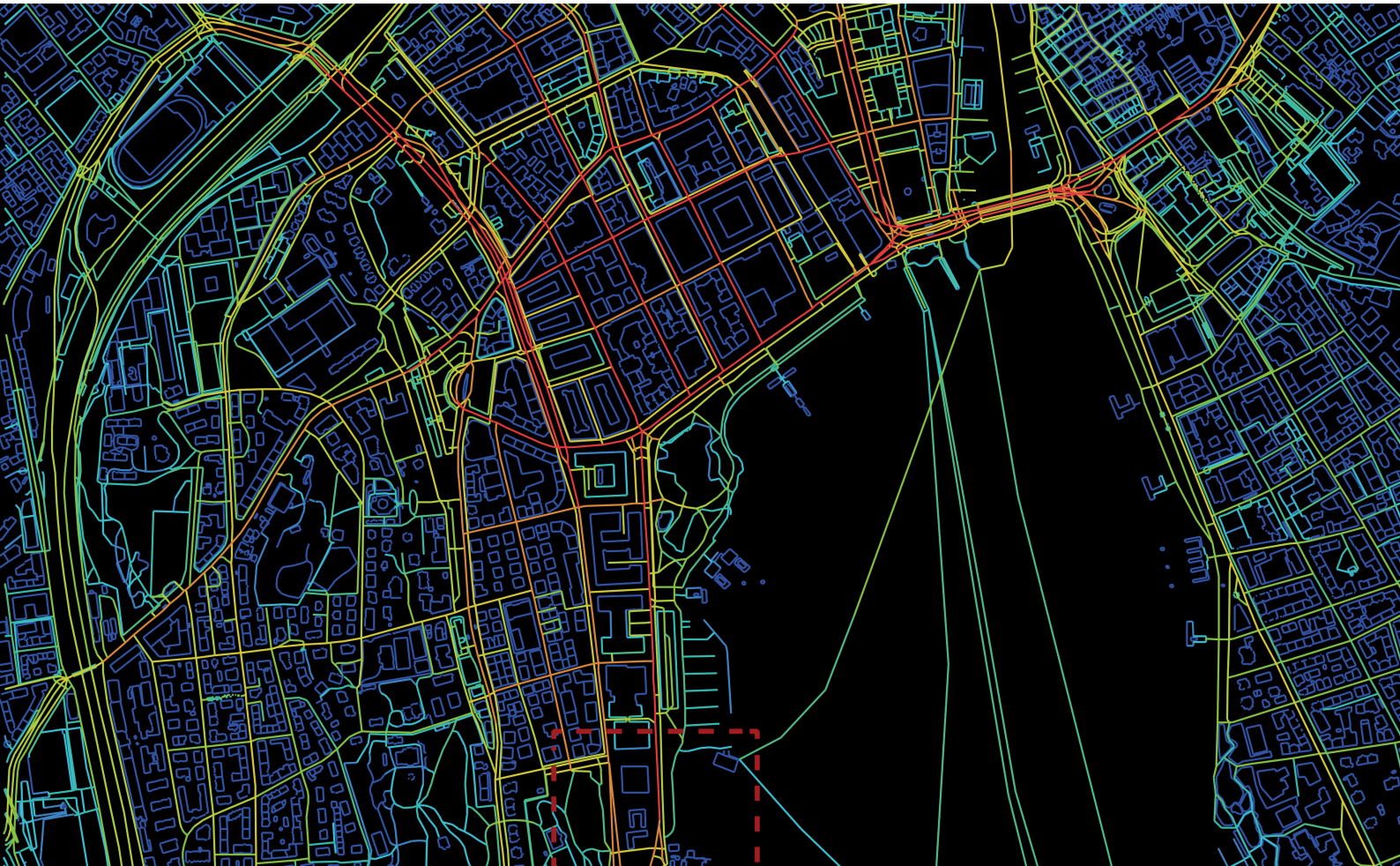


Documentation of the teaching results from the fall semester 2015

# Digital Urban Simulation

Reinhard König, Estefania Tapias, and Gerhard Schmitt



**DARCH**



Chair of Information Architecture

# Digital Urban Simulation

Documentation of teaching results

Reinhard König, Estefania Tapias, and Gerhard Schmitt



Chair of Information Architecture

## Teaching

Reinhard König, Estefania Tapias, and Gerhard Schmitt

## Syllabi

<http://www.ia.arch.ethz.ch/category/teaching/hs2015-digital-urban-simulation/>

## Seminar

New Methods in Urban Analysis and Simulation

## Students

## Published by

Swiss Federal Institute of Technology in Zurich (ETHZ)  
Department of Architecture  
Chair of Information Architecture  
Wolfgang-Pauli-Strasse 27, HIT H 31.6  
8093 Zurich  
Switzerland

Zurich, January 2016

## Layout

Brigitte M. Clements

## Contact

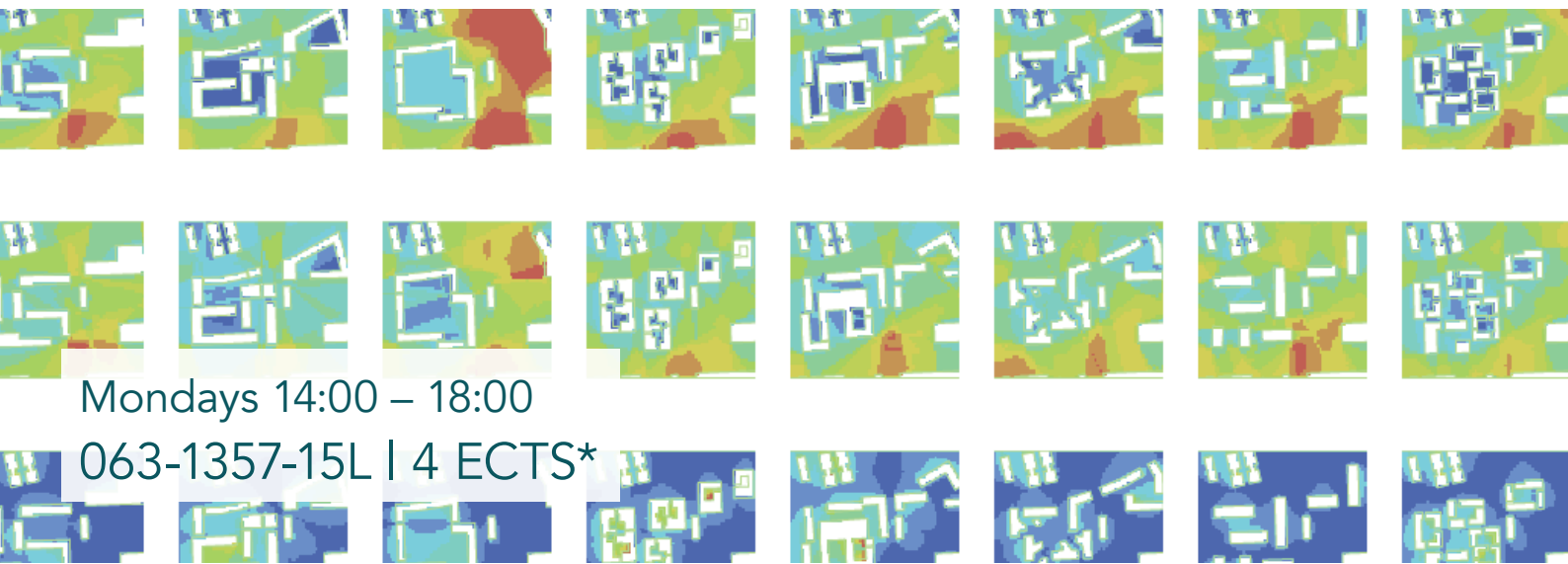
[reinhard.koenig@arch.ethz.ch](mailto:reinhard.koenig@arch.ethz.ch) | <http://www.ia.arch.ethz.ch/koenig/>

Cover picture:

Front side: Alberto Oliver Mercado, Segment Analysis, Zurich



# Course Description and Program



Mondays 14:00 – 18:00

063-1357-15L | 4 ECTS\*

## Digital Urban Simulation

In this course students analyze architectural and urban design using current computational methods. Based on these analyses the effects of planning can be simulated and understood.

An important focus of this course is the interpretation of the analysis and simulation results and the application of these corresponding methods in early planning phases.

The students learn how the design and planning of cities can be evidence based by using scientific methods. The teaching unit convey knowledge in state-of-the-art and emerging spatial analysis and simulation methods and equip students with skills in modern software systems. The course consists of lectures, associated exercises, workshops as well as of one integral project work.

### Where

HIT H 31.4 (Video wall)

### Supervision

Dr. Reinhard König

[reinhard.koenig@arch.ethz.ch](mailto:reinhard.koenig@arch.ethz.ch)

Estefania Tapias

[tapias@arch.ethz.ch](mailto:tapias@arch.ethz.ch)

21.09.2015	<b>Introduction to the course</b> Rhino/Grasshopper tutorial
28.09.2015	<b>Space syntax I</b> E1 - Convex Map, Axial Map of a small area
05.10..2015	<b>Space syntax II</b> E2 - Depthmap & GIS: Prepare data -> Import data -> Analysis methods
12.10.2015	<b>Empirical studies</b> E3 - Collect data (evaluate existing materials)
19.10.2015	<b>Seminar week</b> (No lecture)
26.10..2015	<b>Microclimate analysis I</b> E4 - Ecotect Tutorial I. Analysis of a small urban area.
02.11.2015	<b>Microclimate analysis II</b> E5 - Ecotect Tutorial I. Analysis of a small urban area.
09.11.2015	<b>Best practice examples - Guest lecture, consultation</b>
16.11.2015	<b>Workshop</b> E6 - Data Analysis (Matthias Standfest)
23.11.2015	<b>Final consultation</b>
30.11.2015	<b>Final iA critique</b> Combined critique with the other iA courses (14:00 - 18:00)

\* Total 120 h = 4 ECTS

3 Exercises 25% (documentations)

Presentation 25% (project at the end)

Written documentation 50%

The most recent outline will be found on [www.ia.arch.ethz.ch](http://www.ia.arch.ethz.ch)



# Content

## Atmosphere

Student: Alberto Oliver Mercado

p.9

## Limmat Loop

Student: Alexandra Meuche

p.25

## Analysis of a park's design

Student: Alice Chevrier

p.43

## Hochschulgebiet Zentrum

Student: Jonas Landolt & Stefan Caranovic

p.55

## Bahnhof Stadelhofen

Student: Natalia Daukszewicz & Philippe Blarer

p.85

## Zurich - Historic City & City Blocks

p.105

Student: Ricardo Joss

## Optimisation of agriculture in an urban environment

p.117

Student: Romain Masson

## A school in Cambodia

p.127

Student: Stéphane de Weck

## Olympic Legacy

p.141

Student: Thorben Westerhuys

## Uster 2035

p.163

Student: Vincent Hischier





# Atmosphere

Student: Alberto Oliver Mercado

## Summary

The main topic for this semester is ATMOSPHERE. Although generally in any project factors as transit and sun light are basic, in the attempt to convey a particular feeling to a user, these become crucial. Furthermore, the program to develop is a MUSEUM, making the search for a correct atmosphere even tougher. There are 4 different sites and 5 different collections; each team is assigned a single combination that won't be repeated. The ultimate goal is to generate the most adequate solution for each team's specific site and collection.

The following analysis tries to prove the level of understanding of the project and its surrounding area achieved throughout the semester. Just as the semester, the analysis develops from a very wide perspective into the way of moving through the building, and lastly, the influence of the openings in the rooms.



## Motivation

The generation of a good architectural solution in regards with a particular topic is already a difficult accomplishment; when combined with very particular needs to be fulfilled, it is always helpful to complement the ideas with other tools.

Right now, the project is already set into an architectural floor plan that will not be modified anymore. In regards with this, the attempt is to check if the changes that the floor plan underwent were an improvement according to the concept being developed. During the resting weeks of the semester the goal is to reach the closest state to an optimal atmosphere in each room according to what is required by the project itself and the concept being developed by each team. Currently, the windows are the main and most difficult part of the spaces to be correctly placed; with this analysis, it is expected to get have a better understanding of what the best place to locate the windows could be.





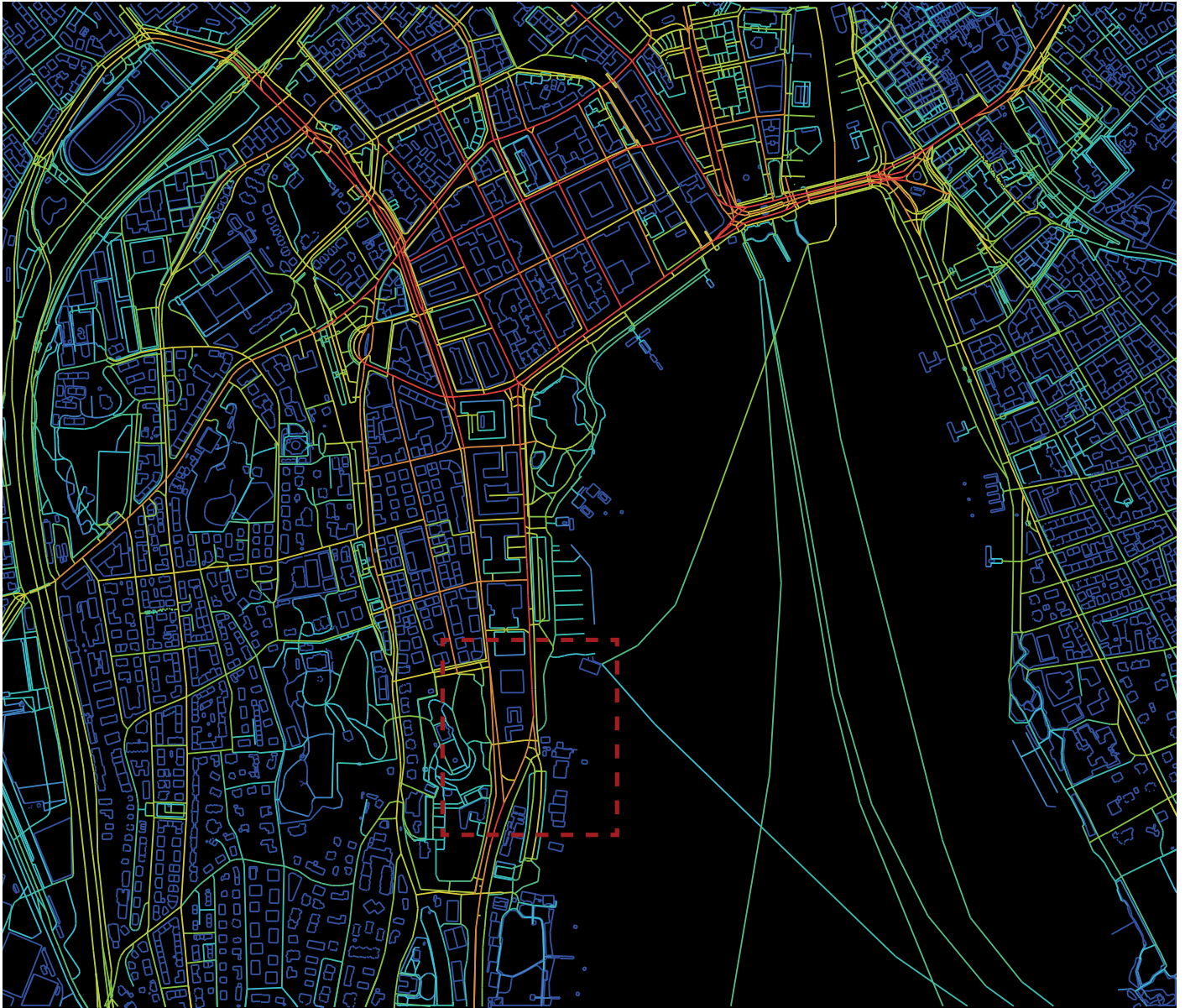






### Segment analysis: choice

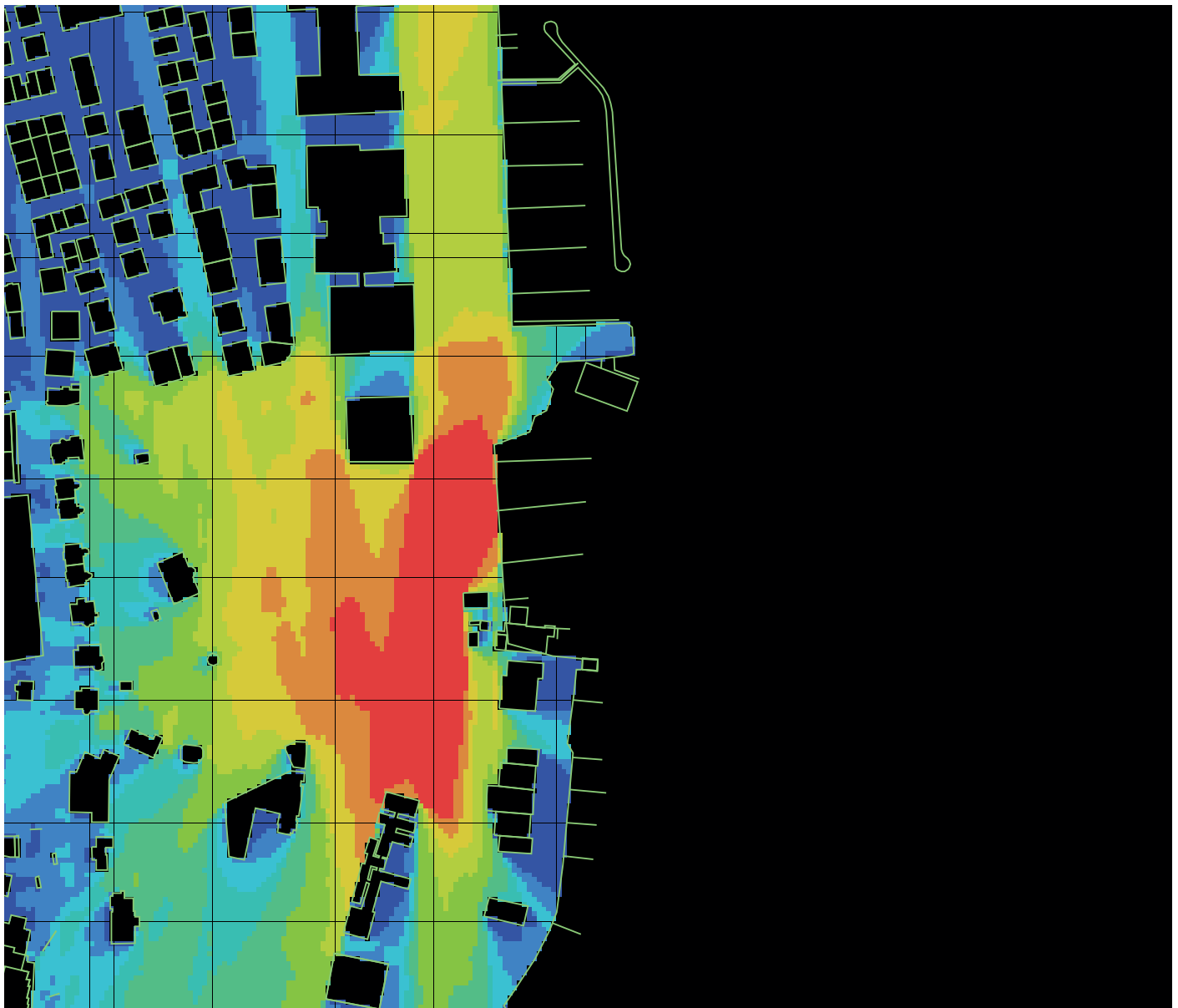
The site is located right at the intersection of what used to be the original entrance to the city. The choice analysis conveys the importance of this place even nowadays as the starting point of the main flow that will later become the busiest street beside the lake. It is important to note that both streets delimiting the site have a similar level of choice, however it is Mythenquai the one that in the end tends to have a higher choice; currently, the buildings' main facades are facing this street.



### Segment analysis: integration

Just like in the choice analysis, the integration analysis shows that this exact intersection is a highly integrated space in relation with the rest of the city centre. Probably because of the size of the analysed area, the highest integrated streets are located North, right beside the Quaibrücke. It is possible that if the analysis contemplates a larger space, these streets will become less relevant. It would be expected, however, that the Mythenquai street keeps its integration level due to its extension and location in the city, as well as the fact that it merges into the General-Guisan-Quai street.

It is important to note as well that the Belvoirpark is becoming isolated in between a set of high and medium integrated streets. Currently our project seeks to generate a park-extension like area in the northeast part of the site, which might actually work due to the high integration, yet lower choice level of the Alfred-Escher strasse compared to Mythenquai strasse.



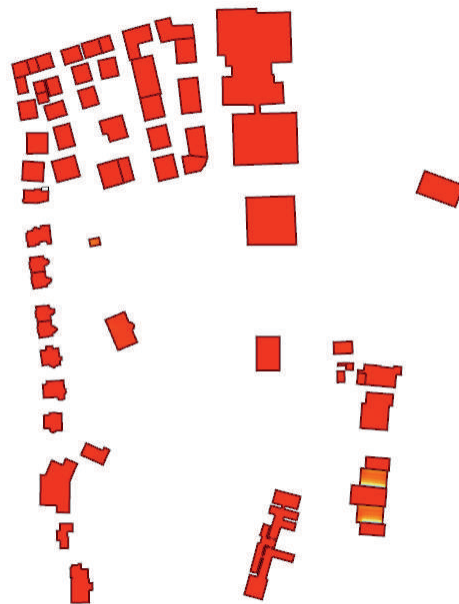
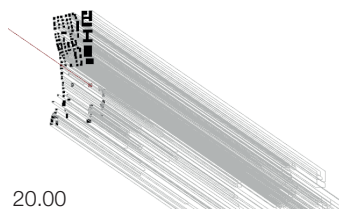
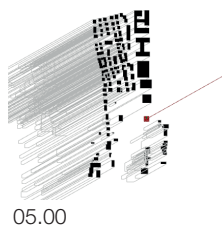
## Insolvists analysis

As mentioned before, at the left side of the site there is the Belvoirpark. Due to the fact that this is a basic positive-negative plan, there are no trees interrupting the view, transmitting the idea of it being a large open area. Still, even without trees being taken into account, it is again the intersection and mainly the side on the Mythenquai the one that enables the highest amount of visual relations with the rest of the area. If vegetation would be taken in consideration the Belvoirpark would have a lower isovist level, making the contrast between it and the project site even more evident.

Taking both the segment and the isovists analysis together, it is clear the importance of this space in relation with its surrounding area. Any project to be executed in it should be carefully placed and will require particular attention to the way it opens itself towards the intersection and the Mythenquai street. Also, due to the openness of the site, vegetation plays a crucial role to create a barrier between the street and the project, as well as to convey a clear way through the site itself.



## Summer solstice



Radiation Analysis  
MUNICH\_DEU  
1 JAN 1:00 - 31 DEC 24:00

kWh/m2

1117.44 <=

1005.69

893.95

782.20

670.46

558.72

446.97

335.23

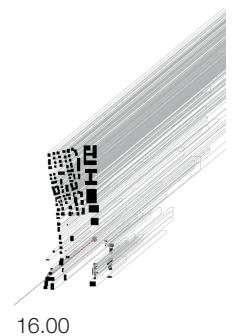
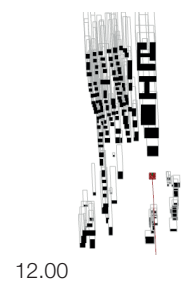
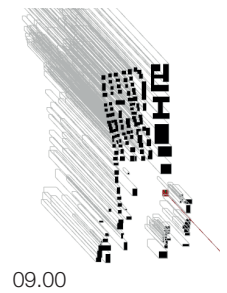
223.49

111.74

<=0.00



## Winter solstice



## Solar radiation and shadows

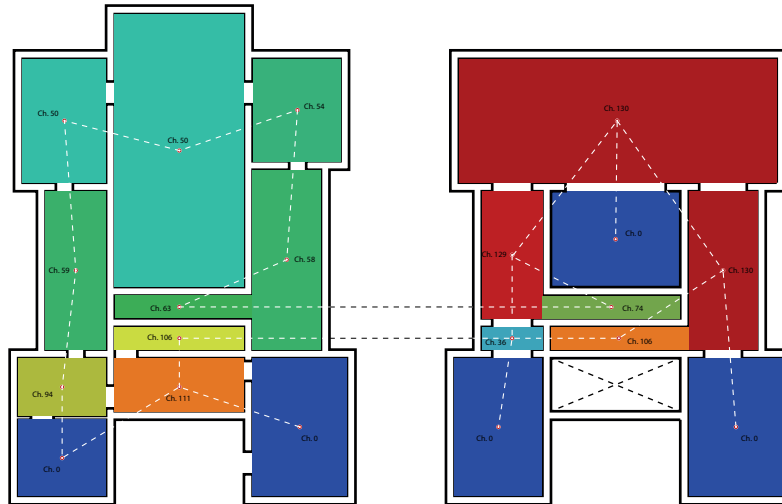
Being at the end of a series of buildings and right beside a park would suggest that this is the ideal place for developing a project.

However, as most of the areas in the city, the low sun during the winter casts a shadow long enough to keep the area cold for a few hours. However, during the summer, all buildings at the northern part of the area are tall enough to cover the site from the hottest sun hours.

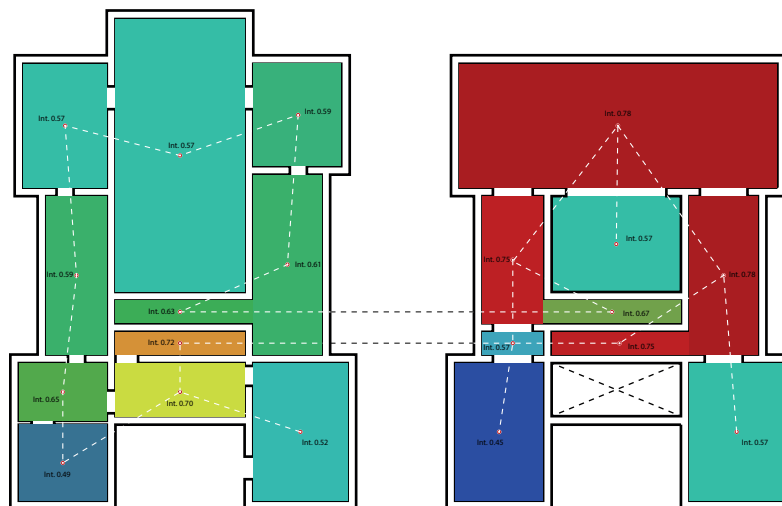
In the end, the site is indeed ideal to place an architectural element with very comfortable temperature and shadow situations during most of the year. Furthermore, the fact that it is an open space enables the possibility to modify or add vegetation in order to make the place even more comfortable. Not only for conceptual reasons, but also for shadow reasons, the best place to locate the building is closer to the southernmost tip of the site, avoiding a constant shadow from the following building, but taking advantage of the surrounding buildings' shadows during the summer.

## Proposal 1

### Choice



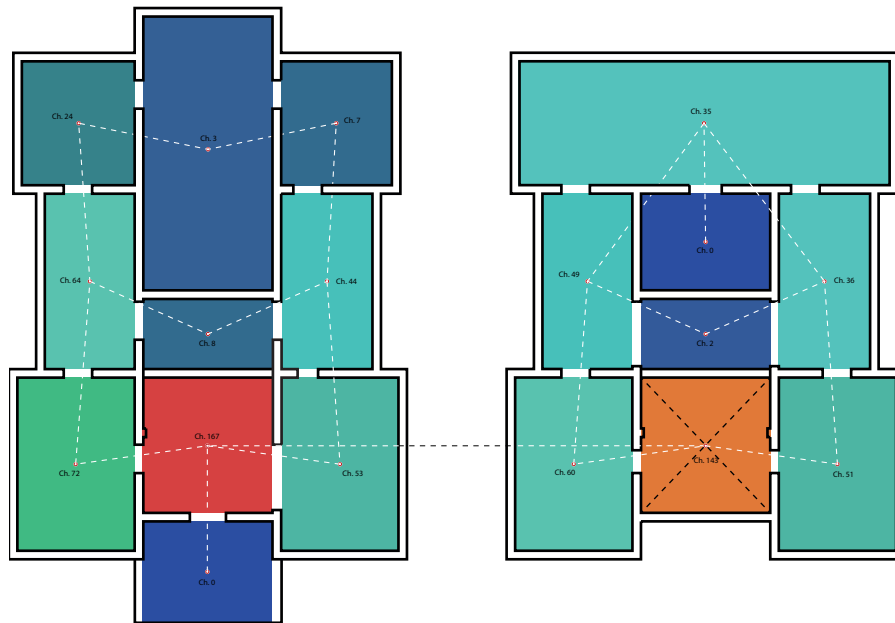
### Integration



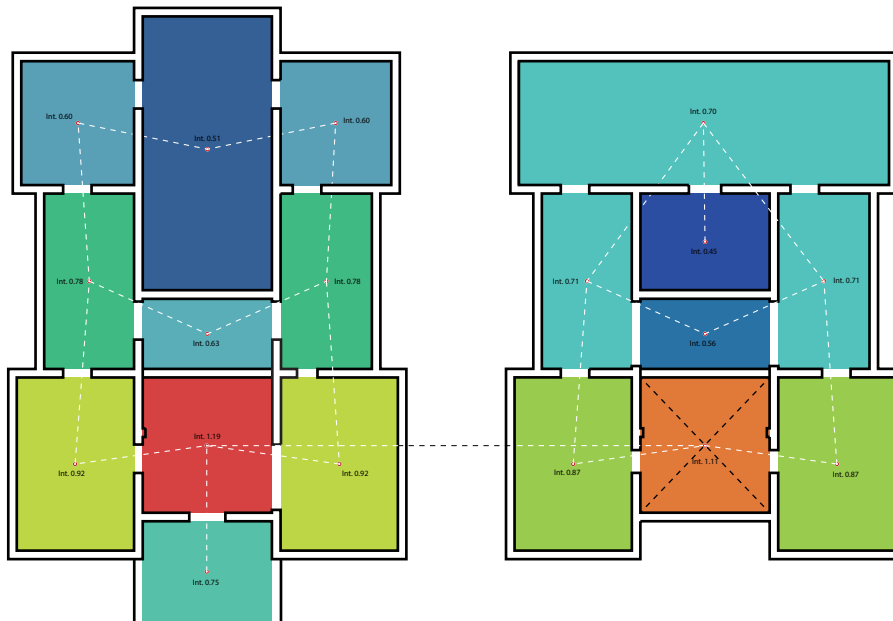
Single way through the building, there is a high choice towards the largest gallery, which is quite convenient, but due to the fact that it is determined as one of the last spaces to be experienced, the user might already be fatigued by that moment.

## Proposal 2

### Choice



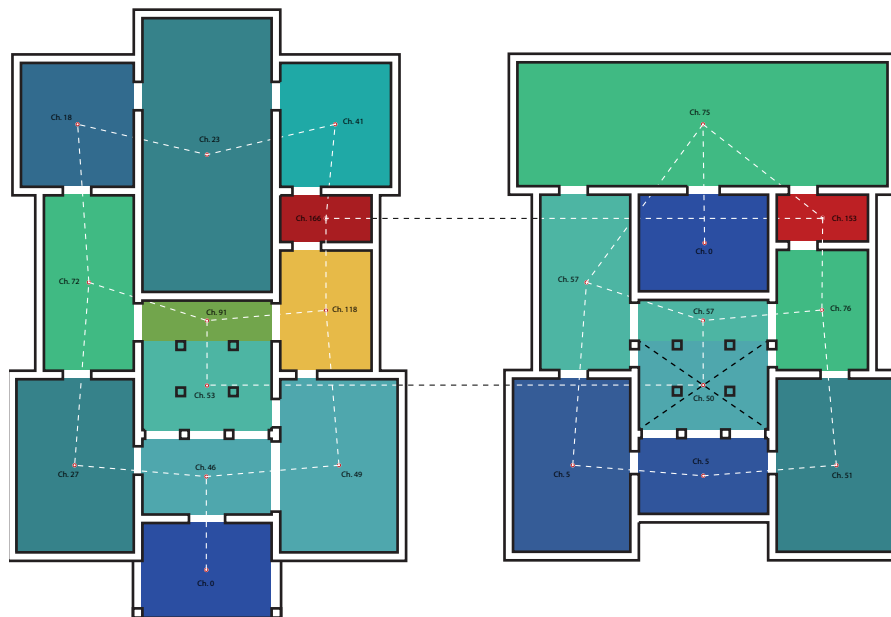
### Integration



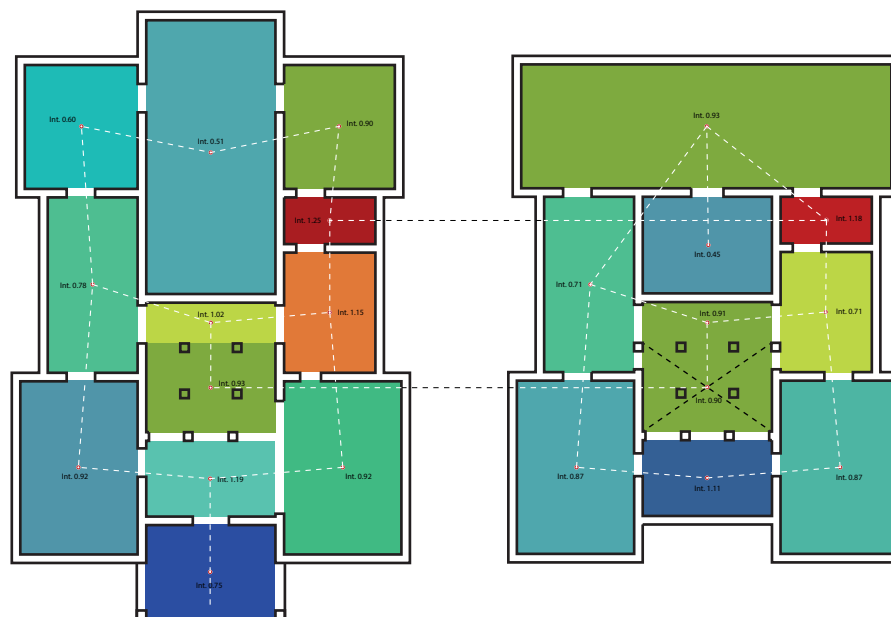
Both the choice and integration concentrate towards the front area of the building as the stairs are directly in the access. There is an uneven distribution of attention which might misdirect the user, making him miss the most important part of the exhibition.

## Proposal 3

Choice



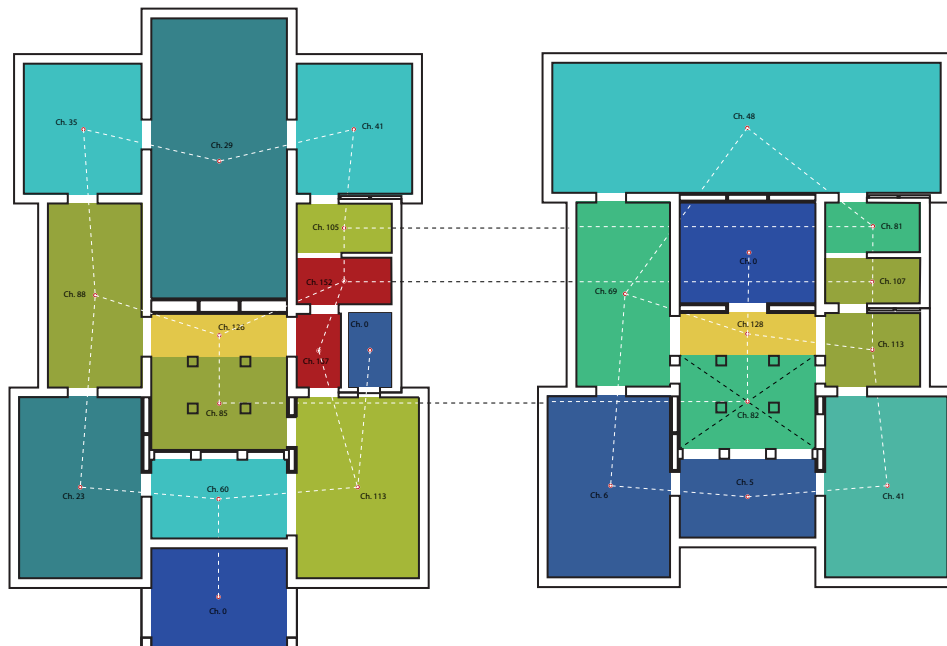
Integration



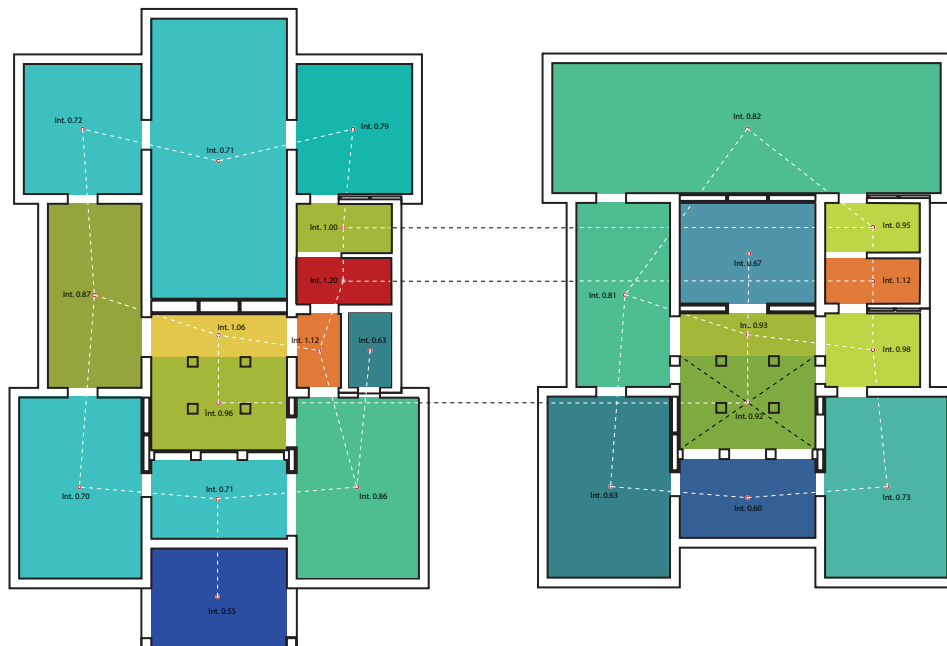
The addition of a second staircase is the result of trying to not only open more options for the user to move through the building, but also to have a better distribution of attention towards the back. However, there is still a desire to even the choice number between the galleries, as well as generate the highest choice number in the transition spaces in order to give a sense of privacy while looking at the art..

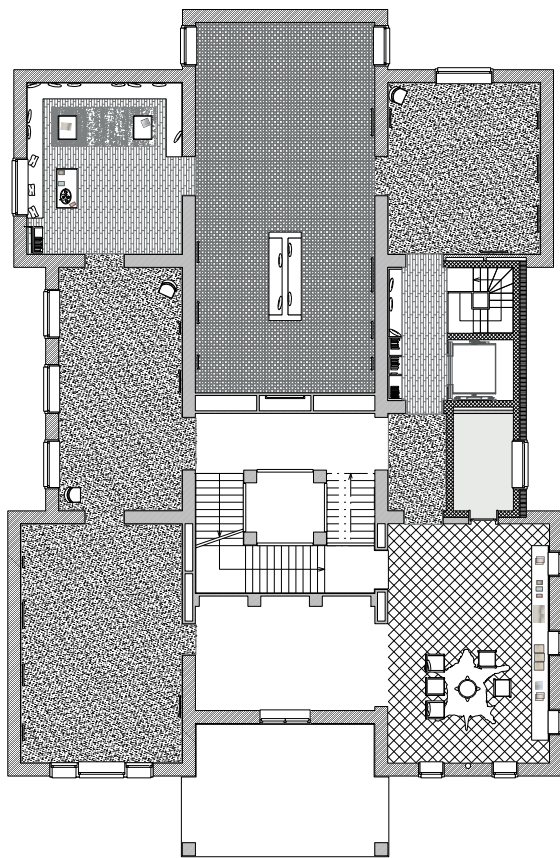
## Final proposal

### Choice

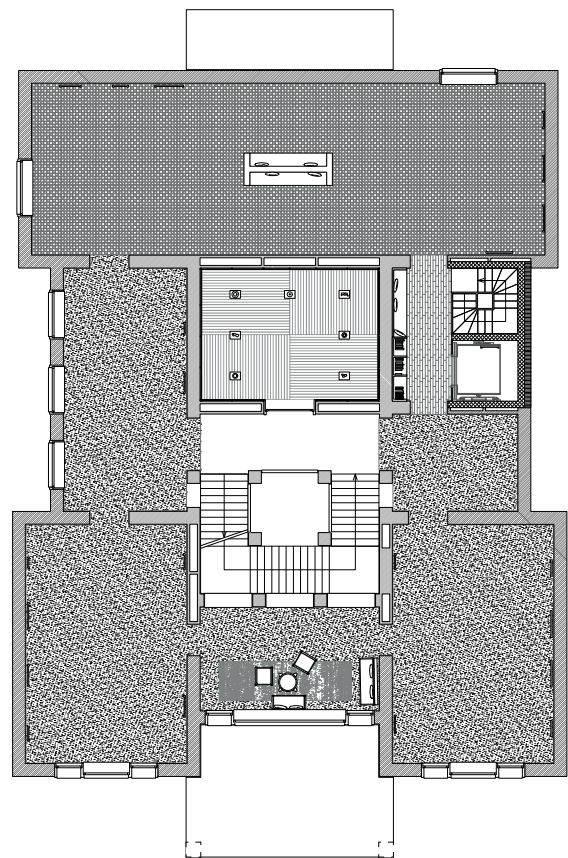


### Integration





Ground Floor

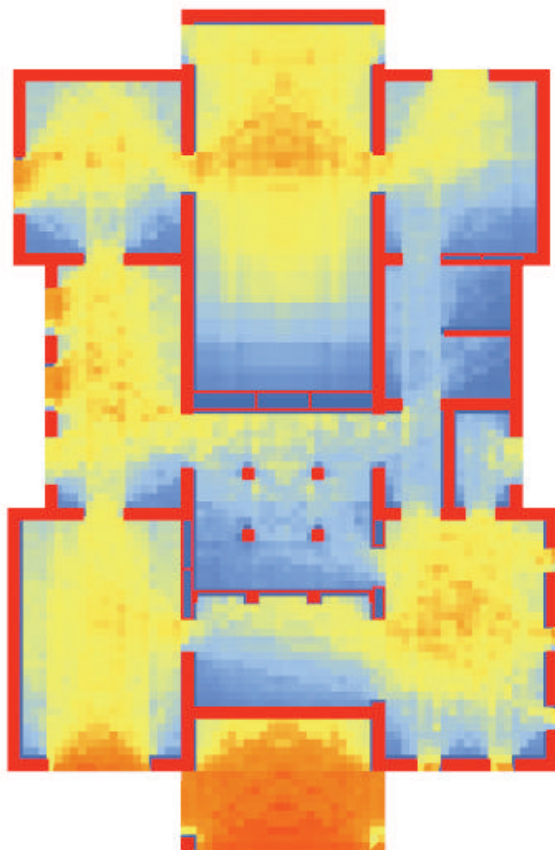


First Floor

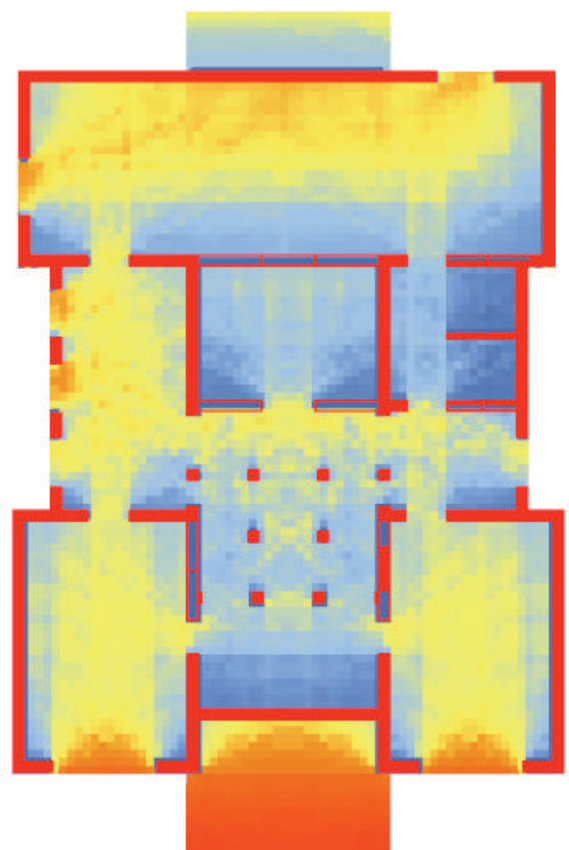
## Convex Analysis

Through this analysis we find out that the modifications made in the building are working almost as desired for the project. The integration is almost evenly distributed between the galleries, being these spaces the areas with the most privacy and concentrating the movement in the displacement spaces. The intention of this is to generate the feeling that the user is able to look at the art in peace, but that while moving through the building, he is not the only one in the museum.

The only undesired result is the highest choice point. The subdivision of the right middle space into smaller spaces helps generate a better balance in regards with the movement of the building. Nevertheless, the analysis shows that the best area to move through it is where the elevator is located right now. This suggests that the stairs are up to an extent a useless element. The solution, though, is quite simple: switching the location of the secondary staircase with the lift.



Ground Floor



First Floor

## Interior radiation analysis

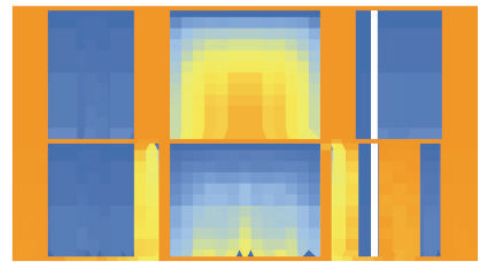
Whilst it has already been established that the site is ideal for the placement of a building in a ‘villa style’, it is still important to consider the amount of light coming into the spaces due to the proposed program.

In the ground floor all rooms are ideally lighted according to the function thought for each one of them. The rooms at the southeast and northwestern tips are designated as living rooms. Although the exhibition space facing the southern facade is highly illuminated, the radiation is soft on the side walls, where the art is meant to be hanging. The largest exhibition space however will require of additional artificial lighting in order to soften the contrast from the light coming from the windows.





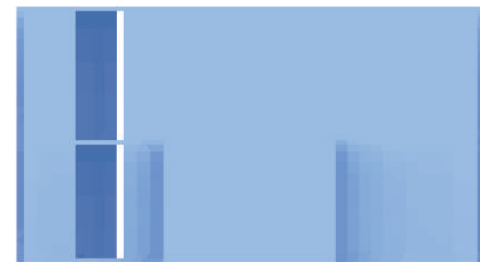
East elevation



South elevation



West elevation



North elevation

## Interior radiation analysis

The first floor is quite adequate as well. The main issue raises in the large gallery, where the amount of light coming from both sides is too high and is basically affecting the largest exhibition wall that is available in the room. Not only the light is not evenly distributed, but it is also forcing the room to require a high amount of artificial lighting and that this one at the same time can be set on different levels according to the space of the room that is supposed to be light.

From the rest of the spaces it can be concluded that while doing opening for exhibition spaces it is better to locate them in the centre of the room, as this will uniformly light the space while hitting with a lower intensity the surrounding walls. For the large gallery in the first floor, top natural light with and a single window might be the best solution to light the space.







# Limmat Loop

Student: Alexandra Meuche



Current Situation: Globus Provisorium



Current Situation: Hauptbahnhof

## Summary:

For this semester's design studio, we've been working on a master plan to improve the situation by the Bahnhofquai and integrate a new building, which shall replace the Globus Provisorium.

The area around the Hauptbahnhof has a few connected pedestrian areas. The idea of the design is to create more pedestrian friendly areas in front of the Hauptbahnhof and by the Globus Provisorium and to connect these to the pedestrian network. This is achieved by restricting car traffic over ground, only allowing it to pass between Hauptbahnhof and Central and leading all other traffic through the existing underpass, which is extended all the way to the police department. Furthermore the newly created spaces and the pedestrian network should be connected to the Limmat, which is a great quality of the city. The open spaces are designed to lead the people down to the river onto decks, where they can experience the river.



Limmat Loop:  
New pedestrian network

## Motivation:

With the analysis of the current situation and the newly designed Limmat Loop I aim to figure out if the new design improves the urban situation. The proposal aims to bring more life into the area by creating more attractive pedestrian areas. Less car traffic and more direct access to the Limmat are the main factors.

The analysis methods I used help show how opening up the Bahnhofquai and the area around the Globus Provisorium for the public brings additional value to the situation. The underpass and streets influence how people move and how much they really see. With help of convex, axial and isovist maps I want to show that the urban situation can be improved significantly.

For the analyses I opened up the hall of the main station, as it is an area used frequently by pedestrians. The new building proposal offers a similar public passage through the building, which is why that part will be left open too for the analysis.



Current Situation: Convex Map - Integration

Both maps show the Bahnhofbrücke and the Bahnhofplatz as most integrated convex spaces. No matter where one wants to go, it all passes through these two areas. This is also the case in reality. The River and the underpass are excluded from the analysis, as these areas cannot be reached as pedestrian.

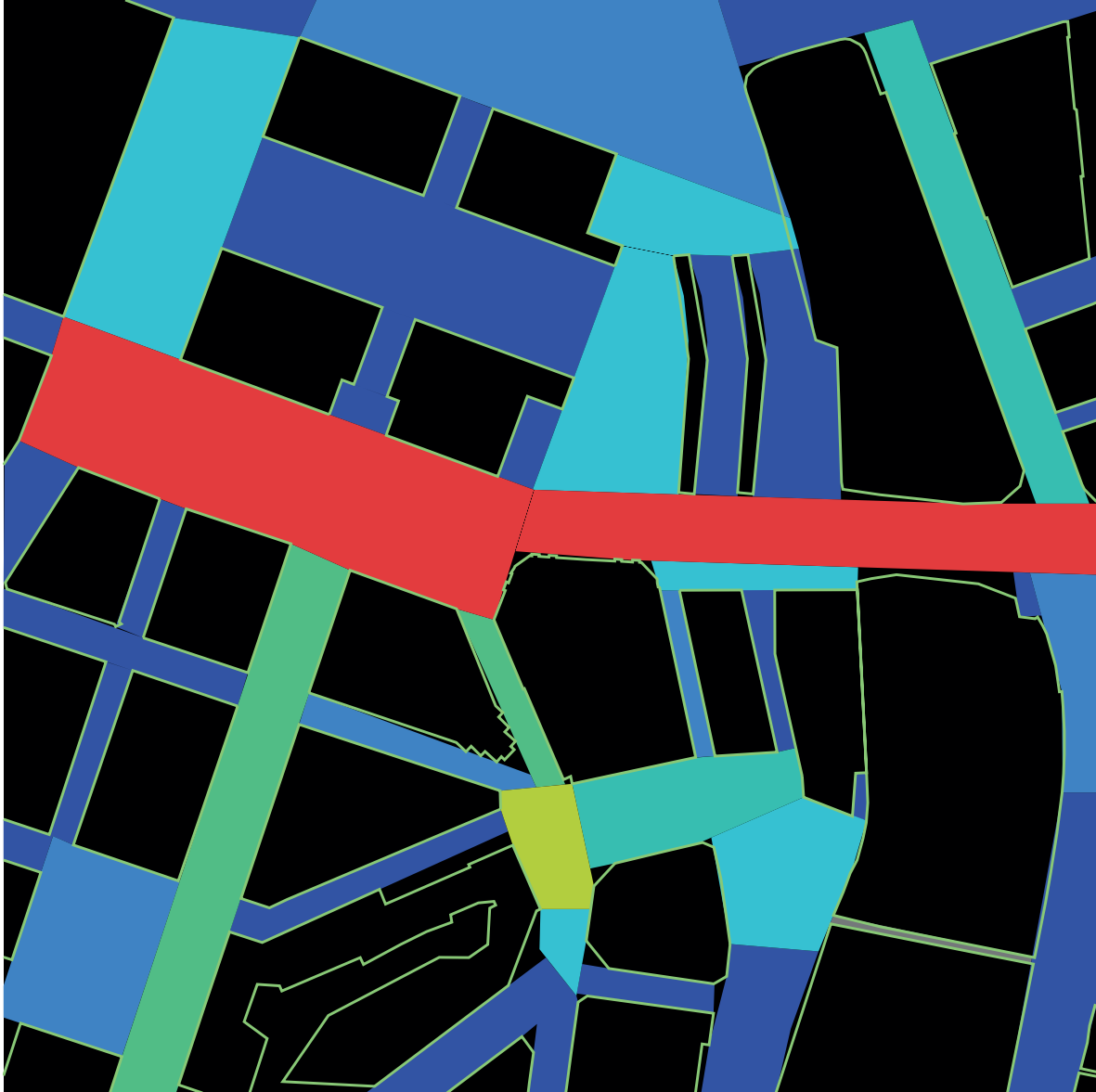
Looking at the map of the current situation, the underpass has a high impact on the integration of the areas by the Globus Provisorium and the Hauptbahnhof. The areas close to the red spaces are well integrated, but the further away the areas get, the less integrated they are.



