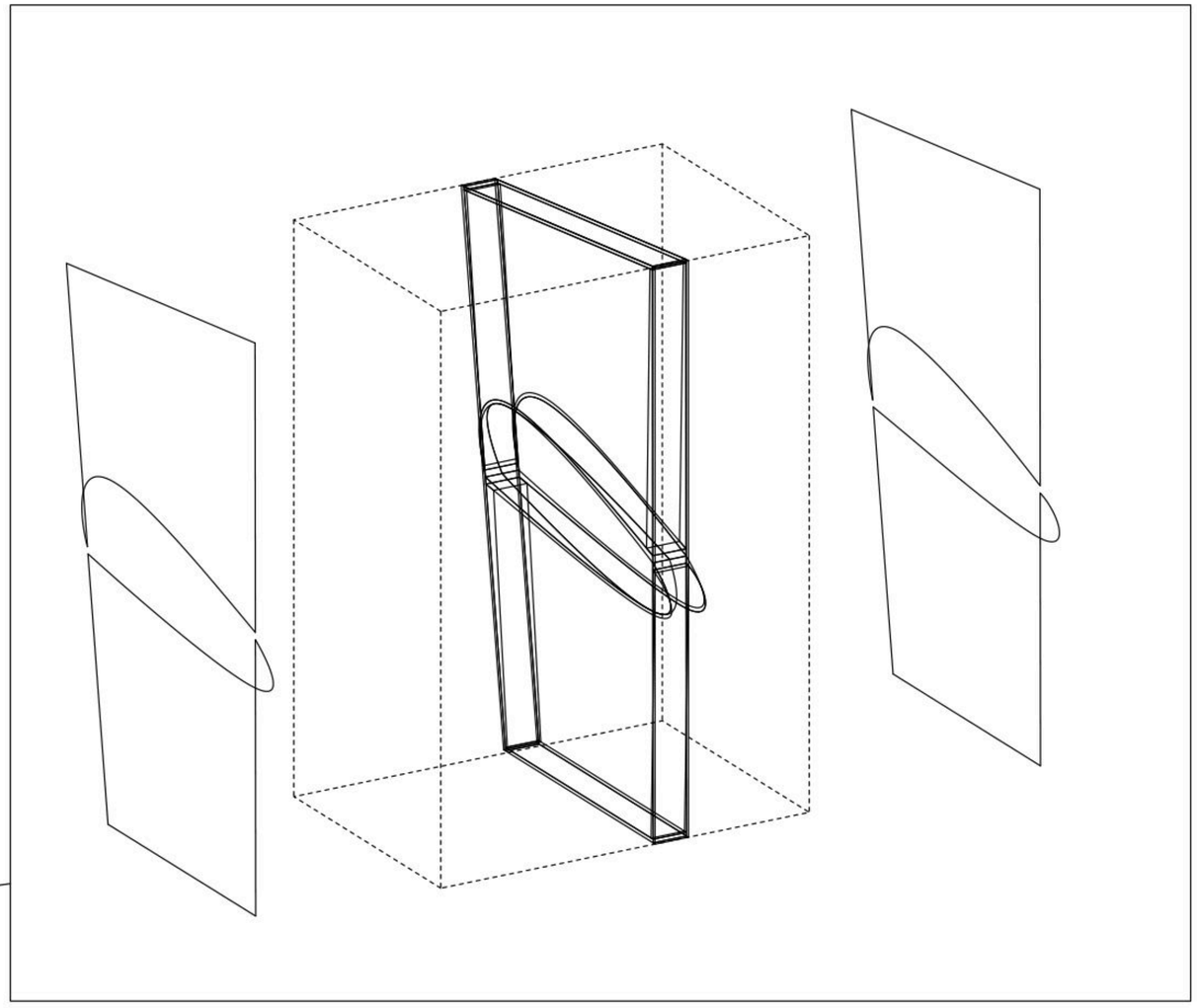
Initial Three-Dimensional Sketch

The initial proposal seemed very heavy handed, it wrapped the whole building, erasing its identity.

The Front facade is not in need of such a large intervention and the staircase would break the sense of privacy for the people working in the PCF building.

Many features seemed superfluous.





Adapting the component to the existing facade
The grid on which the component is placed is calibrated to the existing facade.
A big change is from the previous studies is that the component starts twisting in space which has an important impact on the fabrication (refer to 5.2.4 on page 31)

Generative Component Parametric Global Strategy
Symbolic Diagram of the facade proposal

1.
Cluster defining the Sun-driven Component

1.1.
The Component In defined by four points. Those four points could be located anywhere within the main coordinate system

1.2.
A point shares the same altitude and azimuth angle as the sun at a particular time, day and location. (The sun is set to 1st May in Paris, France 13h00)

1.3.
This Sun Ray influences a coordinate system located in the centroid of the component.

1.4.
Four lines surrounds the component. Those are used later on for the Loft Script.

1.5.
The Sun-driven Coordinate system drives two movements: The lateral rotation and the frontal. in this cluster the front rotation is determined by a Circle which radius is controled by the variable Circle Radius.

1.6.
The Lateral Movement is initiated by the way the sun driven coordinate system intersects the edge of the component.

1.7.
The Lateral Movement is recorded as values in Graph Variables that will influence, through a "condition script" the way the surfaces defin ing the component will be lofted.

2.
Cluster defining the Global Component

2.1.
Point defining the appropriate Sun-Angle for the Global Component (Here 1st May at 17h00)

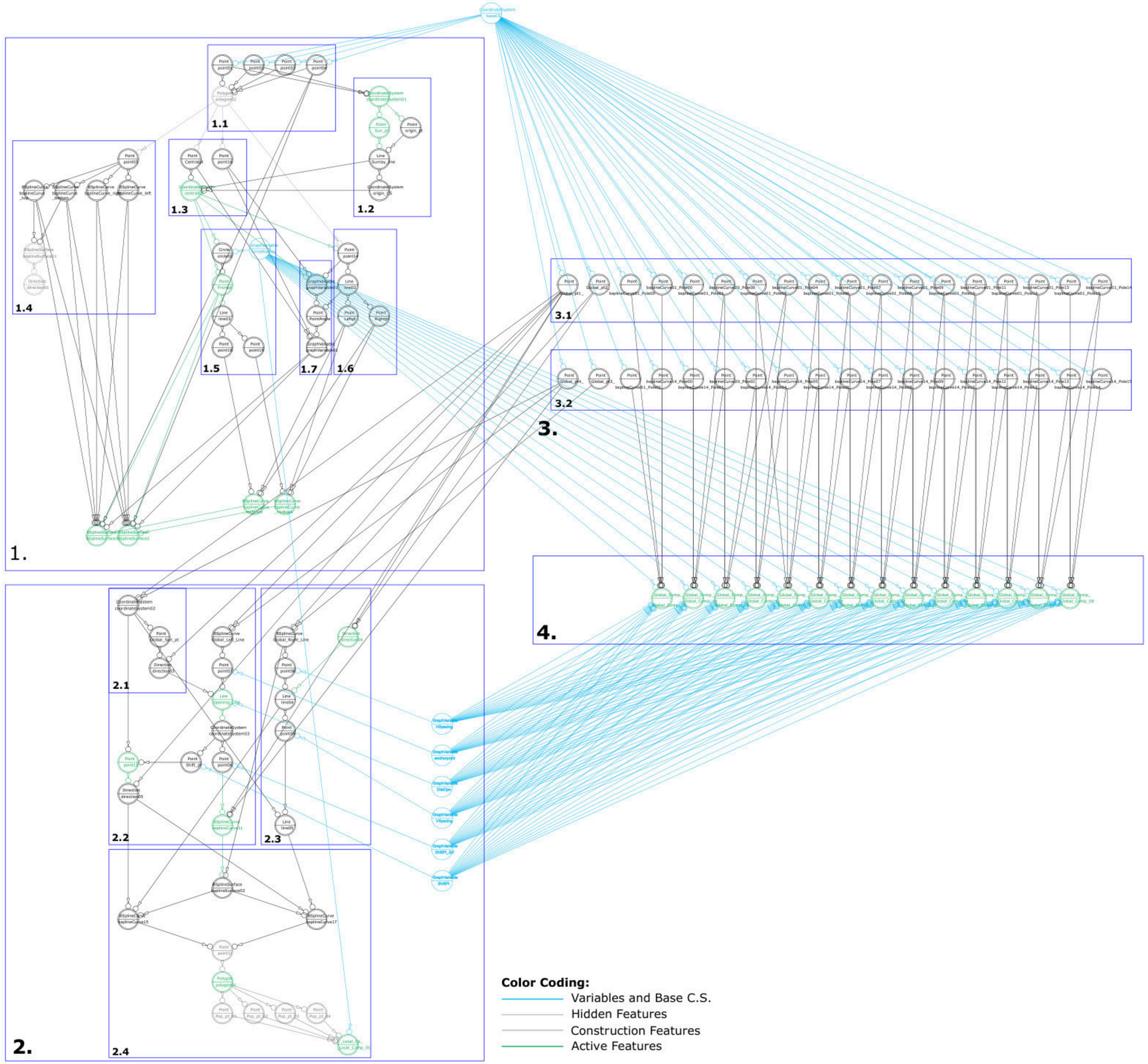
2.2.
The Sun Ray is used to define the opening of the Global Component

Variables:
- Anchor Point: Controls the vertical position of the opening.
- DistOpn:Controls the distance of the opening

2.3.
Defining the grid and its density on which the smaller component will be populated

Variables:
- HSpacing: Controls the Horizontal density of the Point Grid
- VSpacing: Controls the Vertical density of the Point Grid

2.4.
Populating the component (1.) onto the point grid.



3.
Existing Building Key Points
In odrer to design the extension only selected key points are used in the parametric model those points are extracted from the existing mullions location

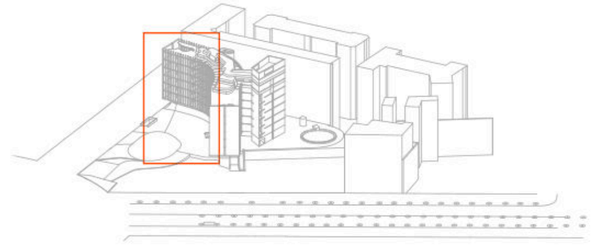
3.1
Roof Points

3.2
Base Points

4.
Global Components
The Components are applied on the facade

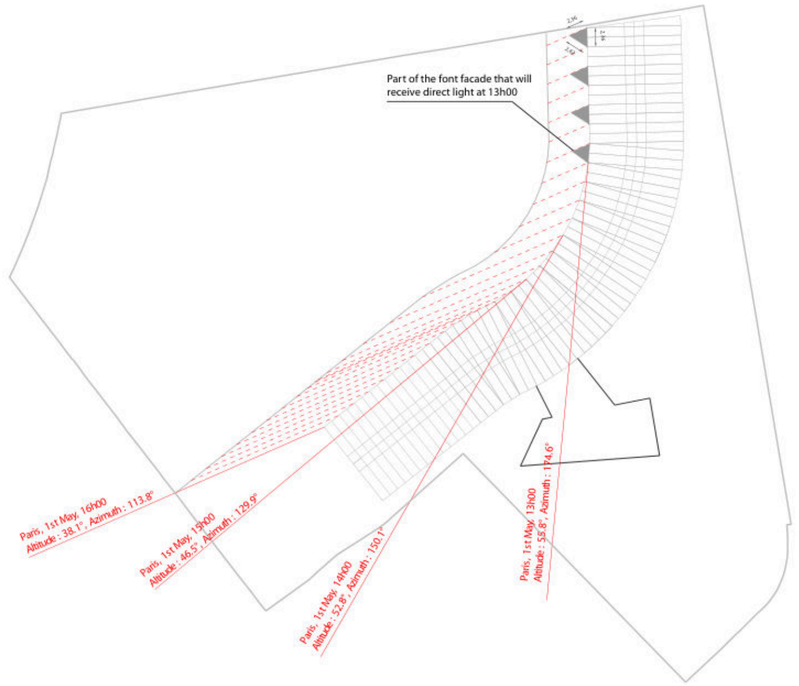
Color Coding:
- Variables and Base C.S.
- Hidden Features
- Construction Features
- Active Features

Generative Component Parametric Global Strategy
Parametric Diagram of the Facade Proposal



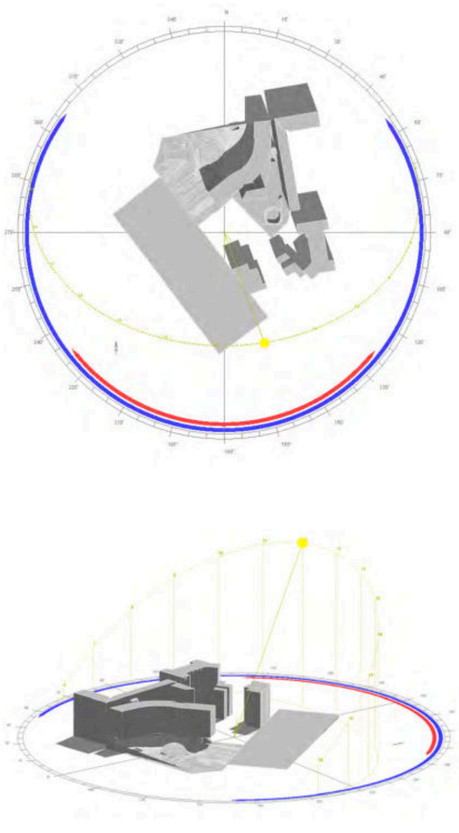
Plan of the Parametric Model

Axonometry of the Parametric Model

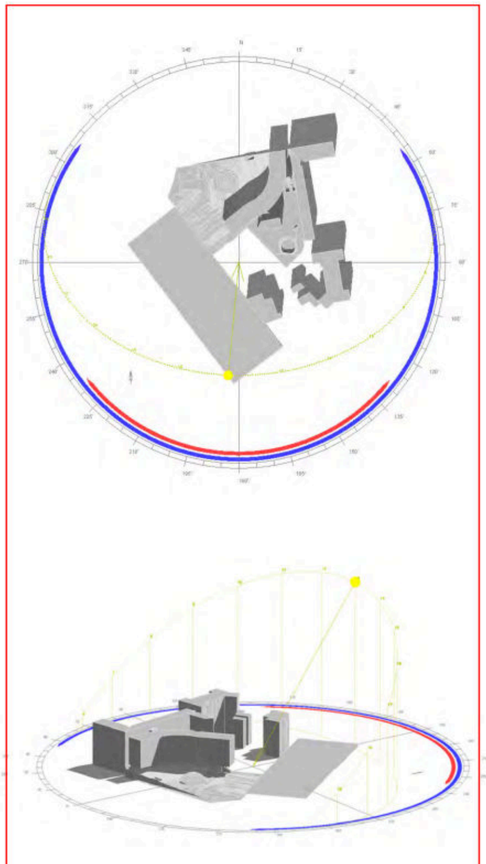


Solar Analysis of Front Facade
The Front facade self-shades partially which makes some components redundant.

