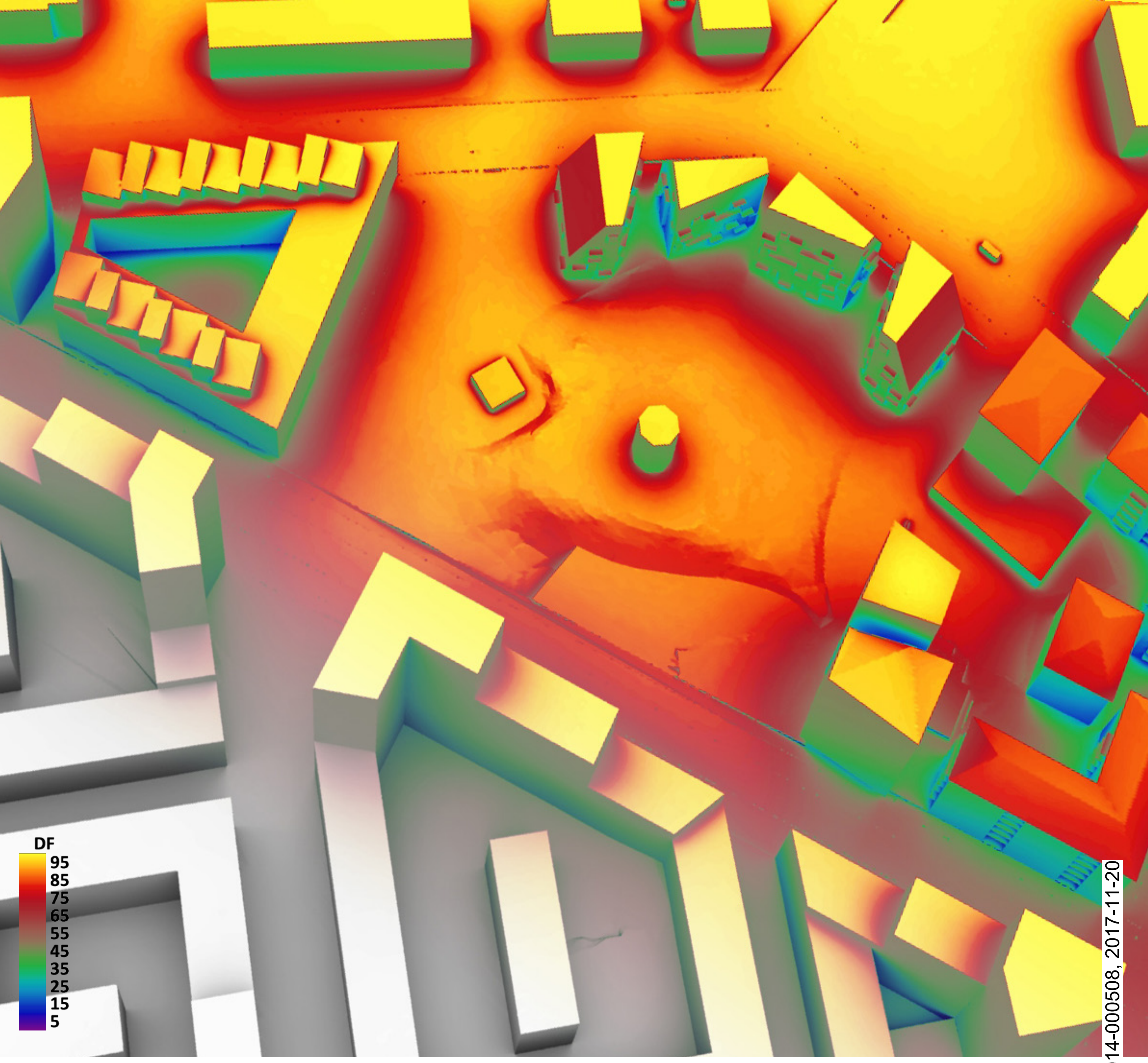


Dagsljus- och solanalys Dp1a Lyrikparken

2017.11.20

Sammanfattning av studie 171023

SWECO

Dp1a 185 dagsljusanalys sammanfattning

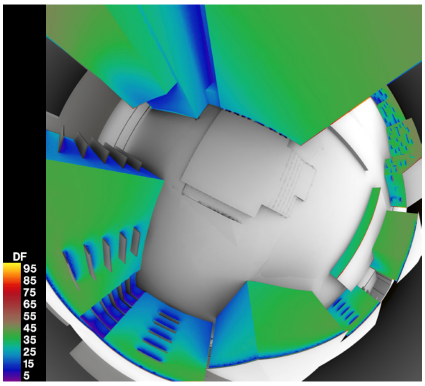
Fasader

Dagsljusfaktor har analyserats för fasad för att finna lämplig storlek för fönster på fasad för att uppnå minst dagsljusfaktorn 1% inne i rummen. Sammanfattat så innebär det att desto mindre dagsljus på fasad desto större yta fönster behövs för att uppfylla kraven (Window to Wall ratio).

Efter beräkningar av hur mycket dagsljus som faller på fasaden kan vi utifrån ett referensrum beräkna ”Window to Wall ratio”, dvs hur svårt eller lätt det blir att uppfylla dagsljusfaktorn i ett rum med en viss mängd fönsterarea. Resultatet presenteras i modellbilder med färgskala där de mörkare färgerna visar på större problem att nå en bra dagsljusfaktor.

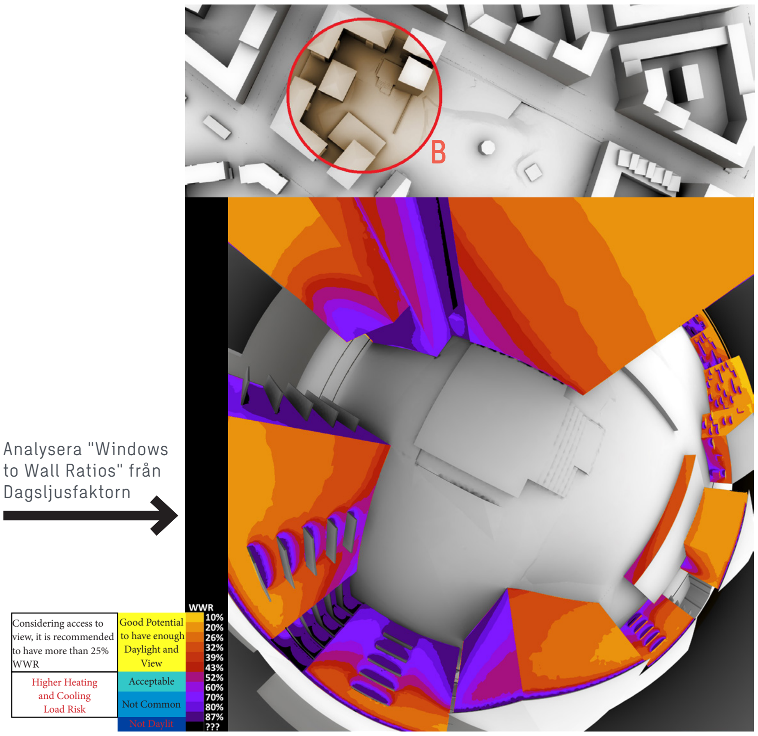
För Dp1a så visar analyserna att de inre gårdarna har svårare på de nedre planen att nå dessa nivåer av dagsljus. I det södra kvarteret uppstår problemen där fasaderna ligger nära varandra och det dessutom finns högra byggnader. Balkonger kan även hindra att rätt mängd dagsljus når in i lägenheterna.

De fyra punkthusen klarar sig bra ut mot gatan och park men kan få problem med fasaderna som ligger i släppen mellan husen då avstånden mellan husen är små.

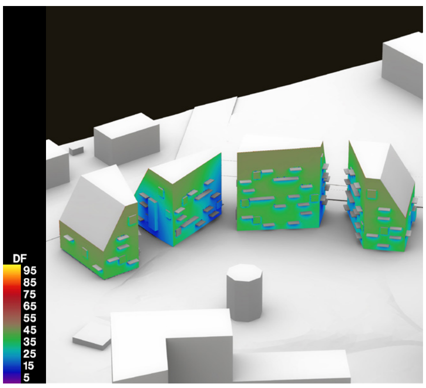


Dagsljusfaktor

Analysera "Windows to Wall Ratios" från Dagsljusfaktorn

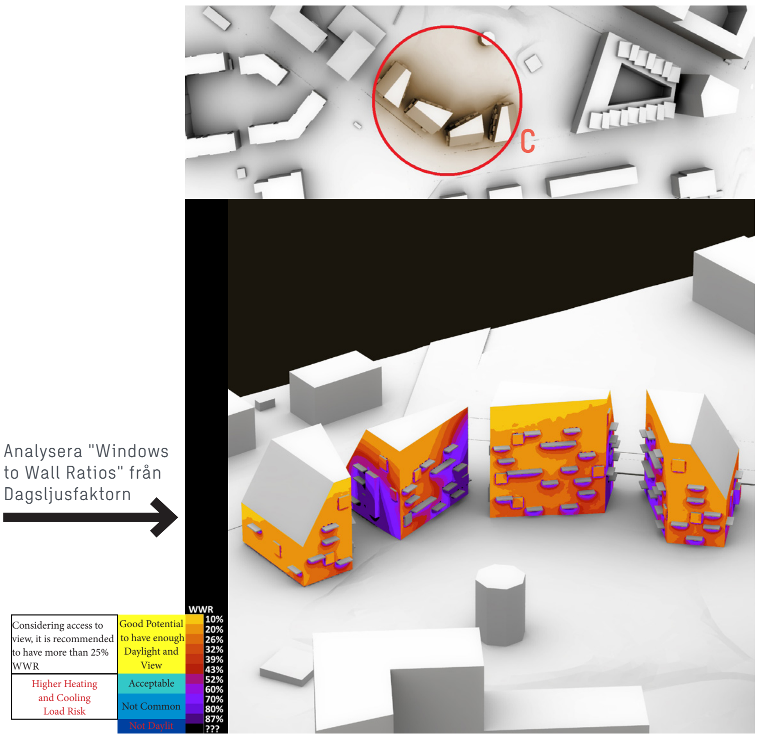


Window to Wall Ratios



Dagsljusfaktor

Analysera "Windows to Wall Ratios" från Dagsljusfaktorn

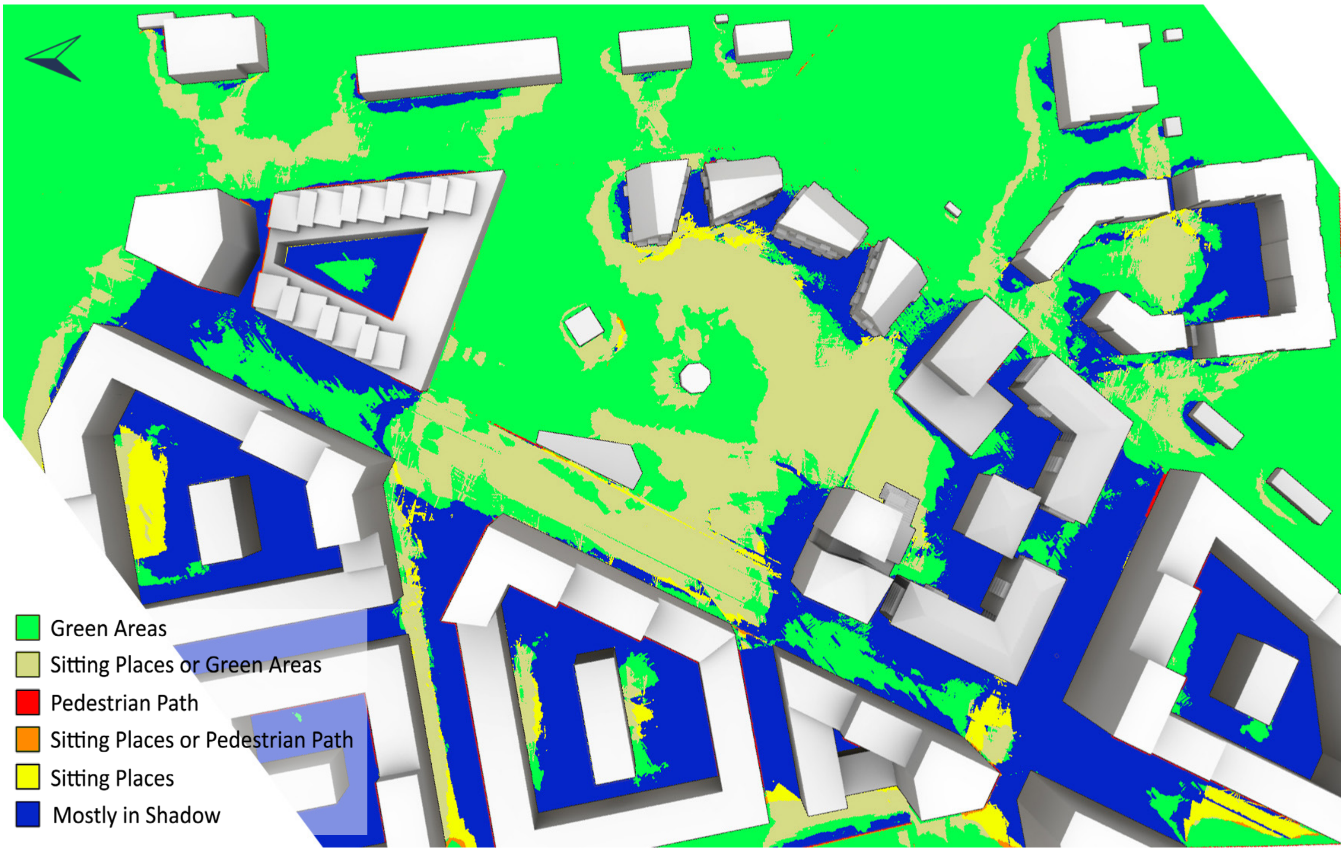


Window to Wall Ratios

Uterum

Utifrån årliga soltimmar så har det analyserats vilka ytor som får tillräckligt med ljus för vissa aktiviteter, tex lekplats, sittplats, gångvägar, planteringar etc. Analyserna kan även användas för att placera solceller. För en fullständig analys av vilka platser som lämpar sig bäst för vistelse bör även en vindanalys utföras.

För Dp1a så har vi genom parkrummet stor tillgång till yta för vistelse samt planteringar av växter. Gårdarna kan få problem att uppfylla tillräcklig tillgång till dagsljus för att vara lämpliga för planteringar och vistelse. Ytan avsedd för förskolan klarar sig dock bra med tillräckligt dagsljus på gården. Gatan i södra delan av området befinner sig mestadels i skugga vilket medför problem för bekväm vistelse i detta rum.



Åtgärder för mer dagsljus i befintlig stadsstruktur:

- Reflekterande fasadmaterial kan förbättra dagsljuset inne i lägenheterna samt uterummen.
- Inne i lägenheten kan ljusare färger förbättra dasgljuset.
- Ljusare fasadmaterial kan förbättra dagsljuset ytterligare, speciellt på de ytor som befinner sig mer i skugga. Mörk fasadfärg kan innebära lika mycket förlust i dagsljus som två våningar högre hus.
- Om man kan använda ljusare material i fasad och mark så kan man acceptera en mindre solbelyst yta
- Större fönsterstorlek
- Minska antal balkonger och deras storlek
- Undvika balkonger över fönster på överliggande våning.

Kvalitetsaspekter för utomhusrum:

Det finns inga låsta siffror för komfort relaterat till dagsljus men man kan rekommendera att en yta ska få solbelysning under 50% av årstimmarna vid molnfri himmel.

Man kan vidare argumentera att denna siffra ska var 30% eller 40%. Dock finns det rekommendationer som IES och LEED för rum inomhus som talar om att en yta ska anses dagsljusbelyst så ska den ha tillräckligt med dagsljus för hälften av den vanliga användningstiden. Man kan därifrån argumentera och rekommendera siffran 50% av alla soliga timmar på ett år för att ytan ska anses dagsljusbelyst eller inte.

Lyrikparken Ulleråker

Daylight and Sun Study

Shadow Range Analysis from sunrise to sunset on 21st of June

Daylight Facts

Quality:

- Continuous spectral power distribution and excellent colour rendering
- Variation (CCT and intensity) through the day and seasons
- High light levels available, ...

Health:

- Circadian regulation, adjusting our body clock
- Human wellbeing, increased alertness, productivity and visual performance
- Importance of view and contact with outside world
    - Knowledge of weather and time of day
    - Relief from feelings of monotony or boredom
    - A change of visual focus
    - Satisfaction (home/job) and decreased intention to quit, ...

Energy:

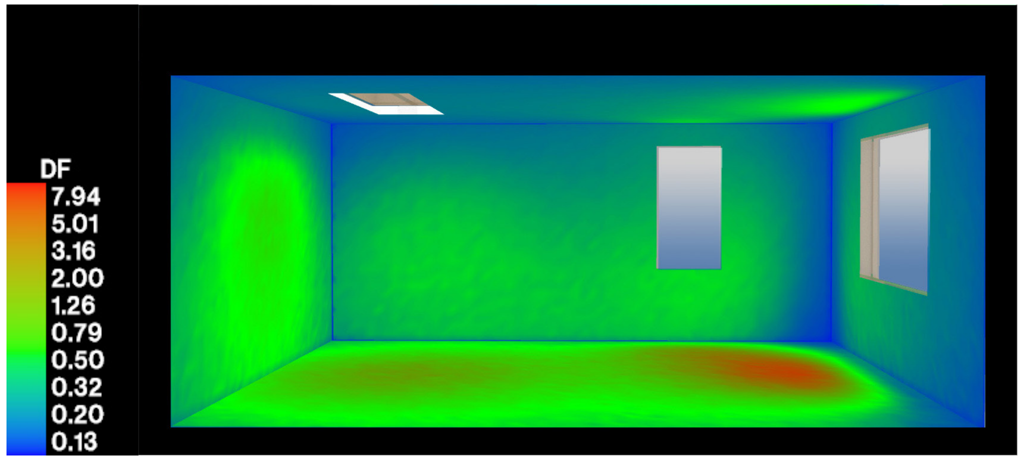
- Daylight is a free source of energy
- Daylight is wireless
- Well-planned daylighting can significantly reduce energy consumption in electric lighting in a building...

Daylight Analysis Metrics

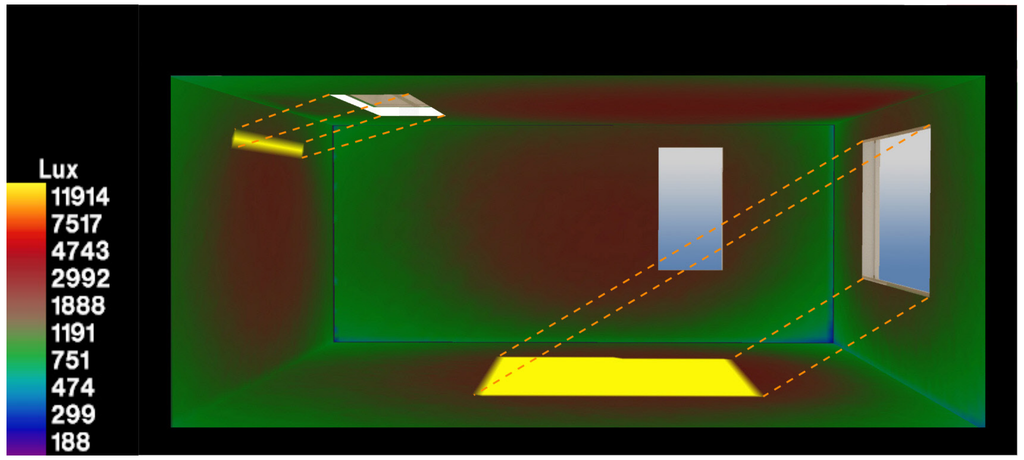
Here in this project, we did three types of daylight analyses. Each one was done for a specific need. In the following we discuss them shortly.

The first is **Daylight Factor** calculation and it was done in order to find the appropriate **W**indow to **W**all **R**atio (WWR) for each specific part of façade. However here it is worth to say that since Daylight Factor is a metric that is only consider a CIE standard Cloudy sky, it is independent from orientation and location. So when measuring Daylight Factor, for the same building and surrounding configuration, the values are the same even if we change the city from Stockholm to Los Angeles (see the below images), or if we rotate the building 90° or 180° (e.x change the main facade orientation from south to east, west or north).

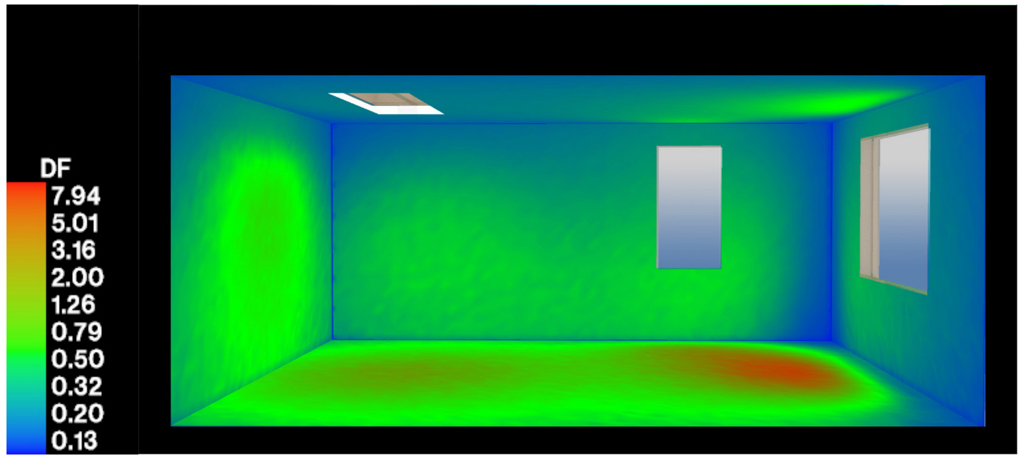
However, we made our Window to Wall Ratio (WWR) suggestions based on Daylight Factor analysis, because in BBR, under BFS2016-6-BBR-23, in 6:322 Dagsljus, it asked to do Daylight Factor calculation to do daylight assessment for interior spaces. Thus, to be able to check if we can fulfil the BBR or not, we should follow BBR recommendation. Moreover, our WWR analysis is based on defining a quite deep room (a room with 8m depth; take a look at pages 7-8) in the back of building facade. Therefore it is a kind of worst case scenario , so it can infer that if we follow this WWR recommendation (pages 10-20), we probably fulfil BBR in most of the cases when interior lay-out and rooms are designed.