### New Proposal: Convex Map - Integration

The new proposal shows improvements in this area. Bigger areas are better connected than before, and the integration is better over the distance as well. This can be seen well along the Bahnhofquai: The areas to the north and the south of where the underpass was are more connected than when the underpass is still there.

This suggests, that creating pedestrian areas in these two areas by removing the underpass and the traffic bring additional value and helps connect these areas to the Limmat.



Current Situation: Convex Map - Choice

Just like in the Integration map, the Bahnhofbrücke and the Bahnhofplatz are the most chosen areas. This is the case, as these spaces are most integrated. It is true that these are the most chosen spaces, as all commuters pass these areas.

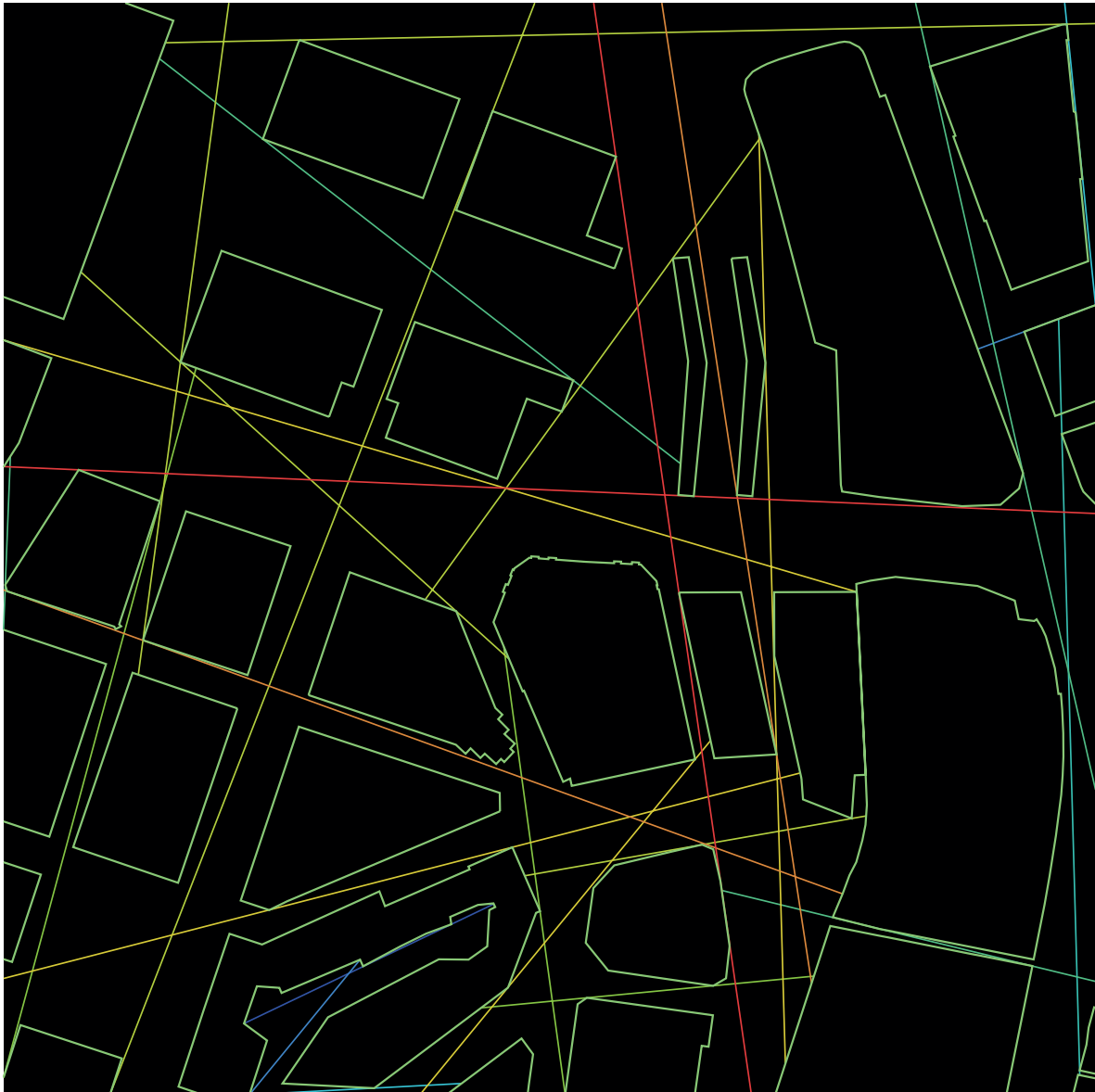
According to the analysis of the current situation, the Bahnhofstrasse and the Waisenhausstrasse are more chosen than other streets in the area. This is true for the Bahnhofstrasse, however the Waisenhausstrasse does not get chosen nearly as much as the Bahnhofstrasse. In reality, the traffic potential in the hall of the main station should be much higher.





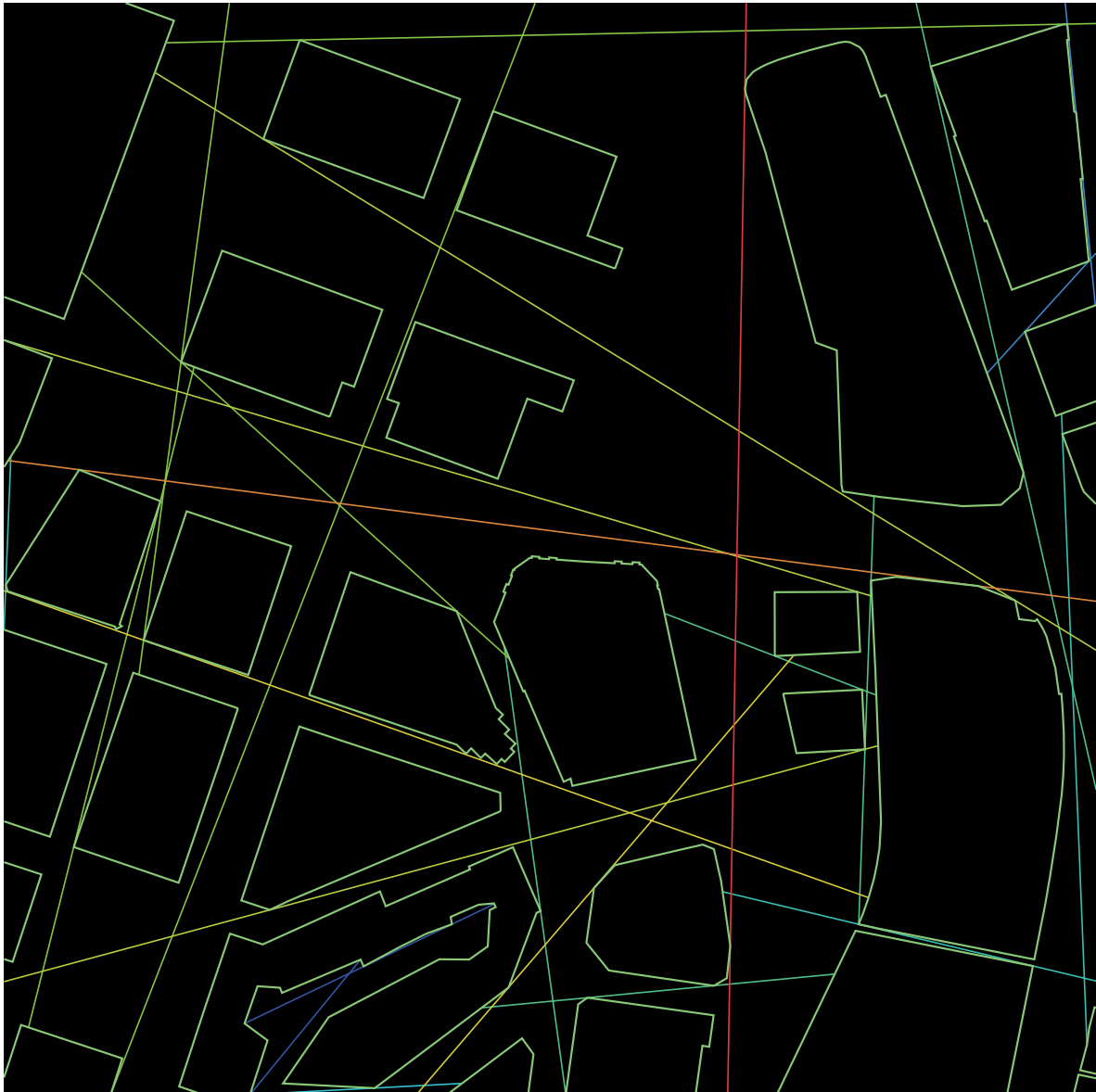
Current Situation: Convex Map - Choice

Removing the underpass seems to connect the Hauptbahnhof more to the outdoor space, but decreases the traffic potential by the Beatenplatz and the Bahnhofstrasse. I believe the decrease of the choice potential will not decrease in these areas, but rather stay the same or increase. In general however, the areas of the new pedestrian zones get a higher traffic potential, which is the goal of the intervention.



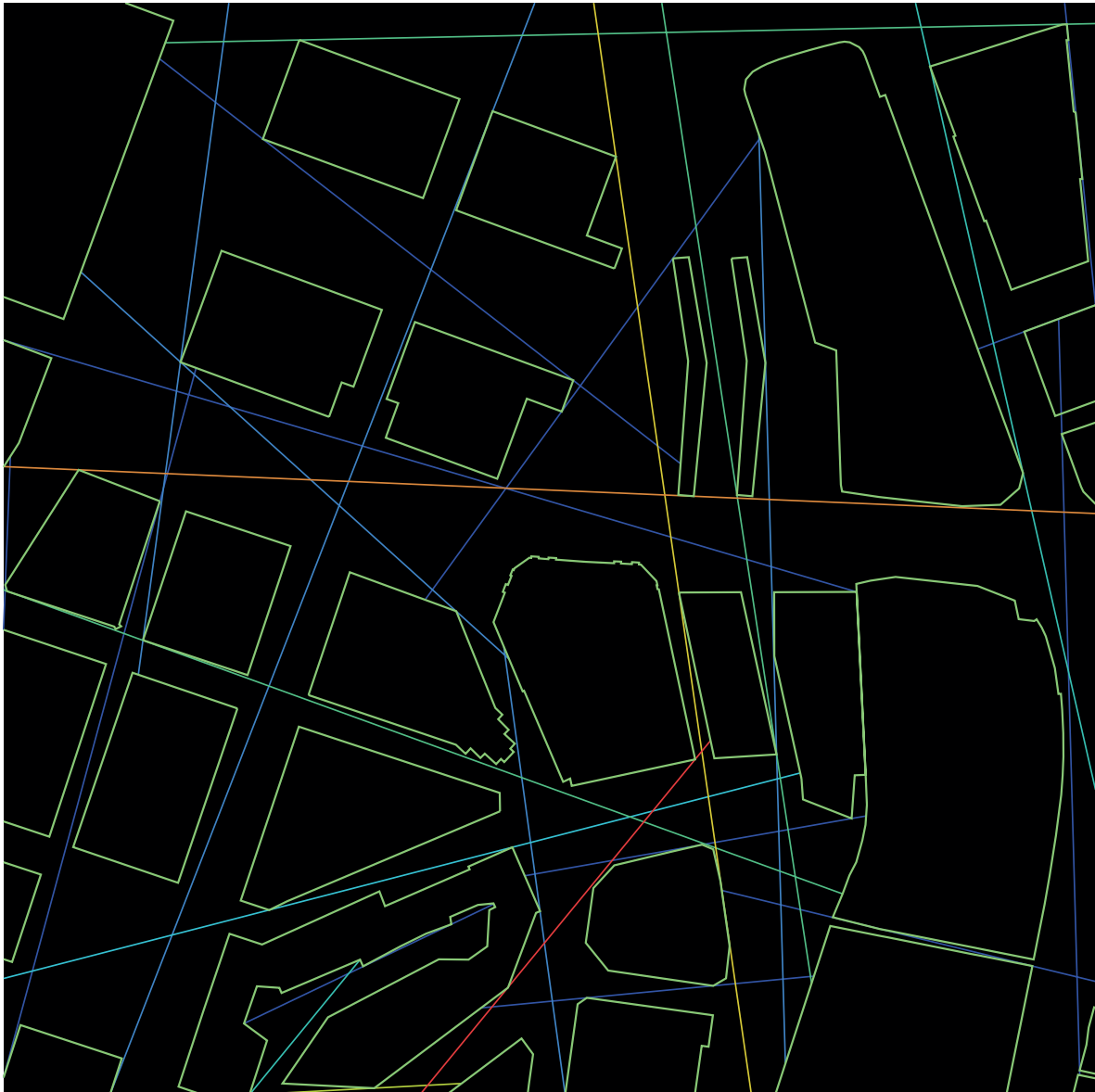
Current Situation: Axial Map - Integration

The map of the current situation shows that the most integrated axes are between the Central and the Bahnhofplatz and run along the Bahnhofquai. However, none of these paths allow the people to get to the Limmat. The paths are purely functional, evading obstacles, in this case the underpass. Standing in this area, this is also the case. People walk between Central and the Hauptbahnhof along the most integrated axes, never really approaching the River.



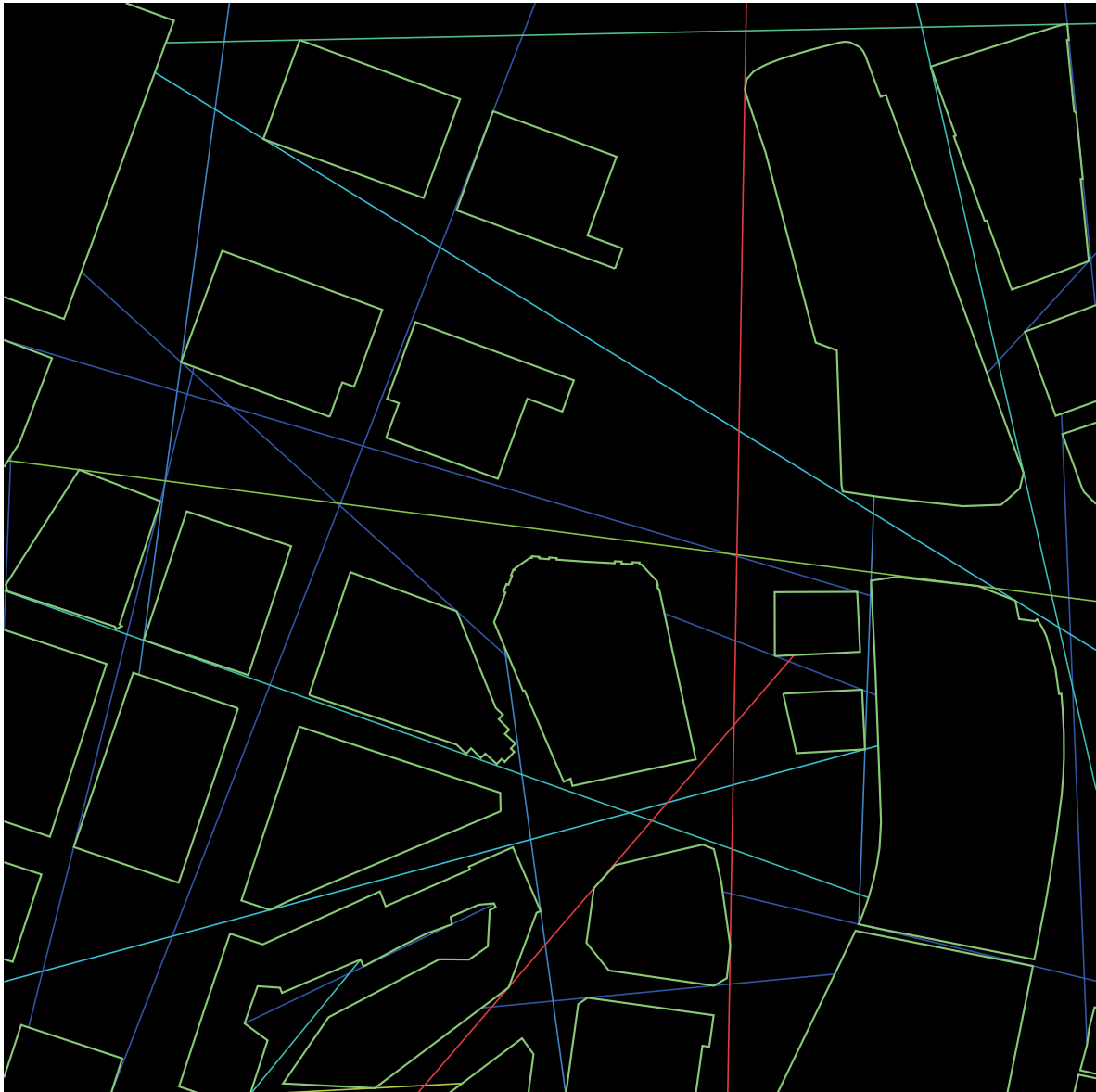
Current Situation: Axial Map - Integration

The new proposal shows a much closer relationship to the Limmat. People will be able to move along the river. Additionally, the axis along the Bahnhofquai gets much stronger integrated, compared to the axis between Central and the Bahnhofplatz. Presumably people will continue using the old paths when commuting, but more people in general might use the two new spaces, as they bring the quality of the Limmat back to the city and are well integrated into the pedestrian network.



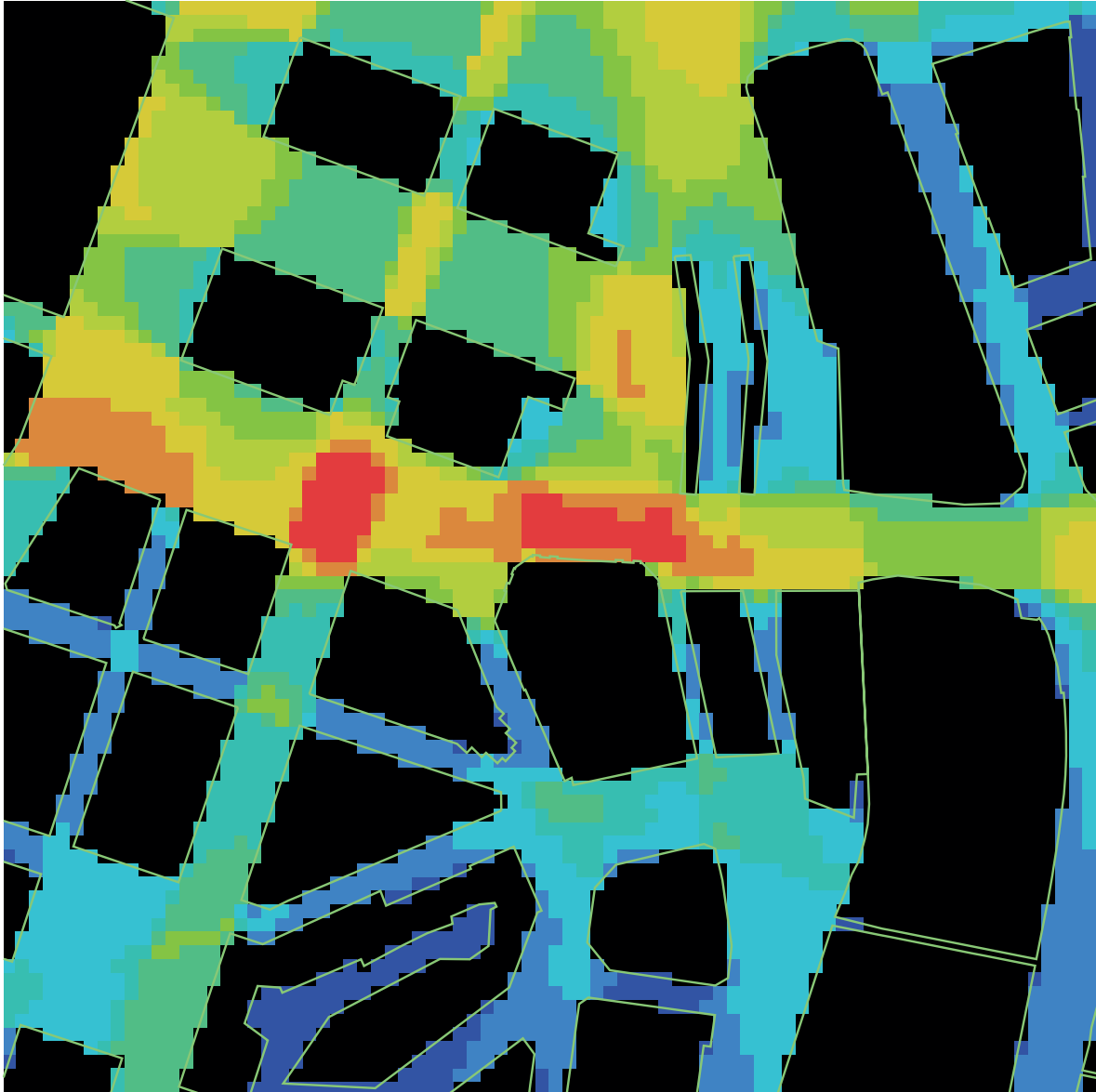
Current Situation: Axial Map - Choice

The choice map for the current situation illustrates, that the axes with highest traffic potential are between Central and Bahnhofplatz, along the Bahnhofquai and between Werdmühleplatz and Beatenplatz. Examining the situation in reality, the axes with highest traffic potential are between Central and Bahnhofplatz and along Bahnhofstrasse. The axes by the Beatenplatz are actually barely used, only if one visits the cinema. This result probably appeared, because most lines intersections appear in that area.



Current Situation: Axial Map - Choice

The new proposal suggests, that the Bahnhofquai will get used much more than the axis between Central and the Bahnhofplatz. Considering the walkways of the commuters, I'm not sure that the choice value of the axis between Central and Bahnhofplatz will really reduce. If opening up the spaces by the Hauptbahnhof and the Globusprovisorium leads to a higher choice value, the map actually recommends creating attractive pedestrian areas. This is the idea of the urban proposal. Looking at the axis between Werdmühleplatz and Beatenplatz, I believe it again shows itself with a high traffic potential, as there are many axes in this area. However, if the pedestrian area by the Globus Provisorium is attractive, people might start using the path towards the Werdmühleplatz more than today.

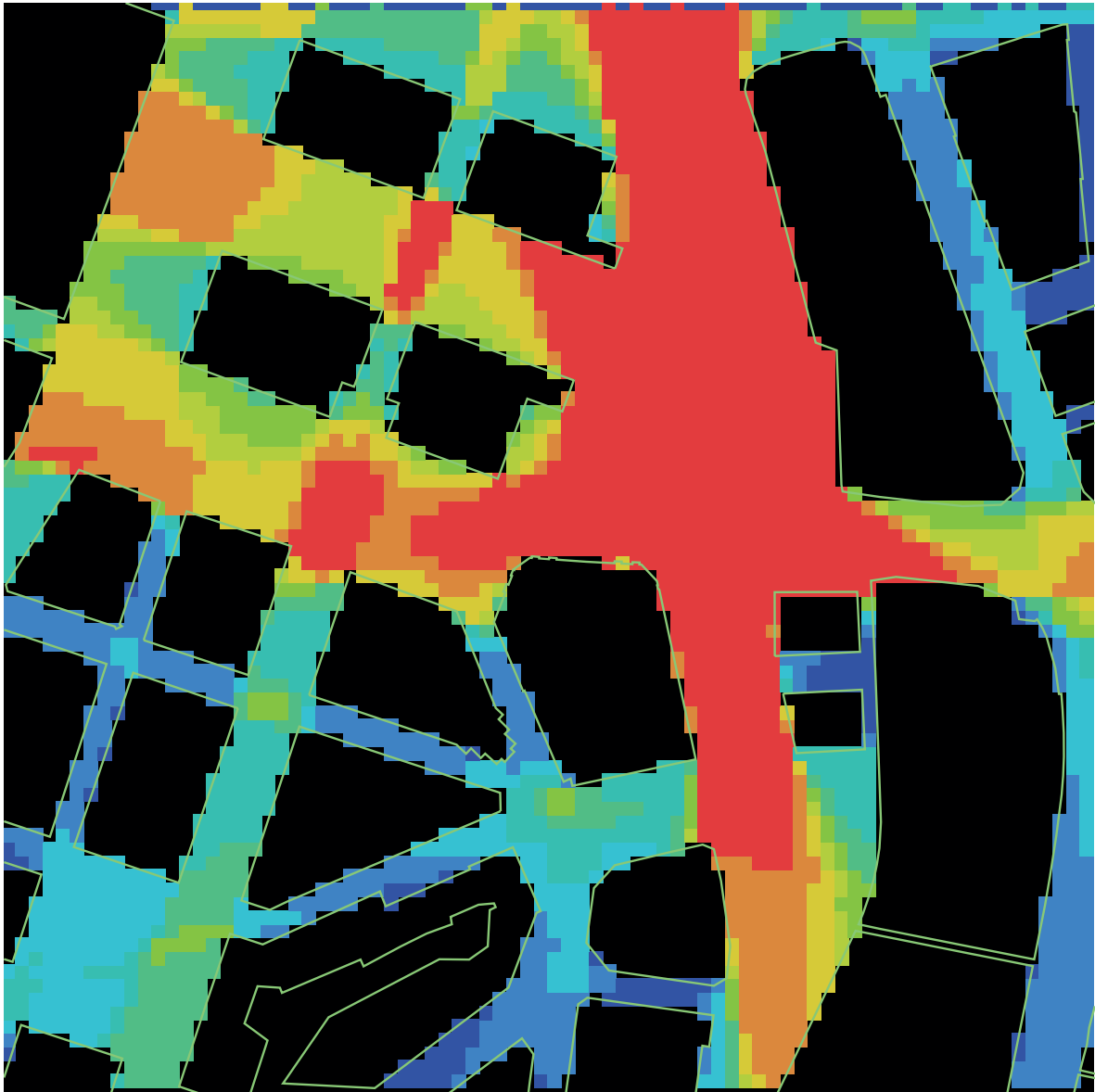


Current Situation: Isovist Map - Isovist Area

The isovist area map of the current situation shows that the areas with the largest isovists are located to the south of the Hauptbahnhof, by the Bahnhofplatz and just below the exit of the main station towards the Bahnhofquai. This makes sense, as these two areas are located by the intersections of larger roads and squares.

Comparing this with experience it is the case that one has the best overview over the overall situation in these areas. It is also advantage for traffic and pedestrians, as a lot of different means of transport cross these areas, and the overview over the traffic is needed to cross the roads.

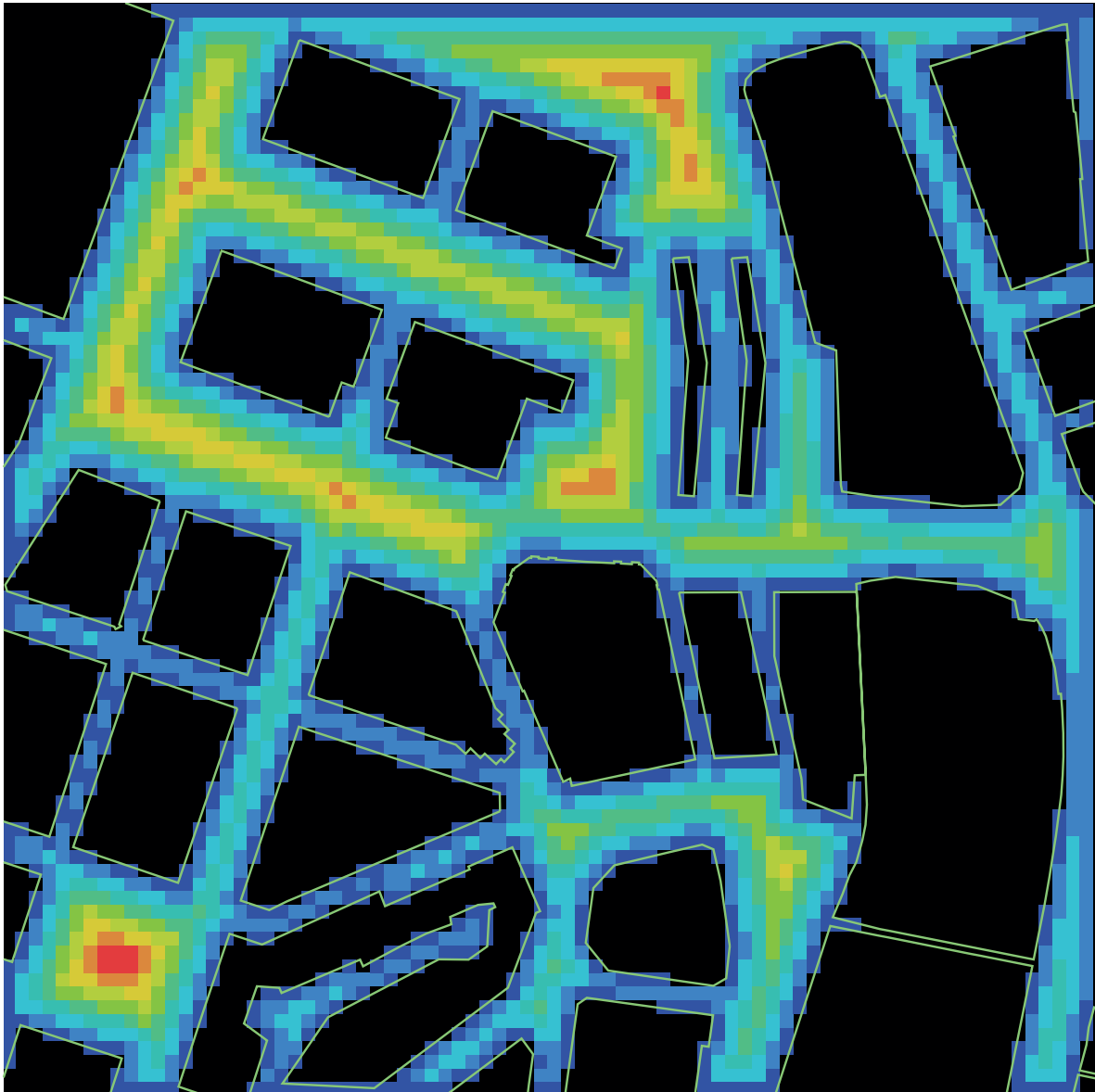




Current Situation: Isovist Map - Isovist Area

Removing the underpasses from the area creates a totally new situation concerning isovists. The whole area from the Landesmuseum along the Bahnhofquai to the Globus Provisorium becomes one big area with large isovists. Considering the new open areas should help connect the city to the Limmat and create a new attractive pedestrian areas, this is a welcome characteristic. It allows a view over the new spaces and on to the river.

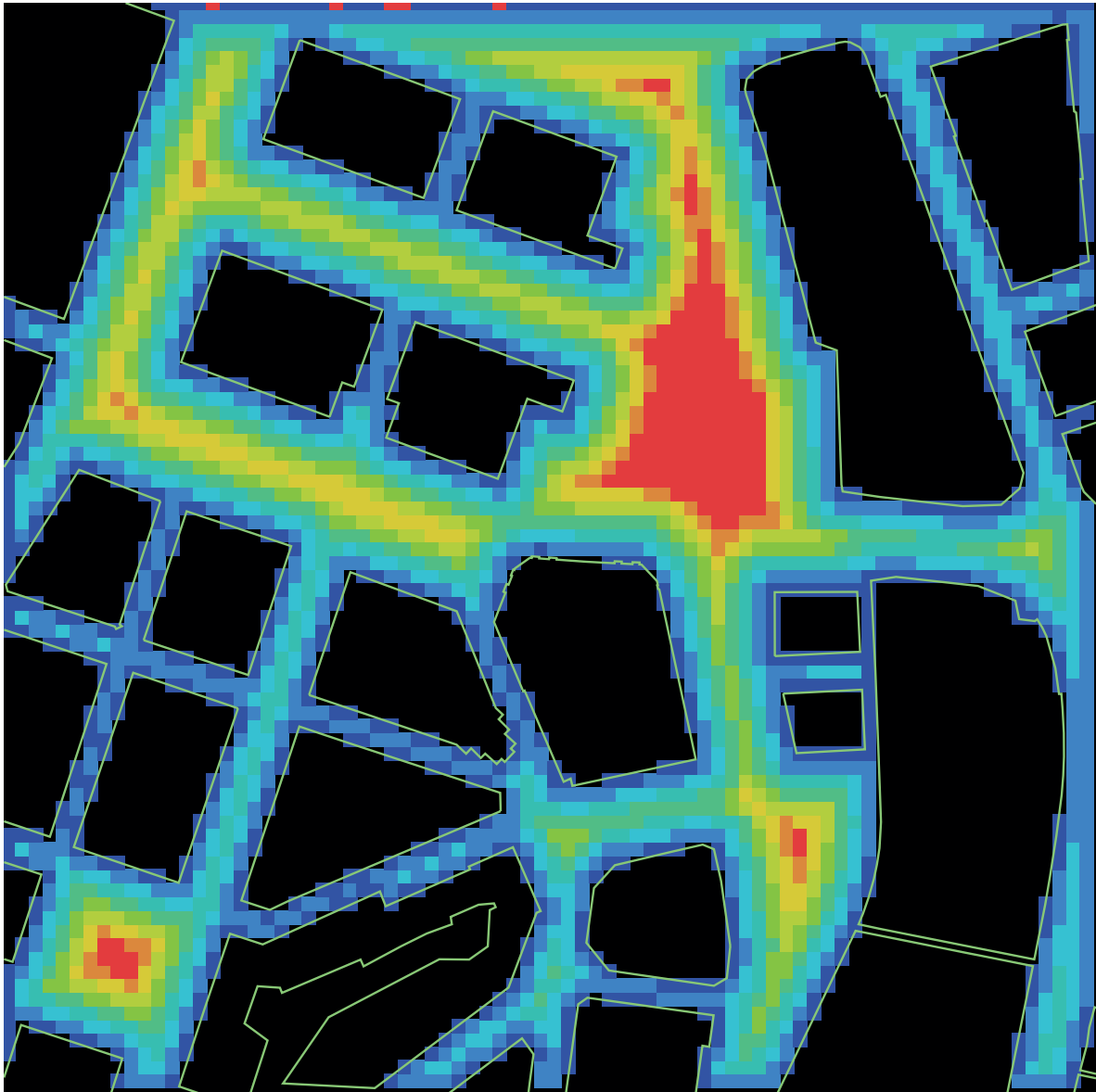
The results are somewhat biased, as the river and underpass are not included in the analysis, and one is actually able to see over the river and over the underpass. The Isovist analysis should be looked at from a walking or openness perspective, not a view perspective.



Current Situation: Isovist Map - Min Radial

The Isovist Min Radial map shows the areas with most movement potential. This is the case for the largest areas.

From experience I would agree that the area by the Bahnhofquai and around the Hauptbahnhof has high movement potential for commuter transit. However I believe space by the Globus Provisorium isn't as active as the analysis shows. It is a busy traffic area and is barely used by pedestrians.



Current Situation: Isovist Map - Min Radial

For my design, the area to the south the Globus Provisorium seems to act as movement area. With the right programming for the area, this space has potential to become a vivid pedestrian area. The opened up area in front of the Hauptbahnhof also shows a very high movement potential. Not only commuters, but also people passing by for leisure can use this space.



Summer 0900



Summer 1800



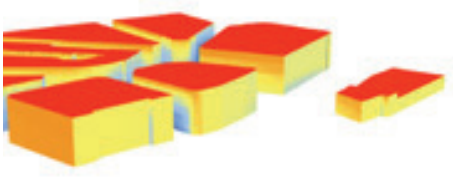
Winter 1100



Winter 1500

For the shadow and radiation analysis of the site I worked with the buildings just next to the Globus Provisorium and around the two new pedestrian zones. I looked at the situation for the current building as well as three variations of the new Globus Provisorium. I did measurements for summer and for winter solstice in the morning and evening.

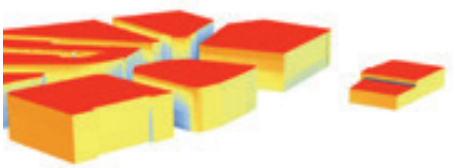
## General Comments:



Current Situation

During summer solstice all open spaces get sun pretty much throughout the whole day. More dense building structures, like the Niederdorf, have more shadow than the open spaces, as less light reaches the ground due to the narrow streets.

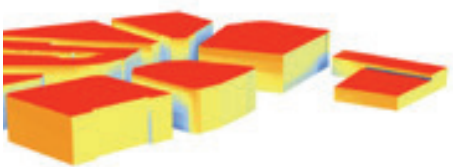
During lunch time every part of the city gets sun at some point. One might have to think about adding some outside structures that provide shade in the open areas, especially considering the hot summer we had this year. This might be some roof structures or groups of trees, so pedestrians can sit or walk in the shade.



New Proposal - Building 1

Zurich is located so far north that we have shade from the buildings even during lunch time at the winter solstice. If the sun shows during that time, one might only find a bit of sun in the open spaces during the midday hours. For this one would have to search the areas around the Limmat, as these are the most open spaces and the chance of catching a glimpse of sun and not shade is highest here. Densely built areas however, like the Niederdorf, have shade the whole day through.

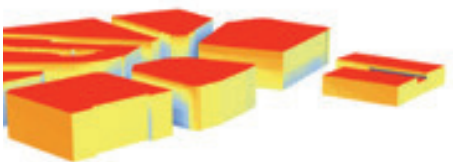
## Comments on the open spaces and building designs:



New Proposal - Building 2

Looking at my design, it is nice to see that the open space located to the south of the Globus Provisorium has sun all day long during summer solstice.

I might have to consider planning a group of trees or some other shade-giving structure in that area, to make sure the pedestrians are comfortable even during long summer days.



New Proposal - Building 3

Additionally the space to the south of my design project also has sun during the lunch hours during winter solstice. Depending on weather and temperature the space could therefore be used during the winter time. Light can get into the building, as the area to the south of the building is free, which helps make sure the building doesn't stay dark inside the whole day through.

Building 1 is very similar to the original building, showing only little shadow on the neighbouring building and casting only small shadow during the day. Building 2 and 3 move closer to the neighbouring building, casting a greater shadow on the other building and the walkway. Therefore staying close to the original design will help bring more light into the area.

RADIATION





# Analysis of a park's design

Student: Alice Chevrier

## Introduction:

Parks are very important social and environmental elements of a city. They provide inhabitants with, among others, places to relax, do sport and get social contact. With their vegetation, parks improve the microclimate and constitute a living space for the fauna and flora.

This is the reason why a park should be designed carefully, to enhance its benefic aspects. Its design needs to be attractive for the inhabitants, as there is no way to force the population to use these areas. This analysis aims to see how the tools we got presented in class can positively impact the design of a park. The environmental aspects will not be furthermore considered.

As a basis the newly created “Pfingsweid Park” in Zürich is used. First the site position will be qualitatively analysed, in order to raise the qualities and/or default of the emplacement. Then, different version of the park will be compared with the application of analysis methods learned in class – a shadow analysis as well as an integration analysis.

## Sources

The 3D maps are created with OSM2World from an OSM file of open street map. The line plan used with Depthmap comes from the same OSM file (open street map), and is then modified with the plug-in Elk on grasshopper in order to get the streets or the buildings only, depending on the analysis.

The followings analyses are part of this report:

1. Integration / Connectivity / Choice analysis site
2. Isovists Analysis
3. Shadow Analysis
4. Connectivity and Choice Analysis in Park
5. Conclusion

Most of the times parks can only be place where there is already an empty space, they have to accommodate to their location. The integration analysis with Depthmap aims to give useful information about the site situation to planers.

Before doing the analysis with Depthmap I had to correct the map of the area. Indeed this map was done with open street map data, which happened sometimes to have more than one line for representing a street.

The area taken into consideration is approximately within 20-30 min walking distance from the park. From my point of view, the people living within this diameter represent the target audience. The south side is bordered by railways, which limit the access to the park.



The park is well integrated in the area as we can see on figure 1.1. This is expected as the area was taken to have the park as middle point (20-30 min to foot).

From the connectivity analysis it can be seen that the streets surrounding the park are between dark blue and light green.

These low values have to be carefully interpreted. The figure 1.2 shows that most of the streets in this area have low value for connectivity, except the Hardbrücke and some crossroads. The average values of 2.4 compared to the high value of 8 corresponding to the red colour shows the colour range is somehow twisted through the high connectivity of the Hardbrücke (figure 1.4). In the area's totality the values are not too bad.

The same reflection on the colour range applies to the choice analysis. Aside from the Hardbrücke (the vertical component) and some horizontal streets with lighter blue colour, all of the streets are showing very low values. The proximity of the railways also should not be forgotten and plays a negative role in these analyses, as it blocks any pedestrian connection on this one side.

Living in the area I think those low values do match the reality. The park is situated behind an apartment building in an industrial area, and even if it is close to the Hardbrücke train-station it is not on the way, which probably is the reason why lots of people pass by

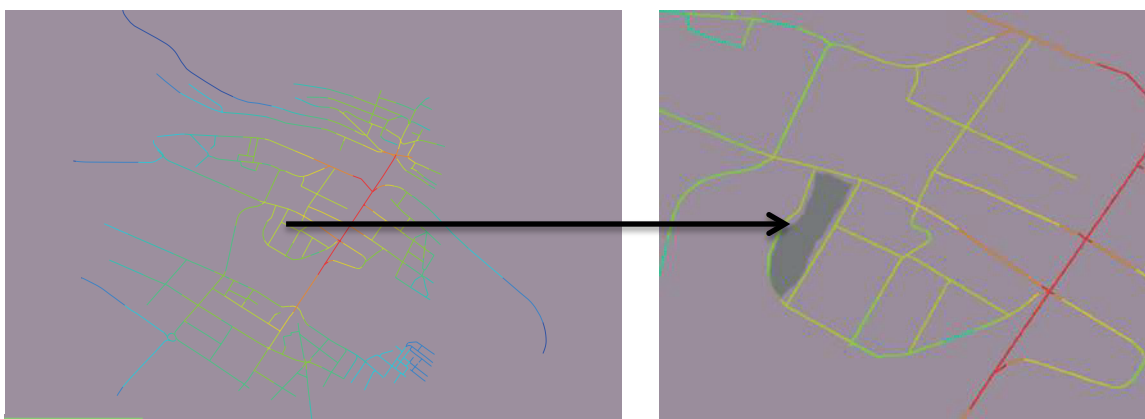


figure 1.1: Integration

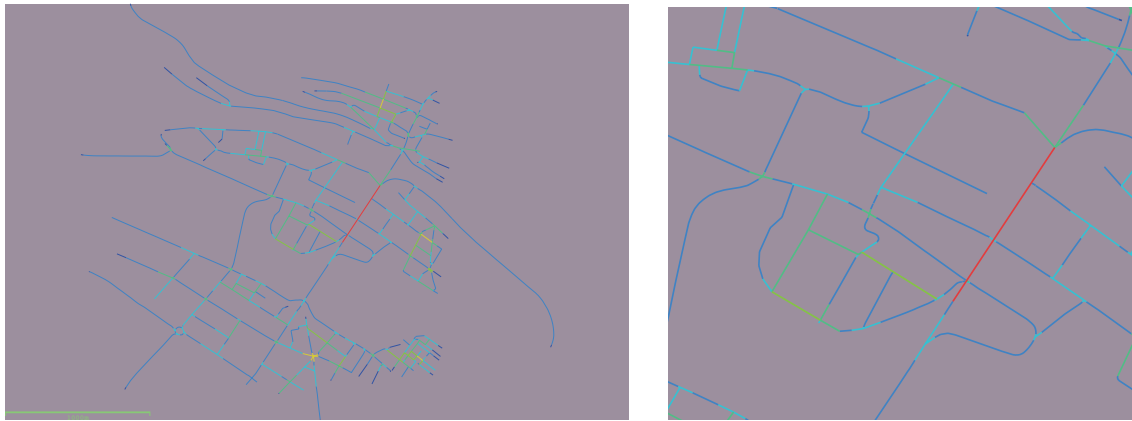


figure 1.2: Connectivity

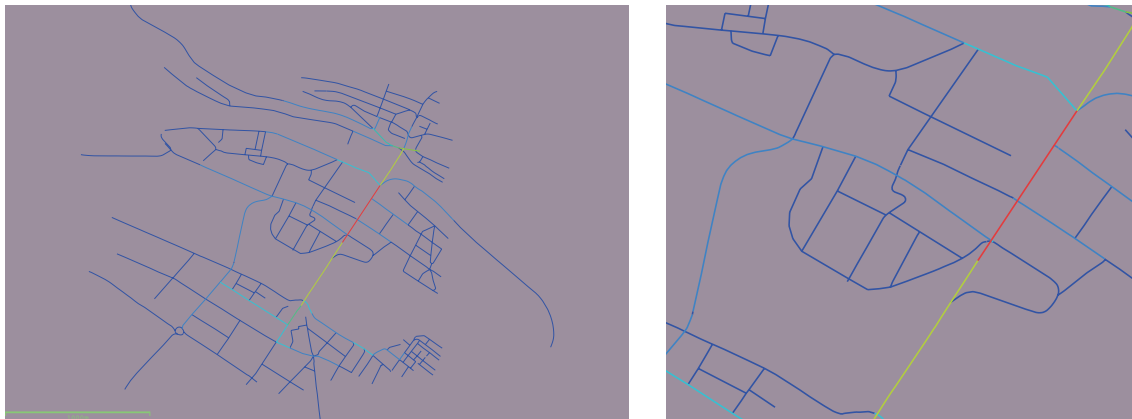


figure 1.3: Choice

	Minimum	Average	Maximum
Integration	0.0863966	0.189797	0.303238
Connectivity	1	2.43063	8
Choice	0	50354.6	816741

figure 1.4: Analysis' Values

## 2. Isovists Analysis

In this part the site's isovists will be analysed with Depthmap. The colour range was set equals throughout the different variants in order to allow a true comparison. Besides the park, a school at the upper end of the park is being planned. This is why the influence of different shapes of the school building on the park will also be commented (fig. 2.0).

The first school building version has one building. The second is made out of two buildings. Finally the third version is made out of three buildings. It is interesting to note, that the first variant's building is lower than the other ones.

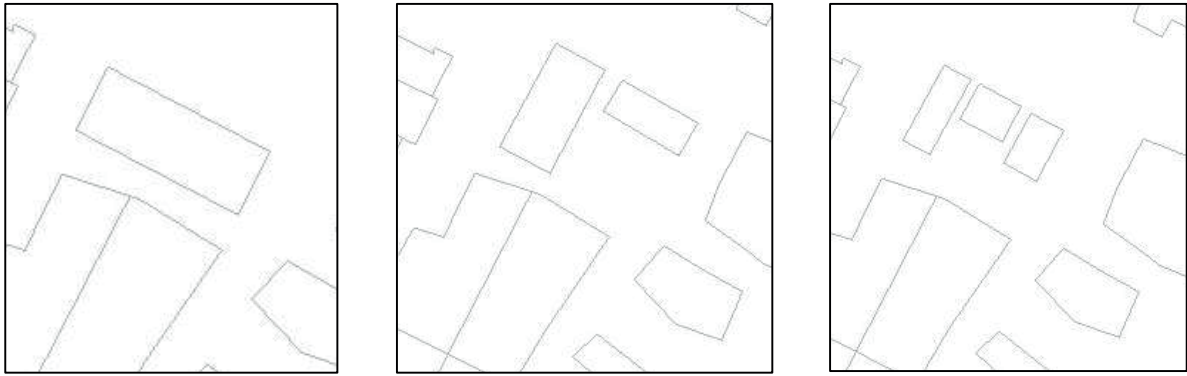


figure 2.0: school variants

Good values for the isovists area and perimeter are benefic. The occlusivity should stay reasonable. This means that the park is constructed in a pleasant environment where people can locate themselves and do feel safe.

As we can see on the figures 2.1 (isovists area) the variant 3 has a larger red area. This is due to the fact that the school building is placed a bit lower than for the other variants. On the upper part of the park the values are very good. The streets in the area are very large and offer a good overview of the surroundings.

On the right side of the park, the colours tend to get colder, meaning that smaller surfaces can be seen from those points. The streets are not as wide anymore as the edifices on the right are a group of residential buildings.

At the lower peak of the park high value are to be found. This is due to the railways and doesn't really match with a feeling of safety, but gives a view on the horizon, which is not so common in a city and can give a feeling of freedom

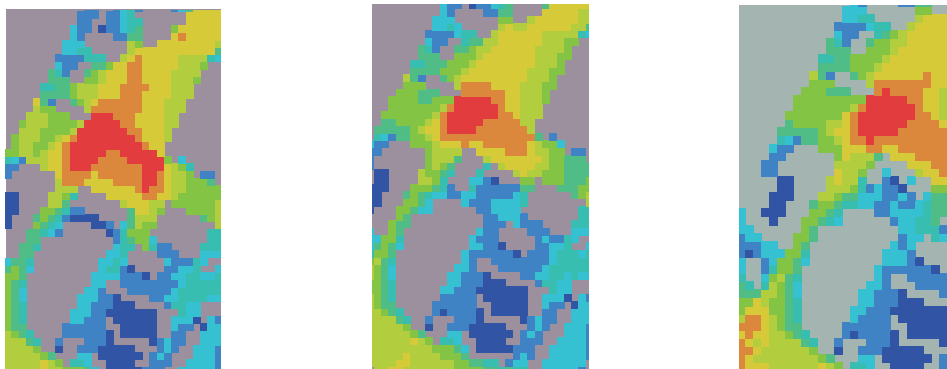


figure 2.1: isovists area - variants 1,2 and 3

The occlusivity (figure 2.2) measures the length of hidden edges and is an important factor for the safety feeling.

The side of the school looking at the park has low value of occlusivity. The schoolyard will probably be placed there as a low occlusivity is a sign for a feeling of safety since not much hidden edges can be seen. For a school, having a high feeling of safety is very important.

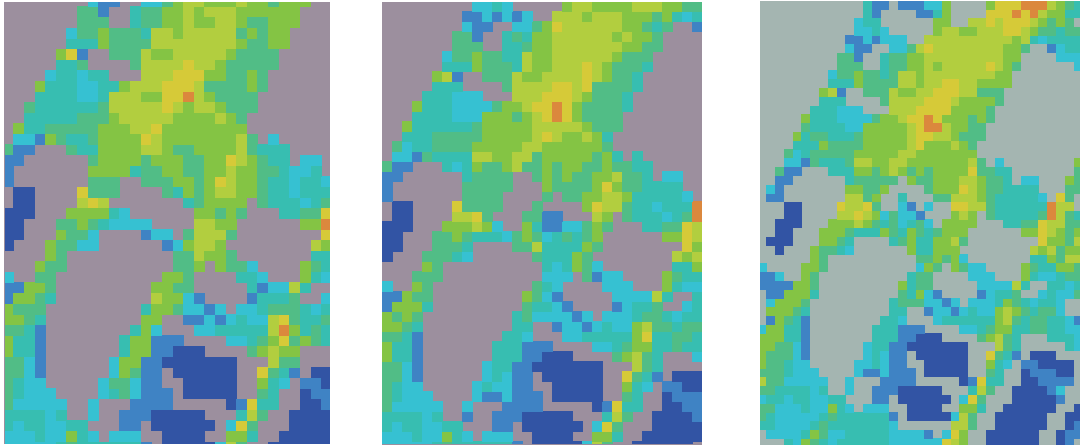


figure 2.2: isovists occlusivity - variants 1, 2 and 3

The isovists perimeter analysis is very similar to the area analysis, with however lower values

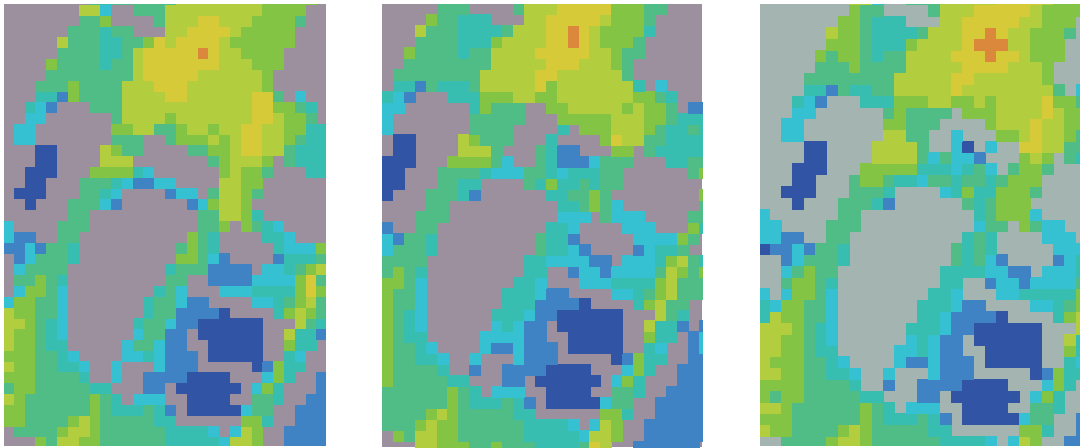


figure 2.3: isovists perimeter - variants 1,2 and 3

It can be outlined that the value for area and perimeter are in reality better. The park is here modelled as a building, in reality however it is reasonably possible to see through. For the occlusivity the value will also rise. However as the trees are creating more hidden edges than a wall, this can lead to a less strong feeling of safety.

