

Il ruolo di città, architettura, urbanistica, sociologia, ambiente nei Paesi mediterranei ed efficienza energetica sostenibile

Bari, 2 ottobre 2014

Strumenti per la progettazione e casi studio di intervento in ambito internazionale

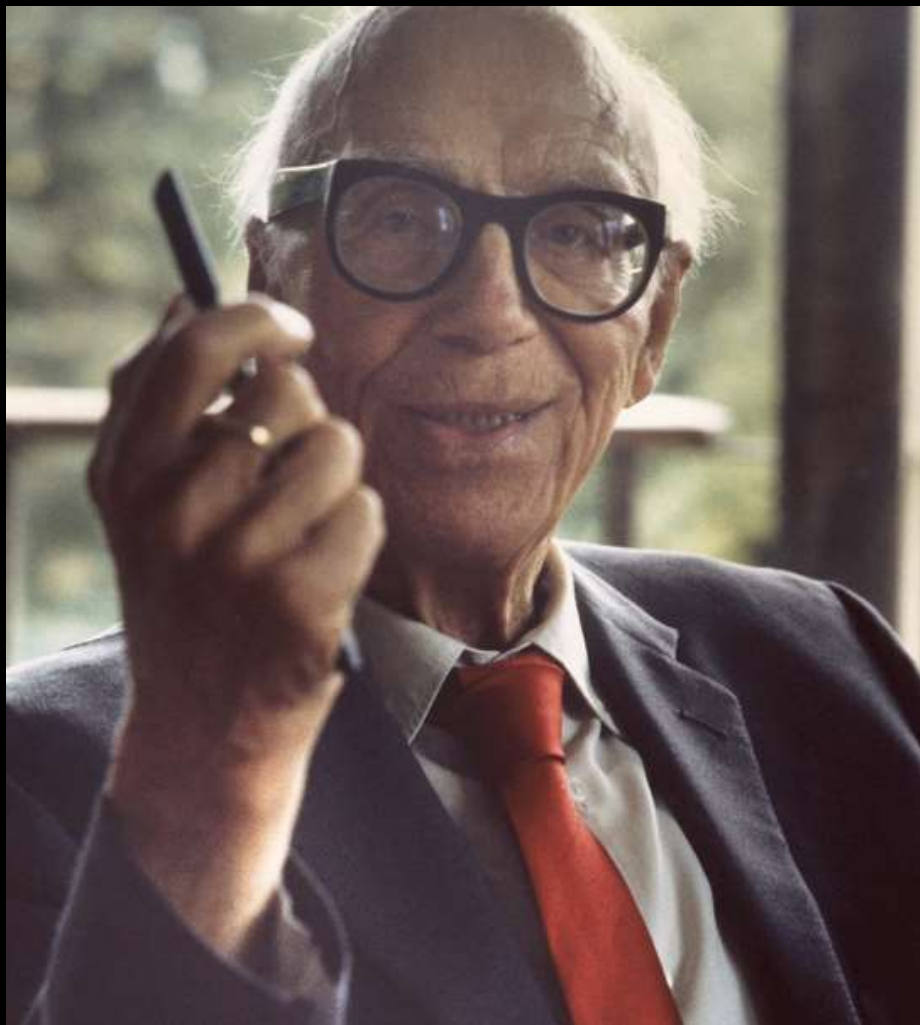
Enrico Zara

Energy Strategies and Building Services discipline leader



Introduction to Arup

Bari 2 Ottobre 2014





Sydney Opera House, Australia



Beijing National Aquatics Centre



CCTV Headquarters,
Beijing, China



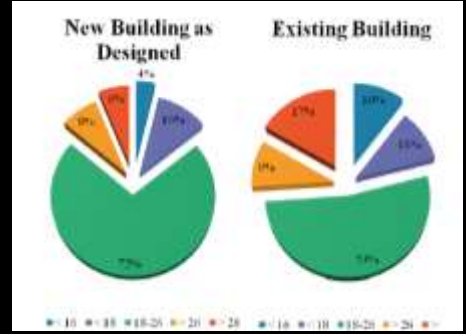
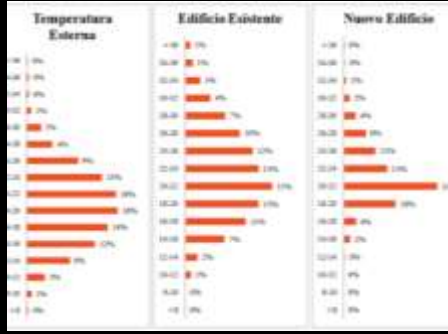
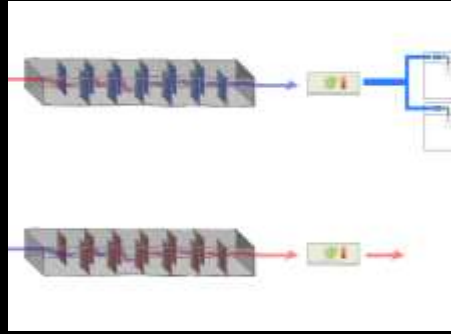
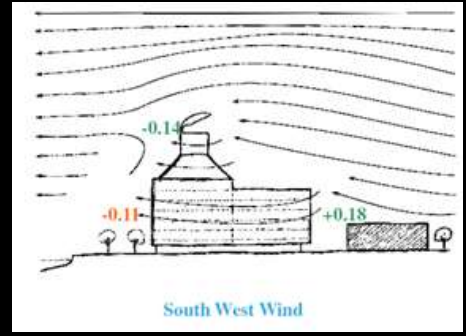
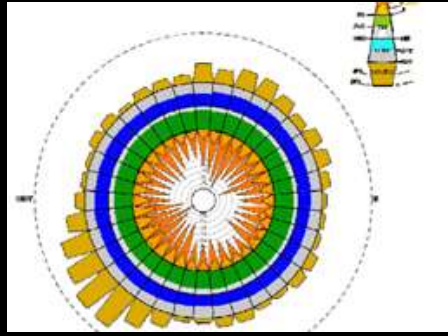
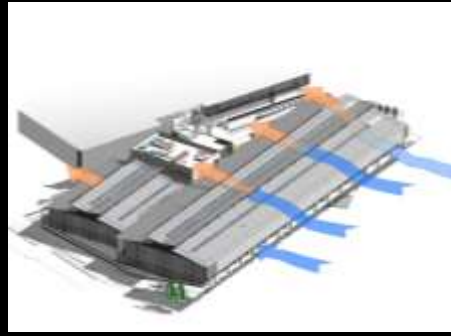
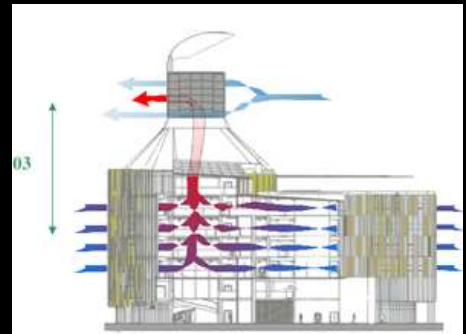
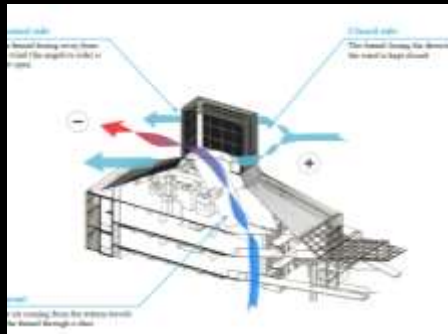
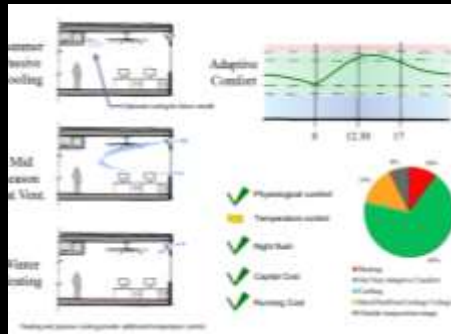
Allianz Arena, Monaco



Beijing Capital Airport,
Terminal 3



Design for Natural Ventilation



ASB Head Quarters

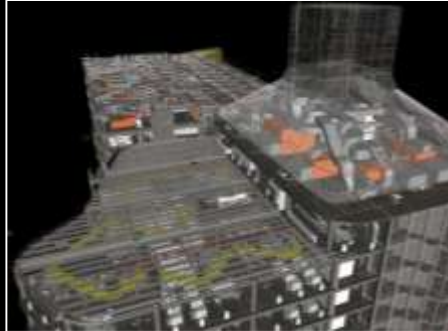
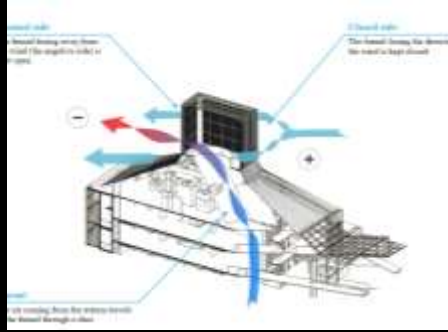
Auckland, New Zealand

- Project to be completed 2013
- Capital cost of NZ\$144m
- Includes 20,000m² office, ground floor retail and cafes, auditorium and BBQ area

ASB HQ Auckland

ARUP scope:

- Sustainable Design
- Mechanical Services
- Electrical Services
- Hydraulic Services
- Lighting
- BIM



ASB HQ

Auckland

Waterfront

BVNArchitects render



ASB HQ

Auckland

Shading devices



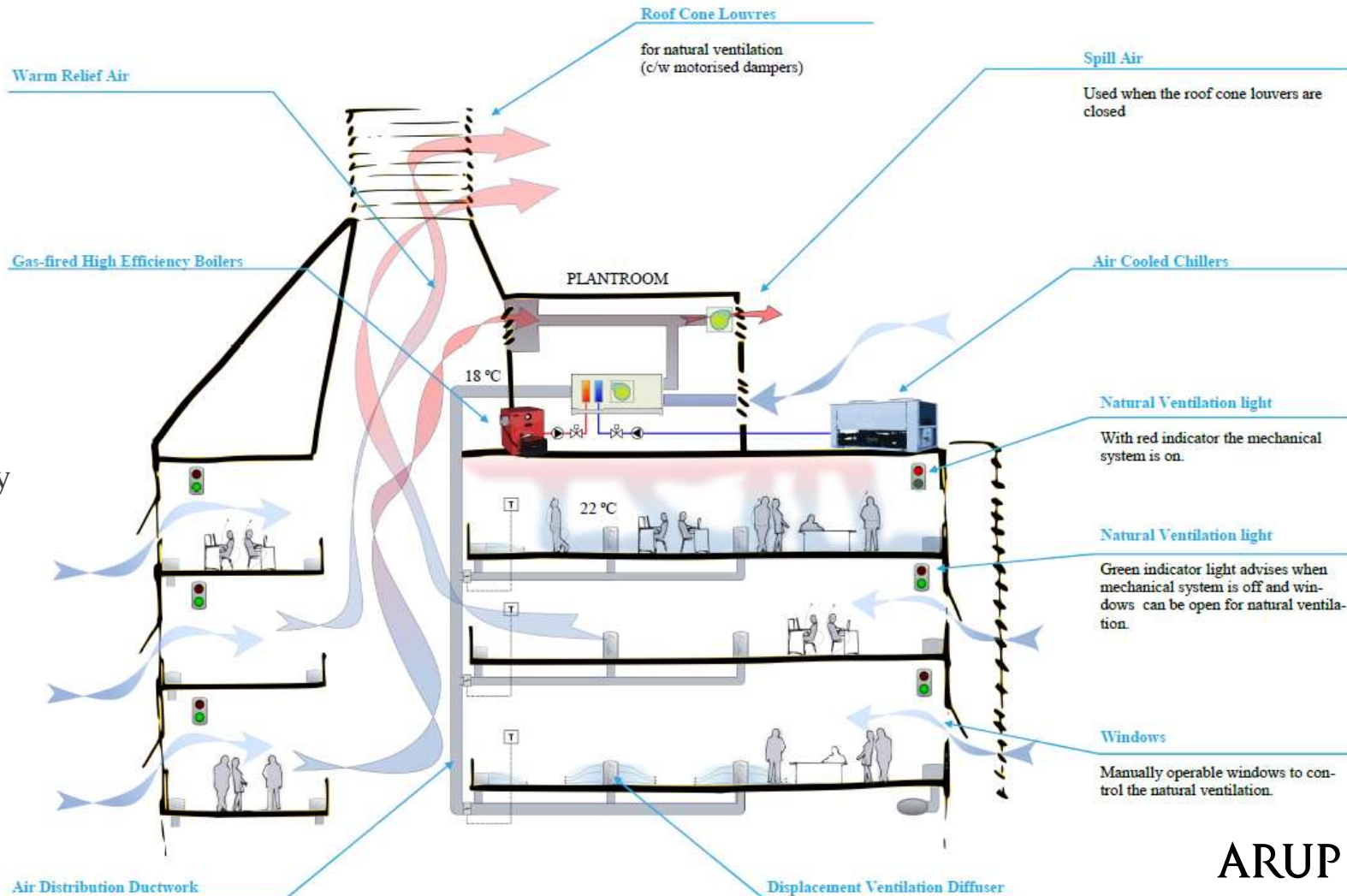
ASB HQ

Auckland



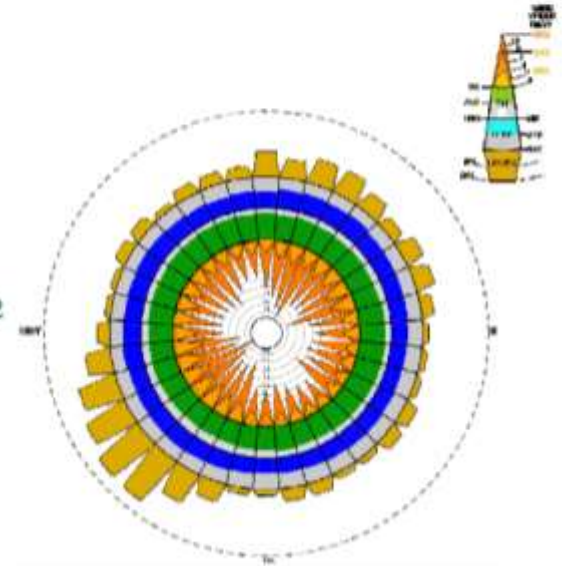
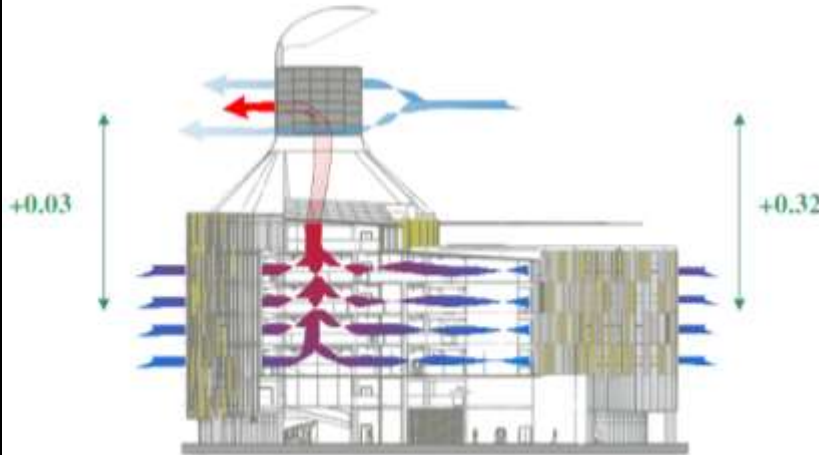
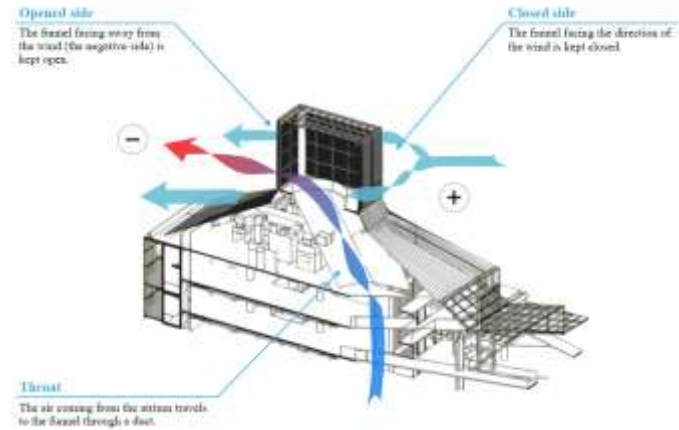
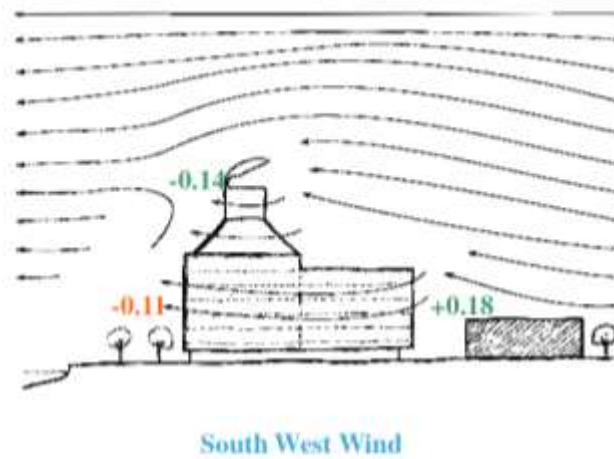
ASB HQ Auckland