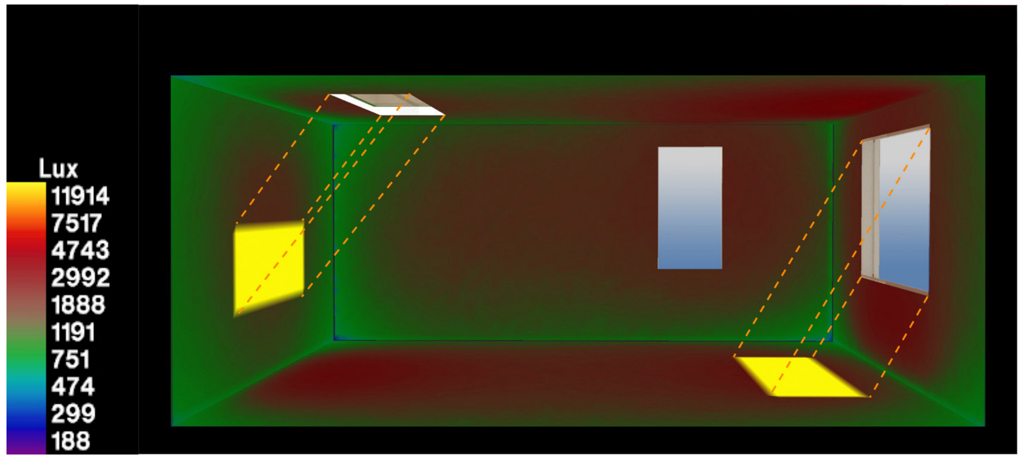
Daylight Factor analysis for Stockholm, Sweden



Illuminance analysis on 21st of March at 12:00 for Stockholm, Sweden

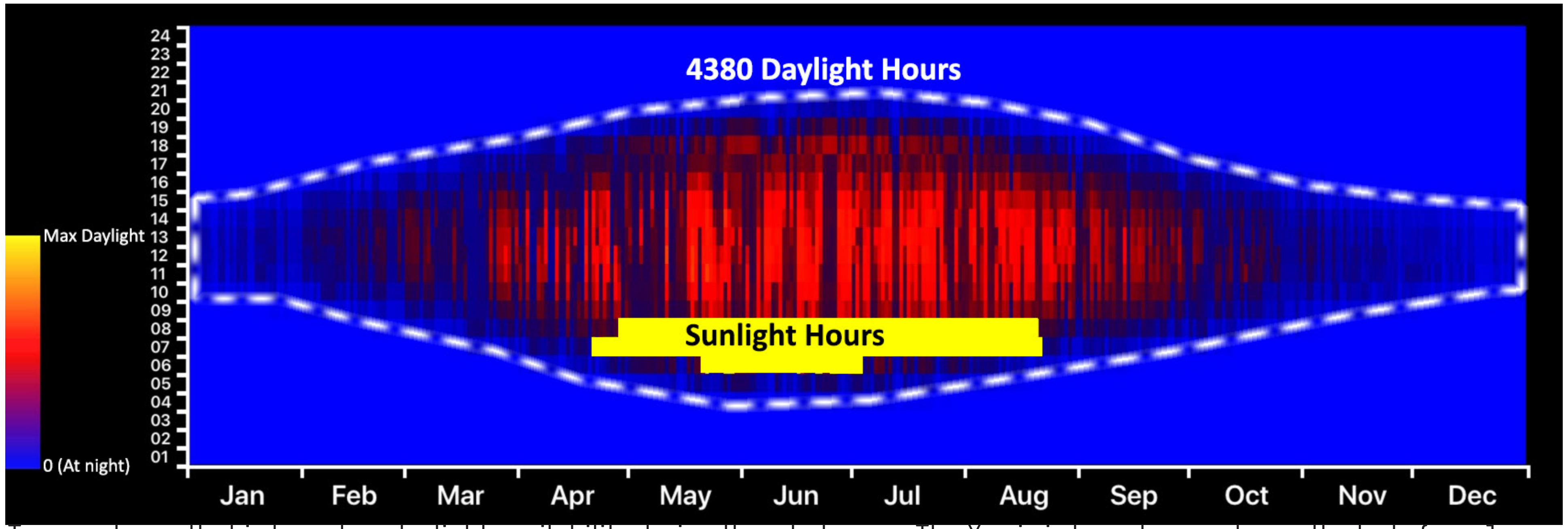


Daylight Factor analysis for Los Angeles, USA



Illuminance analysis on 21st of March at 12:00 for Los Angeles, USA

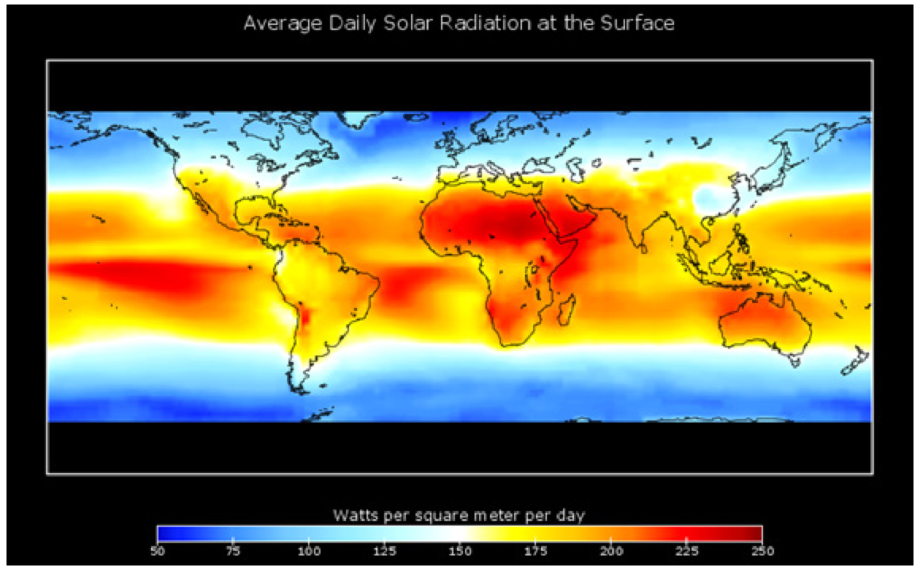
The second is **Sunlight Hours** analysis. Here we did 2 types of sunlight Hours analysis. The first type (sse the page 21) is based on considering the whole year sunny and check how many hours in a year (in comparison with 4380 daytime hours in a normal year) each point in the space can face direct sunlight. We did this analysis when we want to define where is the appropriate places for streets, parking lots, bicycle path, etc.



Temporal map that is based on daylight availability during the whole year. The X axis is based on each month starts from January until December. However Y axis is a 24 daily hours from midnight to midnight. The above image is a map for Stockholm. The yellowish part shows which part of year (from 4380 daylight hours) the selected point in the space can face direct sunlight

However the other type (see the page 22) that we used here is doing Sunlight Hours study only for the time of a year that we feel comfortable temperature when we are outside. Such analysis based on UTCI calculation formula and it is based on the weather data from Arlanda airport weather station. Such weather data represents the prevailing conditions of the place and is created based on on-site measurement over a period of years.This analysis can help us to find where is the best place to sit, play or walk during those time of year that we enjoy to be outside.

The third and last analysis (see the page 23) that we did here is the **Solar Radiation** analysis that is based on how much solar radiation is falling on a surface. The same as UTCI based Sunlight Hours study, this analysis is also based on weather data that is exctracted from Arlanda station. Here in this project, we used this type of analysis to define the suitable green areas. Therefore, we used the whole year Solar Radiation to check where is the best place to grow trees, bushes or vegetables.



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Daylight Factor:

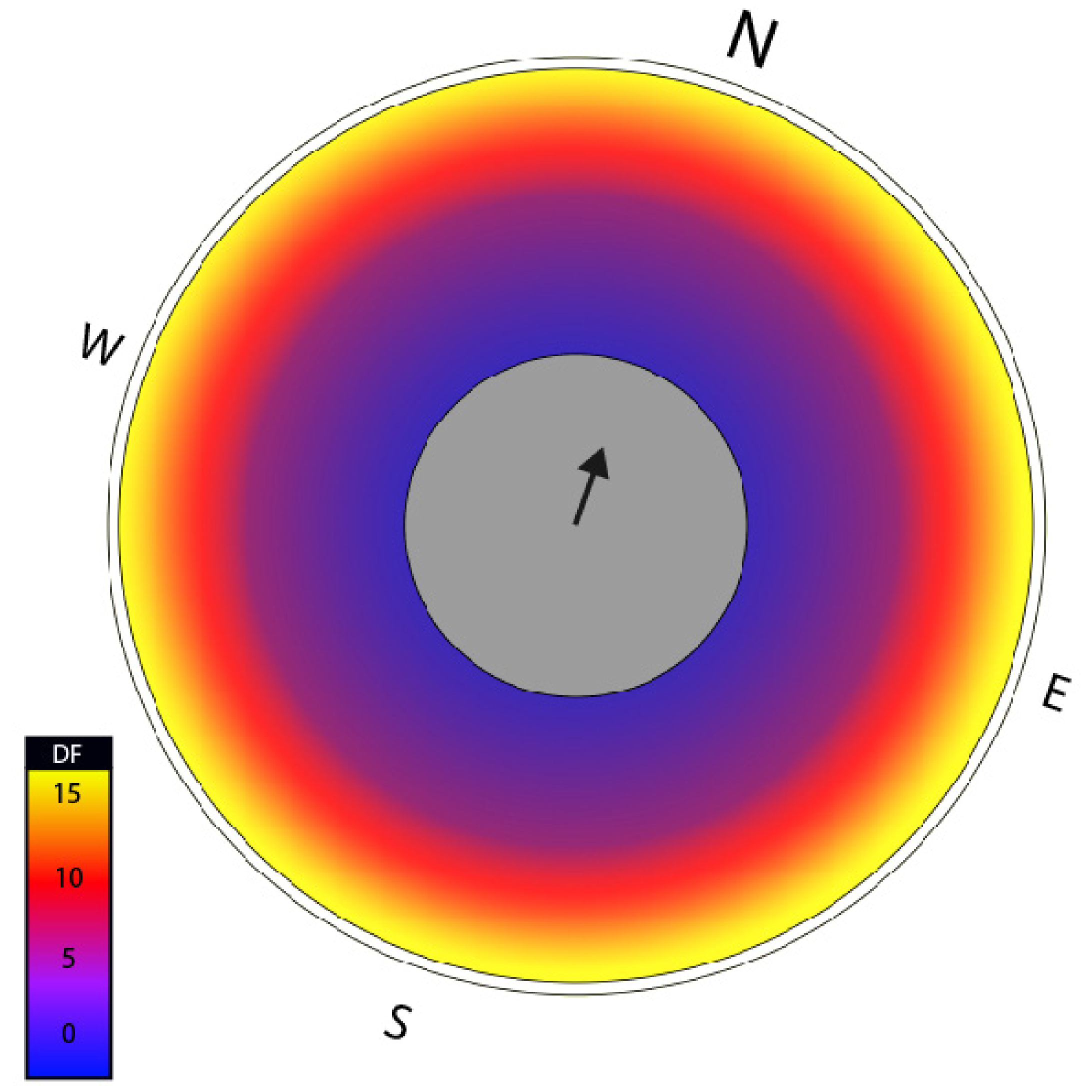
The Daylight Factor (DF), as used for the evaluation of daylight in BBR, is defined as the ratio of the illuminance at a work-plane height at a certain point within the building, to the simultaneous unobstructed outdoor illuminance under the same sky conditions, measured on a horizontal surface. The DF is expressed as a percentage.

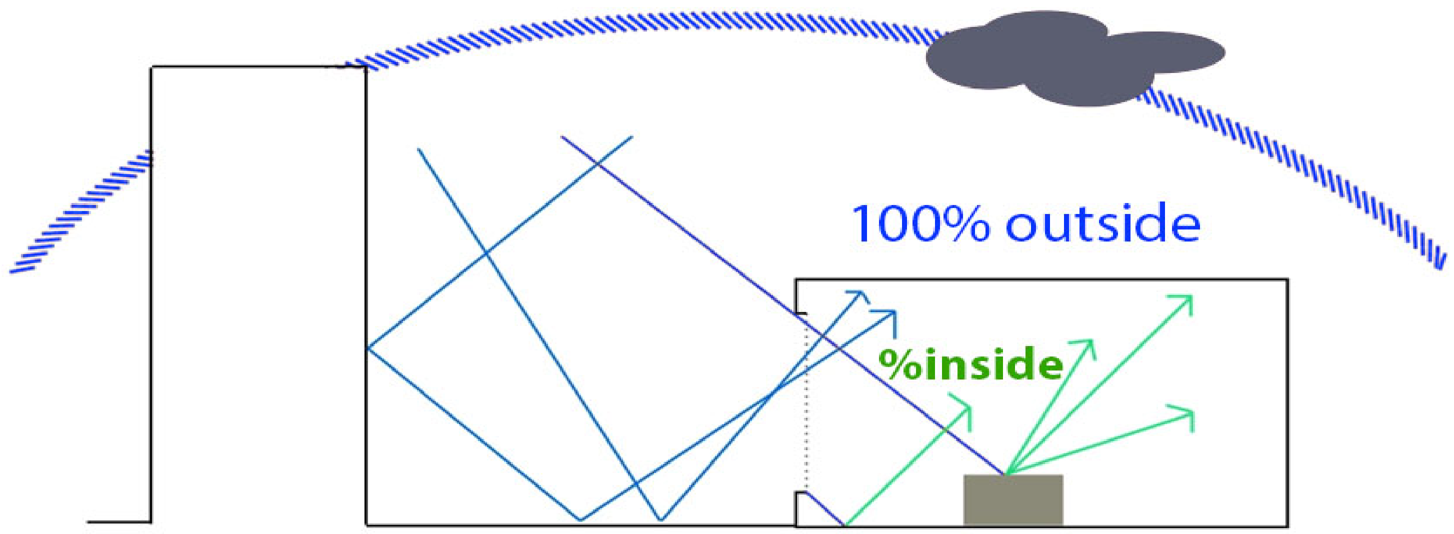
The DF is defined as:

$DF = (E_i / E_o) \times 100\ \%$

E_i = Illuminance due to daylight at a point on the indoor's working plane

E_o = Outdoor illuminance on a horizontal plane from an unobstructed overcast sky





BFS2016-6-BBR-23

6:322* Dagsljus

Rum eller avskiljbara delar av rum där människor vistas mer än tillfälligt ska utformas och orienteras så att god tillgång till direkt dagsljus är möjlig, om detta inte är orimligt med hänsyn till rummets avsedda användning.

I gemensamma utrymmen enligt avsnitt 3:227 räcker det dock med tillgång till indirekt dagsljus.

*** Senaste lydelse BFS 2014:3**

Allmänt råd

För beräkning av fönsterglasarean kan en förenklad metod enligt SS 91 42 01 användas. Metoden gäller för rumsstorlekar, fönsterglas, fönstermått, fönsterplacering och avskärmningsvinklar enligt standarden. Då bör ett schablonvärde för rummets fönsterglasarea vara minst 10 % av golvarean. Det innebär en dagsljusfaktor på cirka 1% om standardens förutsättningar är uppfyllda. För rum med andra förutsättningar än de som anges i standarden kan fönsterglasarean beräknas för dagsljusfaktorn 1,0 % enligt standardens bilaga.

Kriterier för sunda byggnader och material

Ljus och belysning

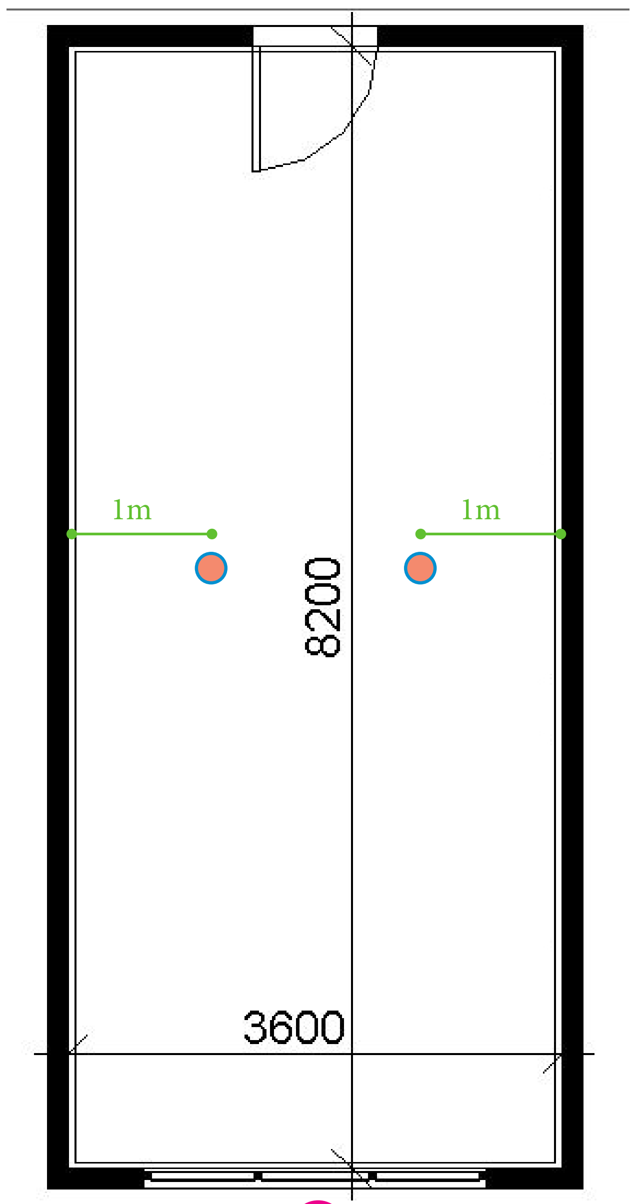
Olika mätmetoder

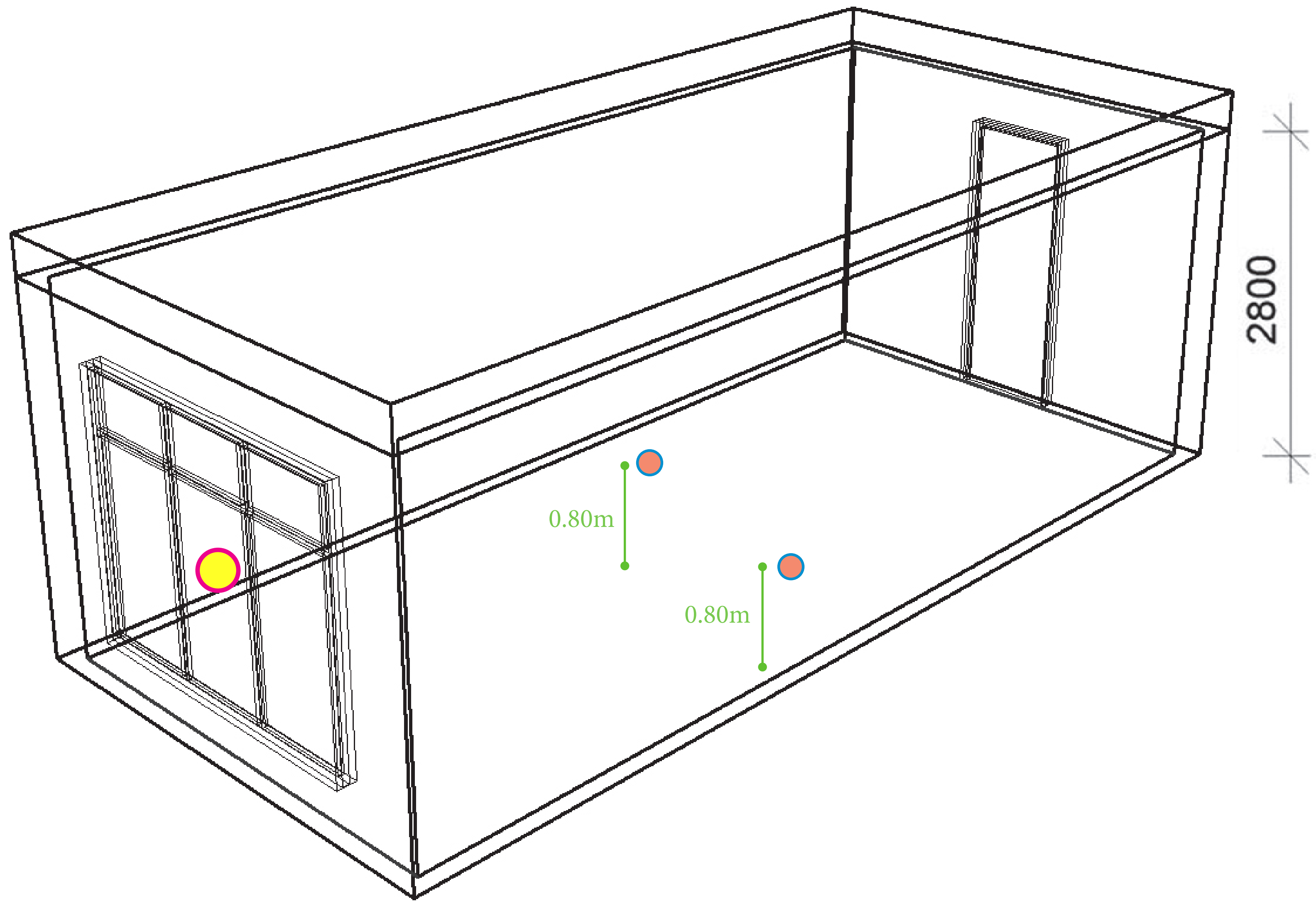
”Dagsljusfaktorn är ett mått på hur mycket av dagsljuset som släpps in i ett rum. Mätning av belysningsstyrka görs mitt i rummet på 0,85 m höjd mitt framför respektive fönster. Dagsfaktorn fås genom division av uppmätt värde med motsvarande oskuggade utomhusvärde. Mätning utförs i mulet väder för god repeterbarhet. Direkt solinfall bör begränsas med inre eller yttre solavskärmning så att luminanskraven fortfarande uppfylls vad avser det normala synfältet.”

Reference Room*

To be able to estimate how much daylight factor each façade should receive to reach the BBR recommendation, we did the daylight factor calculations for a reference room with 10% to 87% window to wall ratio (WWR).