### 3. Shadow Analysis

Shadow analysis is done for the winter (22. December) as well as for the summer solstice (20. June). First this will be done on an empty park. Some statement will be made and then verify on three variants of the park. Furthermore the analysis of the variants will allow discussing on the tree placement.

Winter solstice shadow analysis:

The analysis is performed between 12 am and 16 pm.

This time slot is the time in winter where people are most likely to go out in a park. Classic lunchtime is between 12 am and 2 pm. A good park design has to take it into account in order to provide sunny places for people coming to enjoy the sun.





figure 3.1 - Winter analysis



figure 3.2 - Summer analysis

The area encircled with red (figure 3.1) should have some seating possibilities. If no equipped area can be found inside this red figure, this could lead to lower frequentation of the park in winter.

The emplacement of the park, with its proximity to railways is in this case a huge advantage as there are no buildings in the lower corner, which would project shadows in the afternoon. This is the reason why the red area stays shadow-free from 12h on.

Summer solstice shadow analysis:

Here the same reflection can be applied as in winter. However as the sun is high in the sky, it produces very little shaded areas. This can be seen on figure 3.2. This lack of shaded area can lead to lower comfort for the users in summer. This is why shadings have to be installed. The blue encircled area represents the area that receives sun in winter from 12h on. It is preferable to install shadings out of this blue zone, in order no to affect the shading on this area in winter.

Now we will analyse three variants, and see if it matches our expectations. Those three variants were part of the competition for the park's design. Variant 1 won the competition and was built. The variants can be seen on the next figures. The trees in the first variant are quite dispersed over the whole park. The second variant has a more structured distribution, as the green area is divided in quadratic parts. Finally the last version has most of its trees on the lower peak. The analyses were done for 12h as well as for 16h.

Winter analysis:



figure 3.3 - Variant 1: 12h



figure 3.4 - Variant 2: 12h



figure 3.5 - Variant 3: 12h



figure 3.6 - Variant 1: 16h

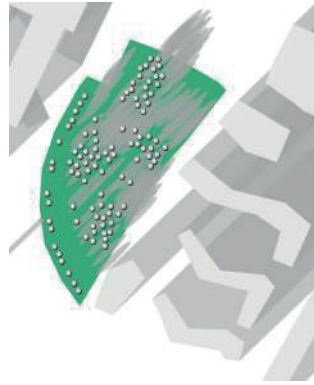


figure 3.7 - Variant 2: 16h

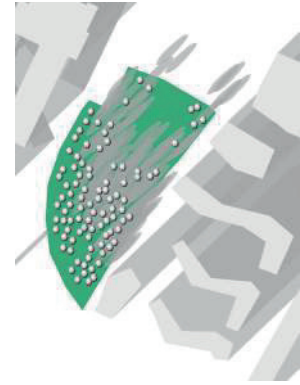


figure 3.8 - Variant 3: 16h

The lower corner that was marked in red in the previous figures is not left empty and even though some sun can get through, this doesn't match the expectations. The version 2 is the one where we can see the most sun on this lower corner. Even though the other designs have less sun on the lower corner, both of them manage a sun window in the upper part of the park. The squared trees distribution of variant 2 doesn't let sun through on the upper part, which makes it the design where there is the less sun at 12h.

On the figure for 4 pm, one of the last shadow projection before the night can be seen. The position of the sun is now such that the high building's shadow doesn't reach the park anymore. At this time the trees are the main reason for shadows in the park. As they stretch up, it is easy to see that the variant 2 is not ideal, whereas the two other variants managed to keep a sun enlighten area on the top of the park. Letting a large area without trees in the middle is indeed a good design in order to let light access the area. Though the building environment has to be considered. It leads in this case to shadows especially on the upper area in the afternoon.

Summer analysis:



figure 3.9 - Variant 1: 16h

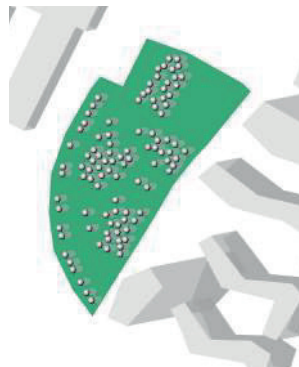


figure 3.10 - Variant 2: 16h



figure 3.11 - Variant 3: 16h

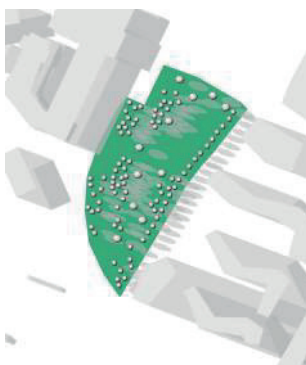


figure 3.12 - Variant 1: 19h

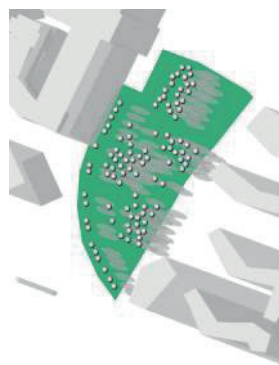


figure 3.13 - Variant 2: 19h

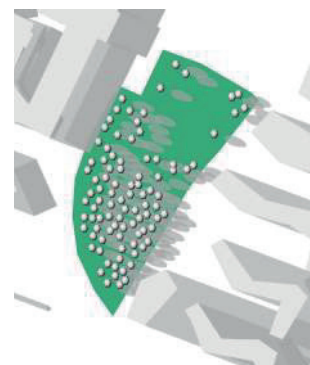


figure 3.14 - Variant 3: 19h

The analysis for 12h is not shown, as it is of limited interest due to the very high position of the sun, which leads to shadow only under the trees. Instead the shadow situation at 7pm was analysed. This is last hour of sun in summer, and a generally very appreciated time to be outside. At 4 pm the trees disposition as well as the building environment doesn't affect the sunlight reaching the park. In this case the variant 2 could be the most enjoyable as sun and shadow spaces are well distributed. The variant 3 on the other hand has clear marked zones for sun (upper part) and shadow (lower part). At 7 pm variants 1 and 2 are also to be preferred, as they allow larger space of sunlight than the variant 3.

#### 4. Connectivity and Choice Analysis in Park

The analysis of the connectivity and of the choice in the park will be made on two new variants. This comes from the fact that the variants used in the above analyses didn't have clearly defined ways. I chose to analyse two intuitive pathway distributions: one pathway is surrounding the park and others crossing it. The first variants has vertically and horizontally pathways whereas the second one diagonals.

In Depthmap I set up the colour scale so that both of the variants have the same. This allows a true comparison. However some caution in the analysis of the results is needed as the analysis is done on segments, which can lead to a lack of exactness. Finally it should not be forgotten that this is a park and therefore the ways are not as definite as a real street can be. There is always a possibility to cross through.

The two figures appear to have a very different choice distribution. The vertical pathway on variant 1 is the most used. On the other hand, the variant 2 has a very equal distribution of the people's flow. This type of analysis is very helpful in order to dimension the ways. In this example the red coloured path would have to be large enough and to be made out of a strong and easy to maintain material. Maybe the landscape architects would rather have a park without a big artery. In this case the variant 2 would fit much better.

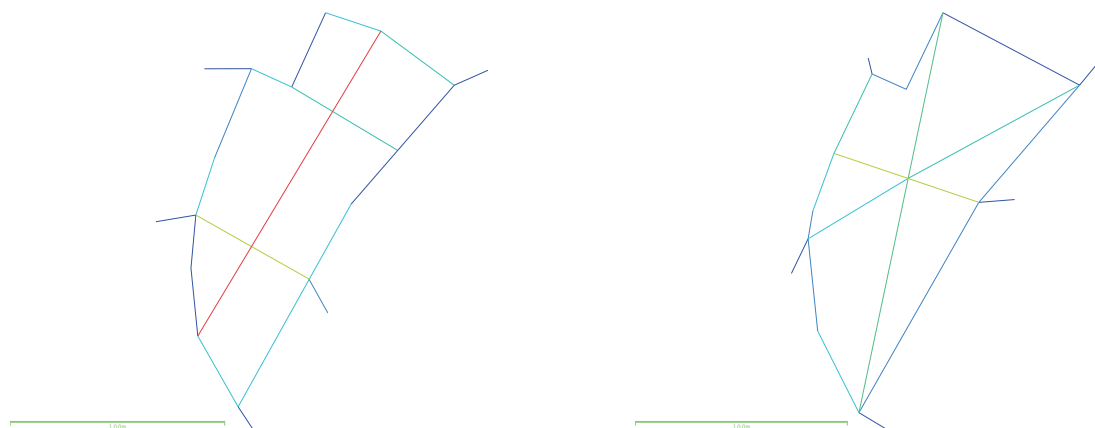


figure 4.1 Choice

The figures above are for connectivity. They give information on how many segments one segment is connected to. The figures have here more similarities than with they had for the choice. The pathways crossing the park show a high connection with neighbouring paths.

Here the segment analysis is not totally correct. For example on variant 1, the two indicated paths should have the same color. However the left one has a lighter blue color due to the fact that the line at the intersection is not a straight line, and is considered by the program as two distinct segments.

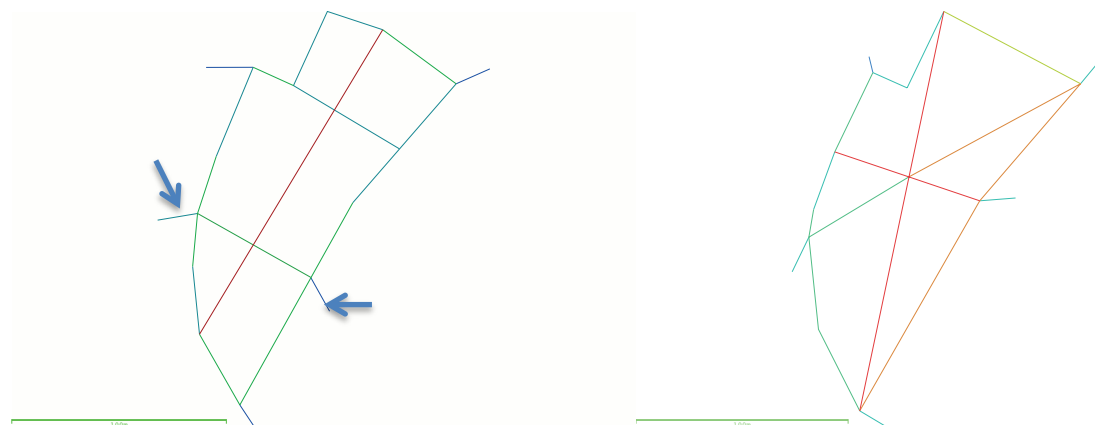


figure 4.2 Connectivity

## Conclusion

Through these analyses I wanted to see how we could apply the tools we learned in class for real design purposes. Such tools can bring a lot of information for a better design. They are a big help into trying to get a social approach as we always have to think what impact this or that property will have on the users and on its behaviour. They are also a way to measure and quantify these properties and allow quantitative and not only qualitative comparisons.

The analysis done on this park was very interesting. However making a choice for the best variant is very difficult for different reasons. First, I analyzed two sets of variants. For the shadow range analysis I used three variants that were actually competing and, for the connectivity analysis, two variants that I drew myself. Making a choice on the three variants only over a shadow range analysis is very difficult and should in practice not be done. Other very important parameters have to be taken into account. However, if I had to give an opinion, relying only on this shadow range analysis, I would take the variant 1, which was built. I make this choice by considering the sunshine distribution on the park over winter and summer. Regarding the variants used in the choice and connectivity analysis I can not make a choice only base on those results. The context in which the park is integrated is here much too important not to be taken into account. This is a choice that the planers have to make, without overlooking the many other important factors.

Theses powerful tools should definitively be used when possible. However the computer analysis isn't enough and a questioning of the results is fundamental to properly use the provided information. These tools have a very wide range of application. Using them for a park design analysis is an example on how much can be done with them.







# Hochschulgebiet Zentrum

Student: Jonas Landholt & Stefan Caranovic







Major Roads

Seilergraben



## Summary

The ETH, University and the University Hospital of Zurich are planning to transform the Hochschulquartier in Zurich City within the next 15 years. During this huge project, lots of older buildings are planned to be demolished and new space will be created. The intention of this gigantic retrofit project is to extend and centralize the space for the high schools and the hospital to form a Campus.

In this digital urban simulation project, the status quo as well as the “Masterplan Hochschulgebiet Zentrum” are analyzed according to traffic, accessibility, open spaces and photovoltaics potential. The “Masterplan” is an existing conceptual study of future transformation potentials for this city quarter.

Beside the analysis of existing variations, some further improvement suggestions and optimization strategies are analyzed.

Figure 1 and 2 show the existing situation as well as the building composition planned in the “Masterplan”. As shown in the figures the “Masterplan” gives a drastic change to the whole campus area. For such a big transformation project it is important to analyse impacts on traffic and pedestrian movement.

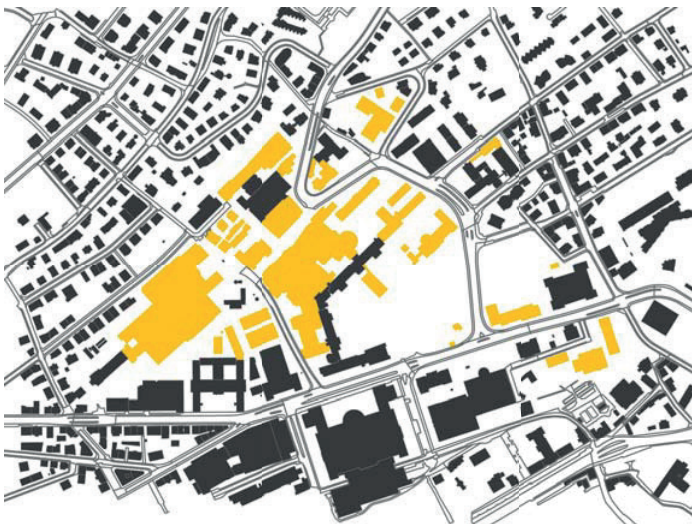


Figure1:StatusQuo,Buildingsthatareintendedtobedemolished(yellow)



Figure2:Masterplan,plannednewbuildings(red)

## Motivation

In the current situation there is quite some traffic through the “Hochschulgebiet Zentrum” coming from the Bellevue and leading towards Bucheggplatz. This traffic is producing quite some noise and is separating the Hochschulgebiet in two parts. In early morning and evening hours where also people flow is massive (~15'000 Students studying in his area), the roads get often jammed by cars and the noise & pollutants load on the pedestrians in quite high and the people flow is also distracted by the cars blocking the roads. To visualize this unsatisfying situation, the first part of the analysis will focus on improvement strategies of the traffic situation, means reduce the private traffic through the “Hochschulgebiet Zentrum”. This analysis will be performed by an integration and choice analysis on a bigger scale

Since the pedestrian density in the “Hochschulgebiet Zentrum” is quite high due to the high amount of students coming to ETH or University Zurich, the pedestrian pathways need to be improved. The “Masterplan Hochschulquartier” includes also a guideline where new pedestrian paths should be created and where new public transportation stations should be built. To analyse the proposed pedestrian paths and further improve the accessibility of the area for pedestrians, an integration and choice analysis is performed on district level.

Since such a high urban transformation is planned, the designers should also think about an integration of renewable energy technologies and how the newly built buildings could be optimised for renewables. With a Solar Radiation analysis, the PV potential is assessed and with optimization strategies, the heights of the new buildings get adjusted in a way to optimise the amount of electricity out of PV.

### Analysis 1: Private Traffic Reduction Strategies - Lake Tunnel

The traffic situation in Zurich is quite complex. There is a very dense city centre whose border on one side touches the lake. Zurich is widely known as a traffic hot spot in Switzerland. If you want to travel from St. Gallen towards Bern / Basel you need to drive by Zurich. And if you want to go from Chur to Bern / Basel you also need to drive by Zurich. Therefore Zurich started to build a Highway ring around Zurich to limit the traffic through the city centre. But this Highway ring has never been closed (see figure on title page). An example: people driving from Zollikon with destination Wallisellen will likely drive through the City - through the Hochschulquartier. The existing road system with highways (red), major roads (green) and minor roads (blue) is shown in on the title page.

In the year 2000, the cantonal government of Zurich planned to build a tunnel under the lake to close the highway ring, but the governing council banned this project and as we all know it has never been realized. In this analysis the Status Quo traffic situation is compared with a situation where a tunnel below the lake would exist and the highway ring would be closed. To see the impact on the traffic, an integration and choice analysis with depthmap was performed. For visualization of urban scale hot spots and choice decisions, the analysis radius was set to infinite.

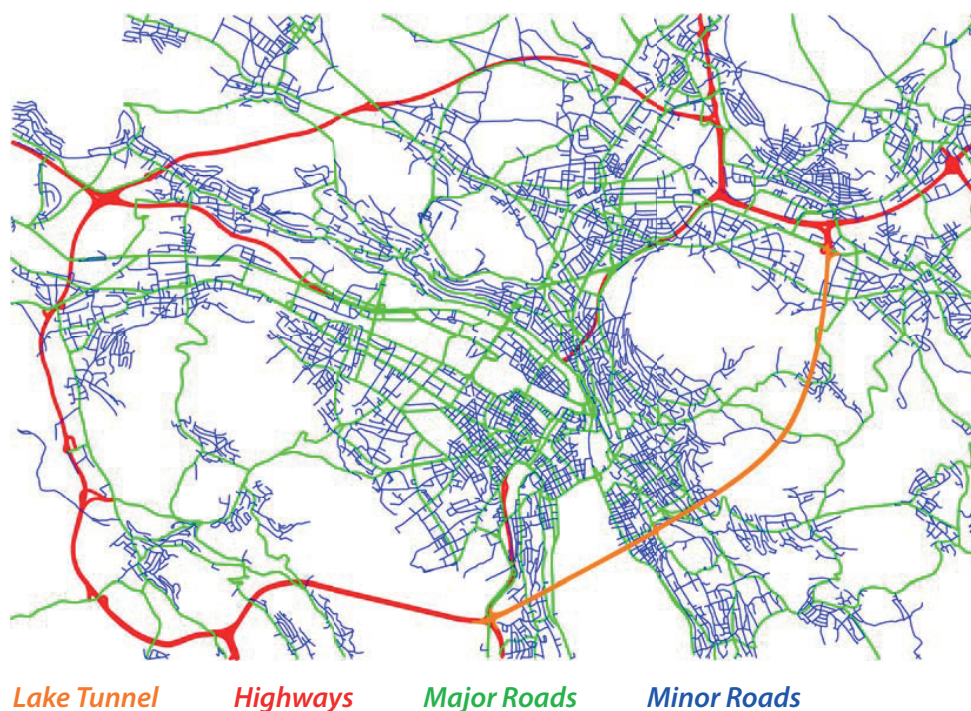


Figure 3: Closed Highway ring with lake tunnel

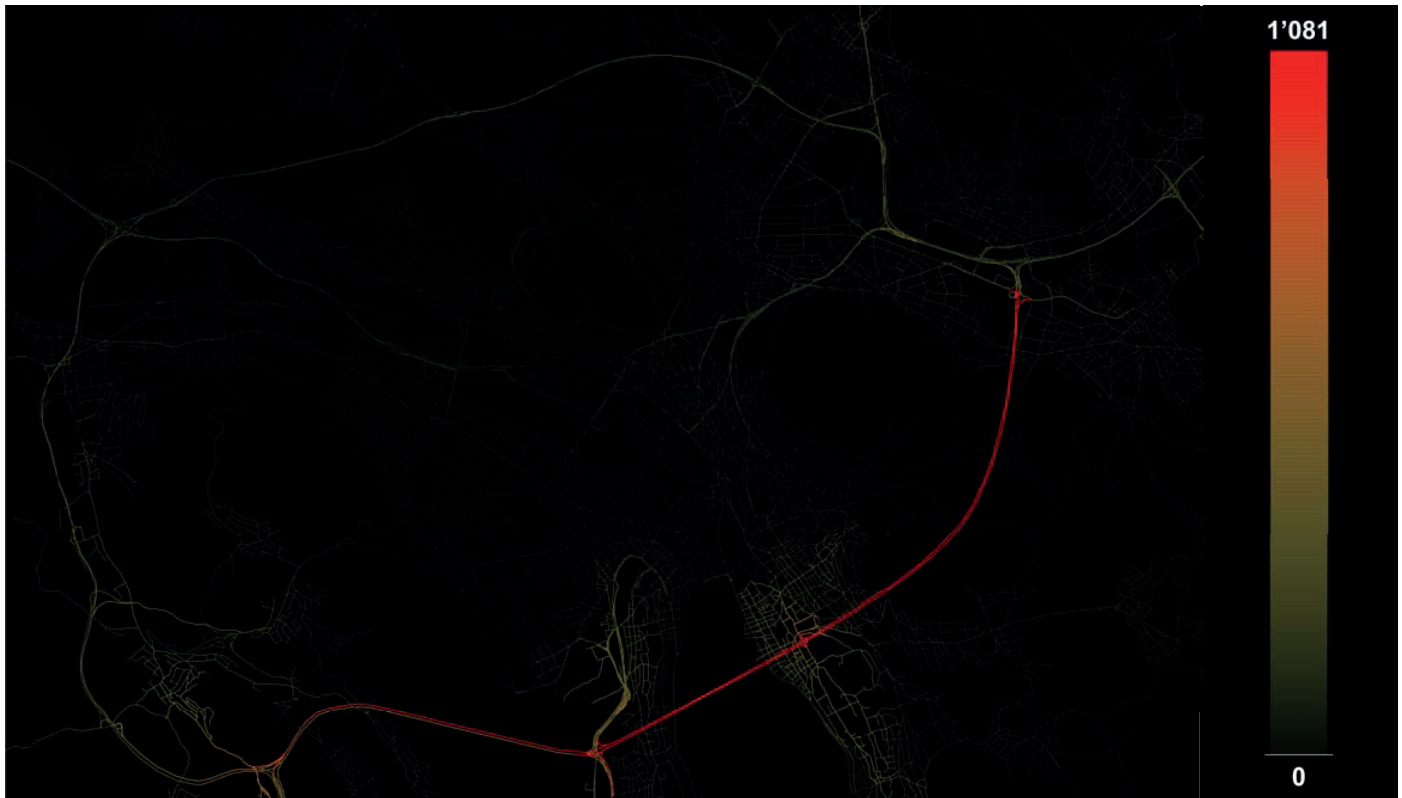




Integration - Status Quo (Figure 4)



Integration - Lake Tunnel (Figure 5)



Integration - Difference between Status Quo & Lake Tunnel (Figure 6)

## Integration Simulation - Status Quo vs. Lake Tunnel

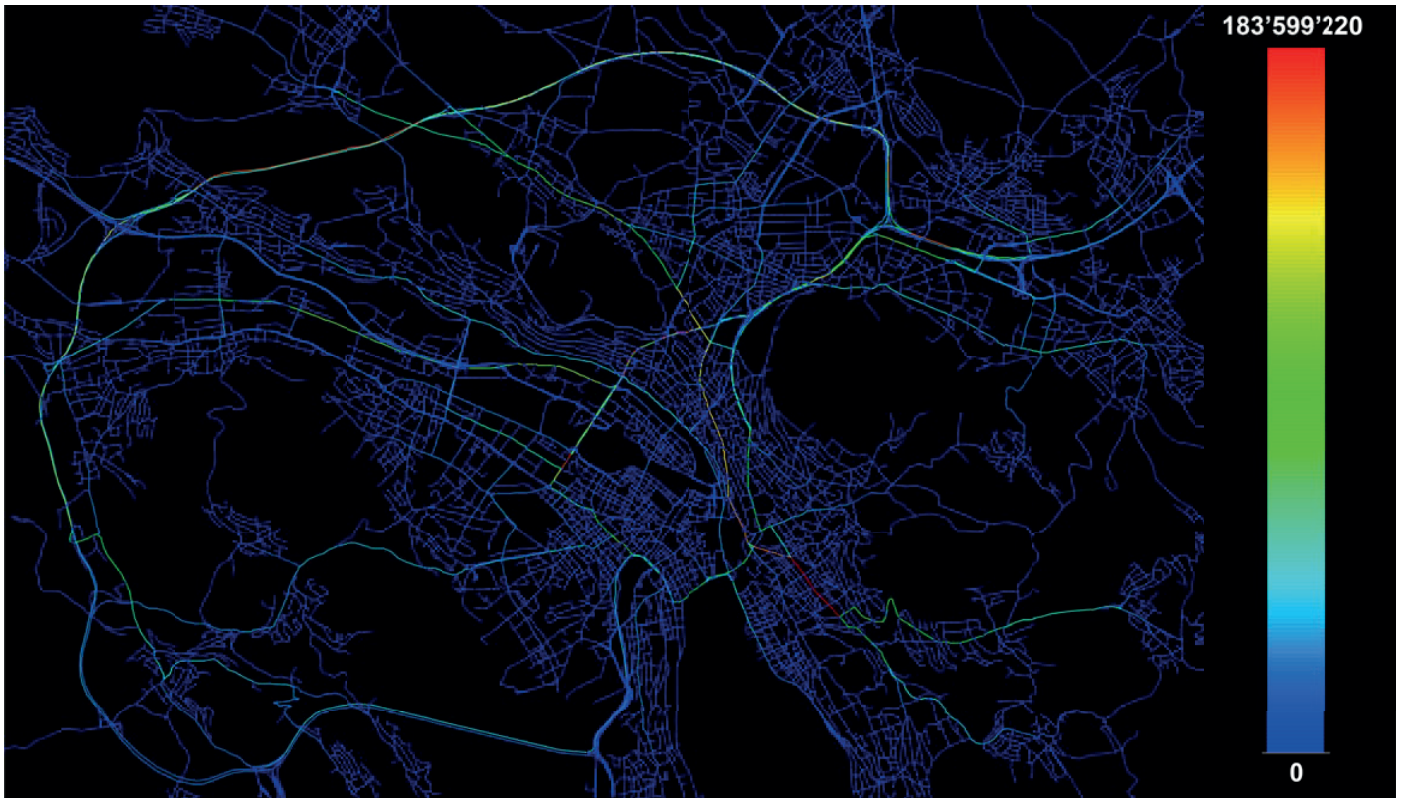
The two scenarios, Status Quo and Lake Tunnel, were analyzed with depthmap to see the difference in integration and to visualize the effect of closing the highway ring. The analysis radius of the integration analysis was set to infinity to get a picture about the city wide hot spots. The scales of the two analysis results were aligned to get comparable results.

Since it is not easy to see the difference between figure 4 and 5, the integration results of the Status Quo scenario were subtracted from the results of the Lake Tunnel values. Figure 6 was drawn with processing and is showing these differences. In figure 6, the roads whose integration value changed is clearly visible.

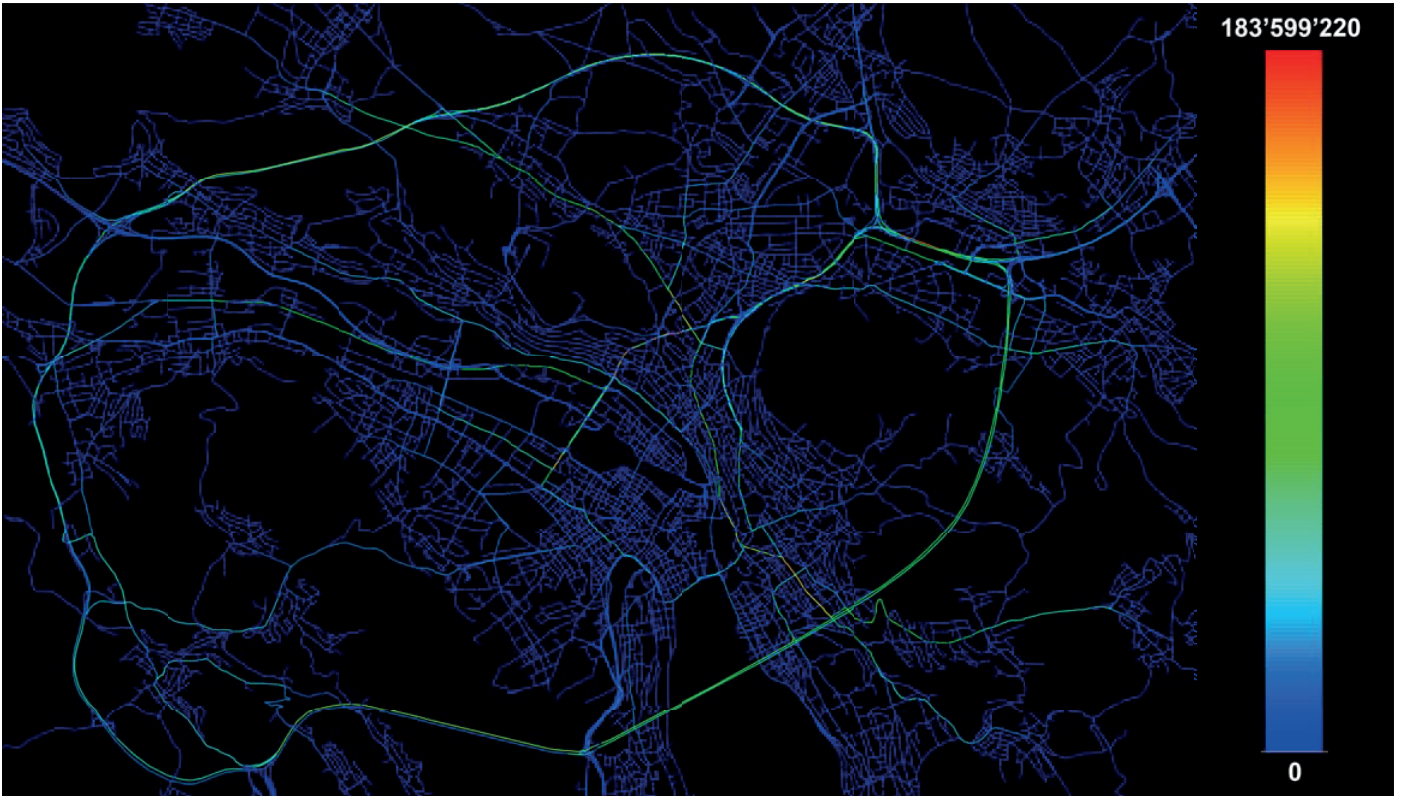
Integration is a value for the centrality of each segment and is calculated by how far a segment is in relation to all the other segments. Since in the Lake Tunnel scenario roads were just added and none were deleted, the integration of all the segments gets either higher or stays more or less the same. As seen in figure 6, the integration around the highway ring is increased much more than in the centre of the city. Especially around the new highway junctions the integration in the Lake Tunnel scenario is much higher than its value in the Status Quo scenario.

City-Wide, as seen in figure 4 & 5, the integration pattern stays more or less the same since the overall hot spots are still almost at the same place.





Choice - Status Quo (Figure 7)



Choice - Lake Tunnel (Figure 8)



Choice - Difference between Status Quo & Lake Tunnel (Figure 9)

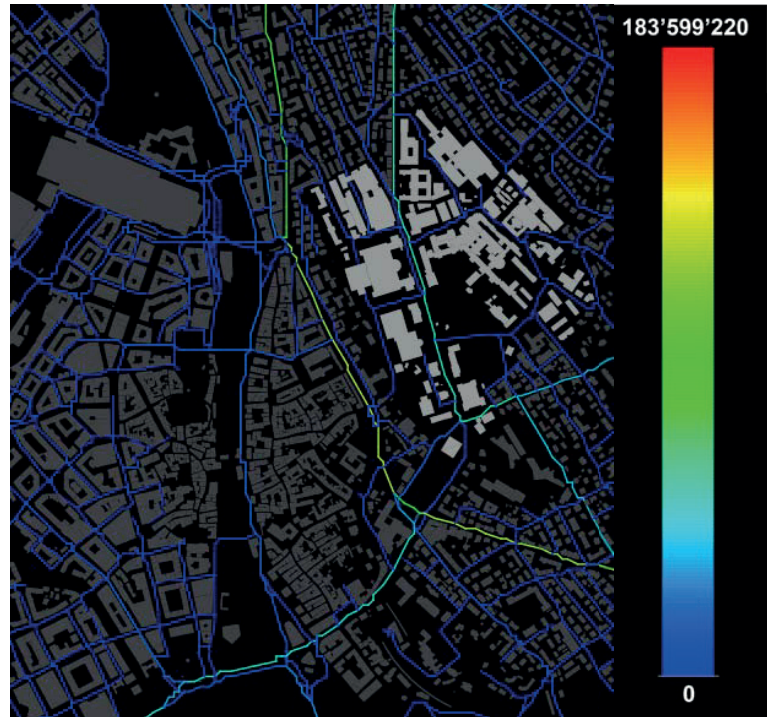
## Choice Simulation - Status Quo vs. Lake Tunnel

Closing the highway ring has quite some impact on the Choice values in the city of Zurich. Choice is an indicator for how often a segment is passed if all the shortest paths between each segment are evaluated. In this simulation case the choice is therefore an indicator for traffic density and visualizes on which road segments high traffic density is expected.

The Lake Tunnel reduces the choice values in a high part of the city centre. Because the change in choice is not obvious visible in figures 7 and 8, also here the choice result of the status quo scenario was subtracted from the choice result of the Lake Tunnel scenario. Figure 9 represents this difference in choice values and it is clearly visible that most of the main road segments in the city centre show a negative choice-difference value which indicates that the Lake Tunnel functions as expected and will likely reduce the traffic through the city. In figure 9, positive values mean higher choice in the Lake Tunnel scenario than in the status quo scenario, negative values mean lower choice in the Lake Tunnel scenario than in the status quo.

Some of the streets around the new highway will be chosen more often. Therefore the main streets leading to the new highway would probably need to be expanded and the highway junctions would need to be designed in an optimal way to prevent traffic jams.

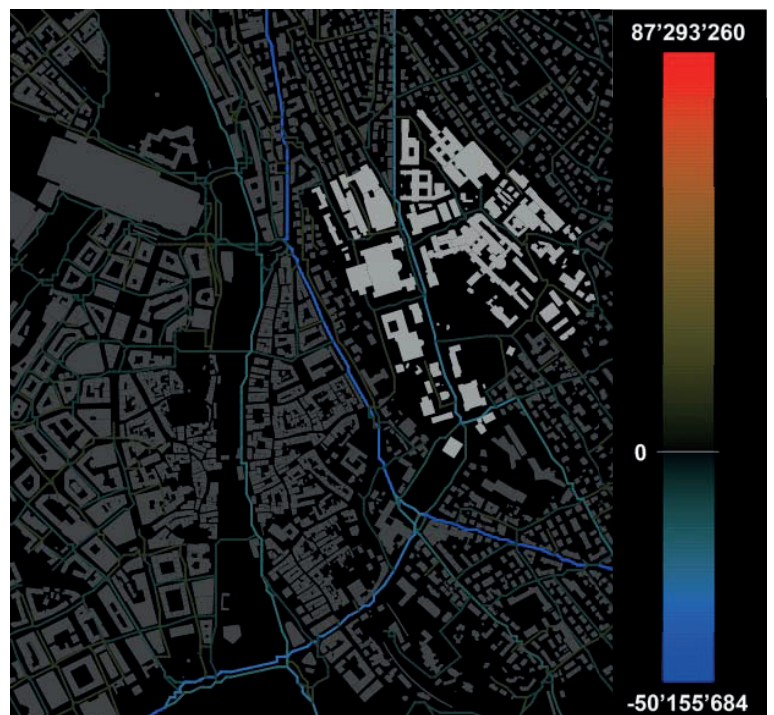




Choice Hochschulgebiet Zentrum - Status Quo (left) & Lake Tunnel (right) (Figure 10 & 11)

The main focus of this project lies on an optimization of the area of the “Hochschulgebiet Zentrum”. In this section the impact of the a Lake Tunnel (closing of the highway ring) on the choice of the roads within the area of interest is evaluated.

Figure 10 & 11 show the absolute choice value. It can be seen that the main roads (Rämistrasse, Universitätsstrasse & Seilergraben) show a lower value in the scenario with the Lake Tunnel than in the status quo scenario. Figure 12 shows again the difference of the choice value of the Lake Tunnel Scenario and the status quo scenario (lake tunnel minus status quo). A positive value means that the choice in the lake tunnel scenario is higher than in the status quo scenario and vice versa.



Choice Difference - Hochschulgebiet Zentrum (Figure 12)

Out of the segment analysis it is visible that a lake tunnel which closes the highway ring could be a good strategy to reduce traffic in the city centre of Zurich and especially in the “Hochschulgebiet Zentrum”.

## Analysis 2: Pedestrian Flow in the “Hochschulgebiet Zentrum”

The transformation of the “Hochschulgebiet Zentrum” and the demolishing and rebuilding of a high amount of buildings is a chance to optimise the pedestrian flow within this city quarter. Since most of the thousands of students studying at ETH and University Zurich are coming by public transportation to this city quarter, a good integration and accessibility of all the high school buildings by foot is desired.

A segment analysis of integration and choice of the various footpaths within the “Hochschulgebiet Zentrum” was run in Depthmap to visualize the pedestrian flow and to simulate improvement strategies and the footpath studies of the “Masterplan Hochschulgebiet Zentrum”.

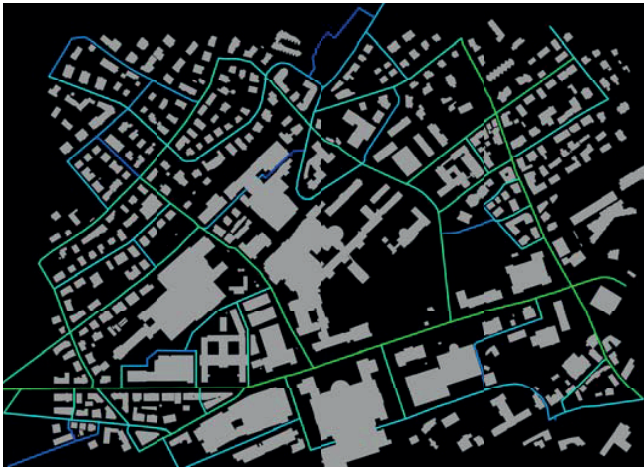
All the footpaths within this city quarter are taken into account. Since most of the students arrive by tram or via the Polybahn and leave the quarter the same way, reducing the analysis area to the Hochschulquartier is reasonable to analyse pedestrian flow within this quarter.

For the integration and choice analysis, the following public transportation stations were taken into account: 1 Polybahn, 2 ETH / Universitätsspital, 3 Haldenbach, 4 Neumarkt, 5 Kantonsschule, 6 Platte, 7 Voltastrasse

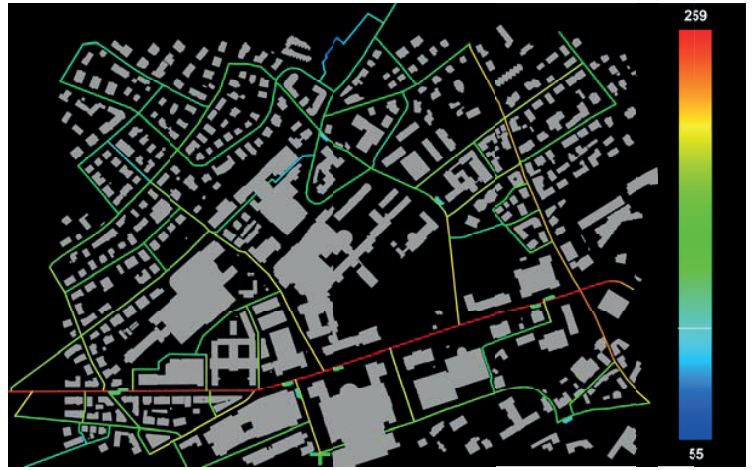


Figure 13: Analysis Area with public transportation stations

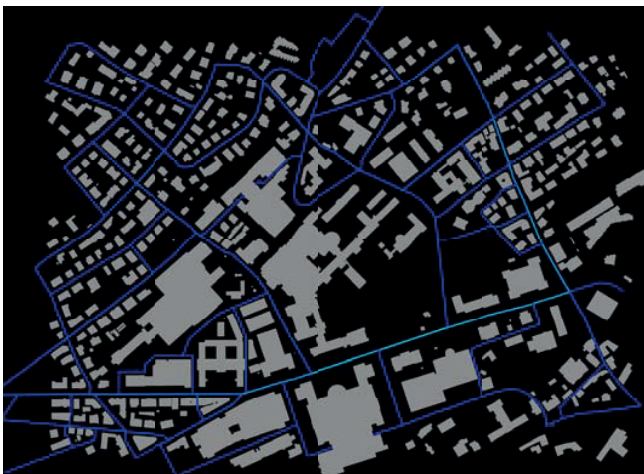




Integration - Without Tram Stations



Integration - Secenario 1 Base Scenario, Status Quo

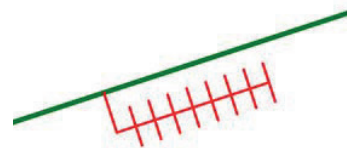


Choice - Without Tram Stations



Choice - With Tram Stations

The pictures above show clearly the impact of the tram stations on the integration and choice values. If you analyse footpaths, it's important to take crowded places into account and to represent them in an adequate way. In the simulations, tram stations and the station of the Polybahn are represented as shown in the sketch on the right side



It can be seen, that in the status quo the upper parts around the university hospital are much less integrated and the paths there show a much lower choice value than in the lower path segments around the ETH and University Zurich main buildings.

In a next step the new footpath setup of the Masterplan "Hochschulgebiet Zentrum" with the new location of tram station "Kantonsschule" is analyzed and further improvements are compared against each other.

Scenario 1: Base Scenario - Status Quo

Scenario 2: Masterplan "Hoschulgebiet Zürich"

Scenario 3: Masterplan as a base with an additional tram station at the new Sternwartstrasse

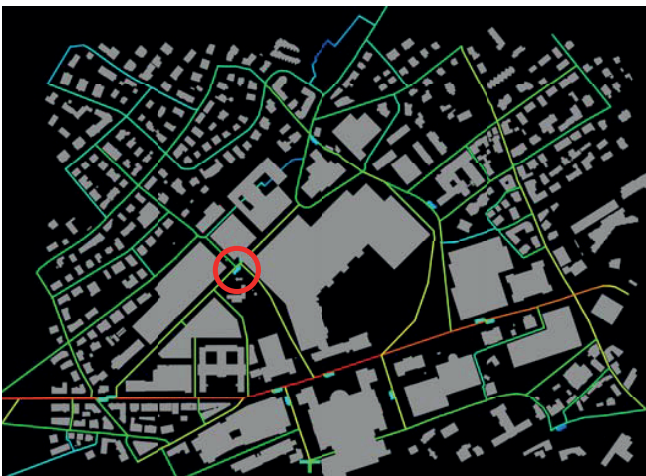
Scenario 4: Masterplan as a base with additional tram station and additional footpaths



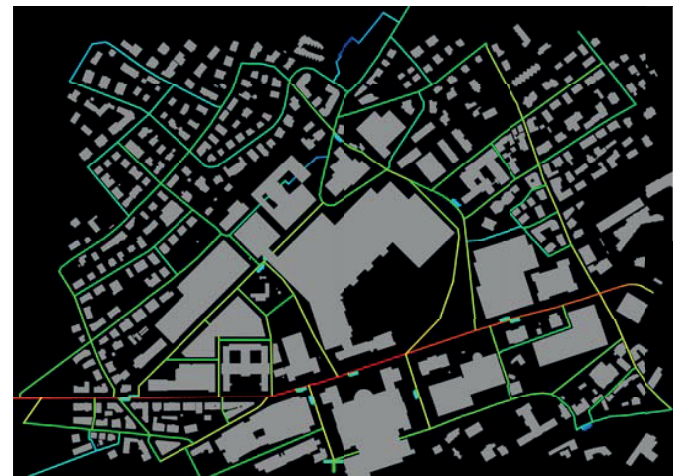
Integration - Scenario 2



Masterplan "Hochschulgebiet Zürich" with paths and tram stations



Integration - Scenario 3  
new tram station marked with a red circle



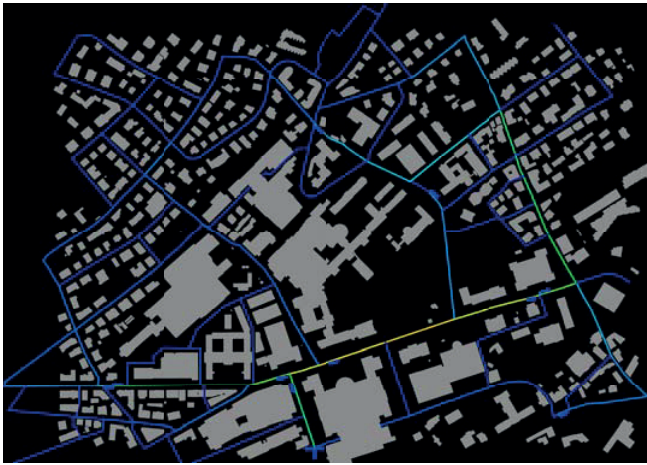
Integration - Scenario 4  
new tram station as in scenario 3 with additional footpaths

With the Masterplan "Hochschulgebiet Zürich" (Scenario 2) and its new and relocated tram station "Kantonsschule", most of the footpaths within the area of interest are more integrated than nowadays (Scenario 1). But still the upper parts around the University Hospital show a much lower value of integration and are still quite segregated from the rest of the university buildings.

If an additional tram station around the upper University Hospital buildings was added (Scenario 3) the upper area of the "Hochschulgebiet Zentrum" gets slightly more integrated. Such an additional station could be accessed by the new Sternwartstrasse and served by tram Nr. 9.

If some additional paths are added (Scenario 4), the upper part of the area gets even more integrated and these additional paths could help to connect the different university buildings and increase the integration quite a bit.

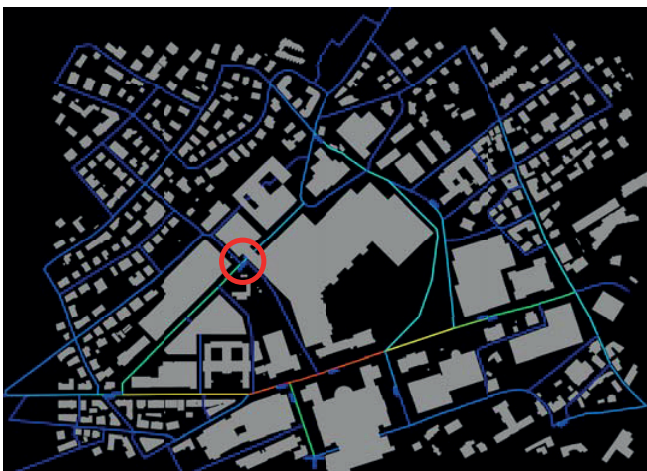




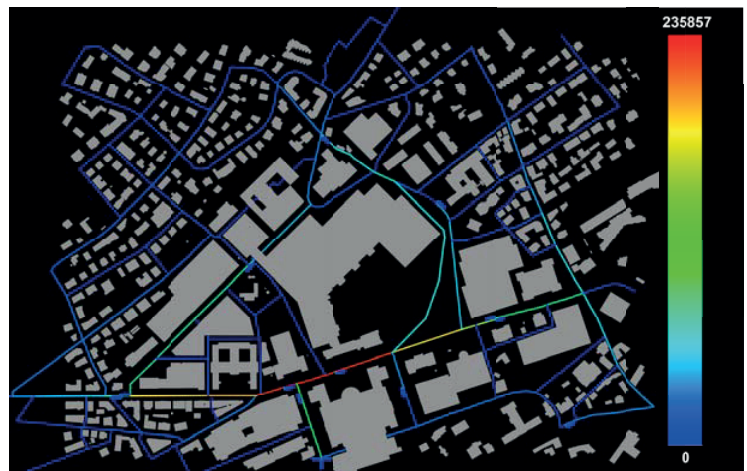
Choice - Secenario 1 Base Scenario, Status Quo



Choice - Scenario 2  
Masterplan "Hochschulgebiet Zürich" with paths and tram stations



Choice - Secenario 3  
new tram station marked with a red circle



Choice - Scenario 4  
new tram station as in scenario 3 with additional footpath

The change in choice is less obvious since the differences in choice are so small that they are hard to see. But also here, the Masterplan (Scenario 2) increases the choice of the paths in the middle and in the upper part of the area of interest compared to the base scenario (Scenario 1).

## Syntheseplan

An additional tram station (Scenario 3) would increase the choice of some segments at the Rämistrasse, Universitätsstrasse and the new Sternwartstrasse leading to the tram station.

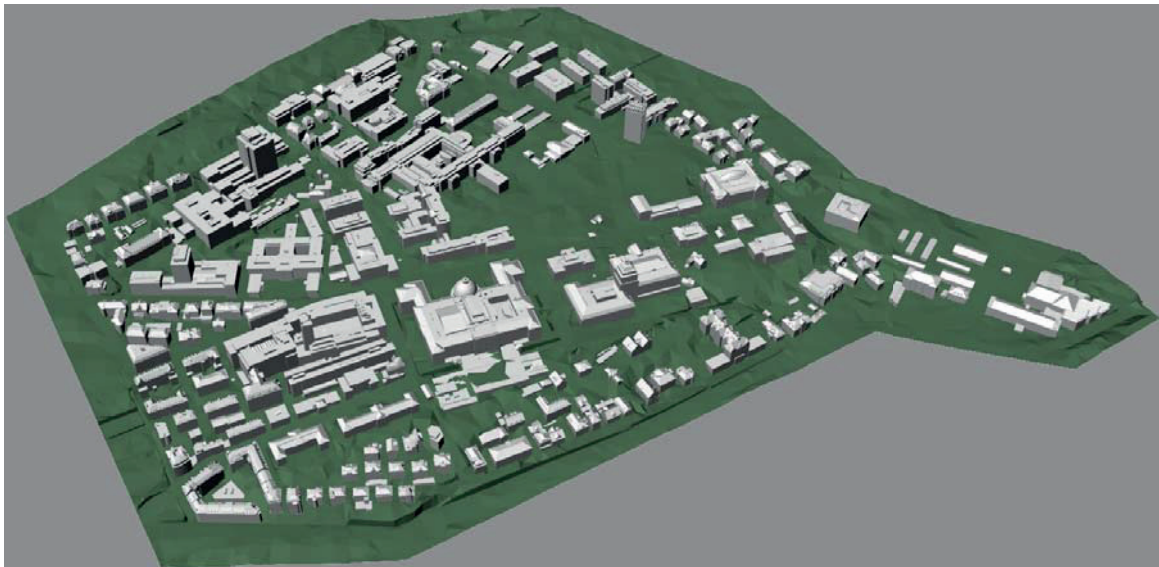
Adding new paths (Scenario 4) is further on slightly increasing the choice around Rämistrasse and the new Sternwartstrasse (axis through the planned new buildings).

Overall in can be stated, that adding tram stations, rearranging or adding paths can have a quite high impact on the integration and choice of the various path segments. For the "Hochschulgebiet Zentrum" we would suggest to set up an additional tram station around the area shown in Scenario 3, to give the pedestrians the possibility to access the upper part of the University Area on a direct way. This would clearly lead to a higher integration of this area as shown in the integration map of Scenario 3.



