RADIANCE WORKSHOP 2019

A DAYLIGHT STUDY OF ZONNESTRAAL SANATORIUM

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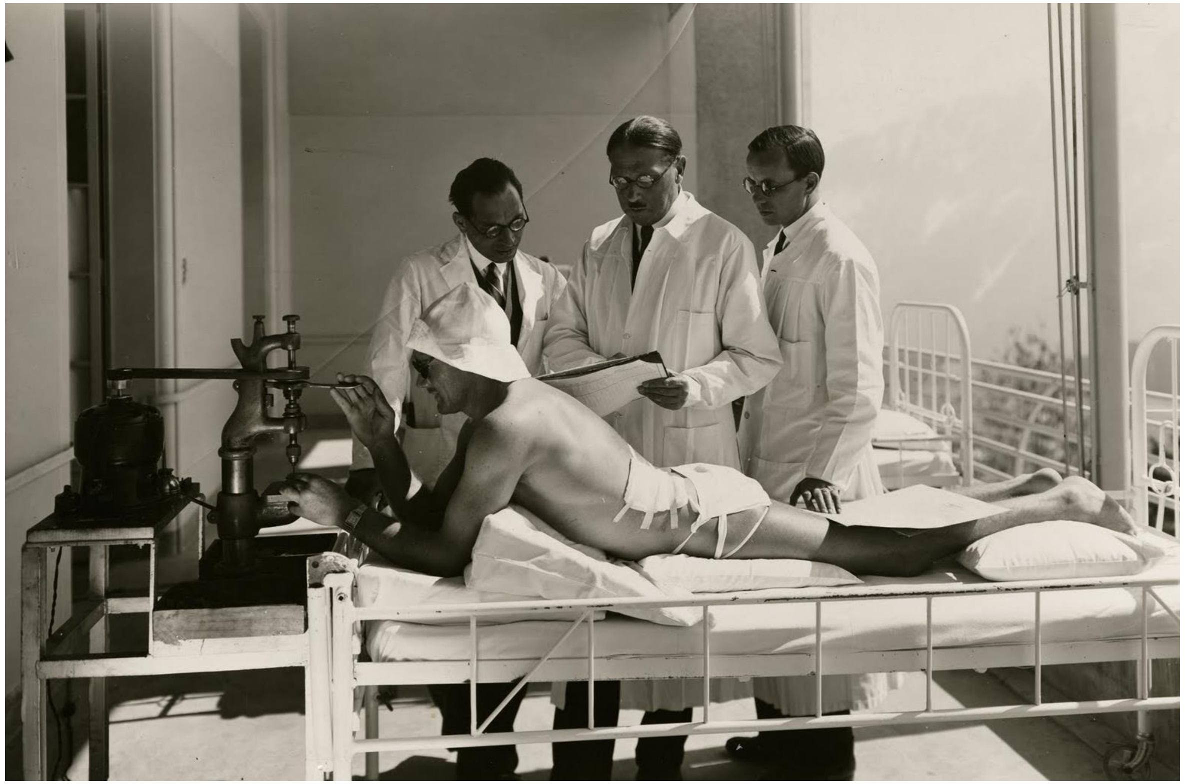
THE MARCH OF THE WHITE PLAGUE.

At the Tuberculosis Exhibition on October 16th, Dr. David Lawson, in the course of a lecture, stated that in Ireland the death-rate from consumption was "THE HIGHEST IN THE CIVILISED WORLD."

Is there no Law to compel House Owners to clean, paper and paint their property at least every five years. We know cases where houses have not been papered or painted for twenty-five years or more, and that consumptives have died in two or three different families during that period. Had the House Owner or Agent been compelled to do his duty, the spread of the disease would have been checked.

Respectfully dedicated to the Public Health Committee, City Hall.

DAYLIGHT AND FRESH AIR



Physical resistance was a crucial factor
Only recourse against tuberculosis was prolonged rest, fresh air, nutritious diet and daylight

ZONNESTRAAL SANATORIUM

LOCATION

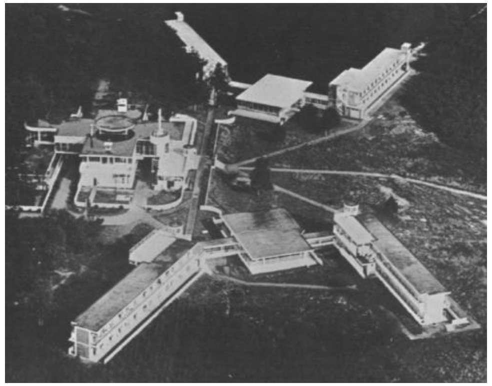
HILVERSUM, NETHERLANDS

TIMELINE

1919

Completion of the main building and pavillions

Treatment of patients starts



1928-1931

Johannes Duiker

Bernhard Bijvoet

Architects Johannes Duiker and Bernhard Bijvoet are assigned the task of designing the sanatorium