*** C F Reinhart J A Jakubiec and D Ibarra, 2013**





Daylight Factor on the facade

SWECO

Reference Room*

To arrive 1% Daylight factor on the representing point (based on BBR) of that standard office room, the amount of daylight factor that we need on the façade (depending of WWR ratios) are as follows. Here it is just worth to say that since the depth of rooms are usually less than 8m, these values are kind of worst case scenario, so if we fol-low this recommendation, final results should be slightly better.

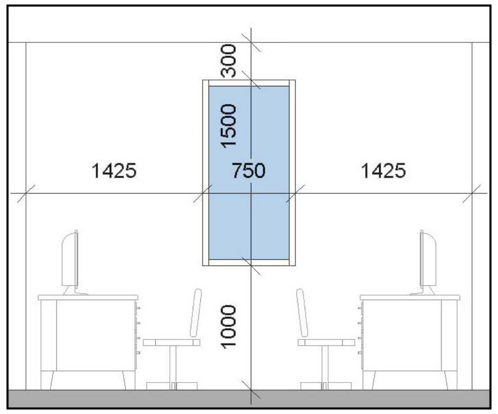
WWR	DF on Facade
10	57,71
20	46,17
26	40,14
32	37,43
39	32,59
43	32,21
52	29,78
60	26,89
70	25,65
80	20,67
87	19,37

Table 1

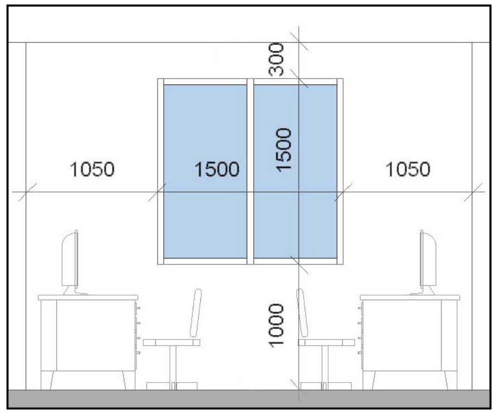
Materials of the reference room:

Walls reflection = 60%
Floors reflection = 30%
Ceilings reflection = 80%

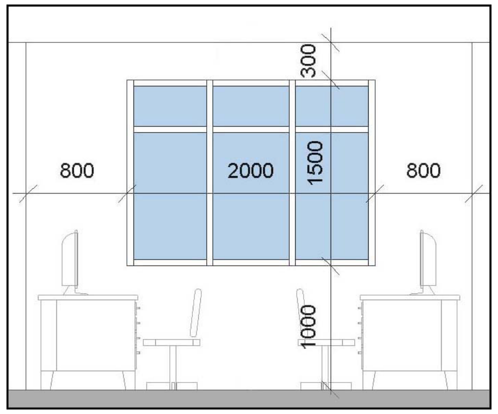
Window glass Transmission = 70%



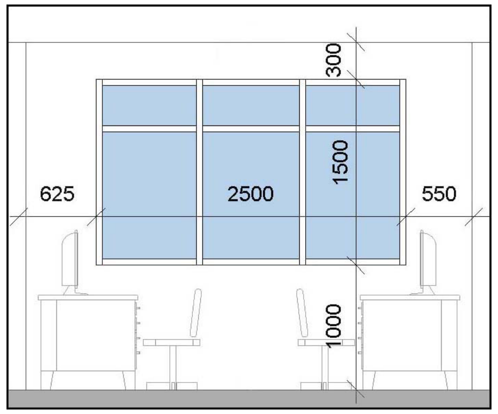
WWR = 10%



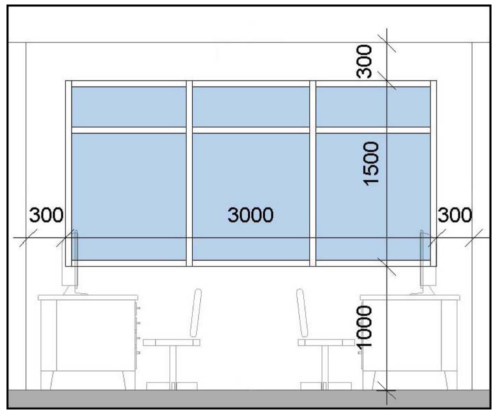
WWR = 20%



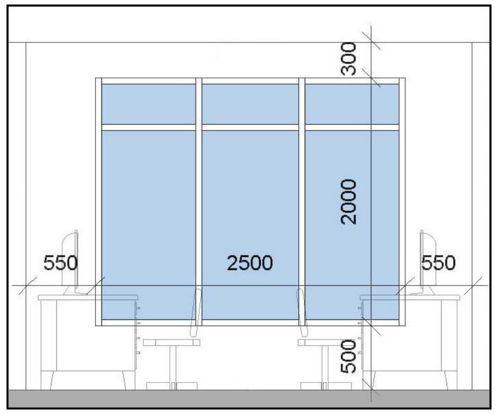
WWR = 26%



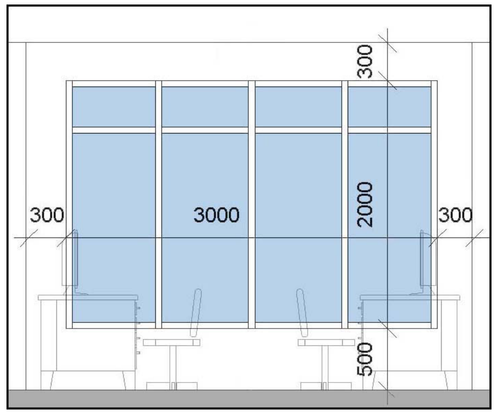
WWR = 32%



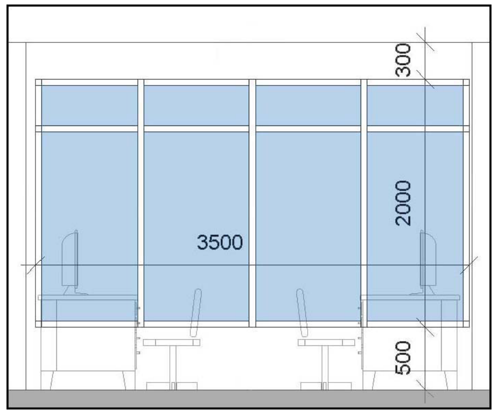
WWR = 39%



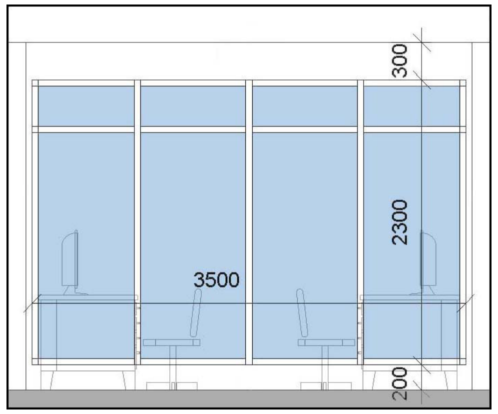
WWR = 43%



WWR = 52%

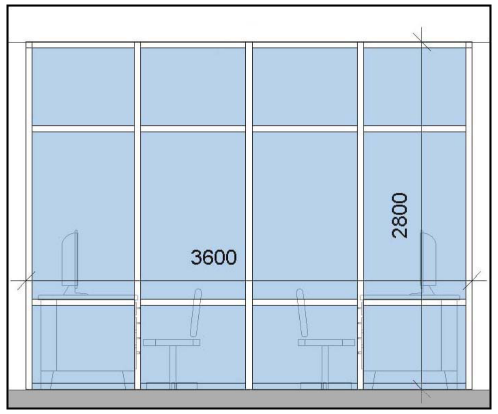


WWR = 60%



WWR = 70%

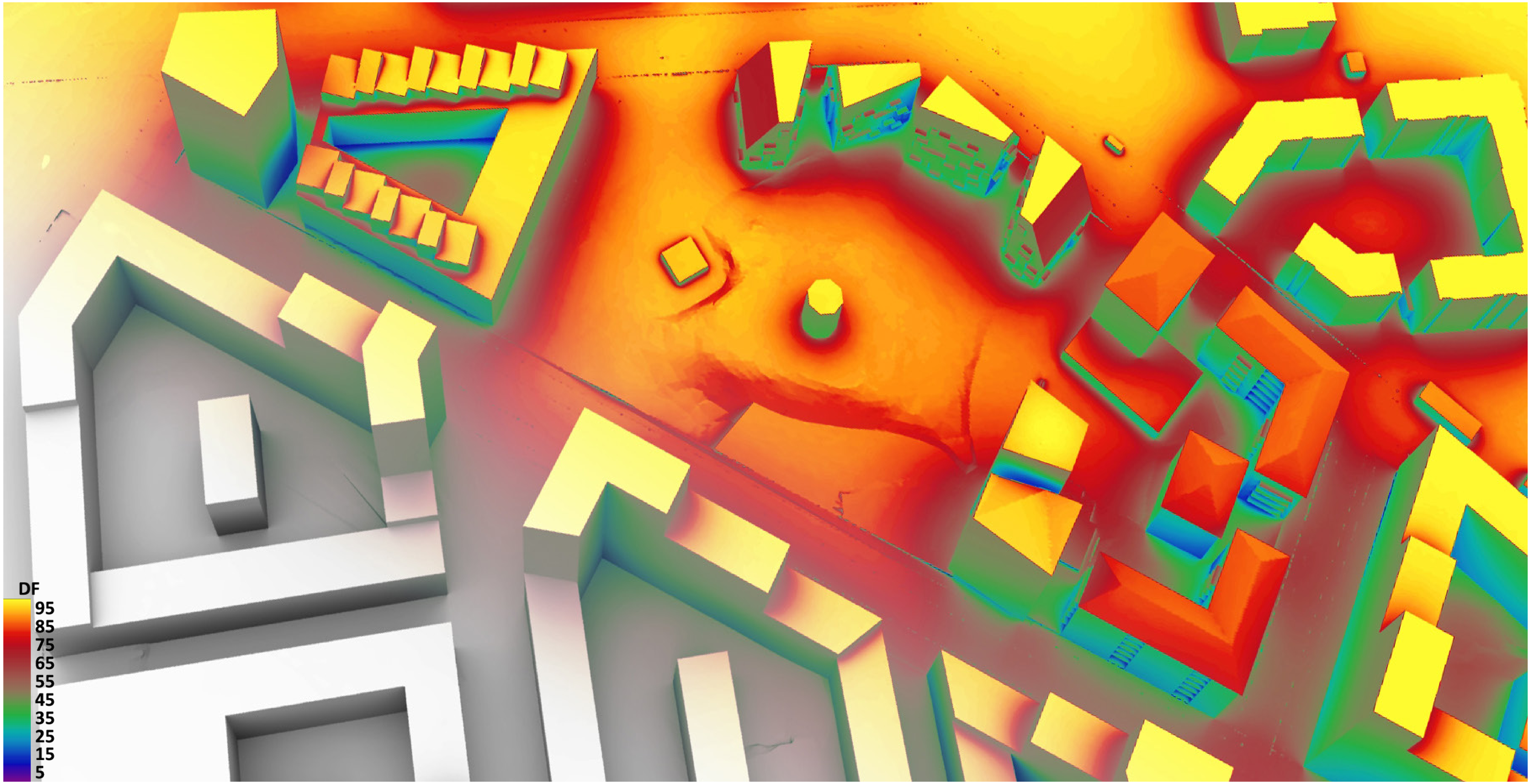
WWR = 80%



WWR = 87%

Calculations on Facades

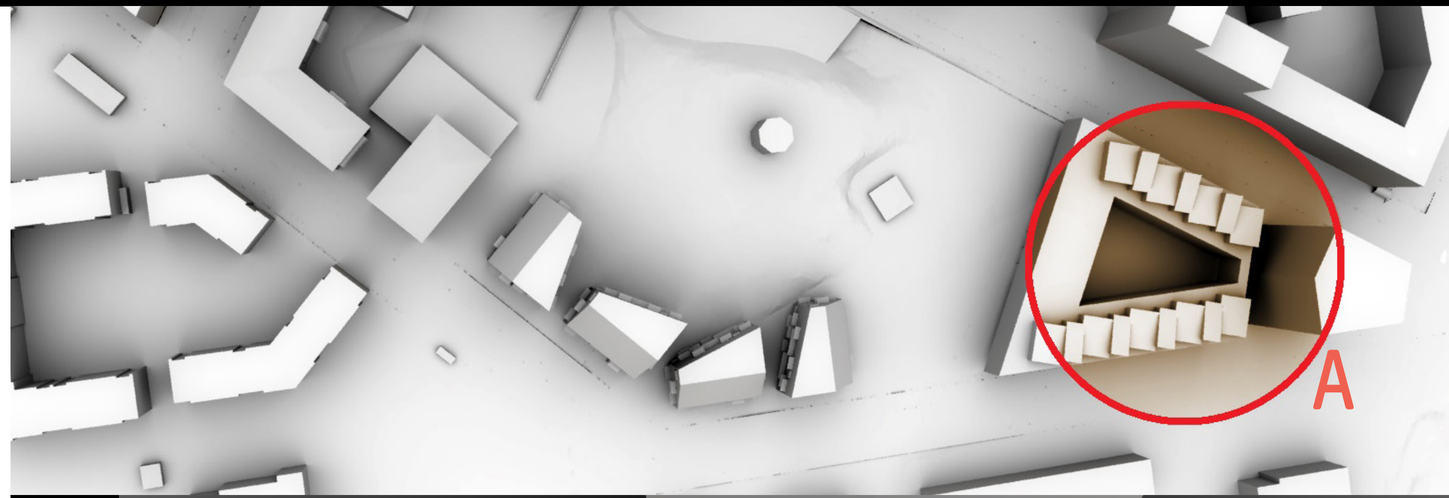
By doing the Daylight Factor calculation on building facades, we can find out the building blocks that have the most critical daylight access conditions (regarding the cloudy skies on which Daylight Factor is based).

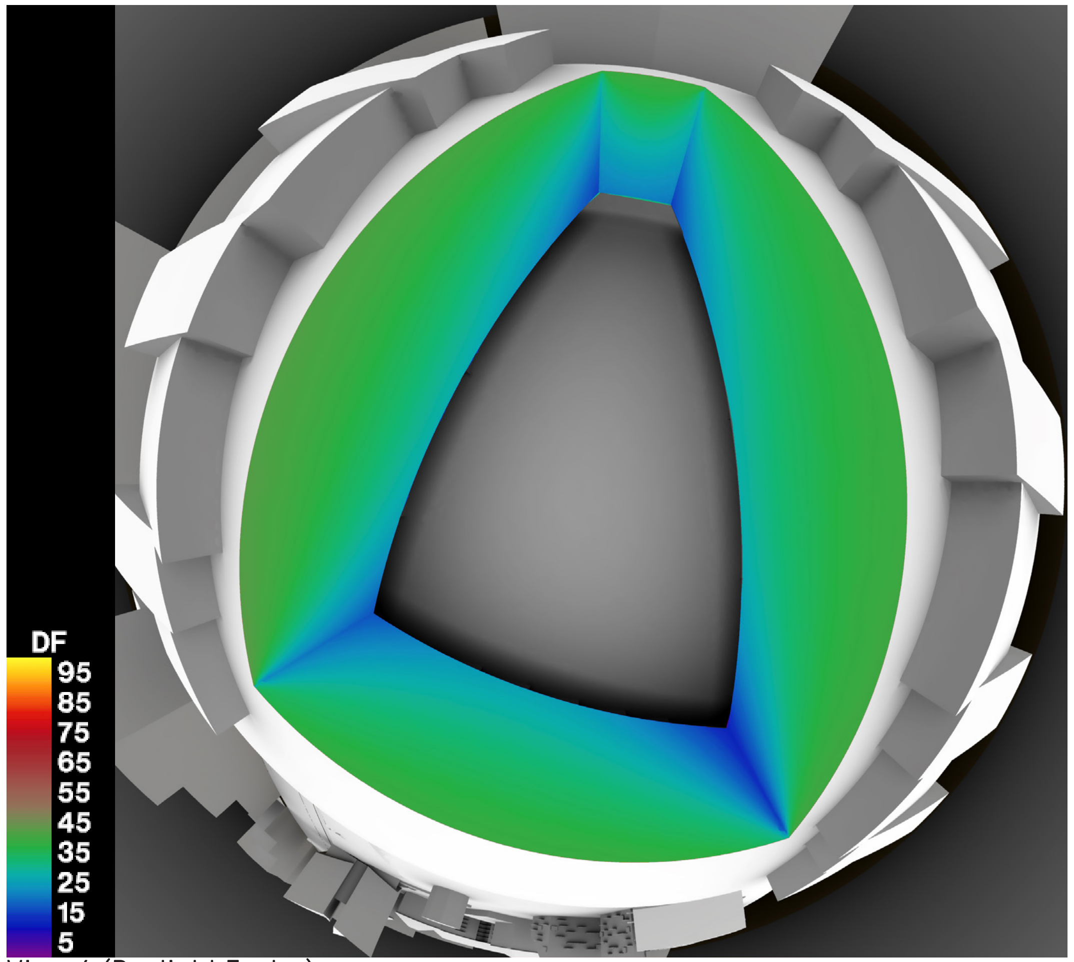


SWECO

Calculations on Facades

Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).

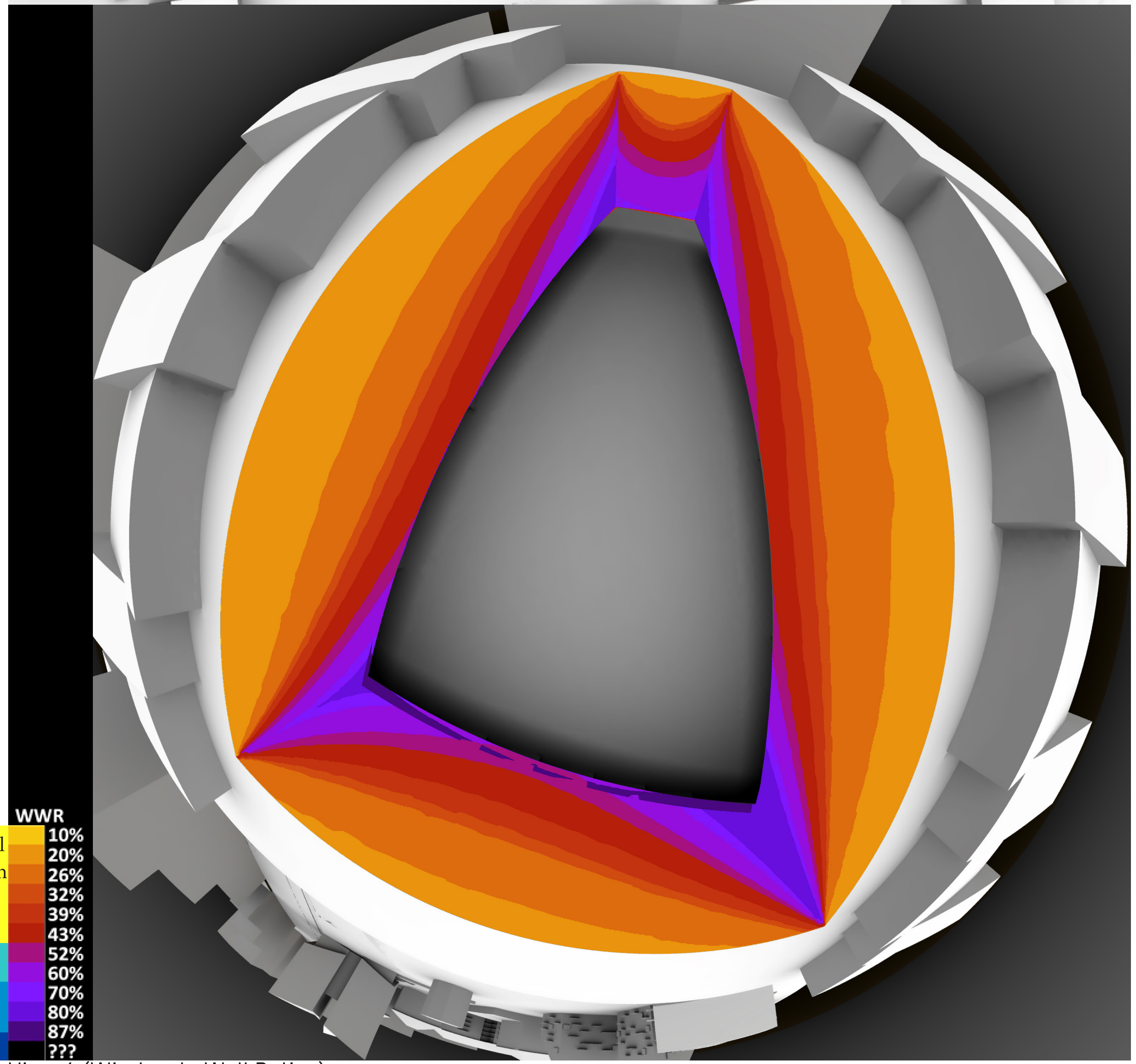




View 6 (Daylight Factor)

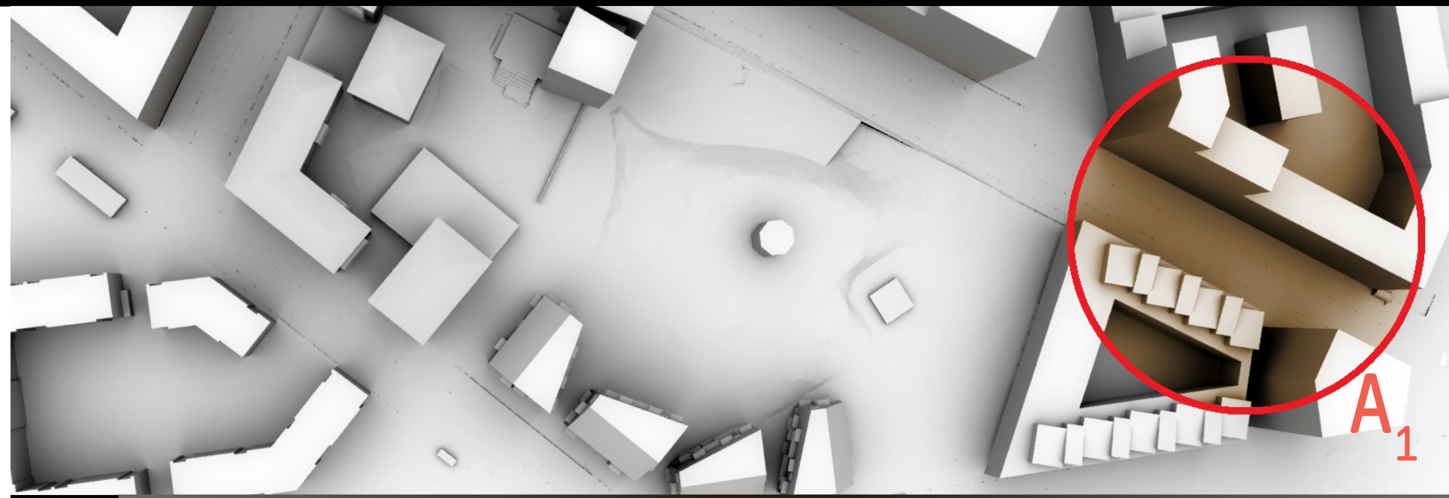
Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable Not Common Not Daylit