As the climatic change progresses (despite all our technological developments), the pressure on the design of buildings, quarters and cities increases in the direction of energy efficiency. Besides the “defensive” measures to prevent energy loss through better insulation and optimising heating/cooling schedules, buildings can be made more energy efficient also through intelligent use of solar energy. Designing a single house on a green field for optimal solar harvesting is a relatively easy task that can be achieved with the help of tables and rules of thumb. But when it comes to designing complex buildings in an urban context, designers need more powerful tools that allows them to handle the complex relationships of the big scale project.

In the following analysis examples we show, based on the “Hochschulquartier” and the new master plan for it (“Syntheseplan”), how Rhino in conjunction with Grasshopper and Ladybug can be used to assess the solar potential of a city quarter and how parametric analysis can help to benchmark different design or even generate a series of design and optimise them towards specific goals. As this kind of analysis are very computational intensive and generate large amounts of data, we will also analyse how these digital processes can be optimised and how the conditions can be set in order to get comparable results.



Existing Situation



Syntheseplan

## Radiation analysis and PV potential

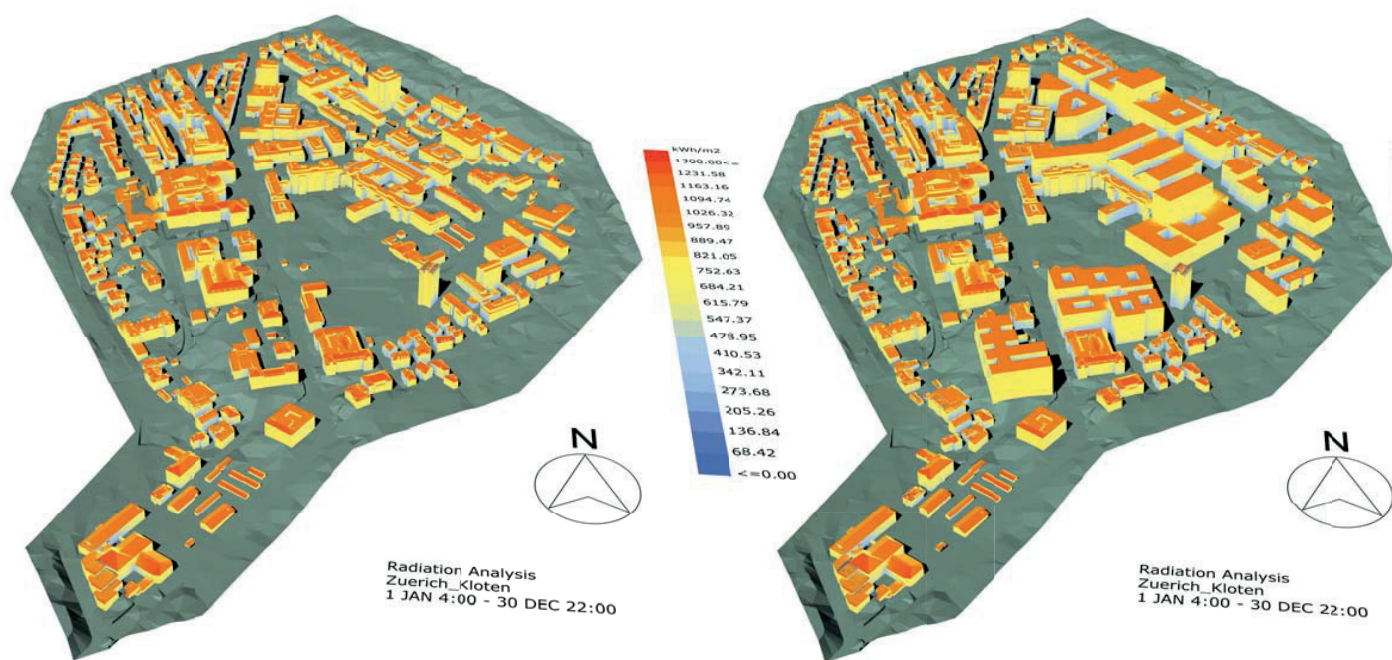
In order to estimate the solar potential of the buildings in the HQ , we use the radiation analysis tool of Ladybug to generate a solar irradiation map. We develop further a tool that takes the results from Ladybug and estimates if certain areas are eligible for the installation of PV or not and generates a visual output of the suited areas. The decision is made based on an economic calculation and the efficiency of the PV modules. Taking into account the price per m2 of PV systems (1000 CHF/m2), the average lifetime (30 years), the efficiency (16%) and the market price of electricity in Switzerland (0.2 CHF/kWh), we come to the conclusion that a threshold of 1040 kWh/m2 of solar irradiation is needed in order to make PV profitable.

After running the script for both existing situation and planned intervention, we noticed an increase of 5'780 MWh PV potential in the "Syntheseplan". This represents an increase of 32% from the initial potential of 18'050 MWh. Moreover, the new image of the areas suited for PV generation shows a much better distribution with bigger areas on flat roofs. Even with the significant improvement, the PV electricity production would cover only ca. 26% of the total electricity demand of the present quarter (90'000MWh).

Besides the distribution off solar radiation on the building stock, we produce also maps that show the solar radiation on the ground plane. First, this shows which areas are highly sheltered from the sun and if there are buildings that suffer from the lack of solar radiation. Secondly, this type of representation could be a new kind of "ground floor plan", one inspired by our era where energy seems to be the driving factor of urban design. Although a direct expression of energy flows, these maps have also a human scale. They show how "narrow" or "closed" a space feels or how close its perception is to the one of an interior space. The bluer a spot, the more it is enclosed and perceived as belonging to the buildings' private space rather than to the public space of the city.

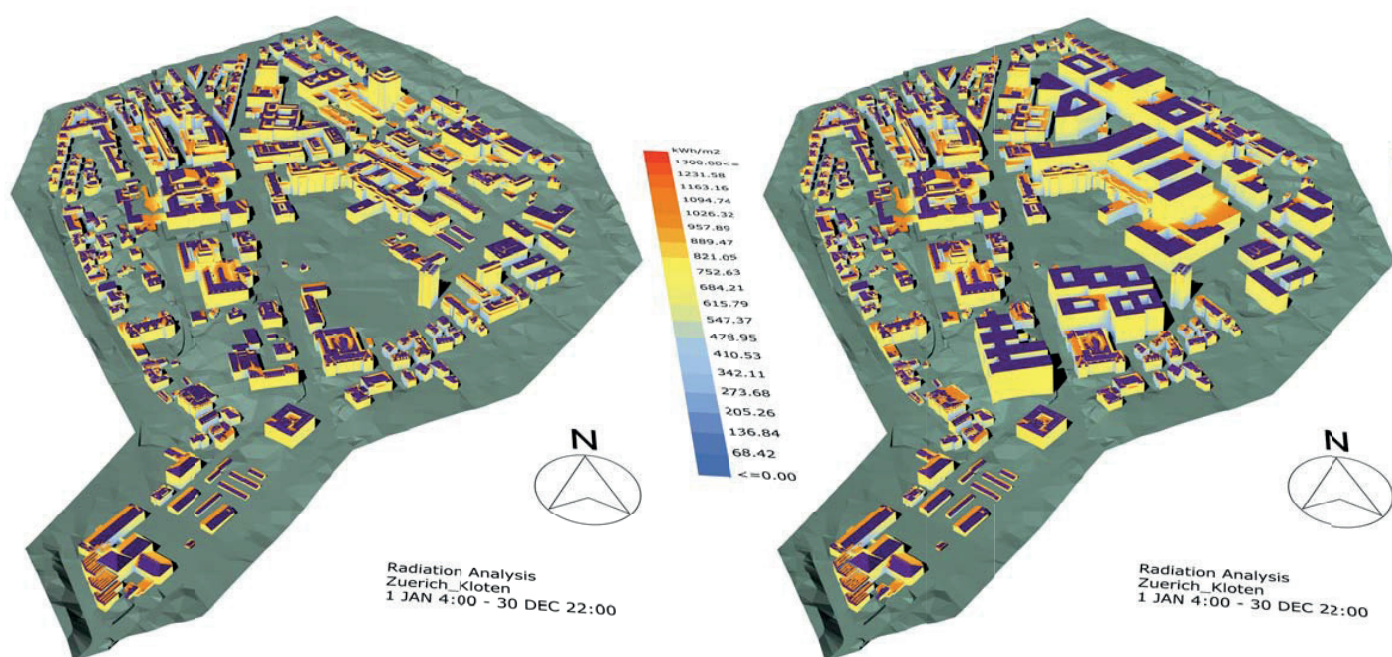
Situation #	PV energy MWh	PV area m2	Electricity demand MWh	Covered by PV %
Original	18,050	102756	90,000	20.06
Syntheseplan	23,900	123513	90,000	26.56
Relative change	32.41	20.20	0.00	32.41

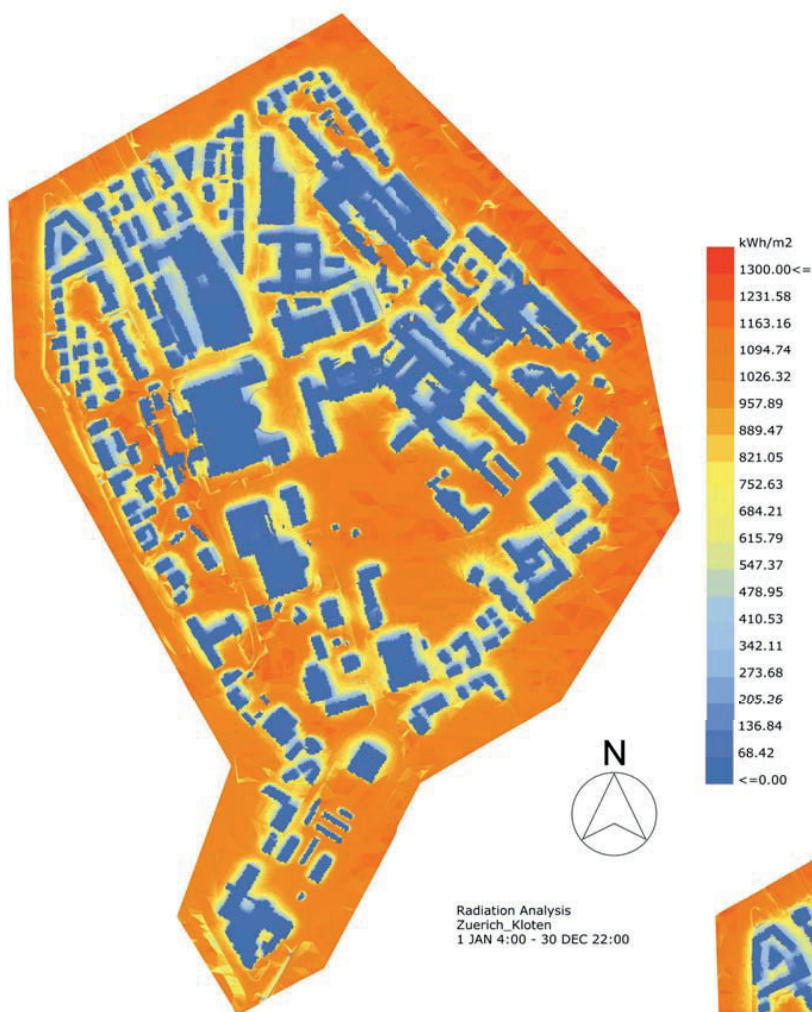




Initial Situation - Solar irradiation analysis + PV potential areas

Syntheseplan - Solar irradiation analysis + PV potential areas





Changes in the "Ground floor radiation plan" (Original, left - Syntheseplan - right)



More blue in the Syntheseplan means that more public space is privatised and the higher buildings generating more darker in-between spaces take up even more of the "orange" public space.



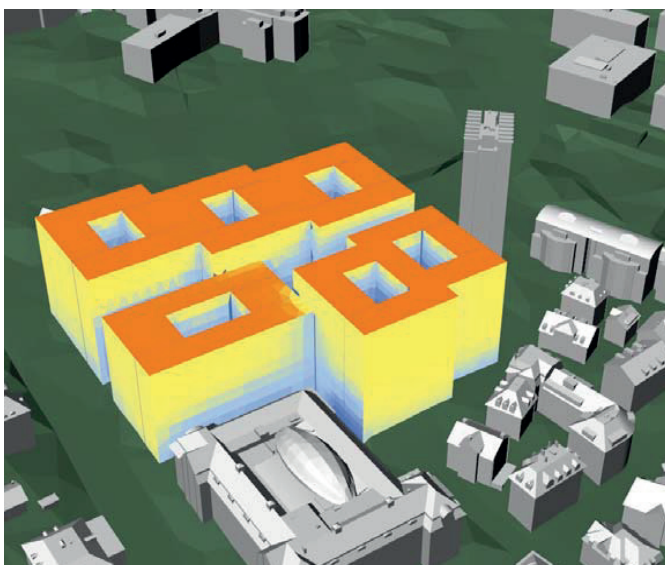
## PV Production Optimization

After the analysis of both scenarios, we also looked at how parametric analysis and design can help benchmark and / or improve the planned intervention. With the help of the Galapagos optimization tool we took the ground floor plan of the “Syntheseplan” proposal, divided each building into several blocks and optimised the height of the blocks for optimal PV gain. In order to still fulfil the space requirement of the programme, we set as base condition that the generated volume has to be equal to the “Syntheseplan” proposal +/- a certain threshold.

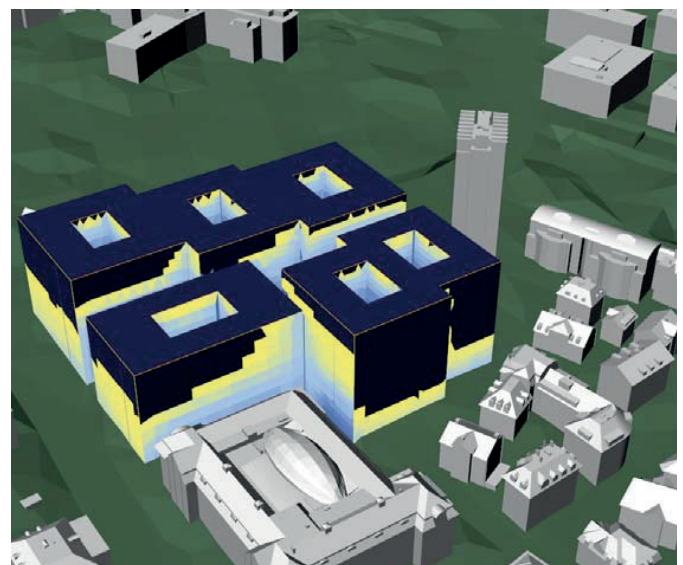
To be even more precise in the generation of output data, we decided to normalize the resulted PV production by the built volume in order to avoid bigger effects of bigger volumes. After running simulations on several clusters we managed to get for all of them noticeable improvements of our benchmark criteria, compared to the initial “Syntheseplan” designs. Especially in clusters 01 and 02 there is a clear tendency of the optimization algorithm to increase the height in the north and decrease it in the south while keeping the volume in the required range. Cluster 03 shows a more unpredictable behaviour probably because of the high amount of parameters it had to adjust.

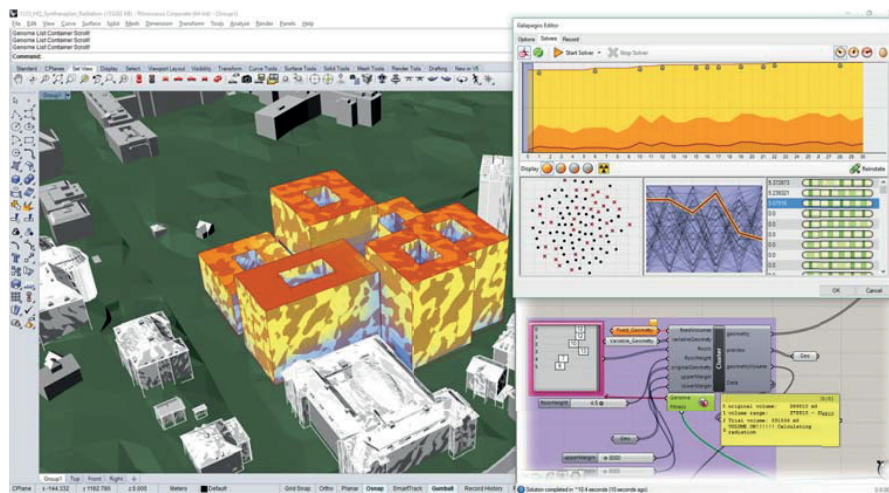
The optimization study shows some main methods how solar gain can be optimised. However, these kind of analysis have to be viewed with caution, for they can distort the view on the quality of a building. The very clear and quantifiable results can shadow other aspects that have to be taken into account but are not easily to be grasped. Even more, the numbers generated can have a strong impact on decision makers that are not necessarily architecturally gifted and lead to planning decisions that hinder architecturally valuable projects from being built.

Cluster	Initial PV energy	Initial PV / V	Trial PV energy	Trail PV / V	PV energy improvement	PV / V improvement
#	MWh	kWh / m3	MWh	kWh / m3	%	%
1	2,120	5.486	2,260	5.88	6.603773585	7.18
2	1,850	6.547	2,080	7.55	12.43243243	15.32
3	1,210	5.236	1,690	8.044	39.66942149	53.63



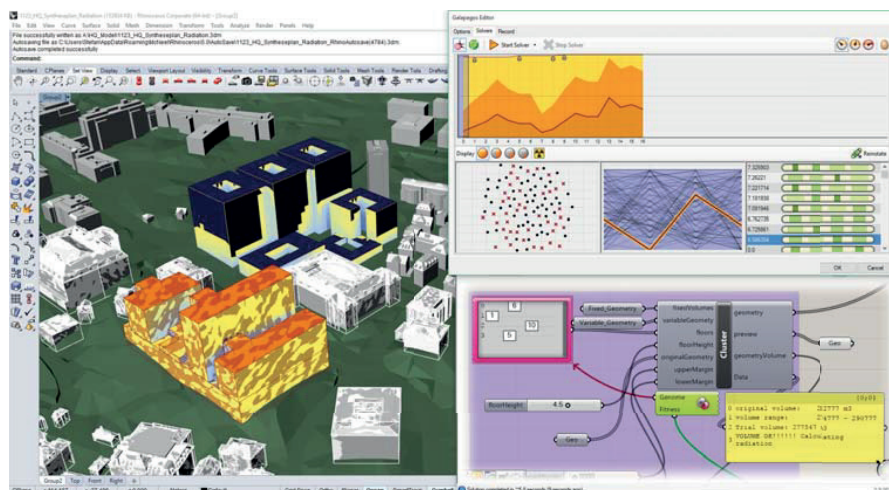
Original Design, Cluster 01





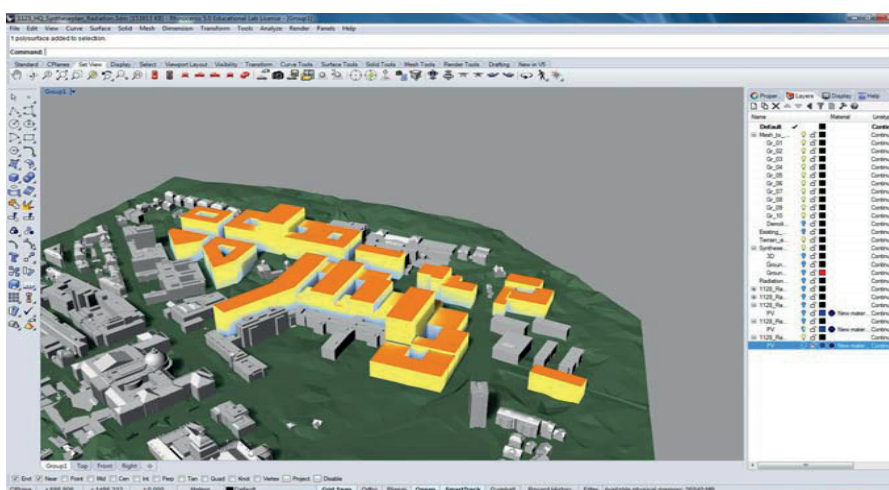
Optimization Cluster 01 -  $pv / V = 5.079$

Initial Cluster 01 -  $pv / V = 5.486$



Optimization Cluster 02 -  $pv / V = 6.586$

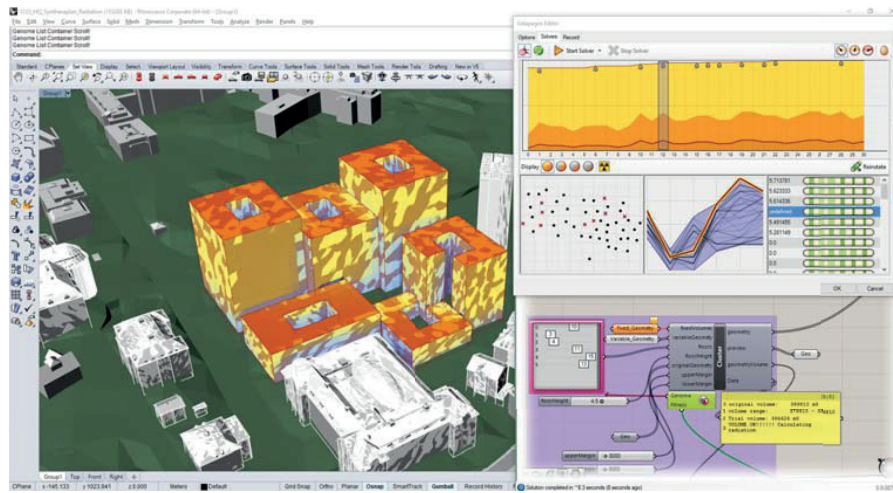
Initial Cluster 02 -  $pv / V = 6.547$



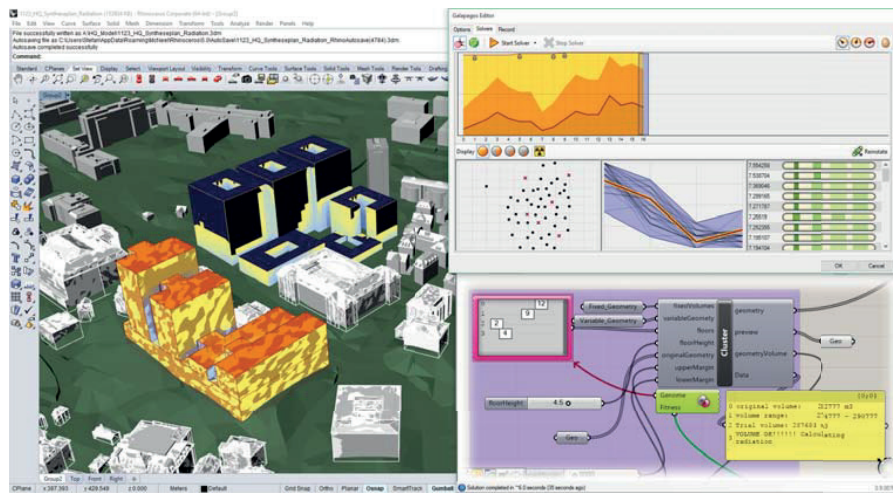
Optimization Cluster 03 - Initial Situation

Initial Cluster 03 -  $pv / V = 5.236$

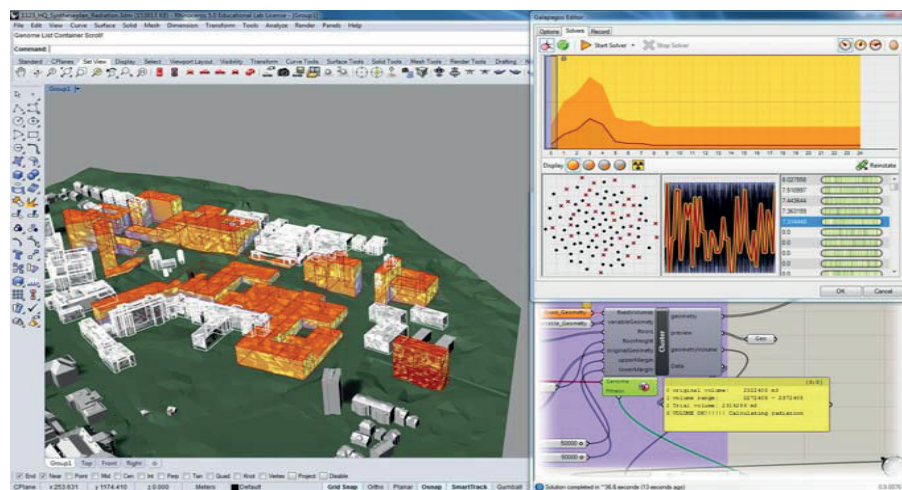




Optimization Cluster 01 -  $pv / V = 5.580$

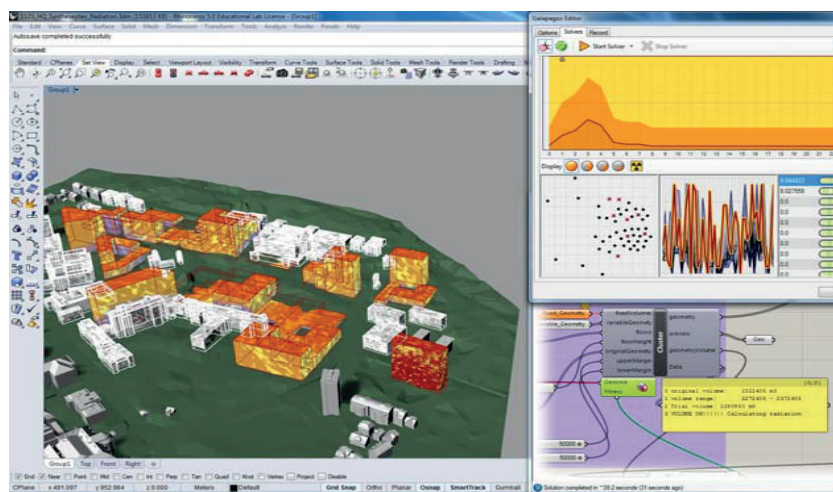
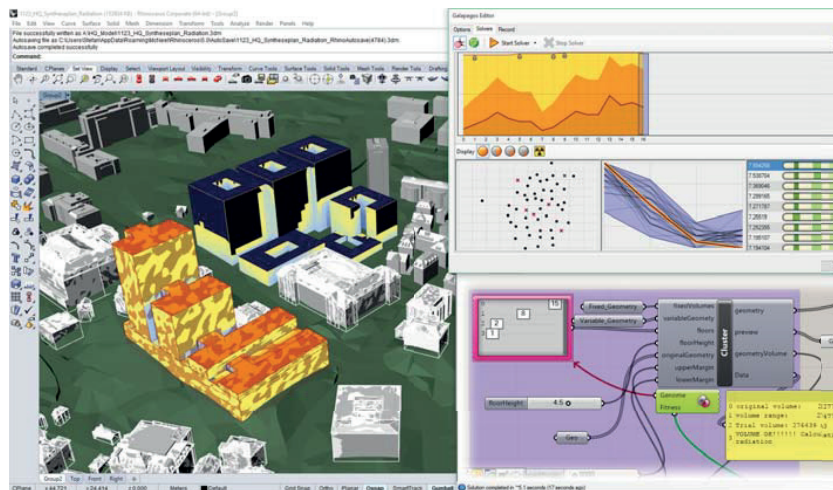
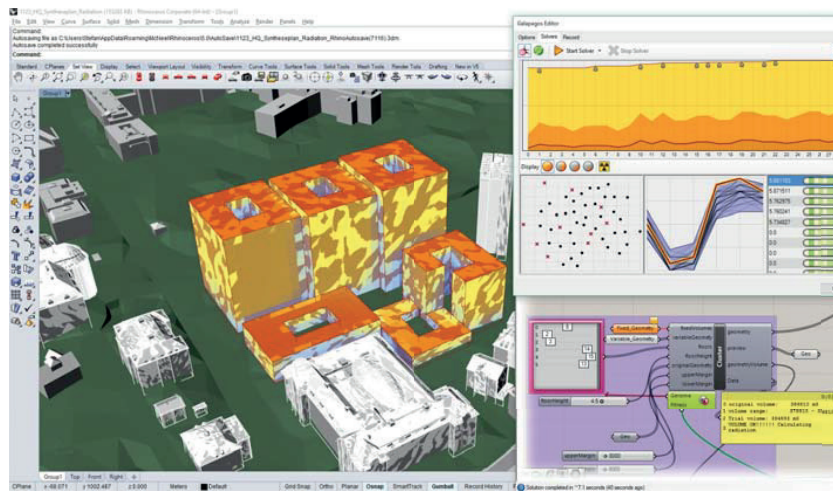


Optimization Cluster 02 -  $pv / V = 6.941$



Optimization Cluster 03 -  $pv / V = 7.310$





## Shadow analysis of Sternwarte Plaza

We identified the place around the Sternwarte to be suitable as a central plaza especially because its connection to the new quarter boulevard and its position between the 3 main actors of the HQ. As the quarter is already quite dense and the buildings are usually very high, there are not many sunny places for pedestrians to sit, except Polyterasse. Because of the normal configuration of streets and buildings, it happens that the sunniest places are usually in the middle of a street, which is unfortunate. Plazas however are places where the normal relation between street (as the space for moving) and buildings turns around. The spaces of movement come very close to the buildings and the sunny centre remains open for pedestrians.

In our analysis we use again the optimization tool Galapagos to find the best geometries for the buildings surrounding the “Sternwarte Plaza” in order to minimize the shadowing. We measure the shadow effect on the day of summer solstice (21 June) and try to minimize the area of the plaza perimeter that is affected during an entire day. From the results we can see a result that does not necessarily surprise: the buildings adjacent to the plaza become lower as the shaded area becomes smaller. Although this could have easily been evaluated by any designer without digital aids, the benefit of using parametric methods is that multiple solutions can be generated very fast while taking into account multiple restrictions (in our case shadow area and volume). In a conventional design process, every volume decrease in one part of a building has to be manually compensated by adding that volume in another part, which for more complex geometries and multiple conditions can become very time intensive.

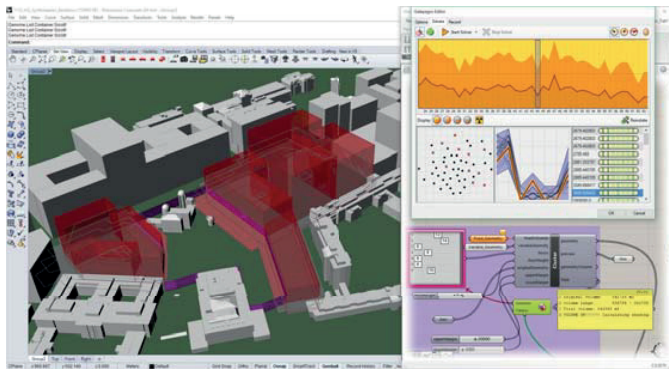


Initial design, perspective

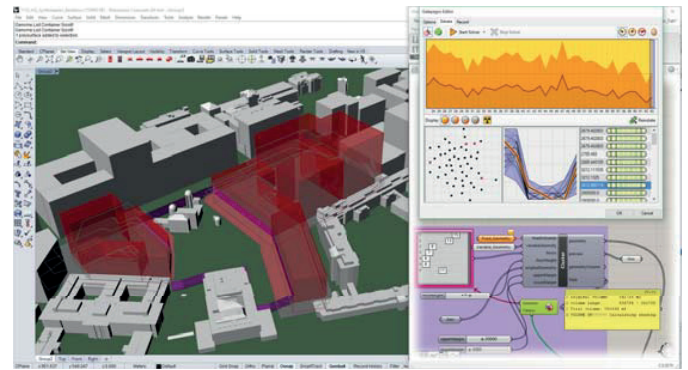


Improved design, perspective

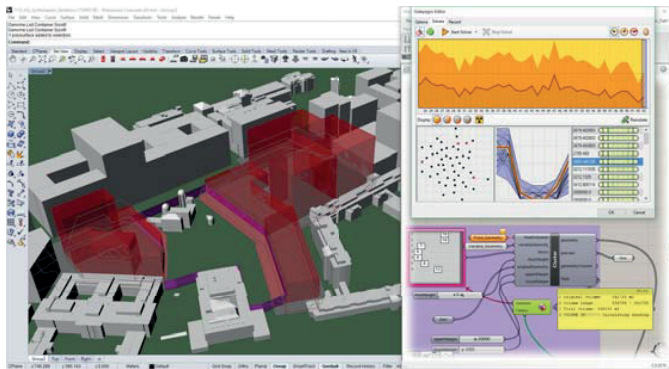




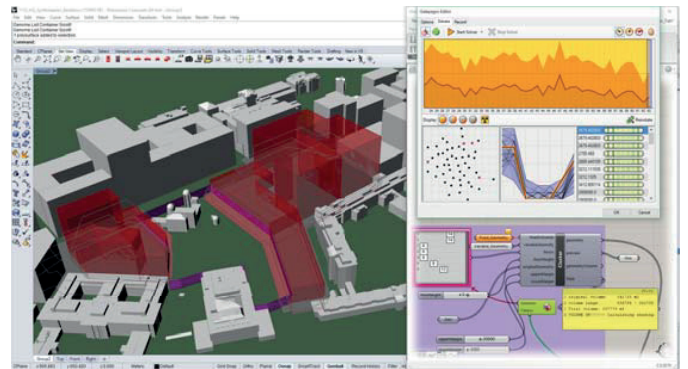
Sternwarte Plaza, shadow optimization -  $A=3685 \text{ m}^2$



$A=3412 \text{ m}^2$



$A=3885 \text{ m}^2$



$A=3679 \text{ m}^2$



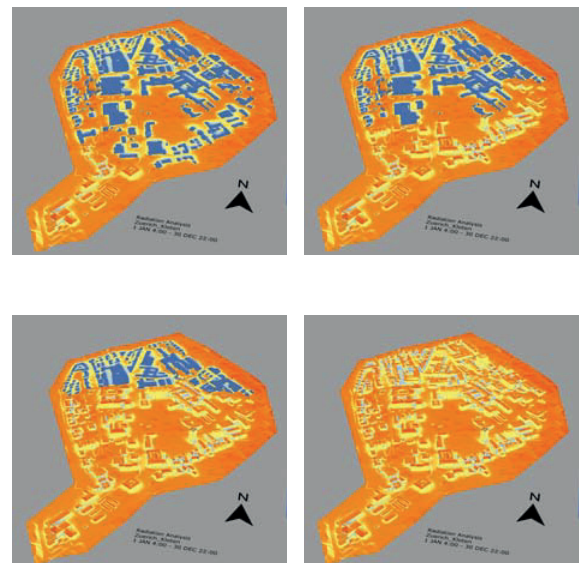
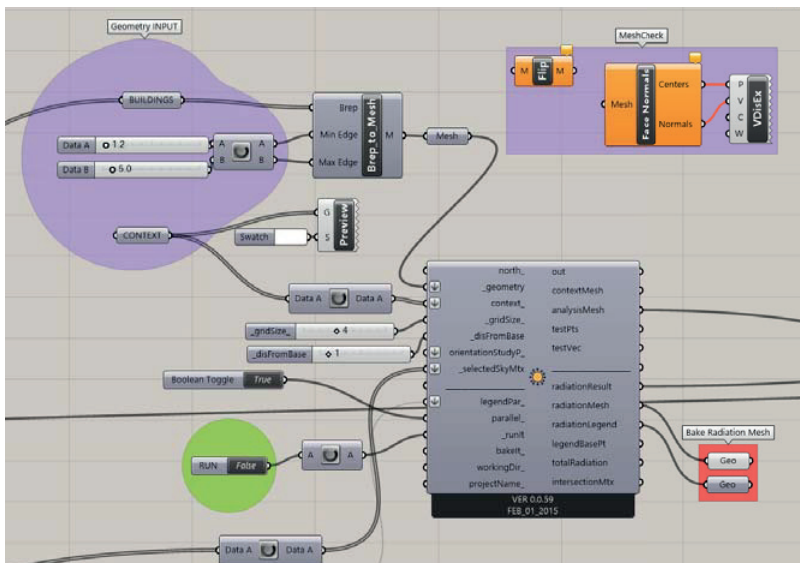
Initial design, ground floor plan,  $A = 5600 \text{ m}^2$



Improved design, ground floor plan,  $A = 2679 \text{ m}^2$

## Radiation analysis

The radiation analysis tool provided by the Ladybug plug-in is a good base for a small scale project, but for a study on quarter level, the script has shown his limits. The main problem we identified is that the use of Breps as input geometries uses an internal mesh generator of the script which adds to the RAM consumption and reduces the power of the solar radiation calculator. Moreover, the script seems to have trouble with surfaces that are not connected to closed volumes and created blank faces where normal vectors show in the wrong direction. To avoid these problems, we created our own mesh generator where we take Breps as input and generate a predominantly rectangular mesh of a specified resolution. If needed, the mesh is unified and flipped in order to perfectly function with the ladybug script. Very large areas had to be split into multiple clusters that where simulated with surrounding context.

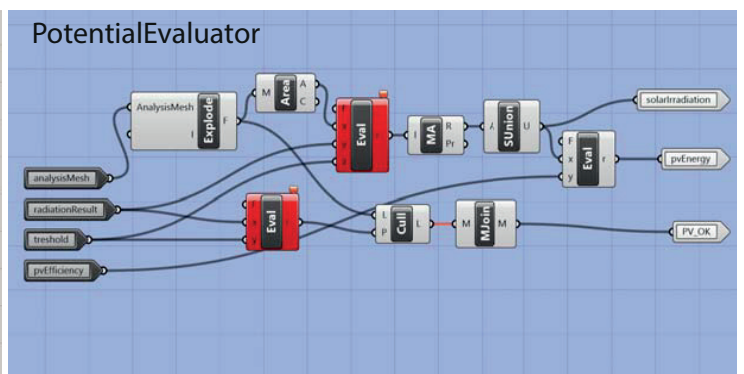
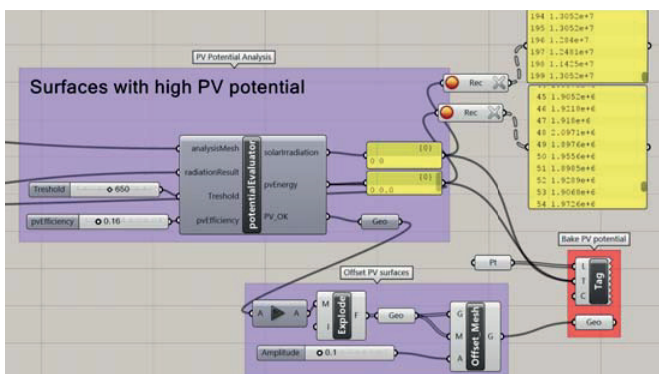


Ladybug component enhanced by separate mesh generator

Smaller clusters for better performance

## PV Potential Analysis

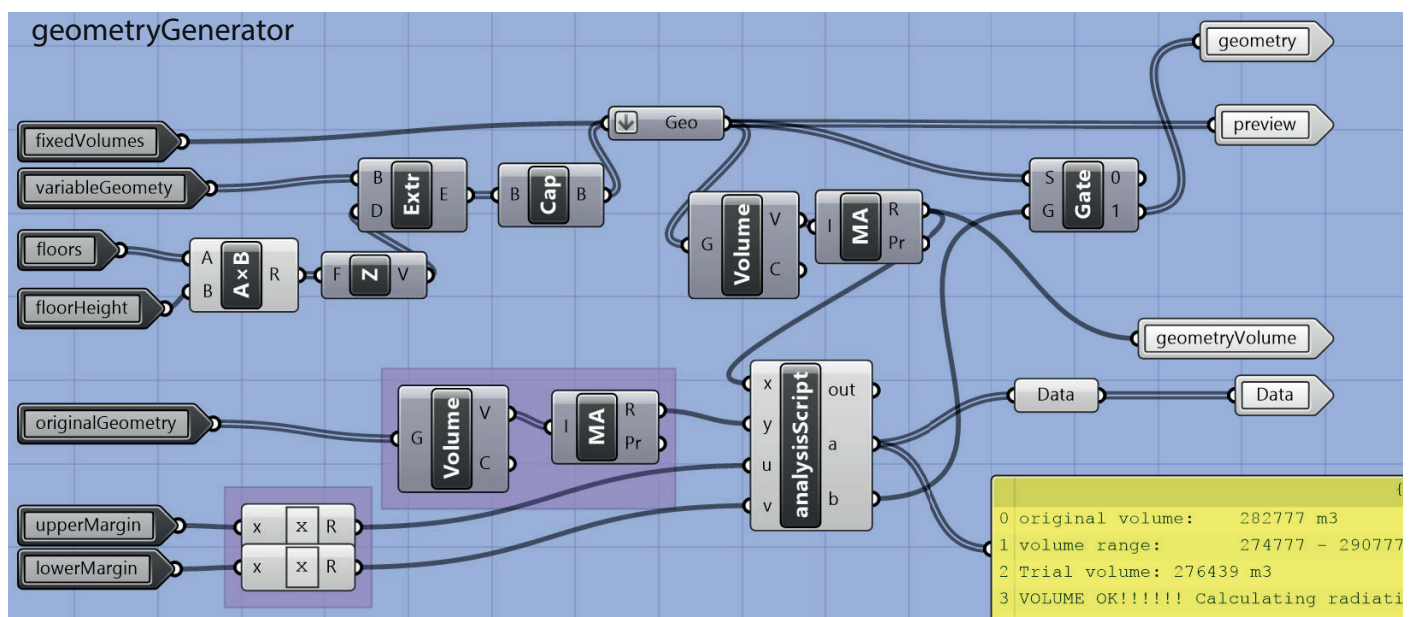
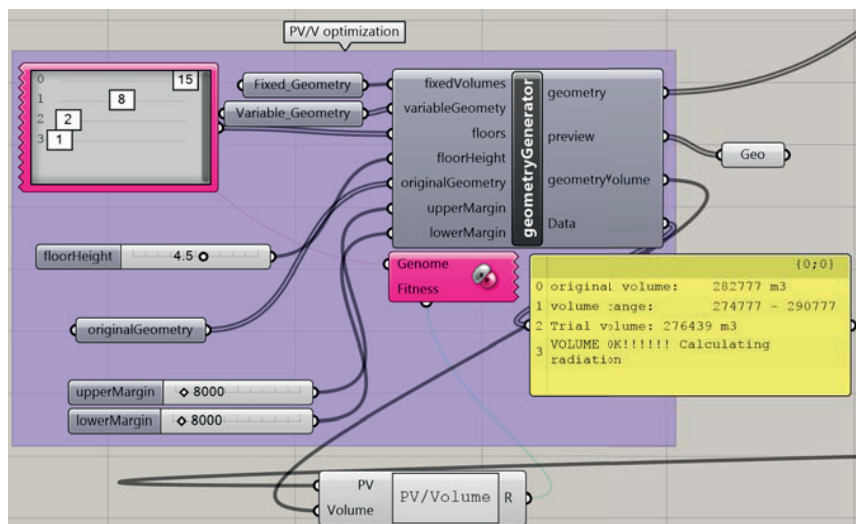
The PV potential analysis part takes as input the analysis mesh and the radiation results from ladybug and generates from these two lists, together with the indicated threshold and PV efficiency, the achievable PV production and the geometry of the PV eligible area.



## Optimization Components

The optimization is done with the help of Galapagos which takes as input a “fitness function” and adjusts a list of “genomes” in order to minimize or maximize the “fitness function”. As fitness function we defined either  $PV / V$  or shaded area.

The main part of these feature is the geometryGenerator, which takes as input a fixed geometry (parts we want to keep constant), a variable geometry (geometry to optimize), the list of genomes (representing the number of floors), the height of a floor, the original geometry (for benchmarking the generated volume) and two thresholds (upper and lower bounds of acceptable volume deviation). In the geometryGenerator component, a set of volumes are generated according to the genome list and the resulted volume is compared to the original design. If it has an acceptable deviation from the original volume, the geometry is sent further to the Ladybug solar radiation tool, else, no data is transferred. This first condition for the geometry is very important in order not to send all geometries to the solar radiation component which usually needs lots of resources and time.





## Conclusions and future perspectives

The architectural design becomes more and more difficult as the design tasks evolve from the building scale to the urban scale. The situation is made even more difficult by the ever increasing number of norms, regulations and energetic, environmental, political and economic factors that need to be taken into account. The analogic design of the past generations is a method that became too slow for the current speed of design and construction. Manpower becomes also gradually more expensive and scarce. The digital and parametric design tools offer the architects and planners the possibility to analyse and handle large numbers of design factors with minimal time investment. The rapid generation of design variants with the help of optimization algorithms allows to quickly recognize the boundaries of the design freedom and complex relationships between geometry and physical parameters.

The problem of digital analysis remains the scale. These tools are usually very good for small scales, where data is processed fast and the accuracy of the results can be estimated by an experienced user. However, once you go on urban scale things get very complicated, data need long time periods for processing, the computational power required grows and the results are difficult to interpret.

In order to handle the complexities of the digital analysis on urban scale, a good and stable workflow needs to be implemented in order to optimise resource requirements. Moreover, it is crucial to decide on few and precisely formulated outputs that can be compared and evaluated by the user. Generating large amounts of complex data only leads to more trouble than it actually could solve.

In our specific case we see multiple future perspectives for improving our analysis and designing process. Besides optimising the input geometry and the resolution of analysis, we could think about improving the optimization criteria and debate about what it really says and how meaningful it is for design benchmarking. For example, setting as optimization criteria (PV / PV area), we could evaluate the economic efficiency of the solar cells. By comparing the (radiation / envelope area) we could get an indication about the thermal performance of the buildings (total gains / total losses).

Finally, the digital and parametric design tools open to the architects and planners numerous new design possibilities and methods, but they still have the limitation of not being able to measure architectural quality and “beauty”. In the end, there is still the need for experienced planners that know how to handle these tools and apply them in a conscious way, avoiding to use them as tools of manipulating decision makers.





# Bahnhof Stadelhofen

Student: Natalia Daukszewicz & Philippe Blarer

## Summary:

We analysed the train station Stadelhofen. It is situated in the north of the Stadelhoferplatz which is directly connected to Sechseläutenplatz, one of the largest squares in Zürich. This park complex is also one of the most representative in the city. Even the public train station building seems to be connected to this area - but its front appears to be plainly functional. Due to the location of parking spaces for cars and bicycles just in front of the building, it seems to be losing its "public face".

There are plans to extend the existing station by the 4th track. While the location of the track is yet to be decided, we took the liberty to analyse the current urban and building situation and deal with its constraints within possible means.

## Motivation:

On one hand, we have a paved Sechseläutenplatz that opens to the Zürich Lake. It is perfectly designed for people gatherings. One should not forget though, that it used to be a green park before. It has been not so long ago, when the trees have been removed and the character of the whole place has been dramatically changed. Then there is a Stadelhoferplatz, green, covered with large trees and water fountains. It gives shadow and relief in summer but it also completely blocks the view between Zürich Lake and the head building of the Stadelhofen Bahnhof. And then there is the train station itself. With all its side entrances, hidden between the other buildings, cars and bicycles, only "unwillingly" opening itself to the visitors.

In the design project we argue that the area in front of the train station should become more open and connected to Stadelhoferplatz. Therefore we suggest the removal of the car and bicycles parking lots and its replacement with trees and another pavement surface in order to create an emotional connection with the park across the street. The building itself should also be able to activate the space in front of it. It becomes necessary to rearrange the ground floor.

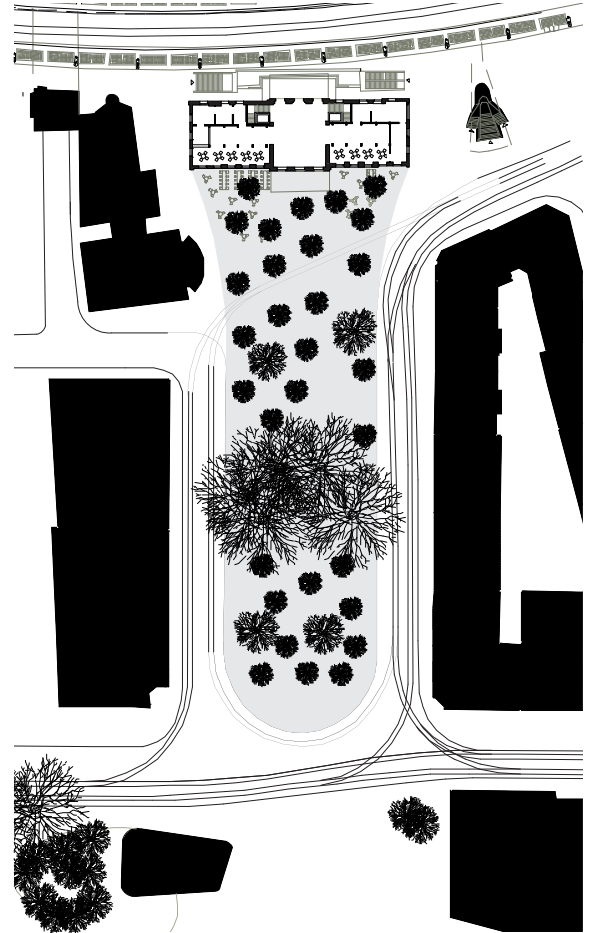
The analyses should show the underlying phenomena that prevent the Stadelhoferpark to become a functional public space. They should also be understood as a further argumentation of a project. They also remain open to interpretations, hinting at decisions.



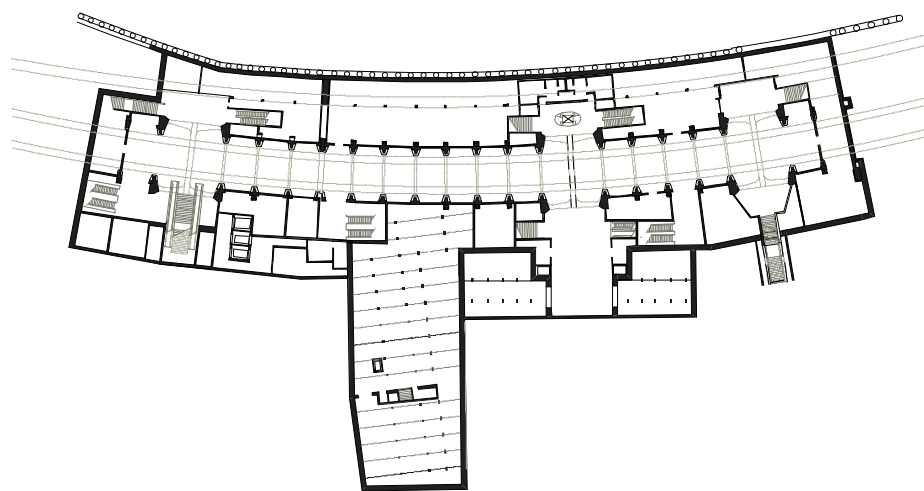
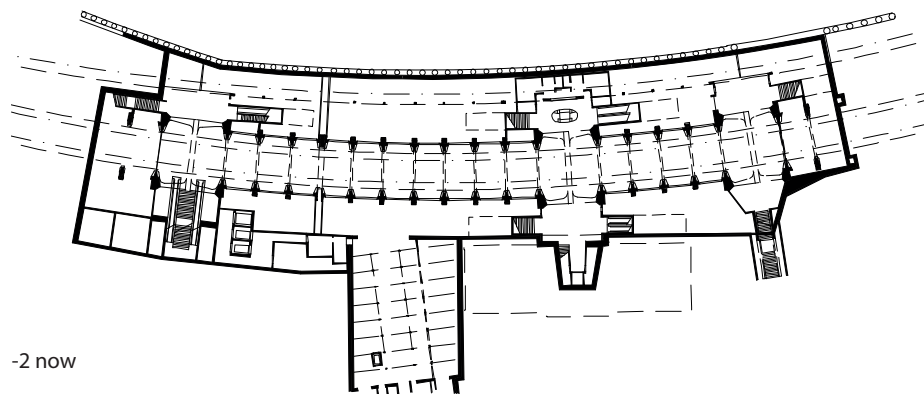




GF now



GF project





The map shows up the potential of urban development for the Stadelhoferplatz.

The Theaterstrasse is the most connected street which correspond to the predominant situation. The street is crossing the two public parks. The parks do also show high connectivity and integration. This indicates a little contradiction: The Stadelhoferplatz is well integrated but the analysis does not feature this as a quality. It suggest, that it is more a transition zone than a representative space with high quality potential.