Comfort Strategy



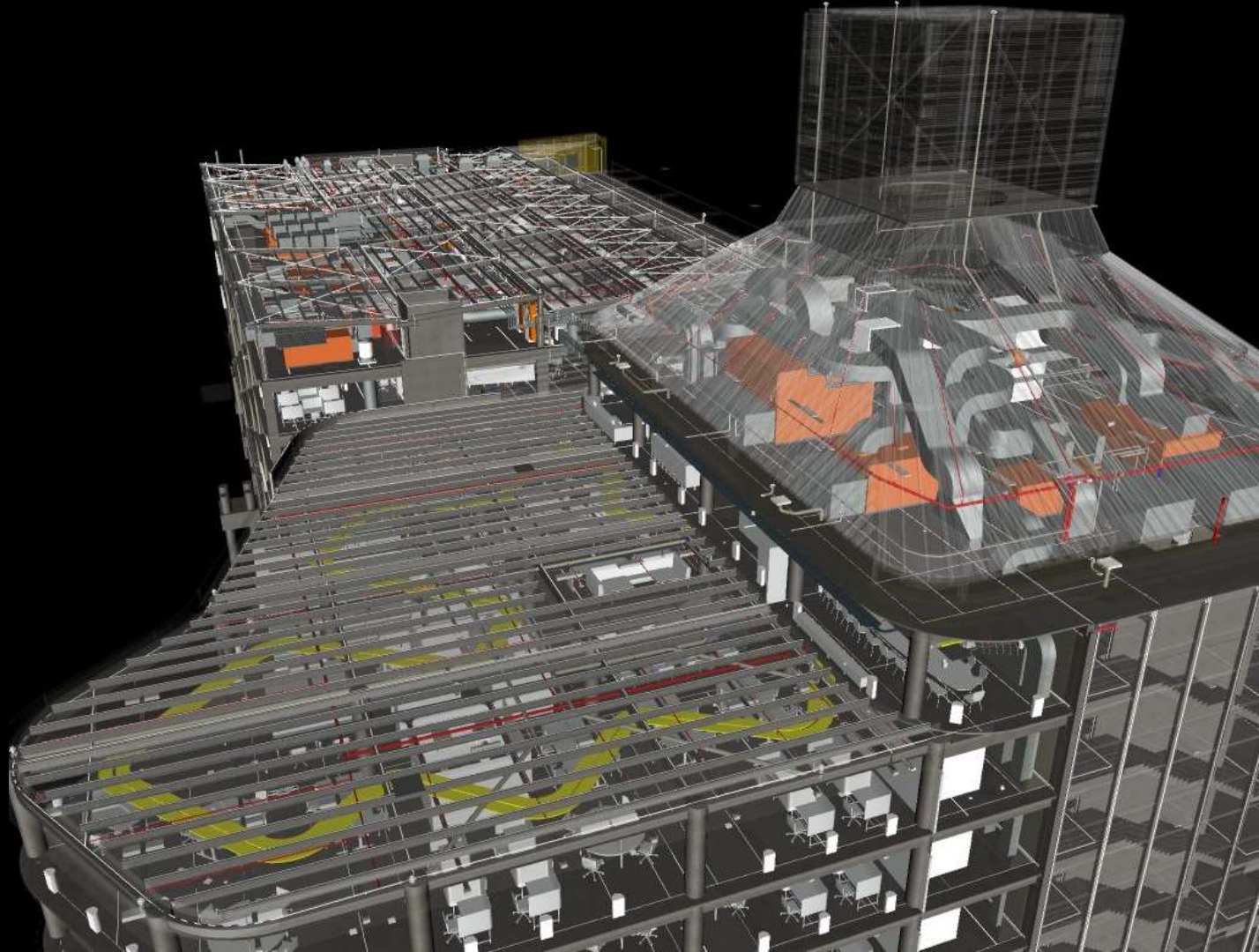
ASB HQ Auckland

Mixed mode strategy and funnel operation



ASB HQ
Auckland

BIM MODEL



ASB HQ

Auckland

http://m.nzherald.co.nz/video.cfm?gallery_id=129053



Derek Shortt
Head of Property, ASB Bank

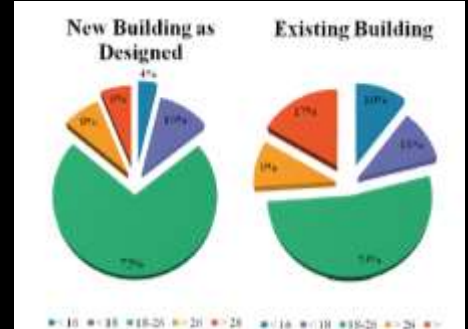
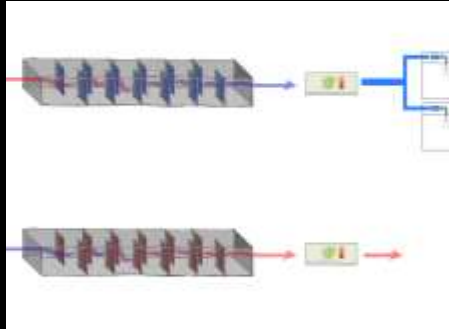
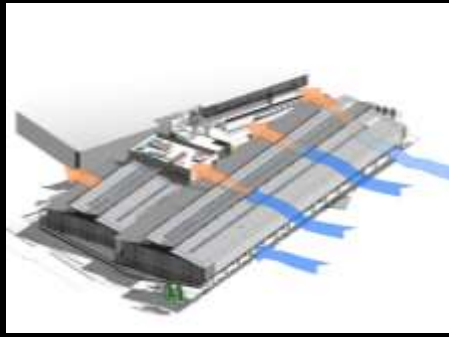
Netball Central

Sydney Olympic Park, Australia

Netball Central Sydney Olympic Park

ARUP scope:

- Sustainable Design
- Structural Design
- MEP Design
- Civil
- Transport
- BIM



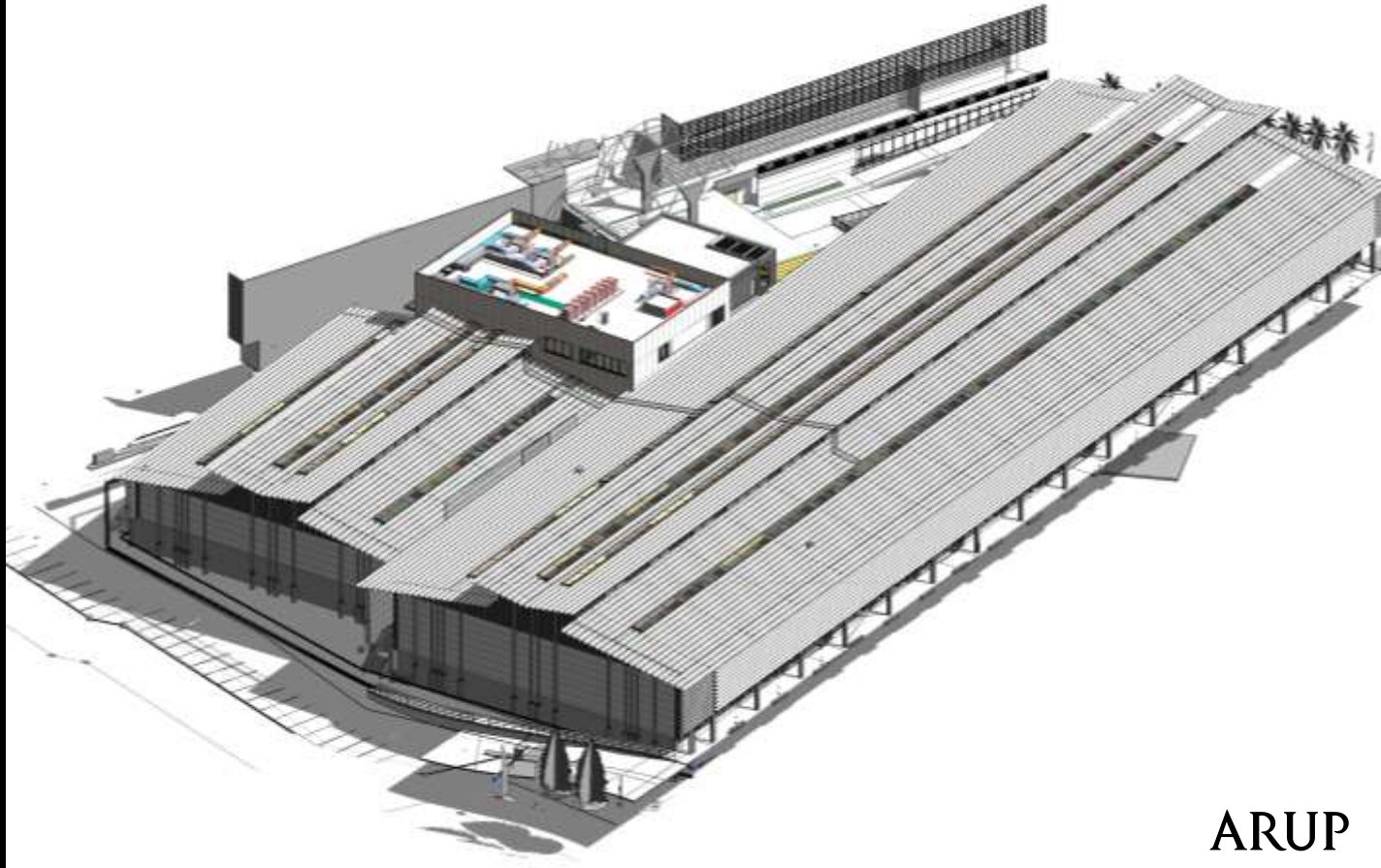
Netball Central
Scott Carver Architects
Vision at Concept Stage



ARUP

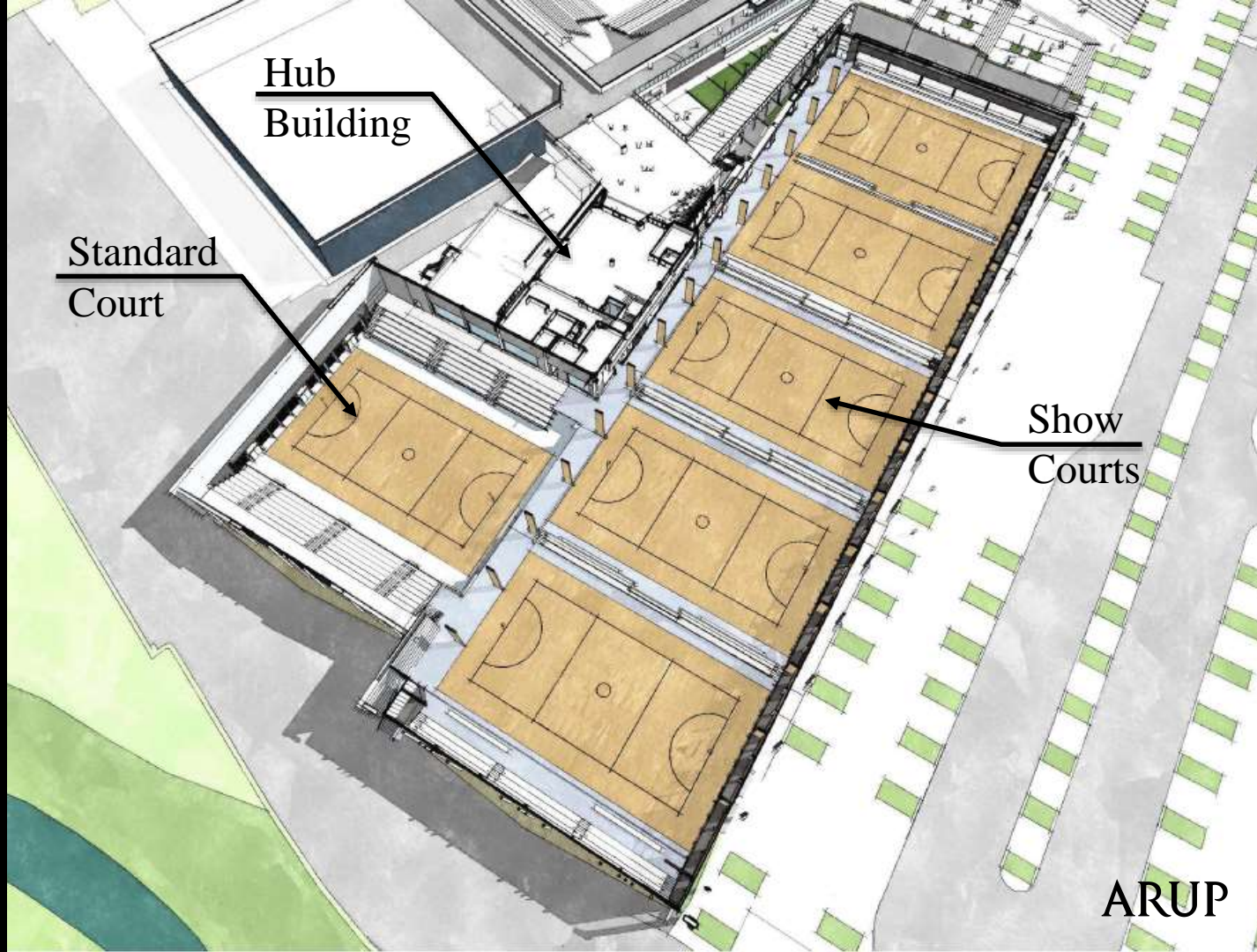
Netball Central

Arch-S-MEP BIM model
at Detail Design phase



Netball Central

- 5 standard courts
- 1 Show court
- 1 Hub Building



Standard Courts



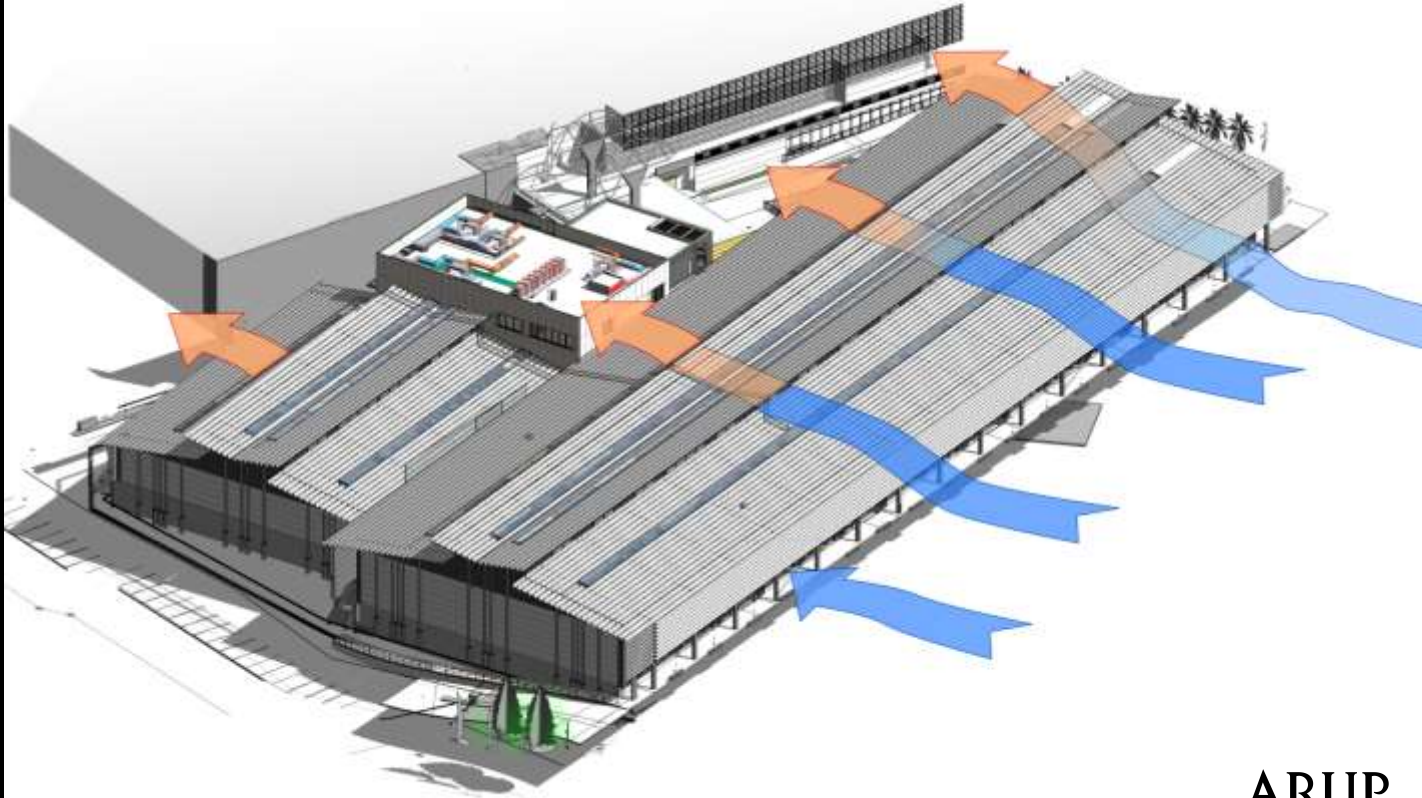
Standard courts



ARUP

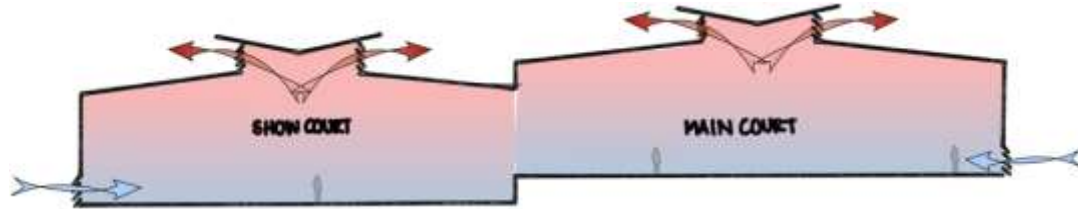
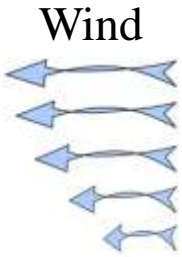
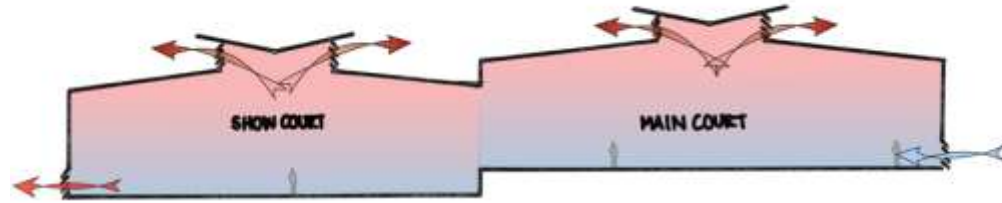
Netball Central