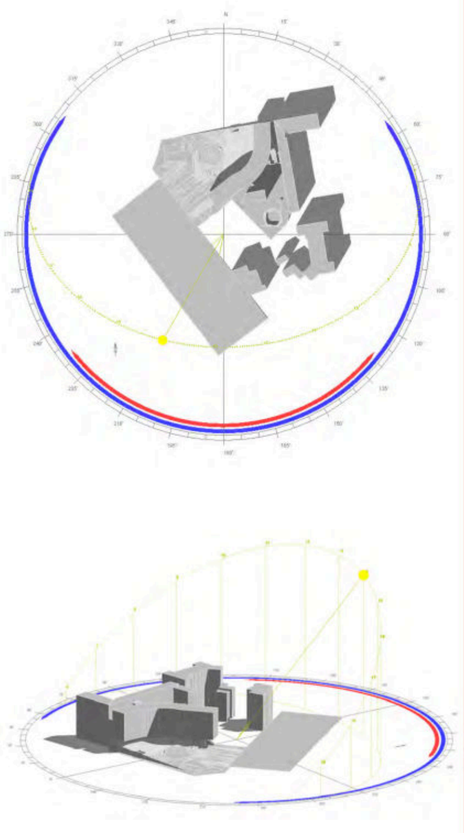
12h00



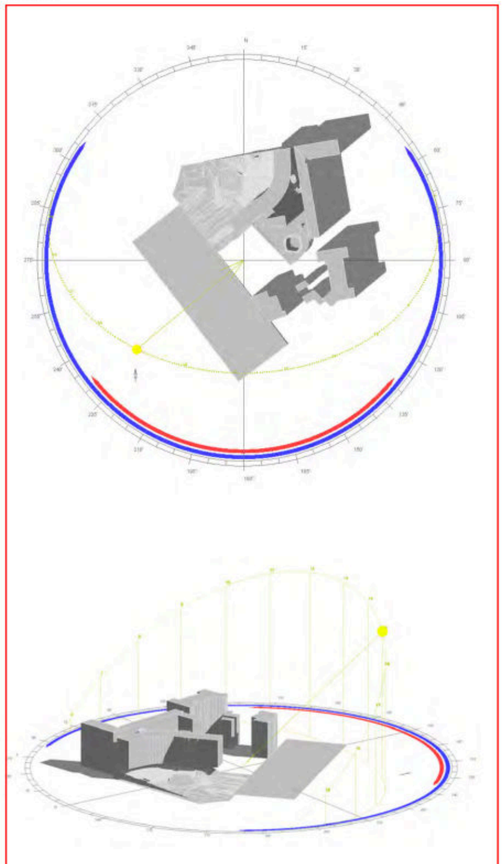
13h00



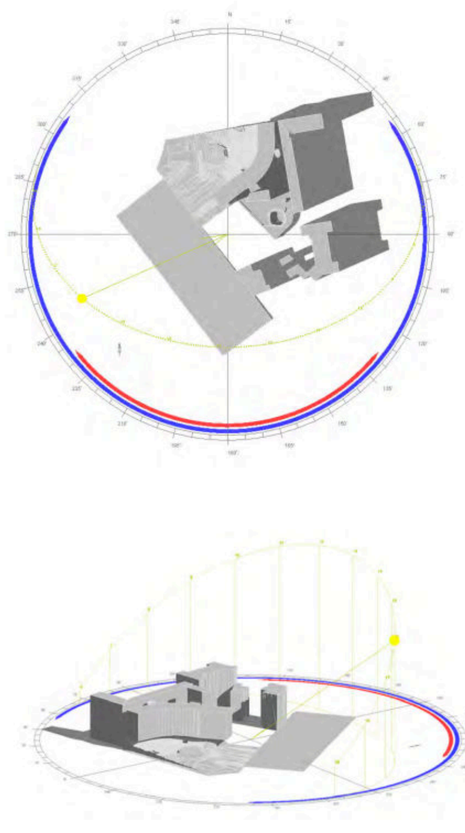
14h00



15h00

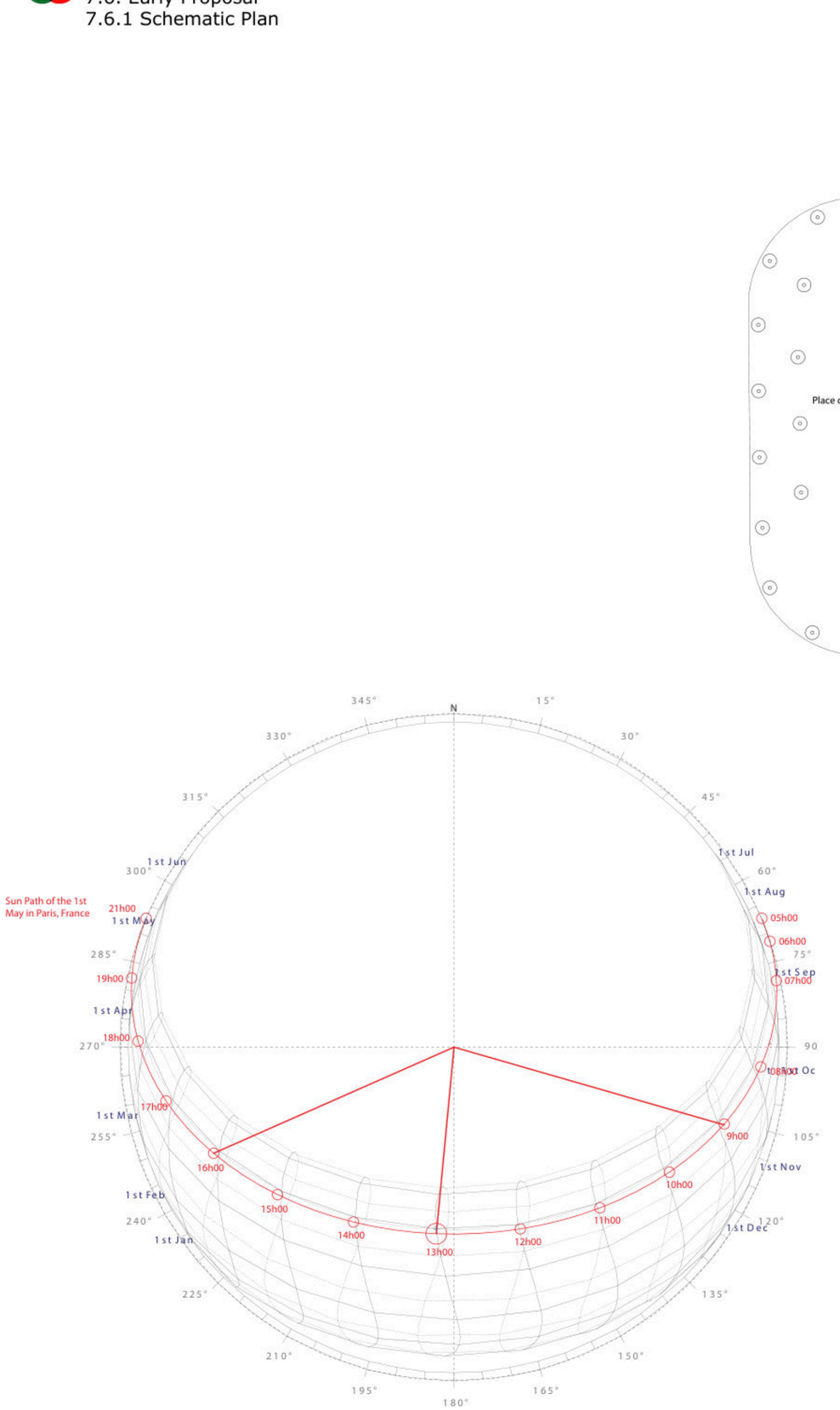


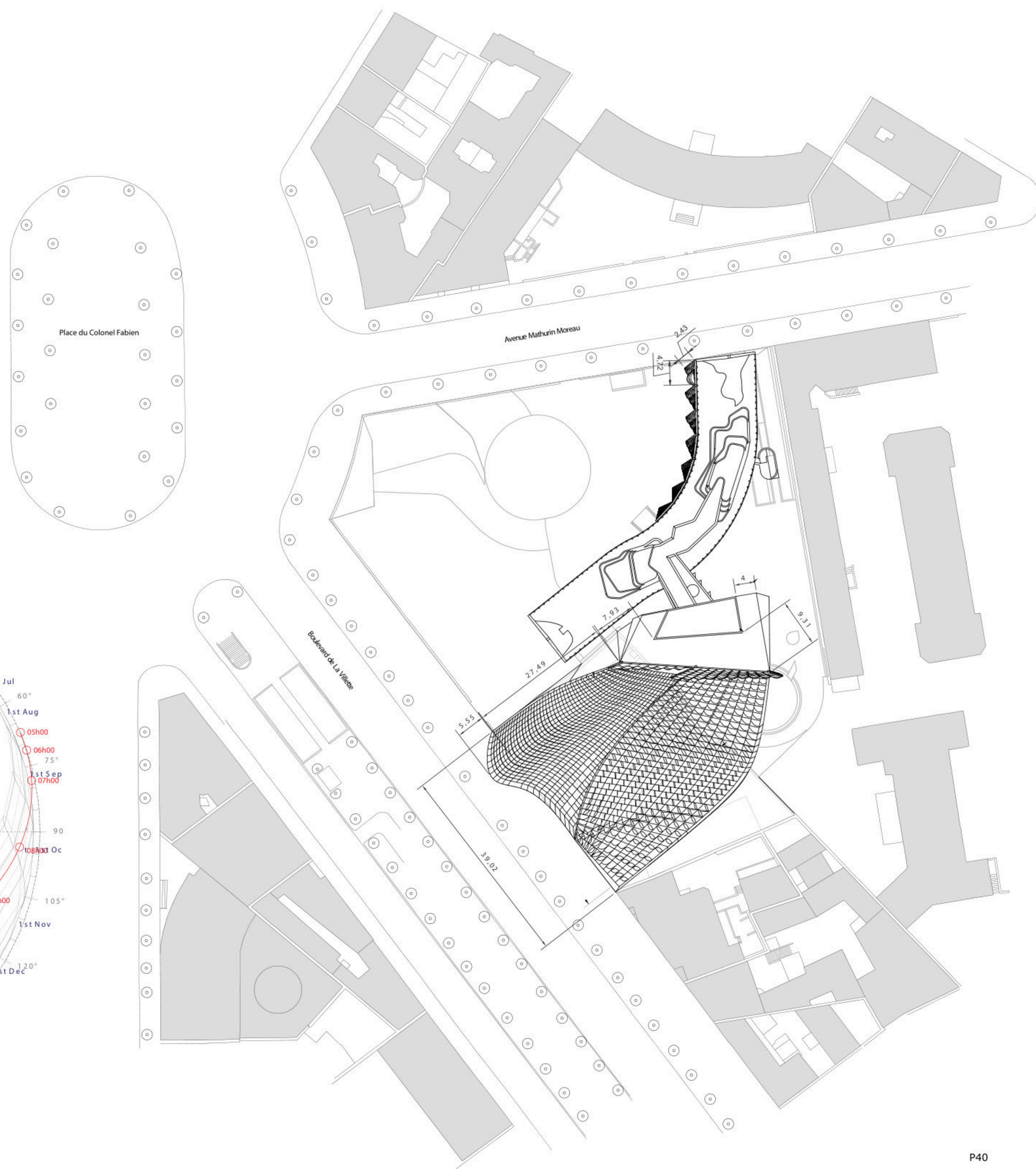
16h00

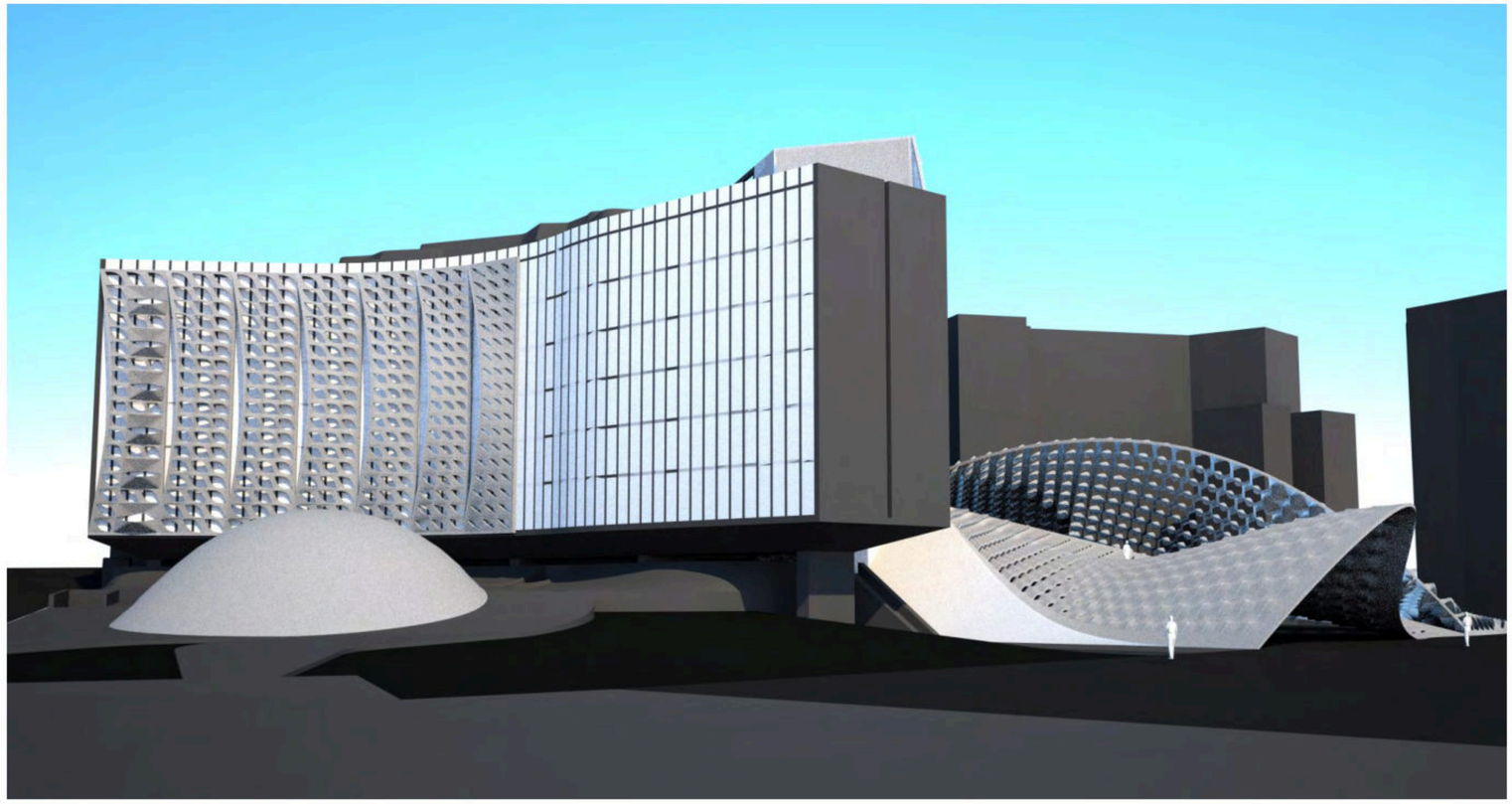


The sun start hitting the front facade in between 12h00 and 13h00
The northern part of the facade should be fully protected