1969

Treatment stops and the building is forgotten

2001

Restoration is initiated by architects Hubert Jan Henket and Wessel de Jonge

Hubert Jan Henket

Wessel de Jonge

2010

Restoration is completed Facilities are in use again

AIM OF THE STUDY

EXPLORE ZONNESTRAAL SANATORIUM

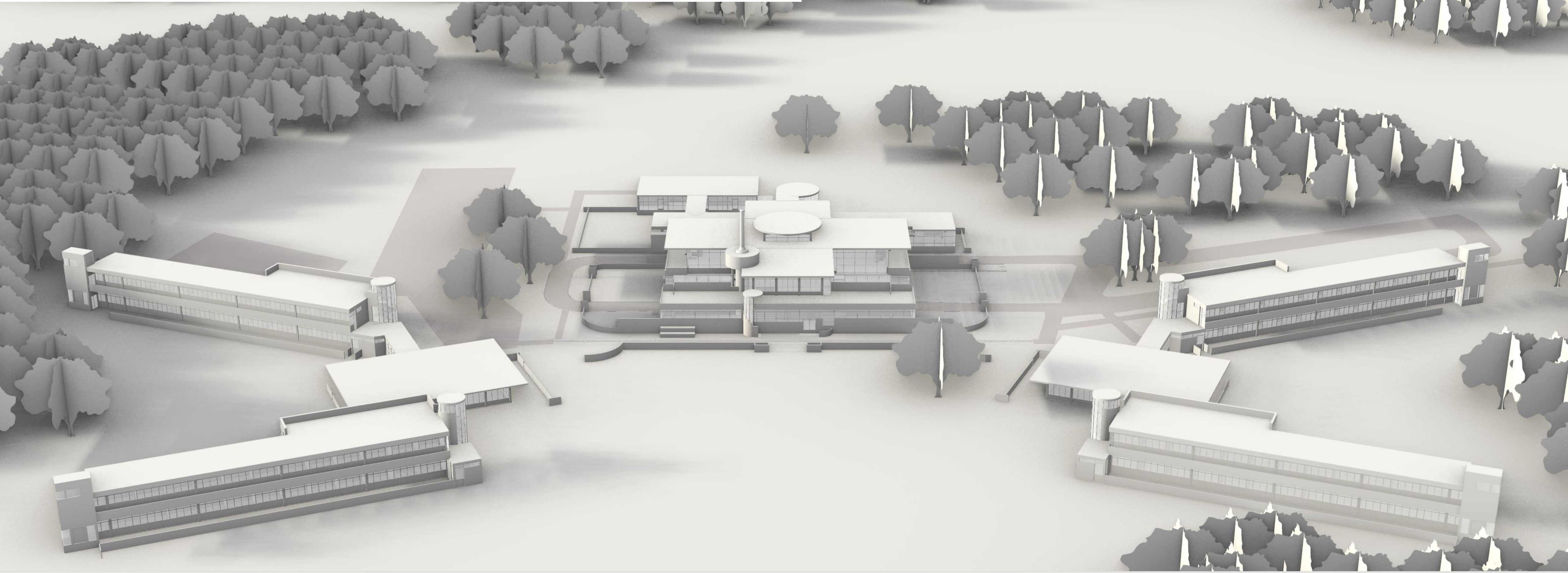
EXPERIMENT WITH RADIANCE

VISUALIZE DAYLIGHT PROVISION

RENDER REALISTIC DAYLIGHT IMAGES

CREATE A **PLAYGROUND** FOR DAYLIGHT STUDIES

MODEL & PROPERTIES

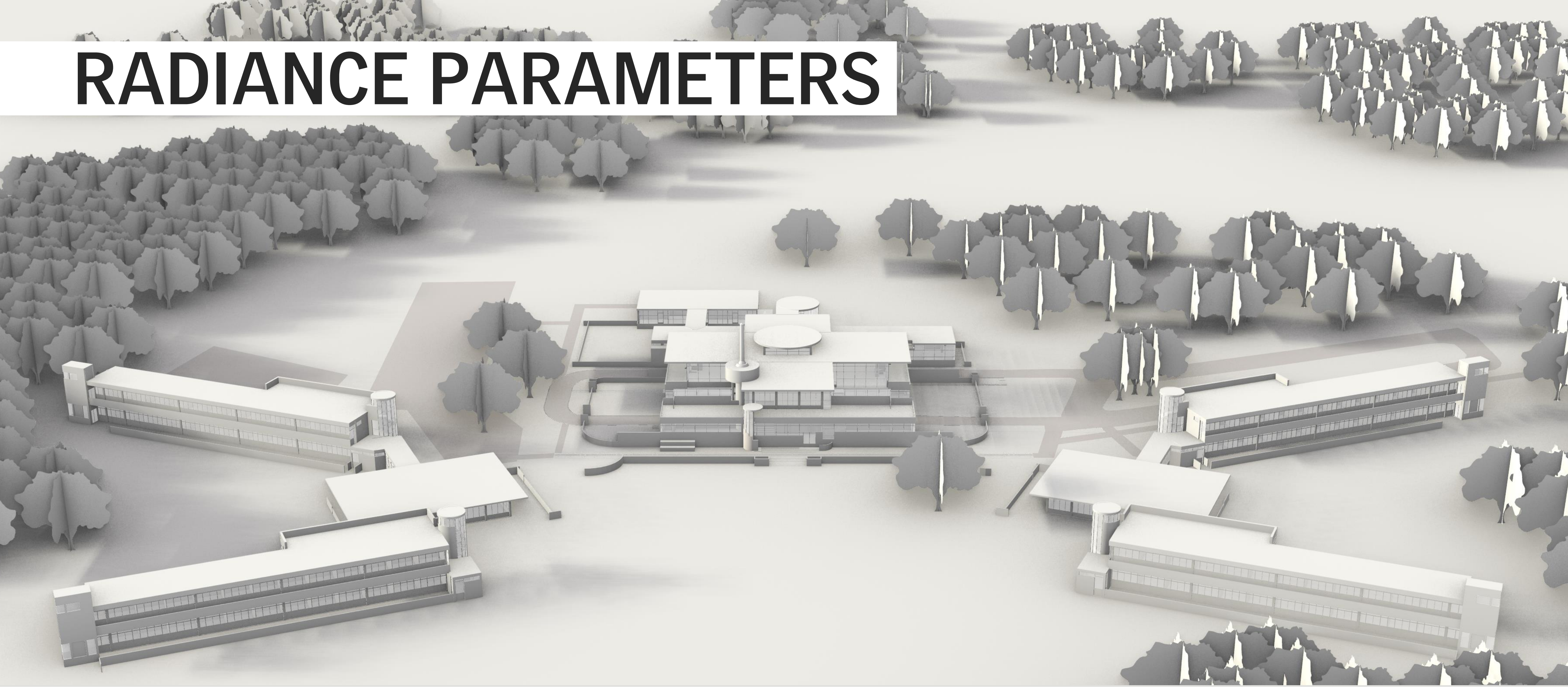


3D model made from 2D CAD drawings delivered by architect Wessel de Jonge

Standard material properties have been applied

The window transmittance has been estimated to $\tau_v = 0.85$

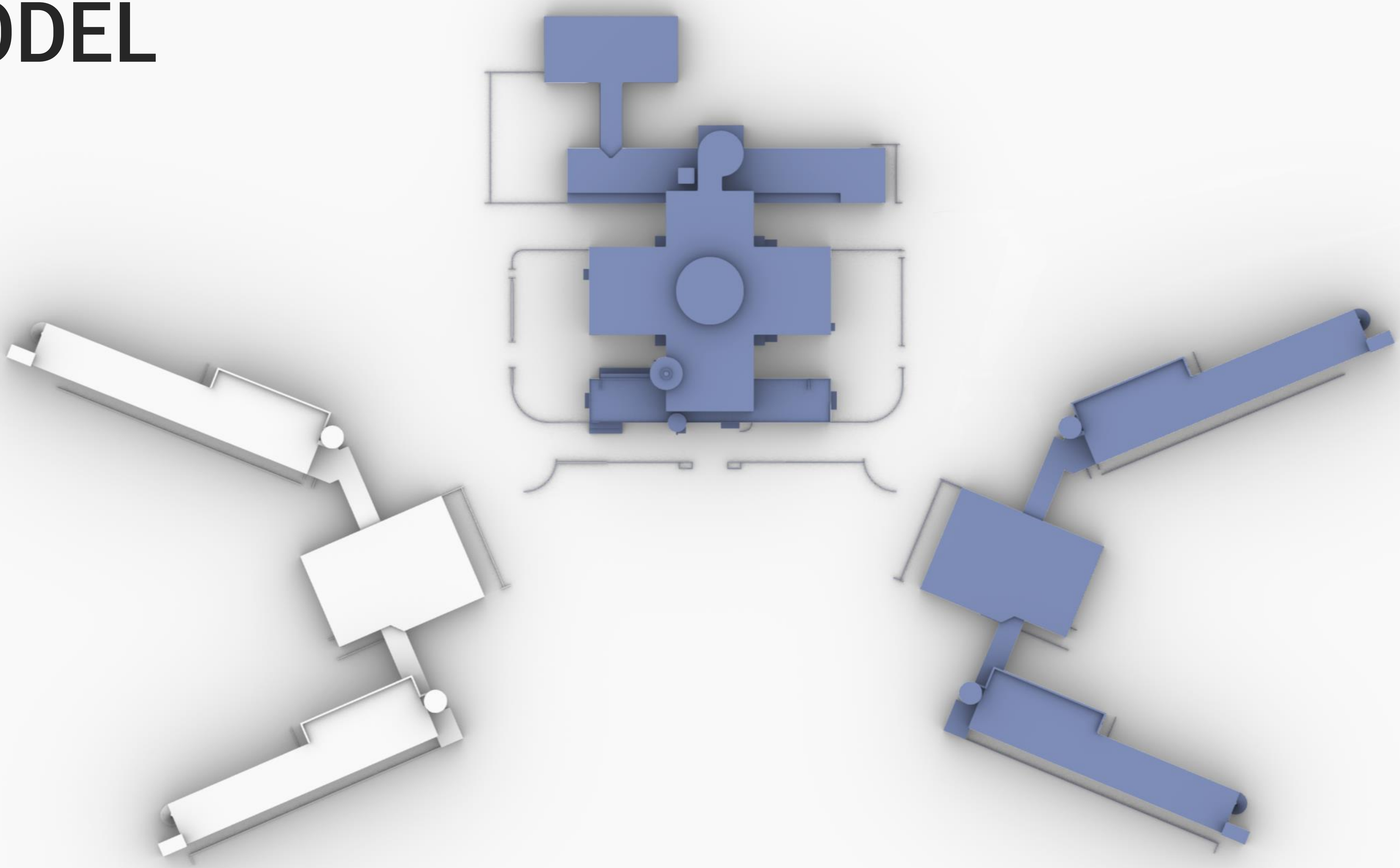
RADIANCE PARAMETERS



The daylight metrics have been simulated with