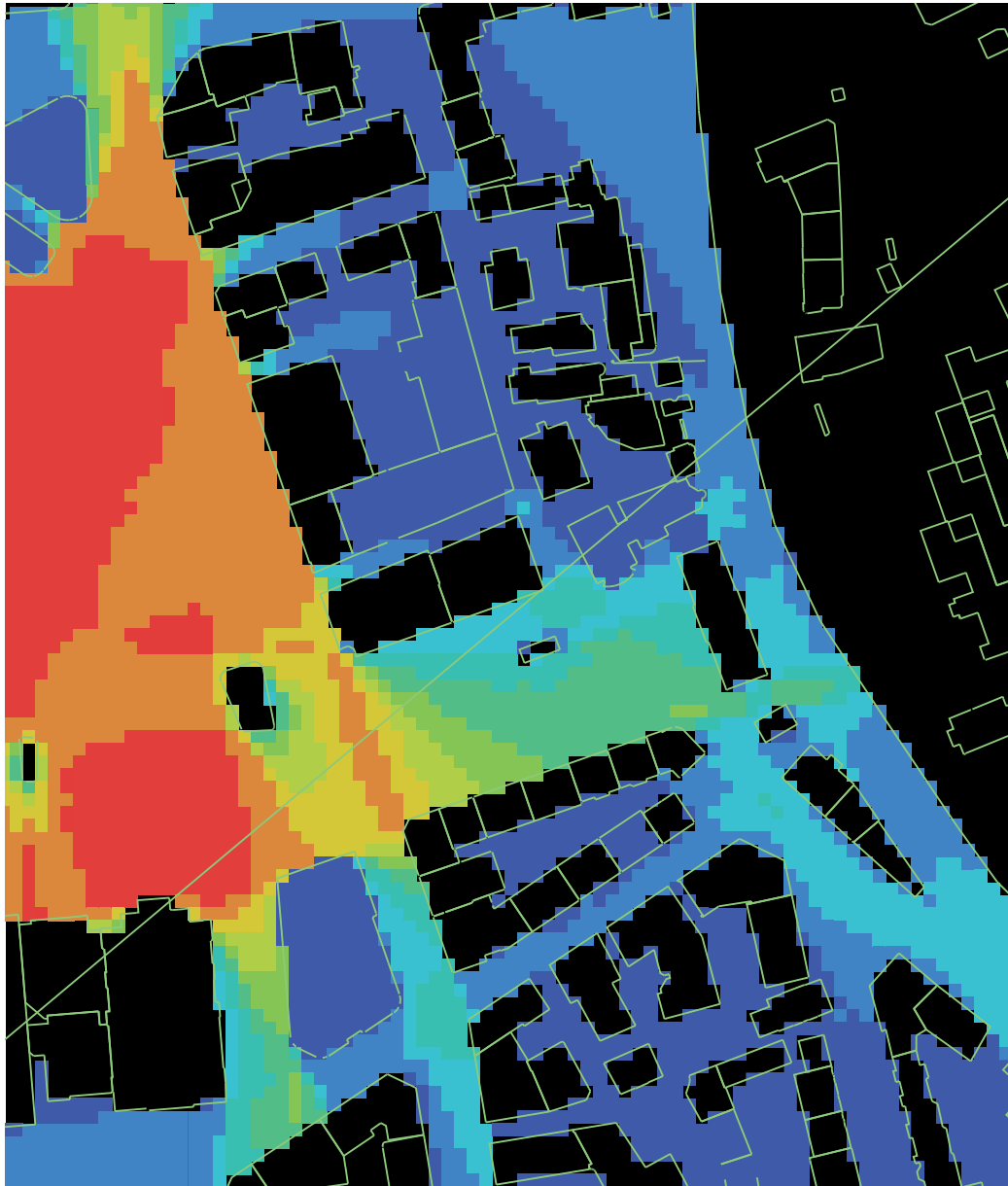


Analysis 1 (City level / axial map - integration):

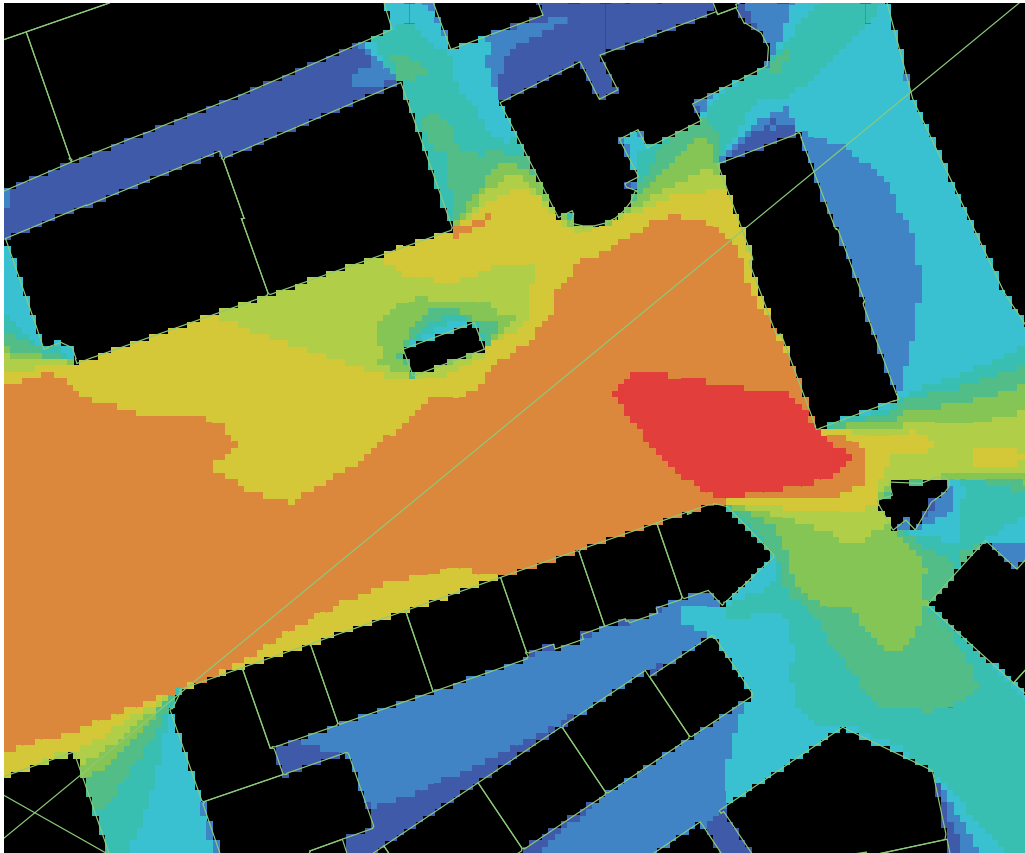


Analysis 2 (City level / axial map - connectivity):

Analysis 3 (City level / visibility map - connectivity):



Analysis 3 (City level / visibility map - connectivity):

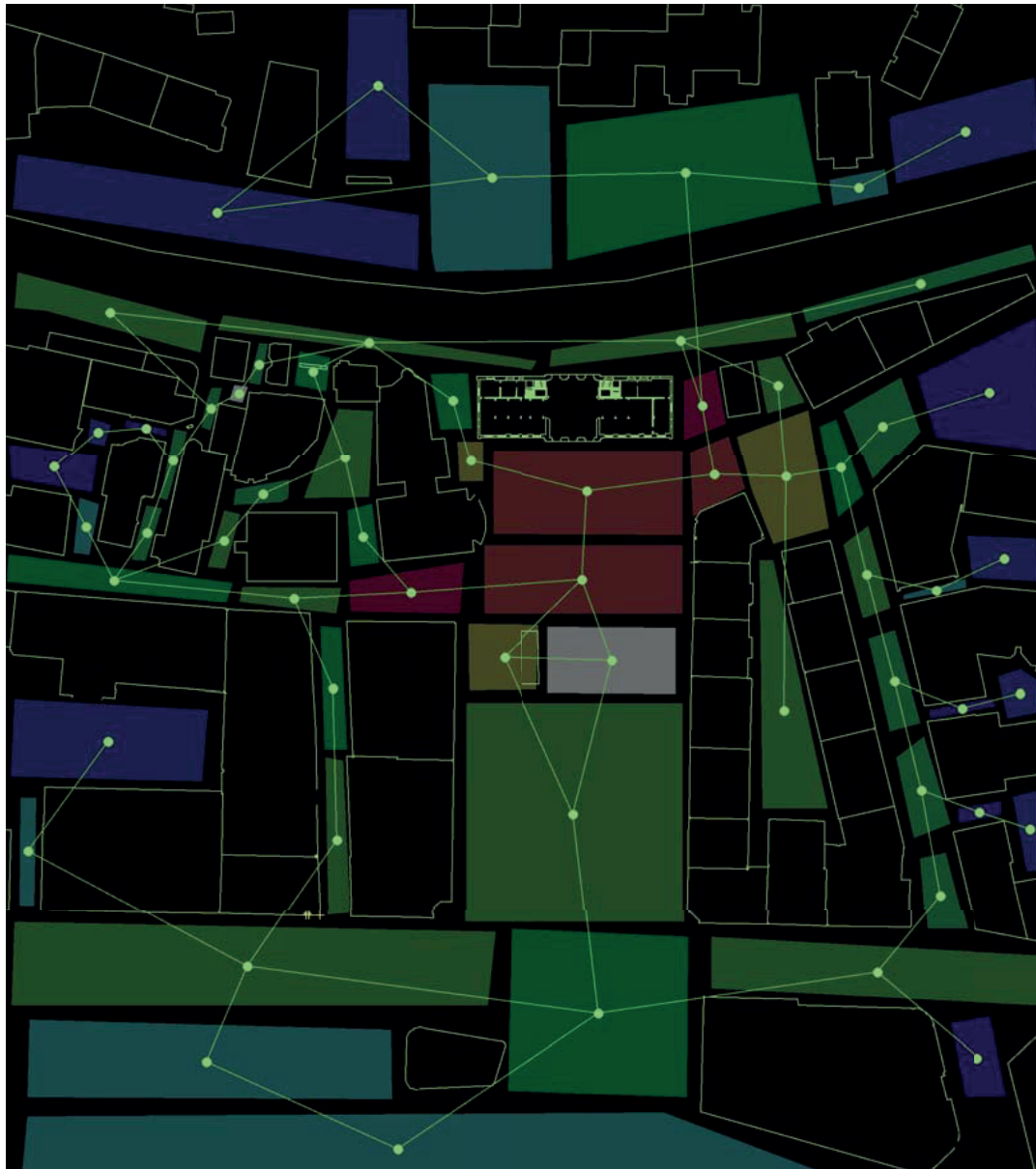


This map shows up the highest visibility at the Sechseläutenplatz. It also shows the visual connection with the Stadelhoferplatz. Most visible are the facades on the east side of the Stadelhoferplatz. These may be places that attract people and activate the Stadelhoferplatz, like coffee shops or restaurants. Profiting from this visibility analysis, combining it with integration and choice, it hints a possibility for intervention.

The visibility map that analysed the Stadelhoferplatz shows that the one of its corners seems to be more connected. The disadvantage of the visibility map analysis is that we have to neglect the terrain. There's a hill behind the train station that prevents the analysis the coverage of the part behind the station .



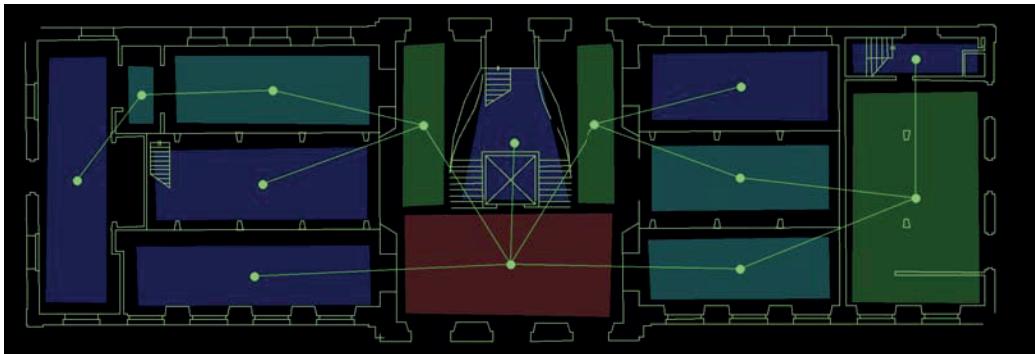
Analysis 4 (City level / convex map - integration):



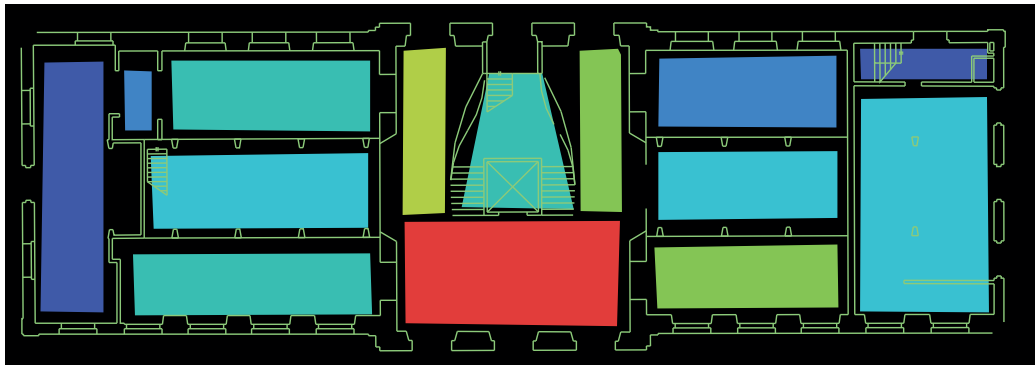
Analysis 4 (City level/ convex map - connectivity):



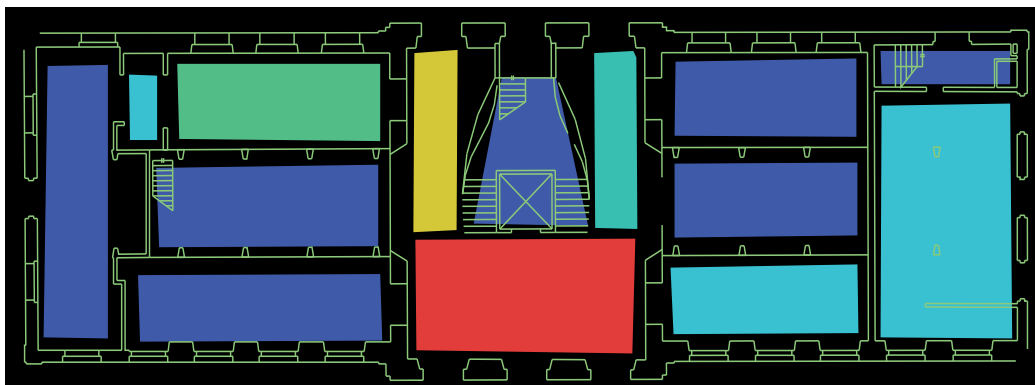
Analysis 5 (Building level GF now / convex map - connectivity):



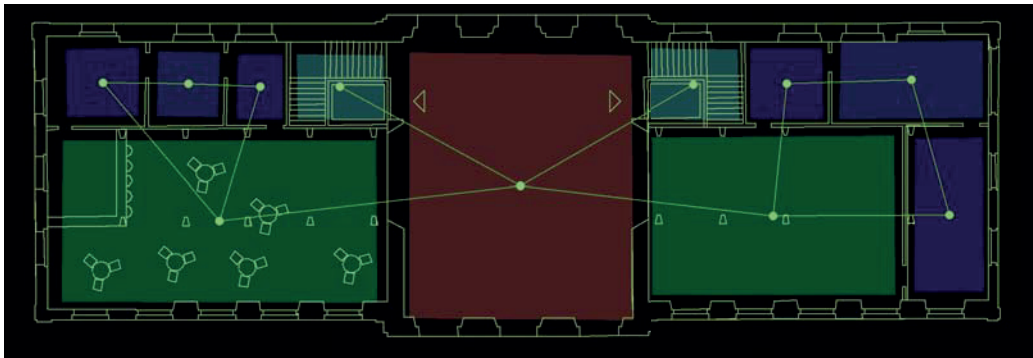
Analysis 6 (Building level GF now / convex map - integration):



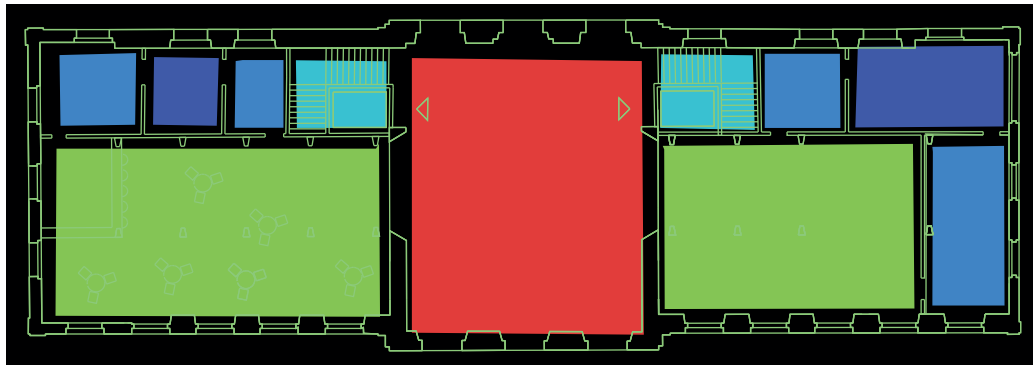
Analysis 7 (Building level GF now / convex map - choice):



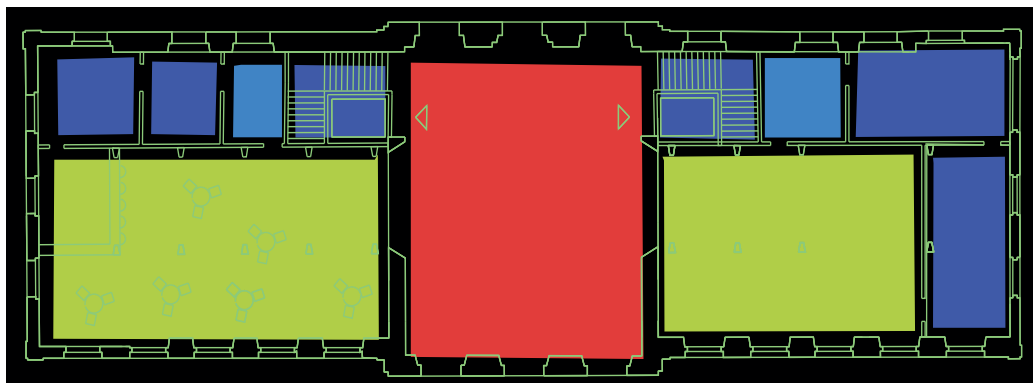
Analysis 5 (Building level GF project/ convex map - connectivity):



Analysis 6 (Building level GF project/ convex map - integration):

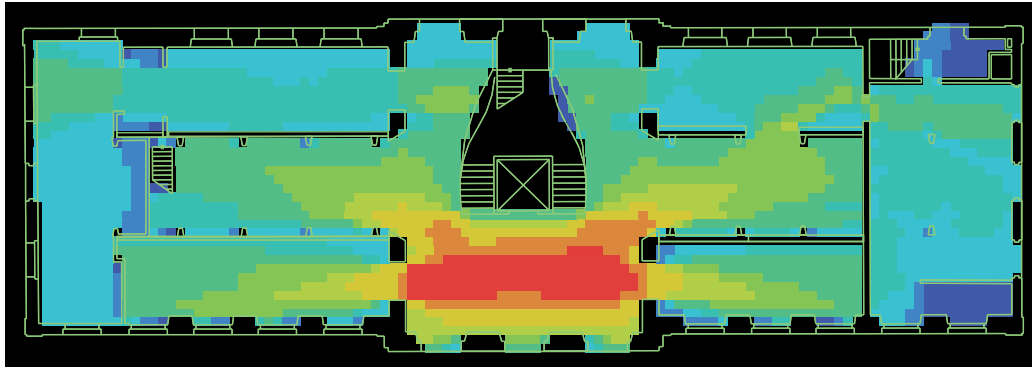


Analysis 7 (Building level GF project / convex map - choice):

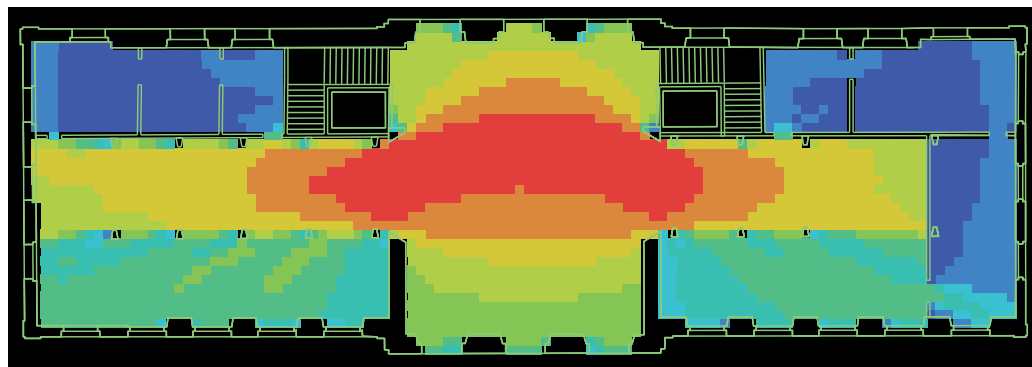




Analysis 8 (Building level GF now / isovist map - connectivity):



Analysis 8 (Building level GF project / isovist map - connectivity):



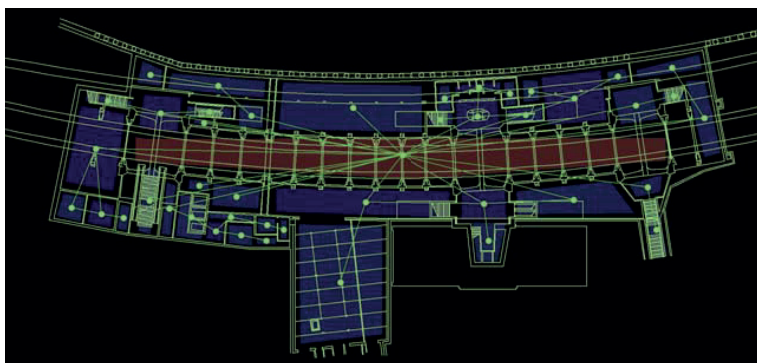
The existing building is symmetrical, so the entrance hall in the middle is the most integrated. The side volumes on the left and right include private rooms that serve the passersby. The integration is increasing to the sides. The central hall shows, as expected, the highest connectivity and choice.

The project aim is to activate the public space inside. That should open the space in front of the building. The staircase and serving rooms have been moved to the back and sides of the building. The public space seems to be the most integrated and accessible while the serving rooms are less integrated and connected. The staff area is connected through the public space but they are also connected with each other, while before they were more separated. So the connectivity increases after changes.

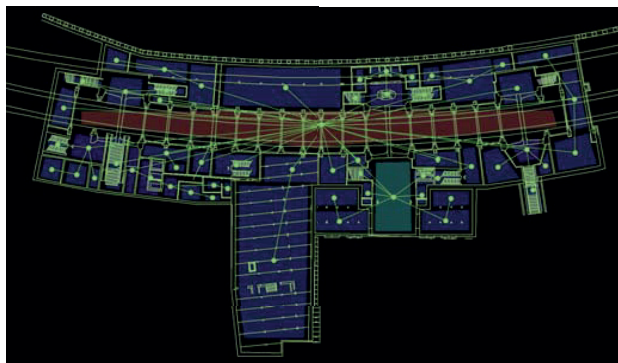
The visibility map of the old ground floor shows the highest visibility at the entrance hall. The staff area is separated and does not exhibit visual connections.

The new ground floor offers a new visual axis running through the building. The main hall is open and all spaces are visible from it. The public spaces and the left and right are less visible. They include coffee tables for visitors, so people walking through the main hall to the staircases will not disturb the visitors.

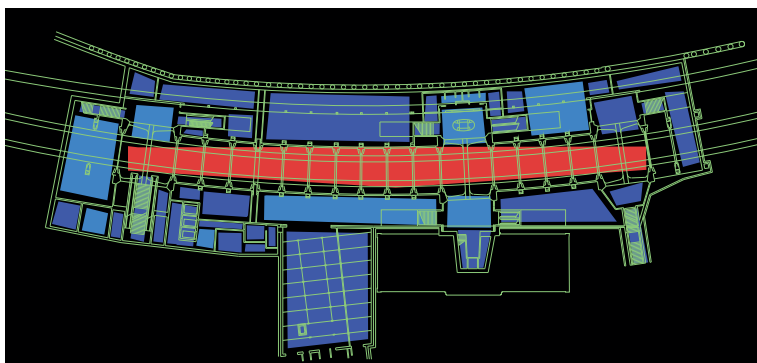
Analysis 9 (Building level -2 now / convex map - connectivity):



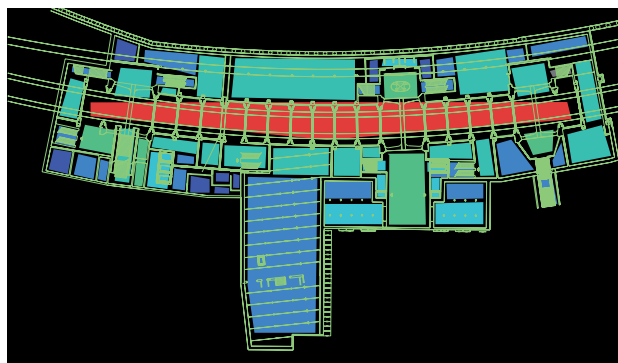
Analysis 9 (Building level -2 project / convex map - connectivity):



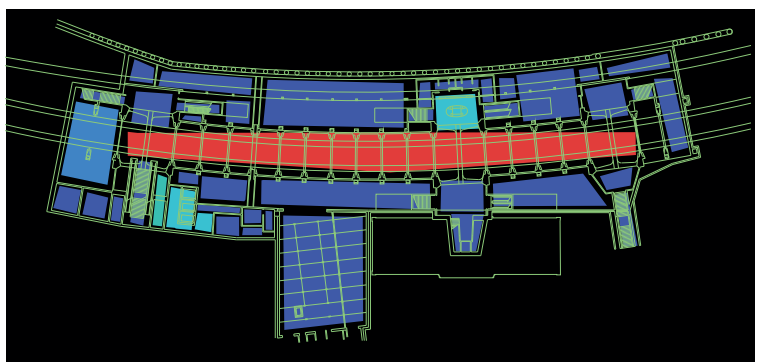
Analysis 10 (Building level -2 now / convex map - integration):



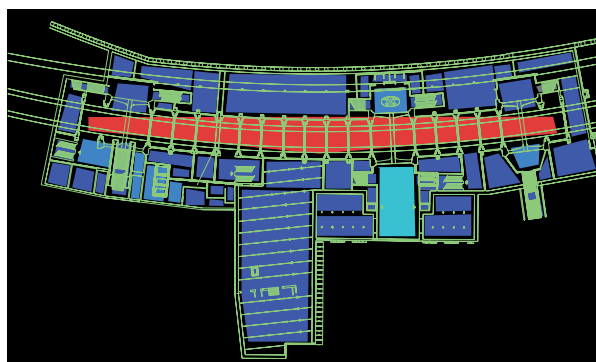
Analysis 10 (Building level -2 project / convex map - integration):



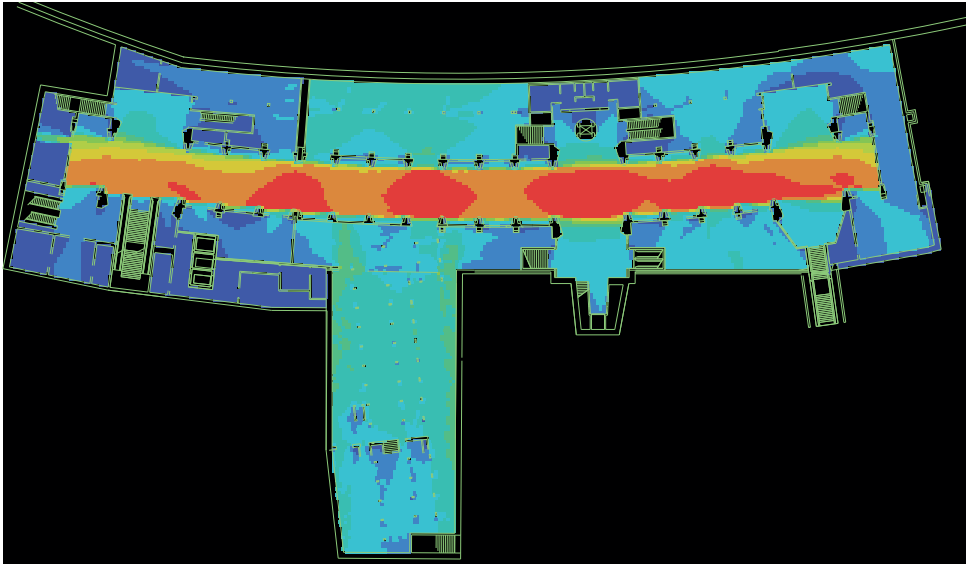
Analysis 11 (Building level GF now / convex map - choice):



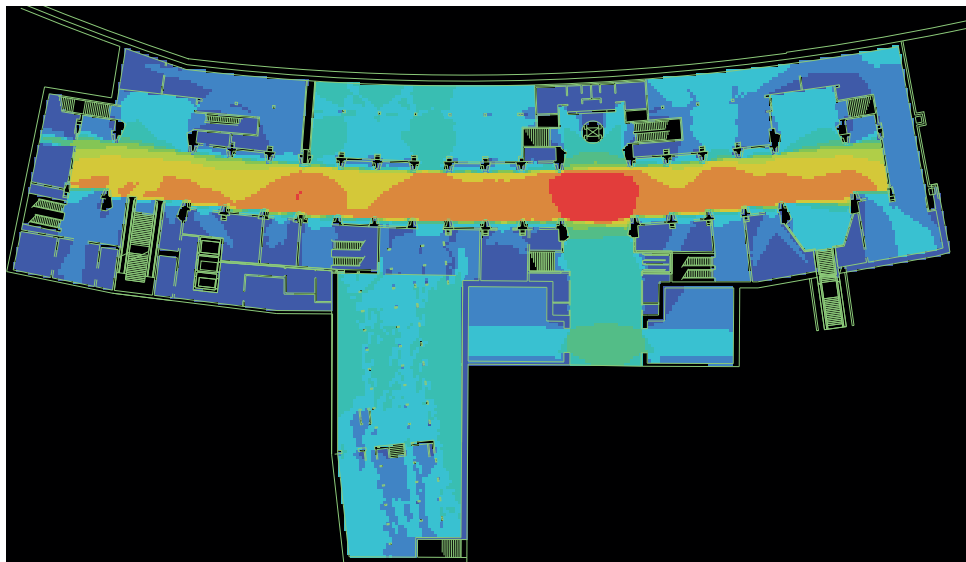
Analysis 11 (Building level GF project / convex map - choice):



Analysis 12 (Building level -2 now / isovist map - connectivity):



Analysis 12 (Building level -2 project / isovist map - connectivity):

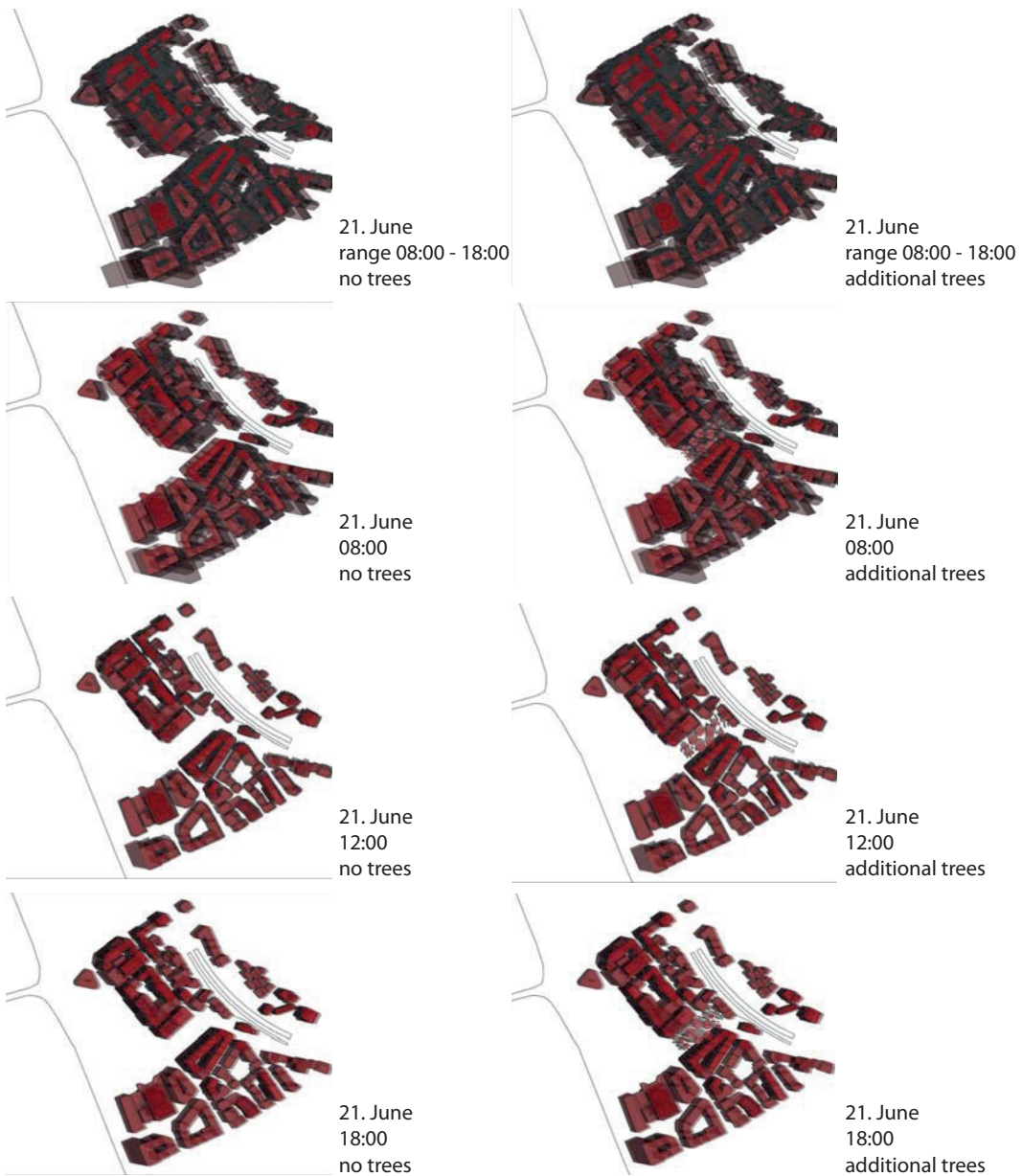


The main floor is as expected the most integrated and also shows up the highest choice. All stores are directly accessible through the main passage. The stores are on both sides of the passage and are only connected to each other through this passage. The storages at the back of the stores are the areas that are least integrated.

In the new situation there are three new staircases leading downstairs to the new platform. They should be good connected, so they are also placed next to main floor. They show the same integration and connectivity to the stores. The most visible and connected part of the underground floor is the intersection of the main floor and the axis where the staircase is leading down from ground level to the underground. The main floor shows some peaks at the store and staircase entrances. The difficulty was to deal with the stores, especially in Coop. There is a large space but it is not really visibly connected because of the shelves etc.

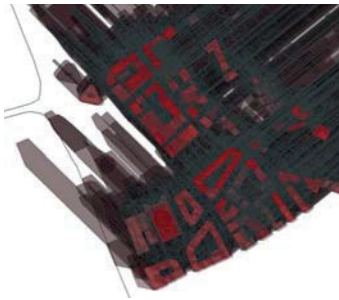
While designing the retail areas, it became clear that the investor wishes to locate some of the most important infrastructure (such as info points of cash registers) in the back of the complex. This would mean for the visitor, that these areas are not well integrated but it would force them to pass the shops on the way to it.

Analysis 13 (City level / shadow range summer solstice):

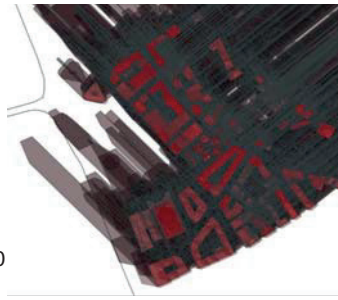




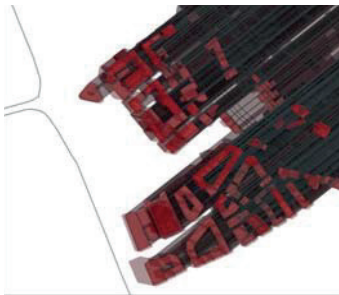
Analysis 13 (City level / shadow range winter solstice):



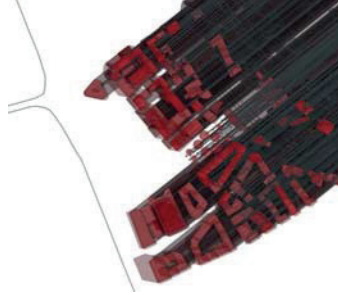
21. December  
range 08:00 - 18:00  
no trees



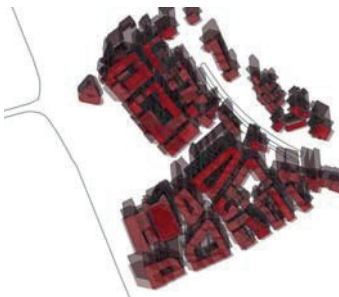
21. December  
range 08:00 - 18:00  
additional trees



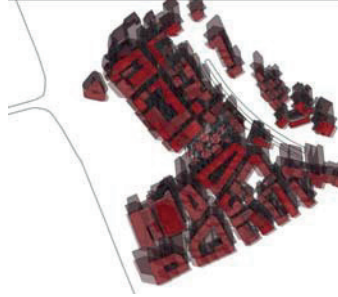
21. December  
08:00  
no trees



21. December  
08:00  
additional trees



21. December  
12:00  
no trees



21. December  
12:00  
additional trees

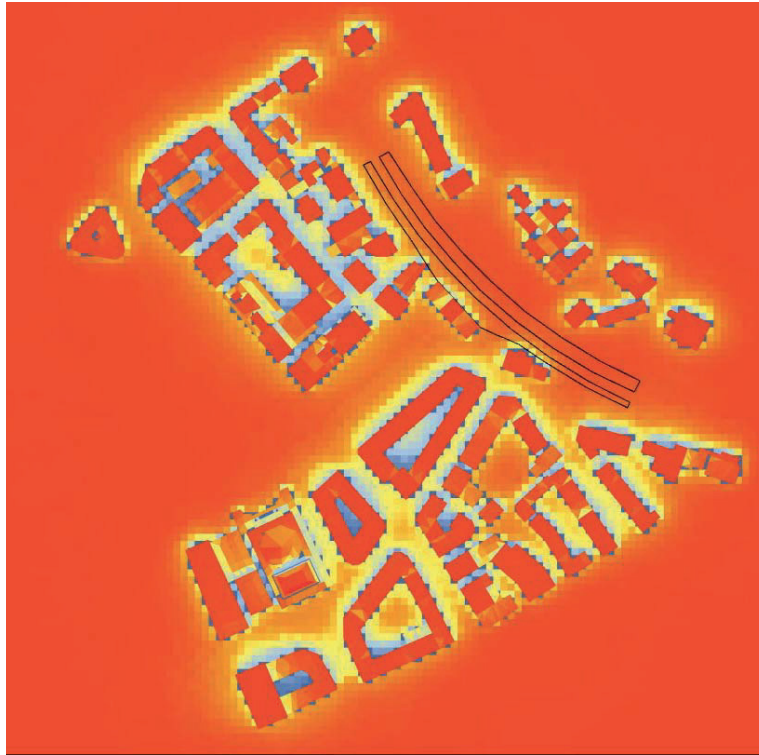


21. December  
18:00  
no trees

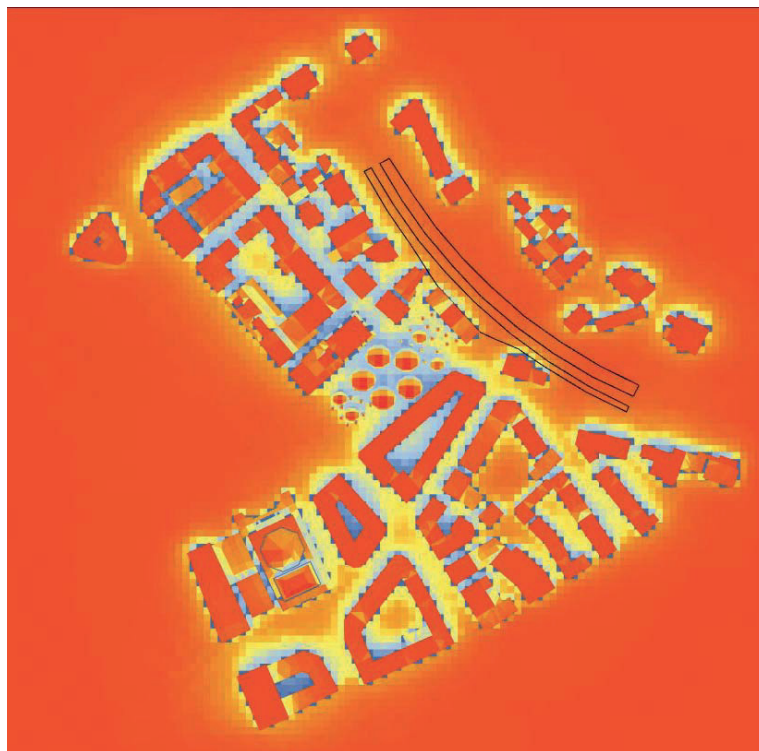


21. December  
18:00  
additional trees

Analysis 14 (City level / solar radiation analysis - no trees):



Analysis 14 (City level / solar radiation analysis - additional trees):



Since the discussion whether to keep or remove the trees at Stadelhoferplatz emerged, we decided to investigate both scenarios. One can clearly see, in both shadow range and solar radiation analysis, that after removing the trees, the square becomes exposed to the sun radiation for almost whole day, especially in warm periods of the year. This would definitely lead to the increase of the temperature in this area and contribute to the phenomenon of heat islands in the city. However, there is a possibility for the hot air to get cooled down due to the impact of the lake, which none of the above analysis were able to incorporate.

## Conclusions:

Improving the existing urban situation is always difficult. One should always ask him- or herself where to start and end with analysis and suggestions. In this case there is a conflict between open Sechseläutenplatz and closed Stadelhoferplatz. To remove the trees from the latter would improve the visibility but it would also destroy the local feeling of Stadelhoferplatz, that we now have. In this case, the design process requires the rethinking of connectivity and visual links.

Also the redesigning of the existing train station, given the investor's needs, cannot entirely rely on common knowledge, even if it is backed-up by simulations.

The above analyses are by far no guidelines to follow but they manage to indicate zones for intervention and highlight the areas for improvement.

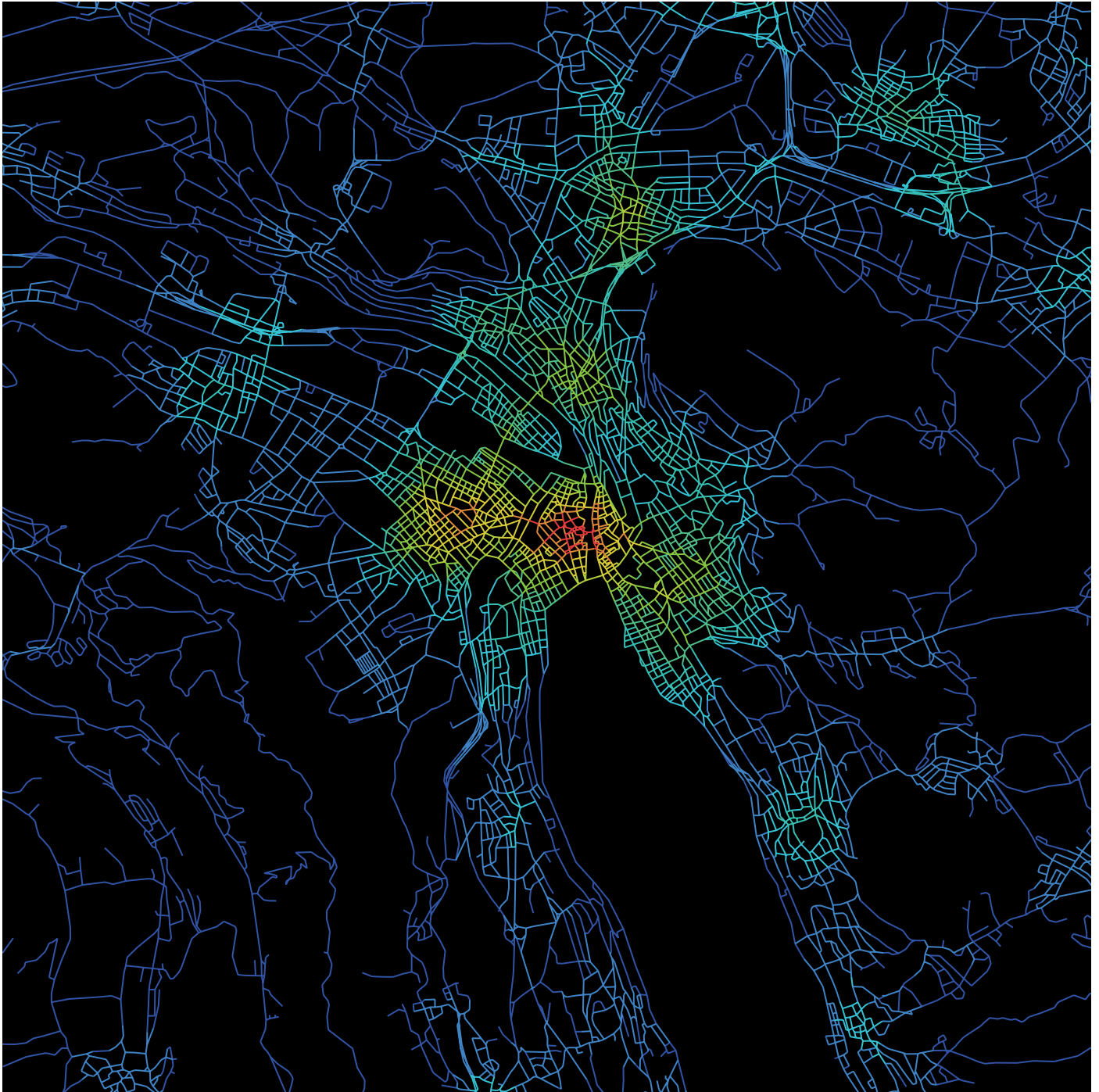






# Zurich - Historic City & City Blocks

Student: Ricardo Joss





Zoom in: Zurich, Historic City



Zoom in: Zurich, City Blocks area

## Summary

The focus in this examination is on analysing these two different city typologies on different scales and with different tools. How do the geometrical properties of those two centres compare to each other? A street network analysis rendered two pedestrian centres in Zurich. Both will be compared using the same tools. The sites are analyzed on connectivity, compactness, minimal and maximal radii. Three chosen points each are analyzed with 2D and 3D isovists.

## Motivation

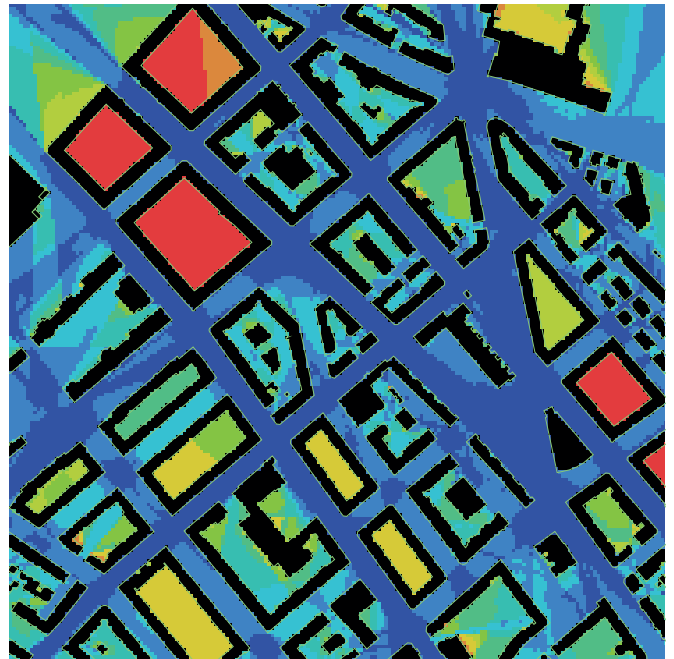
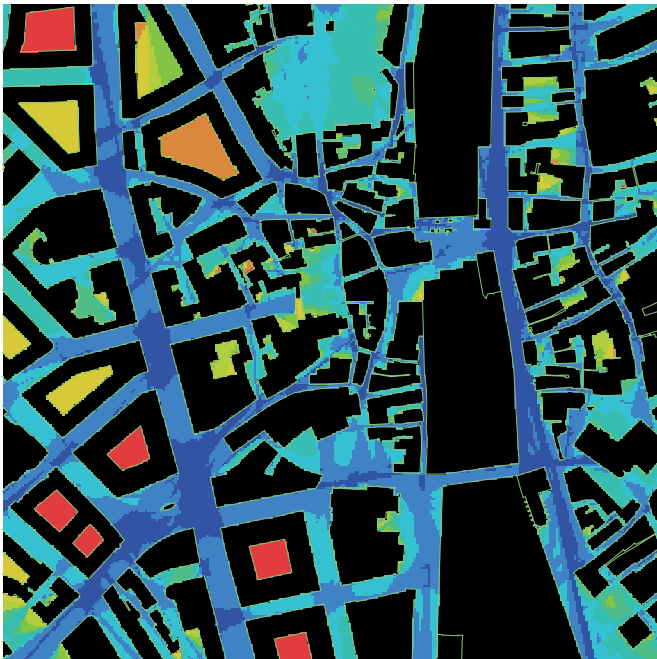
The map on the left shows a connectivity analysis of the streets of Zurich. The Radius is set at 800 meters, because this is a crucial distance for pedestrians. It's roughly the distance of a 10 minutes walk or a distance of two bus stops. Distances longer than this are more likely to be travelled by bike or motorized vehicles.

The map renders two centres. The red one is at the historic city of Zurich, the orange one is at the Kalkbreite area which is typically built with city blocks. The structure, mainly the streets and squares of the historic city emerged from the year 800 on. The city block structure came roughly 1000 years later and was planned in the time expansion due to the industrial revolution.