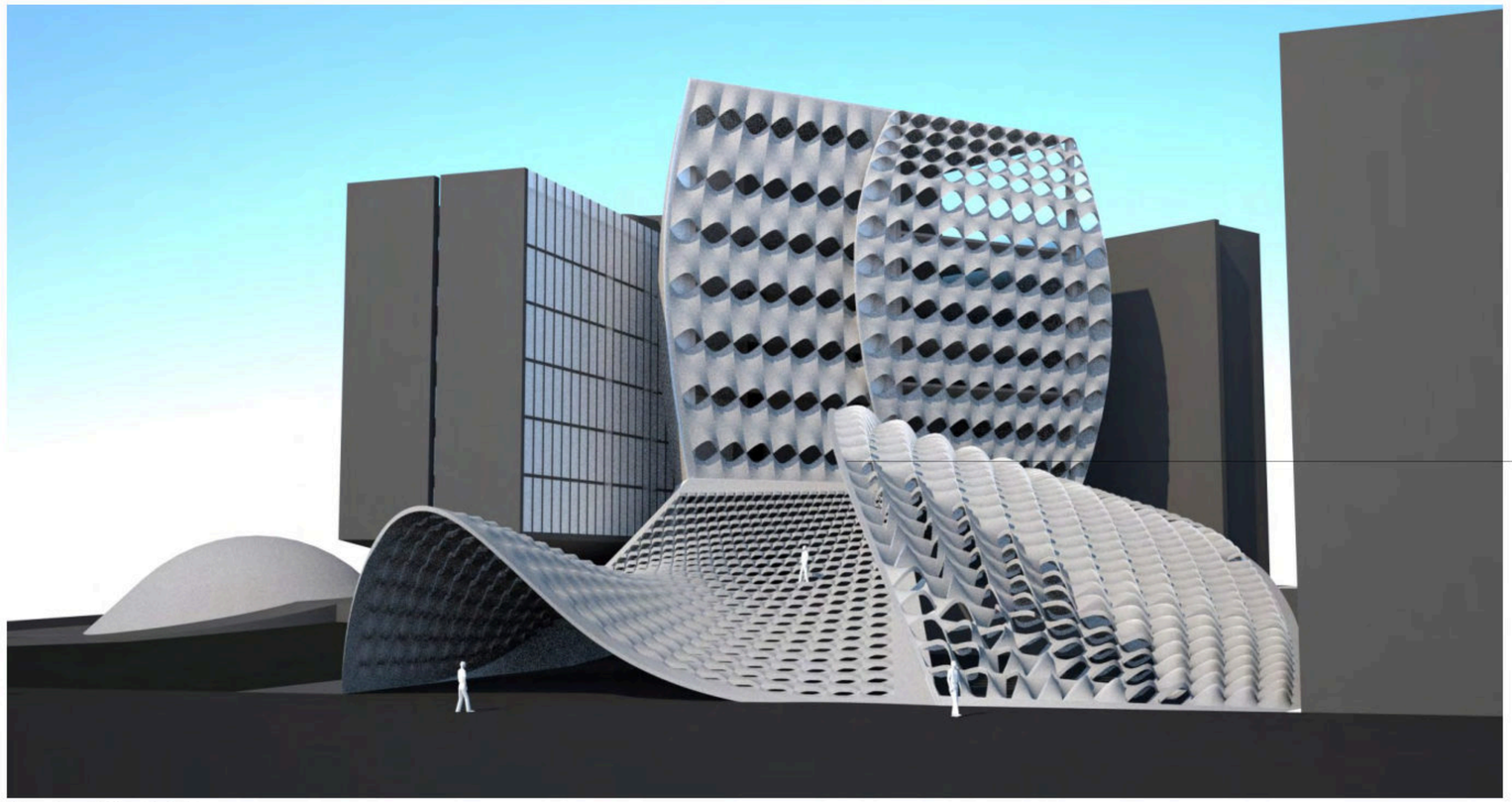
The sun start hitting the front facade fully after 15h00.
Before that, only half of the facade is being directly touched


N
15°
30°
45°
60°
75°
90
105°
120°
135°
150°
165°
180°
195°
210°
225°
240°
255°
270°
285°
300°
315°
330°
345°
1st Jun
1st Jul
1st Aug
1st Sep
1st Oct
1st Nov
1st Dec
1st Jan
1st Feb
1st Mar
1st Apr
1st May
Sun Path of the 1st
May in Paris, France
21h00
05h00
06h00
07h00
19h00
18h00
17h00
16h00
15h00
14h00
13h00
12h00
11h00
10h00
9h00

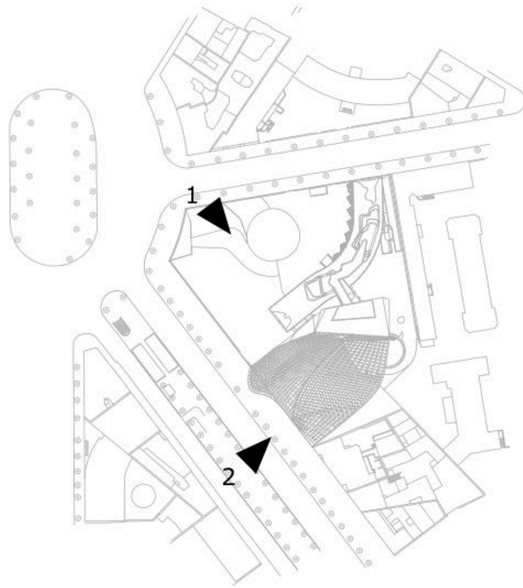

Place du Colonel Fabien
Avenue Mathurin Moreau
Boulevard de La Villette
2.43
4.72
4
7.93
9.31
27.49
5.55
39.07

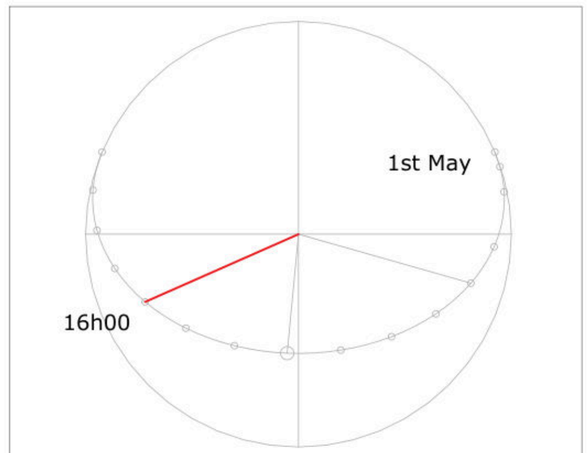


Render 1 Front View



Render 2 Back View





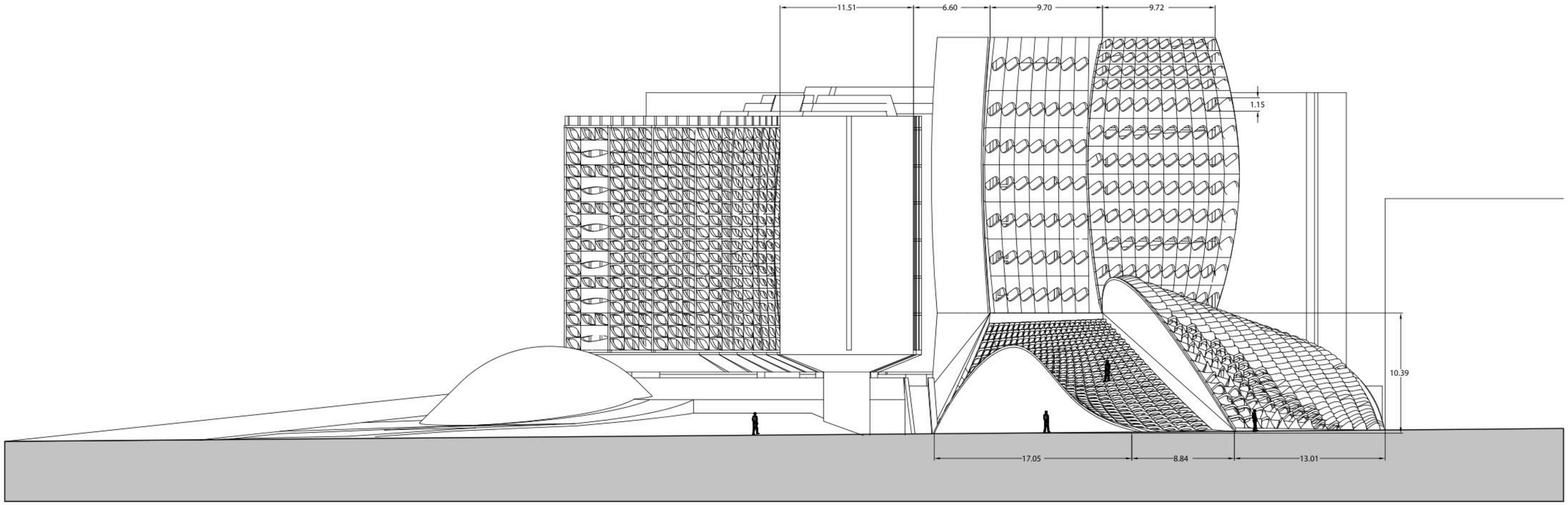
Global form orients itself to the above sun angle:
Only a soft and low winter afternoon sun light is let in.

MAIN PROBLEMS:

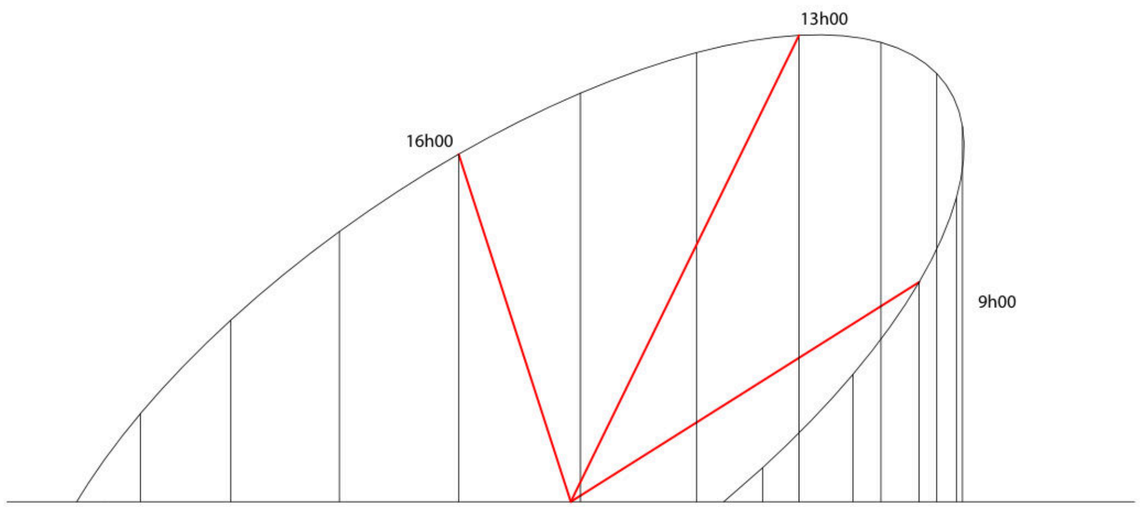
- In this initial Proposal the ground was reduced to the back of the existing building, making the relationship with the existing building quite weak. The ground should be the main feature of the proposal.

- There is no parametric relationship between surfaces (i.e. shaded area)

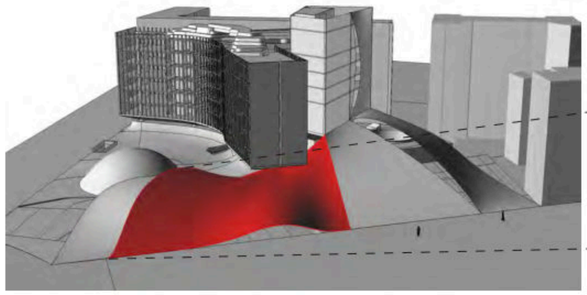
- The facade uses a unique component which makes it very monolithic



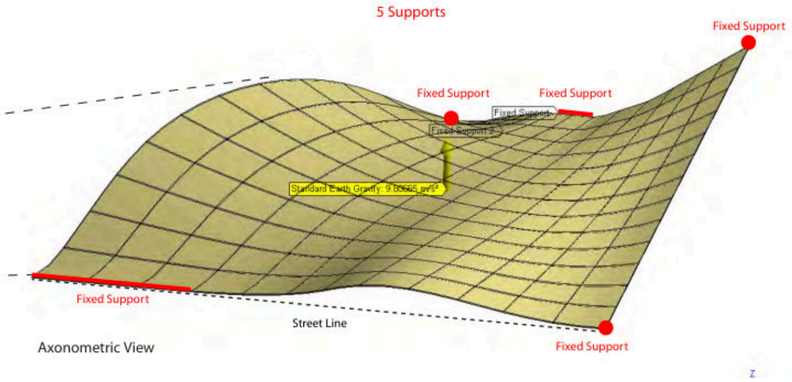
Initial Elevation
The democratic ground being the main connector between the urban context and the building there was a need to extend it. More diversity was needed for the facade as it still appeared monolithic.