Natural Ventilation Strategy

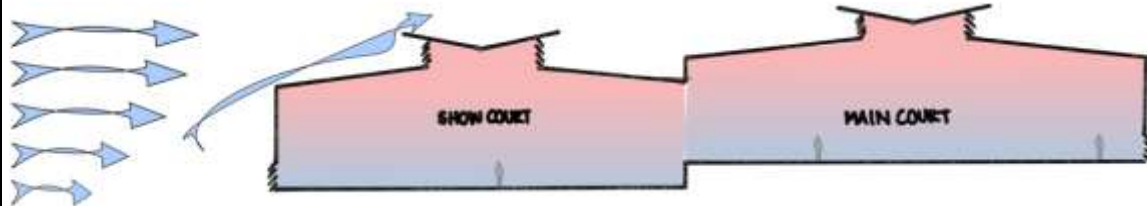


Netball Central

Natural Ventilation Strategy



Stack
Effect



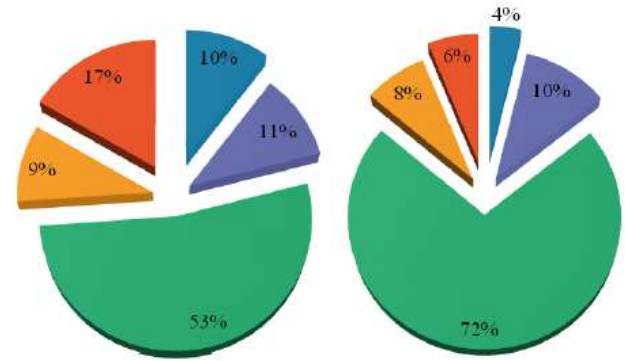
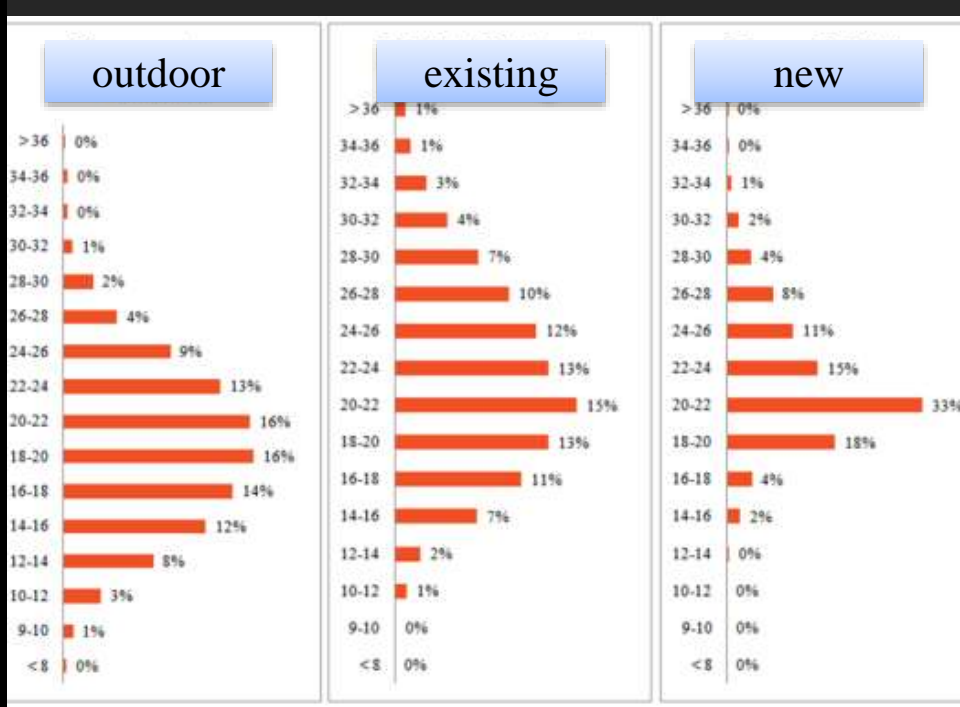
Winter

ARUP

Netball Central

Natural Ventilation Strategy

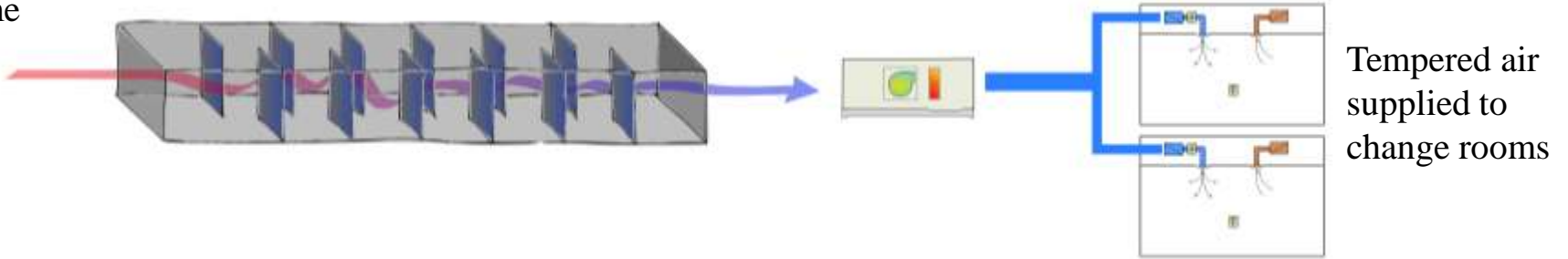
Thermal model results



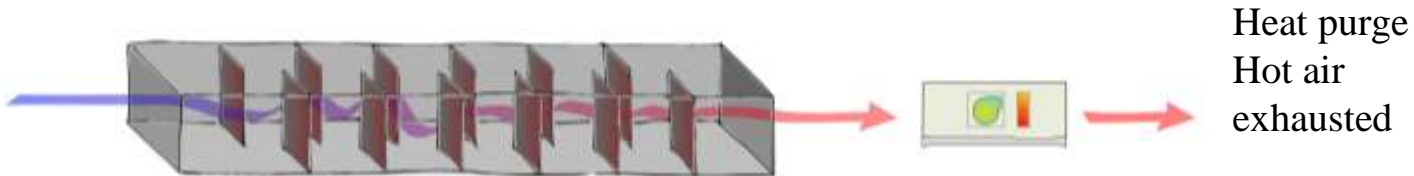
Netball Central - Thermal Labyrinth

During the value engineering phase the architect said: *“we can't remove the thermal labyrinth as it is the key element of the design that is worth mentioning...”*

Day-time

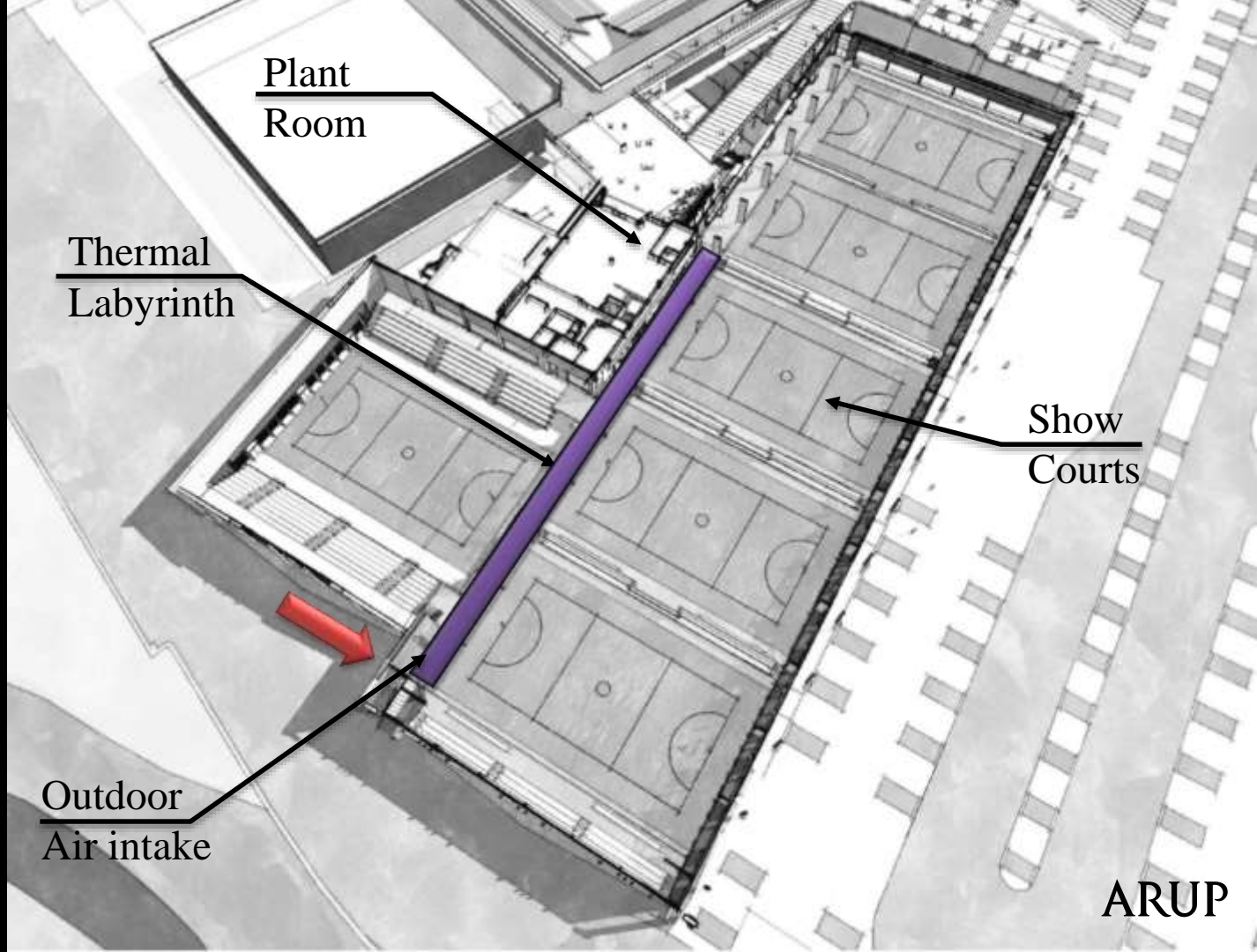


Night-time



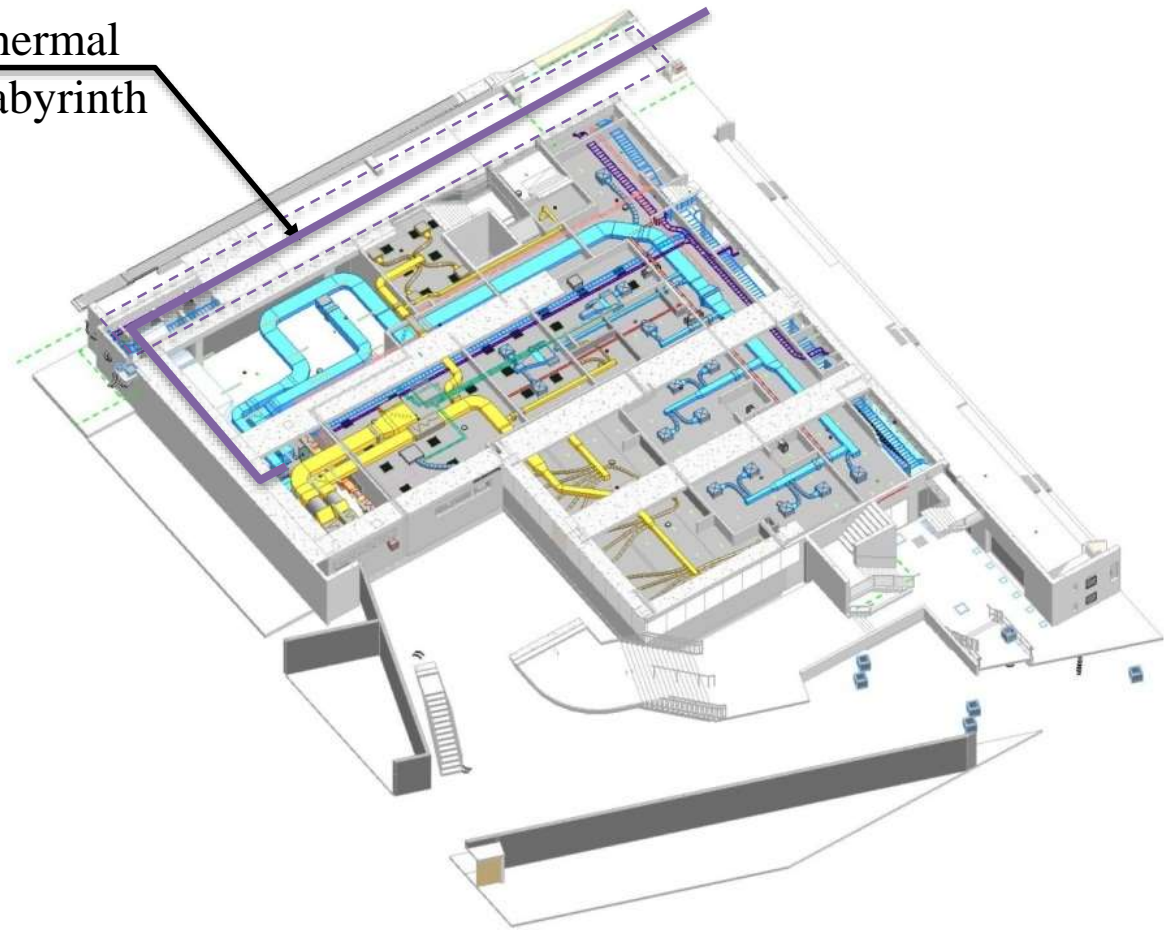
Netball Central

Passive thermal labyrinth
Air conditioning system
for change rooms

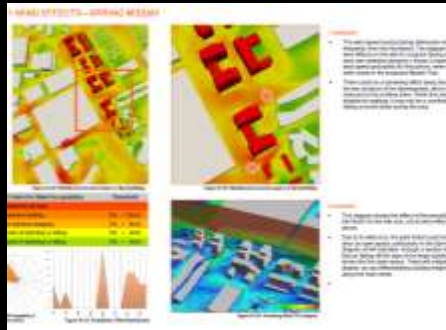
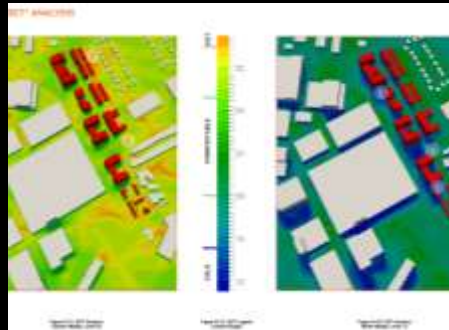
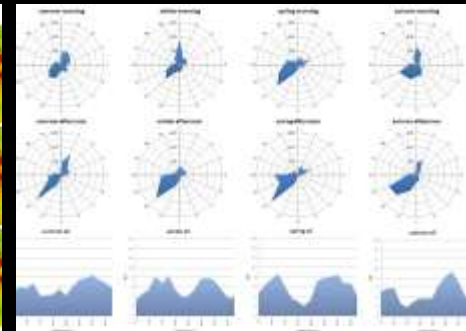
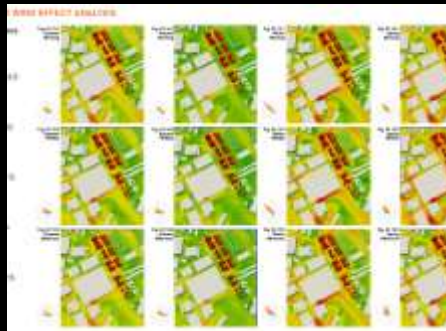
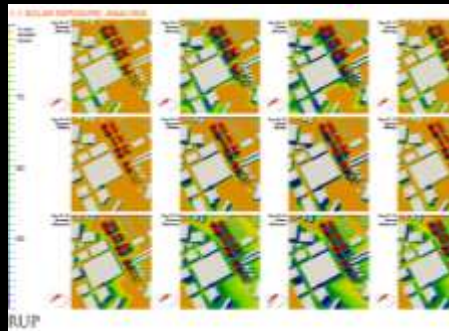
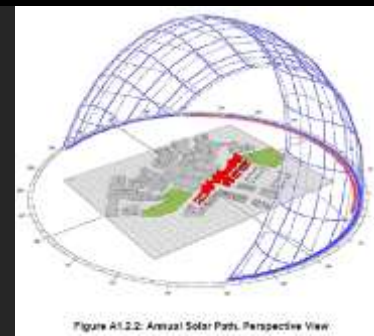
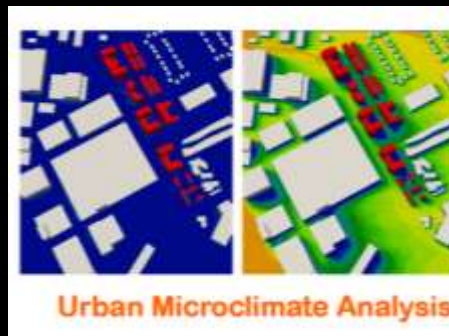


Netball Central
S-MEP BIM model

Thermal
Labyrinth



Urban Micro-Climate Analysis



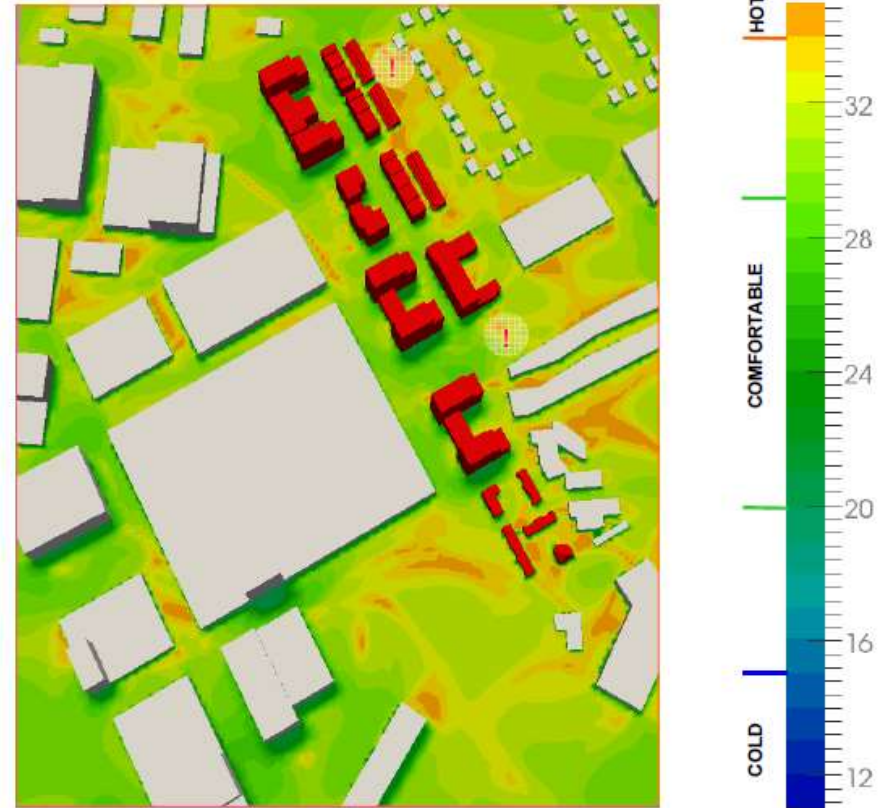
Microclimate Analysis

Thermal comfort of exterior environment can be assessed using the heat balance of the human body.