Blackmap of historic city (St. Peter area) and city blocks (around Idaplatz)

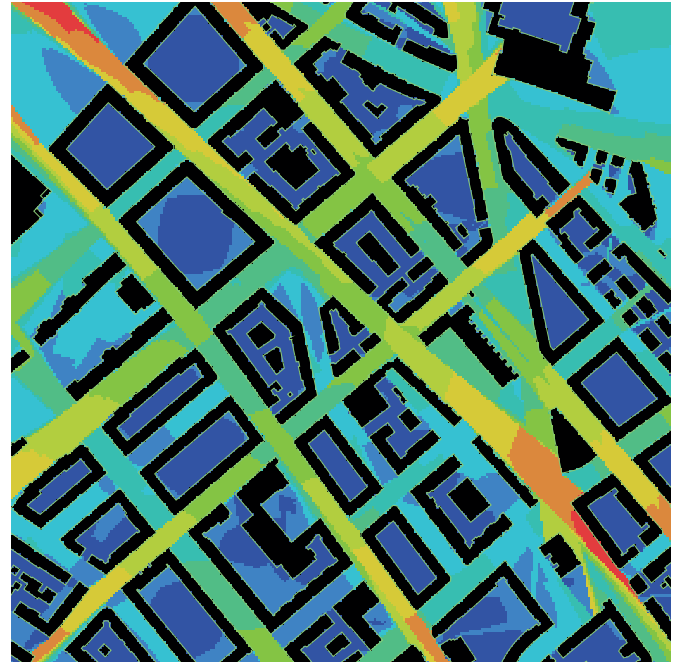
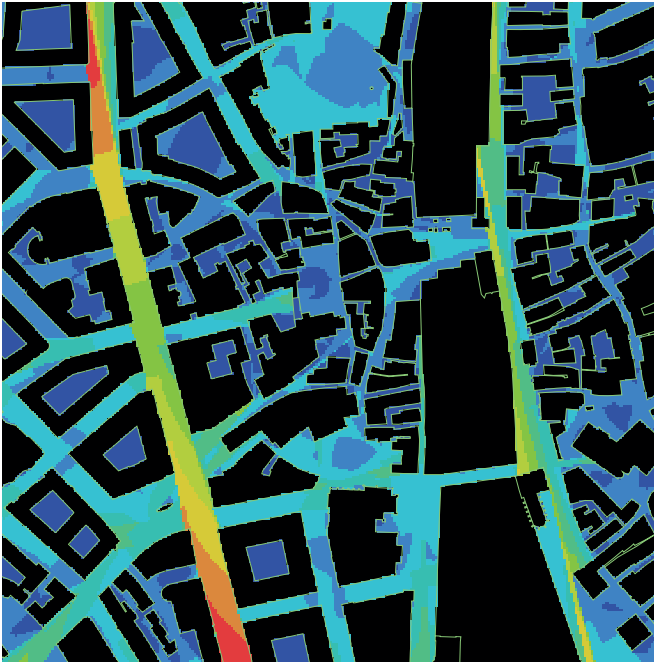


Isovist Compactness Analysis, Grid 3 meters

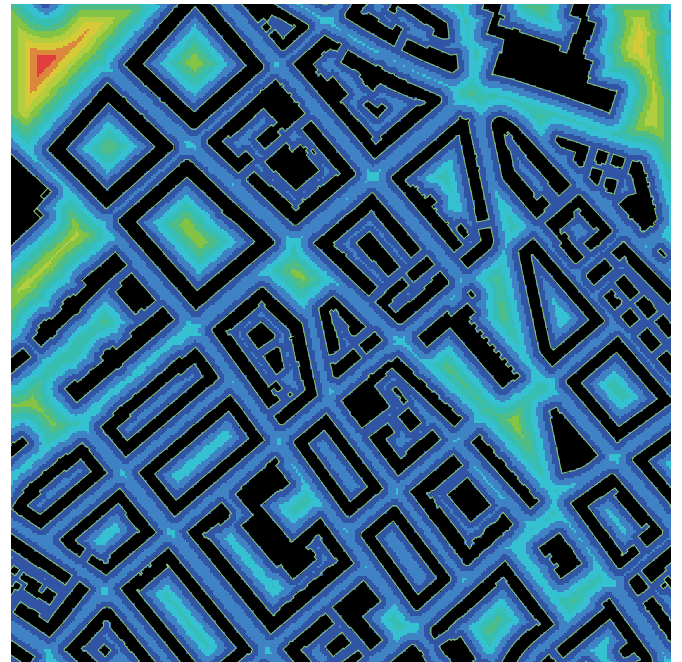
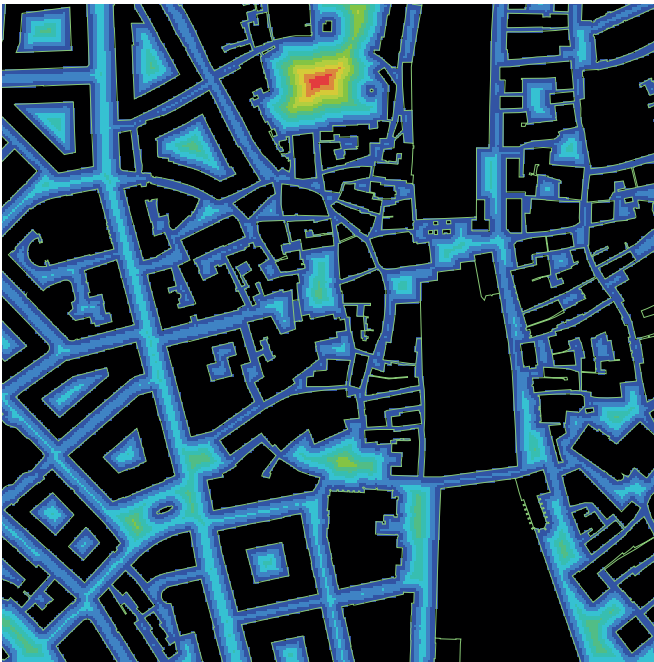
## Analysis and Interpretation - Blackmap and Compactness

The blackmap already shows that the density of the historic city is much higher. Also the regularity and wideness of the streets are very different. The historic city has two big axis, one the right the Limmat River and on the left the Bahnhofstrasse. The site around Idaplatz is much more homogeneous. The streets have more or less the same size and there is mainly just one building typology, the city block with it's courtyard.

The most compact places are in both sites always the empty courtyards of the city blocks. The most interesting aspect is the compactness of the street spaces in the historic city. The narrow streets, niches, pockets and squares form more compact spaces than the long axis of the streets in the city block area.



Isovist Maximal Radius Analysis, Grid 3 meters

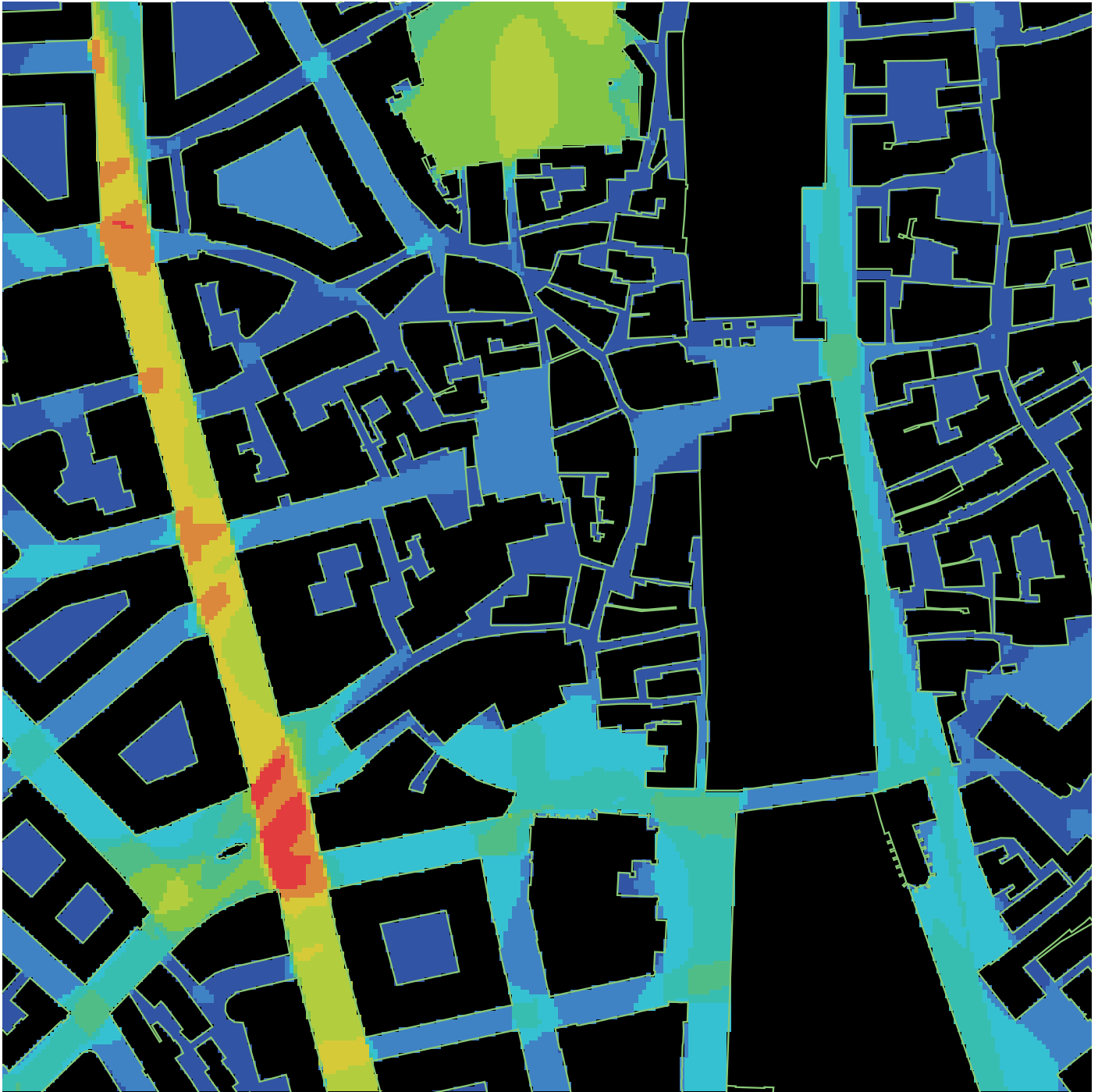


Isovist Minimal Radius Analysis, Grid 3 meters

## Analysis and Interpretation - Maximal Radius and Minimal Radius

The maximal radius analysis emphasizes the long axis in both maps. The left map has, since the river is not analyzed, just one dominant axis which is the Bahnhofstrasse and a not very dominant area right to the river. The historic city has no highlighted areas at all. The city block area has several almost equally dominant axis and most of the streets are part of them.

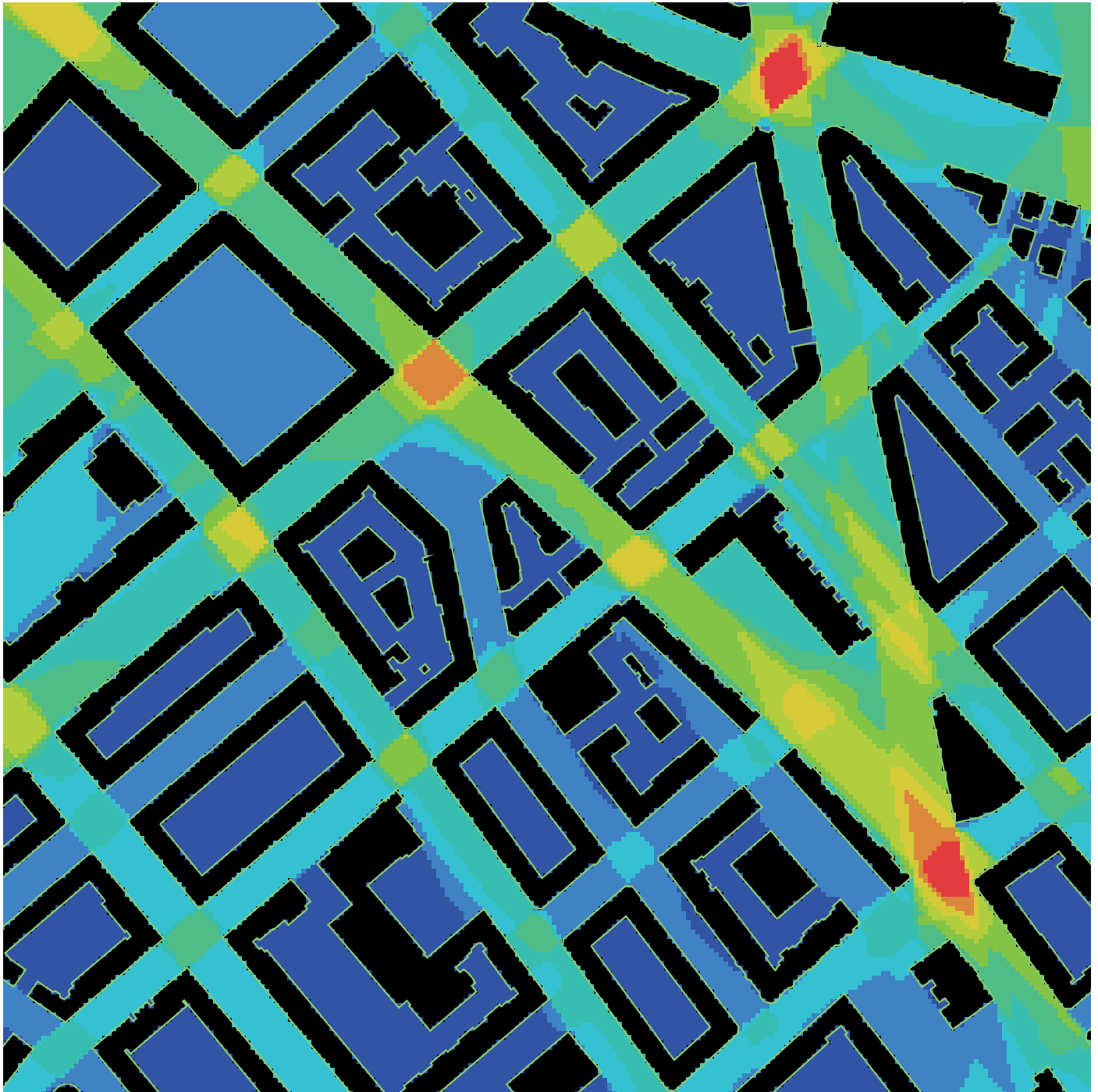
The minimal radius analysis renders a good image of the size of a place. The street widths in the historic city vary much more than in the city block area. The largest area is clearly at the Lindenhof. The city block area is more homogenous, very often the streets have the same width as the inner courtyards. A football field on the top left is the largest place.



Zurich, Bahnhofstrasse, St. Peter Platz, Visual Connectivity Analysis, Grid 2 meters

## Historic City - Analysis and Interpretation

The most connected nodes are all situated on the Bahnhofstrasse and marked in red and orange. Larger squares in green and cyan tones. Due to the small and narrow spaces, all the streets and smaller squares of the historic city are rendered in light and dark blue. It shows clearly that relatively to the newer streets built for cars and tramways, the historic city is visually less connected. The need of cars for wider roads and better overview is reflected in this analysis.



Zurich, Idaplatz, Visual Connectivity Analysis, Grid 2 meters

### City Blocks - Analysis and Interpretation

The highest visual connectivity is at the intersection of larger roads. The wider the road, the higher it's connectivity at the intersection. Also smaller roads render a relatively higher connectivity at their intersection. Also very clearly visible is one of the driving ideas of the city block. It has a public outer facade, defining the public space and the streets. But also the private inner facade, which this analysis renders always in blue colours, even if the courtyard is partially open towards the street.



Scale 1:3'000



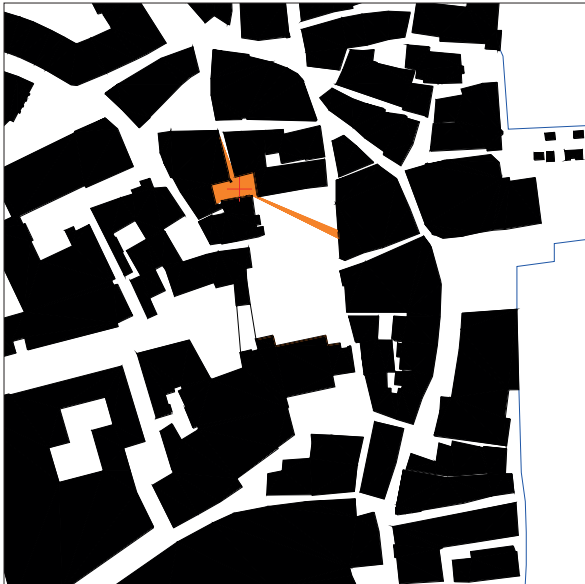
Thermengasse



Scale 1:5'000



Idastrasse



Robert-Walser-Gasse



Idaplatz Middle

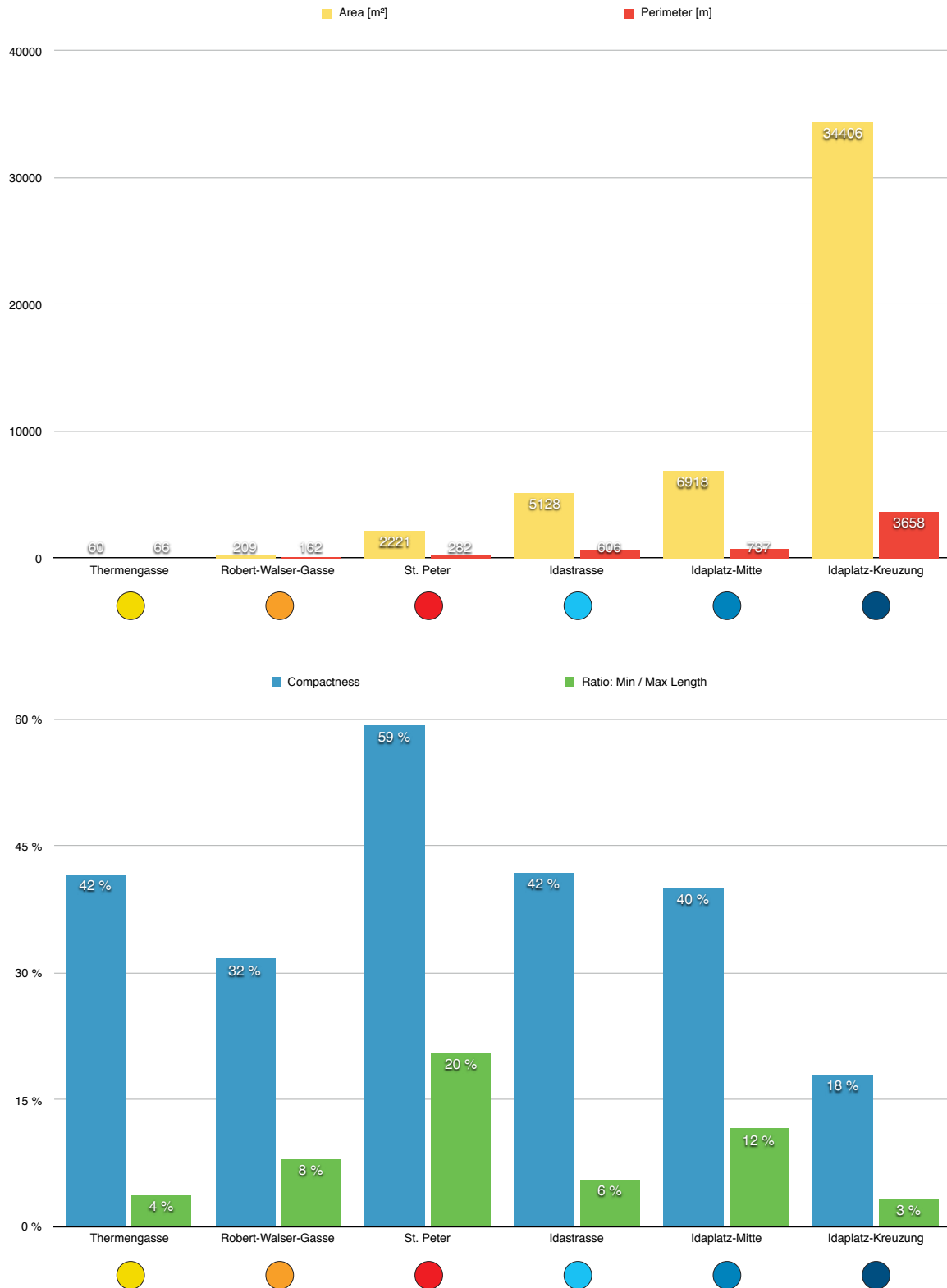


St. Peter-Platz



Idaplatz Junction



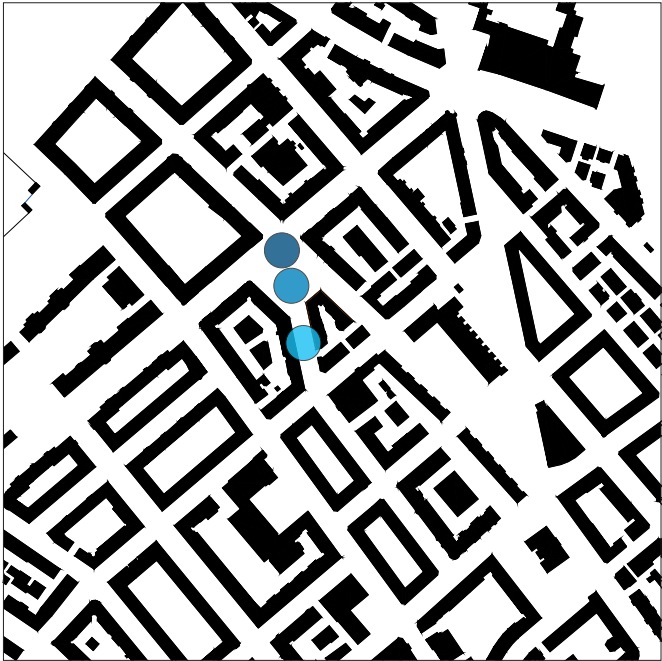


## Analysis and Interpretation - 2D Isovists, from small to medium to large

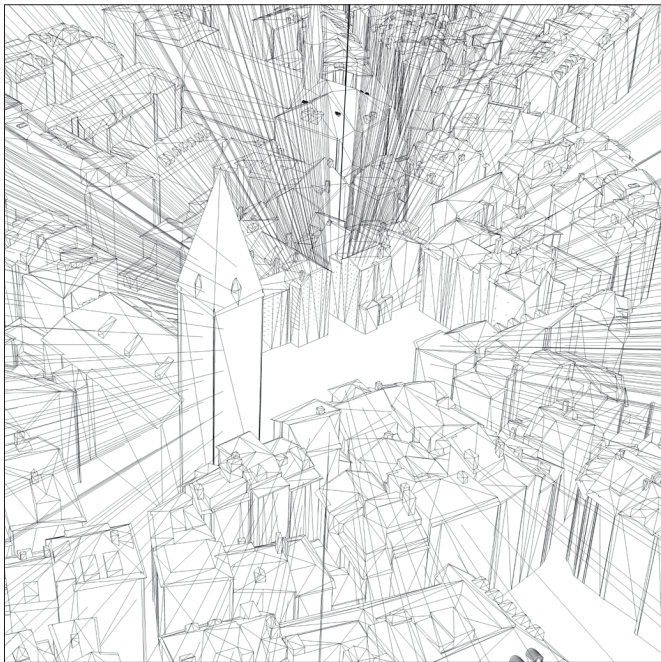
I chose six points, three on each map, to analyse with 2D and 3D Isovists (see next page). In absolute measures, even the largest site of the historic city was smaller than the smallest of the city block area. The largest place of the historic city, the St. Peterplatz is much more compact than the largest area in the city block. The smallest places are by far found in the historic city. Large sites with a long view and low compactness are found in the city block area. Compactness is calculated as ratio between the actual perimeter and the smallest possible perimeter for an area of the same size. The Min / Max Length value compares the ratio from shortest to longest ray in the isovist



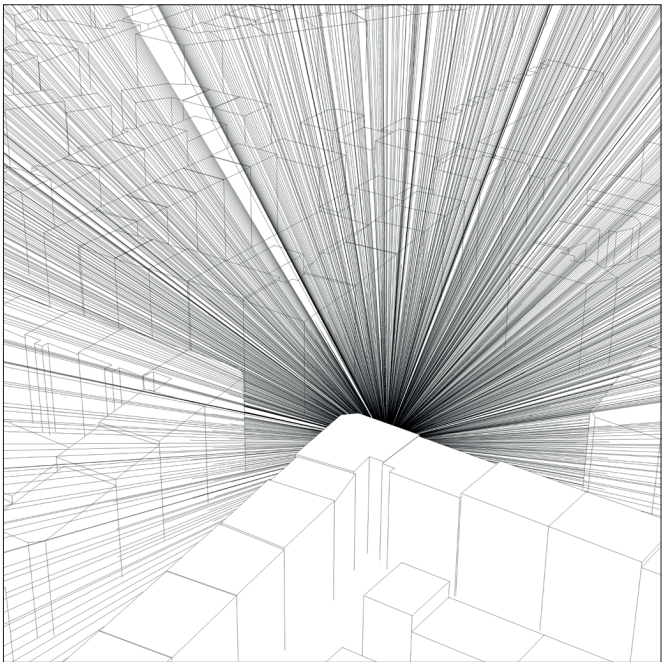
Historic city: Analyzed points



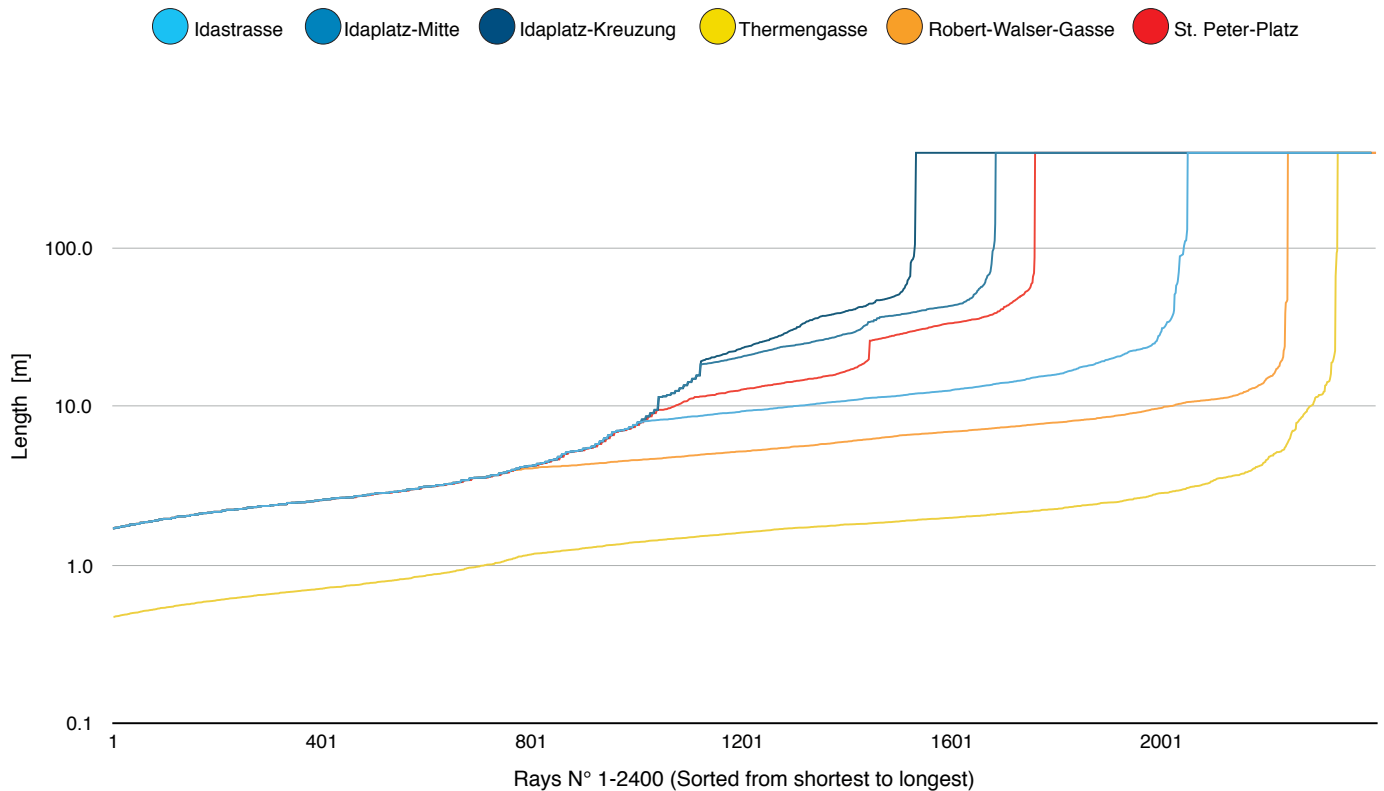
City Blocks: Analyzed points



3D Isovist Rays: Cut-Offs at St. Peter-Platz



3D Isovist Rays: Analyzed Rays at Idaplatz



## Analysis and Interpretation - 3D Isovists, from small to medium to large

To analyse the same six points with a 3D-Isovist, I placed 2400 rays with the length of 400 meters on each point. All the rays were cut when they hit the ground or a building. The left image shows the cut of rays at St. Peterplatz. The image on the right shows the rays used for the analysis at the junction of Idaplatz. The diagram shows the lengths of each ray for each of the six points. Using a logarithmic scale for the lengths, the diagram shows a nice progression and the rays become comparable. The top horizontal line shows all rays with the lengths of 400 meters. This is equal to rays which would reach the sky. The longer the top horizontal line, the more sky view and natural light is visible at the site.

Five out of the six sites have the same progression for the 800 shortest rays. After this mark the spatial characteristics for each site become visible. Unlike the 2D-Isovist analysis, the St. Peterplatz has bigger isovist than the Idastrasse. The very small place at Thermengasse has almost no rays longer than 5 meters and just about 3% reach the sky. Unlike the Junction at Idaplatz where more than half of the rays are longer than 10 meters and almost 40% reach the sky.

## Conclusion

The used analysis tools help to measure and compare spatial properties. They also showed different characteristics of the two analyzed areas. Some were more obvious than others. Sometimes the analysis helps to discover new things or they confirm presumptions. The 3D Isovist analysis is an interesting start. It could be much more sophisticated in terms of modelling and also for analysis. The ray could be analyzed regarding their angle, since the horizontal rays are the most important for orientation. The more vertical the ray is, the less important it is since gravity forces us to navigate mostly in 2D coordinates. The analysis could also be direction sensitive and simulate the visible cone of humans.





# Optimisation of agriculture in an urban environment

Student: Romain Masson

## Summary:

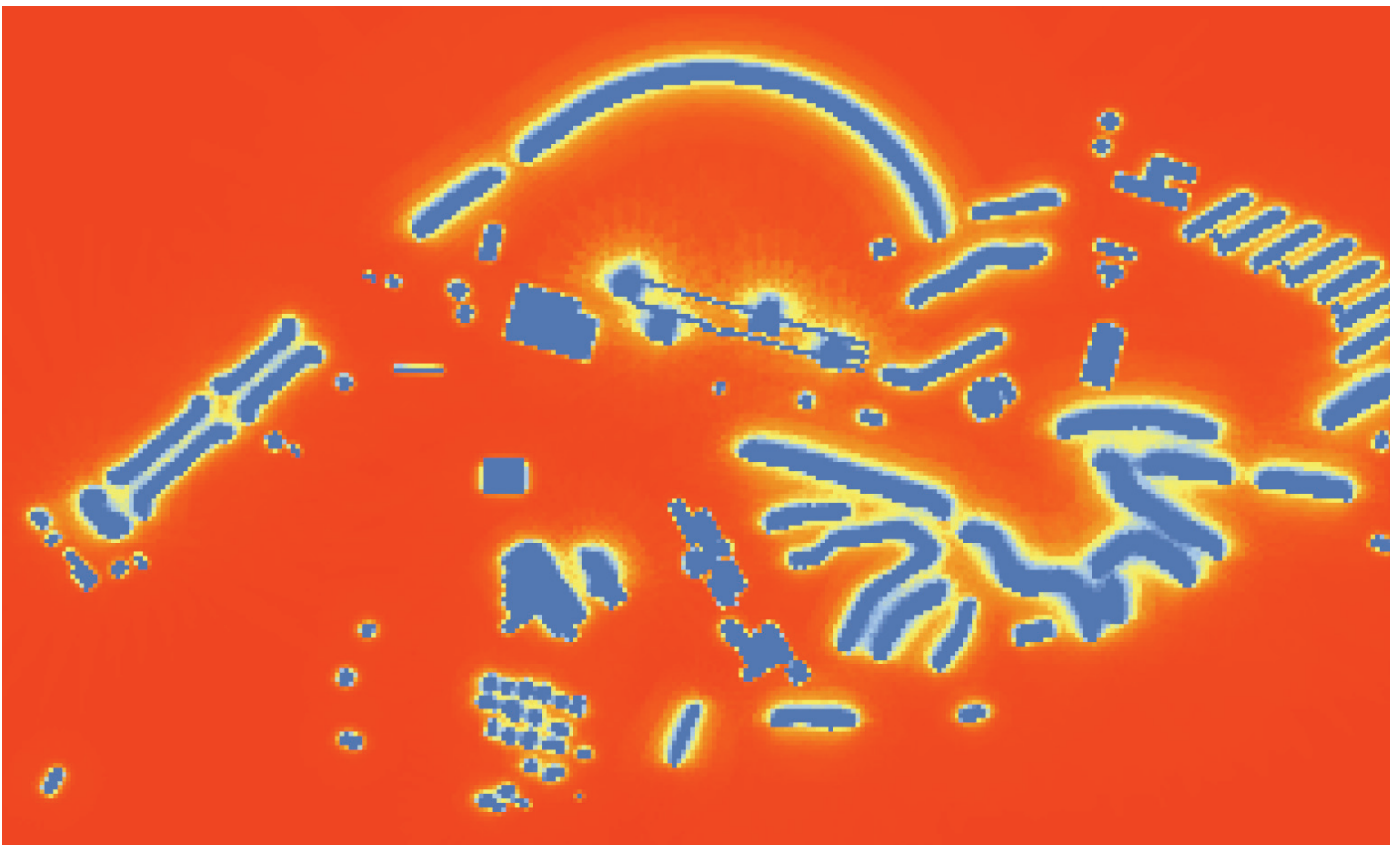
My project is situated in Pilastro near Bologna. I'm working on adding programme on big empty and undefined spaces created between the buildings by the architecture of the 1960-1970 . For this exercise I interested myself into agriculture and greenhouses. Where is the best place to make agriculture and how could I build optimised greenhouses. For this I used grasshopper and tried Galapagos for the optimization

One of the results of my roof from simulations



1

I analysed the solar radiations the ground so I could use these data to put my agriculture / greenhouses. The most surprising fact for me was the big influence of building situated west and east from a measurement point.



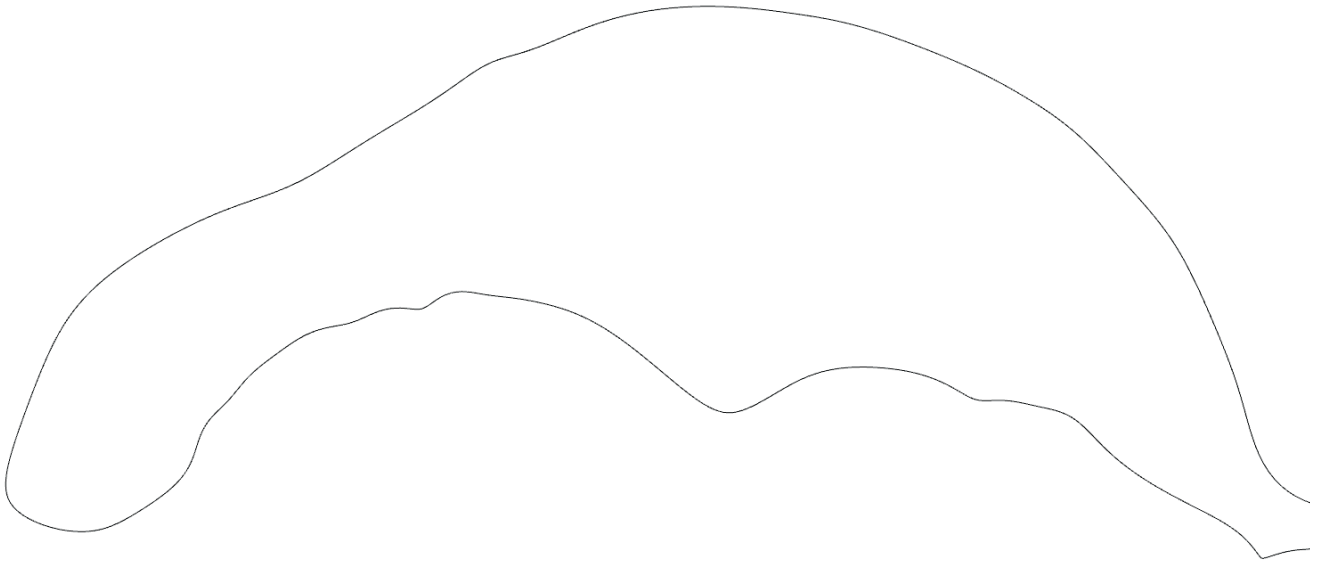
2 Making a threshold at a certain level of radiation (this case 1100)



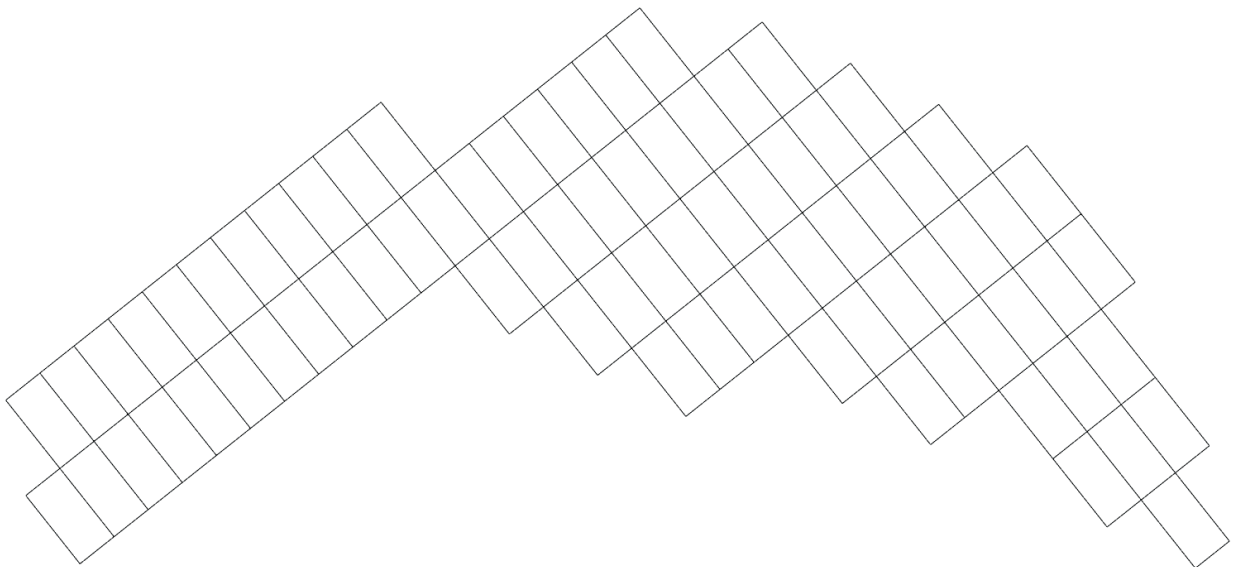
3 I only worked on a part of the site



#### 4 Simplification of the polyline

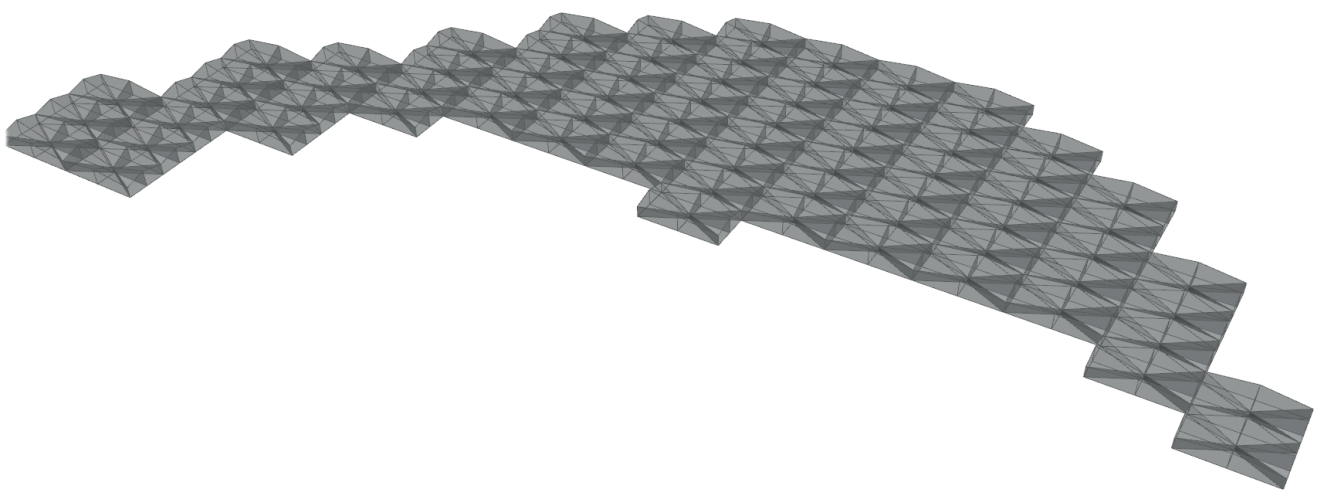
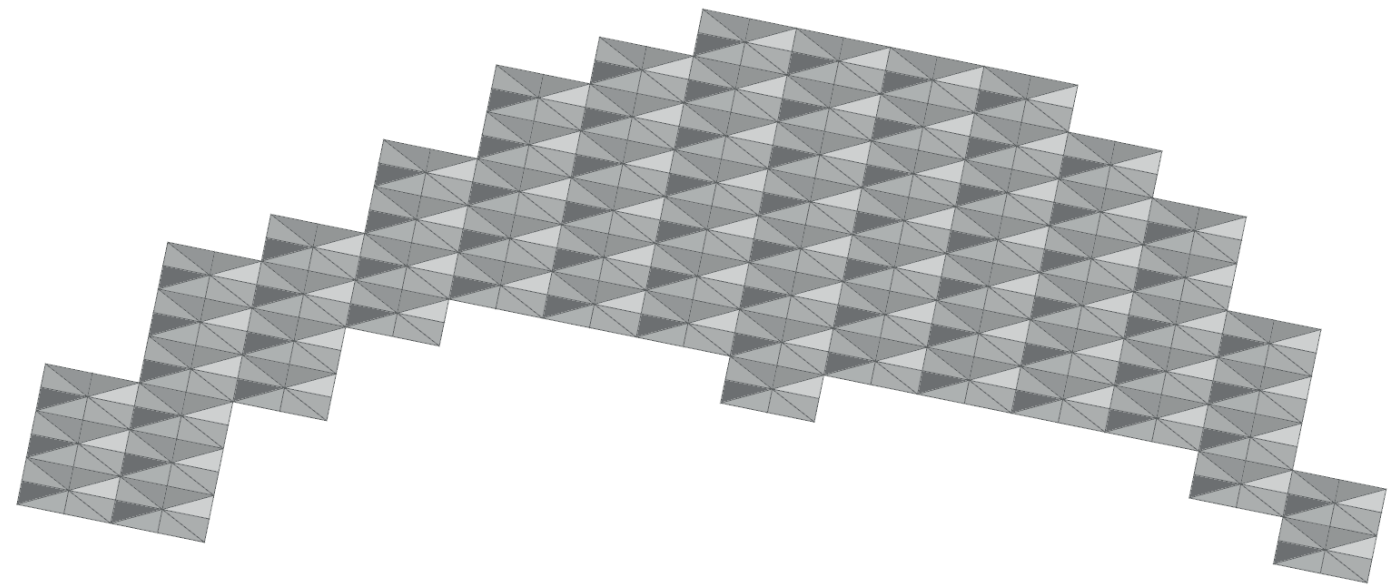


#### 5 Making the grid for the greenhouse

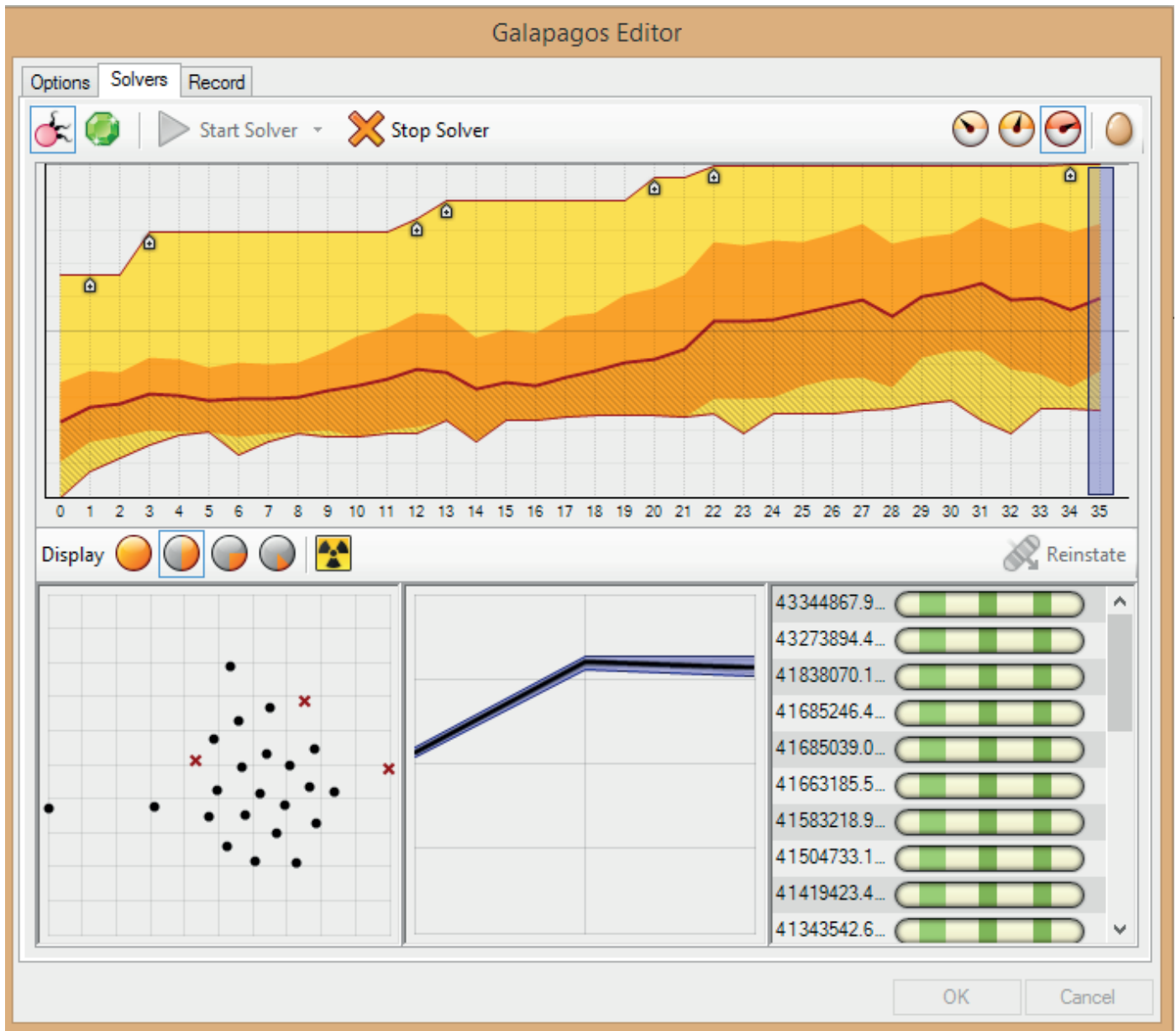




Building the greenhouses from the grid



## 7 running the simulation



Galapagos optimised the total radiation by modifying 3 parameters of the greenhouses, the orientation, and 2 different type of points which are changing the roof. The difference between the best and worst case was around 25 %.

## Conclusions:

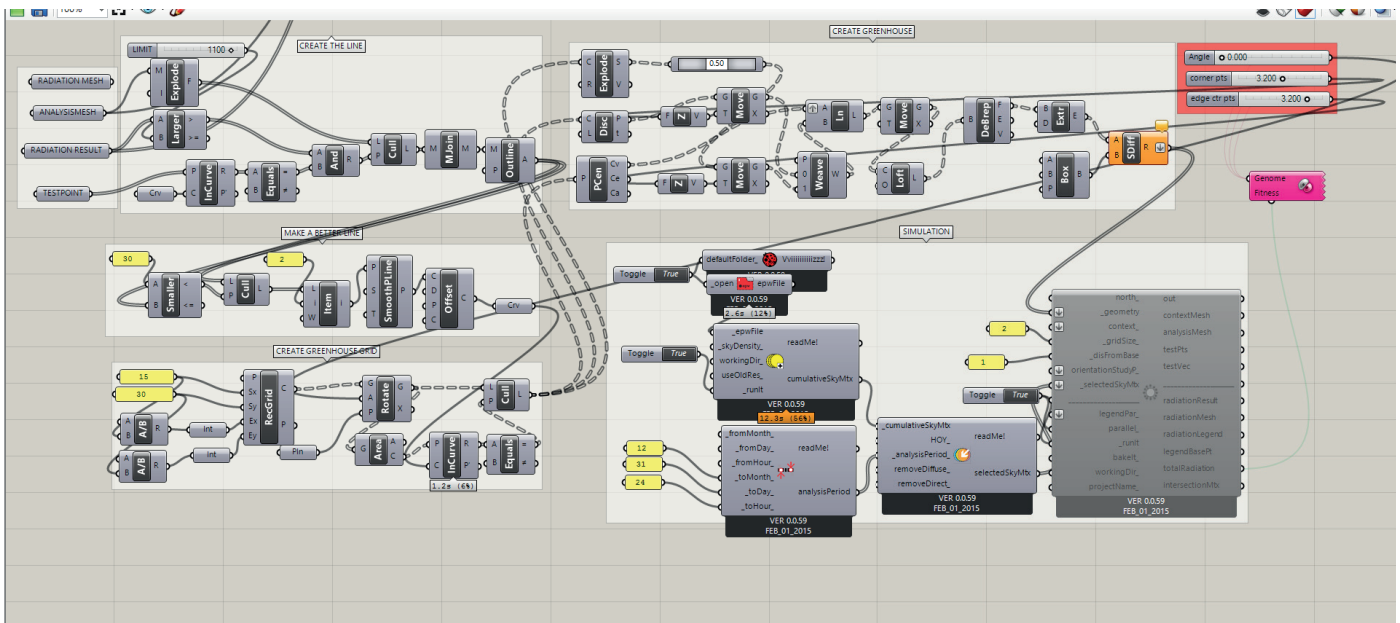
Choosing where to put agriculture was straightforward so quite successful.

The simulation of the greenhouse part was more complex and therefore had more flaws :

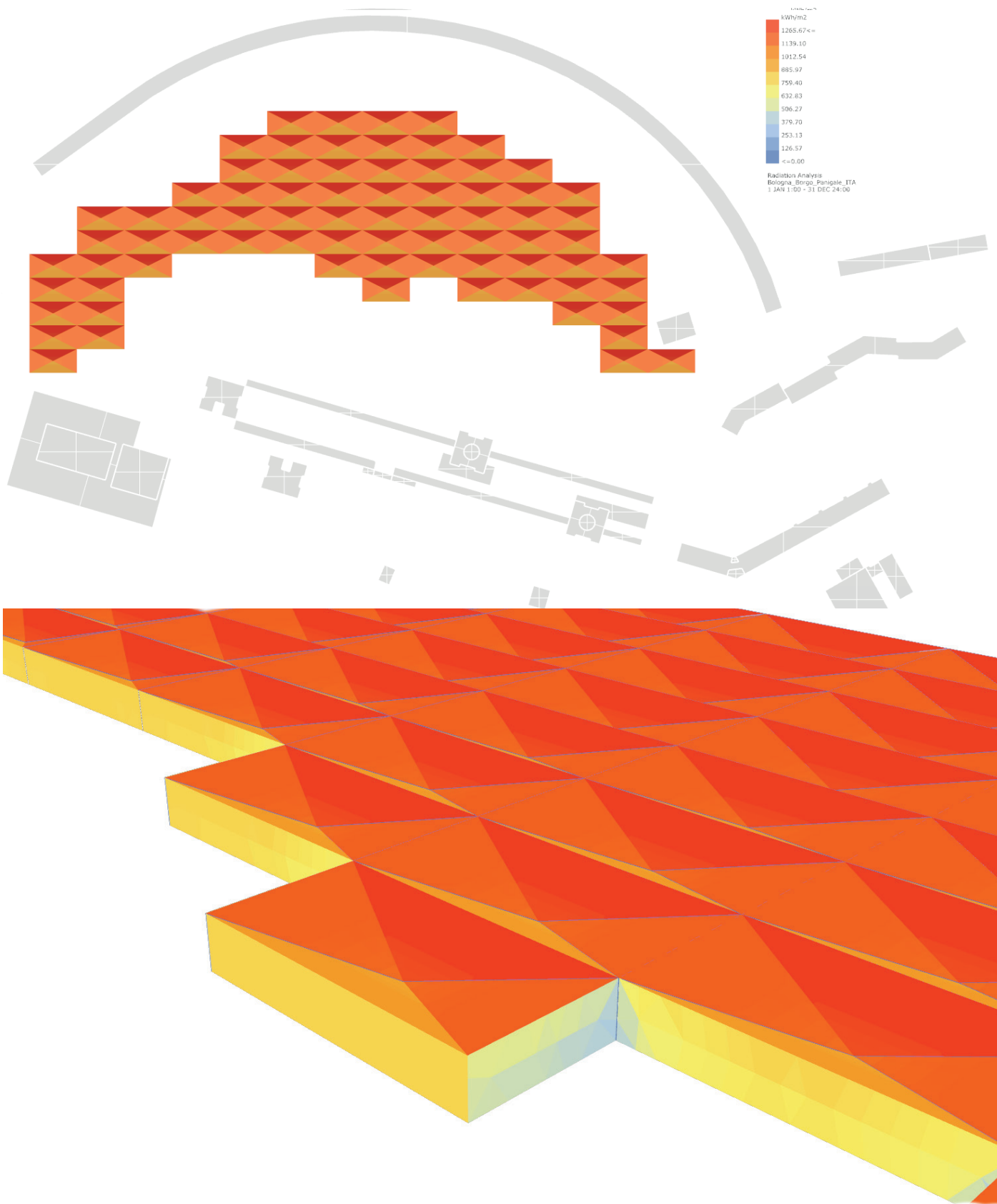
- My design was so restrictive it couldn't be very optimised.
- I only took into account the total radiation the greenhouse received, but the total size of the greenhouse was changing with the different parameters (mostly with the orientation which was then limiting the grid differently and so there is not always the same number of elements)
- There is really more parameters which I could take into account. (aeration, wind, need of light depending on the seasons, etc )
- The precision of the measurement was only of 7m.