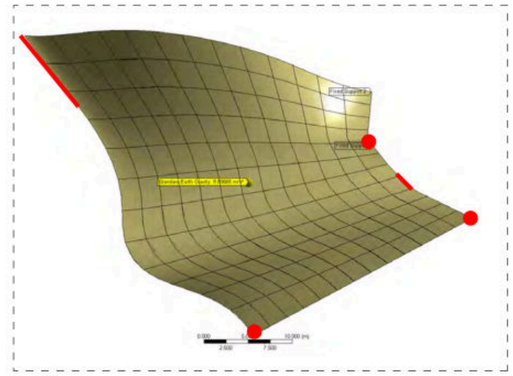
Parisian Solar Path on the 1st May
Both the small components and the overall shape are linked to these specific sun angles



Context

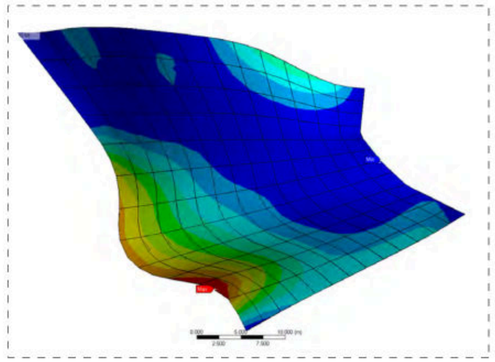


Axonometric View

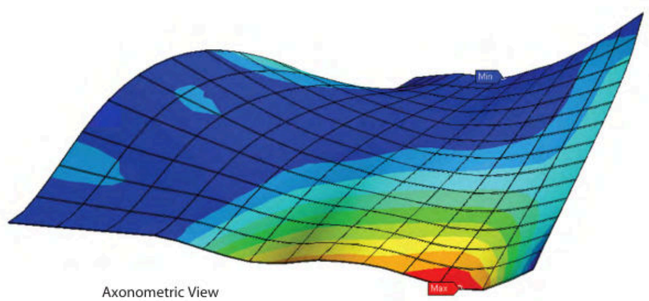


Plan View

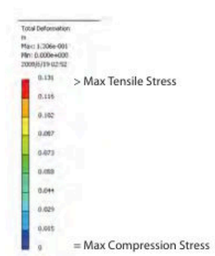
Total Deformation



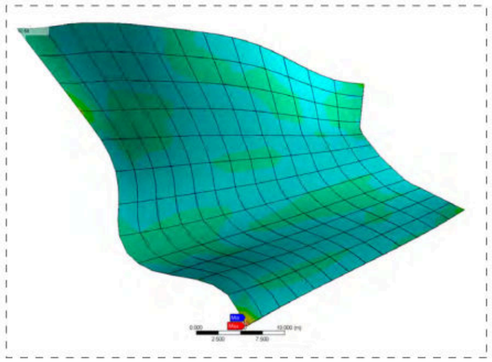
Plan View



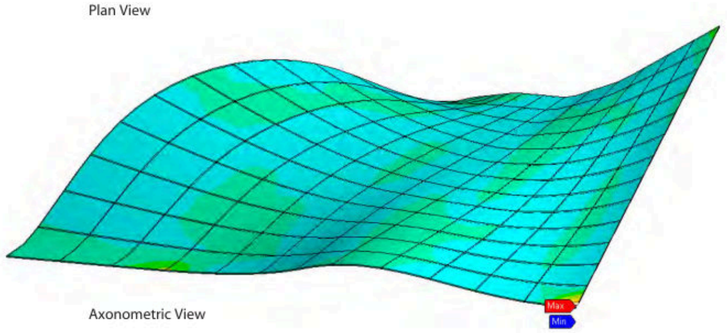
Axonometric View



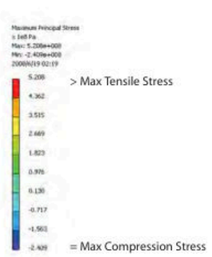
Maximum Principal



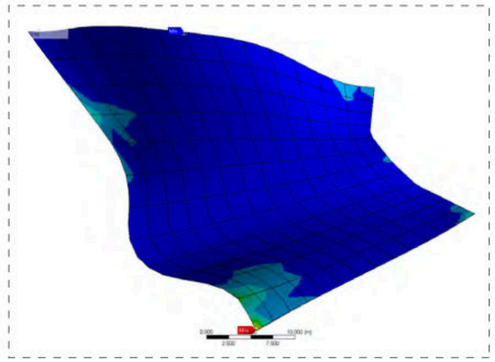
Plan View



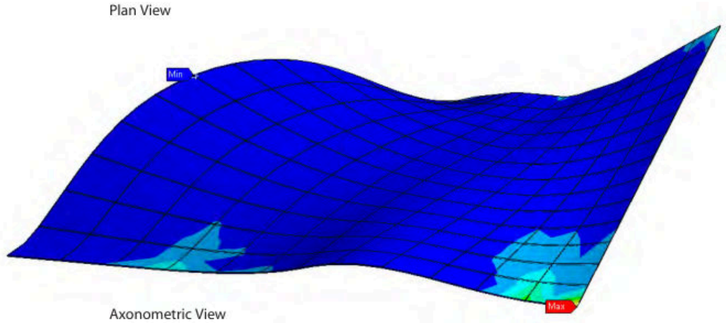
Axonometric View



Equivalent Stress

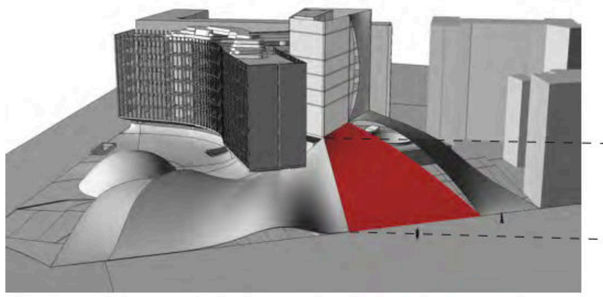


Plan View

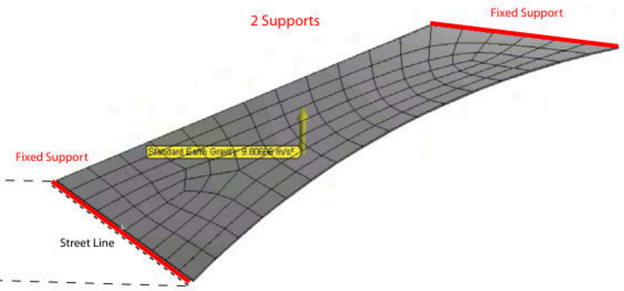


Axonometric View

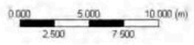


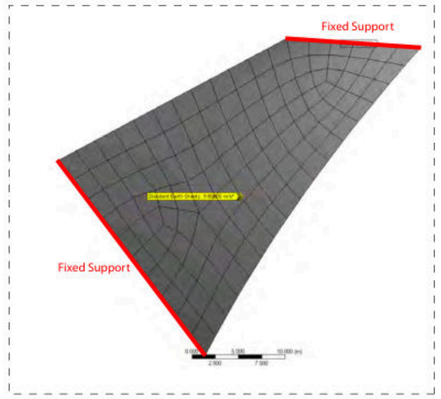


Context



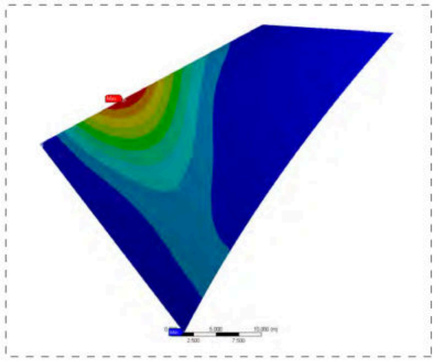
Axonometric View





Plan View

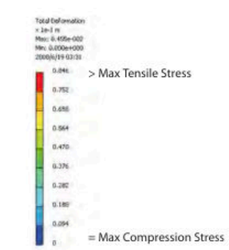
Total Deformation



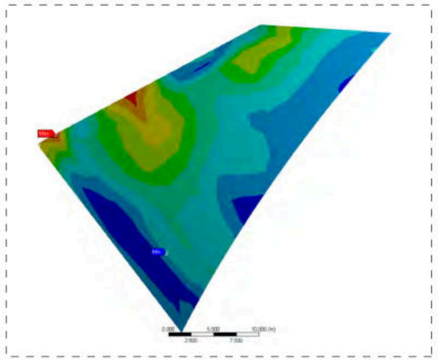
Plan View



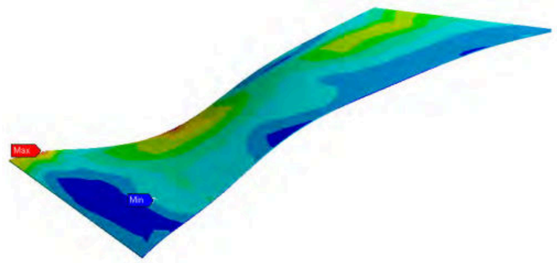
Axonometric View



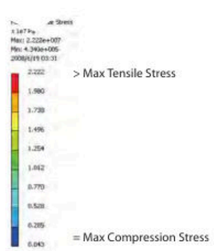
Maximum Principal



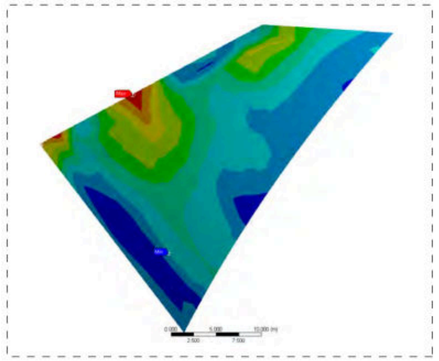
Plan View



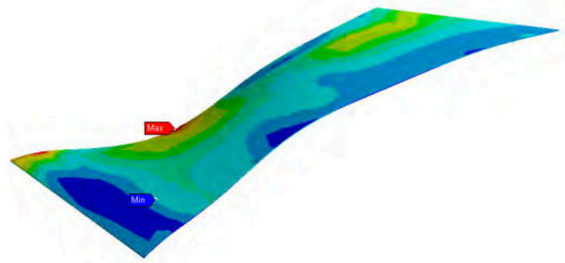
Axonometric View



Equivalent Stress



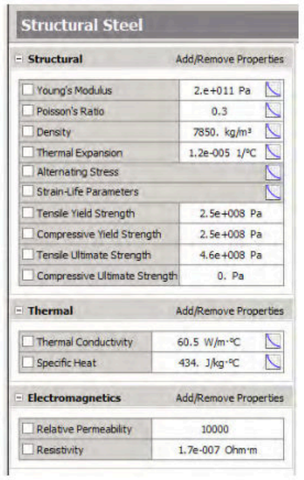
Plan View



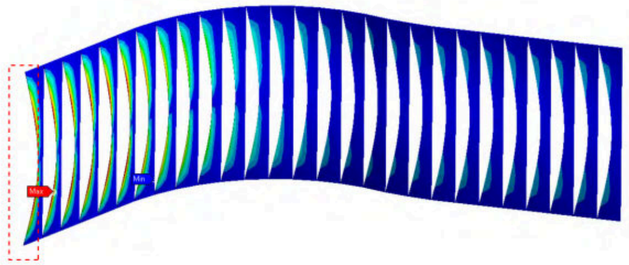
Axonometric View



Defining the material and comparing with results



Analysis of a single element on the facade



Previous model, three fixed supports on the edges
Thickness: 0.1 m
Sun Opening Width: 2m

Back Views

Total Deformation



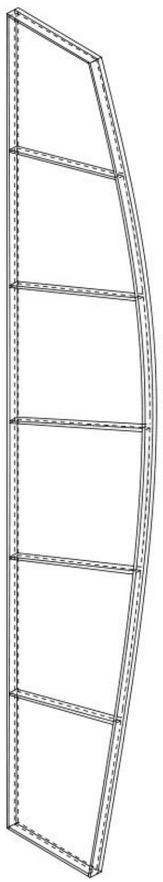
Equivalent Stress



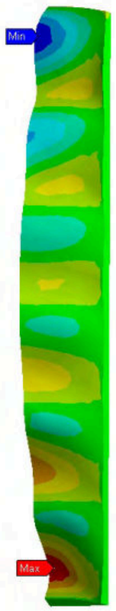
Maximum Principal



Set Up Back View



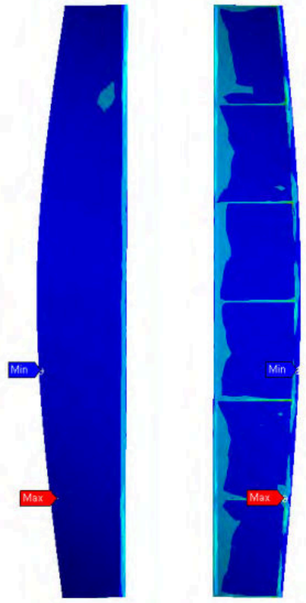
Total Deformation Front View



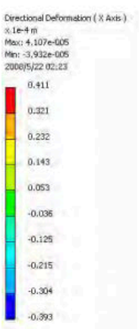
Maximum Principal Stress

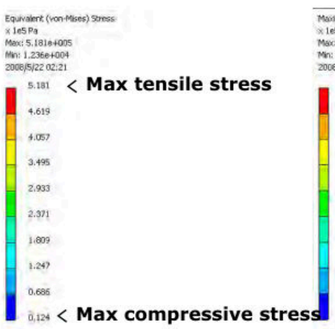


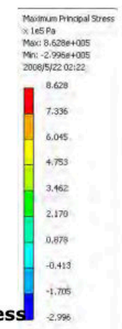
Equivalent Stress

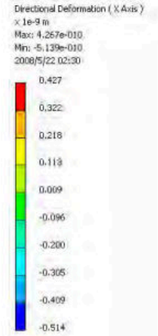


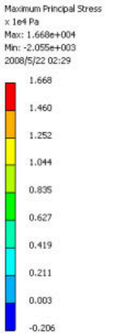
Supports

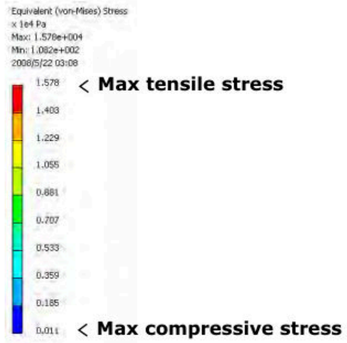








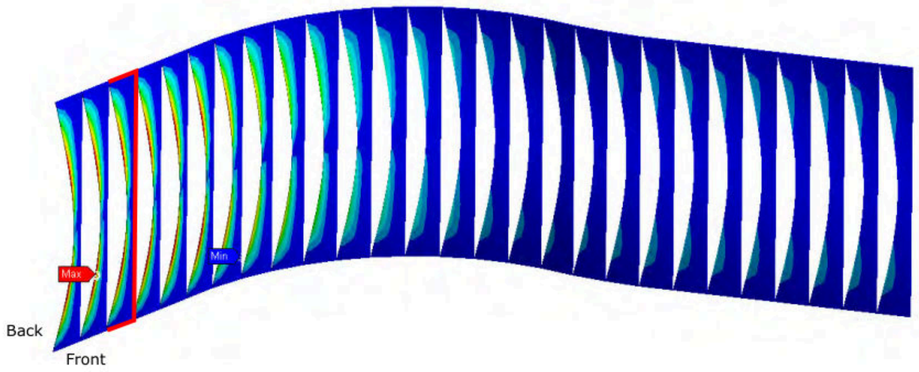




- Fixing the component to the floors and adding structural support to the edges distributes the stresses more evenly.