-ab 5 -ad 2048

MODEL



ANALYSED BUILDINGS

DAYLIGHT FACTOR

MAIN BUILDING 283

MEDIAN DAYLIGHT FACTOR

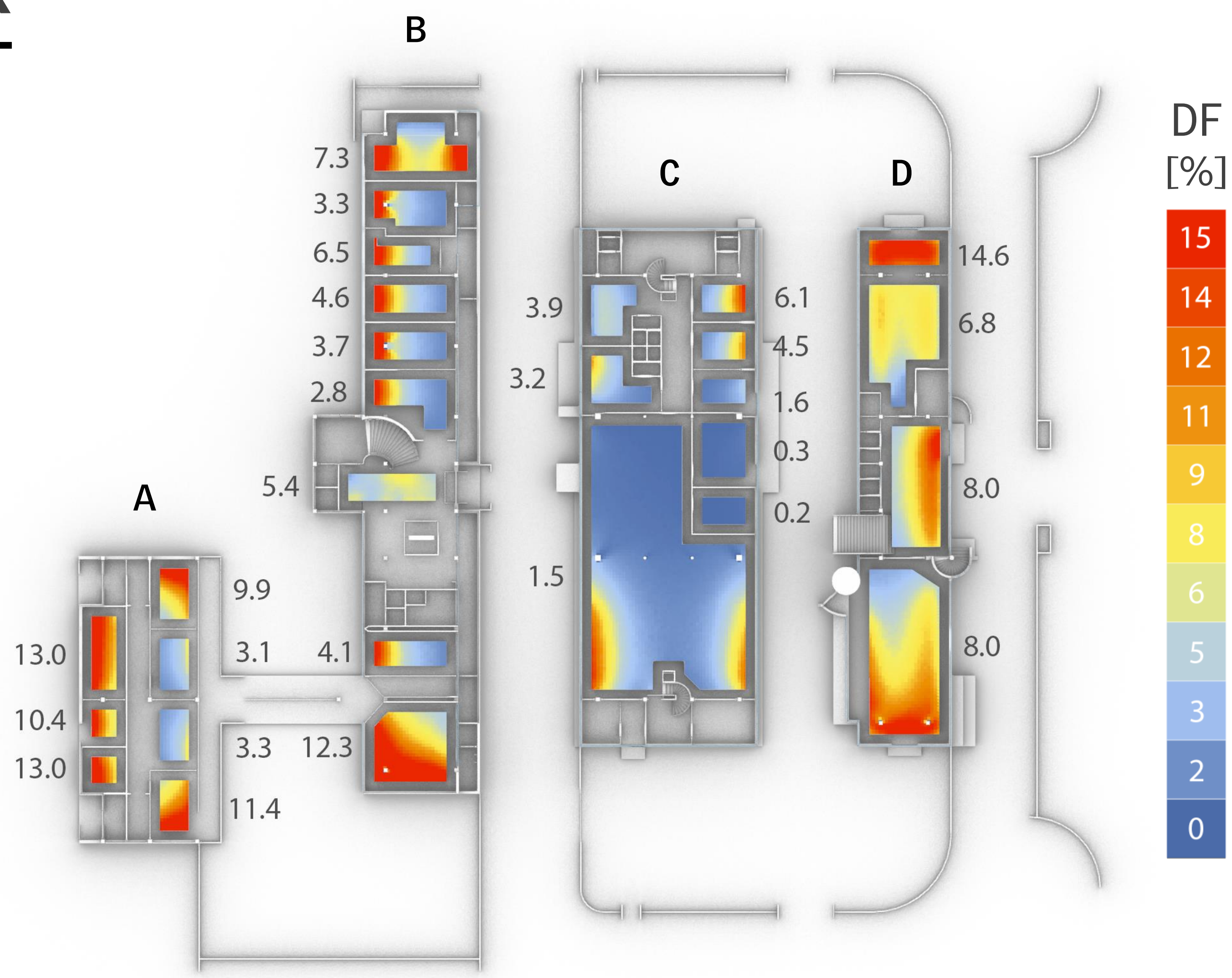
FUNCTIONALITIES

A: STAFF ROOM

B: ADMINISTRATION AND MEDICAL FACILITIES

C: KITCHEN AND UTILITY

D: STORAGE AND BOILER ROOM



GROUND FLOOR

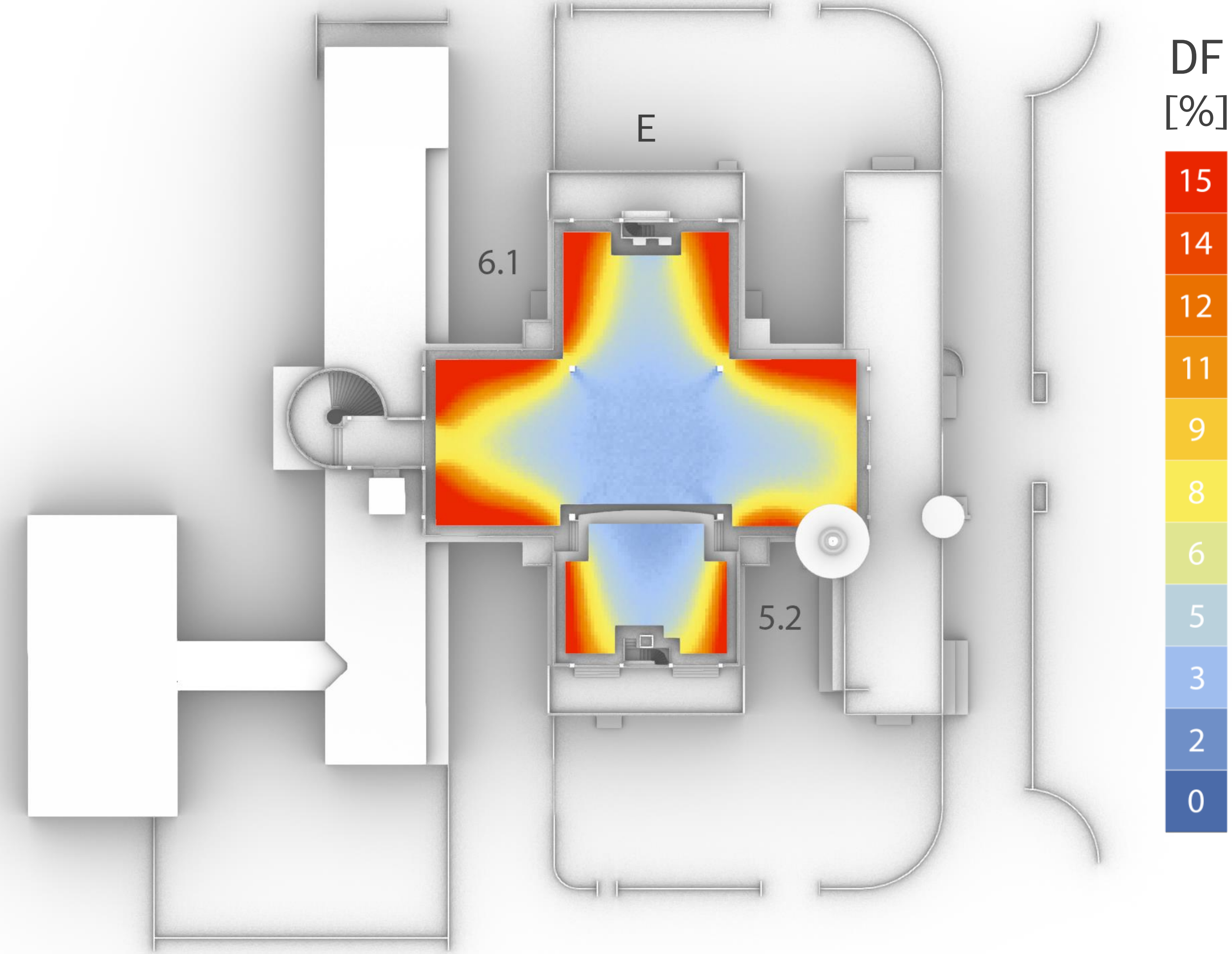
DAYLIGHT FACTOR

MAIN BUILDING 283

MEDIAN DAYLIGHT FACTOR

FUNCTIONALITIES

E: CANTEEN/COMMON ROOM



FIRST FLOOR

DAYLIGHT FACTOR

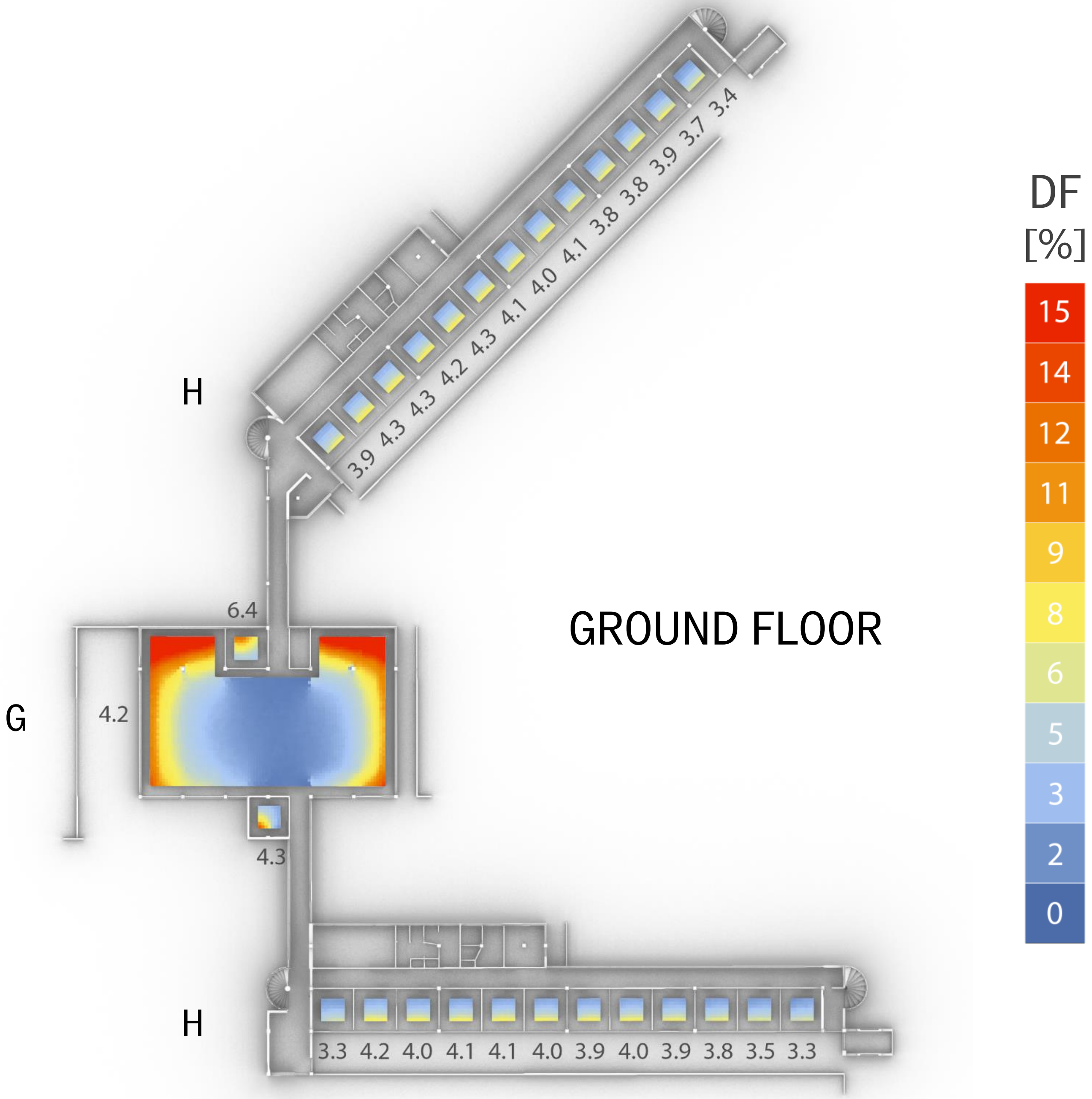
BUILDING 331 EAST PAVILION

MEDIAN DAYLIGHT FACTOR

FUNCTIONALITIES

G: COMMON ROOM

H: PATIENT ROOM



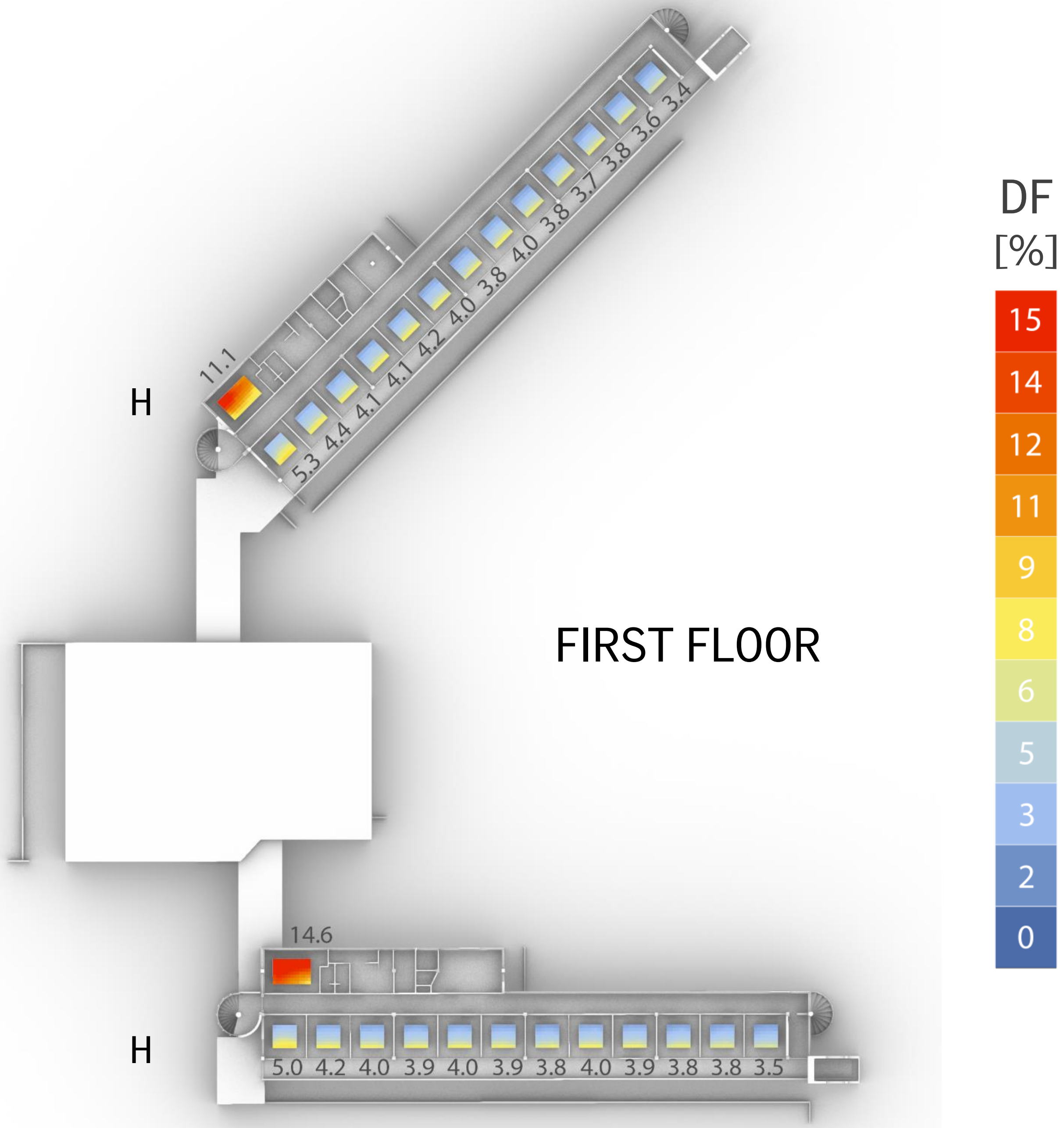
DAYLIGHT FACTOR

BUILDING 331 EAST PAVILION

MEDIAN DAYLIGHT FACTOR

FUNCTIONALITIES

H: PATIENT ROOM



DAYLIGHT FACTOR

Pros

Simple calculation