There are 2 main interesting things in the final result :

- The grid aligned itself on the south-north axe, which seems logical, but still was a small proof that the results weren't totally random !
- Instead of having a "normal roof", there is an inverted roof, perhaps it's better so each element does not give shadows to the elements behind. If I had time it would be really interested trying to do another simulation with a new more free design of greenhouses to see how it could be even more optimised.



Final optimized greenhouses







# A school of Cambodia

Student: Stéphane de Weck

## Summary:

“We are planning a school in rural Cambodia within an existing village structure about two hours north of the capital Phnom Penh. The school consists of several classrooms, a cafeteria, an auditorium as well as medical and infrastructural buildings.

We plan within the specific context of a society which is dominated on one hand by the fascinating history of the Khmer culture and on the other hand a dramatic demographic development due to the brutal civil war in the recent past. 52.1% of the population of Cambodia are under the age of 24 years, the average of the total population is 23.5 years. The question of education and care is thus socially relevant and urgent.

In addition to these specific social conditions, the availability of material resources, talent and technical skills as well as the climatic, ecological and economic conditions have to be considered in the design. The question of contemporary didactical concepts and their spatial implementation is an important issue in the semester. Together with local professionals we will develop a reasonable and customized strategy how the school system and the necessary infrastructure can be implemented in several phases. It is the declared aim of the course to develop designs that are feasible in terms of architecture and construction, from urban and neighbourhood issues to the constructive detailing of individual buildings. The results of the studio should be a relevant contribution to the contemporary architectural culture of Cambodia, respecting the specific social and climatic conditions.”

<http://www.hebel.arch.ethz.ch/fall-semester-2015-cambodia-village-school-project/>

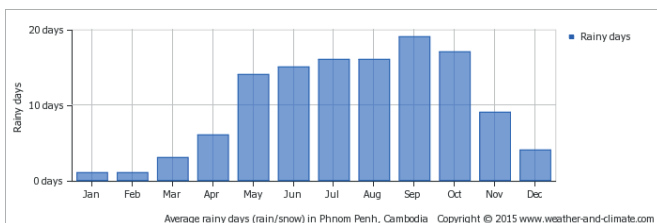


## Motivation:

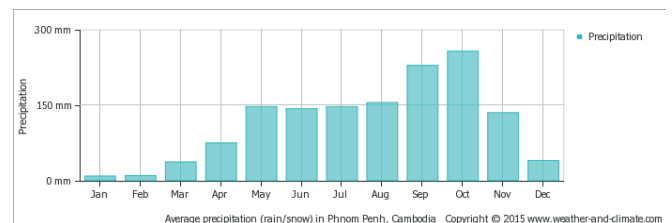
The important climatic factors which were influential in the project, are the solar exposition and the rainfalls. In these latitudes the problem is more the heat itself than the heat variation which is pretty constant. However, the temperatures are high the whole year: from minimum 25 °C to maximum 35 °C. This is why actually Cambodian people live mostly in the shadows. It is noticeable that their architecture is designed more with the shadows rather than with the light. Therefore the first goal will be to sun-protect the users of the building.

Regarding the rainfalls, there is in these latitudes the monsoon phenomenon. In only a few minutes, everything could be potentially flooded. How to design a project to make sure every spaces are effectively reachable even if the ground is flooded ? In other words, how to optimise the connections between the spaces ?

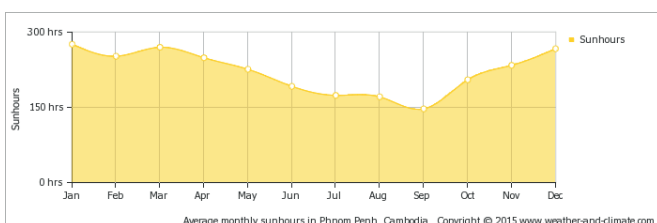
Another goal of the project is to differentiate the spaces by its private and visually reachable aspects. Some spaces have to be quiet and private, others have to be quiet but watchable or public and ceremonial.



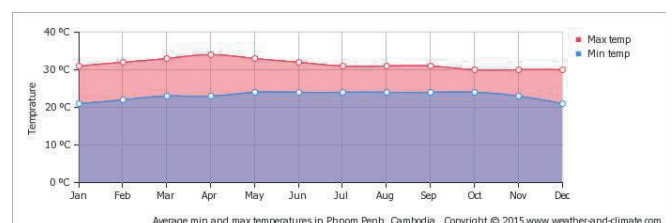
Raindays in Cambodia



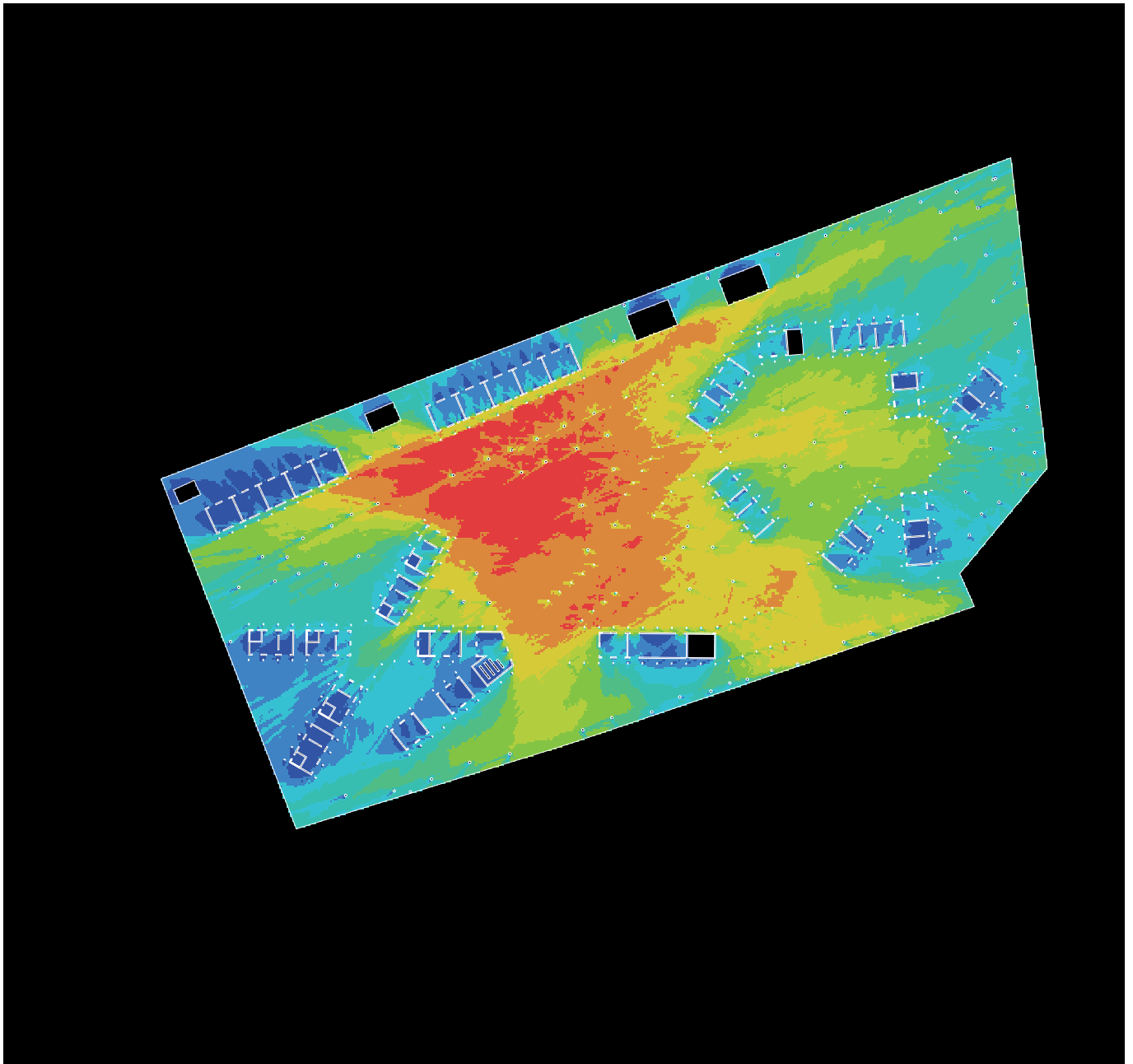
Rainfall in Cambodia



Solar exposition in Cambodia



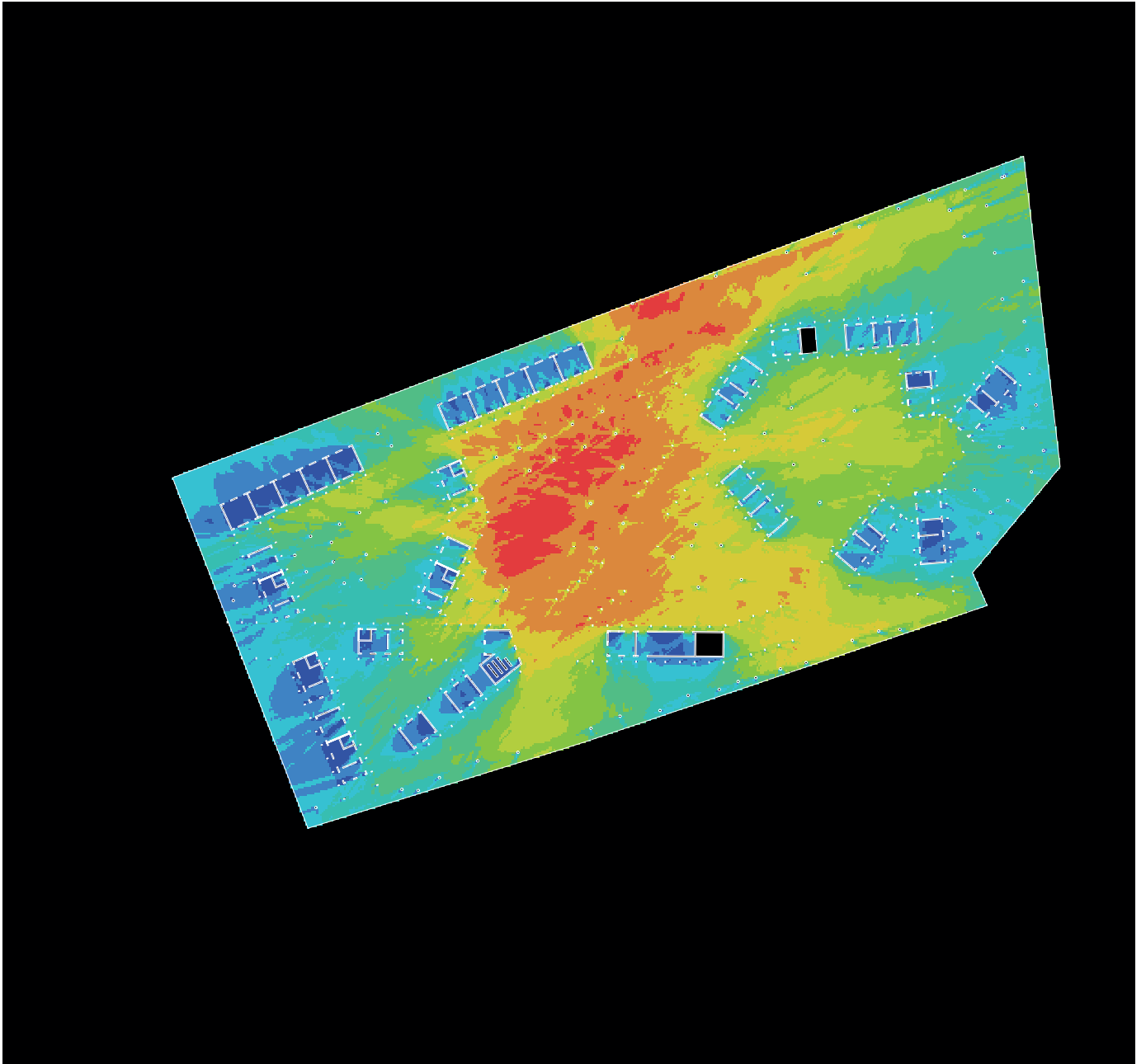
Tempartures in Cambodia



Isovist area, before

This first isovist analysis already explains the project quiet well:

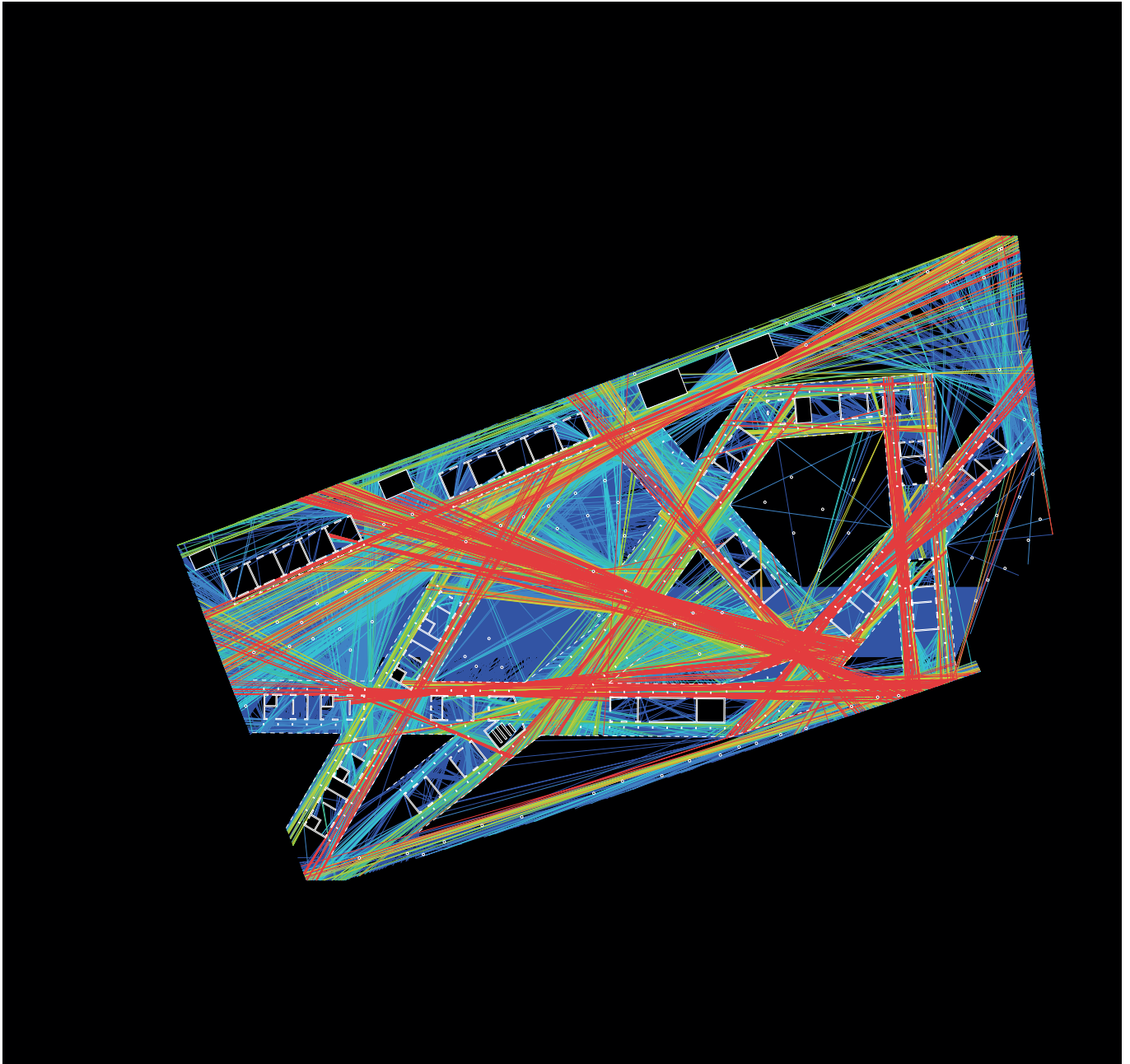
- 1) A big ceremonial courtyard in which the students could assemble for the morning ceremony (red part). Indeed, in Cambodian schools, students are used to raise the flag before the first lesson.
- 2) Public courtyards organised in between the buildings (yellow parts).
- 3) Private courtyards in the crossing points of two buildings (green parts). These are mainly thought to be play- grounds for small children. This is way we want them to be private but watchable.
- 4) Closed classrooms (blue parts)



Isovist area, after

We wanted to have more defined spaces and a more precise hierarchy. This is why we closed the two public courtyards on the left side and extend one building in the middle part. The ceremonial courtyard is now much more defined. The two public courtyards (green-yellow parts) in the left side have now the same value as the ones in the right side.

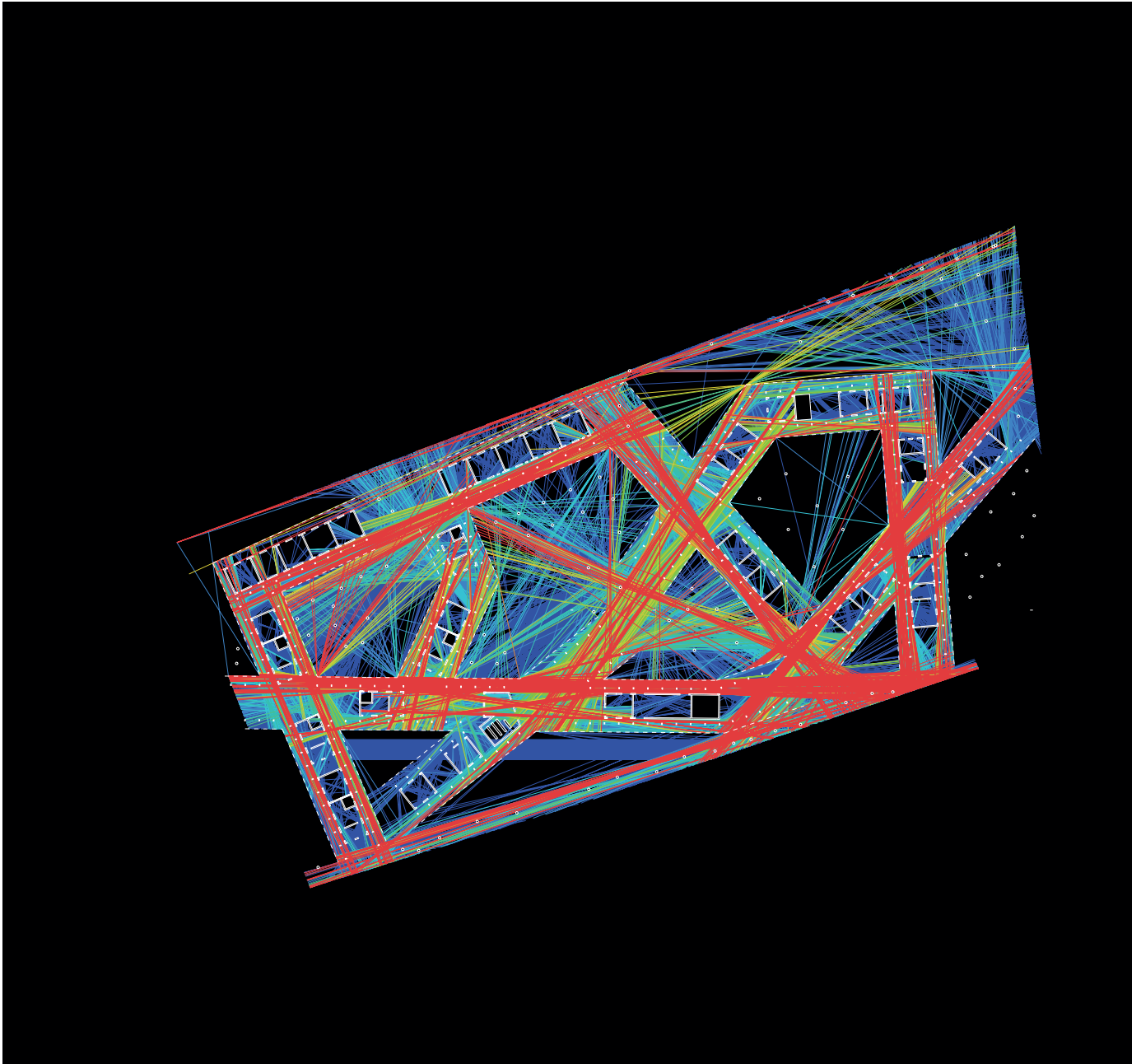




### Axial map – choice, before

For the project and regarding the flood issues, we want to deck the ways that connect the different parts of the school. However, what are the main thoroughfares of the site ? The choice calculation which has been interpreted as movement flow potential is helpful here and answers spontaneously to the question.

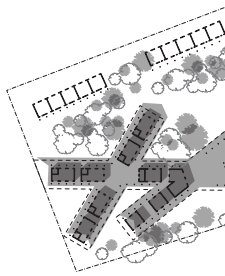
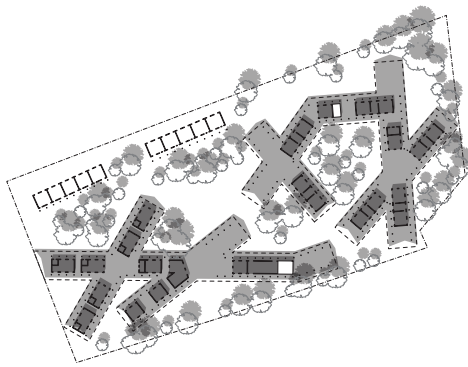
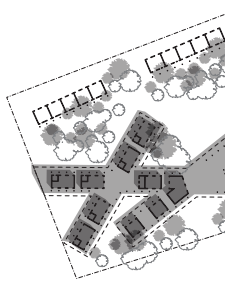
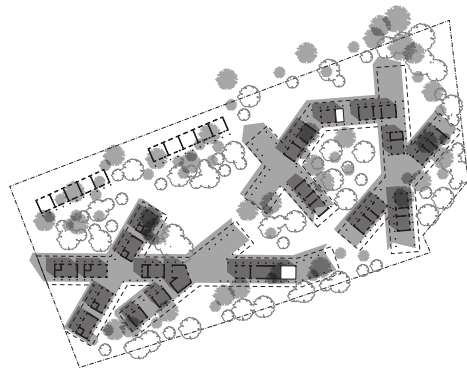
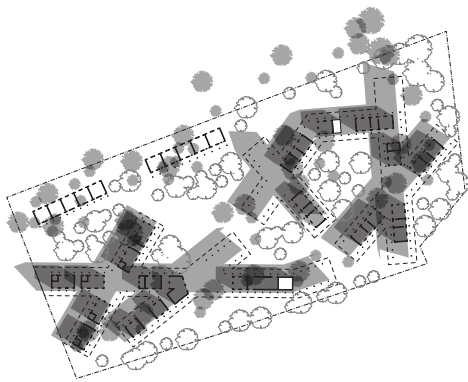
Notice that the analysis also bring to light the courtyards. The courtyard on the right side is noticeable: a public but quiet space. The choice calculation shows the issue we already mentioned in the isovist analysis: the ceremonial courtyard is split because not defined enough. To the same extent, the courtyard on the top left corner looks more like an undefined transit space than a public but quiet courtyard.



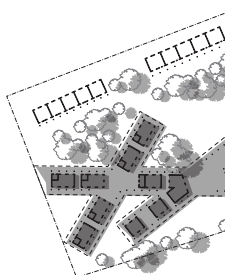
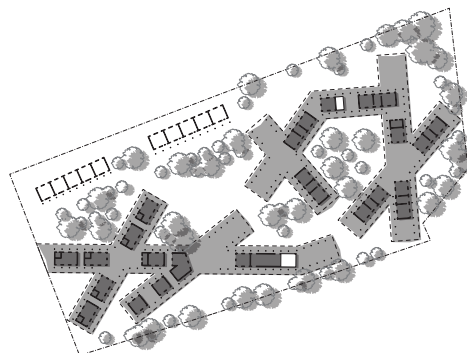
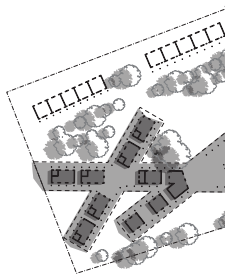
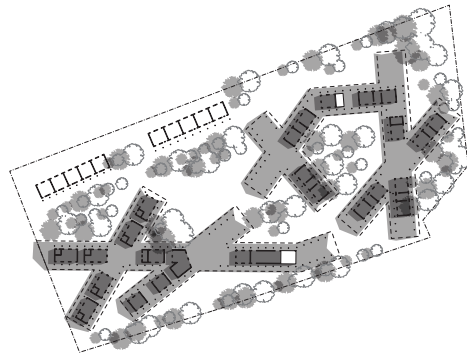
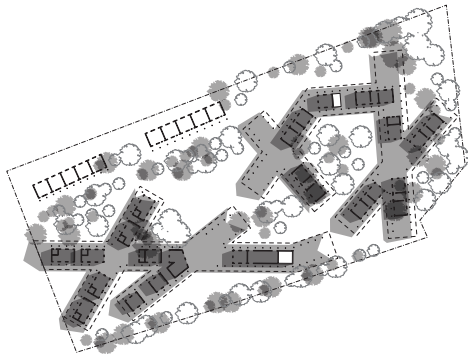
#### Axial map – choice, after

The changes that have already been made on the plan solve the issues above mentioned. The ceremonial courtyard is not split anymore and the courtyard on the top left corner is now much more defined: the flows stay outside and we can enjoy its stillness.

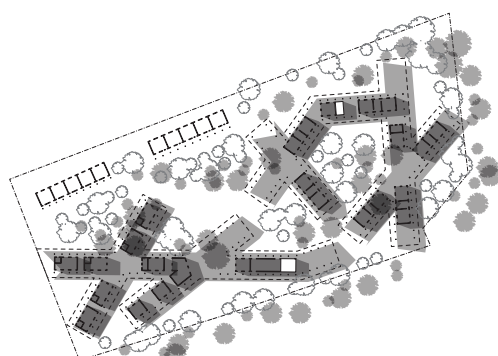
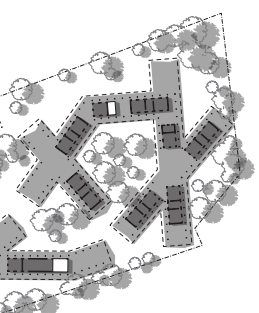
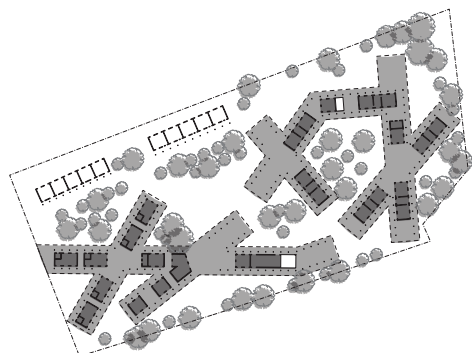
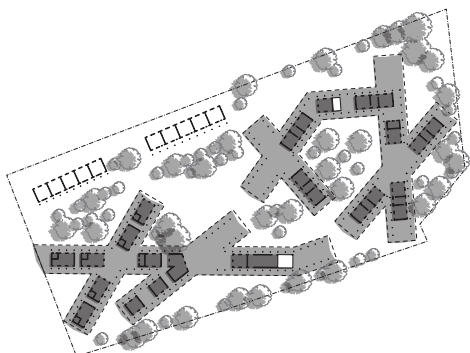
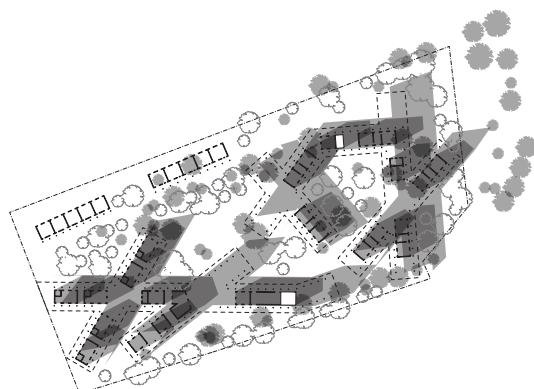
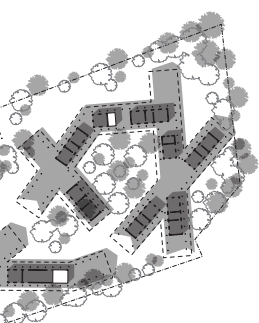
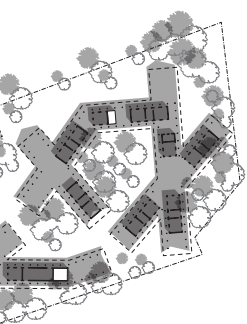
If the isovist map is compared with the axial map we can notice that the playground in the crossing point on the left side is as visible as the public courtyard on the left side but the first one is in the middle of a very dense movement flow and the second one is well isolated. The playground is therefore more watchable.

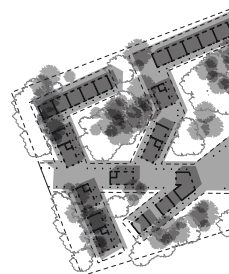
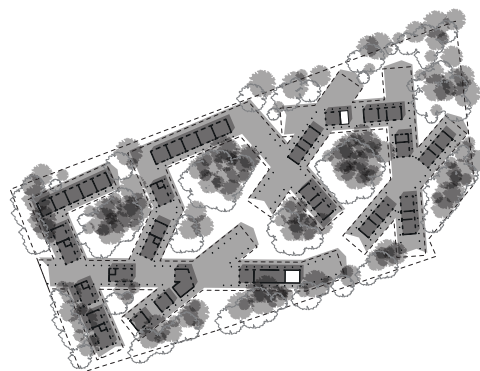
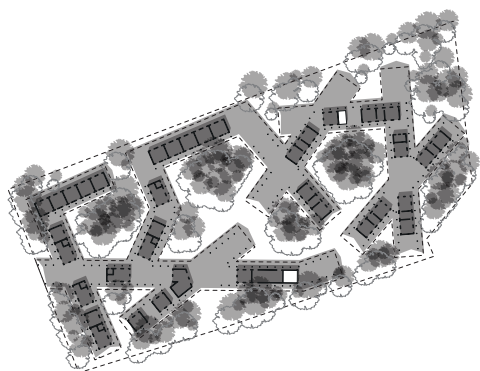
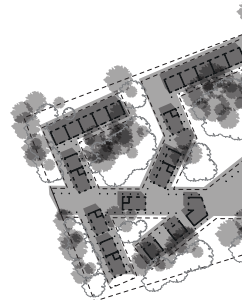
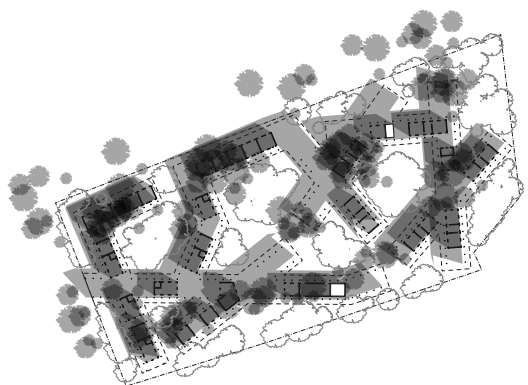


Shadow analysis, before  
from 9 am to 5 pm, December 22<sup>nd</sup>

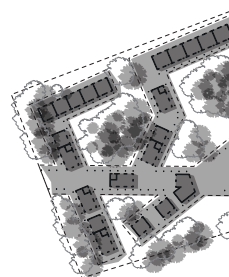
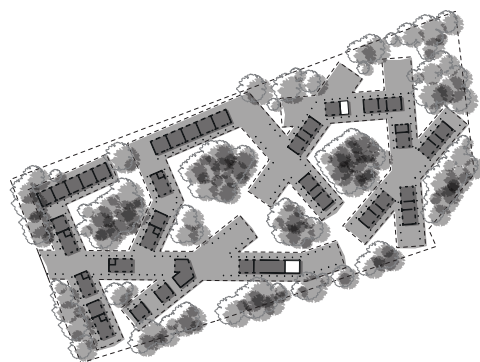
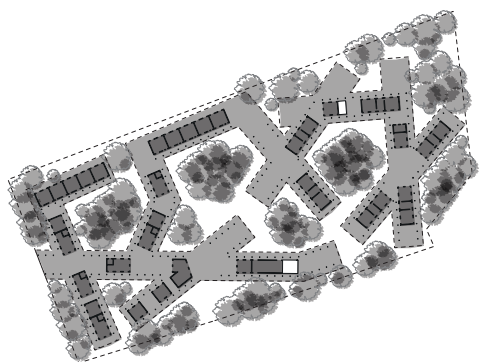




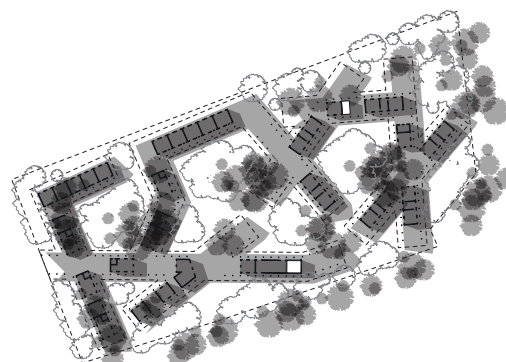
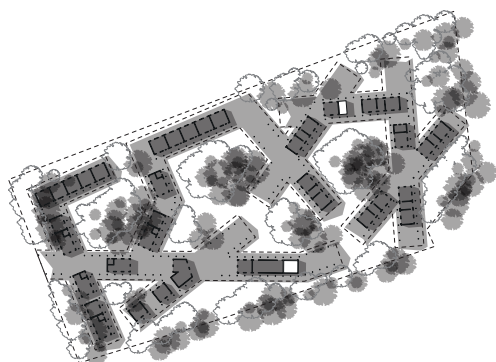
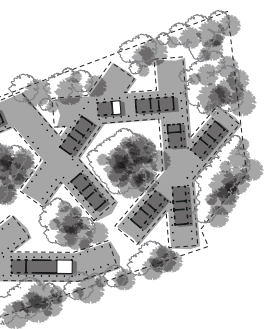
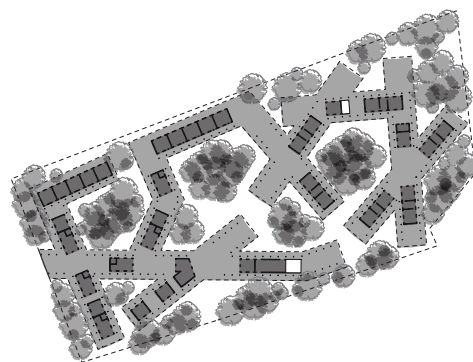
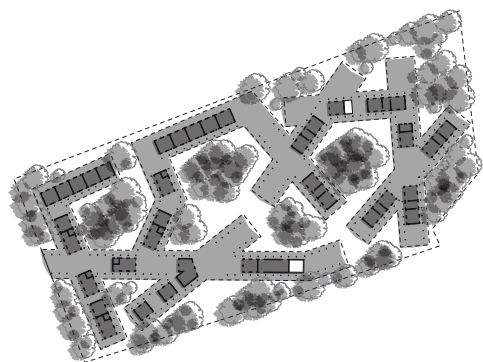
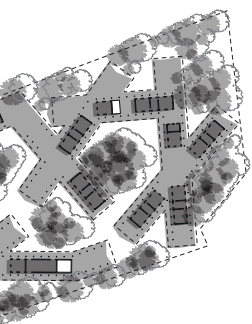
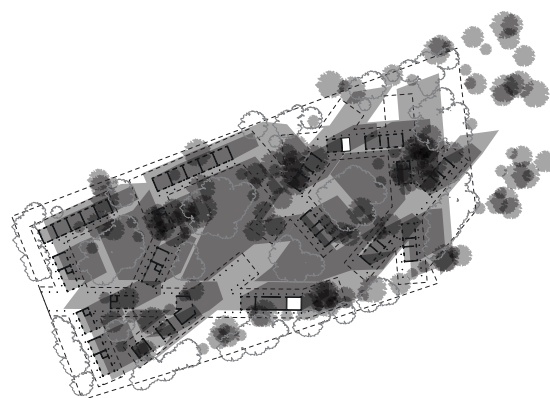
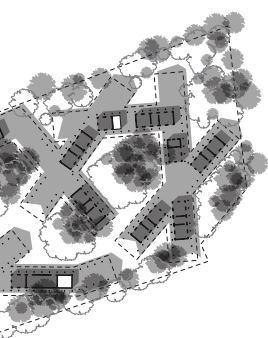
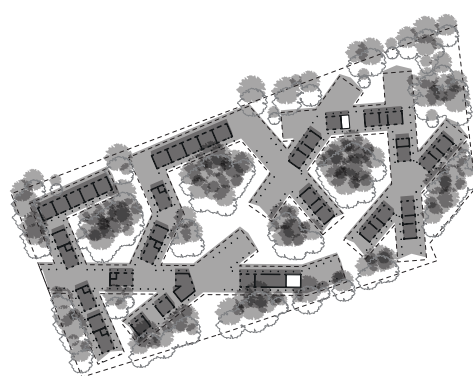
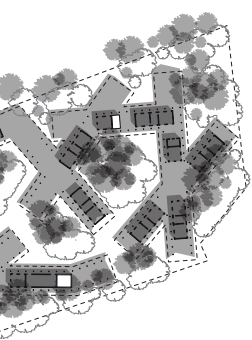


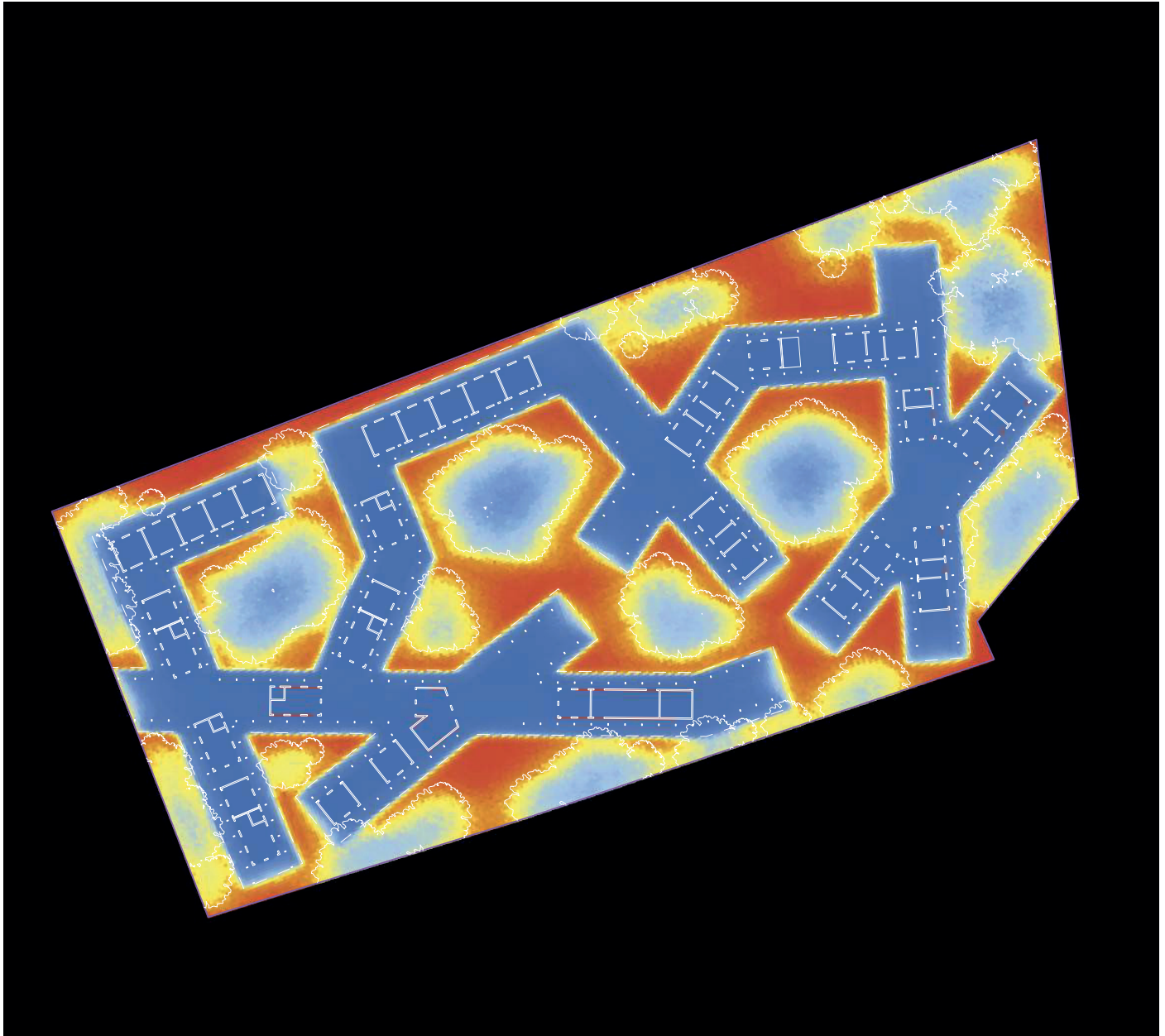


Shadow analysis, after  
from 9 am to 5 pm, December 22<sup>nd</sup>









### Radiation analysis, June

The radiation analysis and the shadow analysis on the previous page, show both the importance of a big a roof and trees. As already mentioned, Cambodian people live in shadows; The heat in radiated spaces is unbearable. Since the project is a school, the control of the atmosphere is even more important: working conditions should be optimal. This is why it was made sure that there is a continuous sun-protected path that connect every single rooms in the school. The second change is the amount of trees in the courtyards which must be sun-protected as well to be in use: The courtyards required much more trees than what was designed originally.





# Olympic Legacy

Student: Thorben Westerhuys



## Summary:

As a final project I decided on a closer look into designs and experiments around the Olympic games candidacy of Hamburg for 2024. The city is actively pursuing a jump beyond the river that cuts the city in half both geographically as well as mentally.

So I acquired the relevant OSM Data, tried to include all pedestrian relevant information that are not already included with ELKs road component and ran a segment analysis.

The current situation shows the disconnect rather clearly but also reveals that Wilhelmsburg is sort of an island between the city and Hamburg, making a connection possible again.

So I took KCAP/gmp/vogts proposal for an Olympic area on “Kleiner Grassbrook” and compared its potential for a re-connection with one from Kees Christiaanses ongoing studio at ETH on the same topic. The second proposal places the Olympic Games further west onto Steinwerder. That location is more centrally located and always visible from the city. This would also revise the old Elbtunnel, that is - together with Elbbrücken and the new Elbtunnel/A7 - the only inner city bridges/tunnels across. Running those analysis I looked at choice and integration in particular since those two become relevant in deciding whether the re-connection can be made and what kind of effects this would produce onto other existing - neighbourhoods.

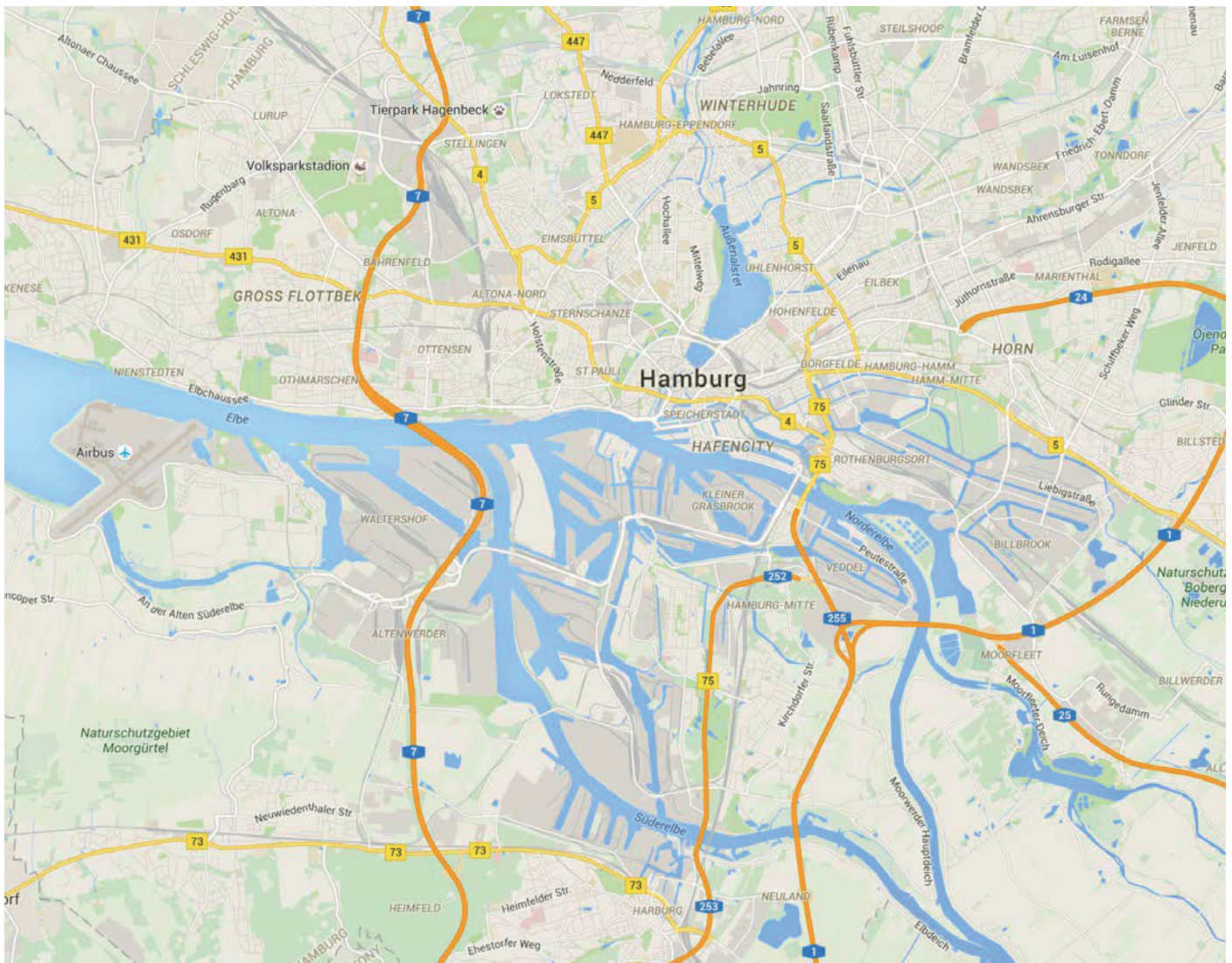
The results are less clear than expected and reveal, that it is a big challenge to bridge the gap. Both proposals have rather limited effects on the overall system, locally however they will have an effect on their surroundings. The first proposal will strengthen the HafenCity - then fully built out, whereas the second one will shift the focus away from HafenCity more towards Landungsbrücken and Altona.

Going a step further I then ran an Isovist analysis on both proposals to look at their spatial configurations on site. Whereas the first proposal tries to balance open and closed spaces by closely interweaving sports and residential uses, the second one deliberately had a sharp contrast between the stadium and residential areas. Both work with alternations on city blocks and hence create compact semi private courtyards as opposed to open streets.

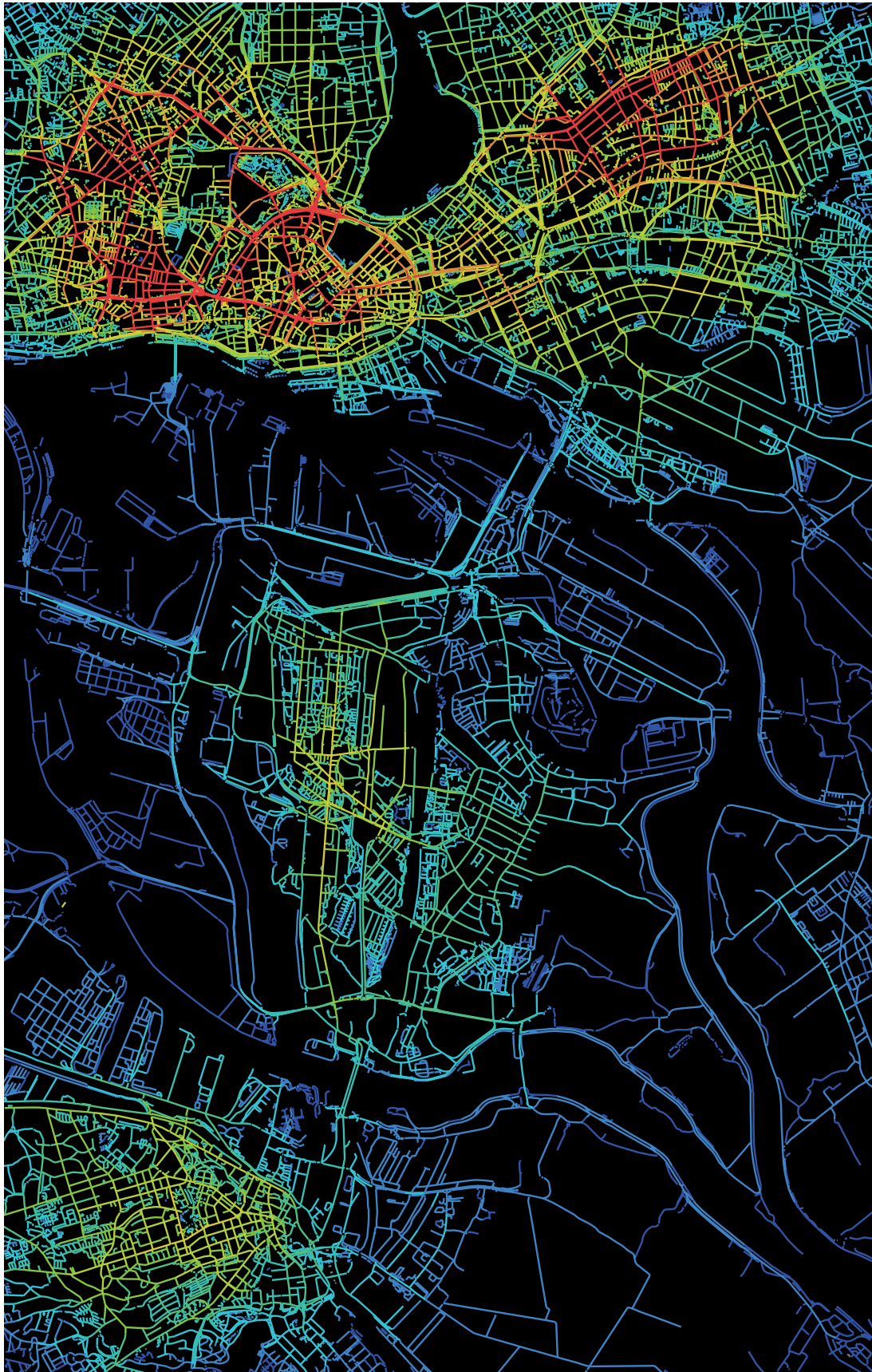
Motivation:

Hamburg is trying to advance urban strategies and developments through different projects. Recently a lot through big projects such as the HafenCity, IBA and now Olympic Games. Each of those had a strong or solely urban planning and development approach and usually aimed at developing the north south axis of the city.

So, being grown up in Hamburg I was intrigued to see, if and what Olympic games and the current plans could bring to this goal using space syntax analysis methods.