The method used is called the Standard Effective Temperature (SET*), which was developed by Nakano and Tanabe in Japan for assessing comfort in outdoor and semi-outdoor spaces.

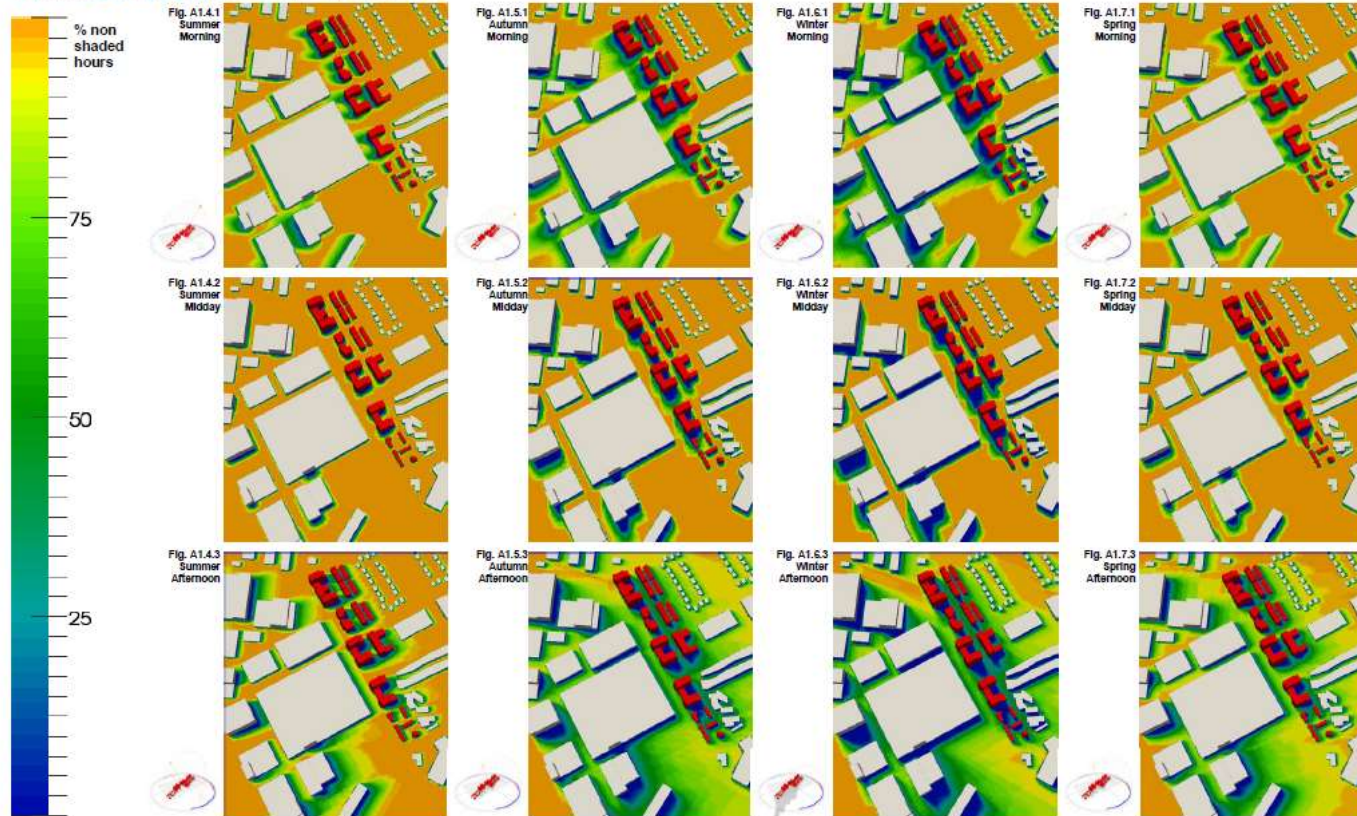
This method can be applied to the external environment by combining the wind analysis and solar analysis to obtain a spatial variation in SET*.

The microclimate review combines two advanced assessments, wind and solar access, to derive a single criterion for estimating comfort conditions.



Step 1. Solar Exposure Analysis

A1.1.1 SOLAR EXPOSURE ANALYSIS



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Step 2. Wind Analysis

A1.2 WIND EFFECT ANALYSIS

Wind is a key contributor to perceived pedestrian comfort. In Summer months, a strong wind can aid physiological cooling, where a person 'feels' cooler due to air movement. In Winter months, however, a cold wind will significantly increase discomfort, especially when combined with rain. In this analysis, wind speed and directional probability are analysed to determine where discomfort or unintended effects could potentially occur.

Methodology

The basis for assessing wind conditions at the pedestrian level is founded on a well-established analysis process explained as follows:

- Undertake a statistical analysis of historical wind data to establish the Weibull parameters. The Weibull parameters describe the probability and strength of wind approaching the site from each wind direction.
- Use CFD to predict the local wind conditions at pedestrian level for each wind direction, for a reference wind speed and atmospheric boundary layer profile.
- Combine the Weibull parameters with the results of the CFD analysis to calculate the mean wind speed for particular times of the day or year associated with a probability of exceedance of 5%.
- Compare the predicted mean wind speed with desirable targets known to be compatible with wind comfort. For the purpose of this assessment, we have used the interpretation of the Lawson criteria established by BMT in the UK, which are regularly used in the UK for assessment of wind comfort [Outdoor Human Comfort and Assessment, American Society of Civil Engineers, 2003]. The threshold criteria for this study has been set at 10m/s with a probability of exceedance of 5%, which corresponds to sites that are appropriate for "fast or business walking". Greater than 10m/s indicates wind discomfort. See the table at right.

Lawson Criteria for Wind Acceptability	Threshold
Uncomfortable for all uses	
Fast or business walking	5% > 10m/s
Strolling or window shopping	5% > 8m/s
Short periods of standing or sitting	5% > 6m/s
Long periods of standing or sitting	5% > 4m/s

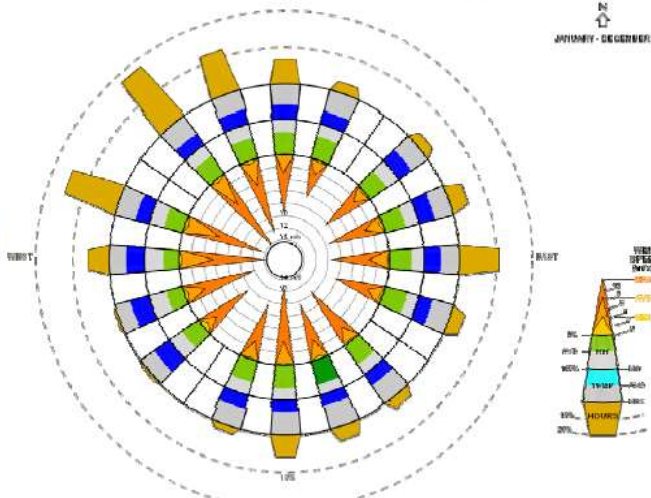


Figure A1.11: Wind Direction Rose.
The prevailing winds come from NW – NNW.

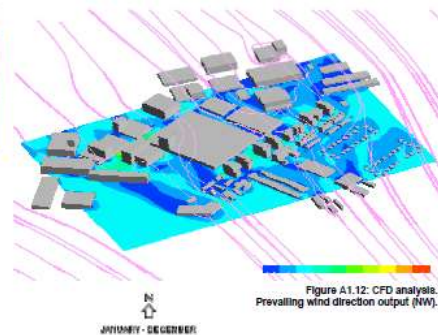
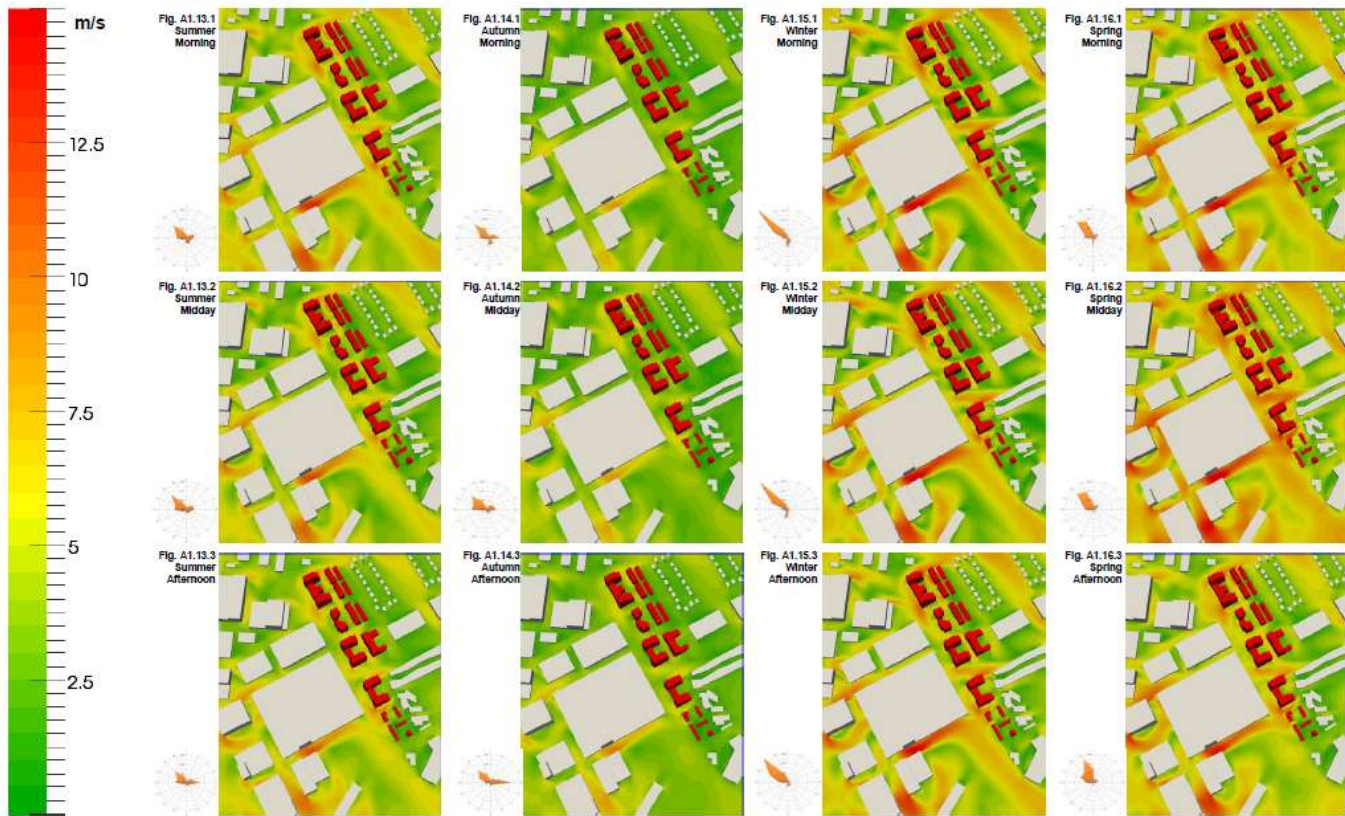


Figure A1.12: CFD analysis.
Prevailing wind direction output (NW).

Step 2. Wind Analysis

A1.2.1 WIND EFFECT ANALYSIS



Step 2. Wind Analysis Detail

A1.2.1 WIND EFFECTS—SPRING MIDDAY

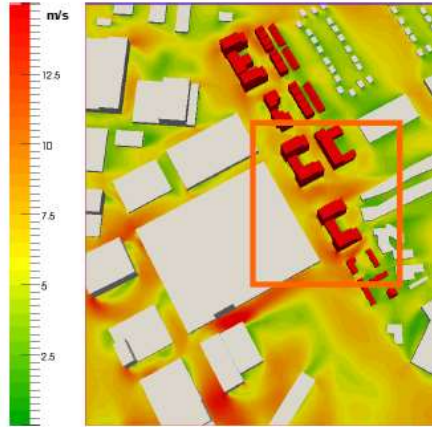


Figure A1.22: Multidirectional wind analysis at Spring Middy.



Figure A1.23: Multidirectional wind analysis at Spring Middy.

Lawson Criteria for Wind Acceptability	Threshold
Uncomfortable for all uses	
Fast or business walking	5% > 10m/s
Strolling or window shopping	5% > 8m/s
Short periods of standing or sitting	5% > 6m/s
Long periods of standing or sitting	5% > 4m/s

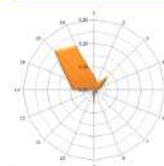


Figure A1.26: Probability of Wind Direction [m/s]

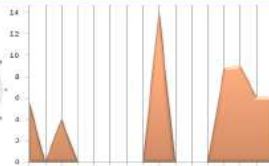


Figure A1.25: Probability of Wind Speed [m/s]

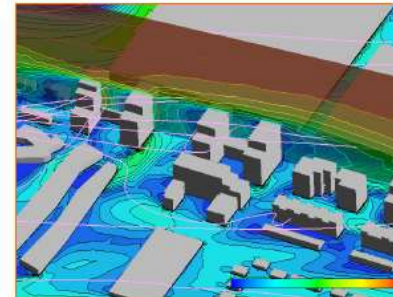


Figure A1.24: Prevailing Wind CFD analysis.

Comments

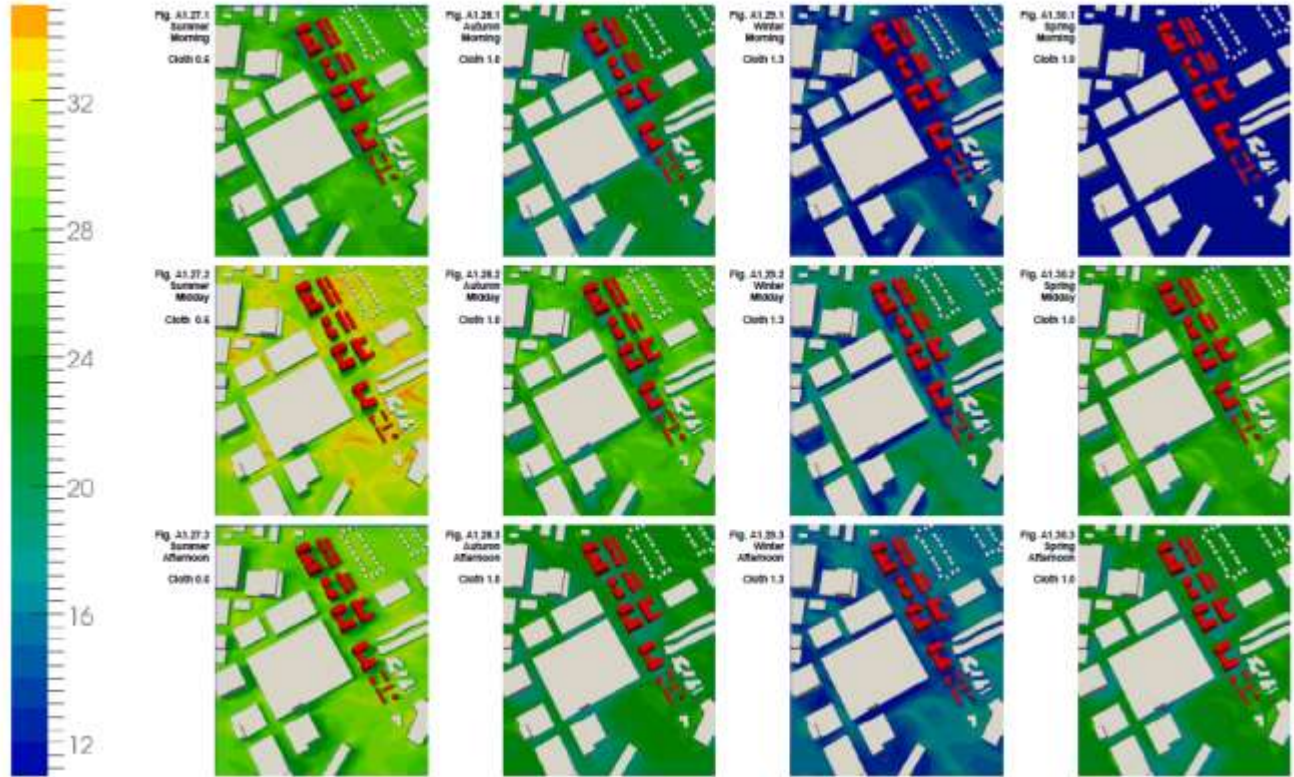
- The wind speed during Spring afternoons will come more frequently from the Northwest. The diagram at left shows all wind effects on the site for a typical Spring afternoon. This area was selected because it shows a higher-than-expected wind speed probability for this period, when compared to other areas in the proposed Master Plan.
- There could be a tunnelling effect along the park between the two sections of the development, which would likely be reduced by the existing trees. While this area would be comfortable for walking, it may not be a comfortable space for sitting at some times during the year.

Comments

- This diagram shows the effect of the prevailing winds (from the North) for the site only, not all wind effects as shown above.
- Due to its wide size, the park street could be termed a 'windy area' as open space, particularly in the Spring months. The diagram at left indicates, through a section wind speed cut, that air falling off the tops of the large buildings in Block B will dump into this open space. Trees will mitigate this to some degree, as can differentiating building heights and frontages along the main street.

Step 3.
Standard Effective
Temperature which
includes solar and
wind exposure
effects

A1.3.3 SET* ANALYSIS



Step 3.
Standard Effective
Temperature which
includes solar and
wind exposure
effects

A1.3.3 SET* ANALYSIS

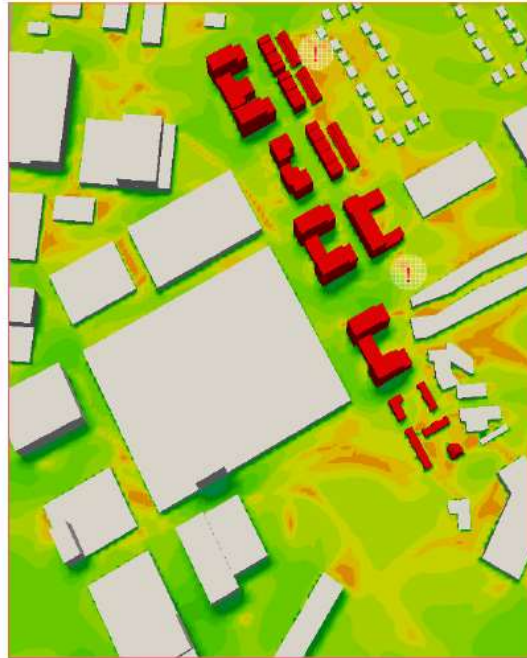


Figure A1.31: SET* Analysis.
Summer Midday, Cloth 0.5.