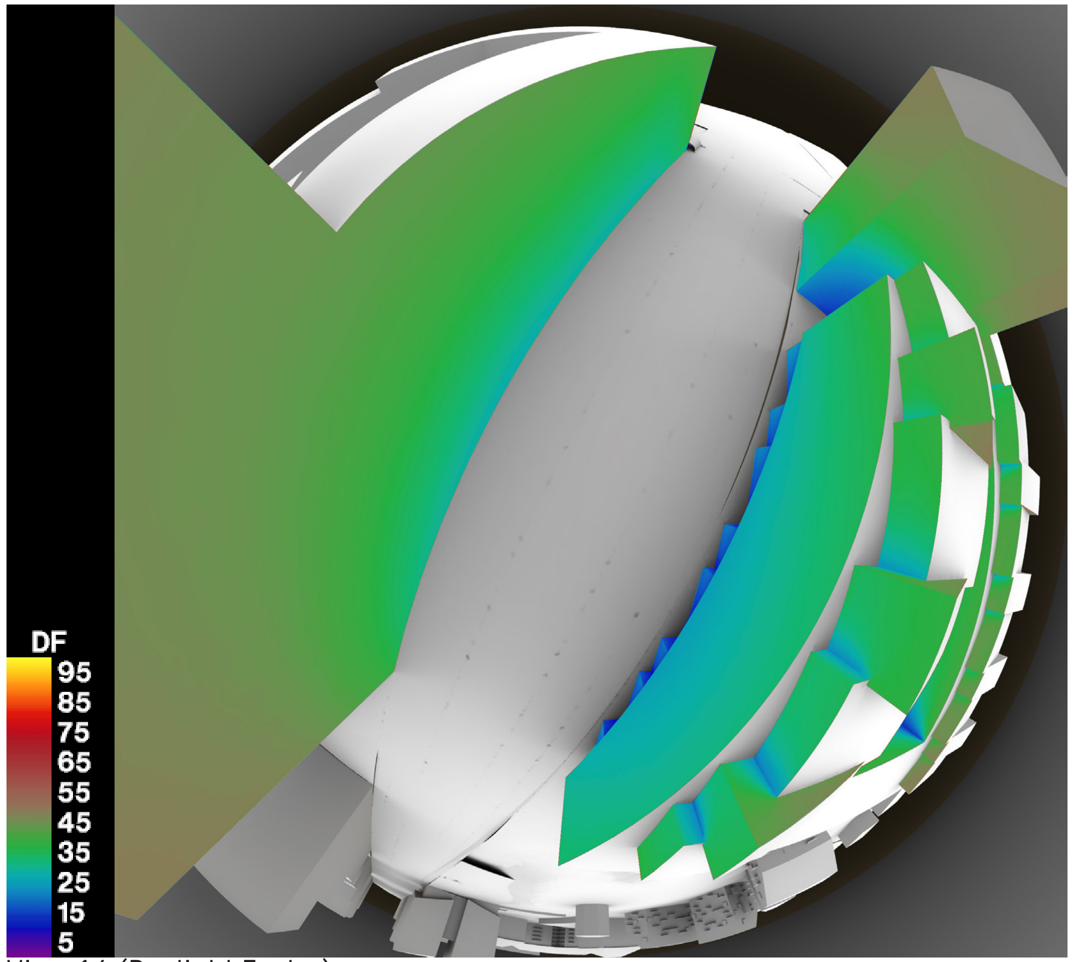
View 6 (Window to Wall Ratios)

SWECO



Calculations on Facades

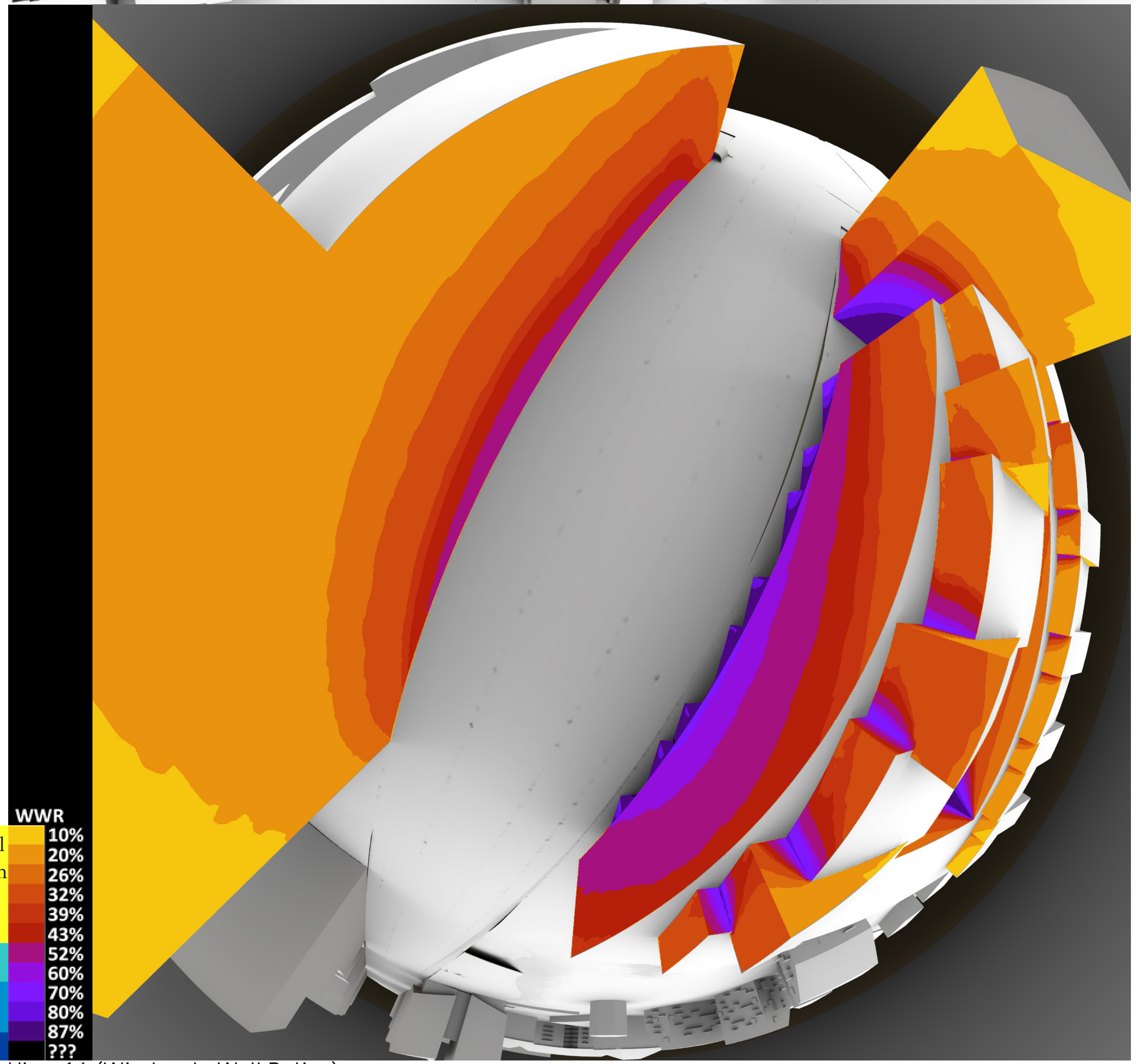
Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).



View 16 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit

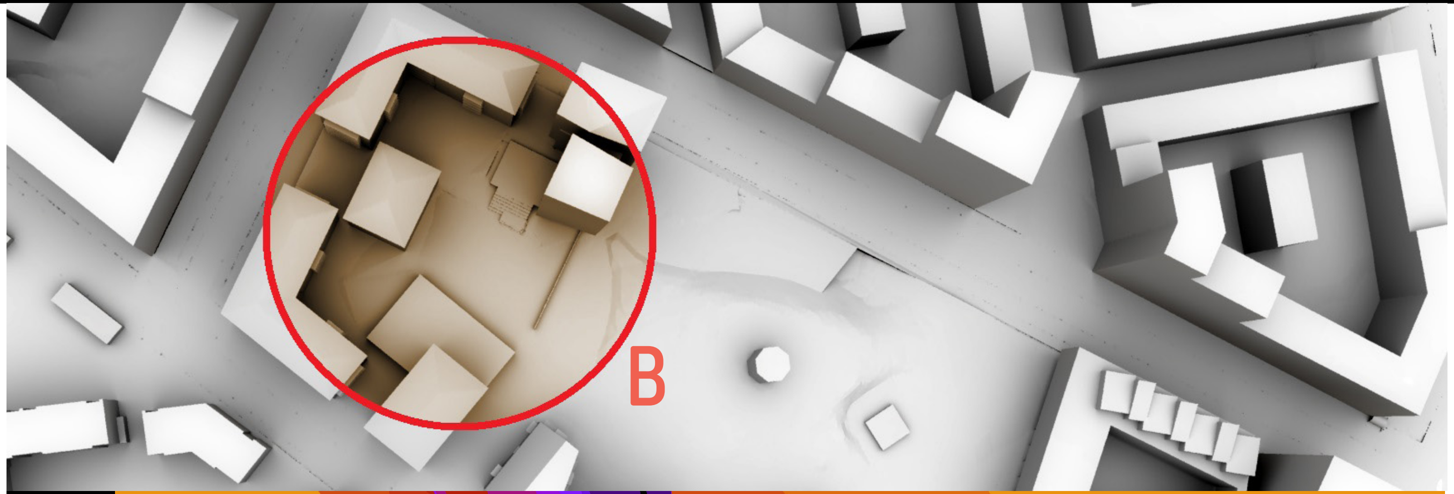


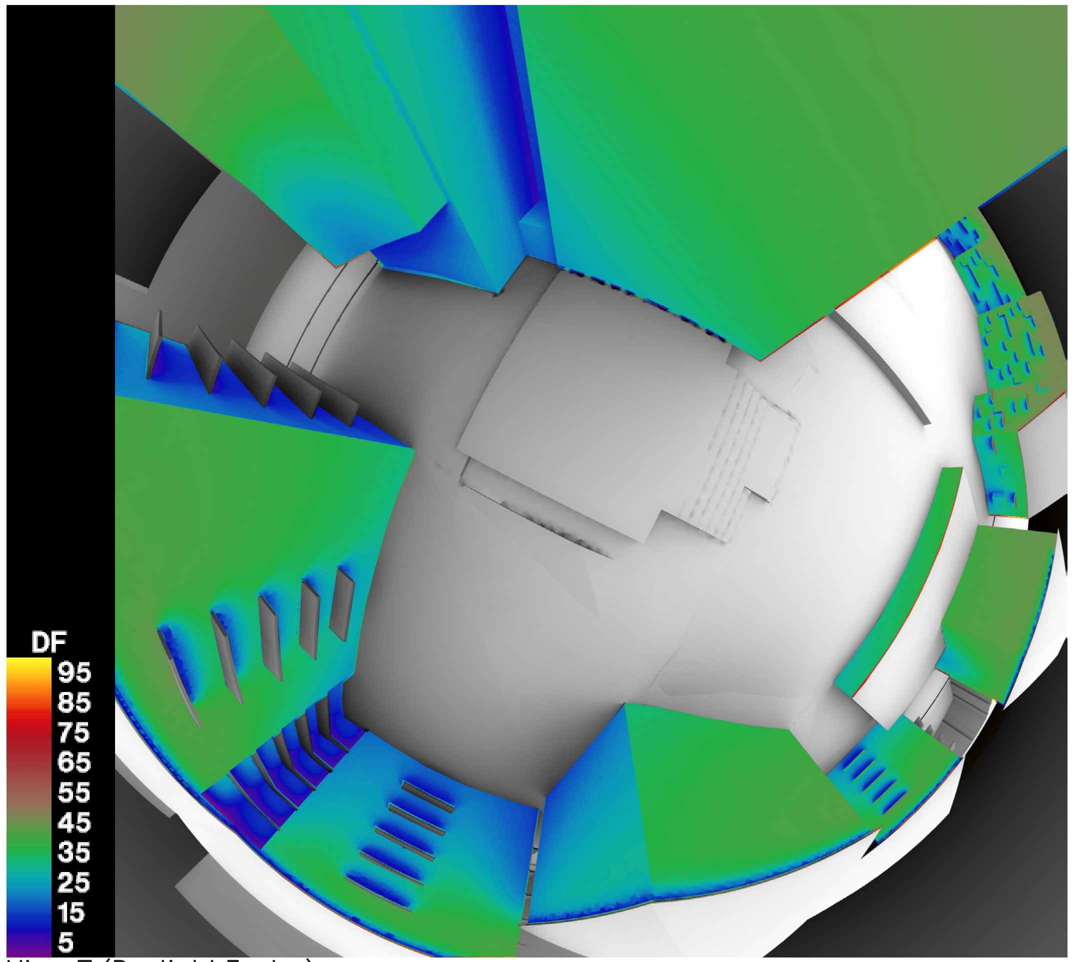
View 16 (Window to Wall Ratios)

Daylight Factor & Window to Wall Ratio

Calculations on Facades

Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).

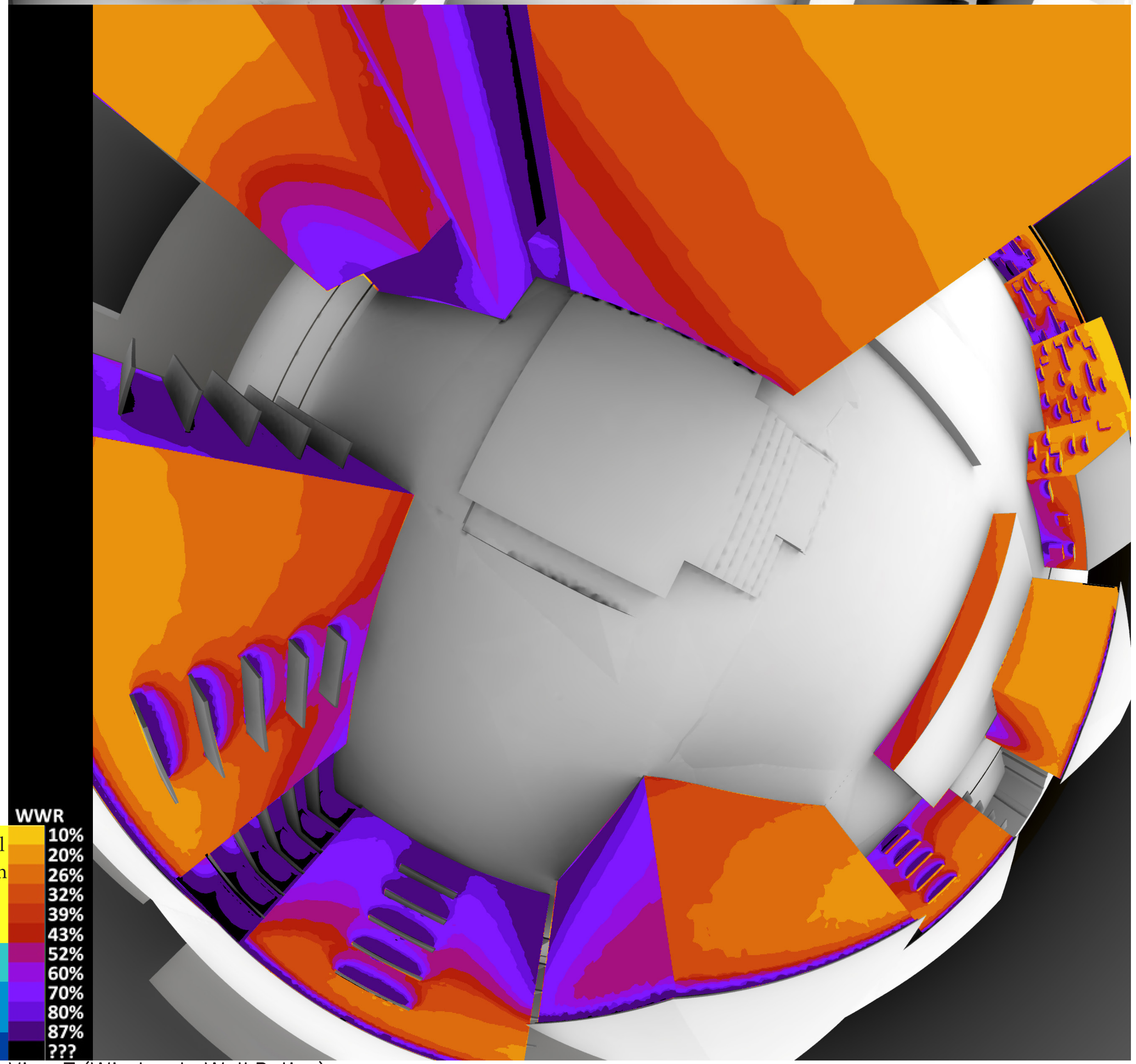




View 7 (Daylight Factor)

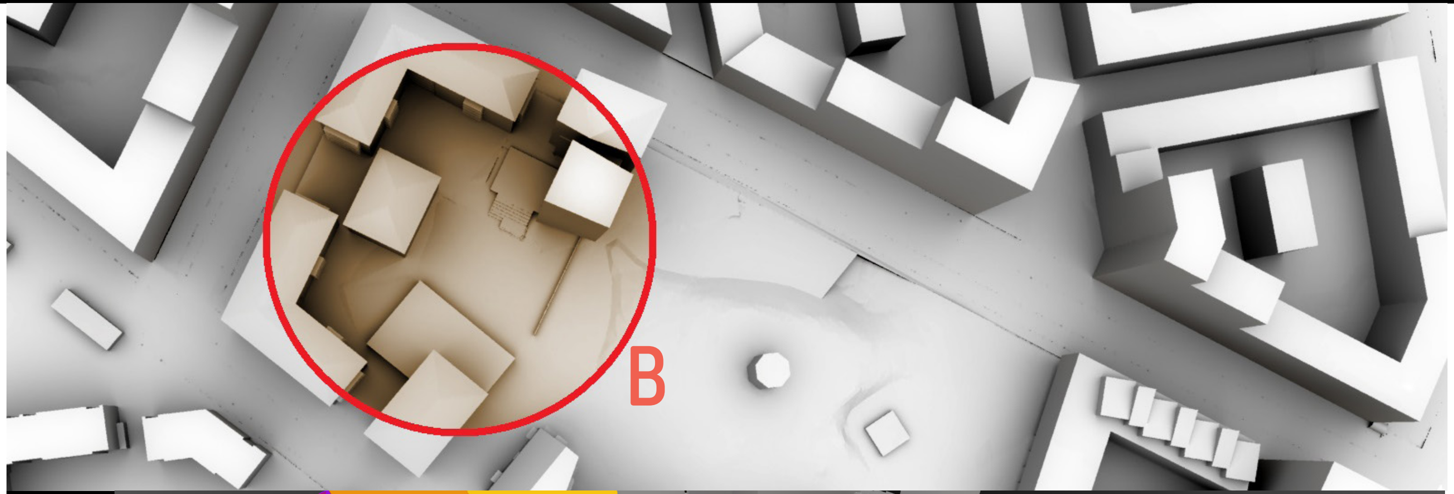
Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit



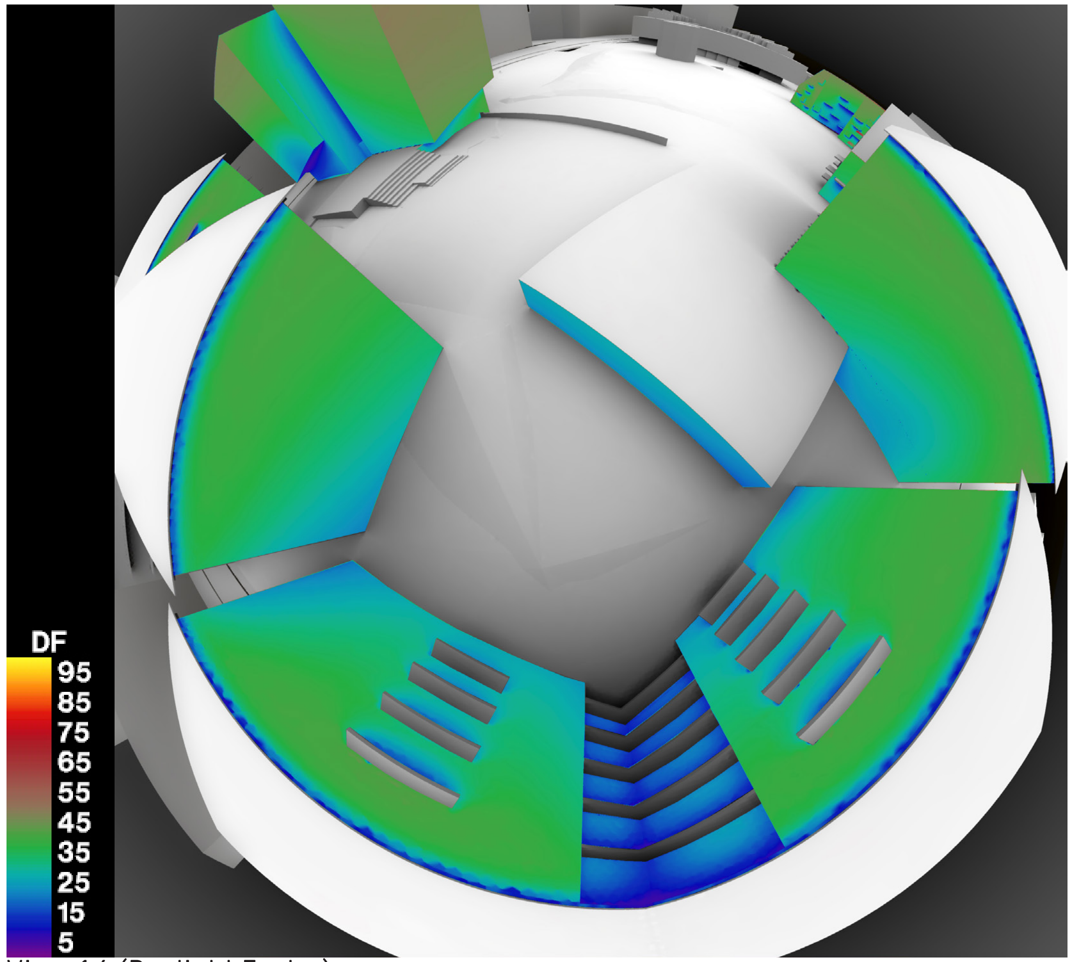
View 7 (Window to Wall Ratios)