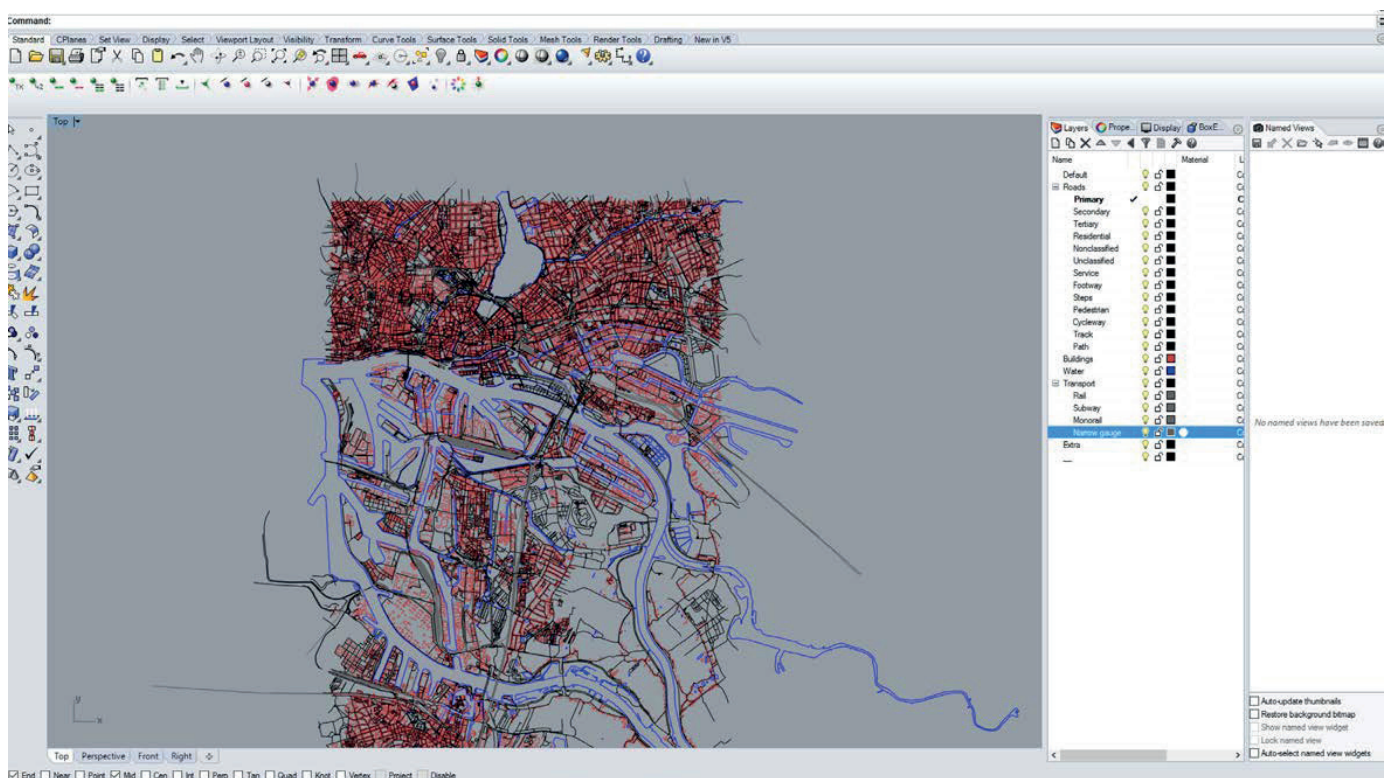
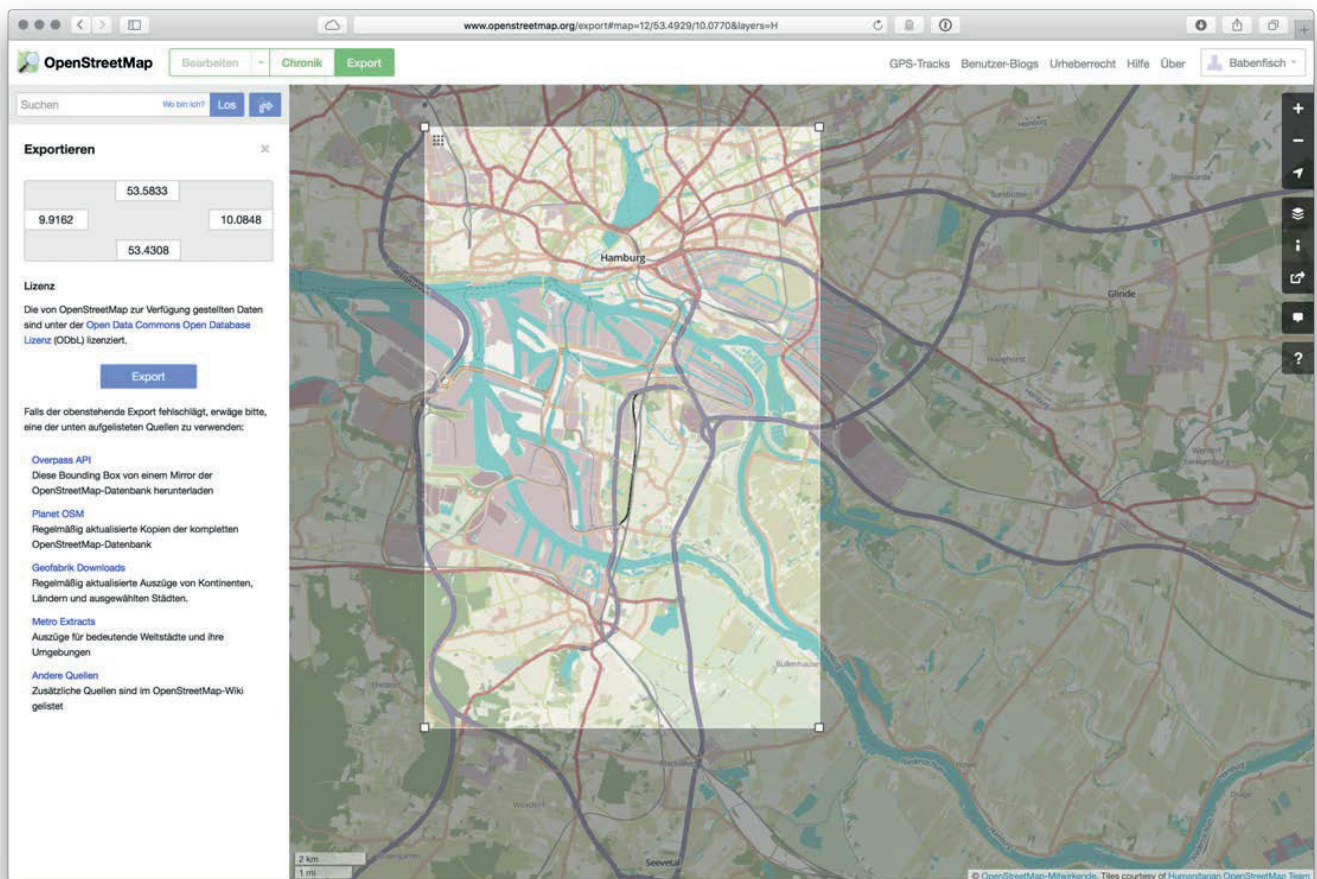


Current situation – Integration, R50 steps

### Current Situation

In the Integration analysis of the current pedestrian network of the city a clear division between the “inner city” and the southern parts becomes visible. Further Wilhelmsburg has been established as a rather well connected islands in between only loosely connected to the south and north. Hamburg on the other side works almost independently on the city.







## Acquisition of Data

I chose a relevant part of OpenStreetMap Data and imported that into ELK. From there I extracted roads and pedestrian paths with different key combinations based on actual usage in Hamburg.

Afterwards I tried to clean up the data for further processing in Depthmap. For the two proposals I drew all relevant entities (roads, pathways, buildings) according to the plans you see below.

Proposal 1 - KCAP, gmp, vogt



Proposal 2 - Students from "Hamburg - Olympic Legacy", Prof. Kees Christiaanse







Current situation – Integration, R50 steps, angular segment



Proposal 1 – Integration, R50 steps, angular segment

## Integration Analysis

The potential for developing a new district on “Kleiner Grassbrook” seems rather appealing, since its the natural link between HafenCity and Wilhelmsburg. The analysis however shows, that much more and relevant connections will be need to achieve that. Only locally an axis forms but Elbbrücken still carries most of the load.







Current situation – Integration, R50 steps, angular segment



Proposal 2 – Integration, R50 steps, angular segment

## Integration Analysis

The proposal has the potential to increase the reachability of former harbour area and there are slight increases in centrality on Steinwerder. However this part does not become the new axis/gate to the south. That still remains with Elbbrücken further in the east.

Locally the new residential areas are quite well organized and do form local centralities. The focus seems to shift slightly from the eastern part and HafenCity towards the west and Landungsbrücken/Altona.







Current situation – Choice, R2km



Proposal 1 – Choice, R2km

## Choice Analysis

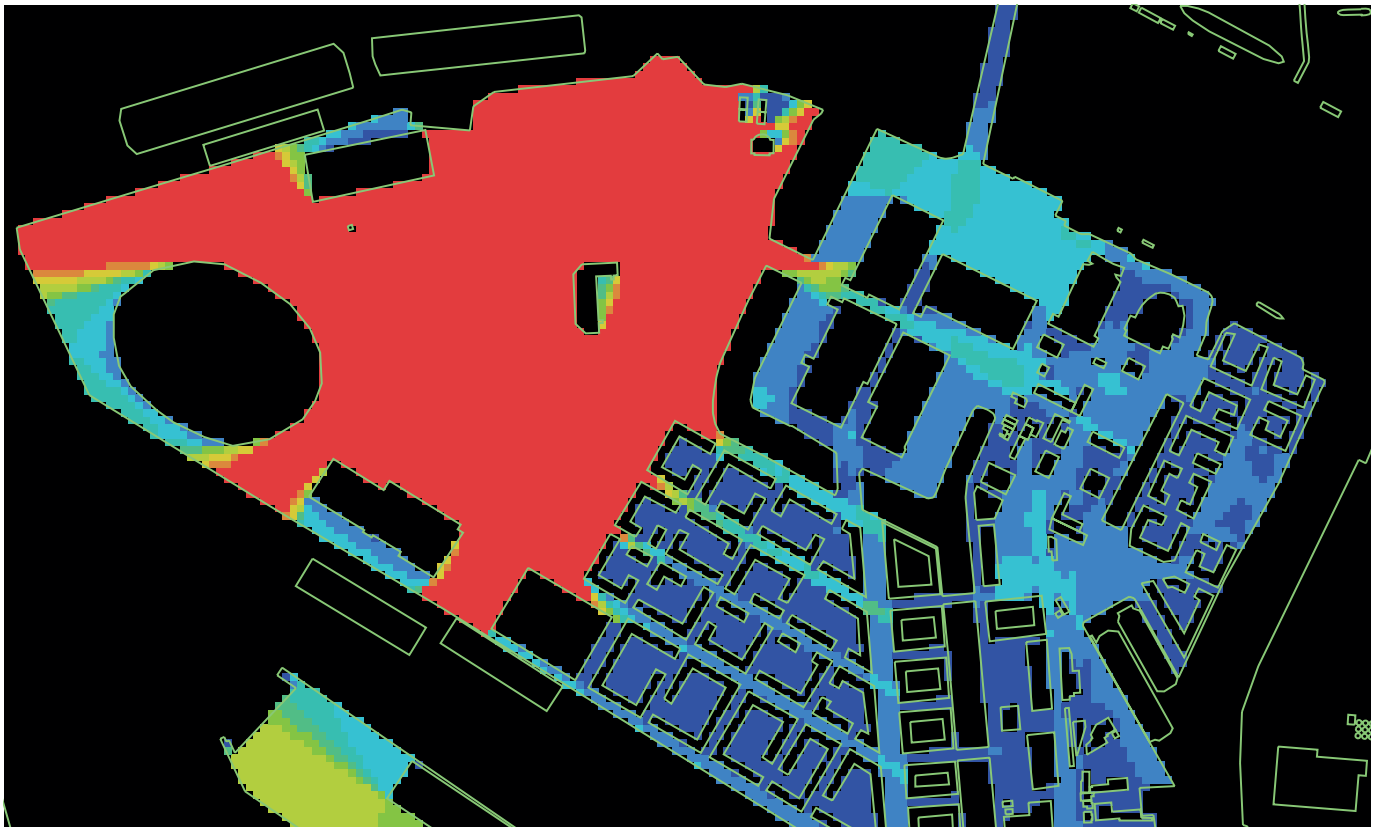
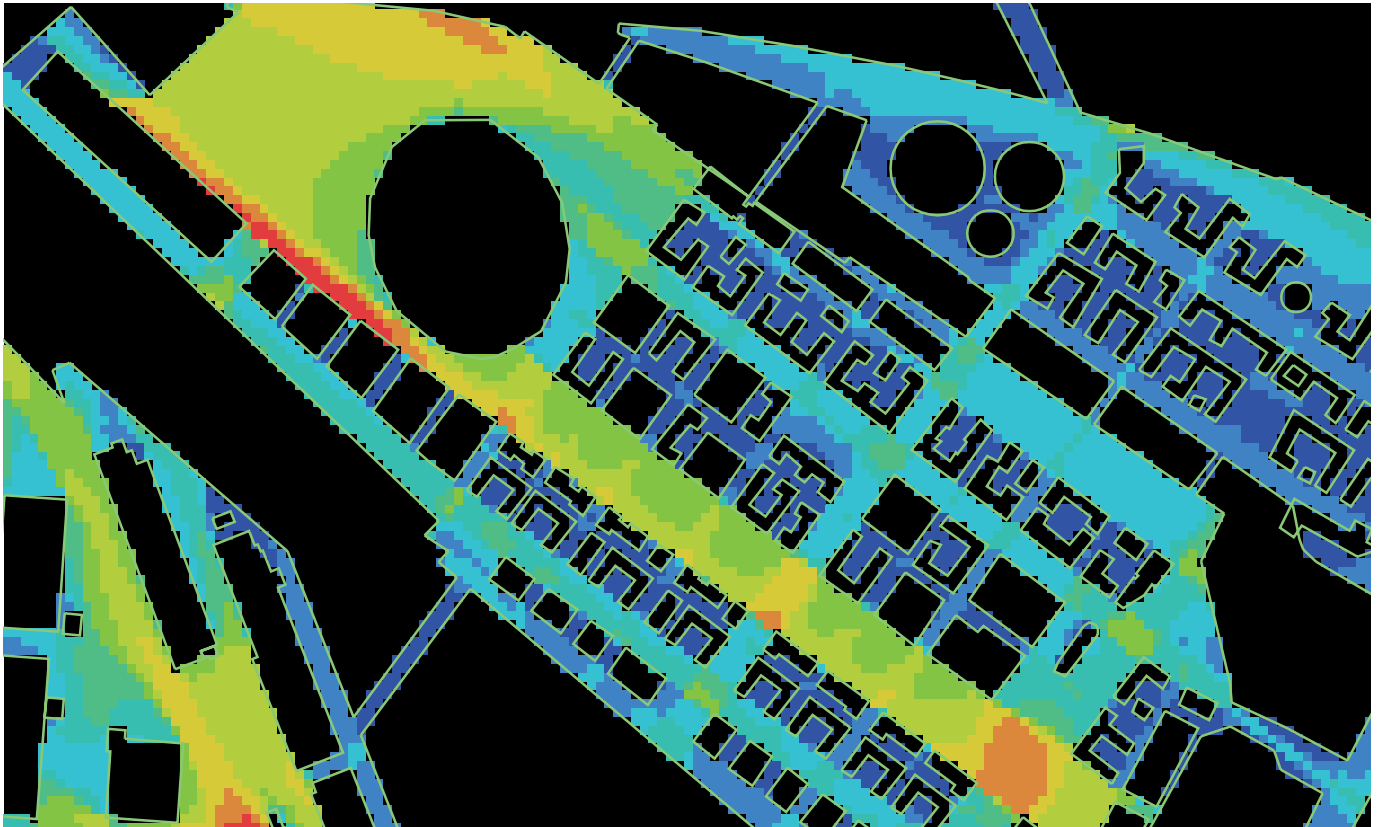
The choice analysis reveals slight increases here and there but no new axis or grand connection. This is concurrent with integration but shows that fact even more clearly.

## Choice Analysis

In this case the choice values for alter Elbtunnel are even decreased and Wilhelmsburg only sees minor choice improvements. This also supports the corresponding integration analysis.

It becomes clear though that choice increases in the area of Landungsbrücken and towards Altona, further support the shift to the west.





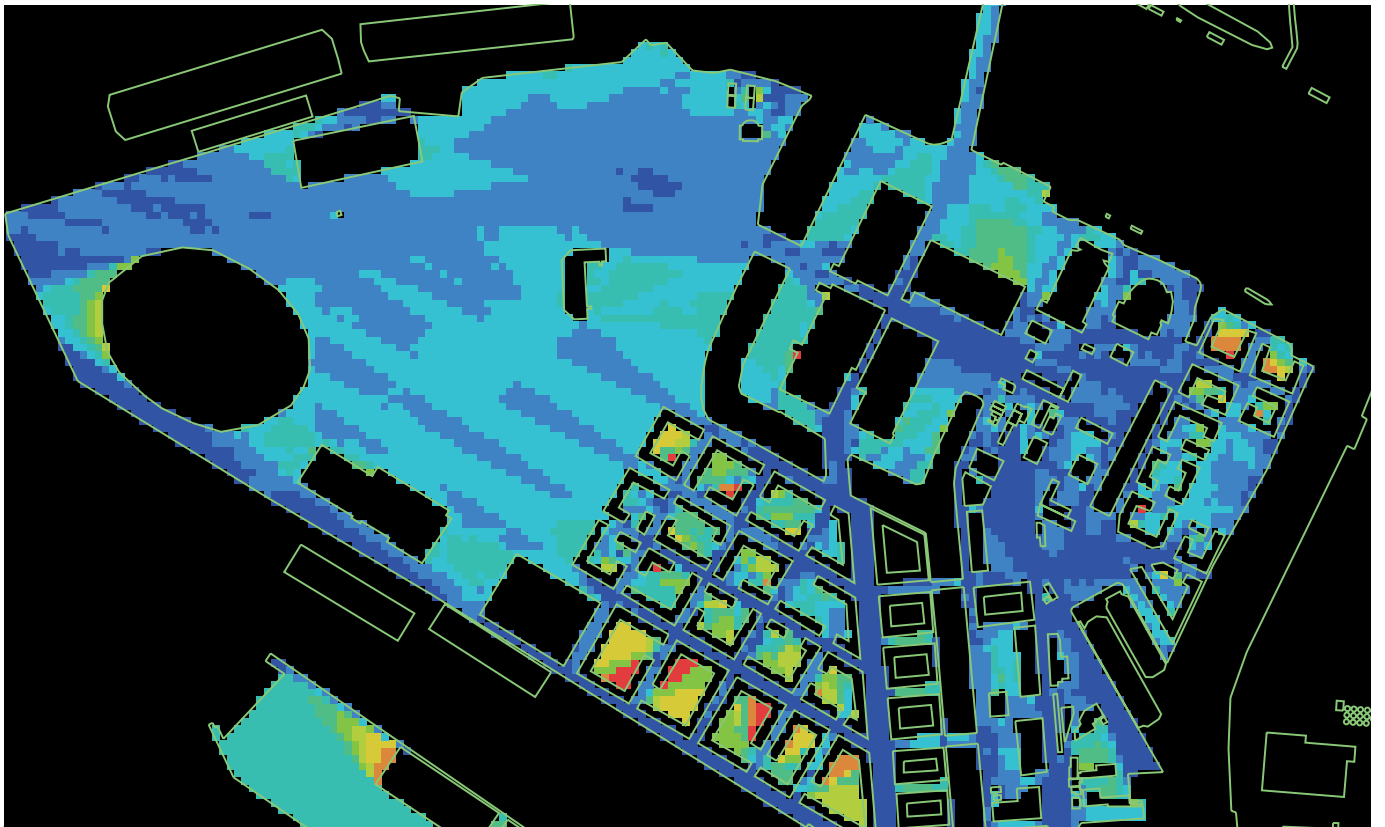
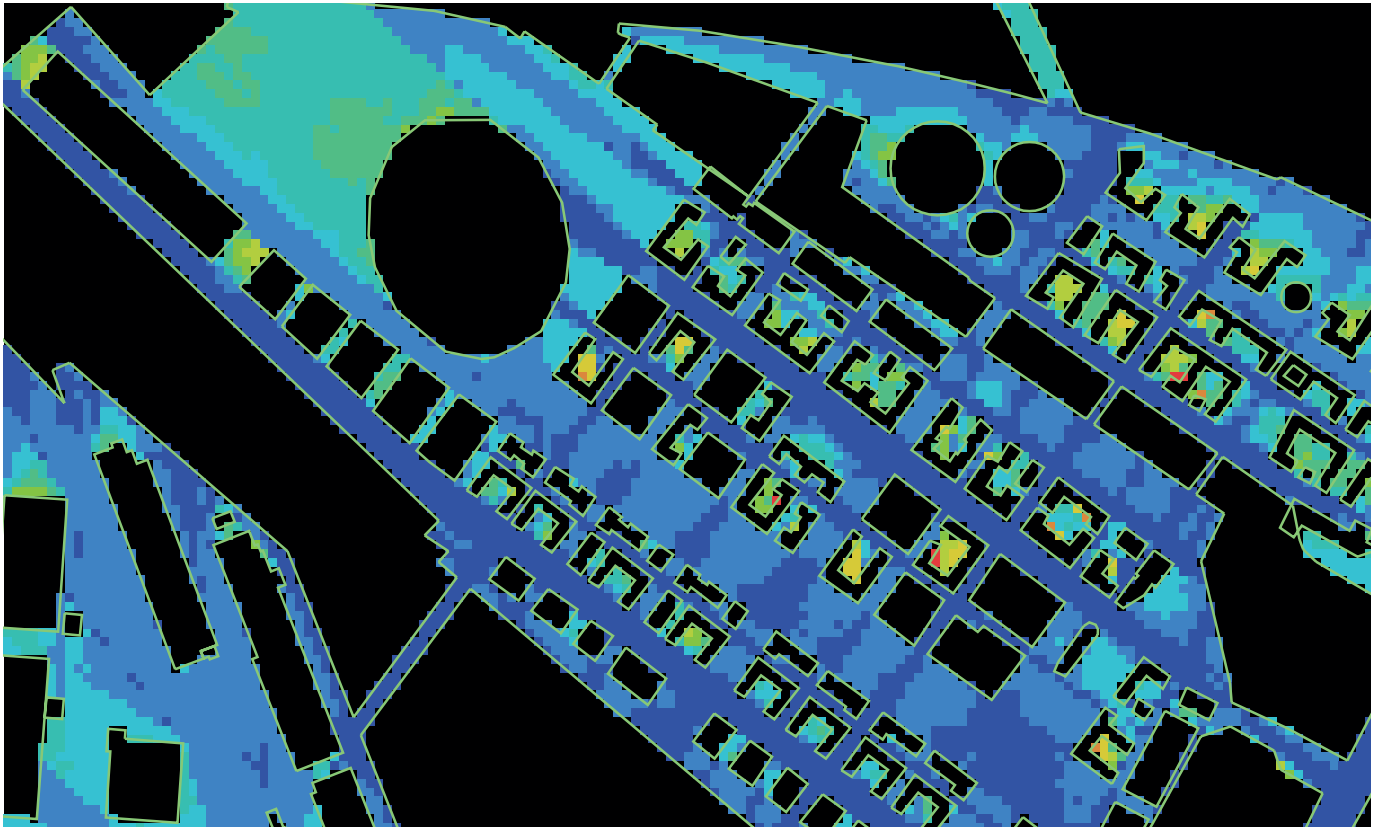
### Isovists Area – Olympic site

Looking at Isovist areas the two proposals differ in their approach to how residential and public spaces are arranged.

The first one tries to integrate both ends of the spectrum as closely as possible while the second one plays with wide open fields as buffers and hence a contrast between the closeness of urban blocks and wide plazas.

The first proposal does achieve a kind of spatial hierarchy through differences in street width, whereas the second proposal does not have that.







### Isovists Compactness – Olympic site

Both proposals use variations of blocks in the residential areas. Hence creating rather closed or very open courtyards. From the analysis proposal 2 tends to have too big courtyards, whereas its more evenly distributed in proposal 1. Though there are more variations in proposal 1 that seem more open on first sight.

Very visibly the street network carries through into the open areas and creates patterns even on the most open areas.

The stadium is placed differently and hence dominates (proposal 1) the open area or merely frames it (proposal 2).

## Conclusions:

Added linkages and a complex project such as Olympic games might not be enough to actually bridge the gaps. Wilhelmsburg currently is not viewed as the island in between that much. That part of the analysis might have the biggest impact on how one should start thinking about the north-south-axis within the city. The key to this part of the city lies within Wilhelmsburg. All analysis show that comparably small interventions in Steinwerder or Kleiner Grassbrook do not have a lot of influences and hence a different view should be taken on how to develop this part of the city.

Since this area carries a long history of harbour related industries breaking with the rail and car-centric past in this area is both challenging and has high potentials. Learning from the analysis this could and should be the focus of new developments especially since Hamburg is facing a crisis in affordable houses and flats. On the more local scale the first proposal creates a heterogenous urban fabric that has private

as well as very public areas. Whereas the second proposal has a very different approach for residential vs. public spaces. However there is no spatial hierarchy in the street network, that is clearly visible in proposal one and should give visitors and citizens a much clearer sense of orientation.







# Uster 2035

Student: Vincent Hischer

## Summary:

In the framework of a semester assignment a vision for the city of Uster (Zurich) in the year 2035 has to be elaborated. Nowadays the city accommodates approximately 35 000 inhabitants. If the growth continues like in the passed few years up to 10 000 new inhabitants are expected until the year 2035.

Where to host the newly arrived inhabitants? Building new houses outside the city border is not permitted anymore due to the Kulturlandinitiative in Zürich in 2012. Inside the city borders there's only few space, which is still undeveloped. So the focus lies on the built environment.

Another problem the city of Uster has to face (like every other city on the western hemisphere) is the aging of its population. New services are needed to satisfy the special needs.

Lastly the city consists of much more inhabitants than working forces. The danger of a bedroom community persists where people only come home to spend the night.

One possible solution to face these challenges would be to densify the existing centre and to build new dense mixed-used neighbourhood centres, which would consist of working places and residential buildings designed especially for elder people.



## Motivation:

As described in the summary new neighbourhood centres could be a solution to face future challenges. Where are possible locations for these new centres? Among other criteria the analysis of the existing street network with a segment analysis could give first hints to know where central, well integrated streets are located. In a next step the impact of the new centre on the neighbourhood network should be analyzed. Lastly an isovist analysis of the new developed area would show its structure from a visual point of view.

Another measure to increase the livability in the city would be to create pedestrian zones in the centre. Shops and other services could be placed along these streets. To do so it would be helpful to know which streets in the centre would suit the requirements for a pedestrian zone. The choice value from the segment analysis could show where the most crowded streets are situated.

## Analysis 1 (Angular Segment Analysis):

With this first analysis the whole street network is looked at. For the angular analysis a 500m radius was chosen as this is a normal walking distance. The result is displayed on the next page.

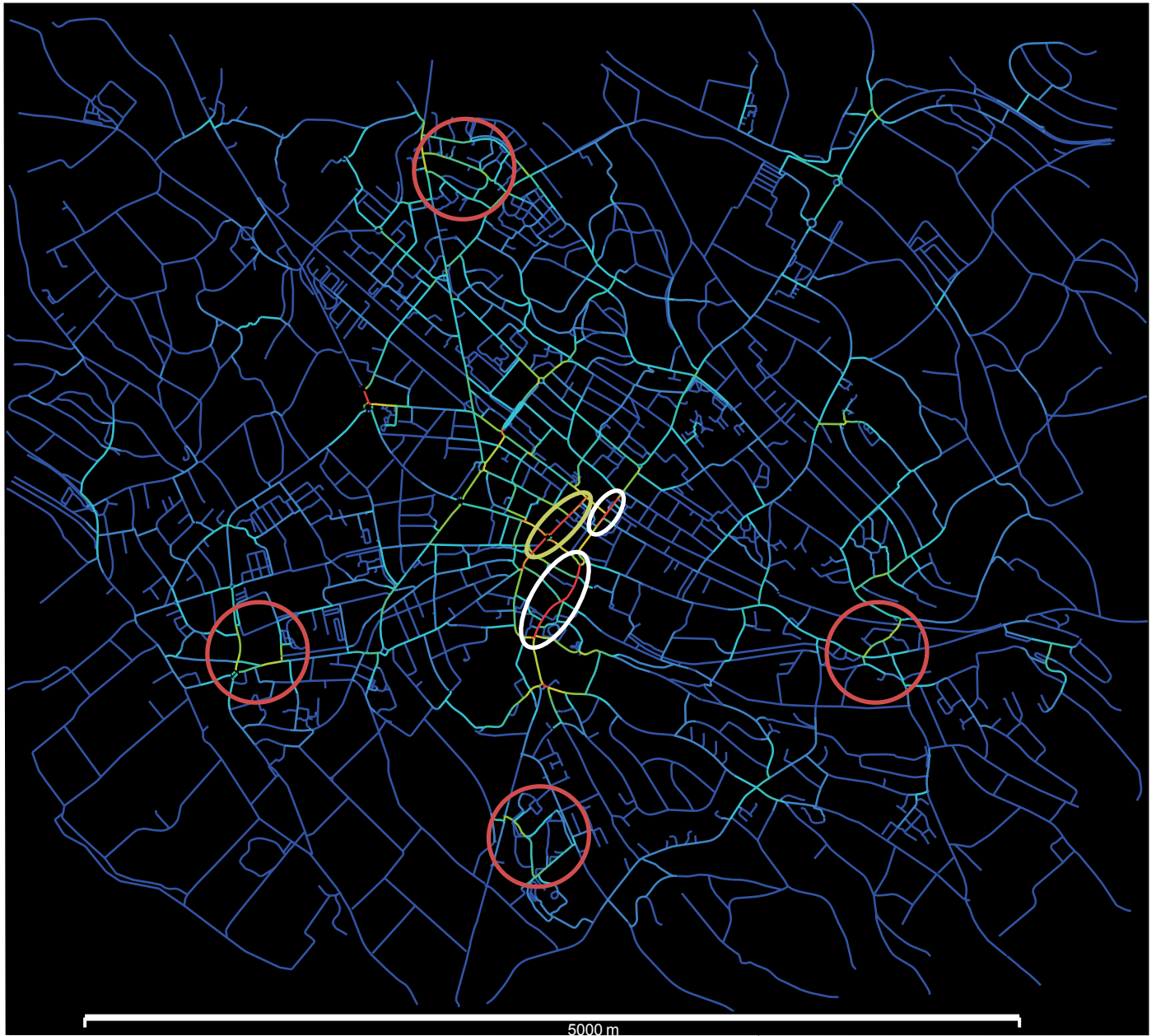
## Choice

According to the choice map the streets that have the highest through movement are located in or around the existing city centre (light blue and green circles). Especially the Poststrasse (green circle) is interesting as it points directly to the railway station. This situation would be very suitable for a pedestrian zone as the is near the existing city centre and its vicinity to the railway station would attract also people from other cities. Therefore this street should be released from car traffic. In a next steps new shops, cafés, hairdresser etc. should be placed in the ground floor to make this street more attractive.

The red circles show possible locations for future developments like a new neighbourhood centre with working places and residential buildings. As there are other factors that influence the decision where to build a new centre the circles show only first possibilities.

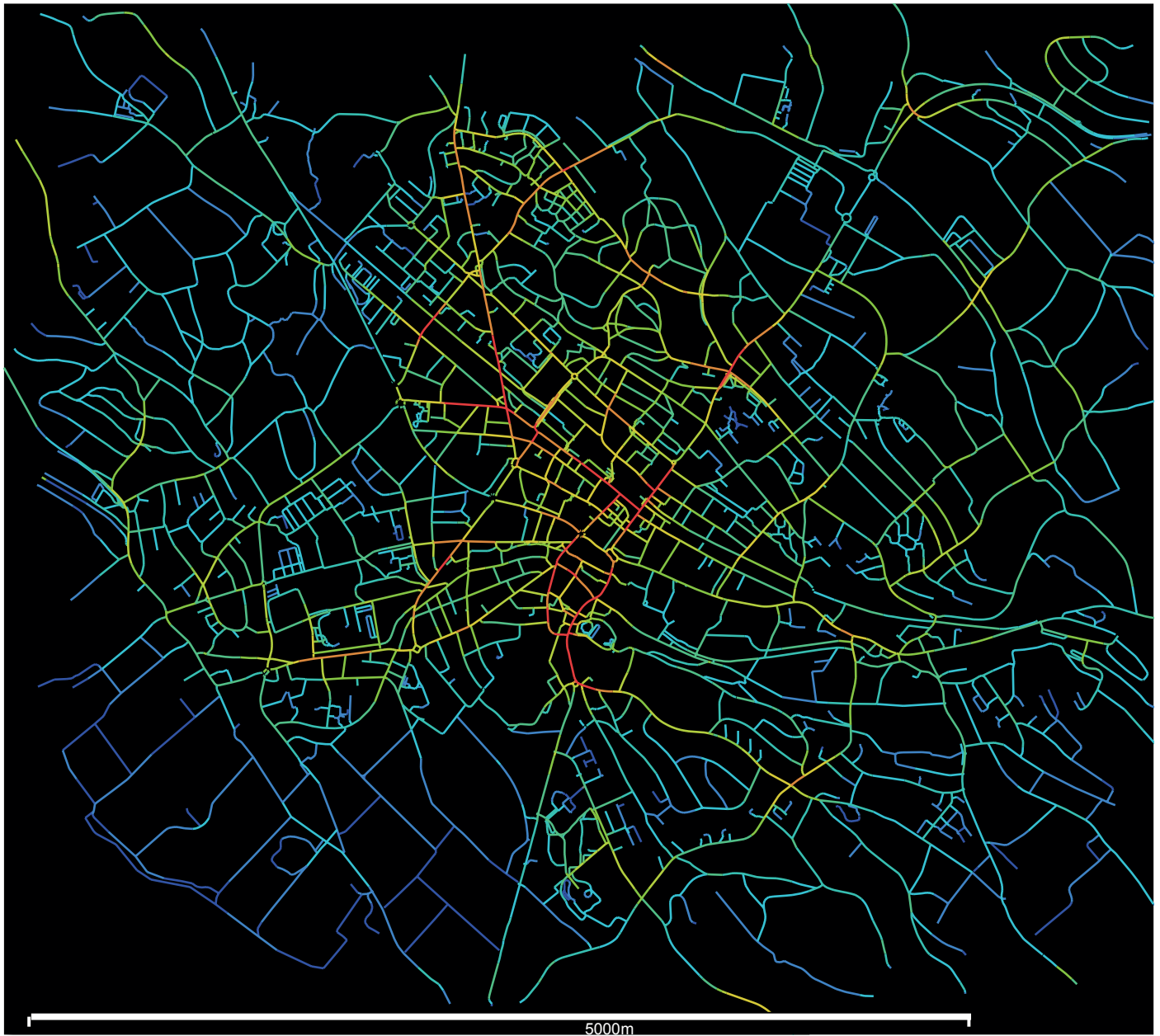
## Integration

The Integration map shows that the integrated streets are well distributed. The streets which are integrated best are located around the centre, they have the highest to-movement potential. The streets with a high choice value do also have a high integration value



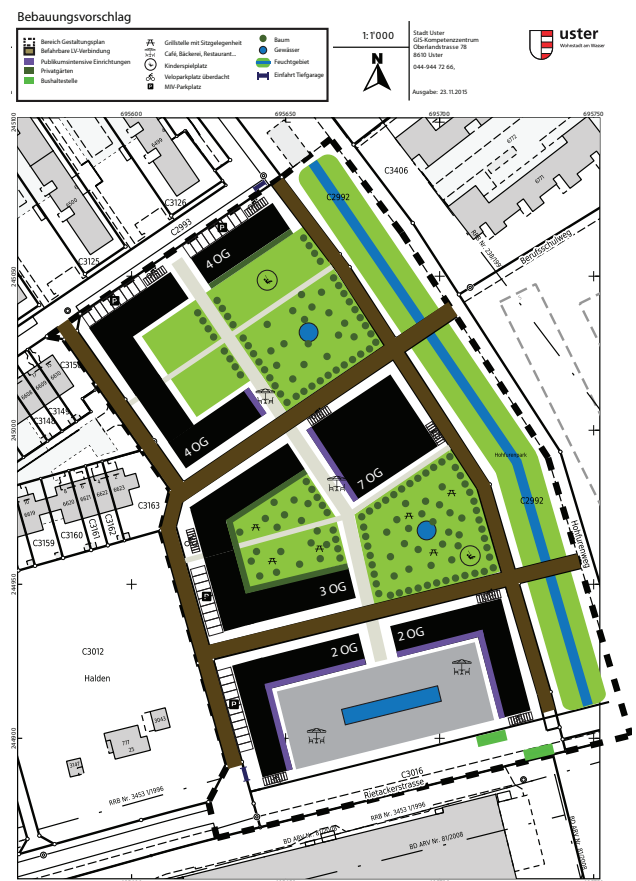
Choice, Radius 500m





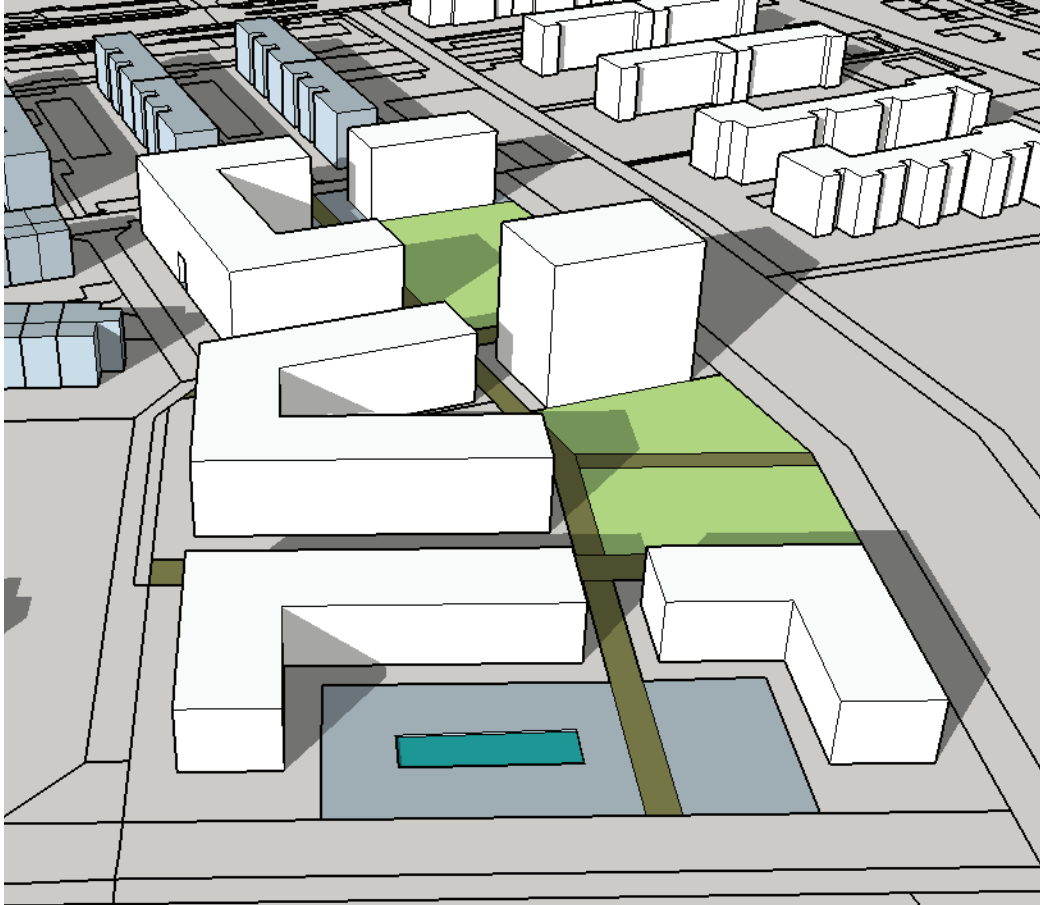
Integration, Radius 500m





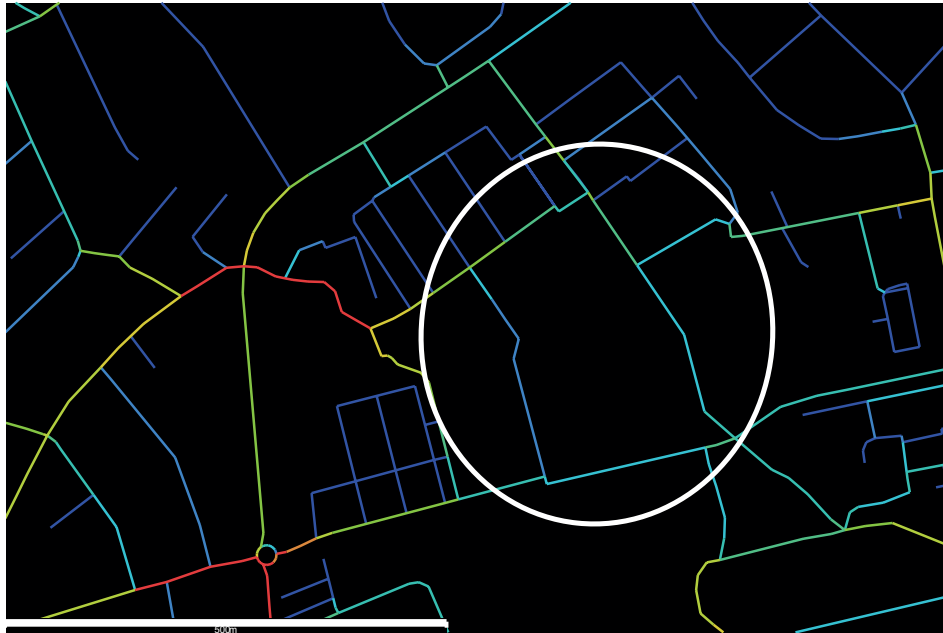
## Development of a new neighbourhood centre

To develop a new neighbourhood centre first a location had to be found. The decision was based on the fact that the municipality still owns undeveloped land in the southwest of Uster. The analysis of the street network played a minor role.



To obtain a high quality development of the site first layout plan with regulations for the future development was established. From the layout plan a design proposal which shows the building volumes, public and private spaces was derived. In the last step the proposal was visualized.

On the next pages this newly developed area is analyzed.



Choice 500m, existing street network



Choice 500m, with streets of new neighborhood center

#### Analysis 2 (Angular Segment Analysis, Choice, radius: 500m):

The aim of the analysis was to find out whether the new streets of the neighbourhood centre would have an impact on the surrounding streets within walking distance. To do so the situation with and without new streets was compared using the same color range. The analysis of the choice parameter shows two streets (orange circles) with significant higher values. Therefore these streets would have a higher through movement.

Looking at the street network inside of the new centre reveals that there is one main street with a significant higher through movement potential for pedestrians than on the others (white circle).



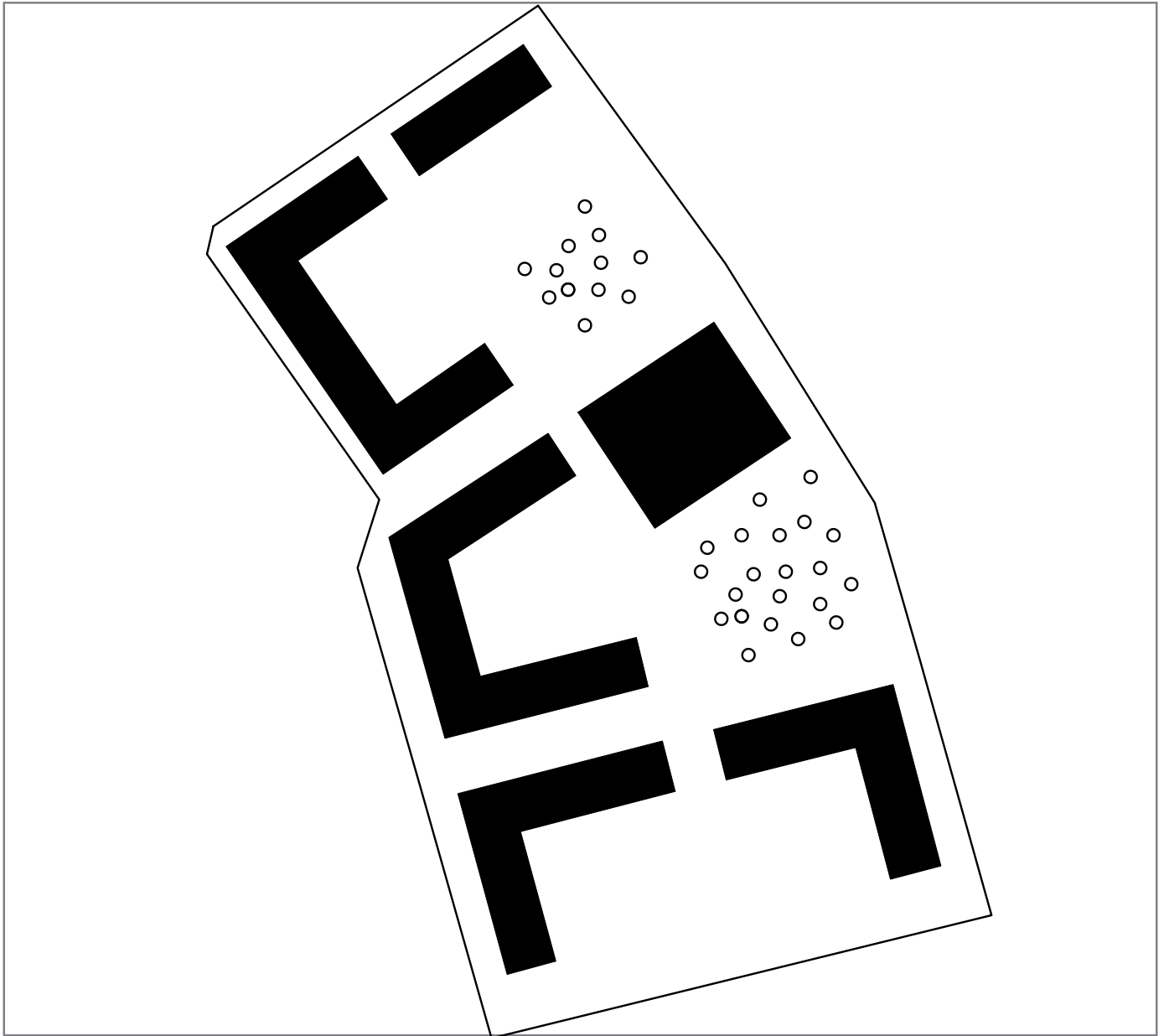
Integration 500m, existing street network



Integration 500m, existing street network

#### Analysis 2 (Angular Segment Analysis, Integration):

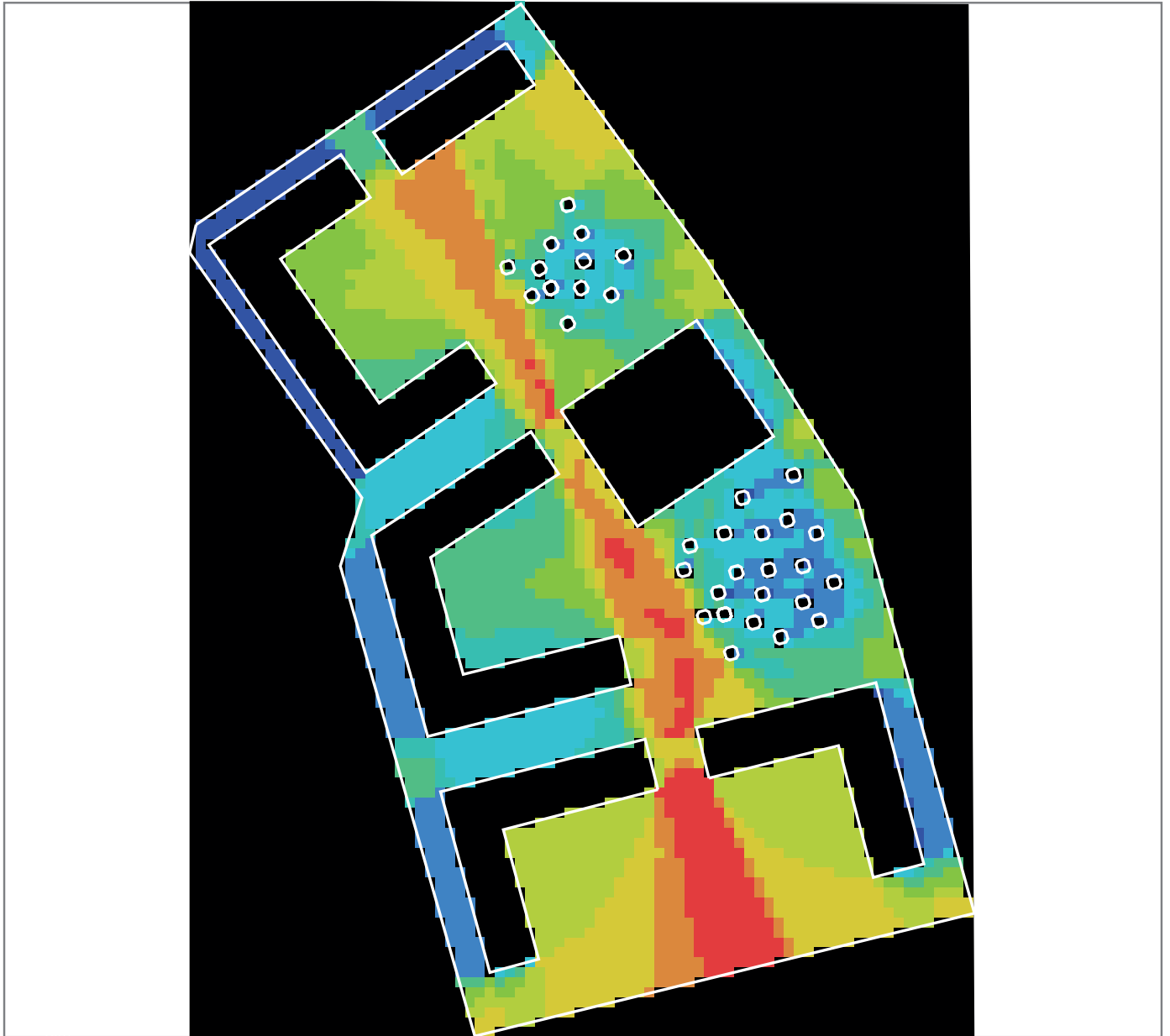
The analysis of the integration values show that many surrounding streets get higher values. The result can be interpreted in that way that the added streets lead to a denser street network for pedestrians in this neighbourhood and is therefore more attractive for them.



### Analysis 3 Isovist analysis

In this analysis the isovist area of the new neighbourhood centre was looked at. The objects which block the view are mainly the buildings and the trees in the parks. The aim of this analysis is to see where the spots are located which can be seen from most other places.





The resulting image shows that the places which can be seen best are located on the central pedestrian street. As the street provides a view through the whole area it is attractive to walk on and will probably be used a lot by pedestrians.

The trees in the park lead to many small hidden places inside of the park, which is positive because the park should be a place for recreation and retreat.

The low values at the border of the area would probably not be that low in reality because the border is not a view obstacle.



Ustertag on 22. November 1830

Conclusion:

### Angular Segment Analysis

The Segment Analysis shows first answers for the question of finding a location for a new neighbourhood centre or a new pedestrian zone without cars. Well integrated streets with high through movement potential are living streets with many pedestrians where shops, cafés and restaurants should be placed and where a new neighbourhood centre could be well visited.

In reality the decision where to place a new neighbourhood centre is much more complex. A big undeveloped location is needed whose property owner is the municipality, the connection to the public transport should be already existing and so on. These aspects are not considered in the analysis of the street network.

Another aspect that is left out by the analysis is the land use and the existing density. A well integrated central street can have a low pedestrian density if its neighbourhood consists of one-family houses.

### Isovist Analysis

The isovist analysis of the area for a new neighbourhood centre highlights an important aspect when designing a new area with lots of public spaces: open areas which can be seen from many other places are attractive for pedestrians and are therefore more crowded. On the other hand quiet places which are hidden can be attractive too when one is looking for recreation. As a result the area should be designed in that way that quiet and crowded areas can coexist.

Aspects that are not considered by the analysis (yet) are objects which can be seen through. Also the terrain does not influence the results.

