BUREAU OF TECHNICS

Energy Efficiency Assessment and the Quality of Microclimate

Flame Towers

Saint-Petersburg, 2016

CONTENT

Section 1

Scope of Work

Scope of work:

- **Energy modeling.**

1.Hotel - Determination of building energy efficiency in comparison with the AHSRAE standard.

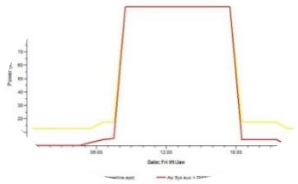
2.Offices and Residential - Determination of potential energy efficiency of the building by using different energy efficient solutions.

- **CFD modeling.**

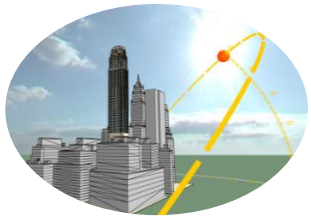
1. Restaurant. Provide comfortable microclimate parameters in the Visitor`s zone of the Restaurant.

2. Hotel room. Evaluate set indoor microclimate parameters.
Evaluate HVAC system Efficiency.

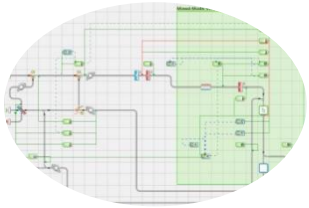
Thermal Loads



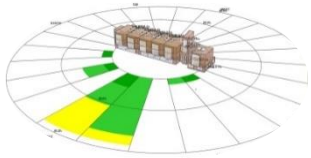
Climate Parameters



HVAC Systems



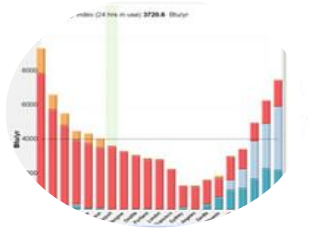
Wind Loads



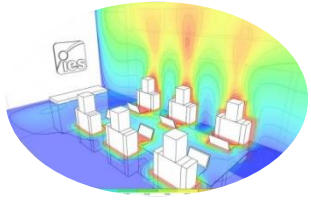
IES INTEGRATED ENVIRONMENTAL SOLUTIONS

Lighting Density Assessment

Energy consumption and cost assessment



Microclimate Assessment

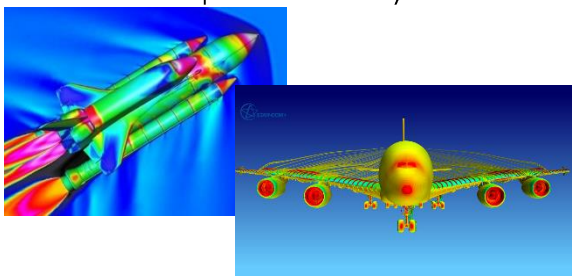


Certification Systems

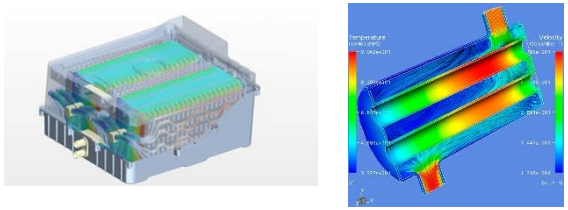
U.S. GREEN BUILDING COUNCIL LEED CERTIFIED USGBC

BREEAM®

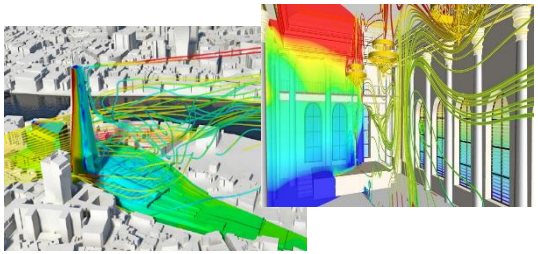
Aerospace Industry