SWECO



Calculations on Facades

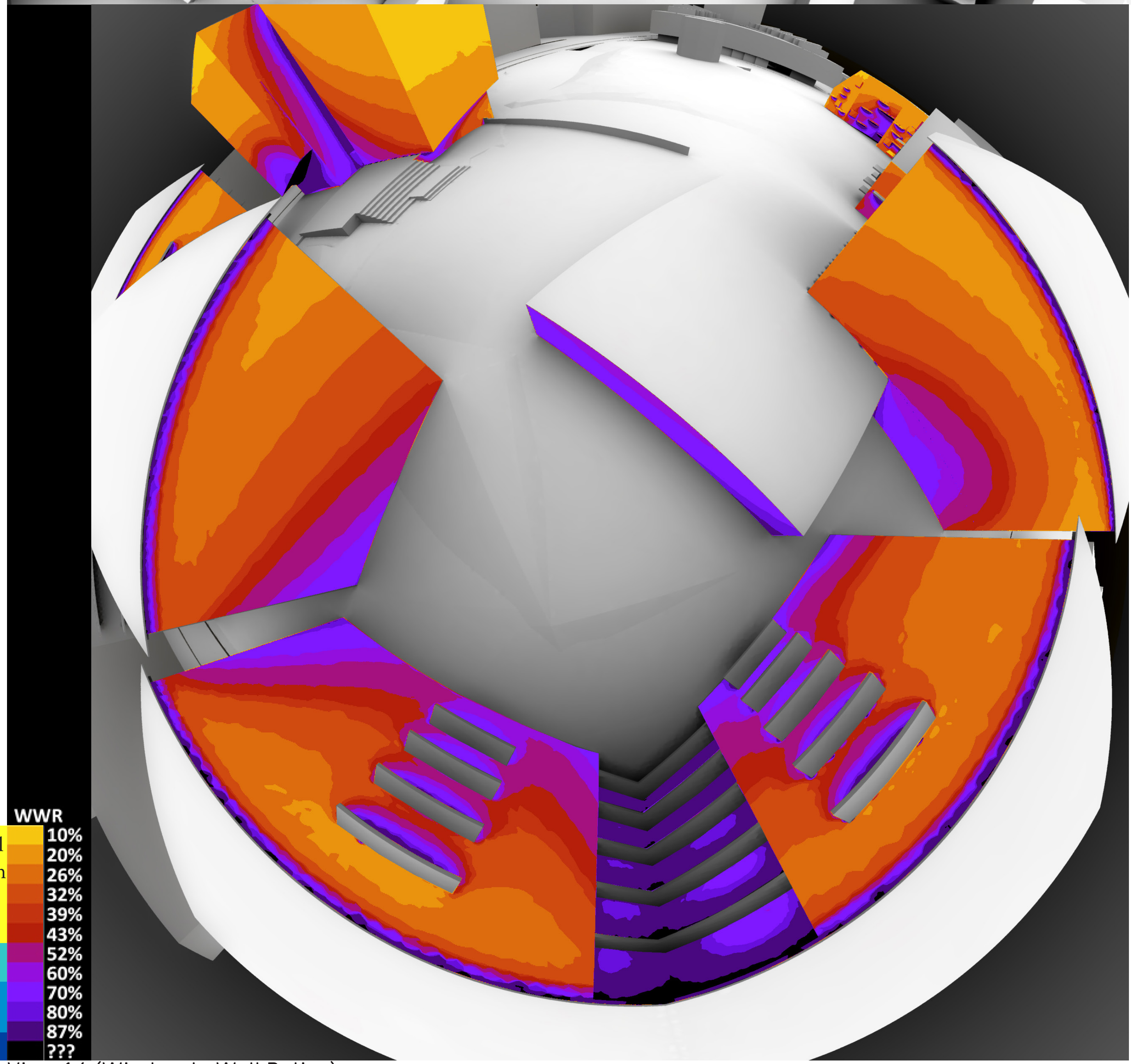
Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).



View 14 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit

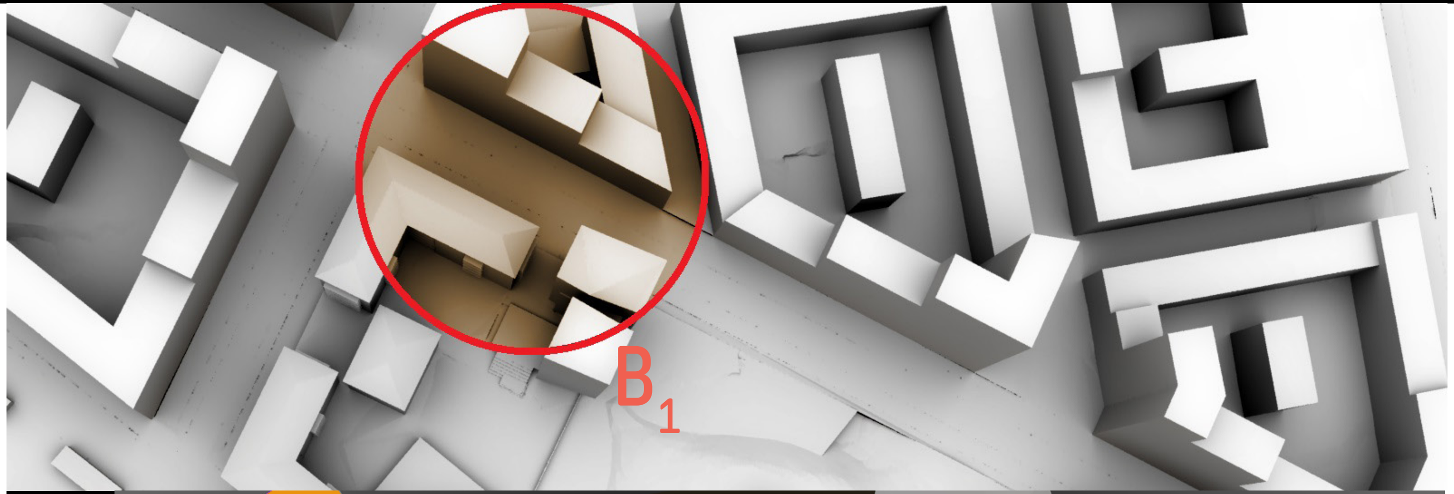


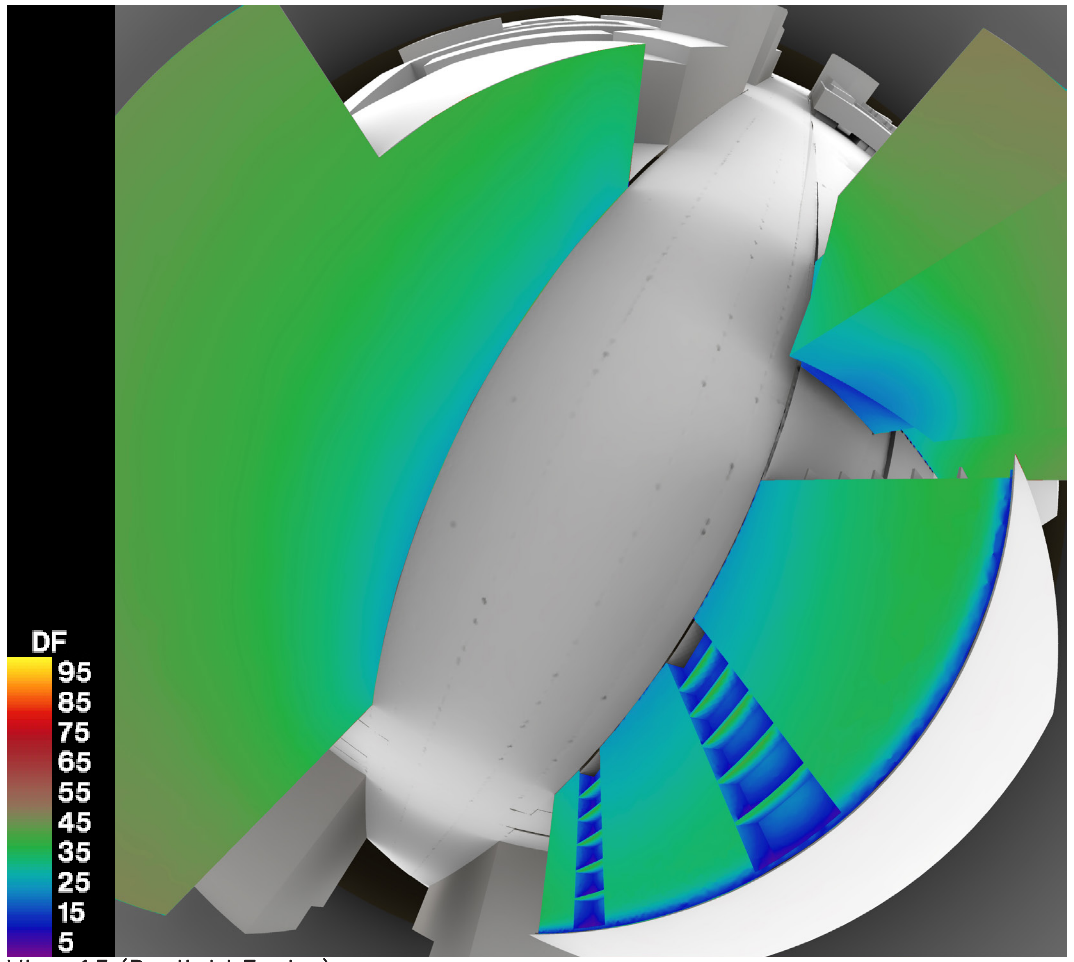
View 14 (Window to Wall Ratios)

SWECO

Calculations on Facades

Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).

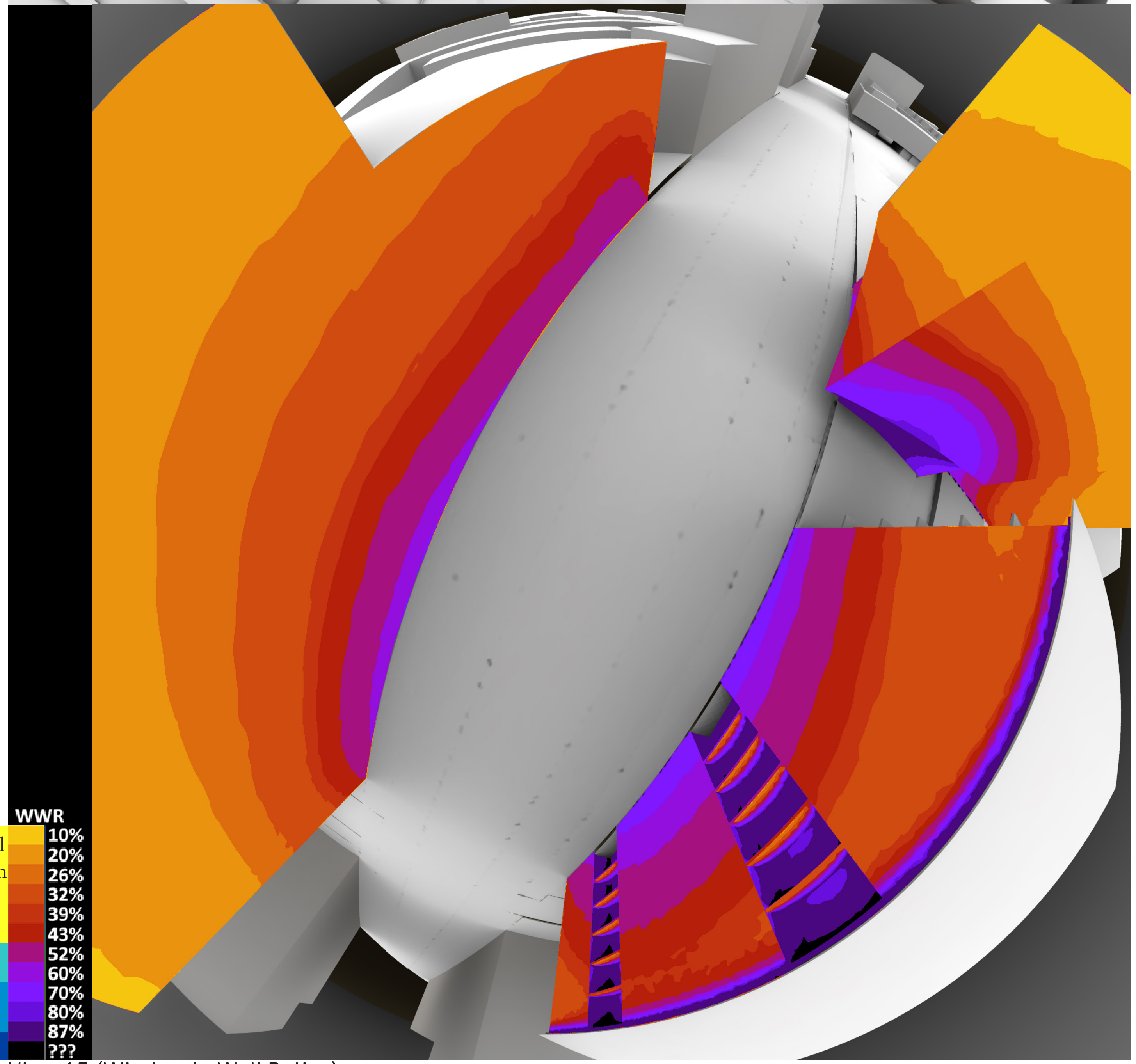




View 15 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit

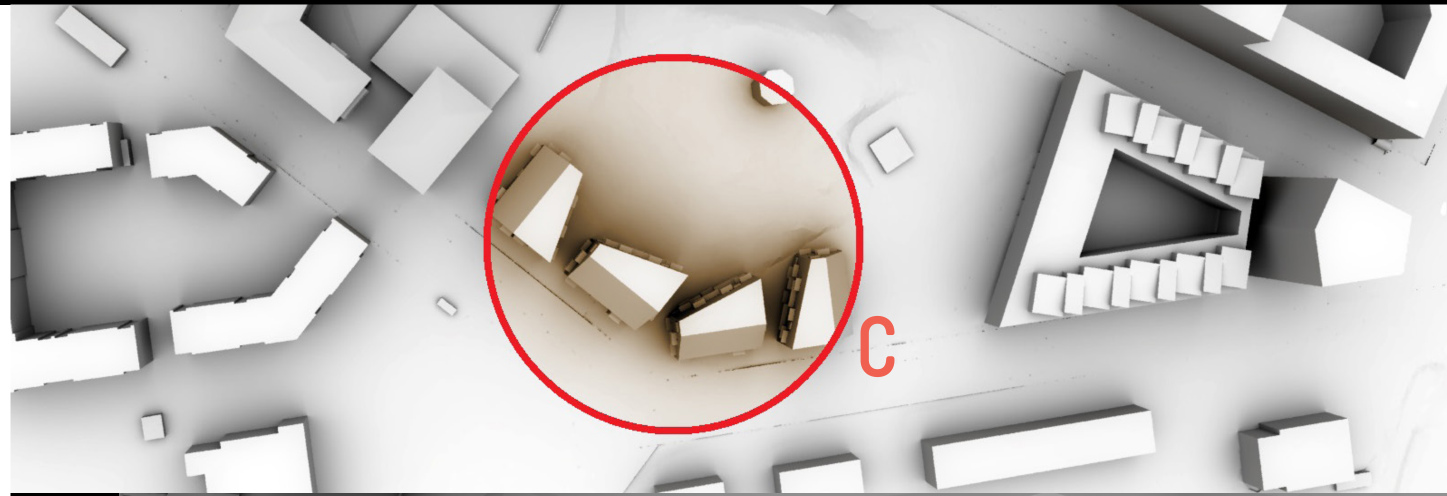


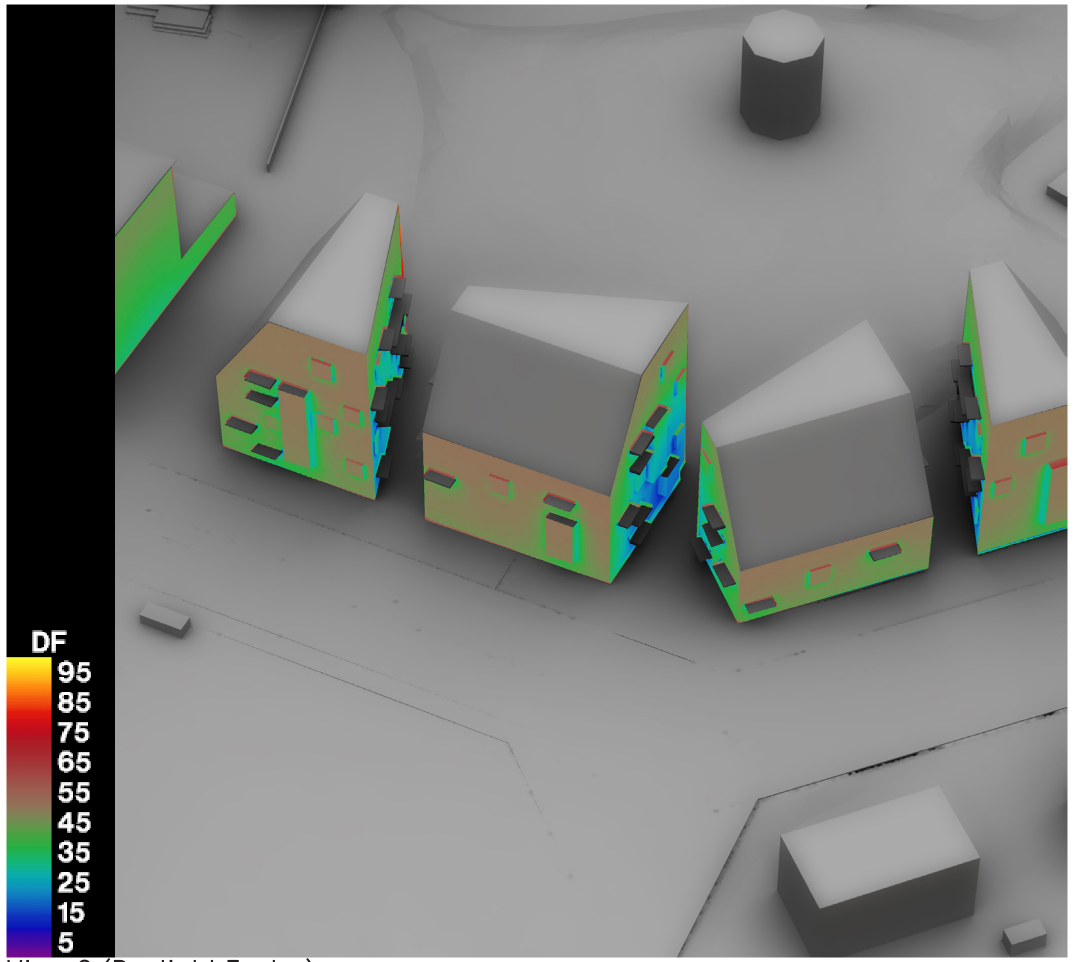
View 15 (Window to Wall Ratios)

SWECO

Calculations on Facades

Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).