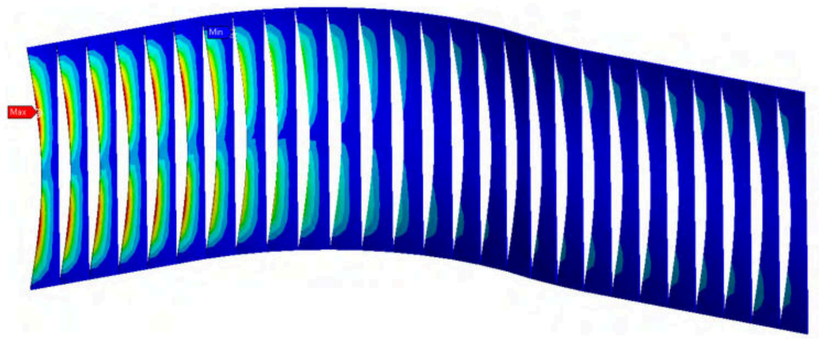
Total Deformation of the Simulated model
Thickness of model: 0.1 m
LWidth of Sun Opening: 2m

All the module are attached being assigned three fixed edges and earth gravity

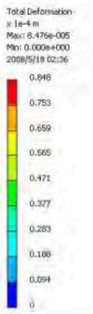


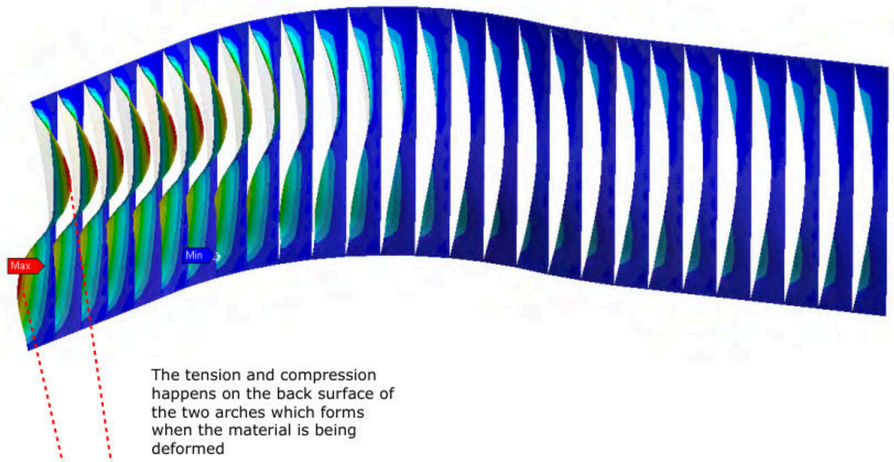
Maximum Principal Stress of a thicker model
Thickness of model: 0.2 m

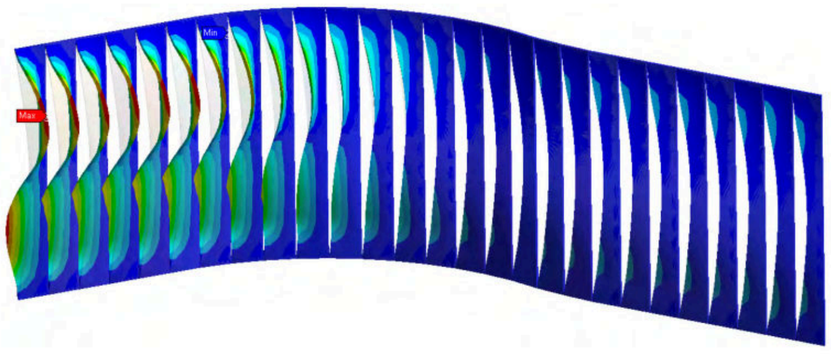




Exageration of the simulation times 0.5
(2.2e+004)

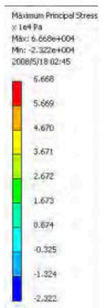




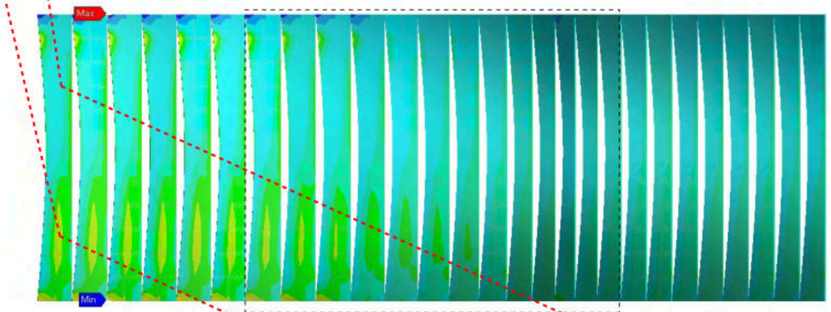


The tension and compression happens on the back surface of the two arches which forms when the material is being deformed

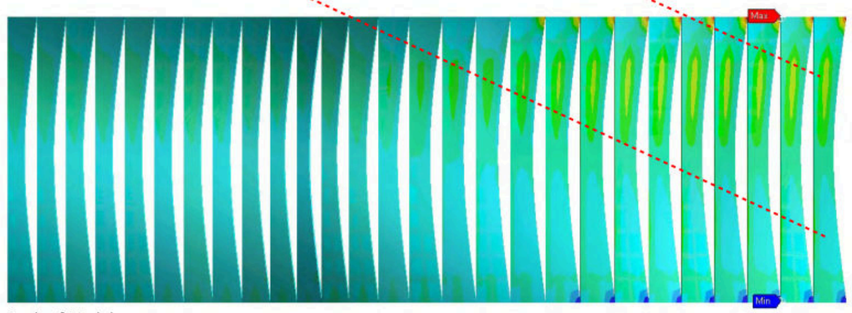
Maximum Principal Stress



Every element from in this frame is different which explains the gradient in the stress.

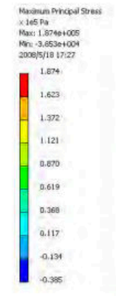


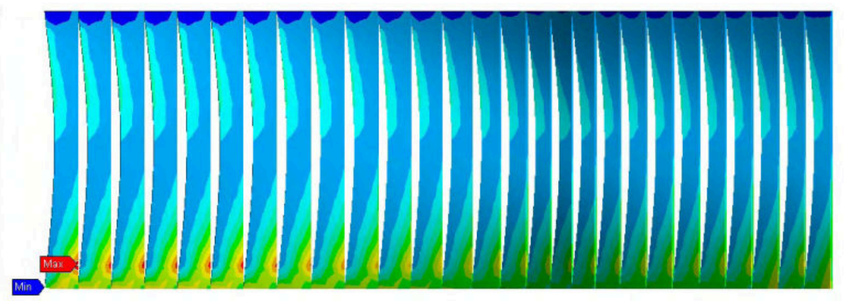
Front of Model

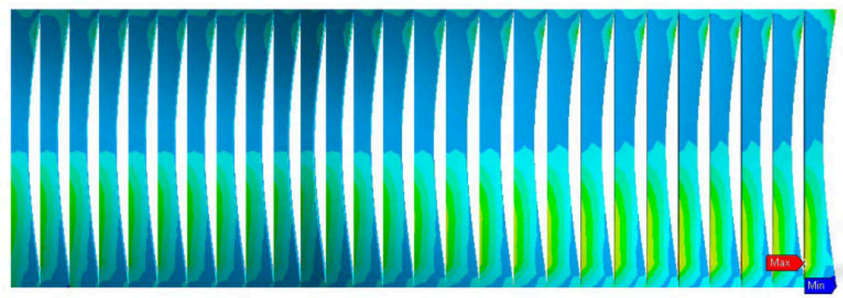


Back of Model

Maximum Principal Stress of a thicker model
Thickness of model: 0.2 m







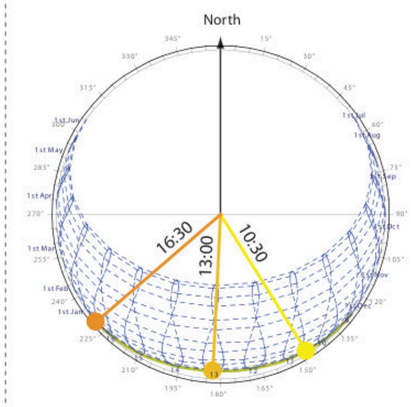
Conclusion:

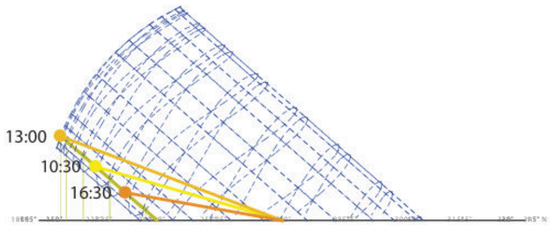
- Tension seems to be concentrated around one point near the lower part of the fully fixed vertical element.

- Compression follows a diagonal path from the upper right to lower left.

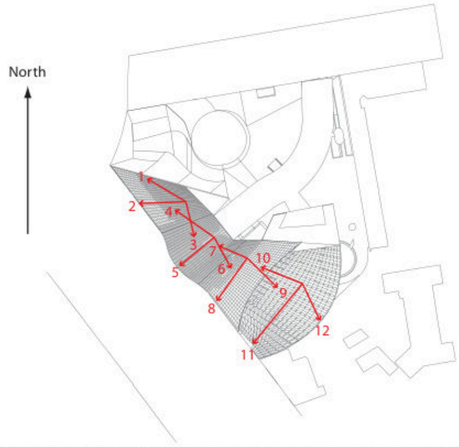
- The larger uniform thickness creates more stresses for an equal area.

Set-up for the testings





January 21 / Mid-October



Observations:

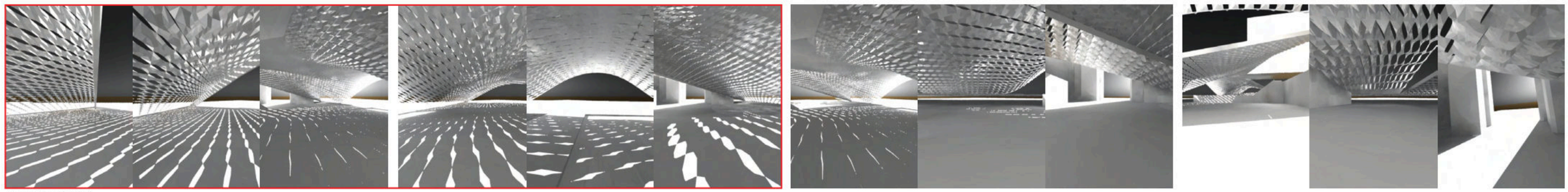
January 21st is in average the coldest day of the year in Paris (Source: Meteonorm Database) where temperature go negative. For this test we would want to see a large area of direct sun touching the ground as opposed to july or May.

10h30: Direct light enters in the morning mainly under the canopy part where views the six first view are located.

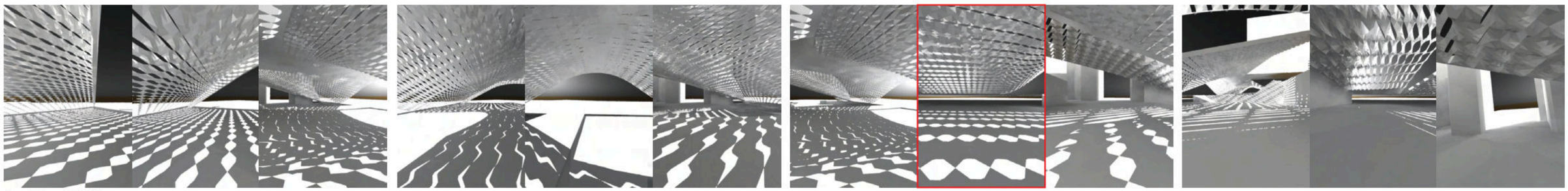
13h00: Almost all the views tend to confirm that more light patches enter the building during the coldest day than the hottest day, especially view 8.

16h30: Night

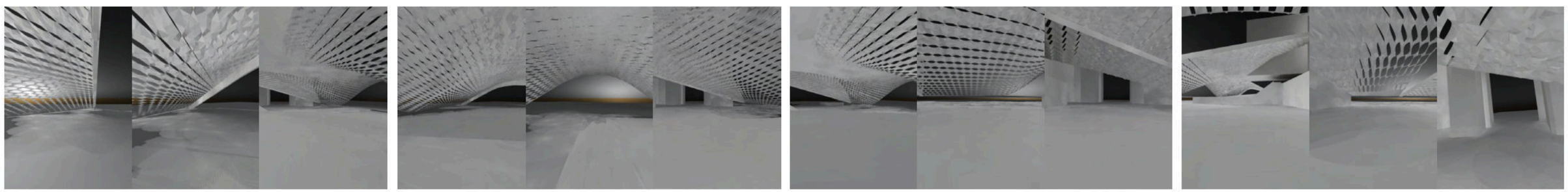
View 1 **View 2** **View 3** **View 4** **View 5** **View 6** **View 7** **View 8** **View 9** **View 10** **View 11** **View 12**



Jan 21 10:30

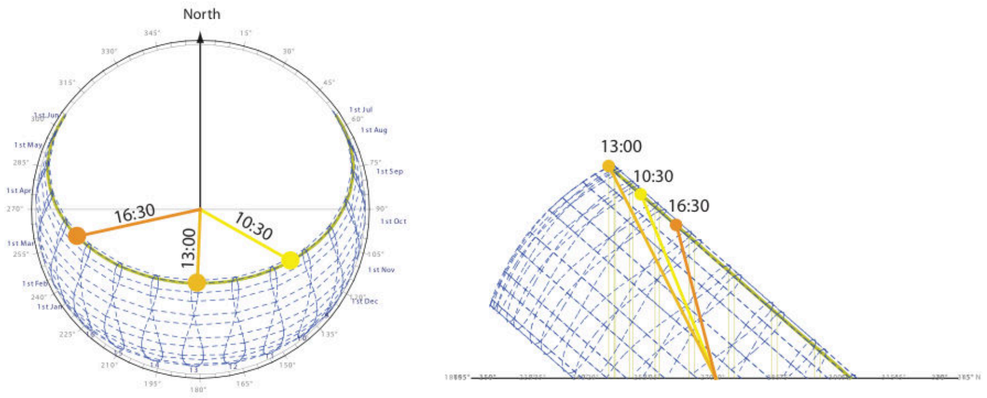


Jan 21 13:00

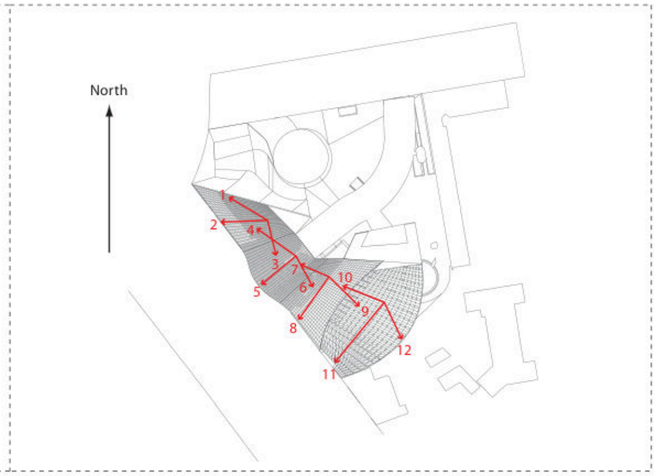


Jan 21 16:30

Set-up for the testings



July 12 / Mid-June



Observations:

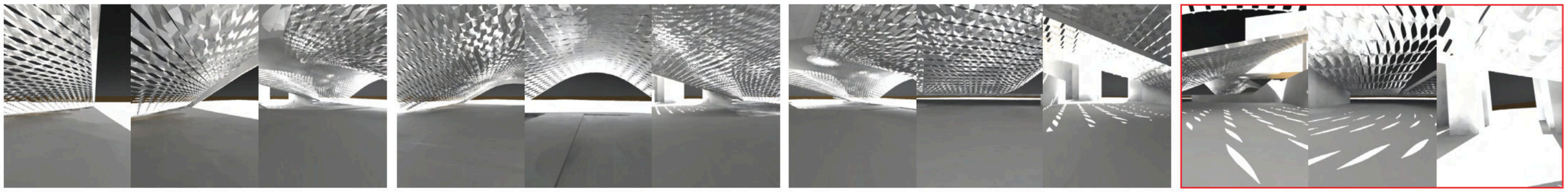
July 12this the hottest day in average in Paris (Source: Meteonorm Database). Idealy, NO DIRECT SUN should enter at all. The curvature of the component is not designed according to the curvature of the but only for one hour of a day therefore in the afternoon light still enters the building. Since the afternoon and the mornings are cooler, those patches could be asppropriate.