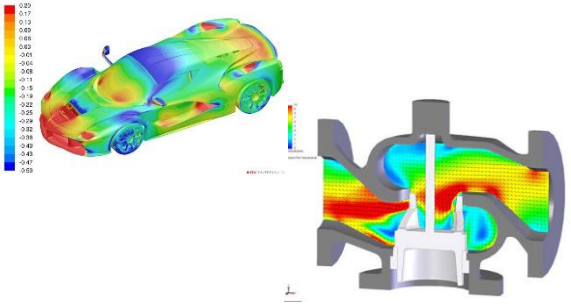
Power engineering



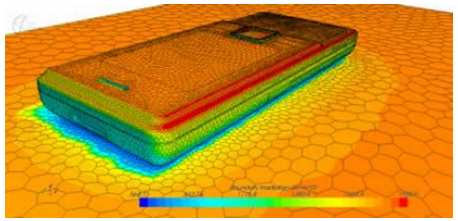
Building industry and Architecture



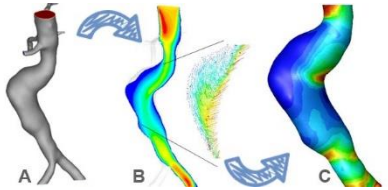
Engineering



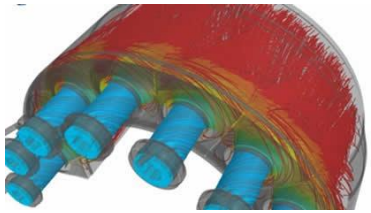
Electronic engineering



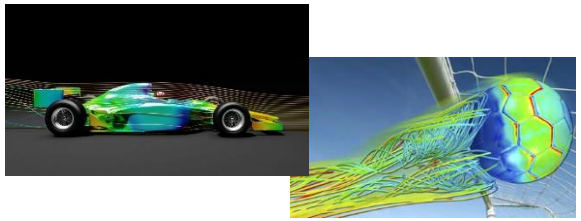
Medicine



Chemical industry



Sports industry



Computational Fluid Dynamics

- CFD allows for accurate predict temperature, velocity, humidity and CO_2 concentration in any point in close or open space
- CFD is a powerful approach facilitating ventilation system design
- CFD can be extremely useful for flow optimization in different scales
- CFD helps to prove correction and efficient of applied decisions in design

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Section 2

Energy modeling Flame Towers

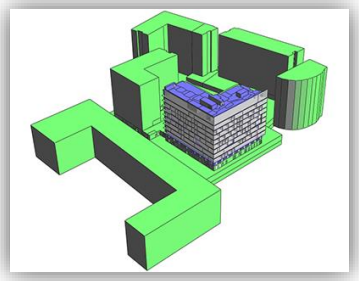
Hotel
Office
Residential

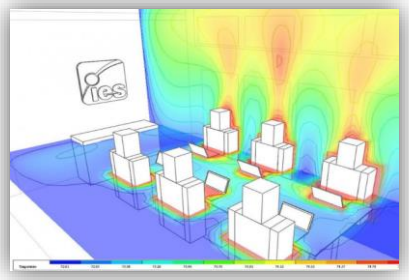
Flame Towers

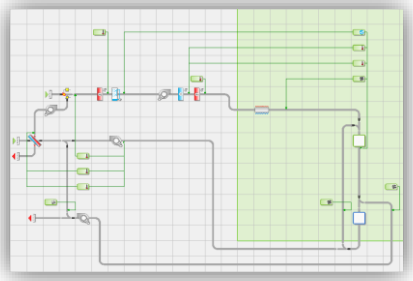
Flame Towers, Baku, Azerbaijan, 227 000 sq. m
The buildings consist of residential, a hotel and office blocks.

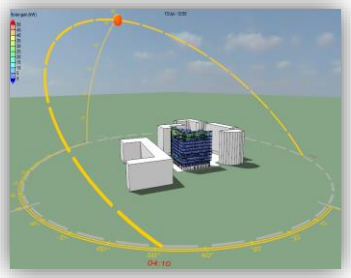
Building Energy Modeling

BUILDING 3D GEOMETRY OF THE OBJECT → LOAD AND CONSTRUCTION SETTINGS → LOAD CALCULATION FOR DESIGN PARAMETERS → HVAC SYSTEMS SETTINGS → SIMULATION OF BUILDING ANNUAL OPERATION