Can be done without time-, location- and weather information

Cons

Does not consider the contribution of direct sun

Can not be used to describe illuminance levels of specific hours, days and months

Results are independent of orientation, time of day, weather and climate

CLIMATE BASED ANALYSIS

Daylight Autonomy (DA)

Time- and location dependent, using statistical weather data to simulate changing weather and seasons.

DAYLIGHT AUTONOMY (DA)

The percentage of annually, occupied hours a surface receives illuminance above a certain threshold.

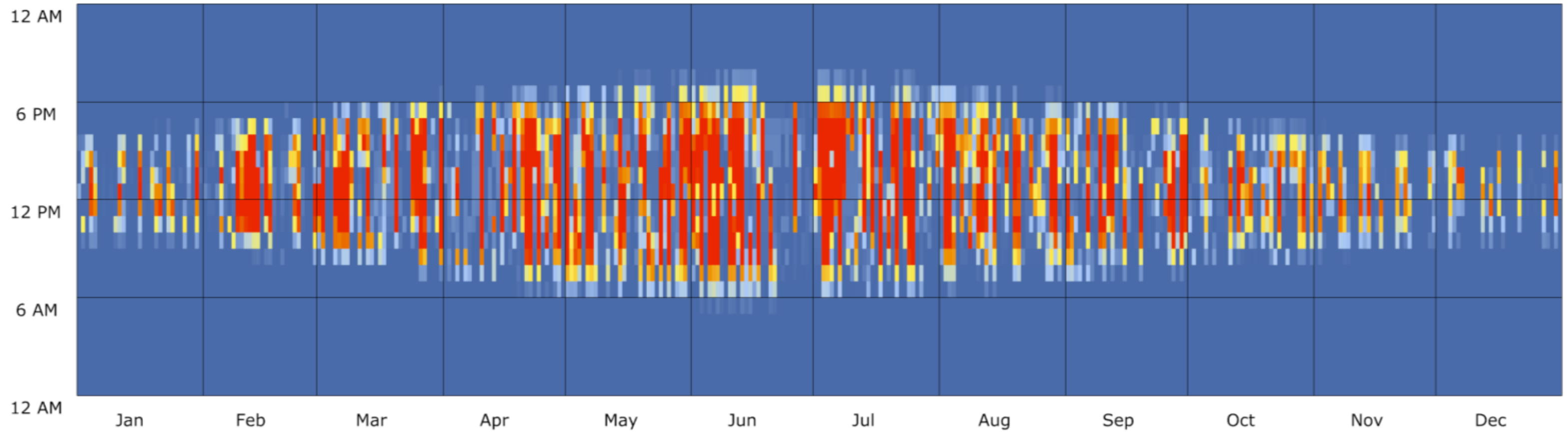
300 lux
500 lux
1 000 lux

Occupied hours has been defined as half of the annual hours

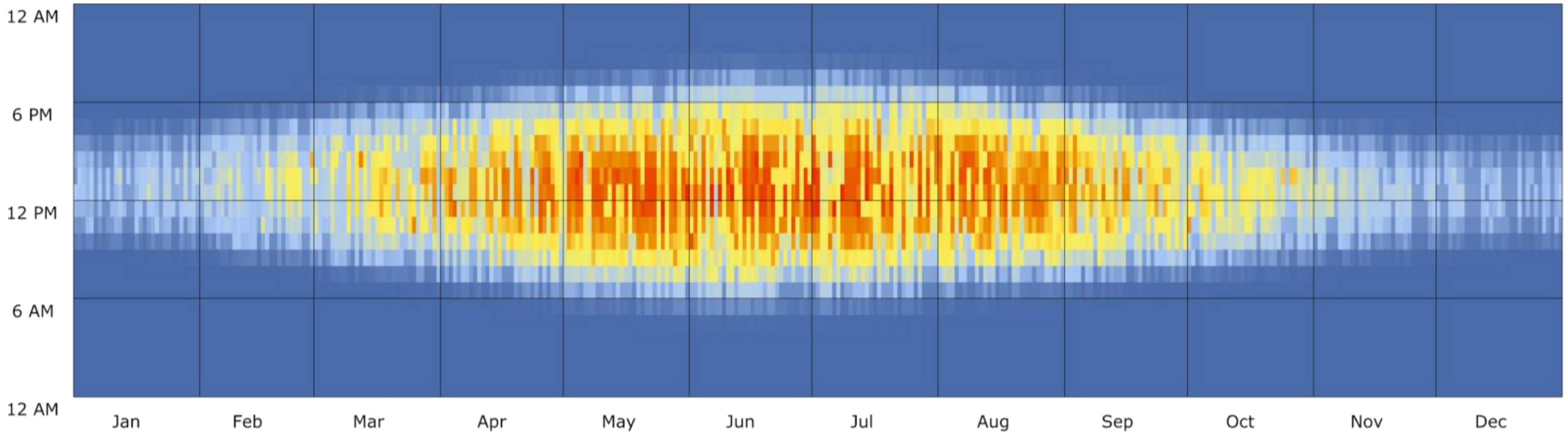
CLIMATE DATA

AMSTERDAM, NETHERLANDS
1. JAN 1:00 – 31. DEC 24:00 (2009)