10h30: More direct light enters through the large component of th sculpture yard than in May.

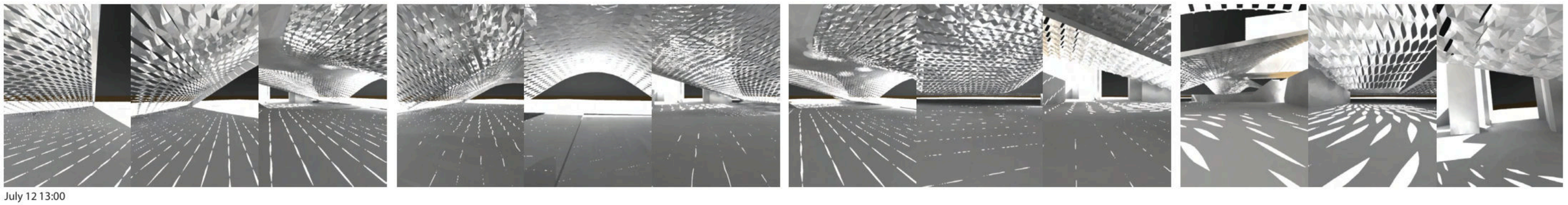
13h00: The patches of direct light are almost invisible.

16h30: The area that received a lot of direct light in the 1st May test receives less light.

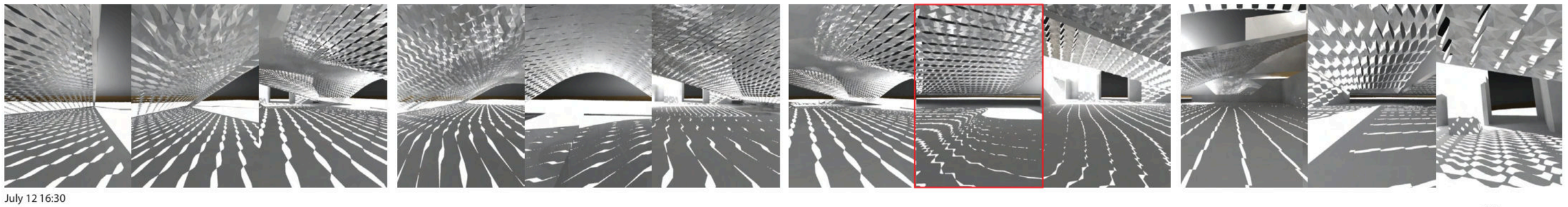
View 1 View 2 View 3 View 4 View 5 View 6 View 7 View 8 View 9 View 10 View 11 View 12



July 12 10:30

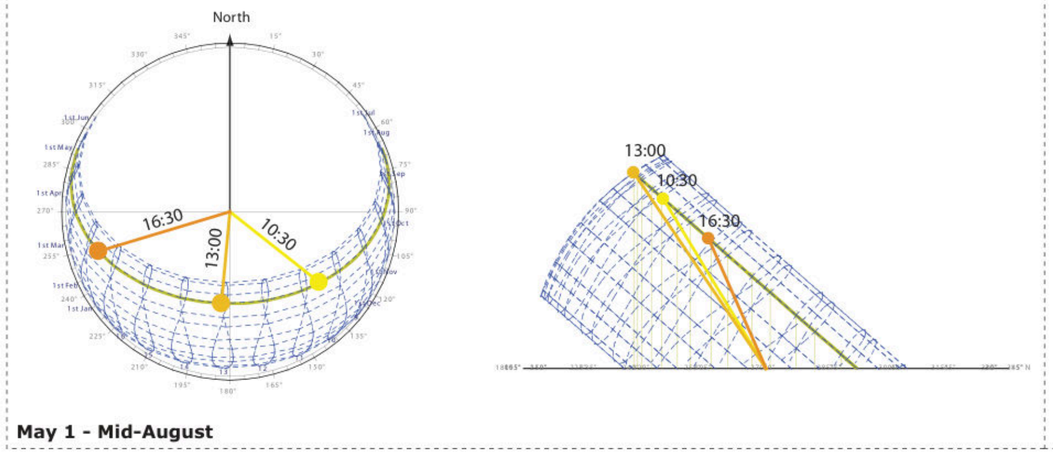


July 12 13:00



July 12 16:30

Set-up for the testings



May 1 - Mid-August

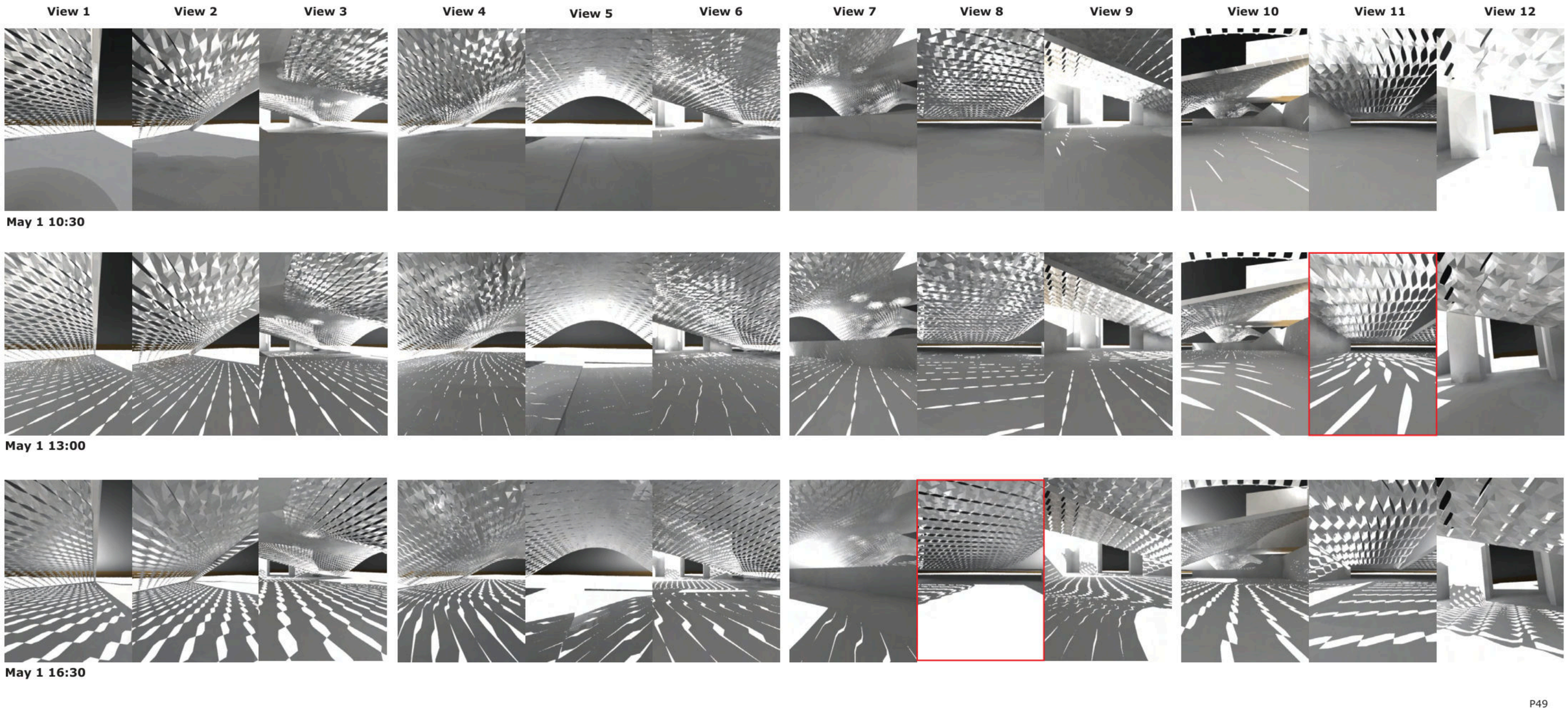
Observations :

The Sun-path Curve of 1st May - 15th August is the main driver for the entire design. Before this period, the Sun enters the building to warm it up, after it blocks everything. This is in theory. This test should prove if it works practi-caly.

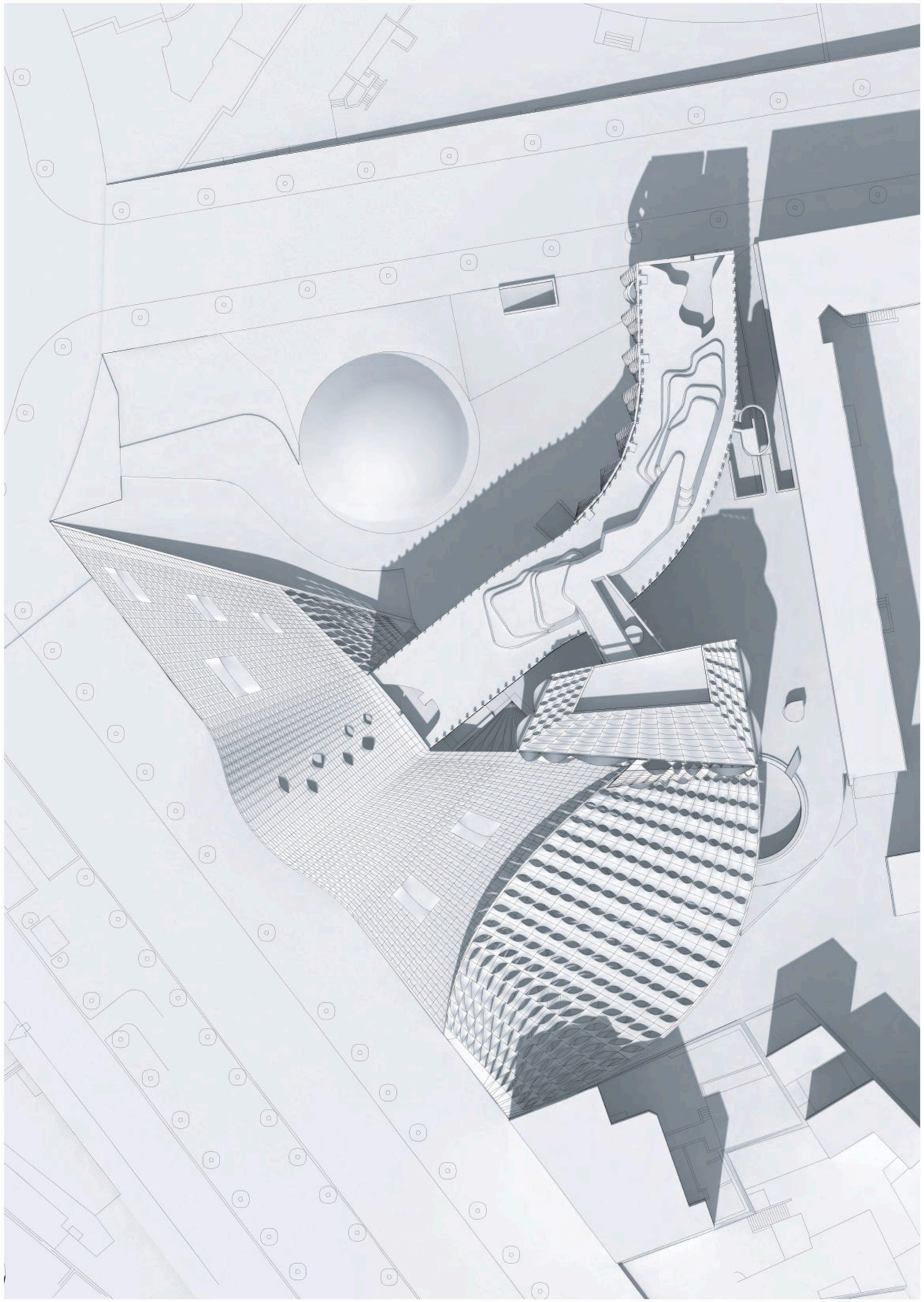
- 10h30: Almost no direct light hits the ground.

- 13h00: The patches of direct light that enter the building are quite thin under the stair component but much larger under the roof element covering the sculpture yard (highlighted in red).

- 16h30: The patcher are much wider but still covers less than half the ground of the building. A very large patch of direct light enters the building through the front opening on View 8 (Highlighted).