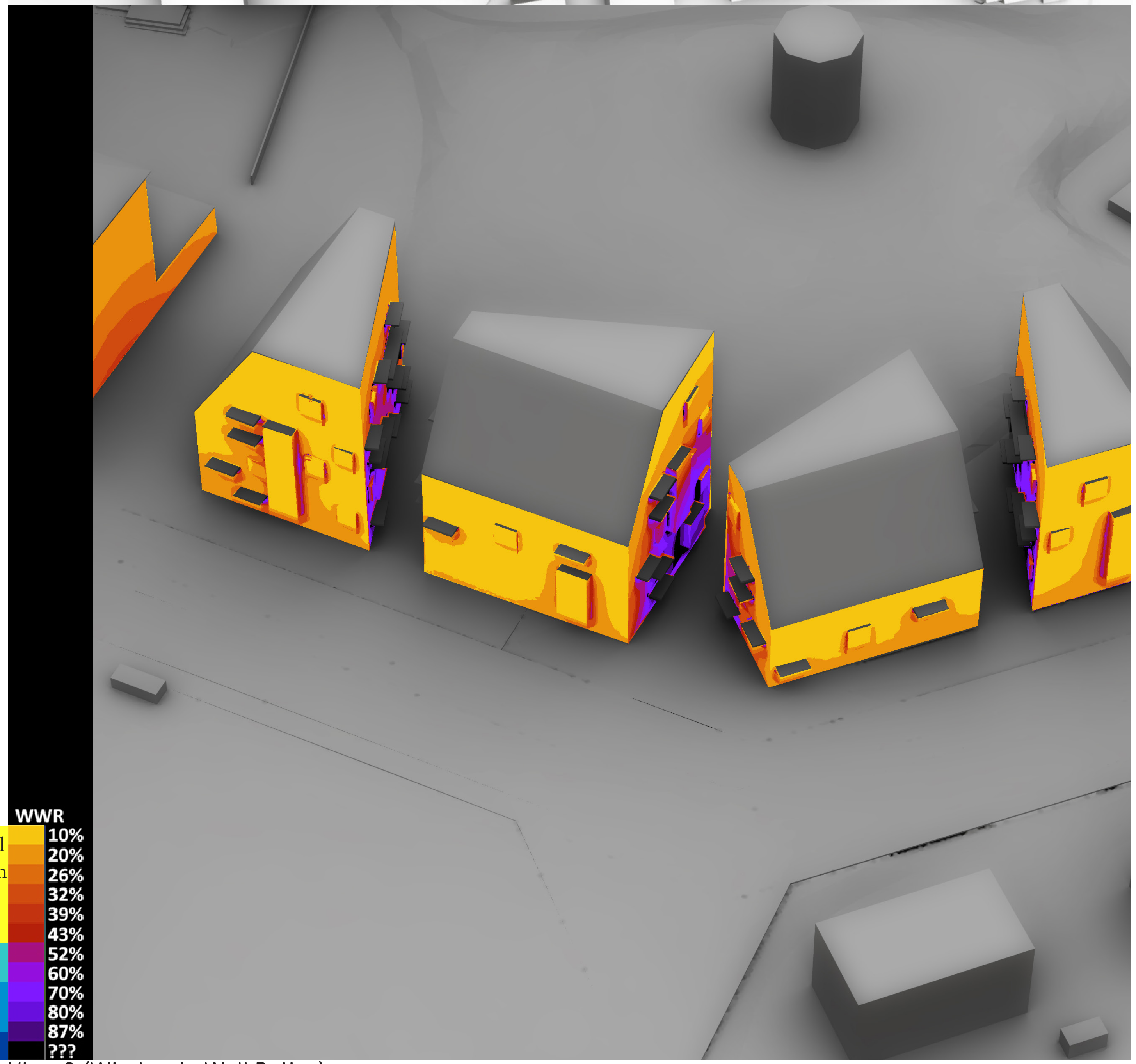




View 8 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

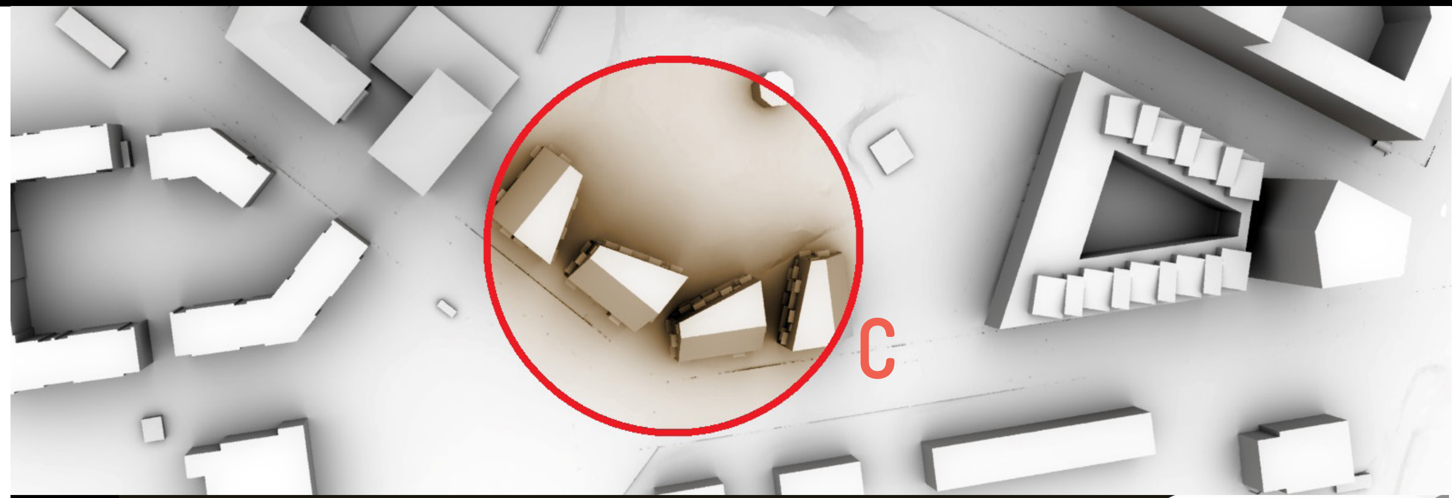
Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit



View 8 (Window to Wall Ratios)

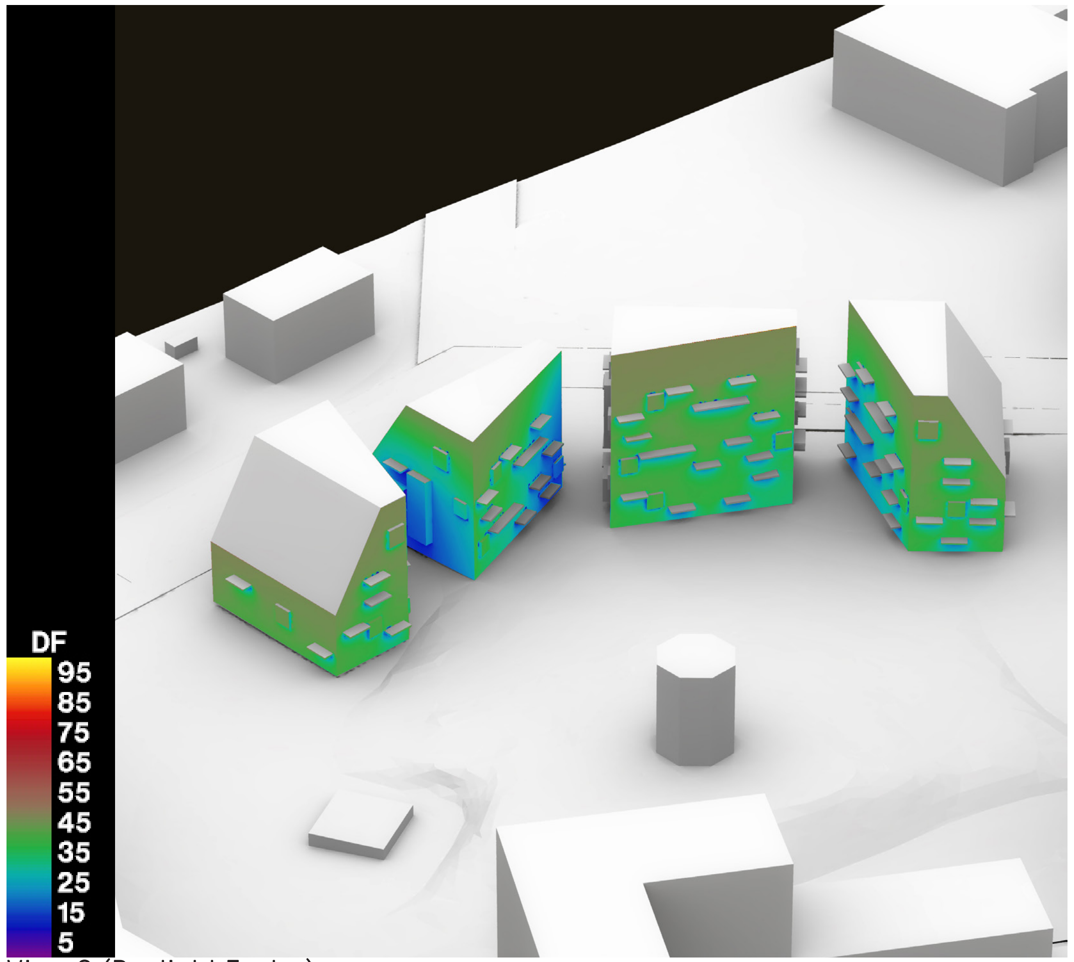
Daylight Factor & Window to Wall Ratio

SWECO



Calculations on Facades

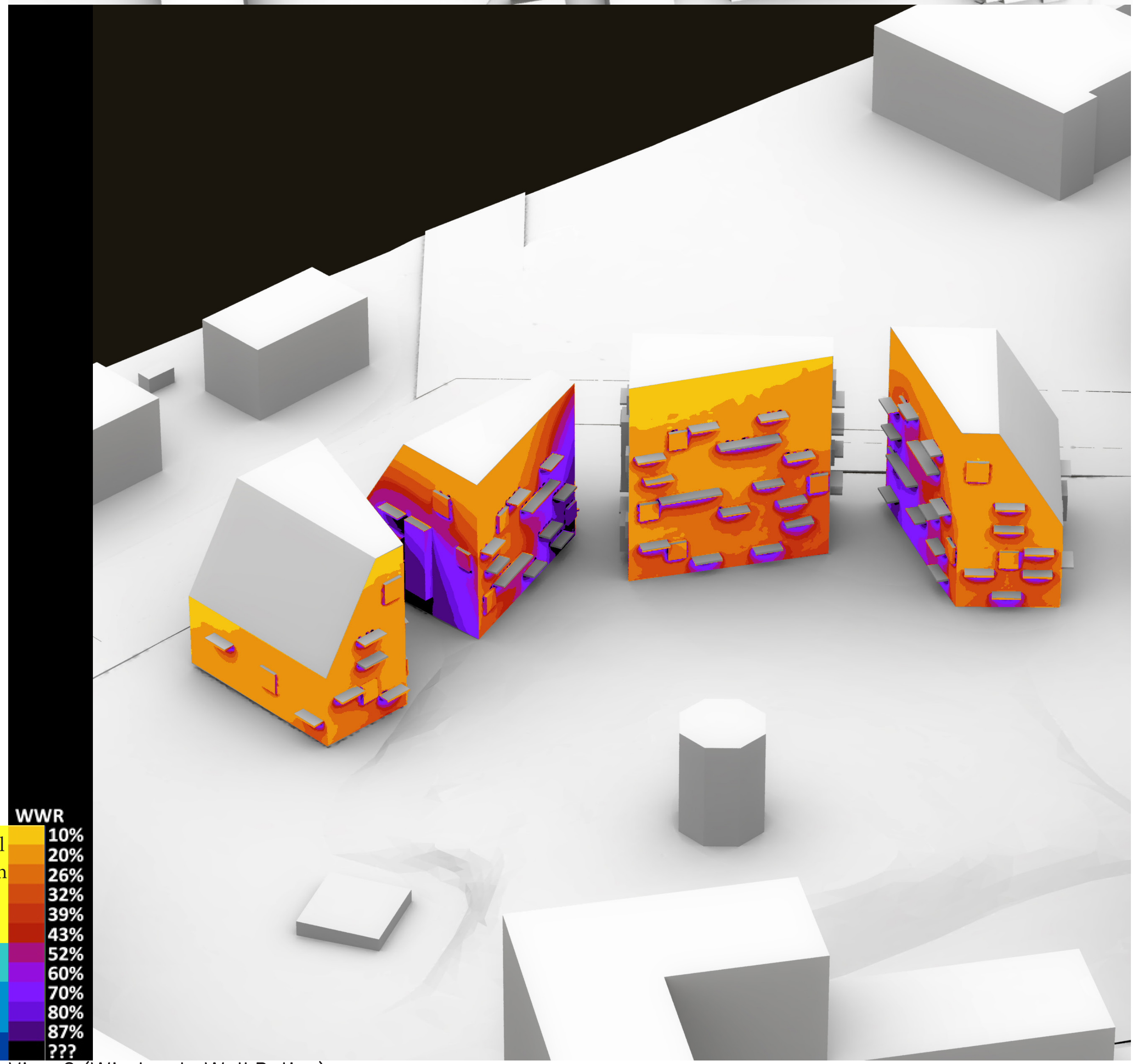
Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).



View 9 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit

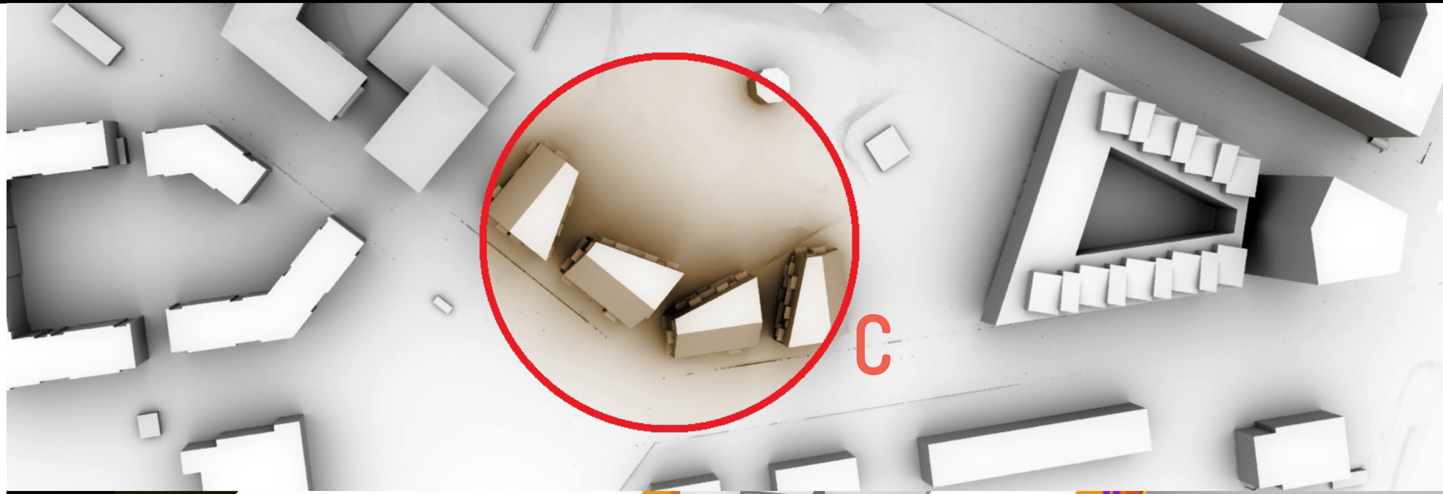


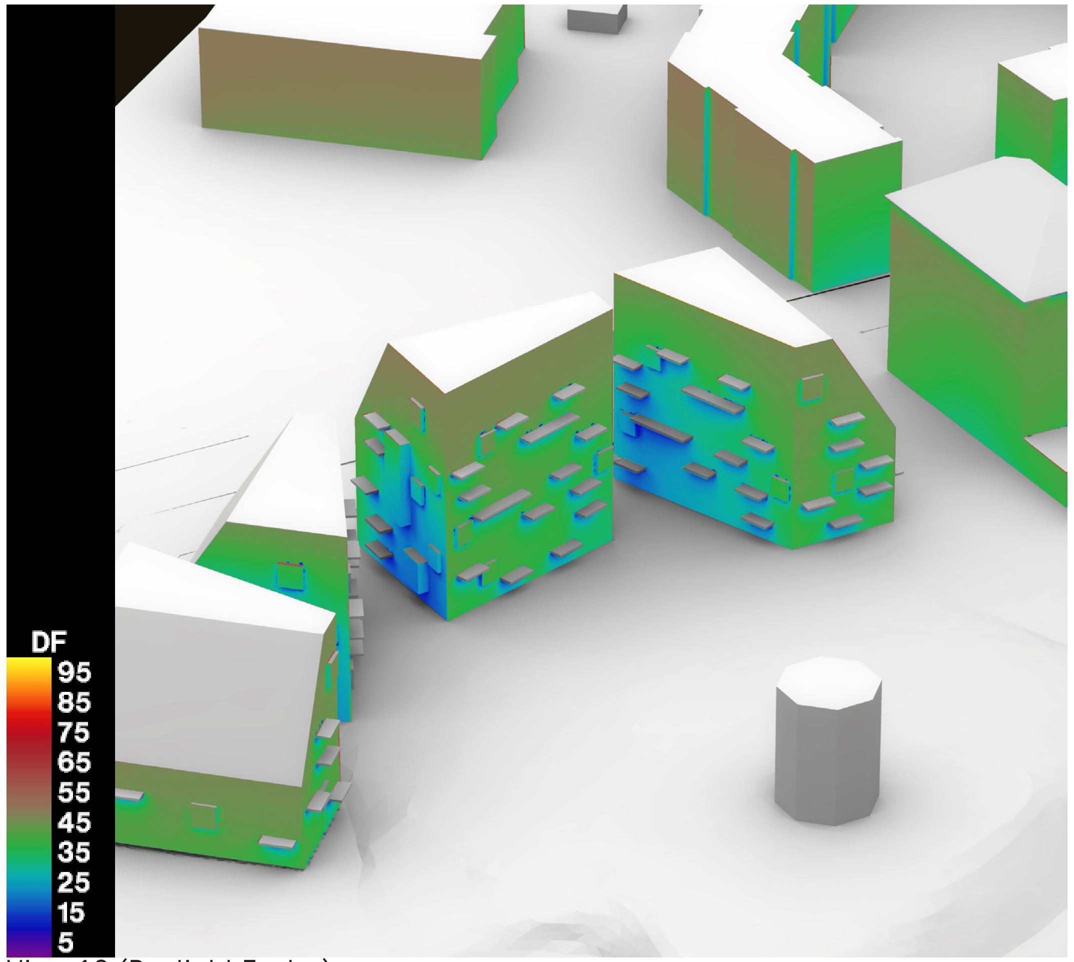
View 9 (Window to Wall Ratios)

SWECO

Calculations on Facades

Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).

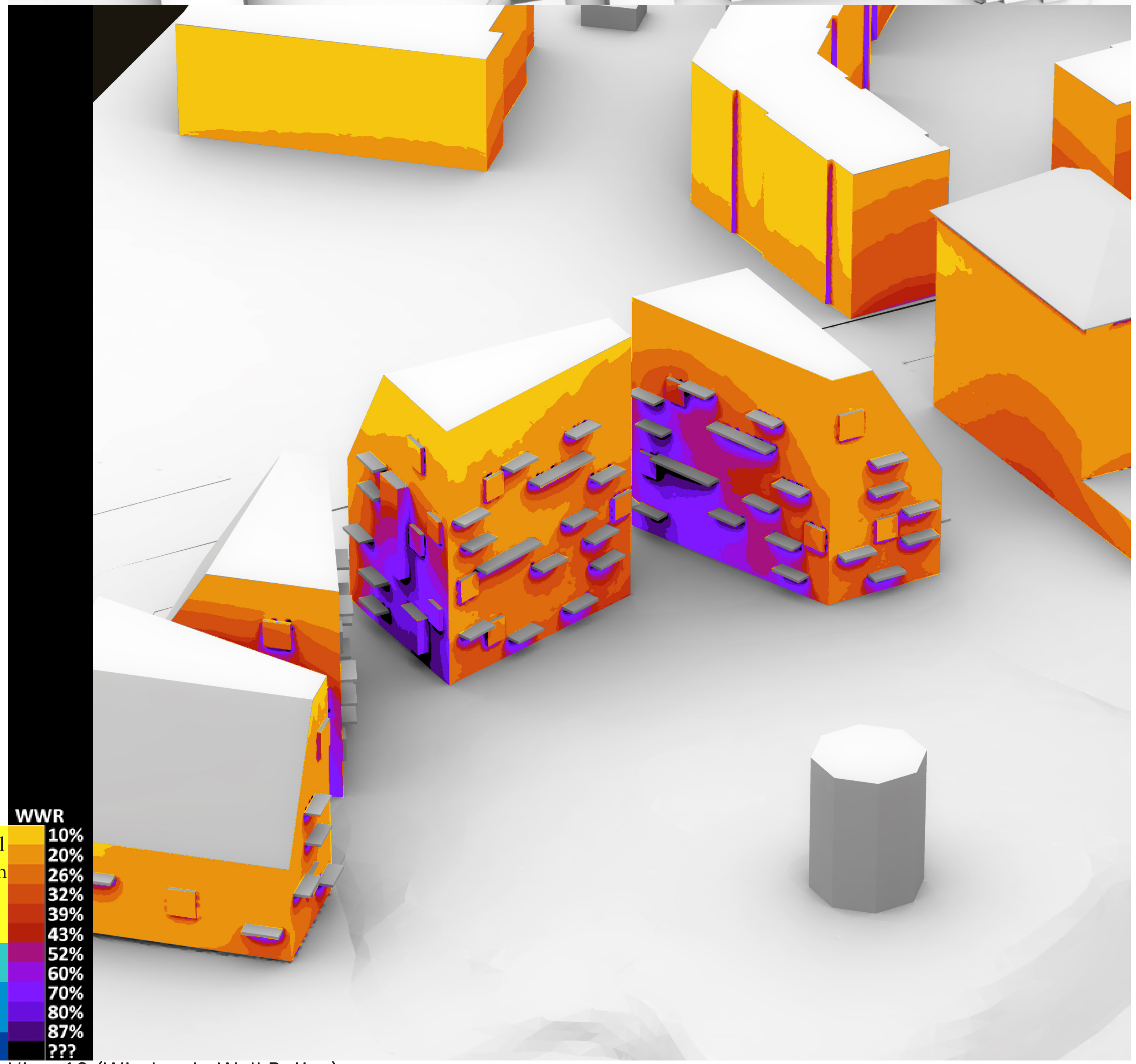




View 10 (Daylight Factor)

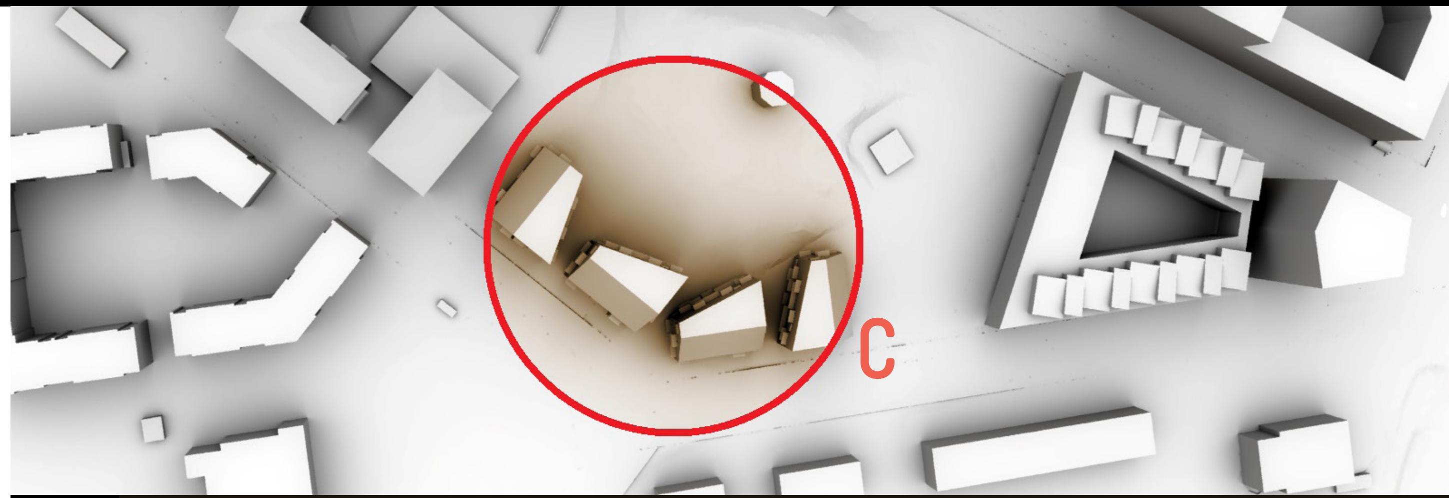
Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit

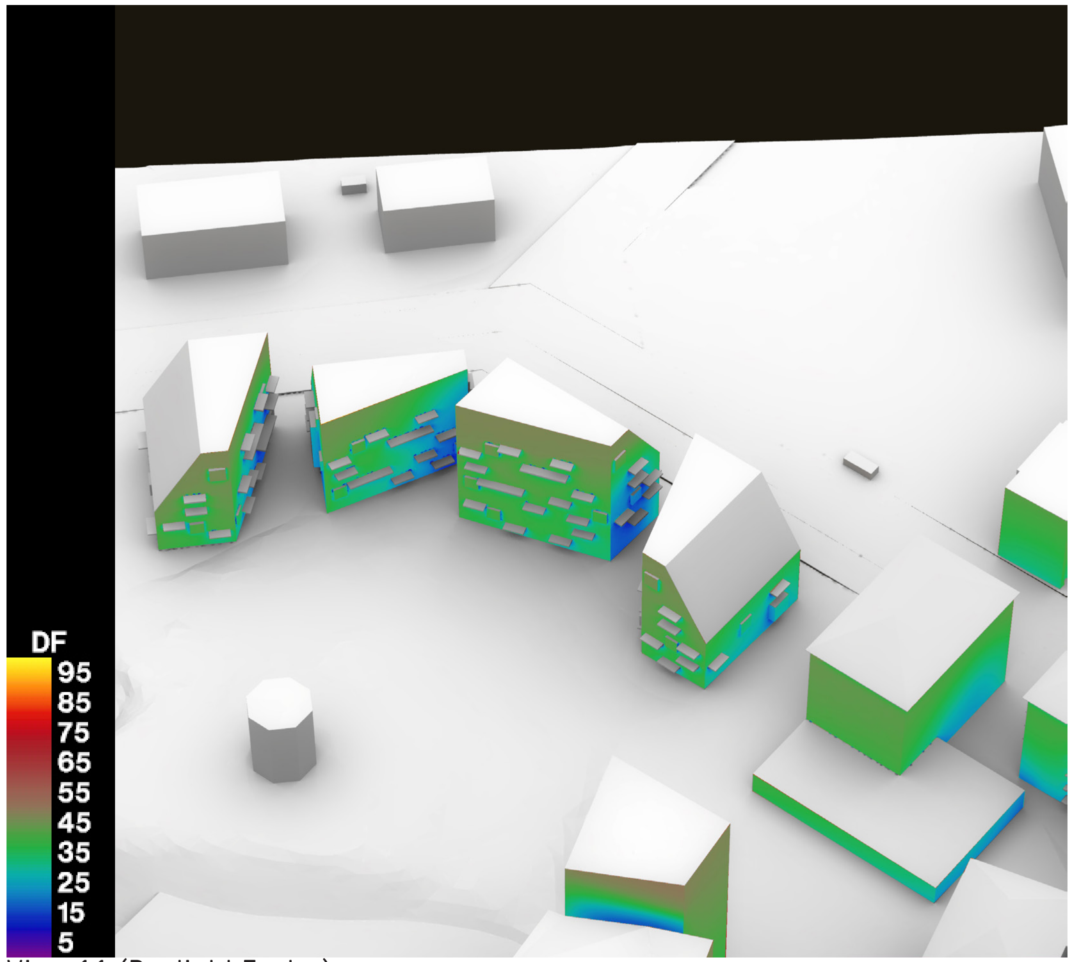


View 10 (Window to Wall Ratios)

Calculations on Facades



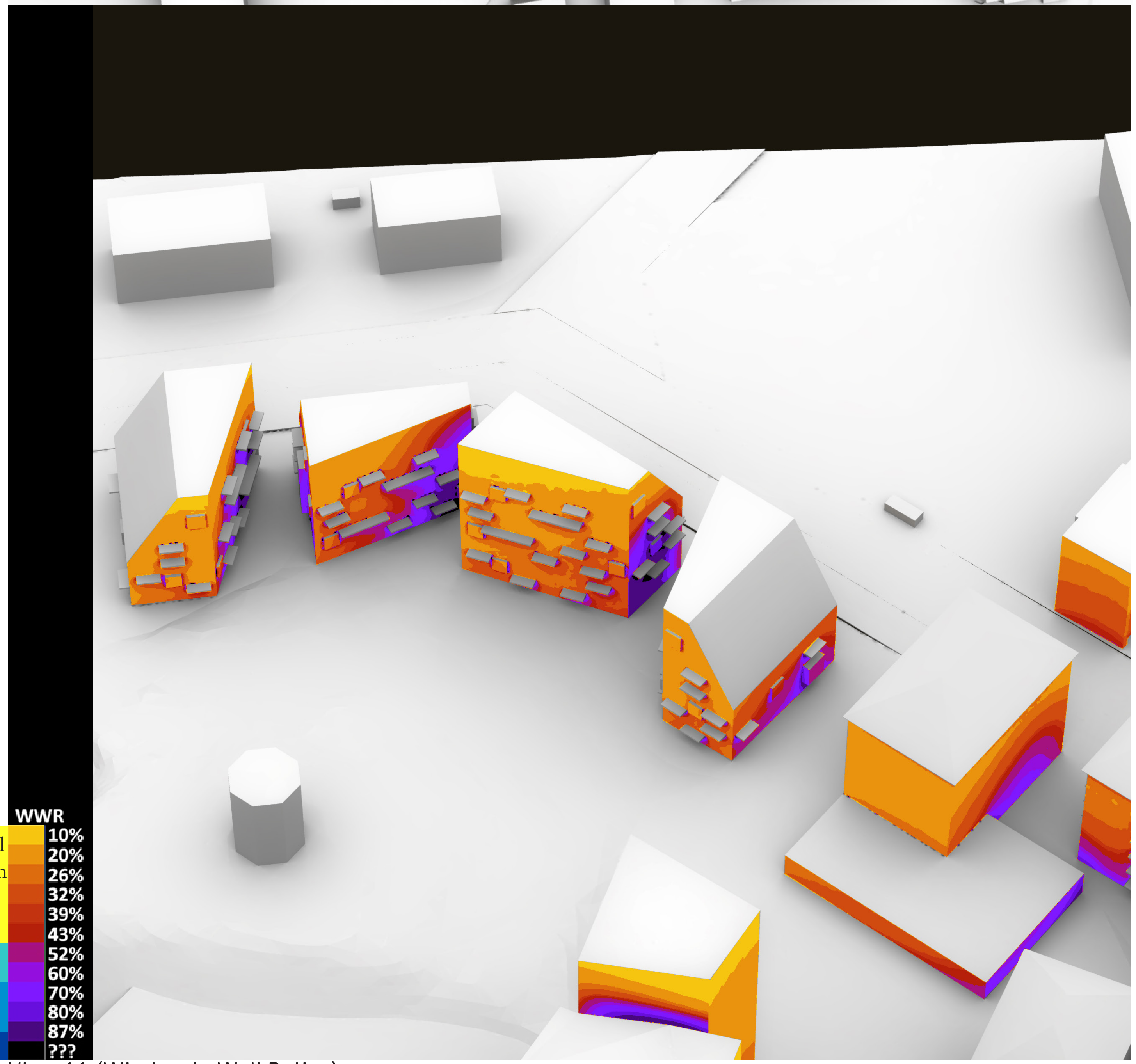
Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).



View 11 (Daylight Factor)

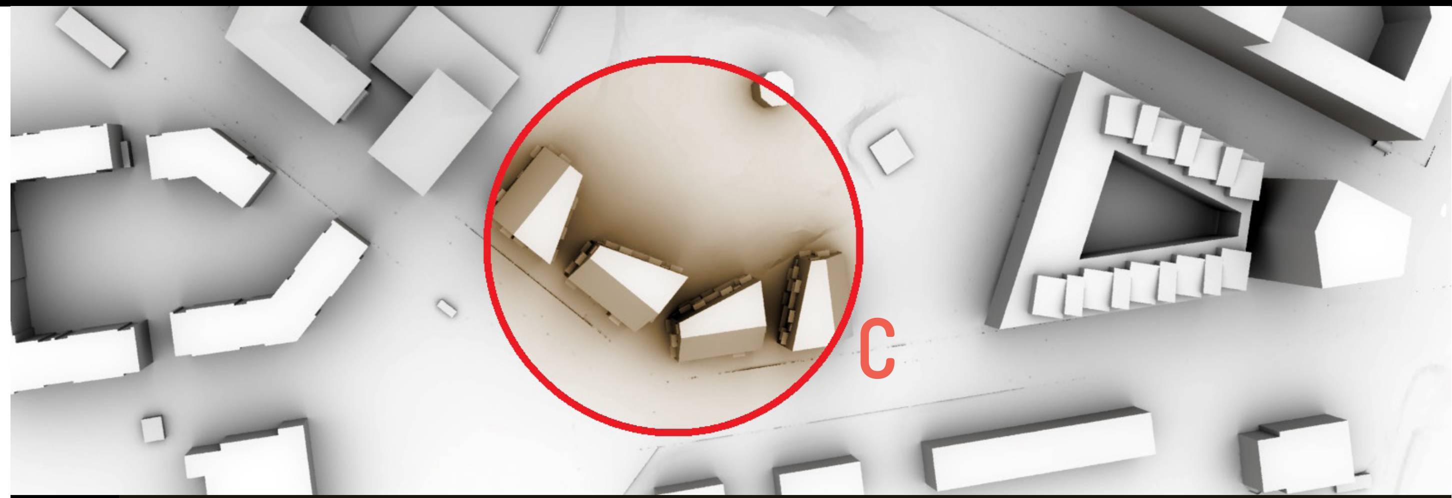
Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit



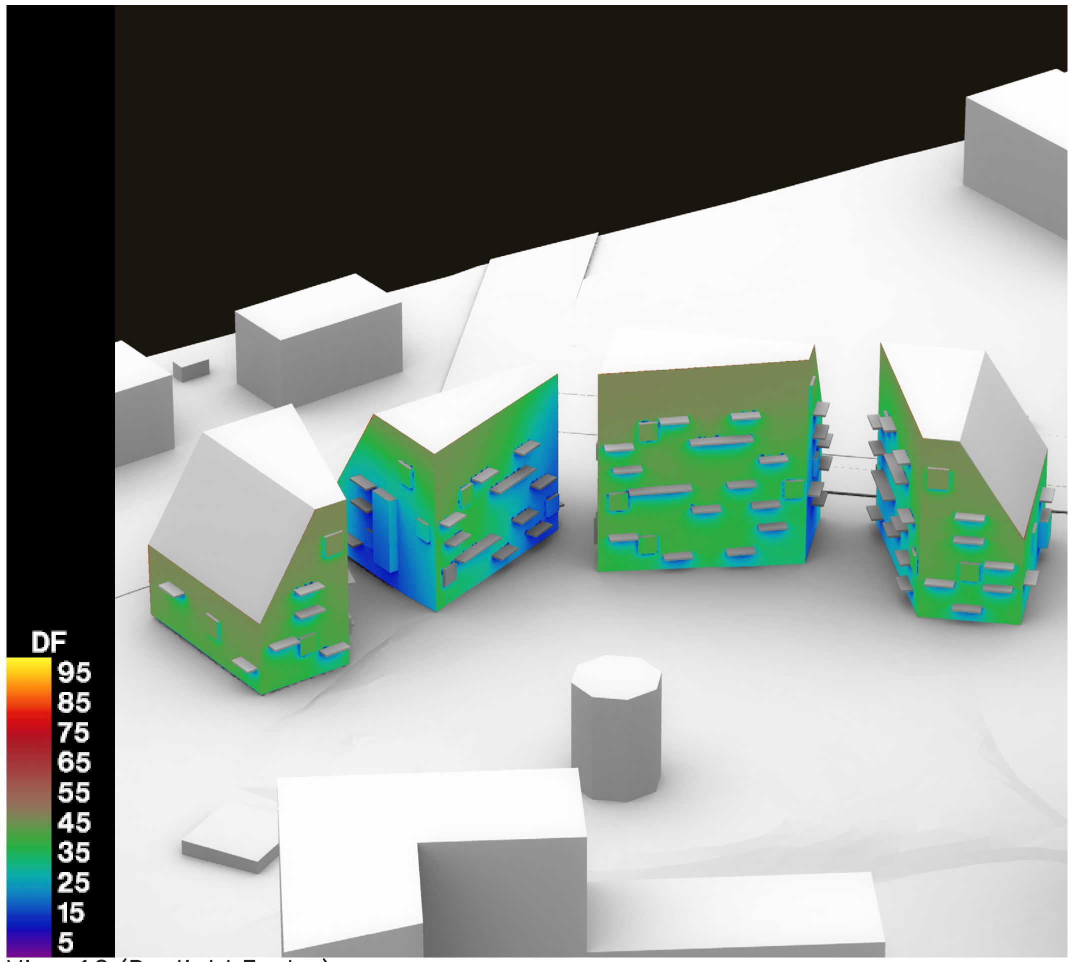
View 11 (Window to Wall Ratios)

Daylight Factor & Window to Wall Ratio



Calculations on Facades

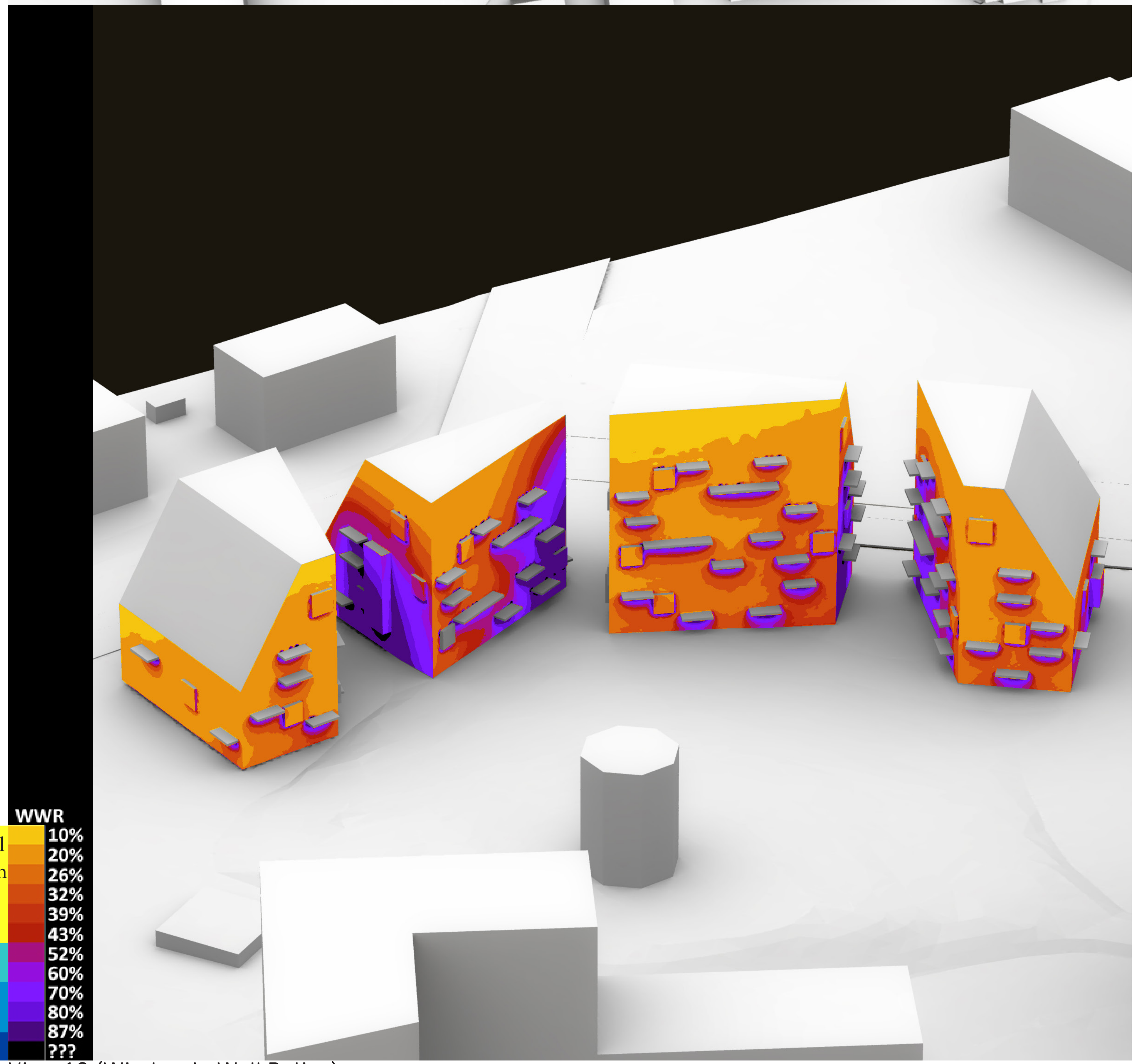
Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).



View 12 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit

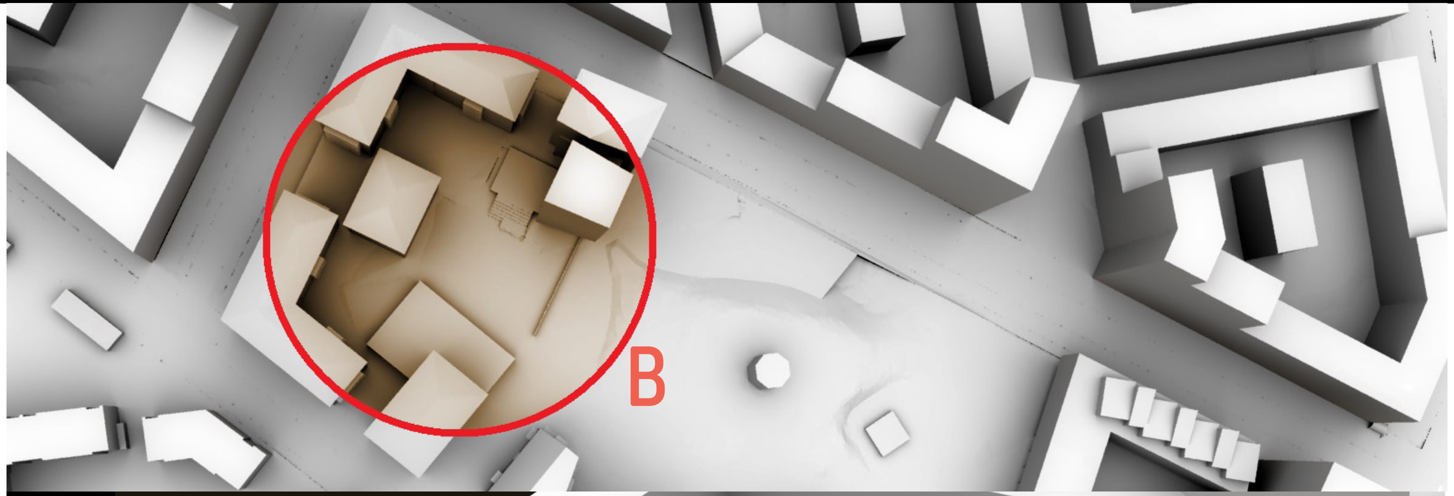


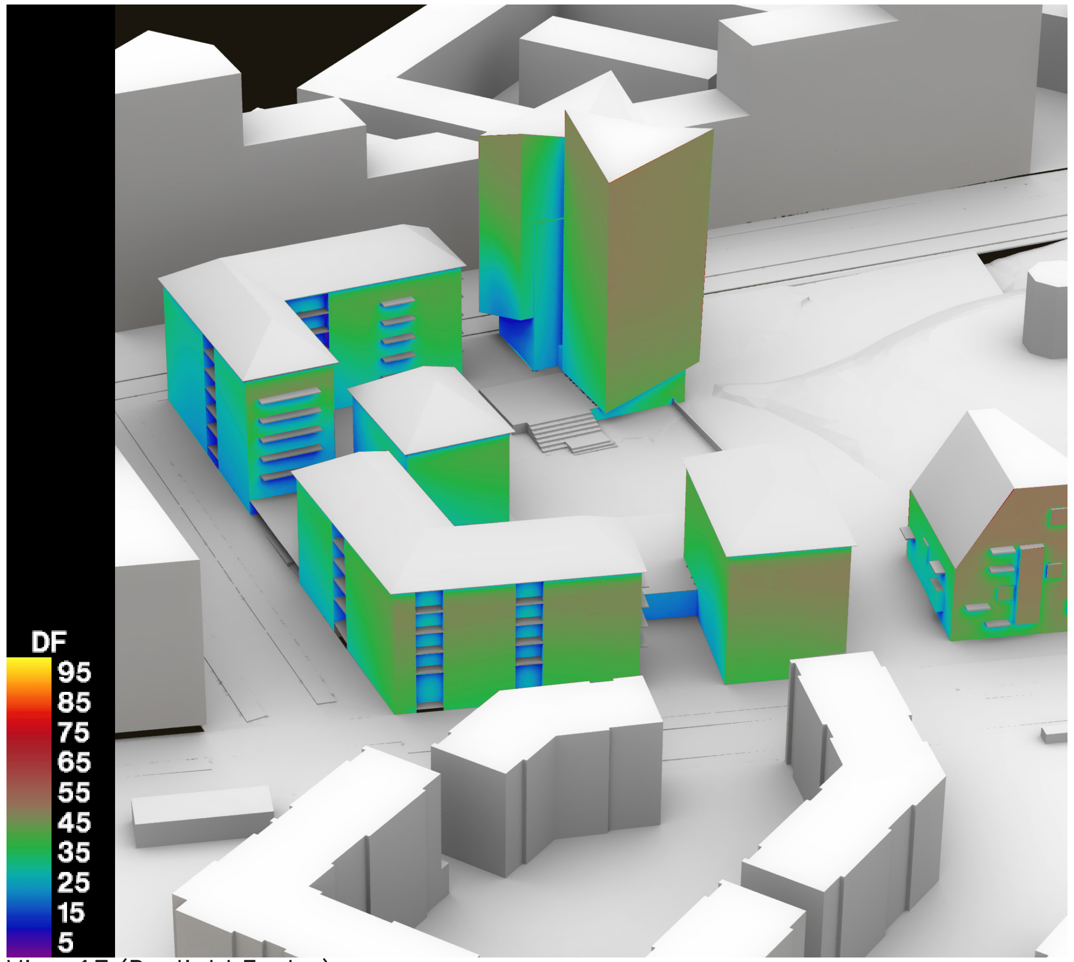
View 12 (Window to Wall Ratios)

SWECO

Calculations on Facades

Considering the table 1, we can categorize the façade to assign appropriate Window to Wall Ratios (if we are going to have a room with the same size and the same material as the reference office room). In the below-right image, the Window to Wall Ratio (WWR) estimation for each part of the facade is shown. Such assessment is based on the Daylight Factor availabity on the same facade (that is shown in below left image).