Direct Normal
Illuminance (hourly)



Diffuse Horizontal
Illuminance (hourly)

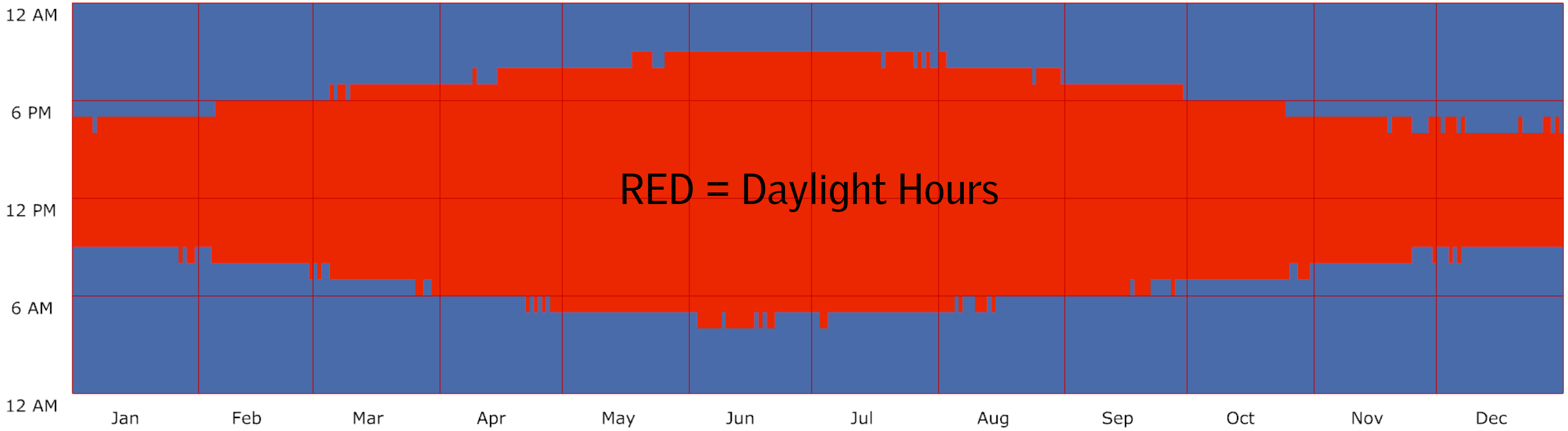


*Weather file available from EnergyPlus.com

CLIMATE DATA

AMSTERDAM, NETHERLANDS
1. JAN 1:00 – 31. DEC 24:00 (2009)

Global Horizontal Illuminance (hourly)



Full year = 8760 hours
Daylight hours = brightest half of year = red 4380 hours
50% of daylight hours is 2190 hours.

EN17037 DAYLIGHT IN BUILDINGS

Table A.1 — Recommendations of daylight provision by daylight openings in vertical and inclined surface

Level of recommendation for vertical and inclined daylight opening	**Target illuminance** E_T lx	**Fraction of space for target level** $F_{plane,\%}$	**Minimum target illuminance** E_{TM} lx	**Fraction of space for minimum target level** $F_{plane,\%}$	**Fraction of daylight hours** $F_{time,\%}$
Minimum	300	50 %	100	95 %	50 %
Medium	500	50 %	300	95 %	50 %
High	750	50 %	500	95 %	50 %

NOTE — Table A.3 gives target daylight factor (D_T) and minimum target daylight factor (D_{TM}) corresponding to target illuminance level and minimum target illuminance, respectively, for the CEN capital cities.

EN17037 DAYLIGHT IN BUILDINGS

Table A.3 — Values of *D* for daylight openings to exceed an illuminance level of 100, 300, 500 or 750 lx for a fraction of daylight hours $F_{time,\%}$ = 50 % for 33 capitals of CEN national members

Nation	**Capital**[a]	**Geographi cal latitude** φ [°]	**Median External Diffuse Illuminance** $E_{v,d,med}$	***D* to exceed 100 lx**	***D* to exceed 300 lx**	***D* to exceed 500 lx**	***D* to exceed 750 lx**
Poland	Warsaw	52,17	14 700	0,7 %	2,0 %	3,4 %	5,1 %
The Netherlands	Amsterdam	52,30	14 400	0,7 %	2,1 %	3,5 %	5,2 %
Germany	Berlin	52,47	13 900	0,7 %	2,2 %	3,6 %	5,4 %
Ireland	Dublin	53,43	14 900	0,7 %	2,0 %	3,4 %	5,0 %
Lithuania	Vilnius	54,88	15 300	0,7 %	2,0 %	3,3 %	4,9 %
Denmark	Copenhagen	55,63	14 200	0,7 %	2,1 %	3,5 %	5,3 %
Latvia	Riga	56,57	13 600	0,7 %	2,2 %	3,7 %	5,5 %
Estonia	Tallinn	59,25	13 600	0,7 %	2,2 %	3,7 %	5,5 %
Sweden	Stockholm	59,65	12 100	0,8 %	2,5 %	4,1 %	6,2 %
Norway	Oslo	59,90	12 400	0,8 %	2,4 %	4,0 %	6,0 %
Finland	Helsinki	60,32	13 500	0,7 %	2,2 %	3,7 %	5,6 %
Iceland	Reykjavik	64,13	11 500	0,9 %	2,6 %	4,3 %	6,5 %

[a] Other cities could be added by countries to take into account more precise role of latitude and climate.