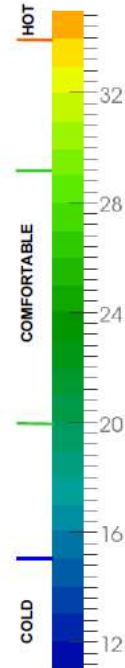


Figure A1.31: SET* Legend.
Comfort Ranges.

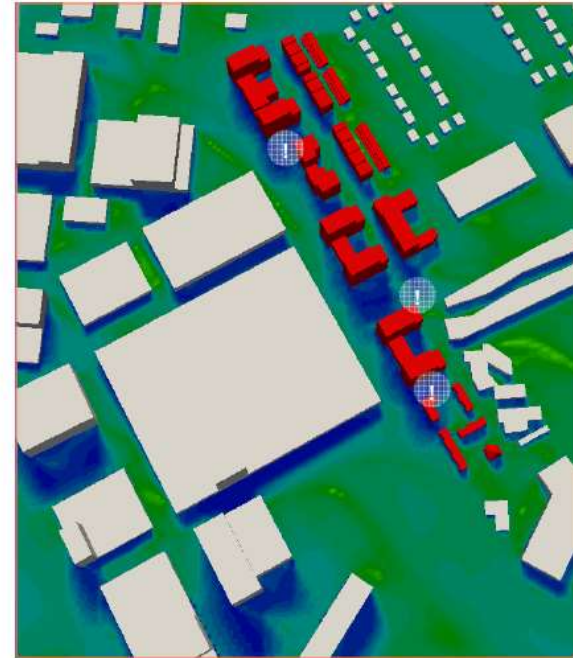


Figure A1.33: SET* Analysis.
Winter Midday, Cloth 1.3.

Step 4. Conclusions and Design Recommendations

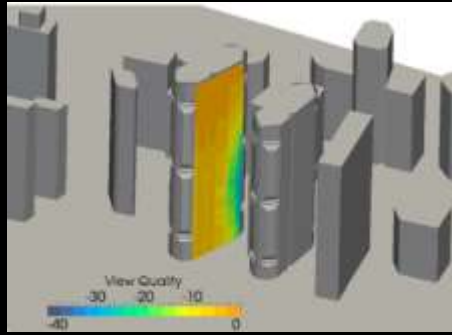
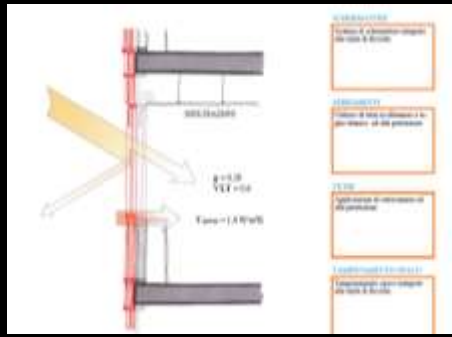
A1.4 MICROCLIMATE CONCLUSIONS



Figure A1.34: Microclimate Analysis summary.

In general, the public spaces are expected to function suitably for a range of activities throughout the year, including sitting, resting or walking. The main impacts are the following, as keyed to the model shown at left:

1. The courtyards create a sheltered and pleasant space which will be protected from frequent winds coming from the North-west during most seasons. The building shape could be optimised to increase the solar radiation in winter, when the spaces will often be shaded, by increasing density along the main street and on the south side of each block.
2. The area east of the proposed Master Plan site will benefit from the sheltering effect of the new buildings during Winter. However, during peak summer days, this sheltering effect will prevent some cooling winds from passing into this low-density residential area. This is likely similar to what already occurs on site.
3. Due to tunnelling effects, there will be some increase to wind speed along this main street, but it otherwise operates similar to other parts of the city's main precinct.
4. The landscaped island in this divided park street will experience reduced solar access due to overshadowing, but is otherwise a comfortable space.
5. This north-northeast corner of the building generates wind turbulence that will affect the low-rise residential to the east. This can be mitigated, in part, with trees and by vertically stepping the corner of the building.
6. The large building to the north overshadows this building quite significantly, while also increasing wind speed effects as air drops after passing across the top of the building. This will impact the comfort conditions of public space in this area.
7. Further considerations could address the microclimate results by shifting building heights in each block without negatively impacting on the environmental performance of the proposed Master Plan.









C3



C4



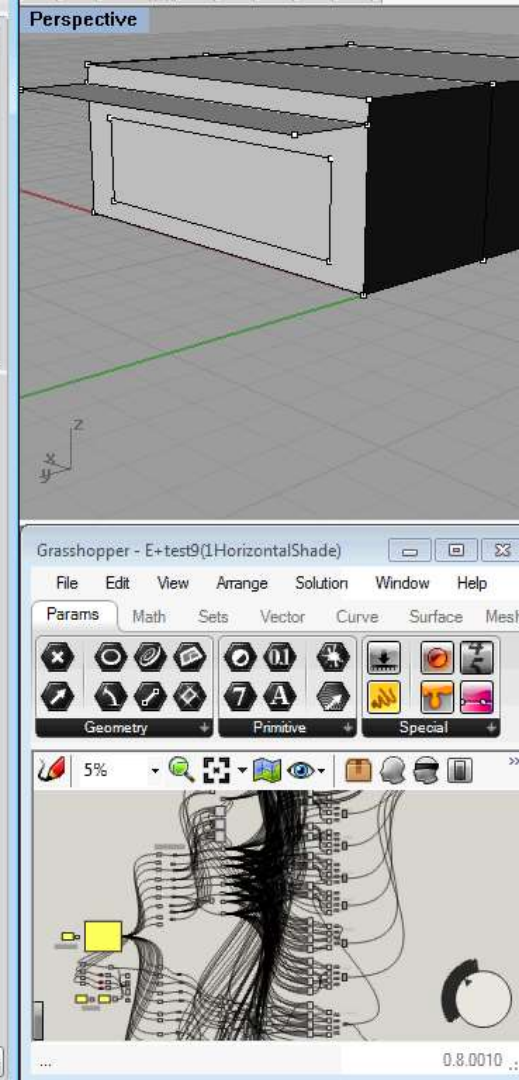
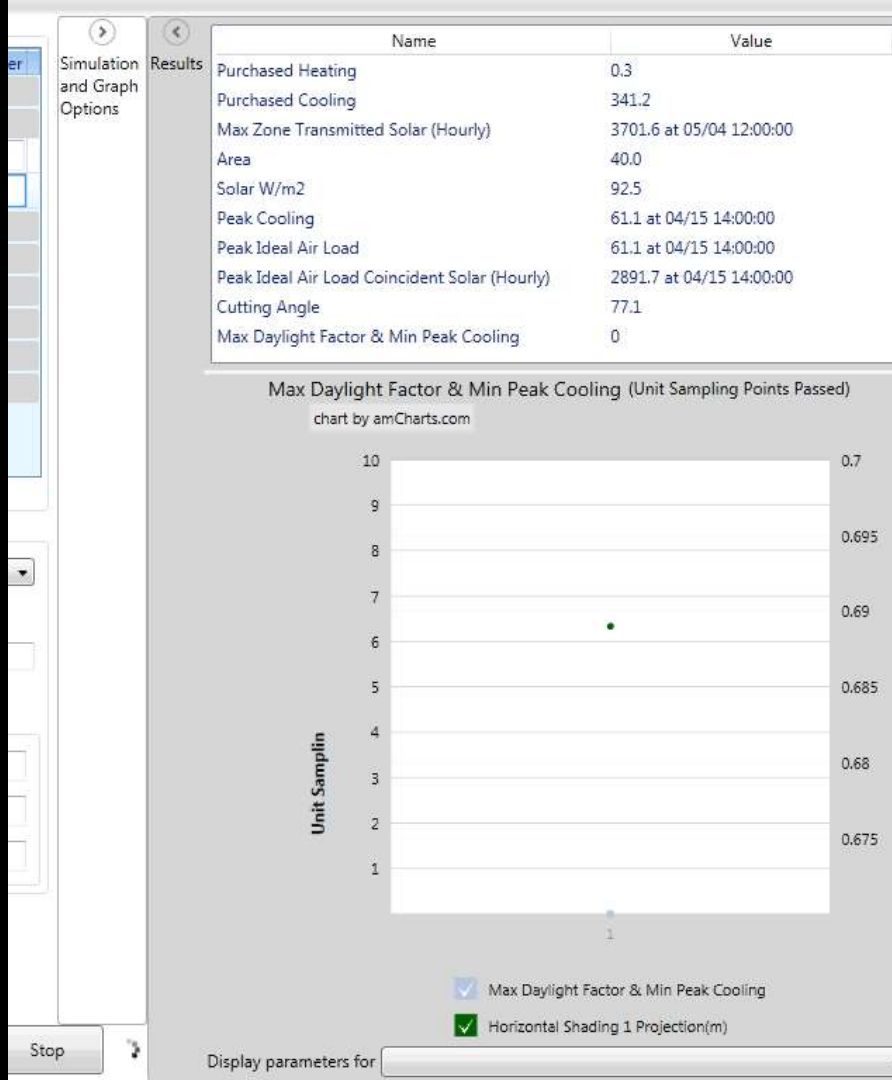
C5

Façade are expression of the architecture language and the building physics design

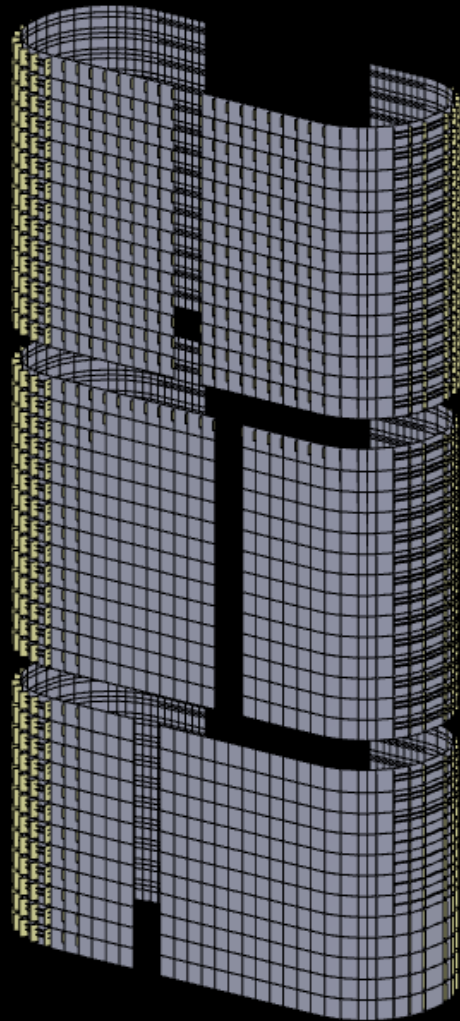
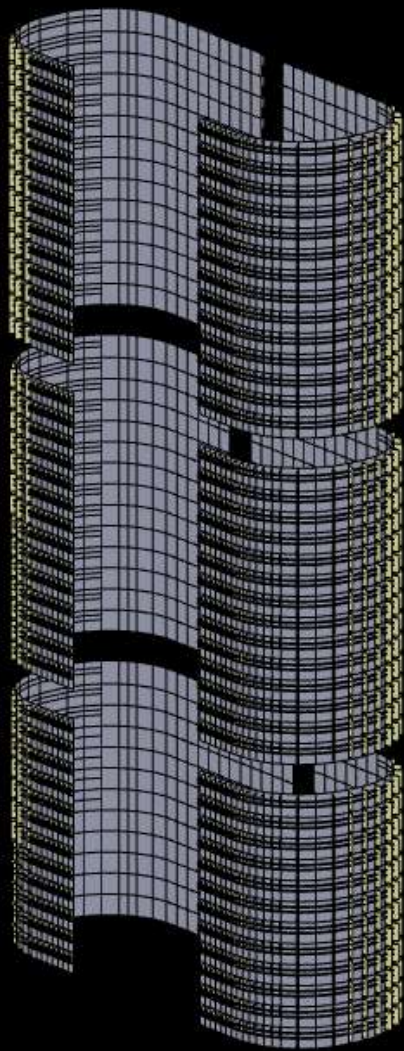
North Façade