Green Re-Articulates Red



Green Re-Articulates Red
10.1. Roof Plan in Urban Context

0 4 8 16 32 64m

Public entrance
under canopy

Public entrance
Through Staircase
"democratic ground"

Existing Market Place
which could be linked to
covered Market under
canopy



Green Re-Articulates Red
10.2. Roof Plan

5400
5690
6100(TOPO)
6000(TOPO)
5800(TOPO)
5700(TOPO)
5600(TOPO)
5500(TOPO)
5943
5845
6180
5614
B
5550
5500 (Topo)
5500 (Topo)
A
5900
5500 (Topo)
6180
5580
C
5820
6000(TOPO)
5700(TOPO)
0 4 8 16 32 64m

Green Re-Articulates Red
10.2. Common Plan

5690
5400
6100(TOPO)
6000(TOPO)
Possible re-organisation of interior
with a "buffer zone" corridor behind
protected facade.
5500(TOPO)
5600(TOPO)
5943
6180
5614
A
5550
5500 (Topo)
5500 (Topo)
B
5500 (Topo)
5580
C
5820
6000(TOPO)
Art Gallery
Separate access from main building
6180
5700(TOPO)
0 4 8 16 32 64m

Green Re-Articulates Red
10.4. Ground Level Plan

0 2 4 8 16 32m

Market Place

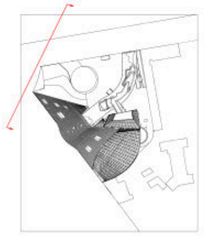
Public / Service Entrance

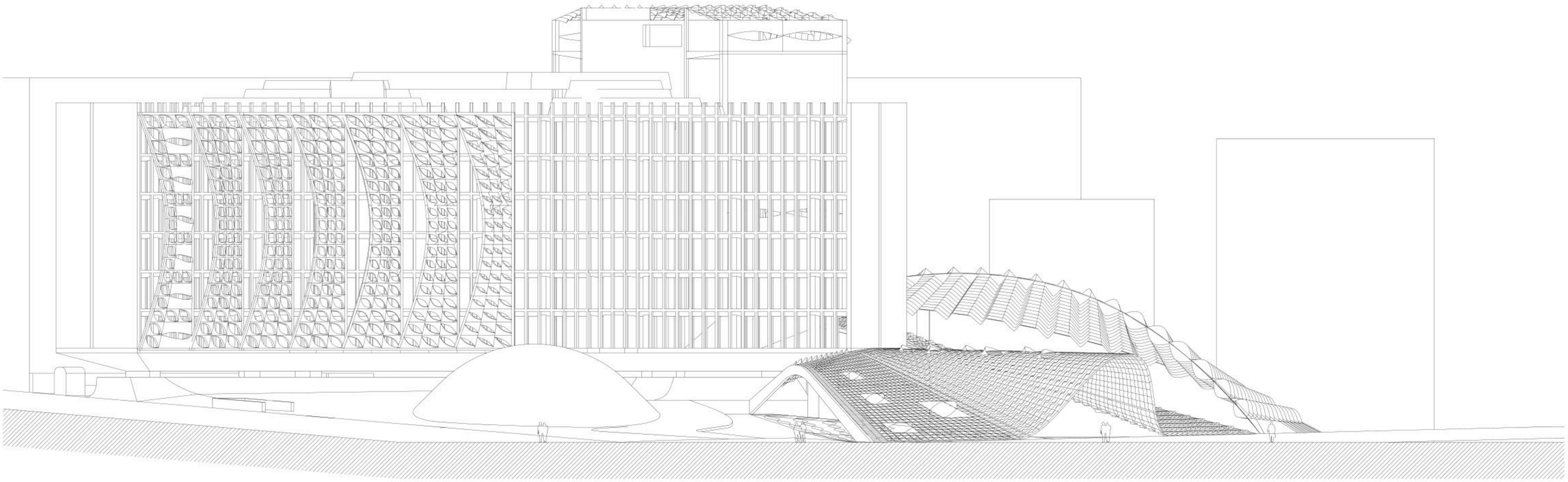
PCF Lower-Ground Level Entrances

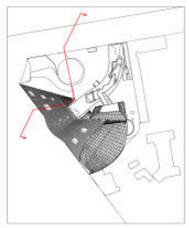
Sculpture Courtyard

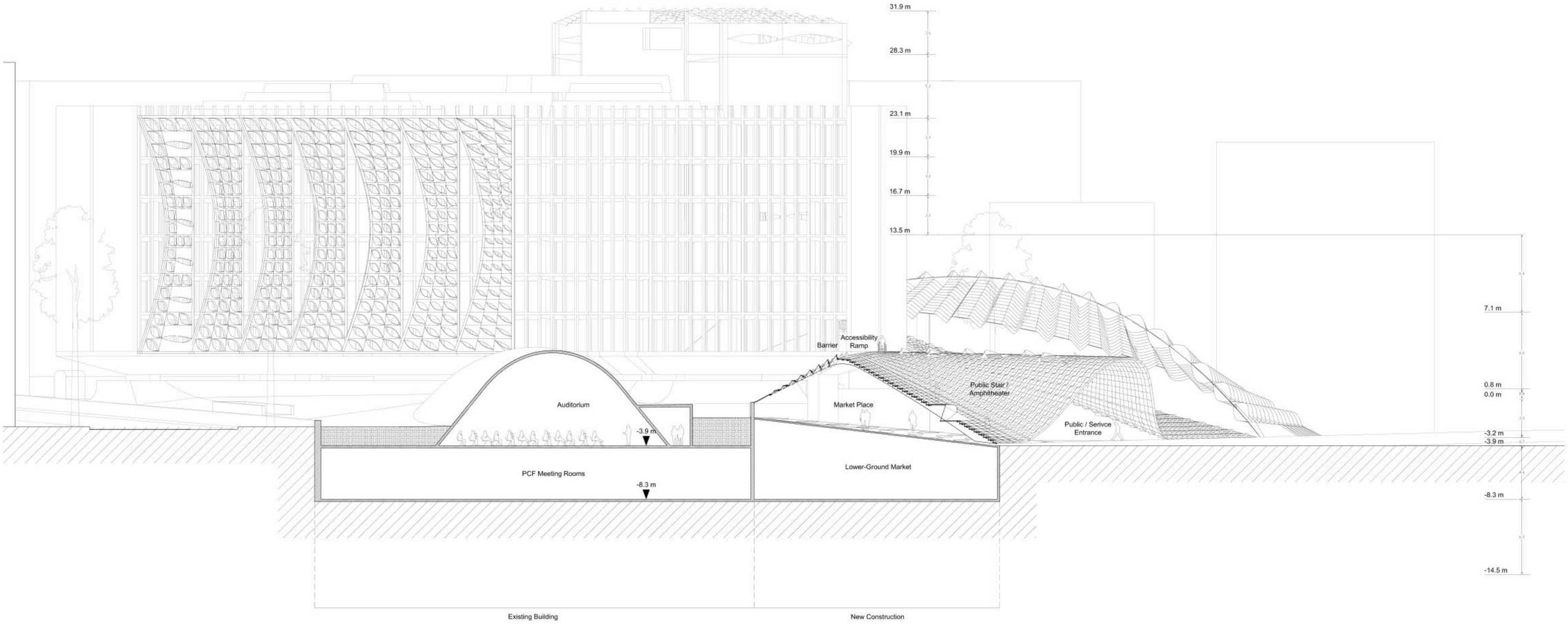
Green Re-Articulates Red
10.5bis Elevation towards existing building

0 1 2 4 8 16m



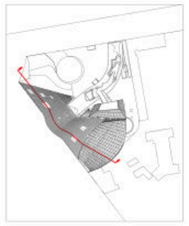


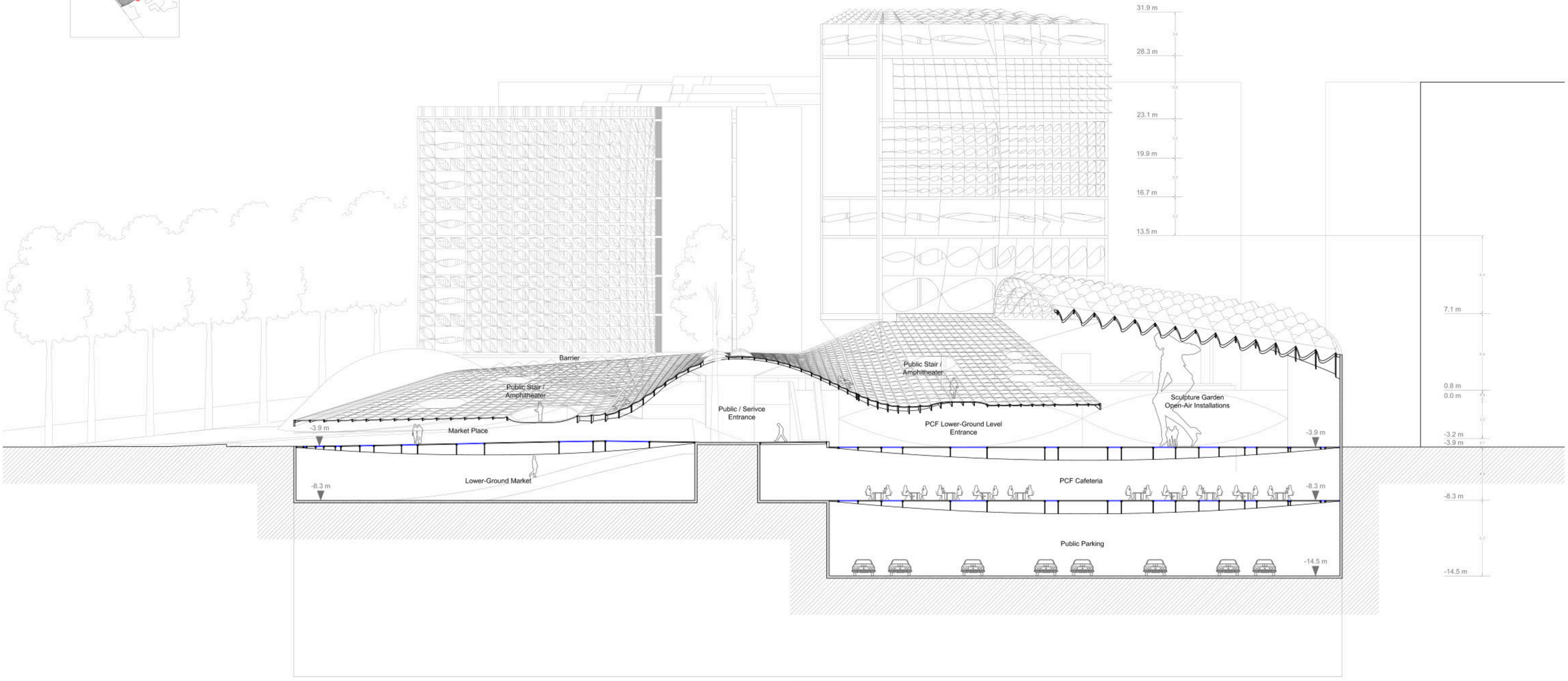



31.9 m
28.3 m
23.1 m
19.9 m
16.7 m
13.5 m
7.1 m
0.8 m
0.0 m
-3.2 m
-3.9 m
-8.3 m
-14.5 m
Barrier
Accessibility Ramp
Public Stair / Amphitheater
Market Place
Public / Serivce Entrance
Auditorium
-3.9 m
PCF Meeting Rooms
-8.3 m
Lower-Ground Market
Existing Building
New Construction

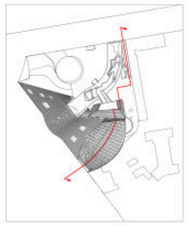
Green Re-Articulates Red
10.6. Section B