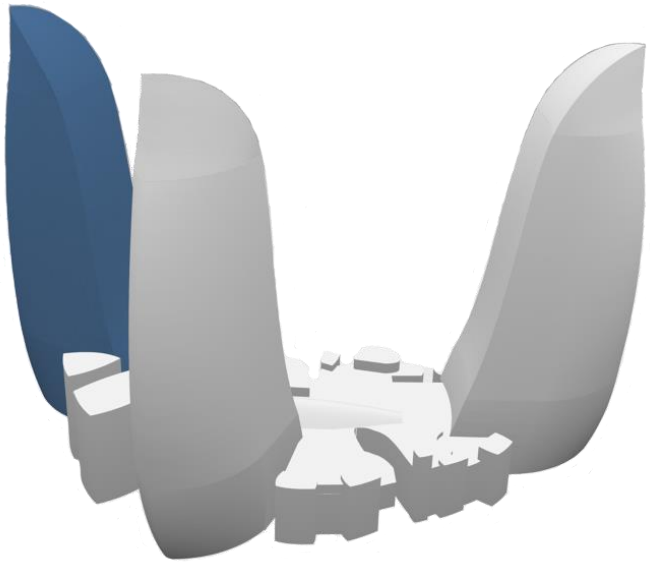






IES INTEGRATED ENVIRONMENTAL SOLUTIONS

Hotel

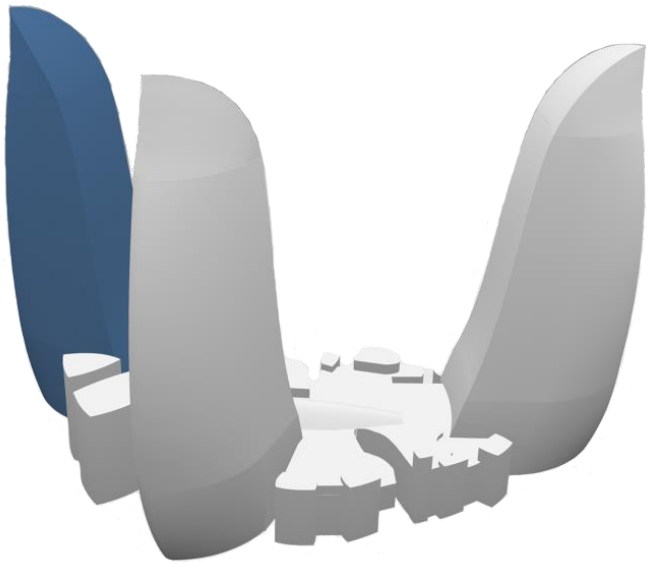


The list of energy-efficient solutions:

1. Usage of heat recovery (75% efficiency).
2. Usage of CO2 sensors in hotel spaces.
3. Usage of LED-lamps.
4. Usage of continuous dimming control systems.
5. Usage of energy-efficient insulating glass.
6. Energy-efficient elevators.

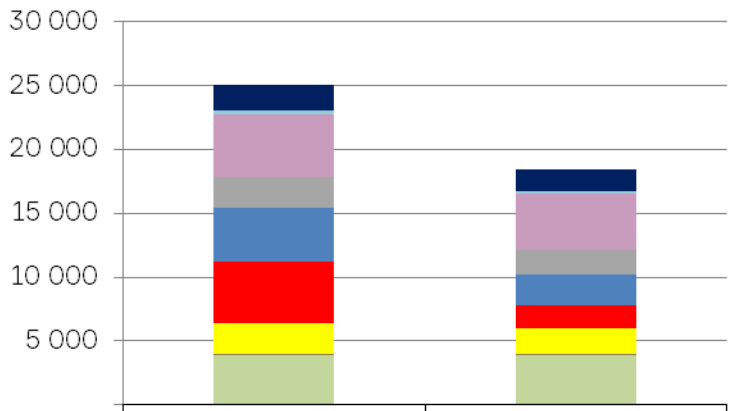
Height of building: 164,6 m
Number of floors (above ground): 36