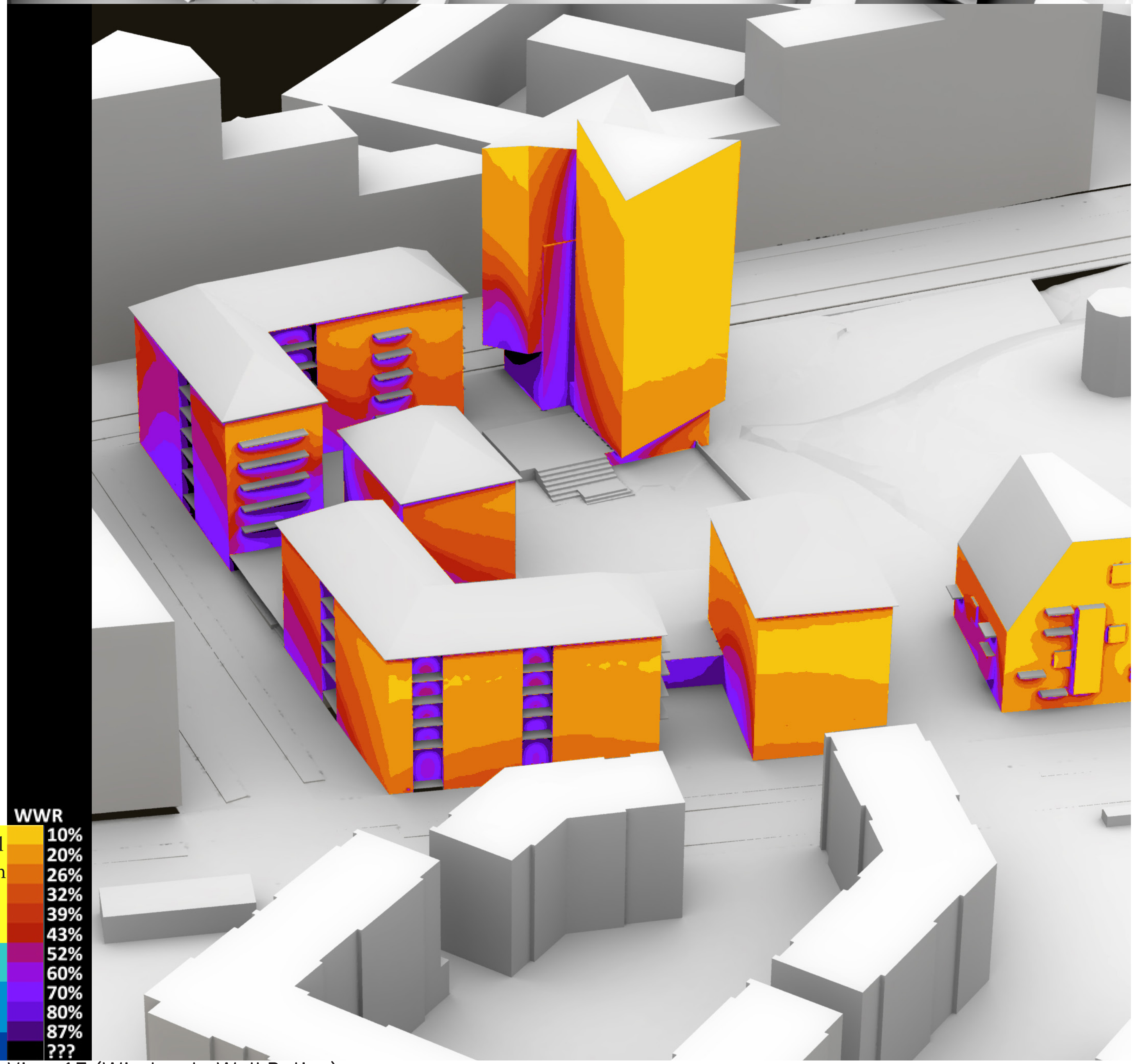




View 13 (Daylight Factor)

Finding the Windows to Wall Ratios from the Daylight Factor analysis

Considering access to view, it is recommended to have more than 25% WWR	Good Potential to have enough Daylight and View
Higher Heating and Cooling Load Risk	Acceptable
	Not Common
	Not Daylit



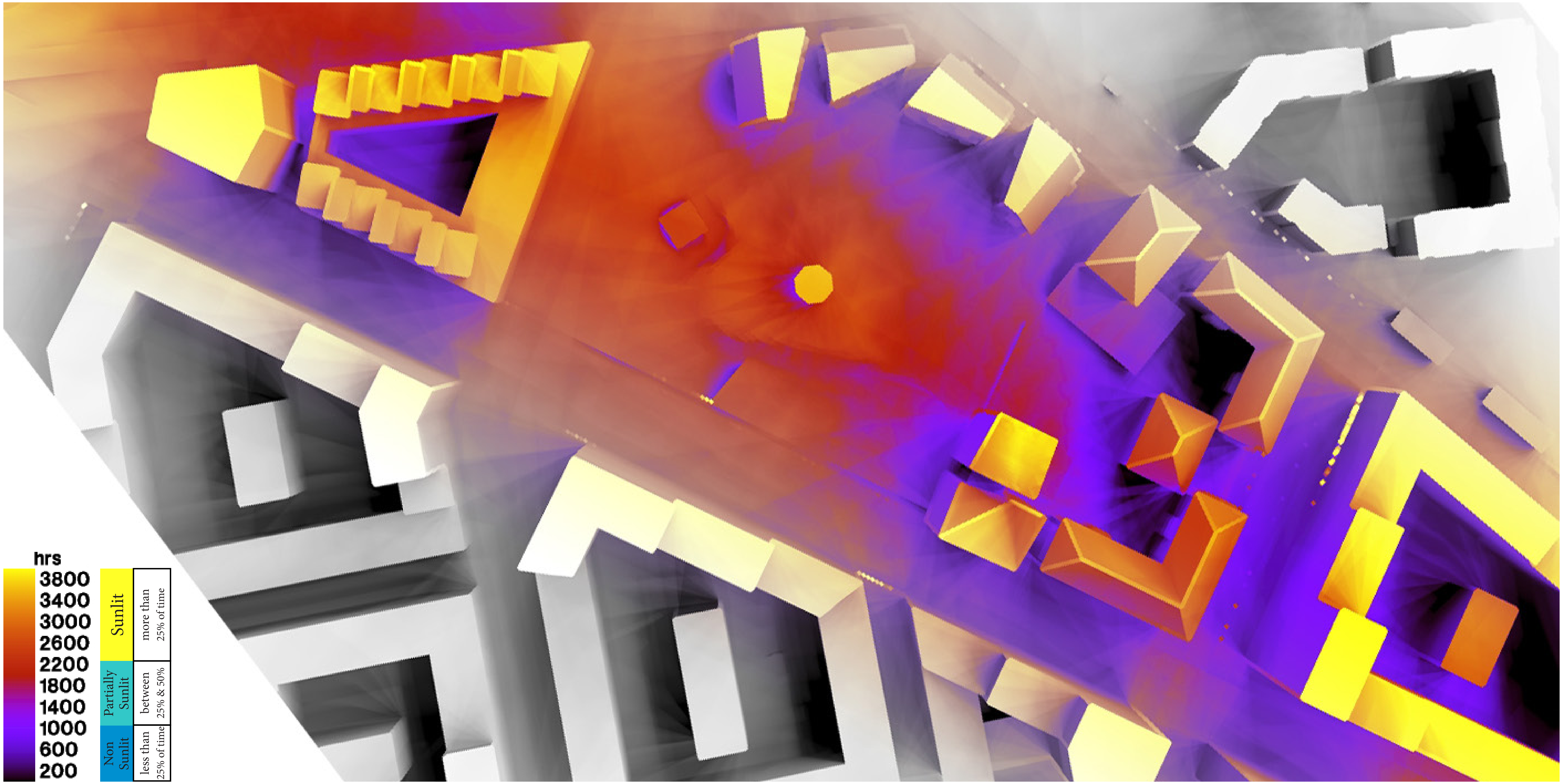
View 13 (Window to Wall Ratios)

Annual Sunlight Hours

SWECO

This kind of analysis calculates total sunlight hours (considering the whole year sunny) that each interested point is supposed to get during a specific or in a yearly period (in comparison with 4380 daytime hours in a normal year).

This type of analysis gives us information to find out where the most problematic areas regarding glare or excess heat are, while it also shows where is potentially good for placing a children play ground, pedestrian walkways, or parking lots.

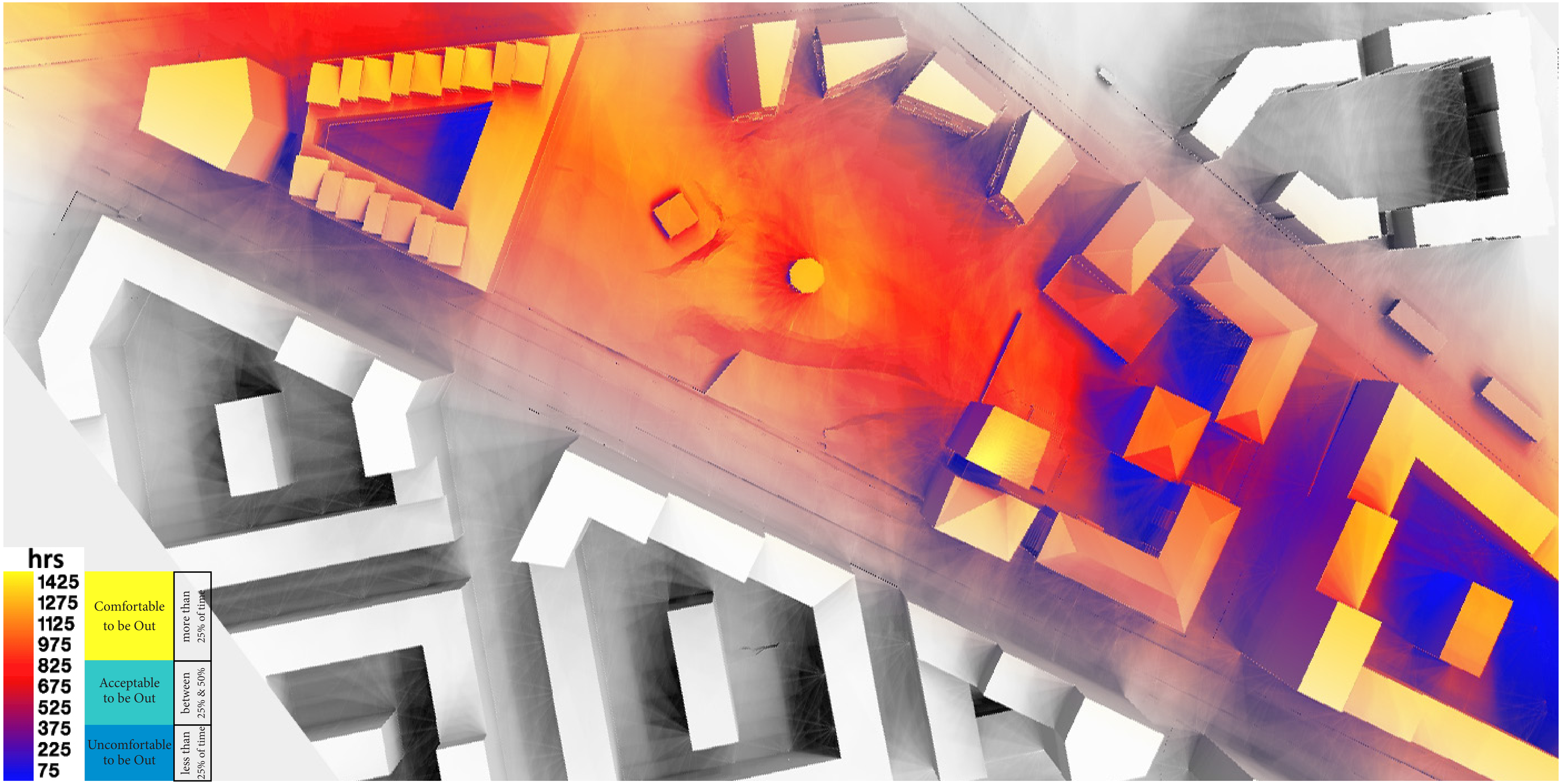


UTCI based Annual Sunlight Hours

UTCI (Universal Thermal Climate Index) is the temperature that weather forcast media used when they say that the temperature "feels like" something higher or lower than the actual outside dry bulb temperature.

Here, in the below image, what is done is based on firstly finding the comfortable outside temperature (from a simplified version of UTCI calculation formula) for the whole year and then doing the sunlight hours study for all those hours that people enjoy to be outside.

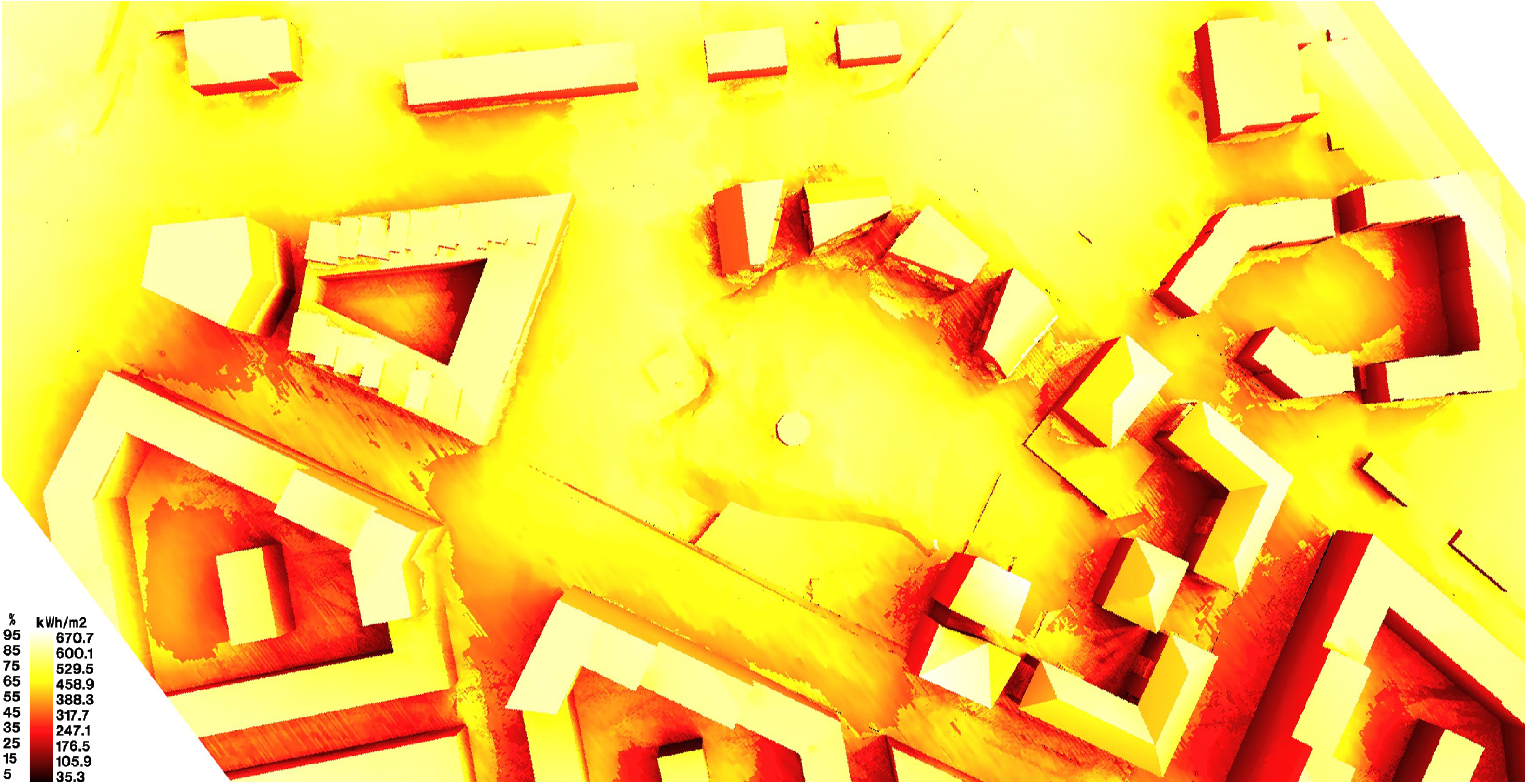
The weather data that is used in the simplified version of the UTCI formula is from Arlanda airport.



Annual Solar Radiation (Insolation Analysis)

The insolation analysis is a way to calculate Incident Solar Radiation falling on a surface. Its calculation is based on a standard weather data file representing the prevailing conditions of the place and is created based on on-site measurement over a period of years.

At an urban scale, it shows where it is best to locate photovoltaic panels, solar collectors or the potentially good locations for plants, vegetation and trees to receive the right amount of light that is needed for them to grow.



Categorizing the spaces with different functions

By doing the aforesaid analysis (Annual Sunlight Hours, UTCI based Annual Sunlight Hours and Annual Solar Radiation analysis) and considering the following definitions, we categorize the outdoor areas as six different types of function that are illustrate in pages 25 and 26:

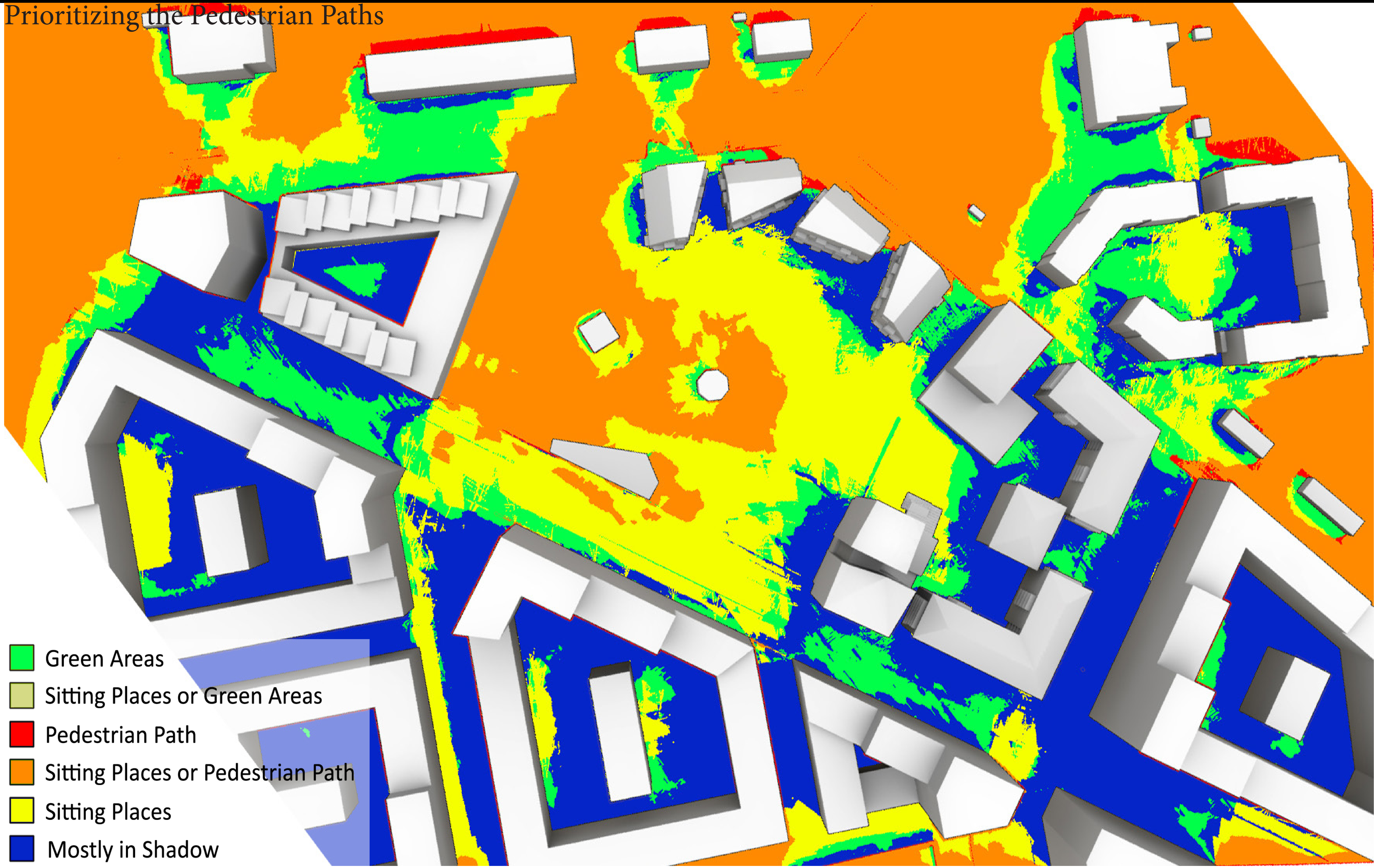
- To define the best places for pedestrian paths (“**Pedestrian Path**”), we choose those areas with more than 50% of all the sunlight hours show them with **reddish** color.
- To define a good place to sit (“**Sitting Places**”), we choose areas with more than 50% of all yearly hours that are categorized as “No Thermal Stress” (it means those hours that have comfortable temperature feeling in outside) in the UTCI scale. Such areas illustrated by yellowish color.
- Regarding the difference between pedestrian paths and sitting places, as any places that are categorized as a appropriate place to sit will be good to walk too, we make another category that is defined as “**Sitting Places or Pedestrian Path**” by intersecting the area between “**Pedestrian Path**” and “**Sitting Places**” that represent by orange color.
- To define a good place for green areas, we choose areas with more than 400 kWh/m2 per year and show the by greenish color.
- Since most of the time, the area that are suitable to sit is an area that is good to grow trees and plants, we make a union between “**Sitting Places**” and “**Green Area**” and name it as “**Sitting Places or Green Area**” . It is represented by light green color.
- All the areas that are not belonged to any of the above categories are classified as a place that are “**Mostly in shadows**” all year round.

Since the areas that are suitable for sitting or pedestrian paths and places that are good to be define as green areas share a considerable proportion, we made two pages that one is based on an illustration that green areas are prioritized the other is where the pedestrian paths are prioritized.

Here it is also worth to say that to have a better conclusion about the function of each area in the space, we need to include other factors such as wind comfort analysis too.

Categorizing the spaces with different functions

Prioritizing the Pedestrian Paths



Categorizing the spaces with different functions

Prioritizing the Green Area