0 1 2 4 8 16m

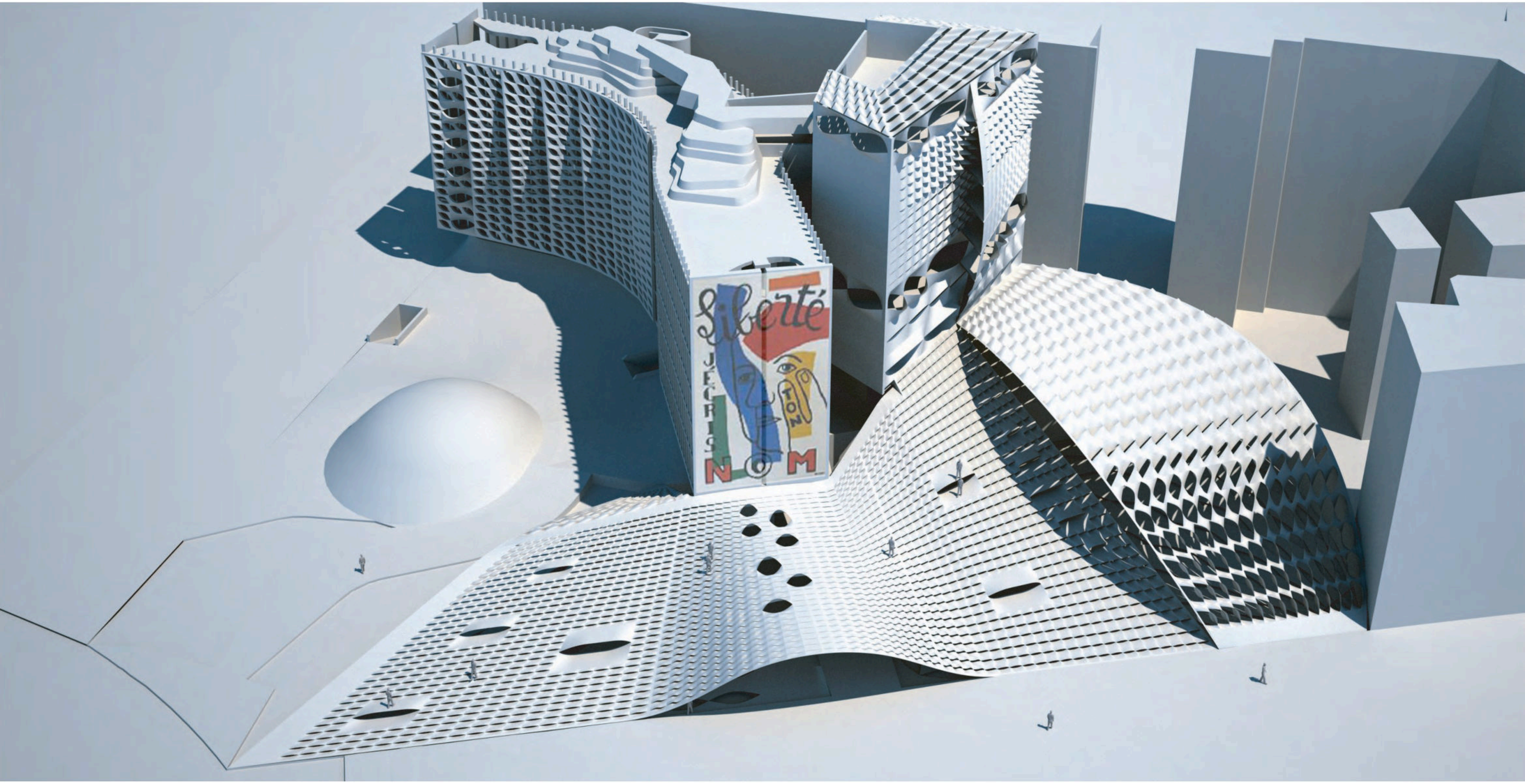




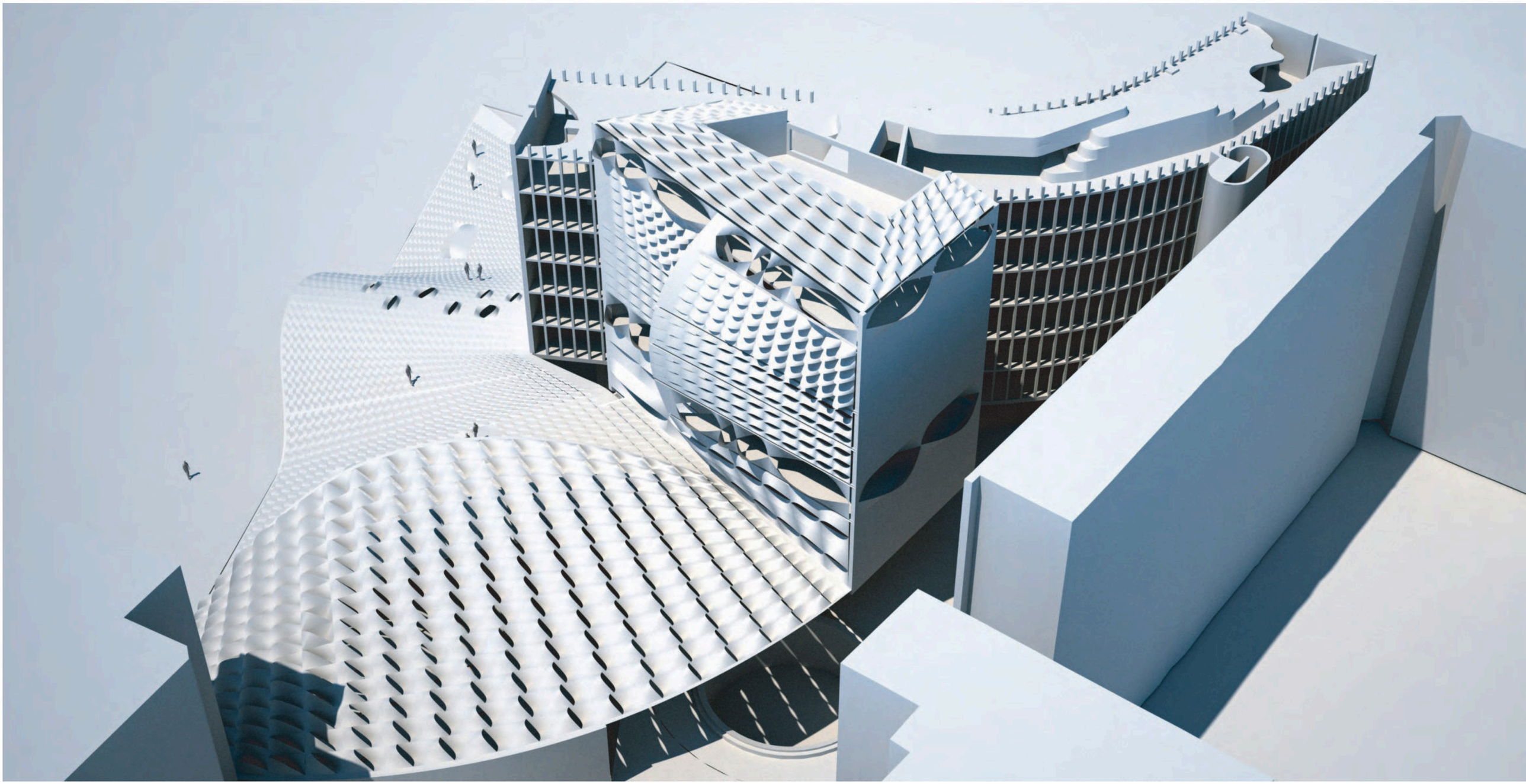
0 1 2 4 8 16m

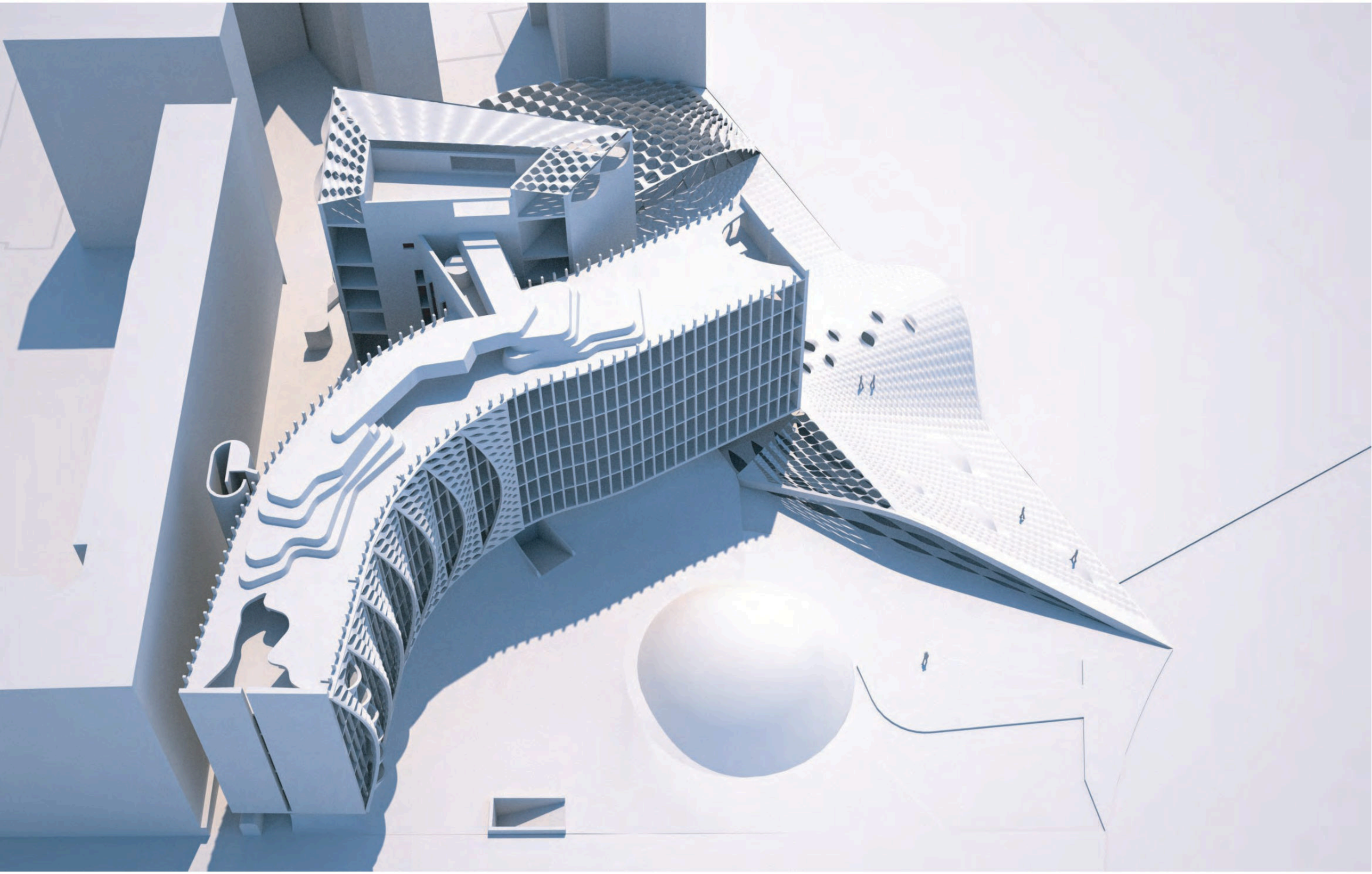


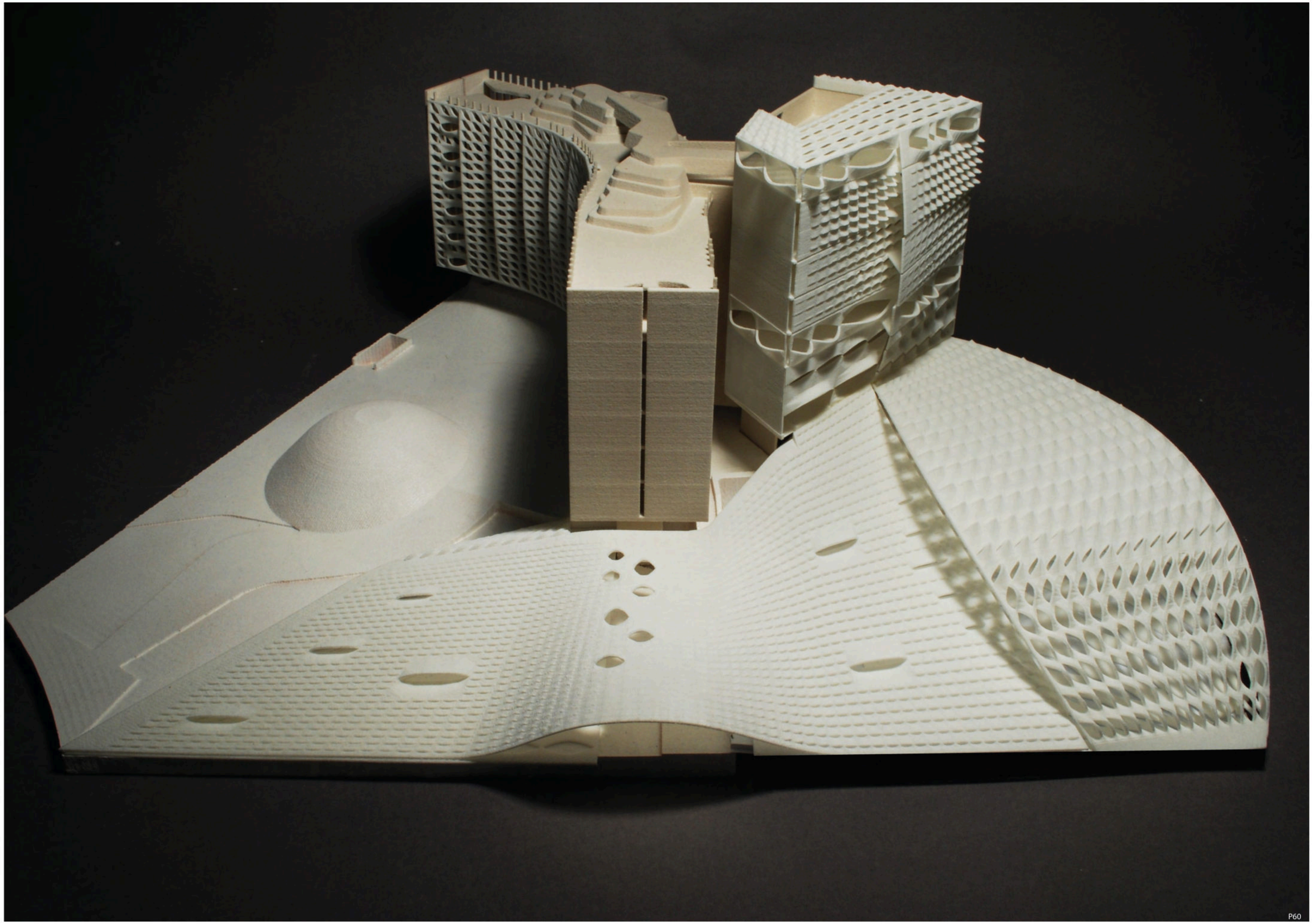
1st May, 13h00
1st May, 13h00
1st May, 13h00
South Angle
25th December, 13h00
1st May, 13h00
22nd June (Highest Sun Angle), 13h00
22nd June, 13h00
25th December (Lowest Sun Angle), 13h00
25th December, 13h00
31.9 m
Cafe / Restaurant
28.3 m
28.3 m
Art Gallery
23.1 m
23.1 m
Library Third Floor
19.9 m
19.9 m
Library Second Floor
16.7 m
16.7 m
Library first floor
13.5 m
13.5 m
Sculpture Garden
Open-Air Installations
7.1 m
7.1 m
0.8 m
0.8 m
0.0 m
0 m
-3.2 m
-3.2 m
-3.9 m
-3.9 m
PCF Cafeteria
-8.3 m
-8.3 m
Public Parking
-14.5 m
-14.5 m
New Construction
Existing Building

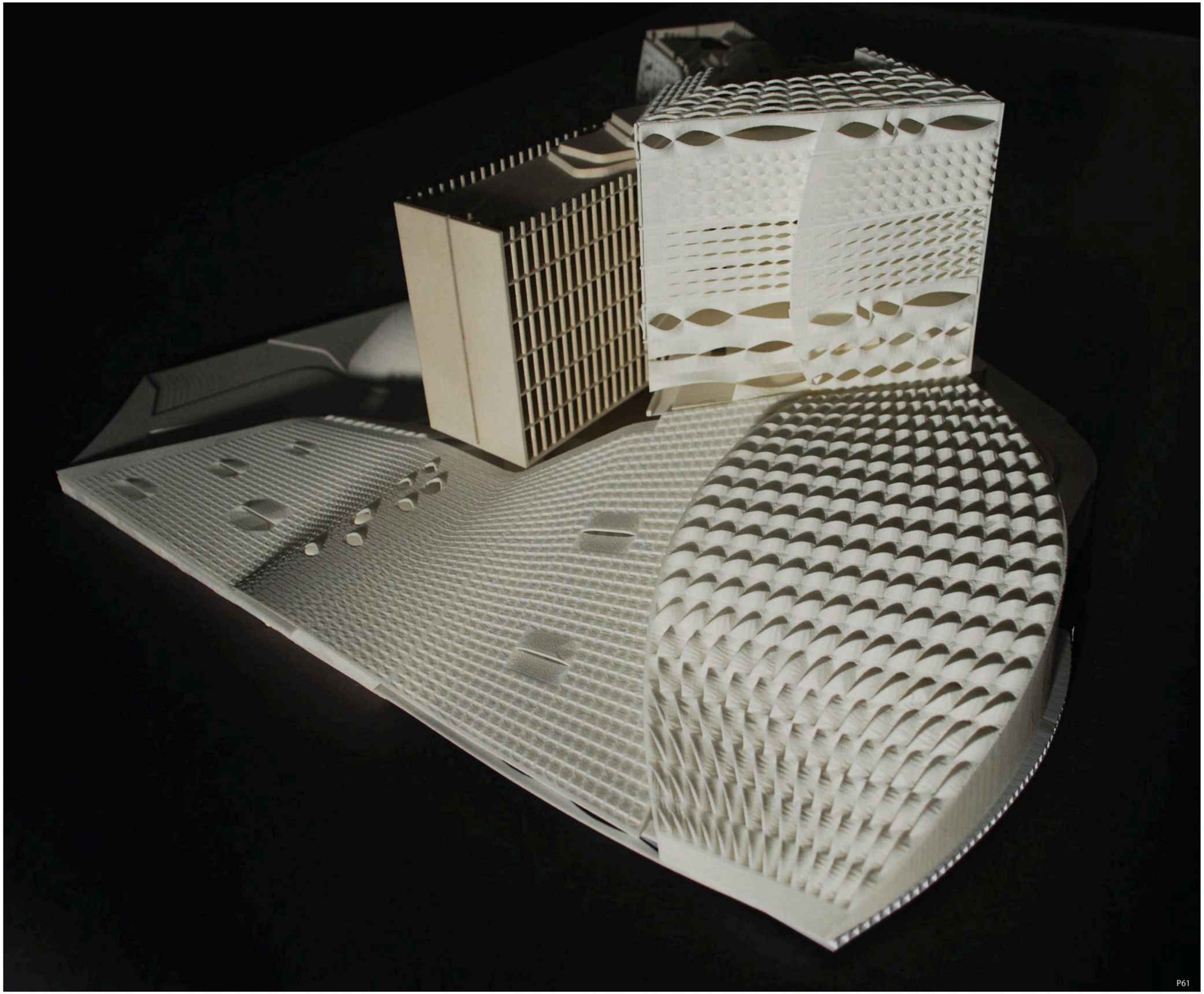

Liberté
FRANÇAIS
NON

Green Re-Articulates Red
11.2 View towards the Art Gallery









Green Re-Articulates Red: Ground and Daylight Transformations of the French Communist HQ

Acknowledgment:

First I would like to thank all my family and especially my parents Alain and Chantal Mamou-Mani for their constant love and support.

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