Hotel



Height of building: 164,6 m
Number of floors (above ground): 36

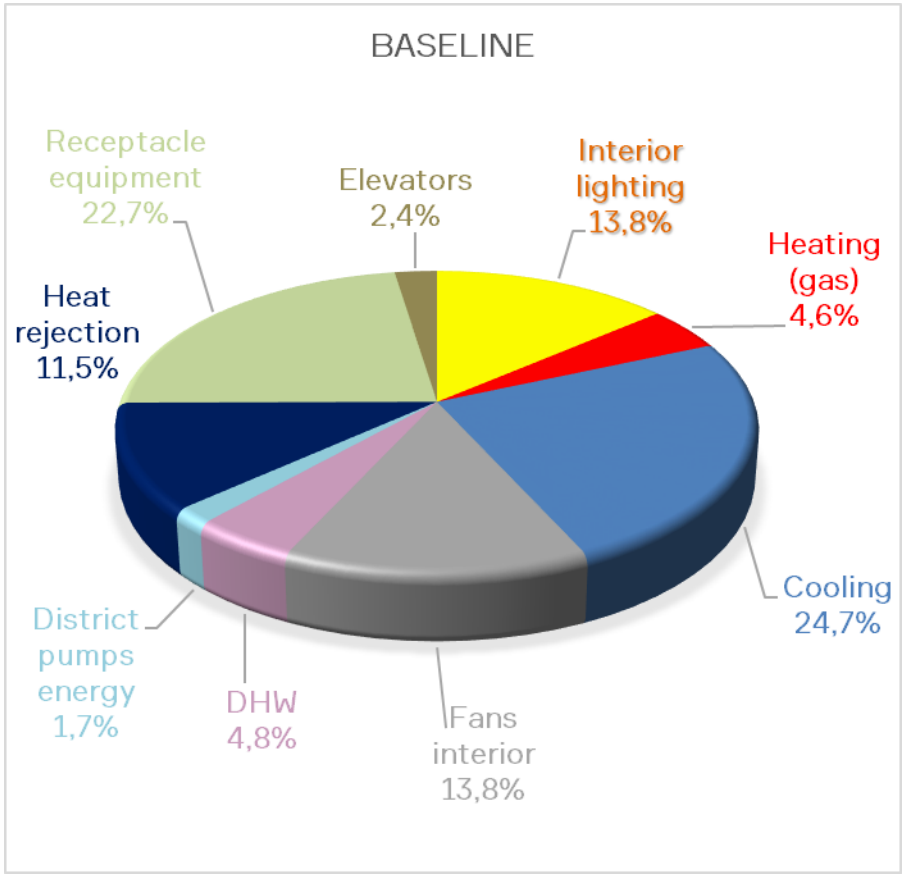
ANNUAL DISTRIBUTION OF ENERGY CONSUMPTION BY CATEGORY IN BASELINE AND PROPOSED BUILDINGS