DAYLIGHT AUTONOMY

MAIN BUILDING 283

PERCENTAGE OF SPACE ABOVE
1000 LUX THRESHOLD

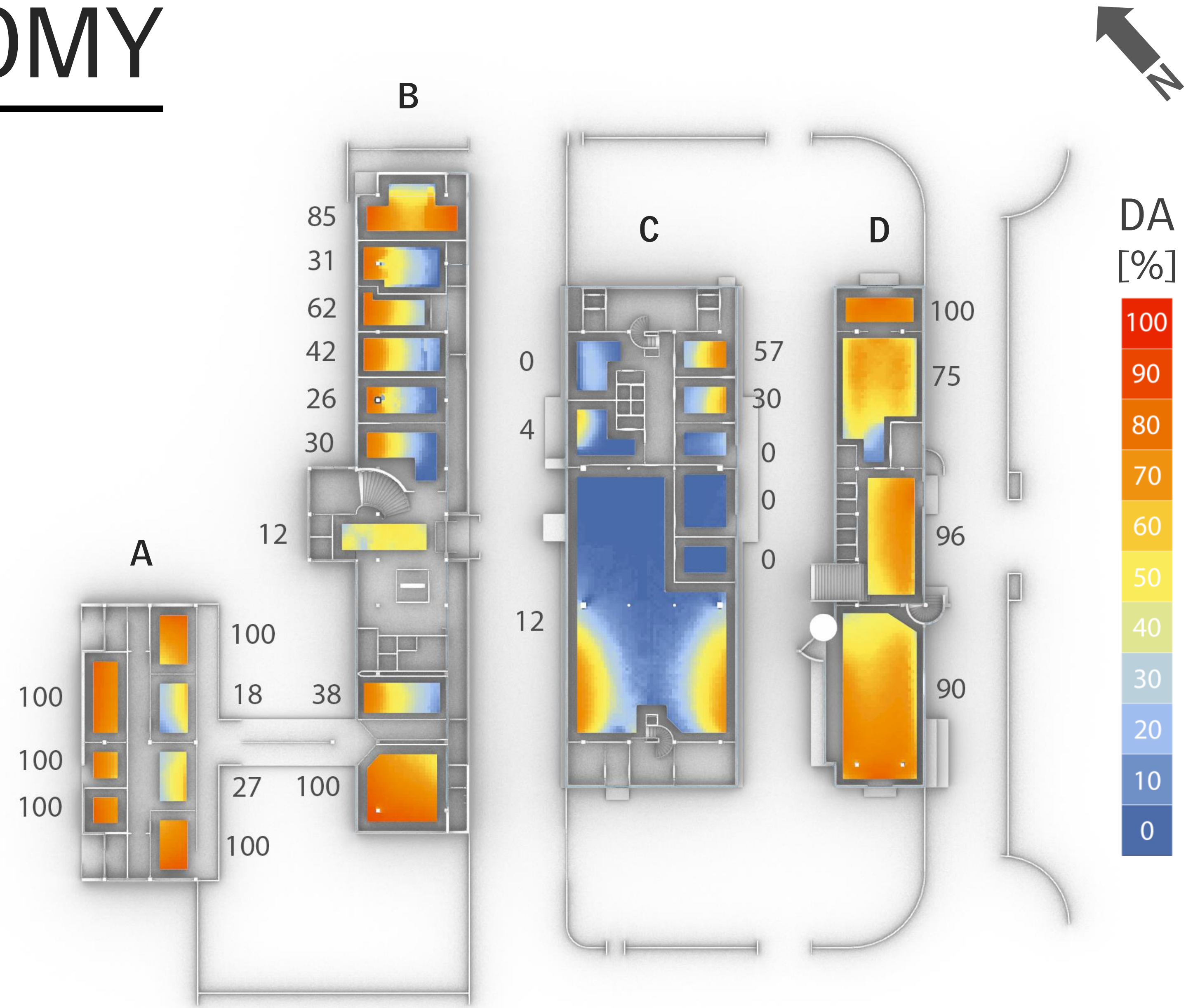
FUNCTIONALITIES

A: STAFF ROOM

B: ADMINISTRATION AND MEDICAL FACILITIES

C: KITCHEN AND UTILITY

D: STORAGE AND BOILER ROOM

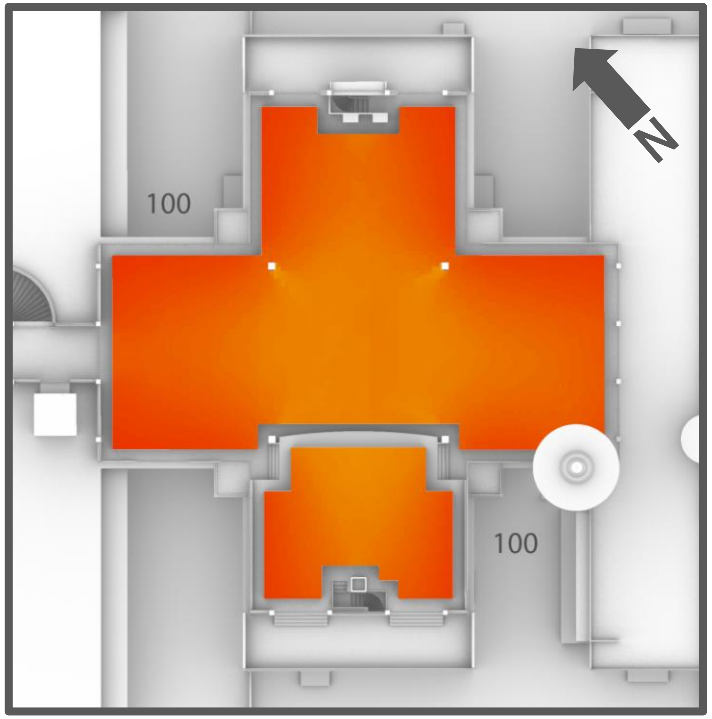


GROUND FLOOR

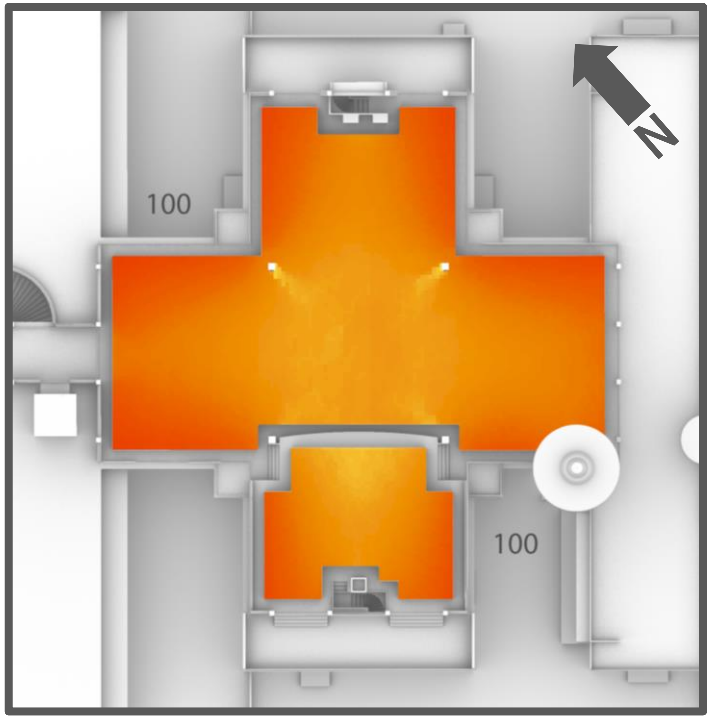
DAYLIGHT AUTONOMY

MAIN BUILDING 283

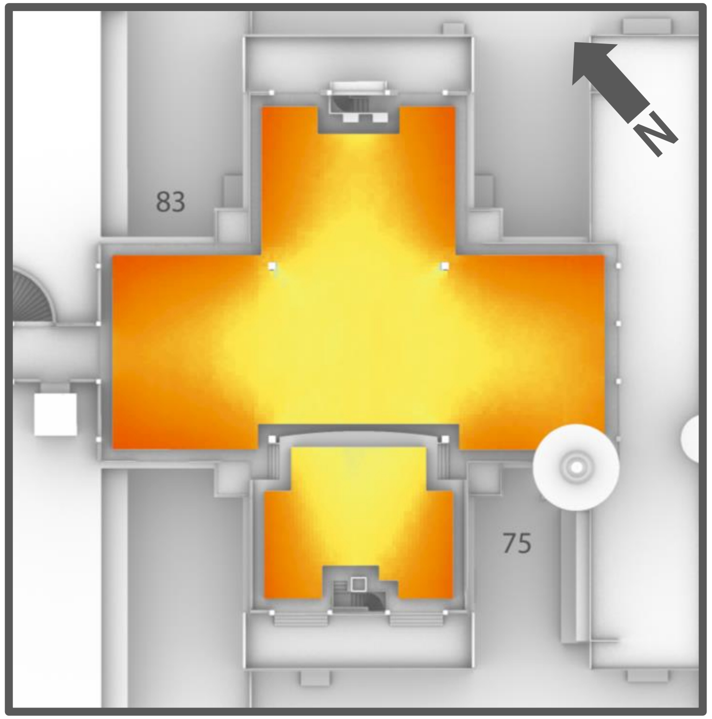
DAYLIGHT AUTONOMY AT DIFFERENT THRESHOLDS



300 lux



500 lux



1000 lux

DAYLIGHT AUTONOMY

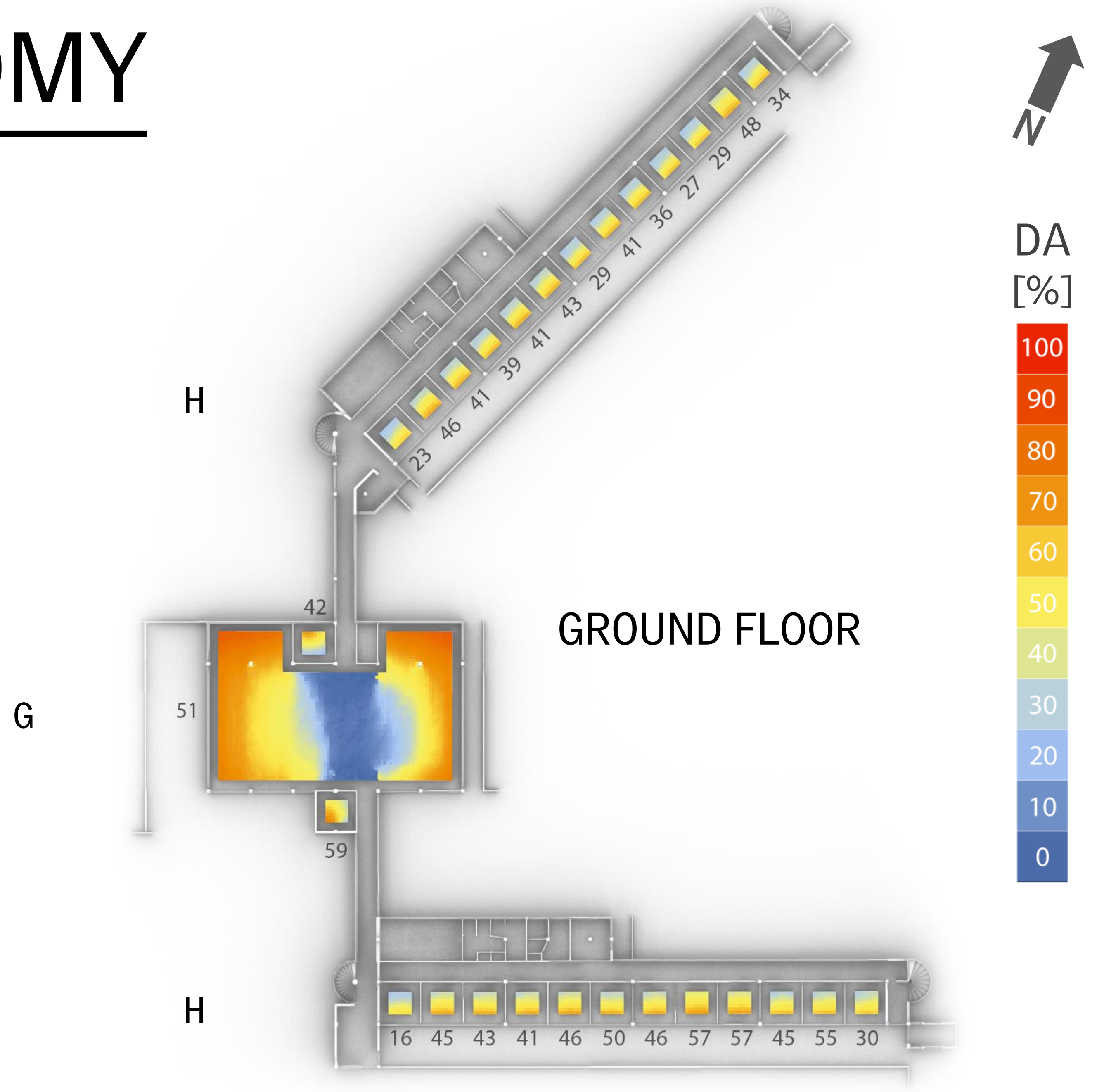
BUILDING 331 EAST PAVILLION

PERCENTAGE OF SPACE ABOVE
1000 LUX THRESHOLD

FUNCTIONALITIES

G: COMMON ROOM

H: PATIENT ROOM



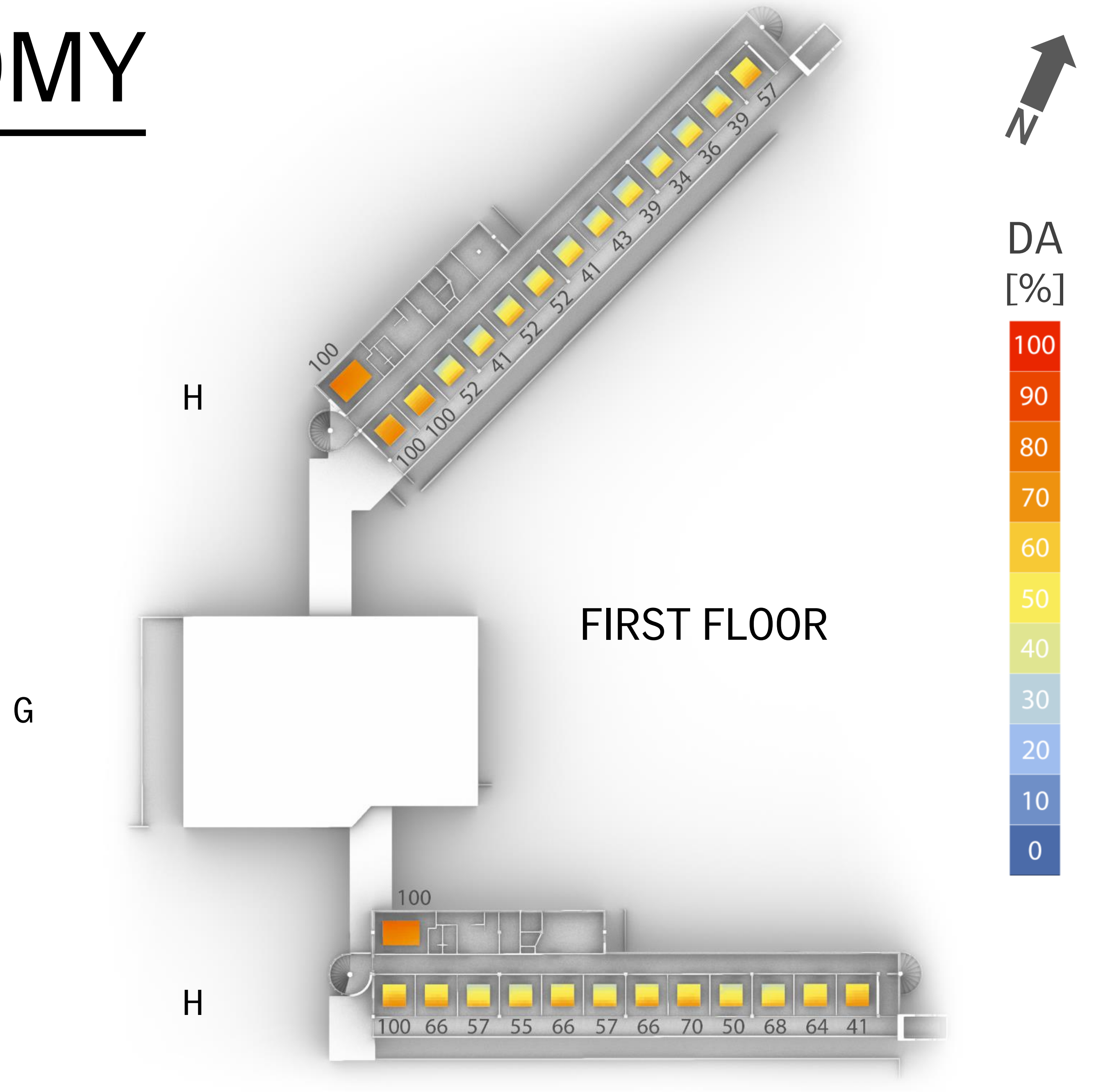
DAYLIGHT AUTONOMY

BUILDING 331 EAST PAVILLION

PERCENTAGE OF SPACE ABOVE
1000 LUX THRESHOLD