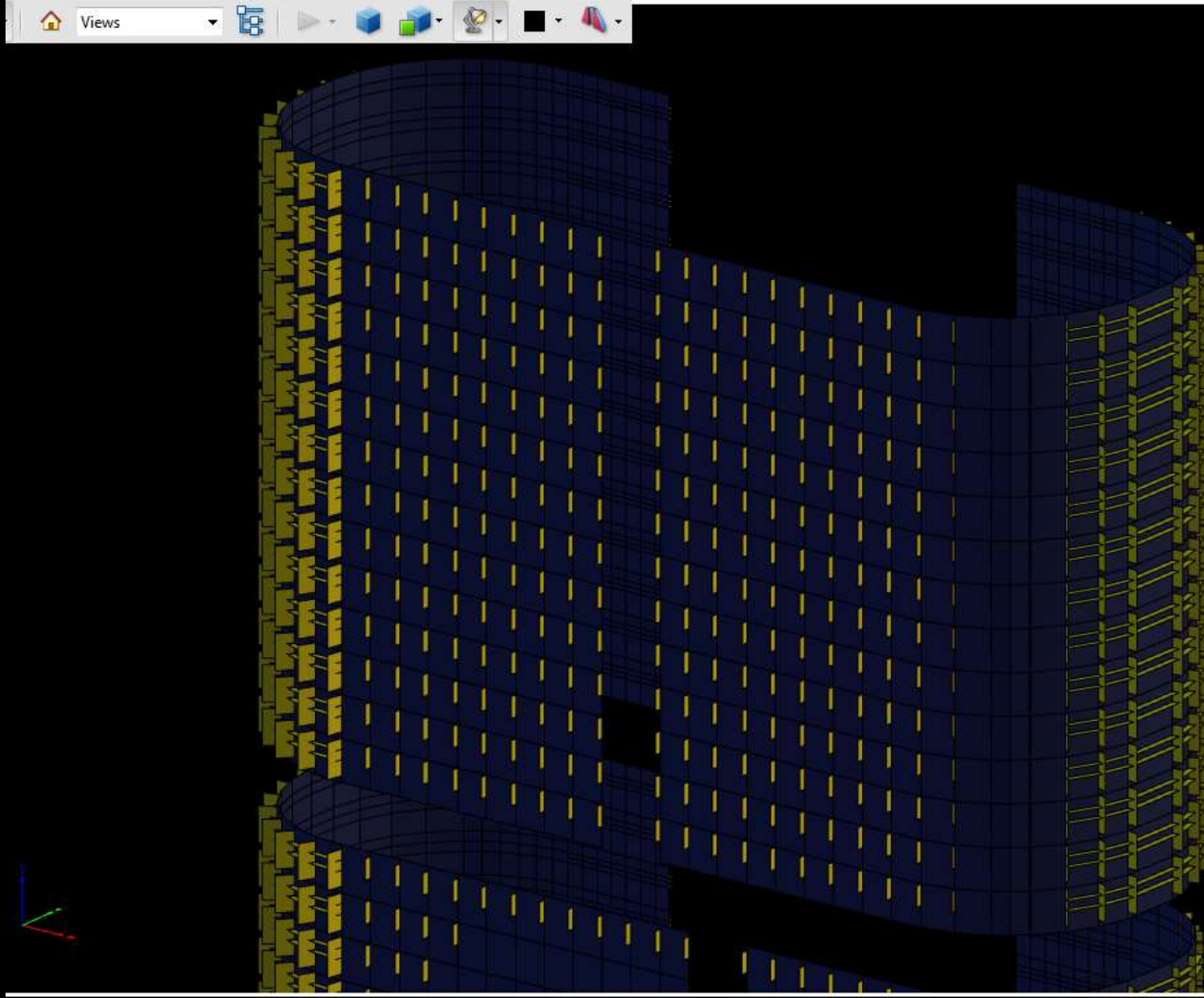
Façade Explorer



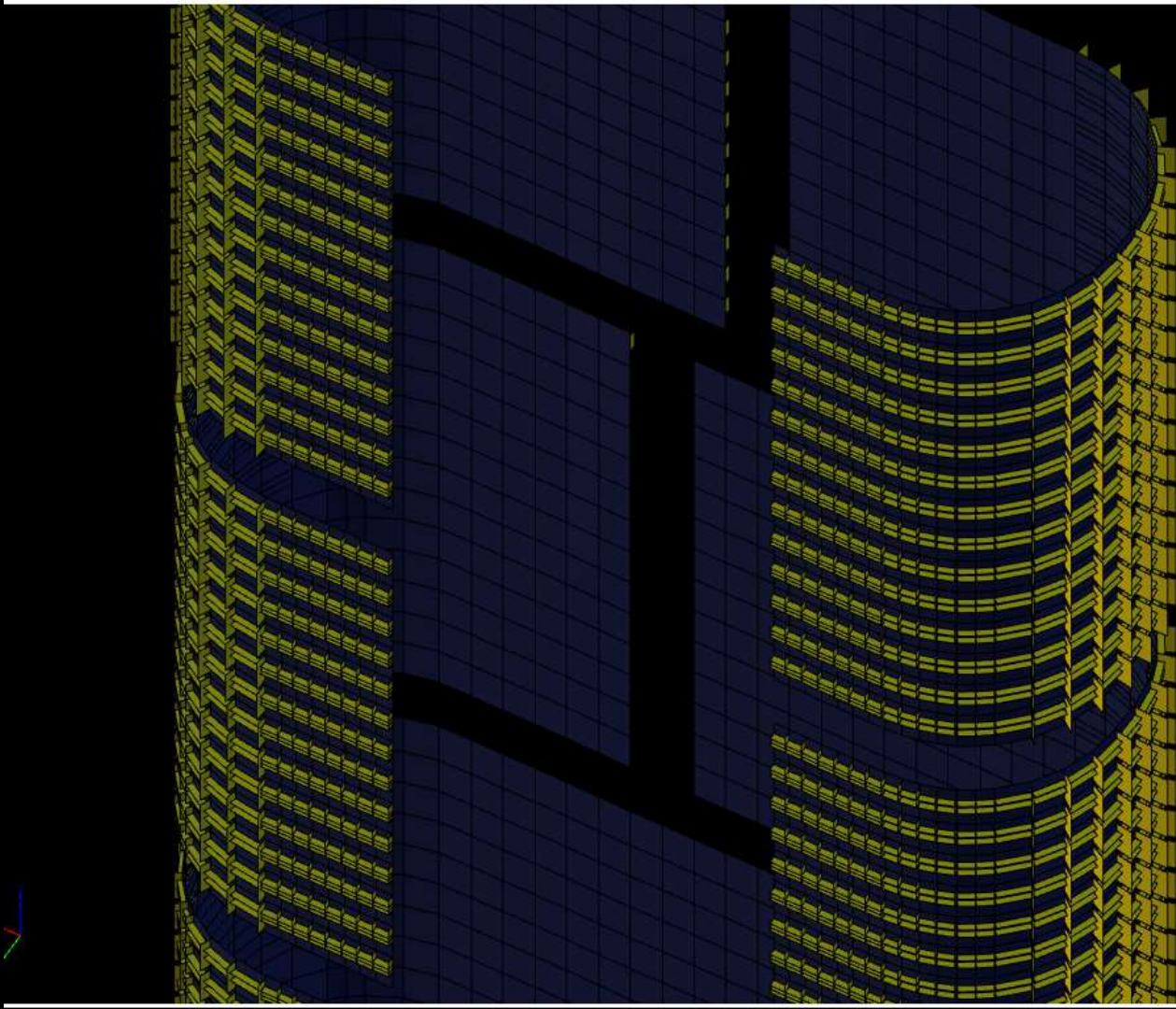
3d model



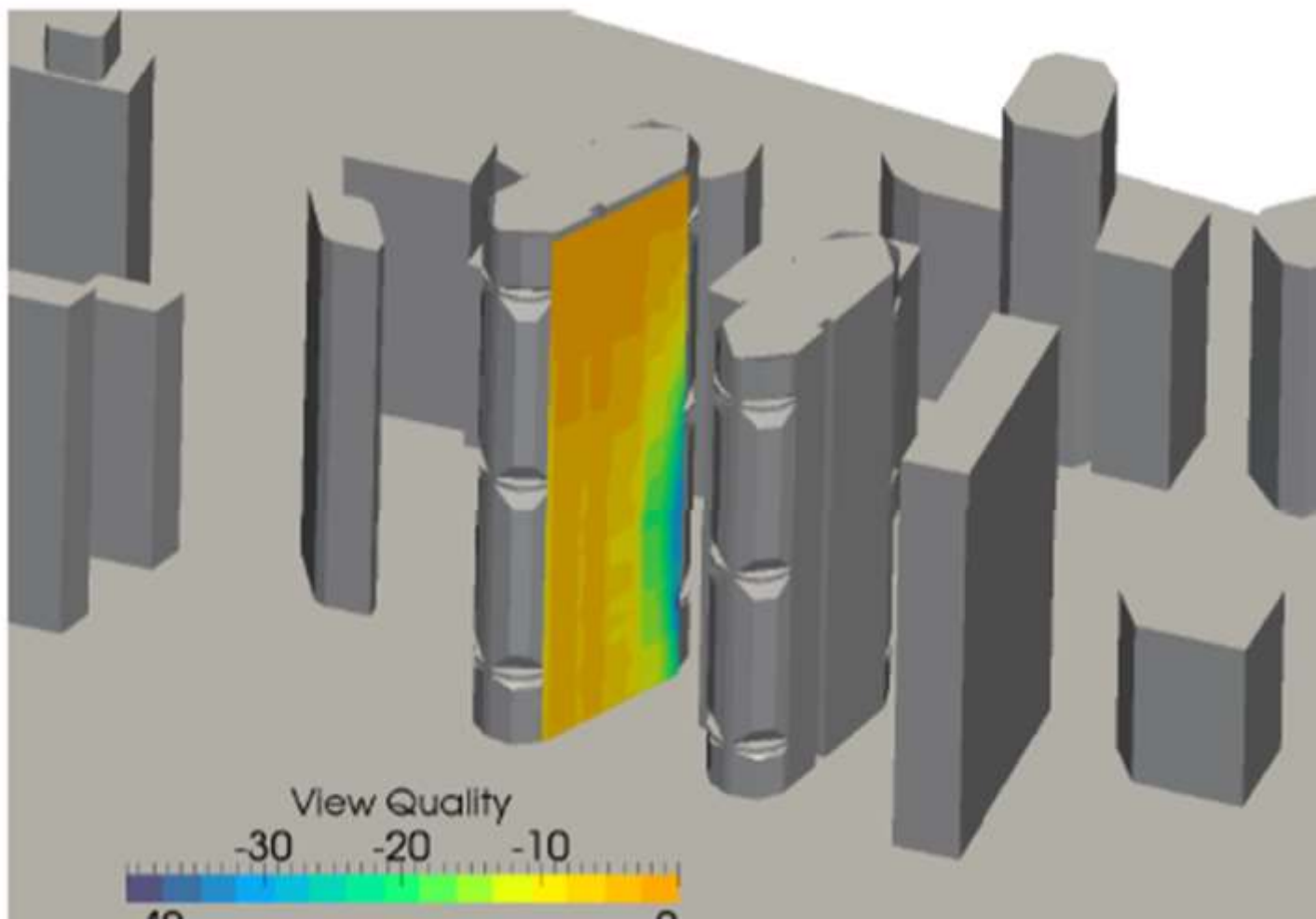
South Façade



North Façade







Archimede Solar Energy

Case Study – Sustainability strategy

Net floor area : 4000 m²





Summary

Primary Energy Demand : 3,80 kWh/m³year – Class A

Heating-Cooling energy saving: 60%

Electrical energy saving: 40%

Total Primary energy saving: 88%

CO₂ emission saving: 93ton/anno



Geothermal Air Heat Exchanger



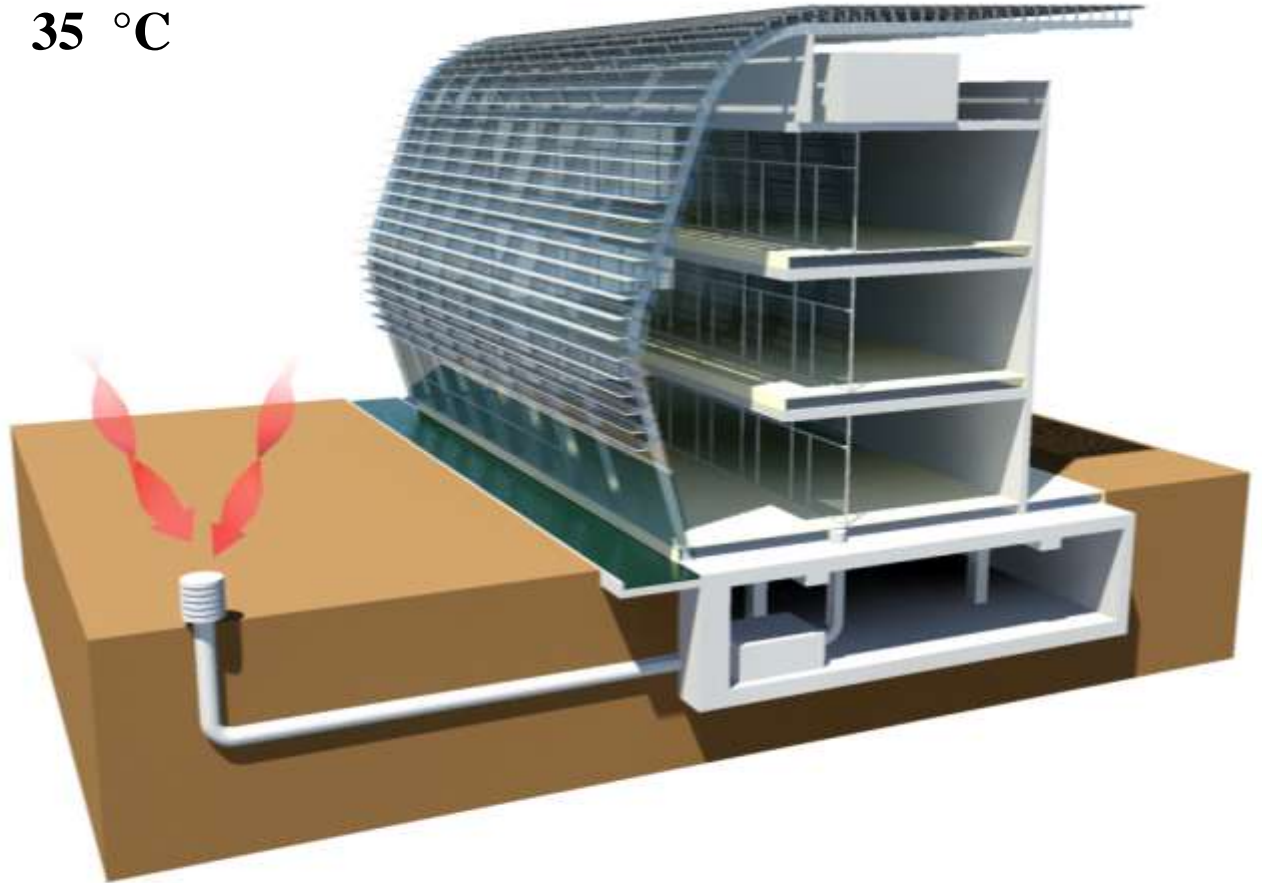
35 °C

Geothermal energy

Summer
Atrium

Energy saving: 42%

Outside temperature decrease
from 35 °C to 26 °C



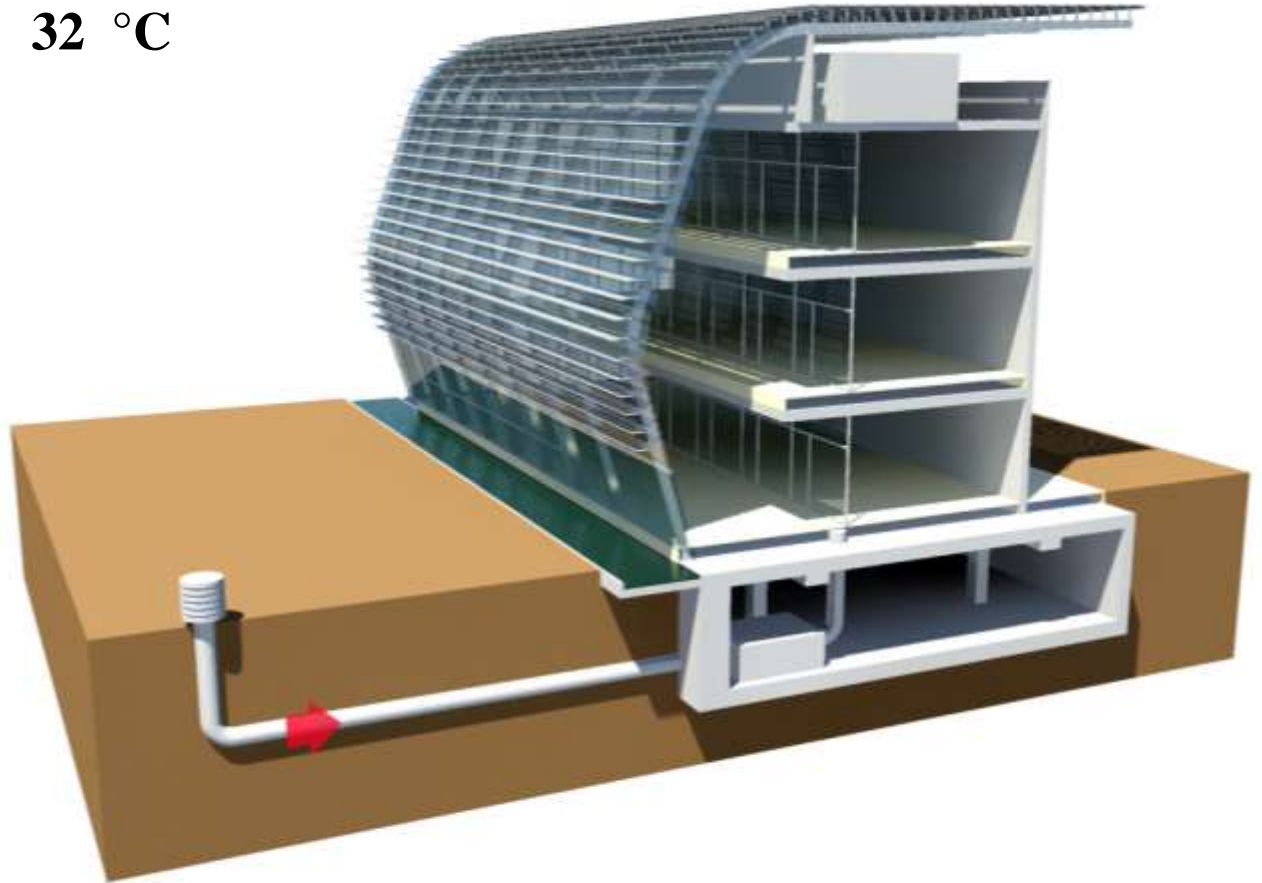
32 °C

Geothermal energy

Summer
Atrium

Energy saving: 42%

Outside temperature decrease
from 35 °C to 26 °C

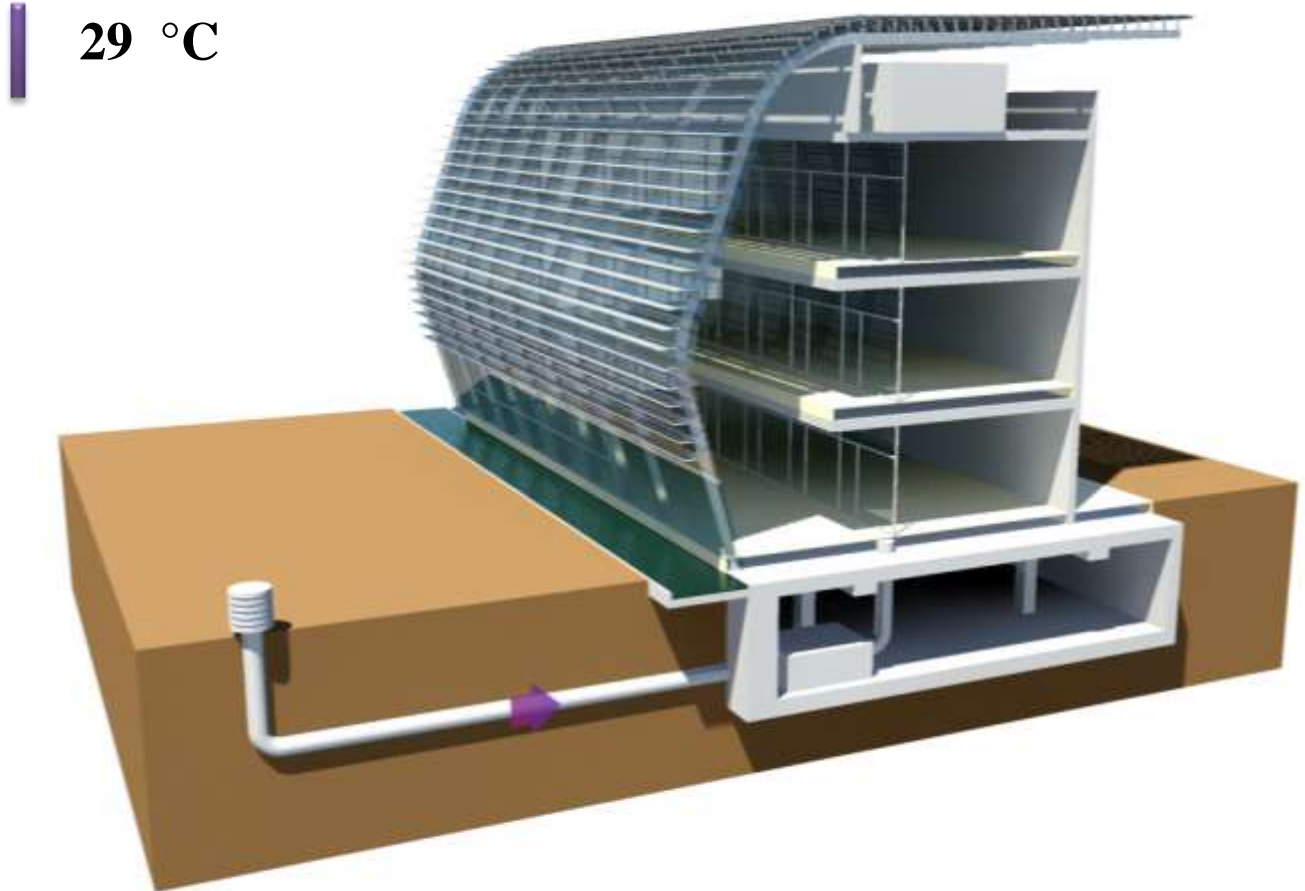


Geothermal energy