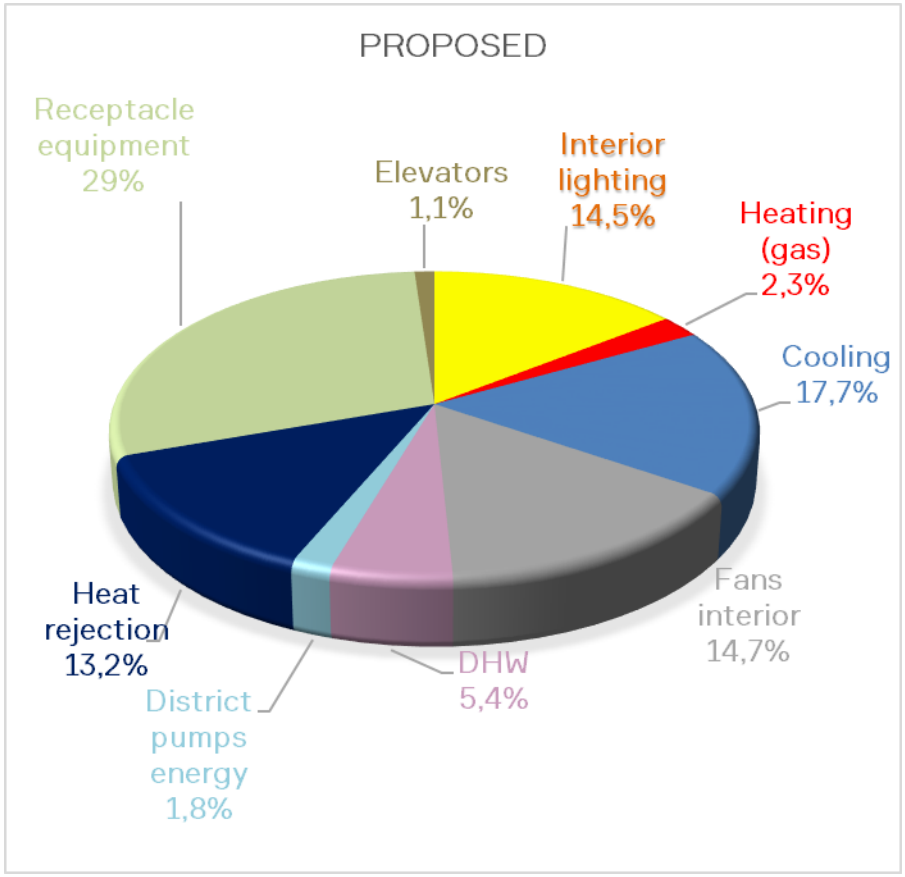


	Baseline	Proposed
Heat rejection	1 970	1 753
District pumps energy	297	240
DHW	4 930	4 352
Fans interior	2 373	1 954
Cooling	4 240	2 354
Heating (gas)	4 809	1 864
Interior lighting	2 368	1 923
Elevators	150	150
Receptacle equipment	3 891	3 891