FUNCTIONALITIES

H: PATIENT ROOM



The following Radiance parameters have been used for the renderings using -rpict

-x 3840 -y 2160 (4K resolution)
-ab 4 -ad 8000 -as 4000 -aa 0.1 -ar 400

VISUALS

CANTEEN MAIN BUILDING 283

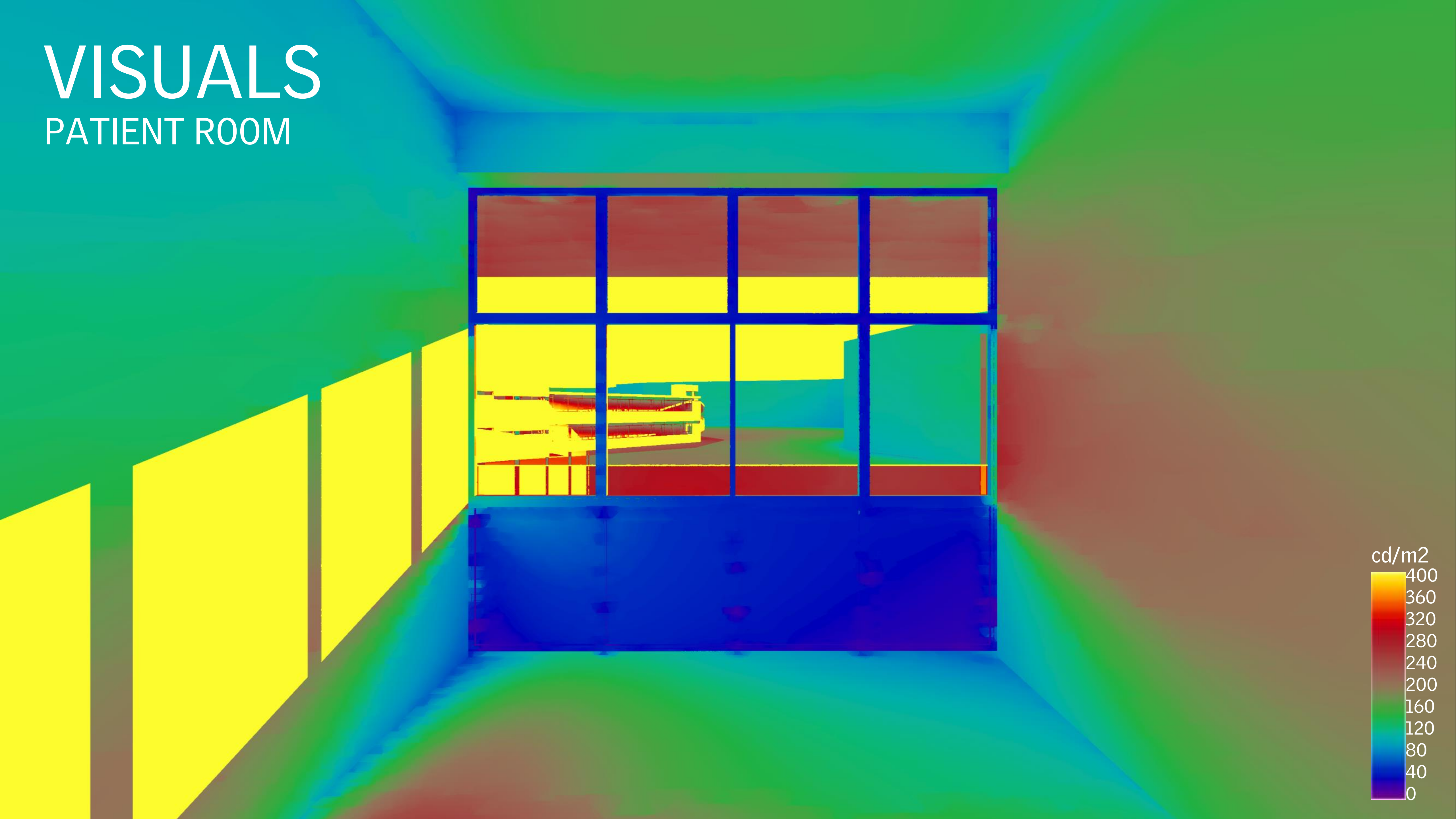
VISUALS

CANTEEN MAIN BUILDING 283

VISUALS

PATIENT ROOM

VISUALS
PATIENT ROOM



VISUALS

VIEW FROM PAVILION LOUNGE


VISUALS
MAIN BUILDING 283 - STAIRCASE
Ground floor

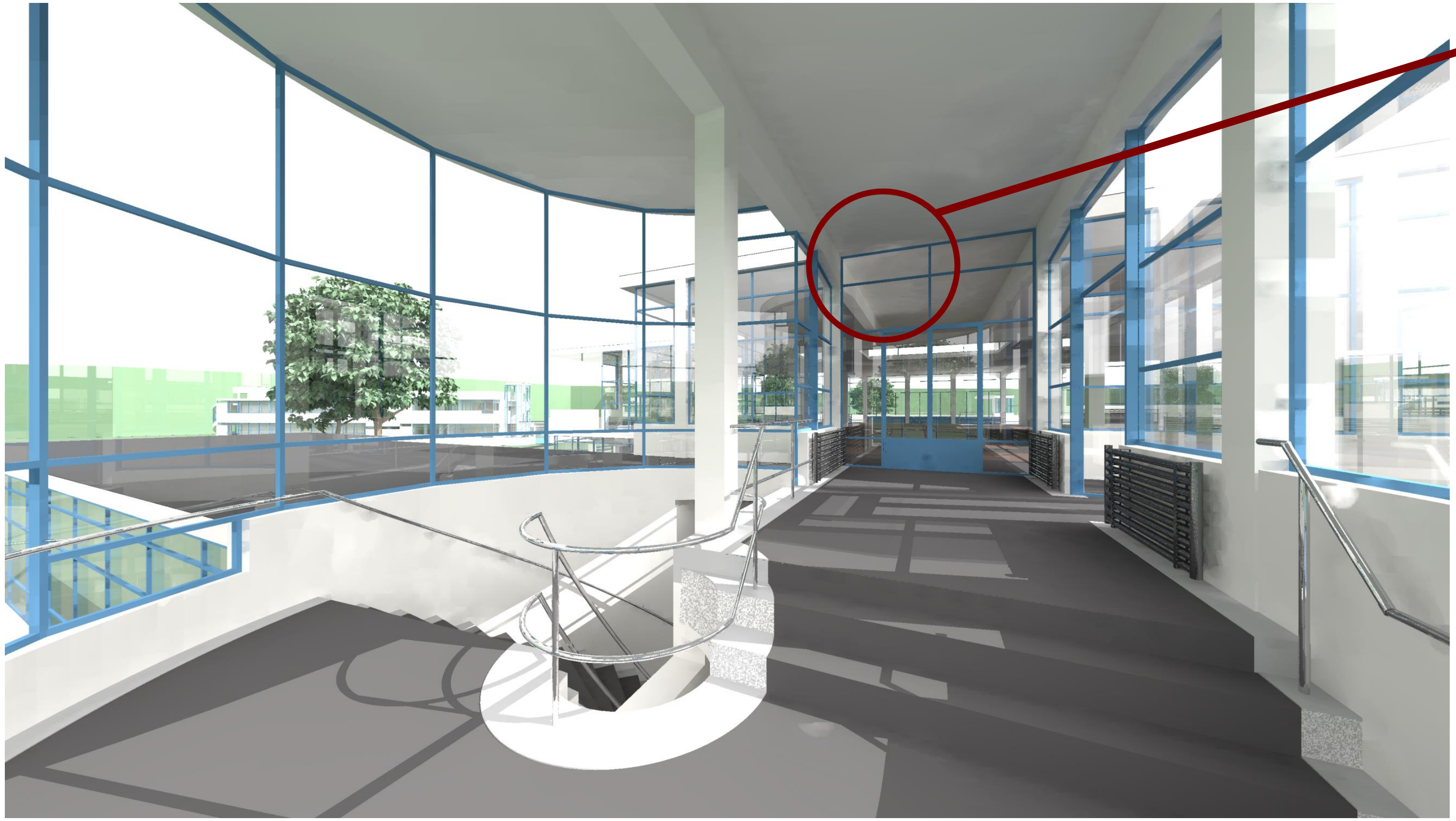
VISUALS

MAIN BUILDING 283 - STAIRCASE

1st Floor

OBSERVATIONS

Model size impacts rendering time and quality



Shading is wrong
in some areas

Radiance parameters

-ar ambient resolution:

Determine the maximum density of ambient values used in interpolation.

OBSERVATIONS

Radiance parameter settings impacts rendering time and quality