Summer
Atrium

Energy saving: 42%

Outside temperature decrease
from 35 °C to 26 °C

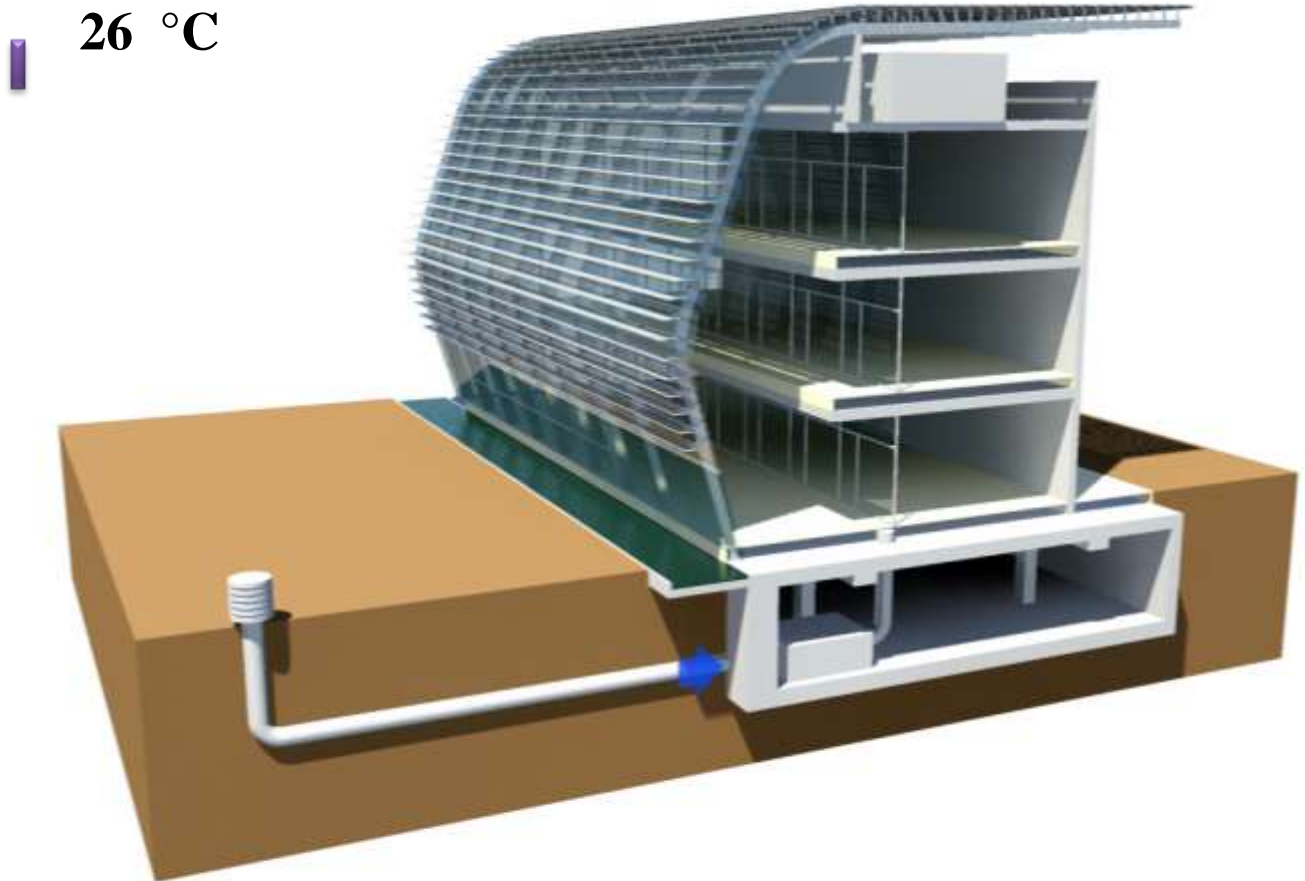


Geothermal energy

Summer
Atrium

Energy saving: 42%

Outside temperature decrease
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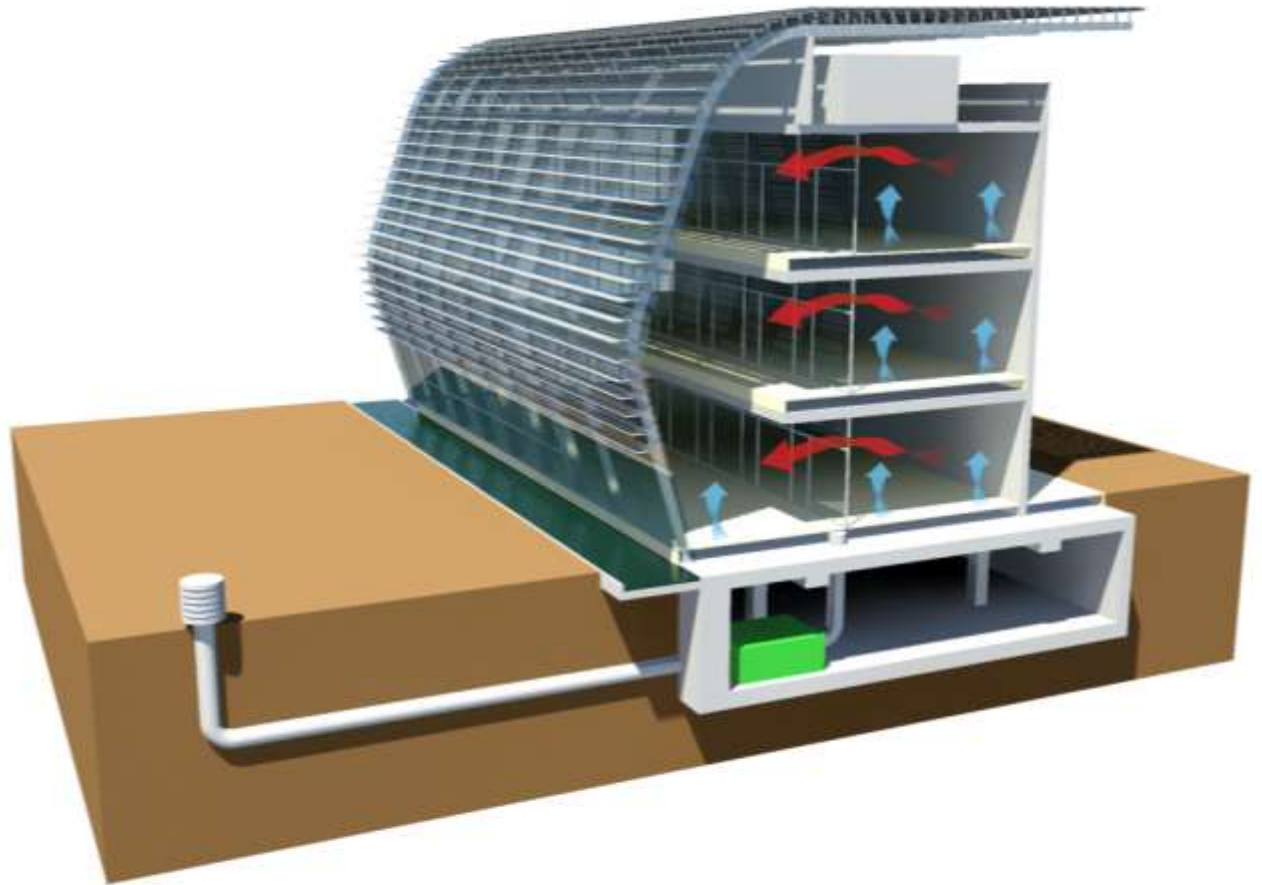


Natural Ventilation



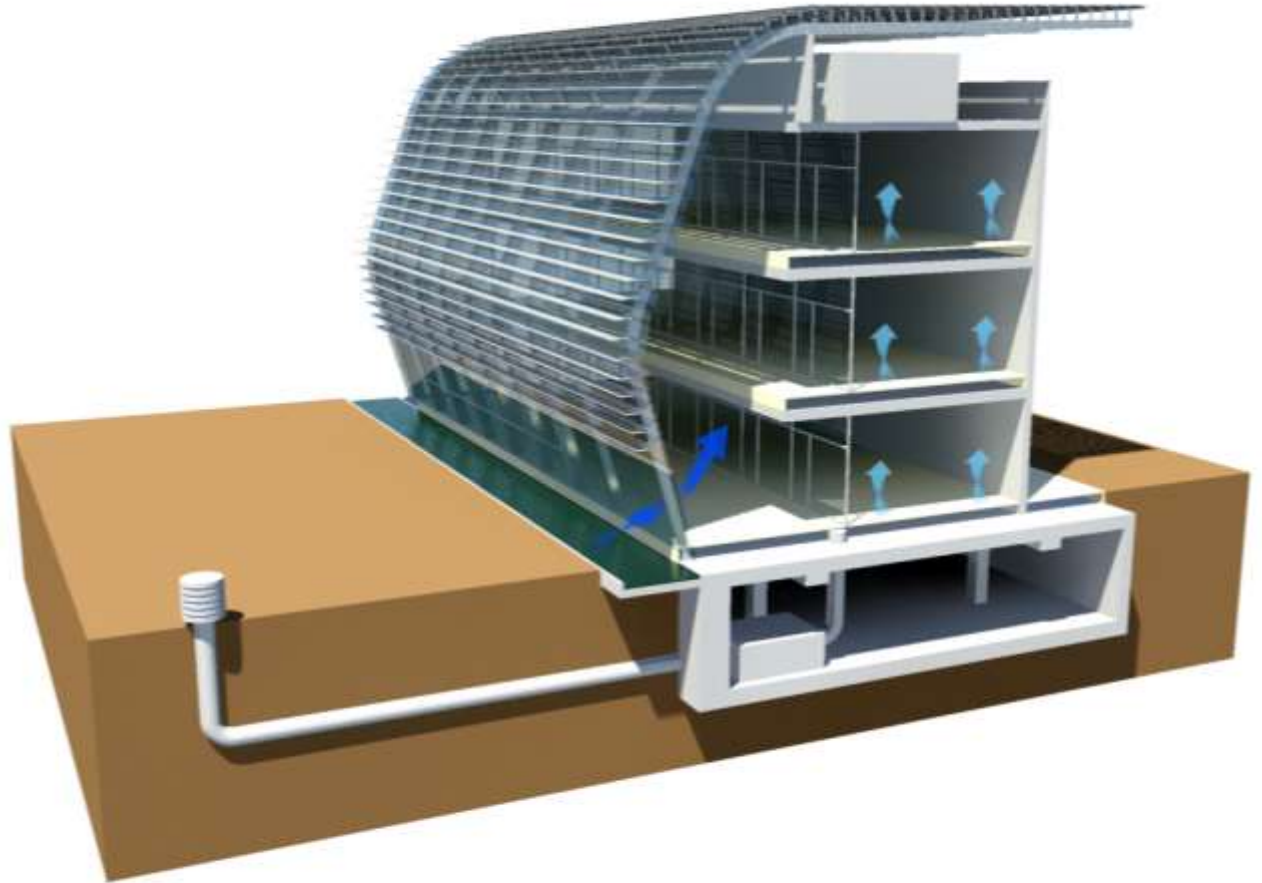
Passive transfer ventilation

Atrium summer energy saving: 18%



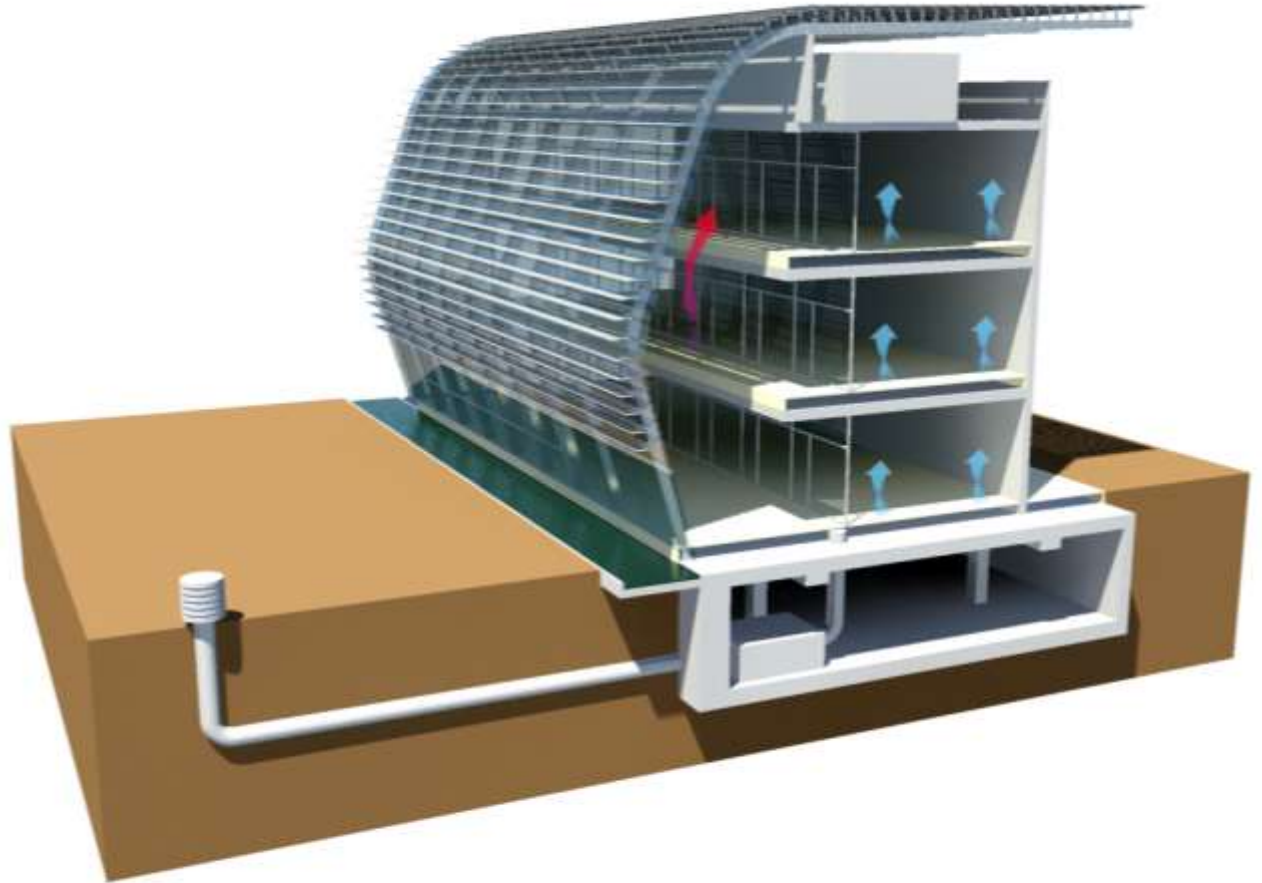
Natural Ventilation

Atrium summer energy
saving: 25%



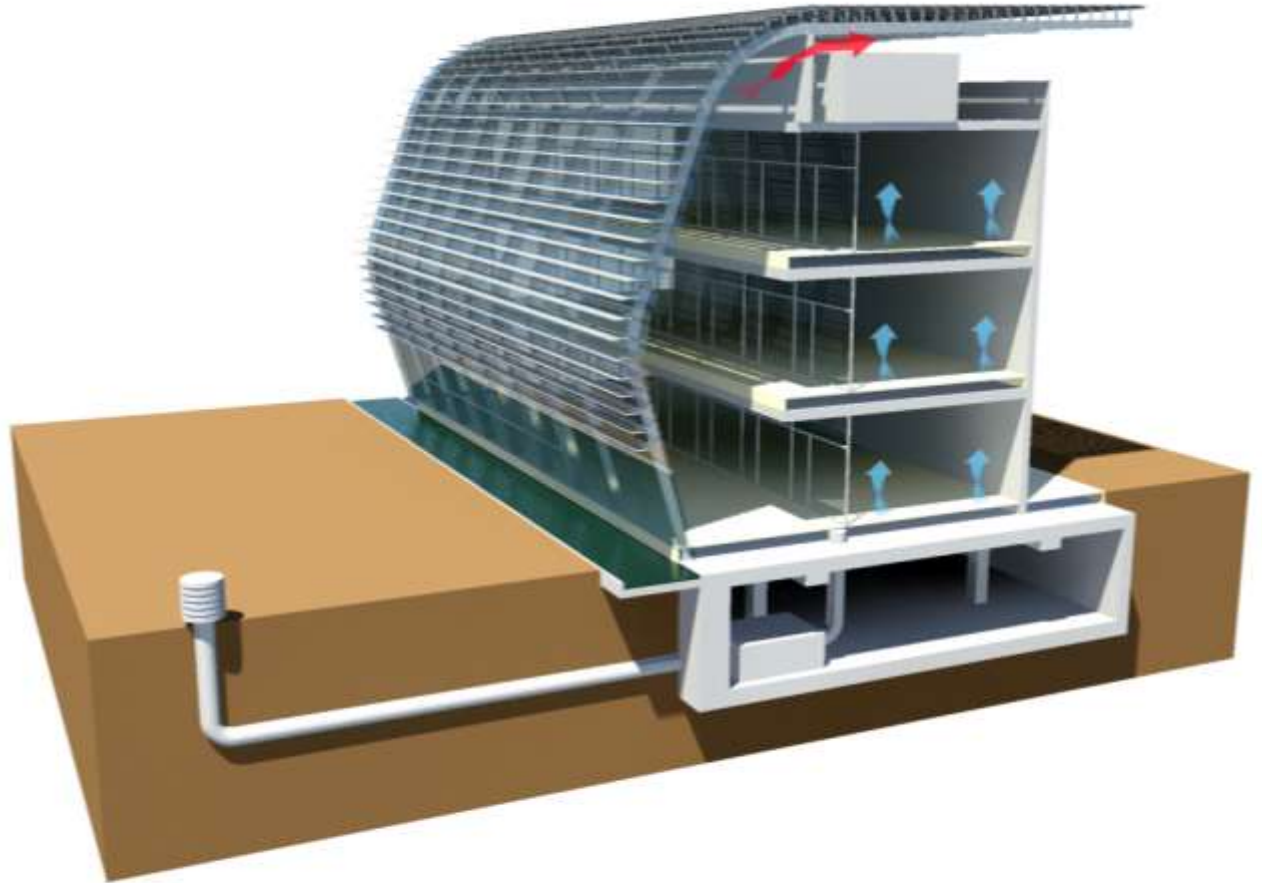
Natural Ventilation

Atrium summer energy
saving: 25%

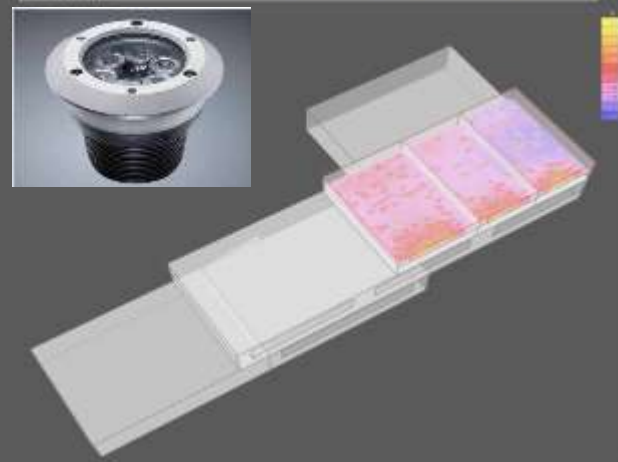
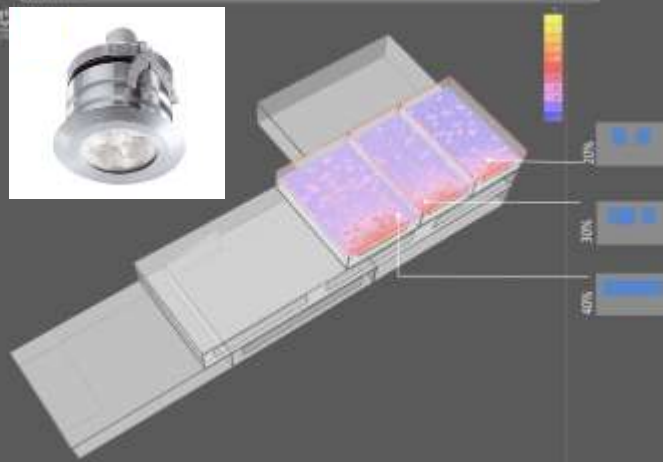
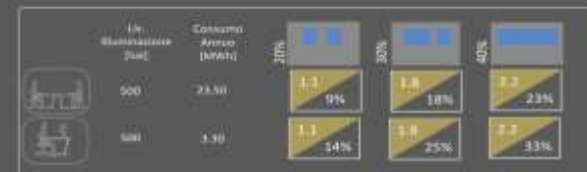
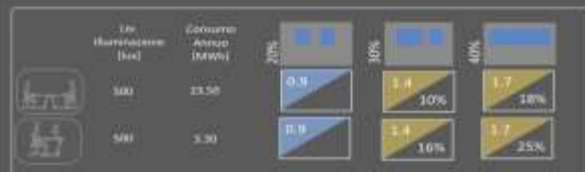
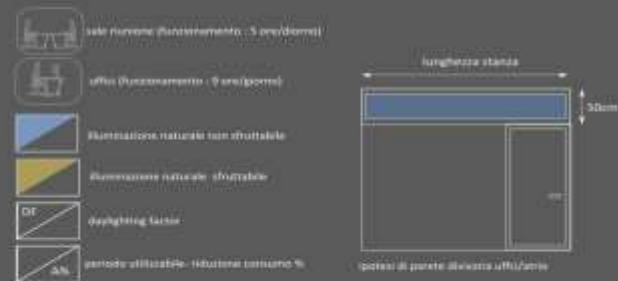
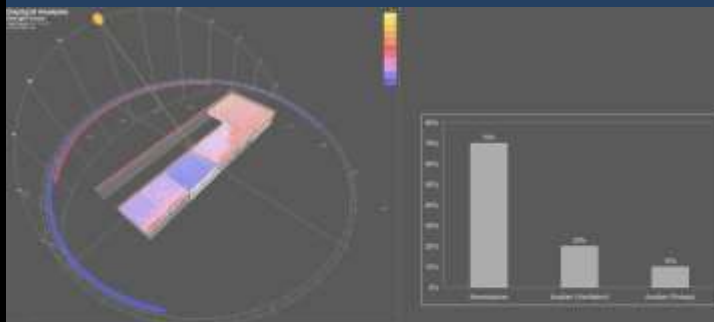