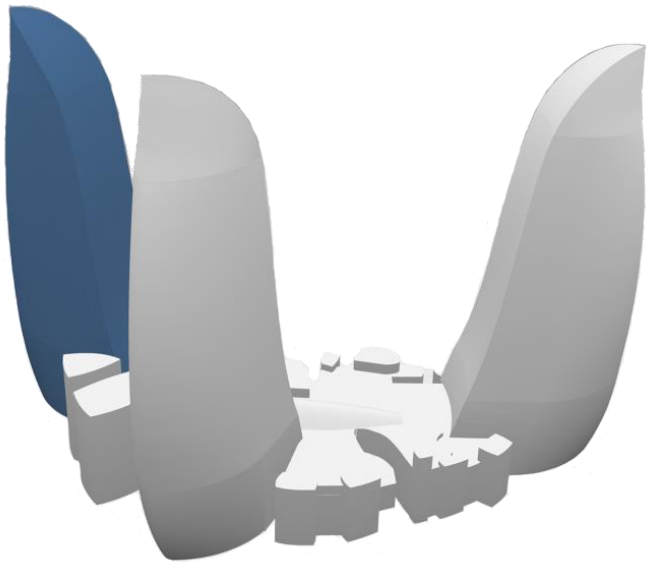
Hotel

DISTRIBUTION OF COSTS BY CATEGORY IN BASELINE AND PROPOSED BUILDINGS





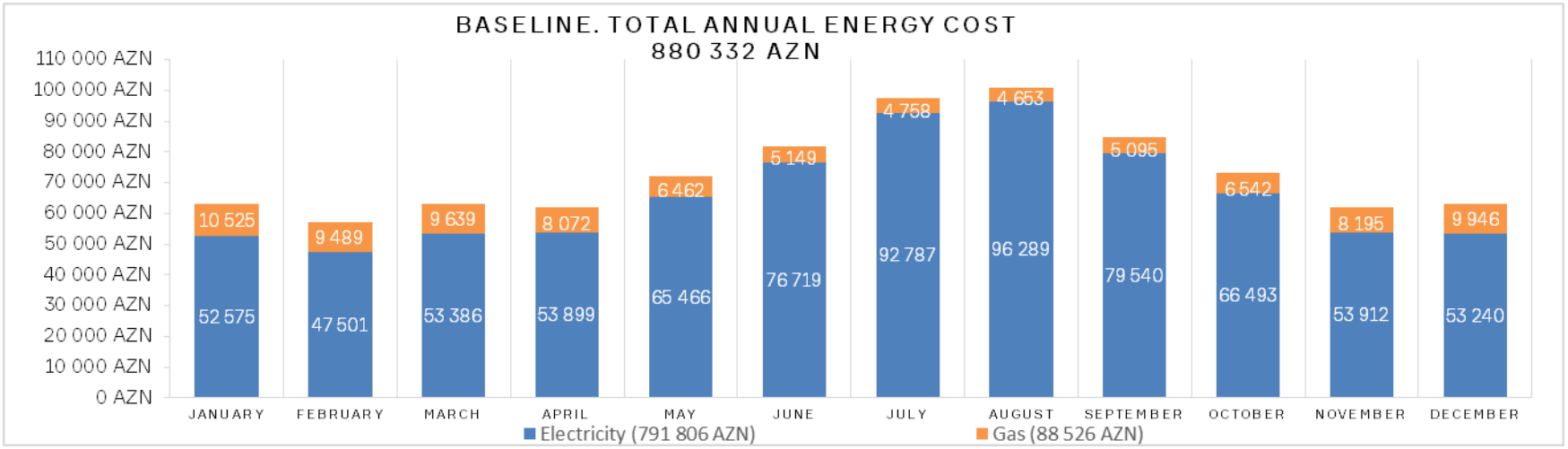
Hotel

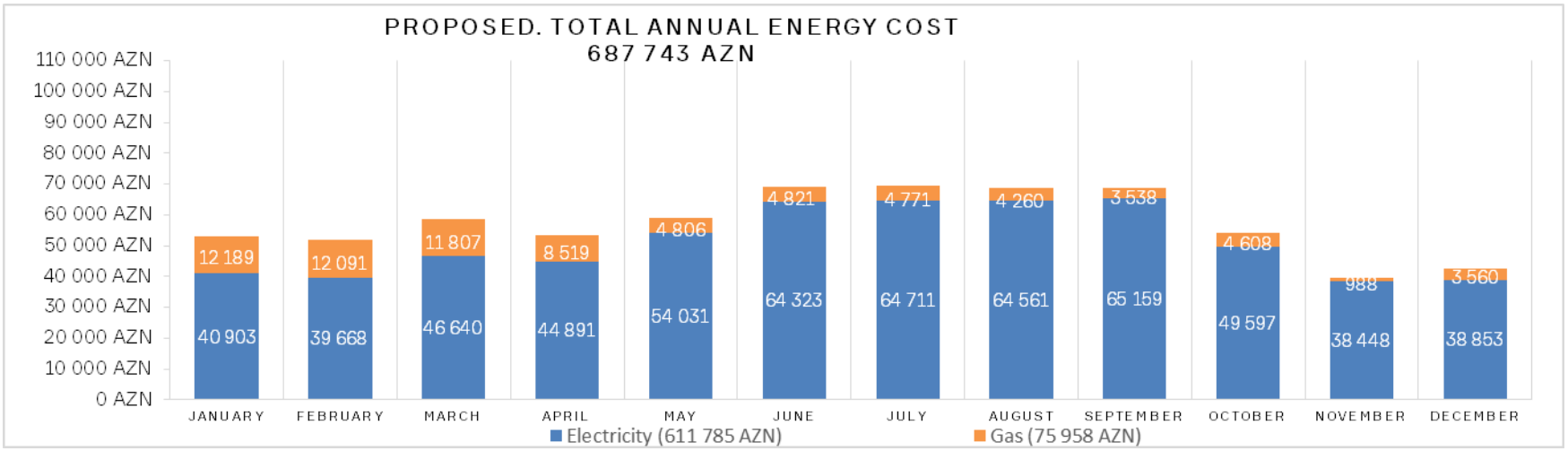


Height of building: 164,6 m
Number of floors (above ground): 36

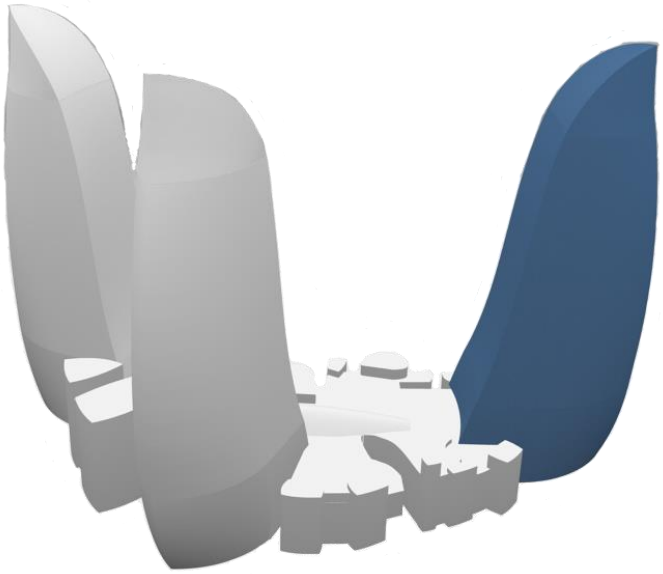
Energy-efficient solution	Efficiency, %		Reduction of energy cost, AZN
	Reduction of energy consumption, %	Reduction of energy cost,%	
Usage of heat recovery (75% efficiency).	12,30	7,2	63 384
Usage of CO2 sensors in hotel spaces.	15,20	10,10	88 914
Usage of LED-lamps.	1,06	2,41	21 216
All energy-efficient solutions	**25,11**	**21,88**	**192 589**