"Splotches" of light

Radiance parameters

-ad ambient division

-as ambient super-samples

The error in the Monte Carlo calculation of indirect illuminance is affected by these settings.

OBSERVATIONS

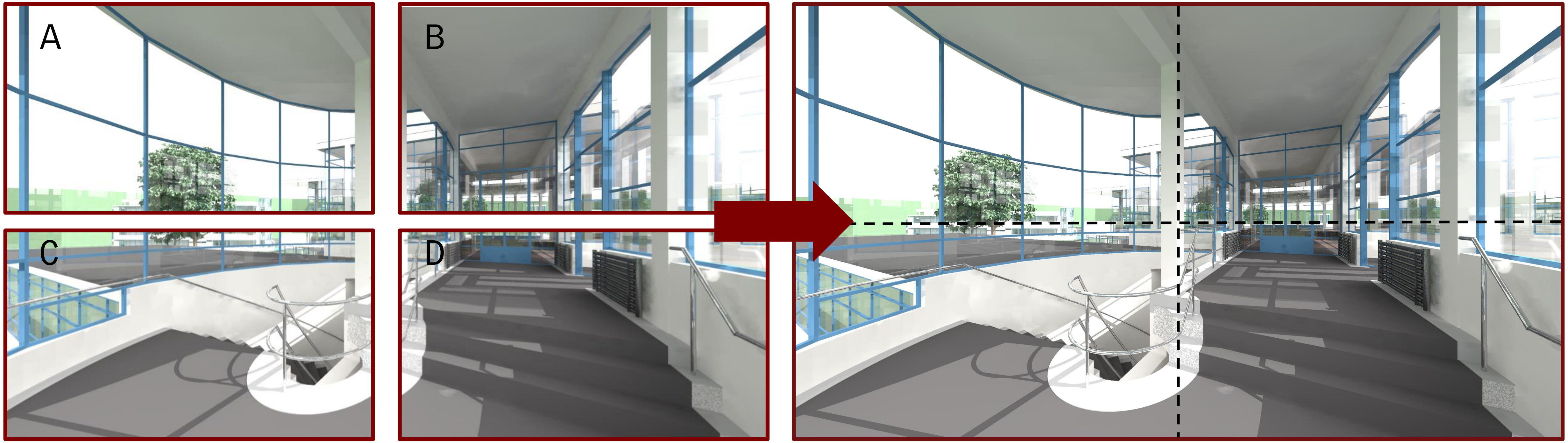
Exterior obstruction has an impact on daylight results

Obstruction should be placed as accurately as possible

Light from the horizon should be blocked

FURTHER STUDIES

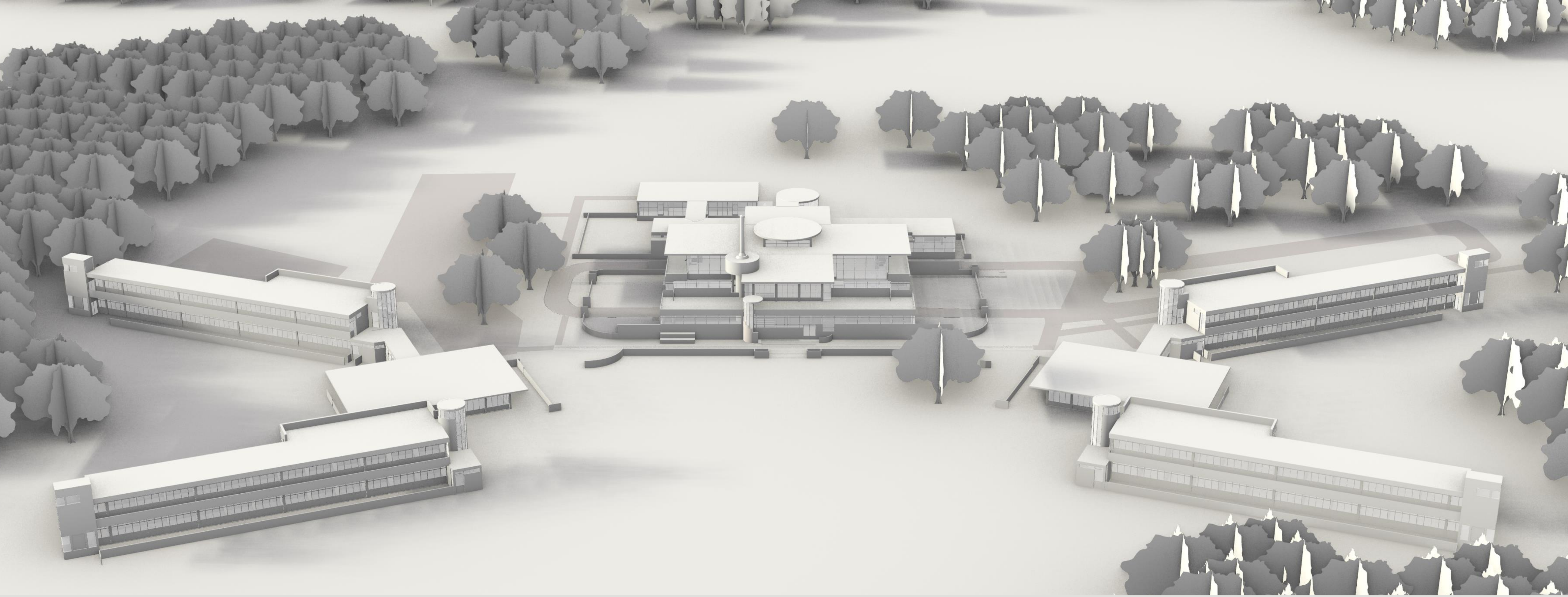
Experiment with –rpiece to generate visuals instead of –rpict



FURTHER STUDIES

Explore glare probability by selecting
highly exposed areas of Zonnestraal Sanatorium

Create VR environment using radiance renderings
for immersive experience.



Model, scripts and images will be available upon email request

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