Natural Ventilation

Atrium summer energy
saving: 25%

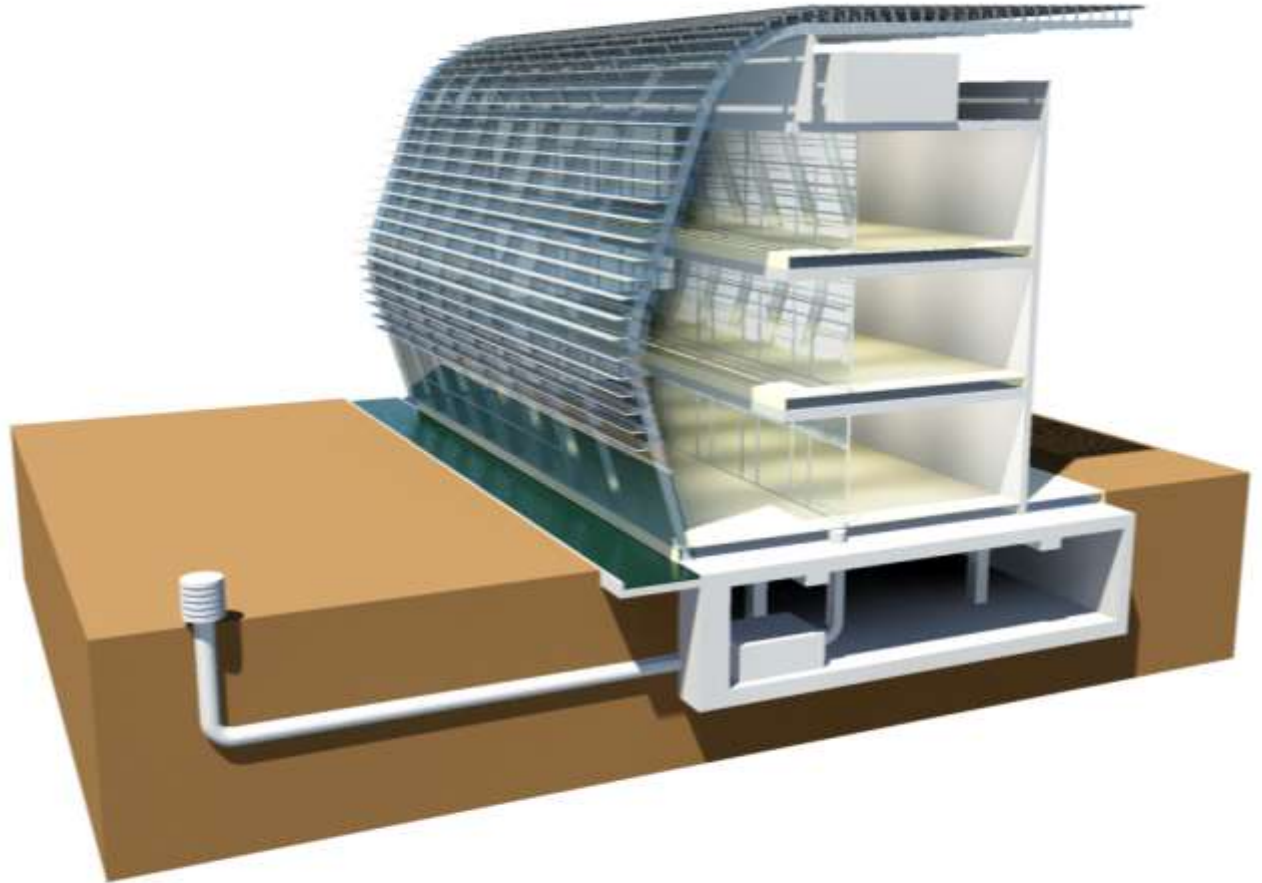


Daylighting Office DLF: 1.8 - 25% Energy Consumption



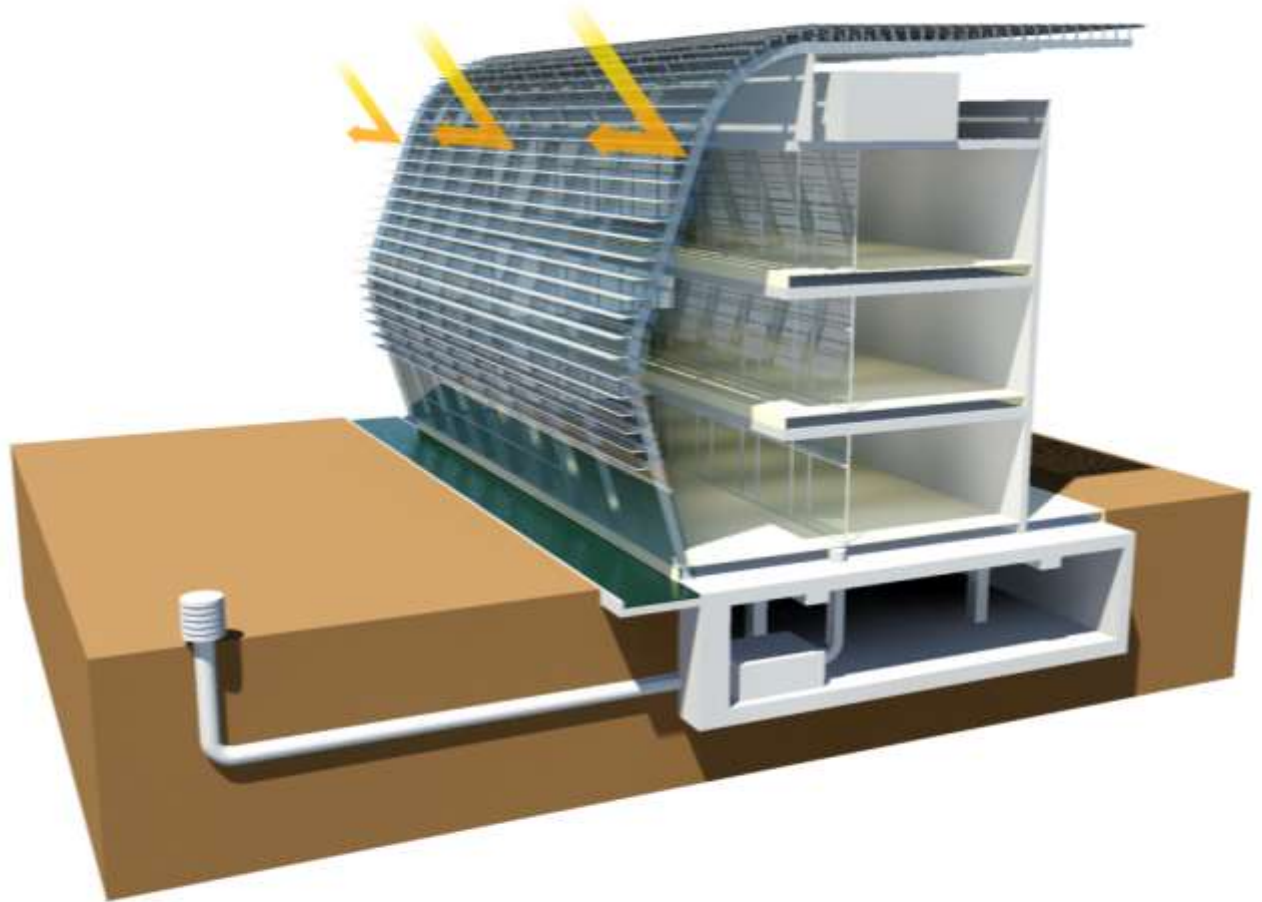
Dimmerable lighting

Energy saving: 29%



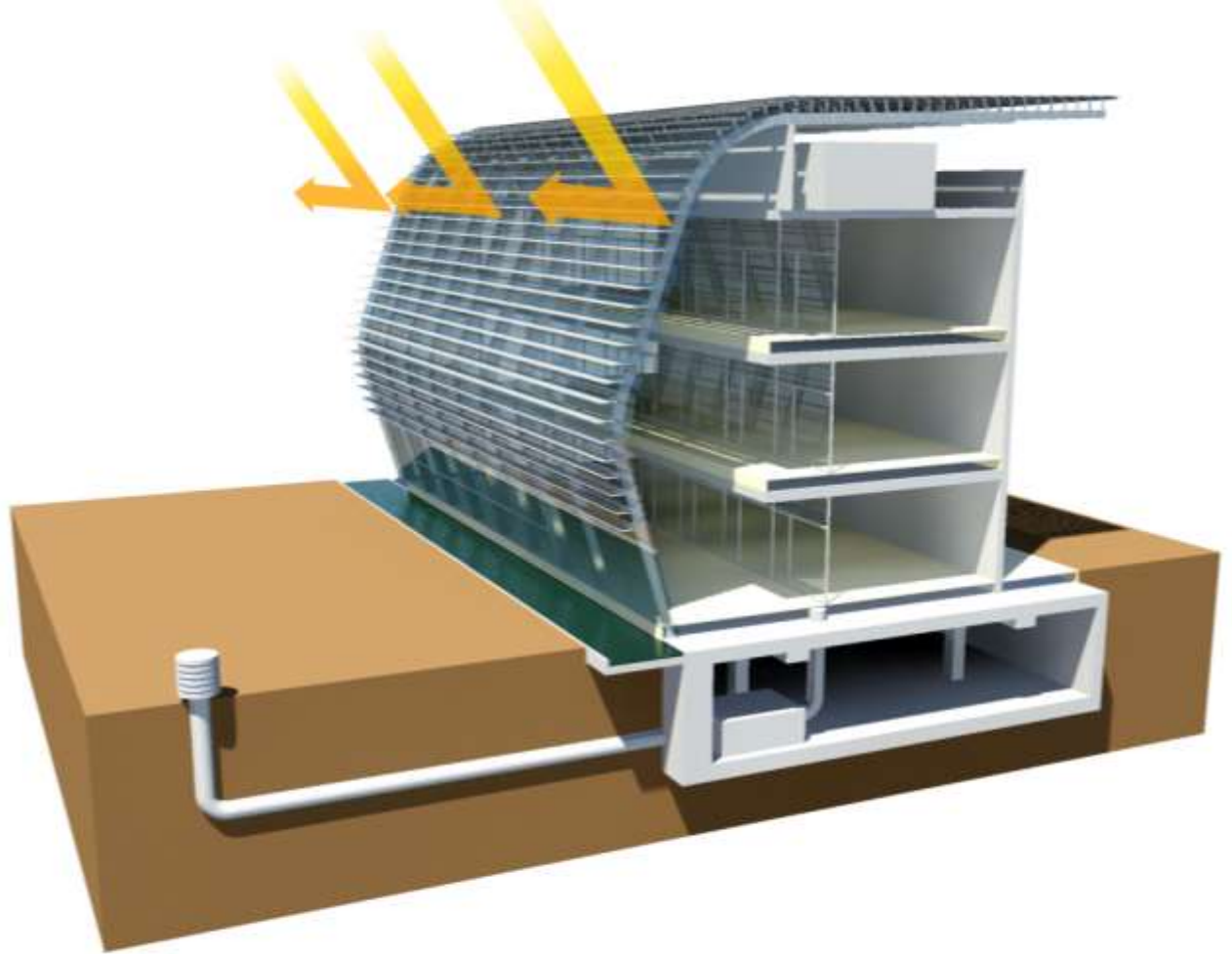
Dimmerable
lighting

Energy saving: 29%



Dimmerable
lighting

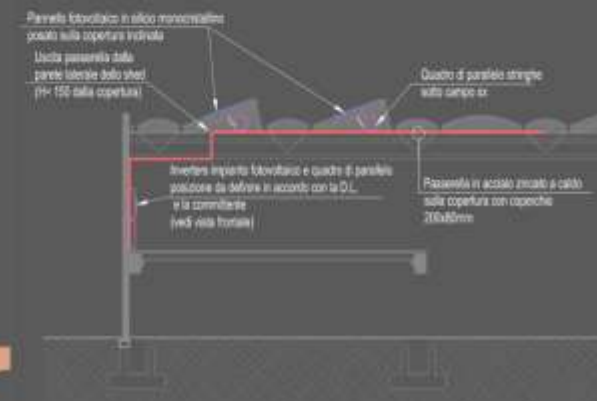
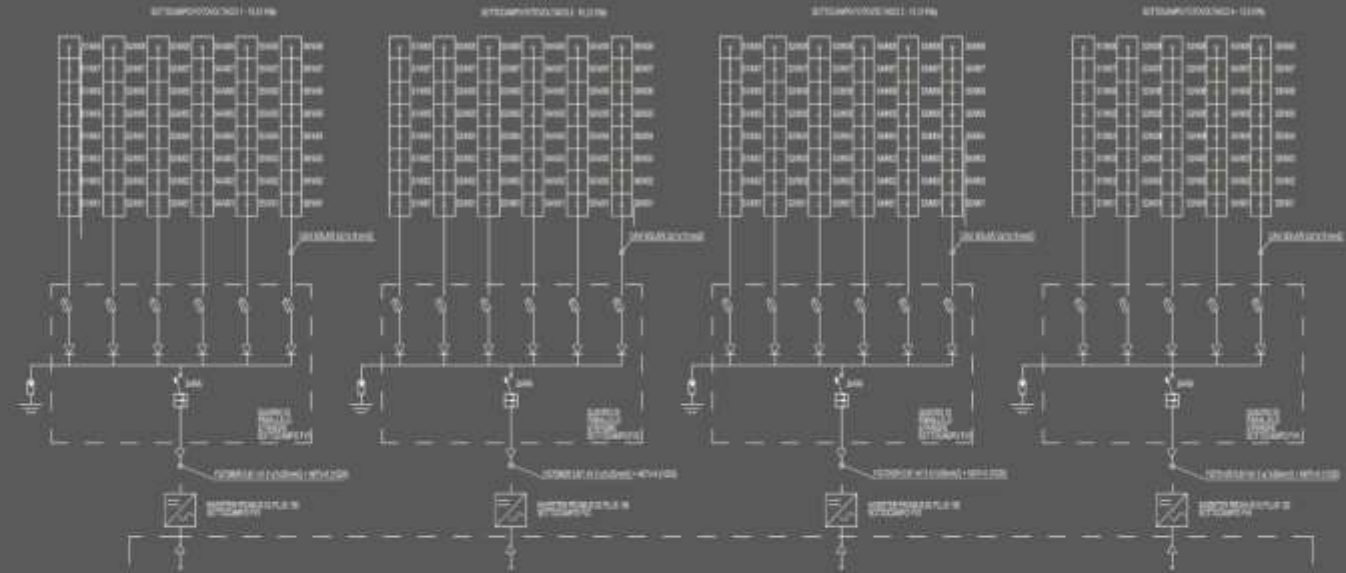
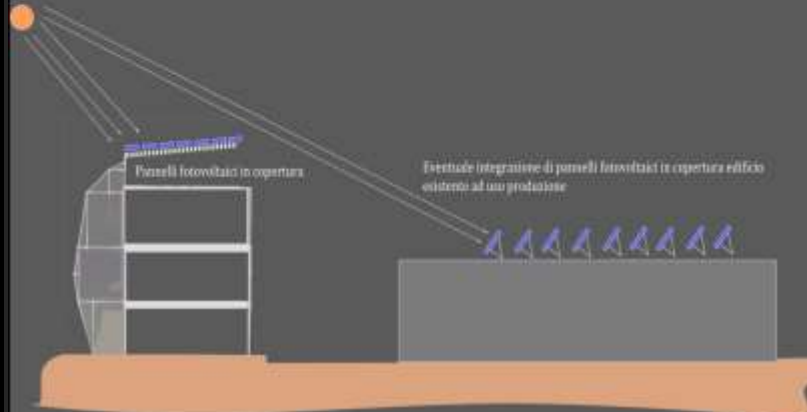
Energy saving: 29%



Carbon Neutral PV System

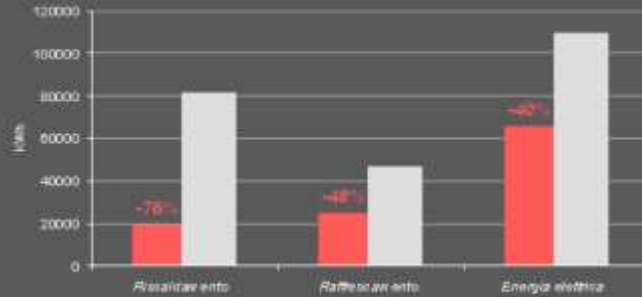
380 m²

100% electrical energy
demand covered

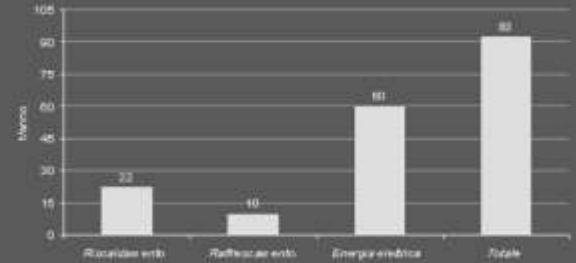


Energy Balance

Fabbisogno energia termica ed elettrica



Riduzione annua di CO2



Fabbisogno energia primaria



- Standard office Building
- Archimede Solar Energy

Grazie per l'attenzione