Hotel

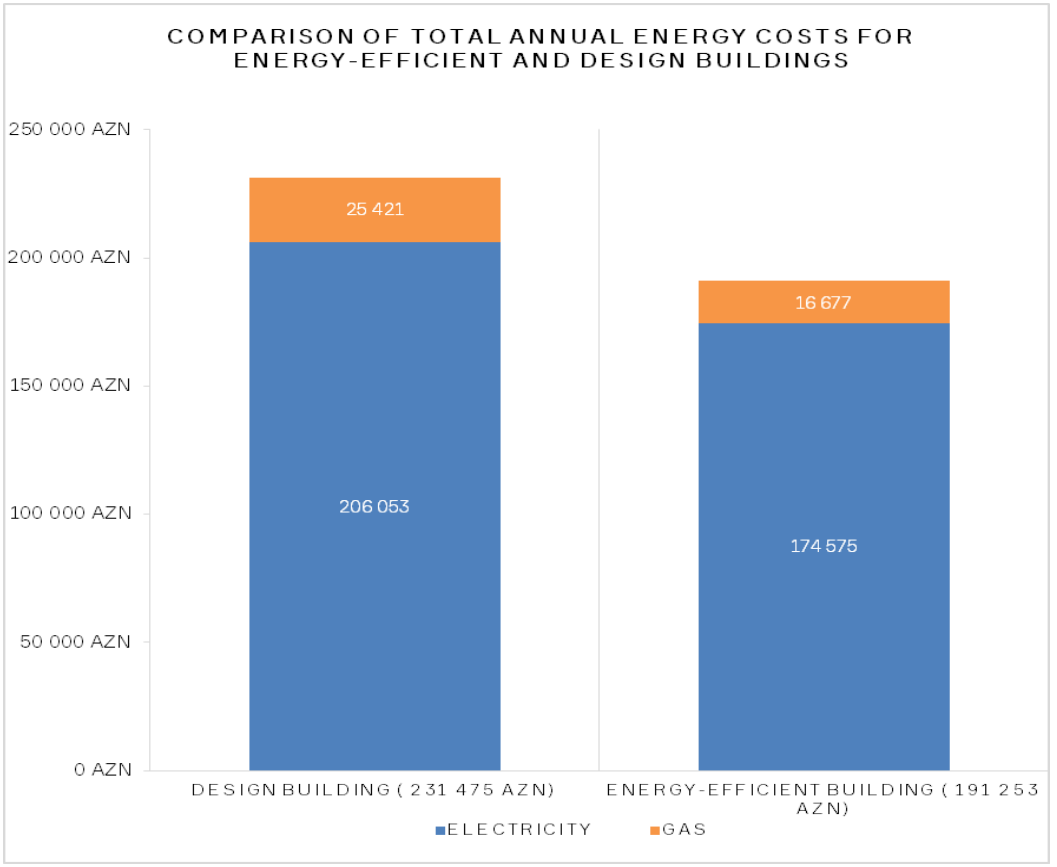

BASELINE. TOTAL ANNUAL ENERGY COST
880 332 AZN
110 000 AZN
100 000 AZN
90 000 AZN
80 000 AZN
70 000 AZN
60 000 AZN
50 000 AZN
40 000 AZN
30 000 AZN
20 000 AZN
10 000 AZN
0 AZN
JANUARY 10 525 52 575
FEBRUARY 9 489 47 501
MARCH 9 639 53 386
APRIL 8 072 53 899
MAY 6 462 65 466
JUNE 5 149 76 719
JULY 4 758 92 787
AUGUST 4 653 96 289
SEPTEMBER 5 095 79 540
OCTOBER 6 542 66 493
NOVEMBER 8 195 53 912
DECEMBER 9 946 53 240
Electricity (791 806 AZN)
Gas (88 526 AZN)


PROPOSED. TOTAL ANNUAL ENERGY COST
687 743 AZN
110 000 AZN
100 000 AZN
90 000 AZN
80 000 AZN
70 000 AZN
60 000 AZN
50 000 AZN
40 000 AZN
30 000 AZN
20 000 AZN
10 000 AZN
0 AZN
JANUARY 12 189 40 903
FEBRUARY 12 091 39 668
MARCH 11 807 46 640
APRIL 8 519 44 891
MAY 4 806 54 031
JUNE 4 821 64 323
JULY 4 771 64 711
AUGUST 4 260 64 561
SEPTEMBER 3 538 65 159
OCTOBER 4 608 49 597
NOVEMBER 988 38 448
DECEMBER 3 560 38 853
Electricity (611 785 AZN)
Gas (75 958 AZN)

Residential



Height of building: 181,7 m
Number of floors (above ground): 39

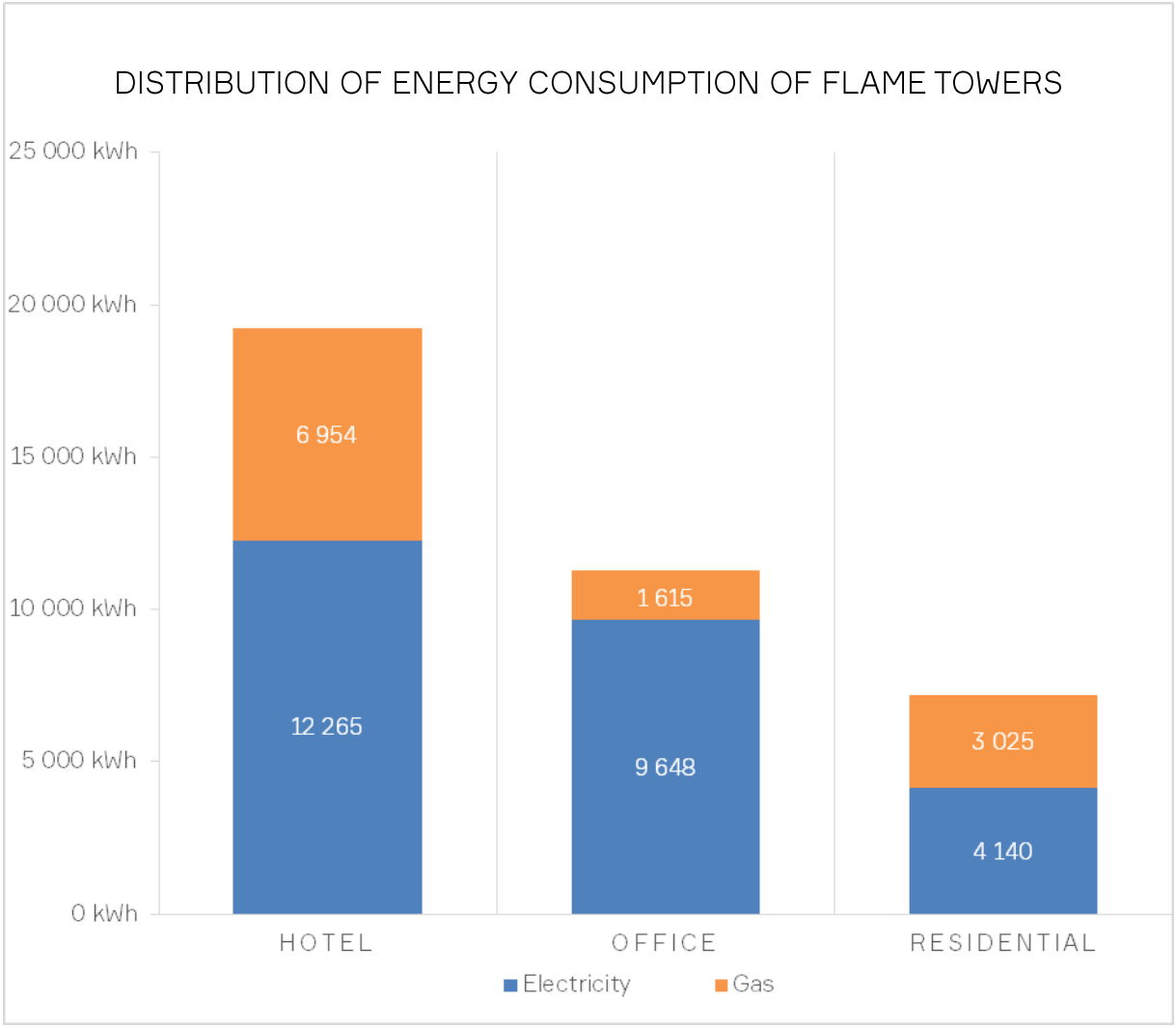


Reduction of annual energy operating costs – 40 222 AZN per year

Flame Towers

Building	Annual energy consumption in design building, kWh	Annual energy consumption in energy-efficient building, kWh	Reduction of energy consumption, %	Reduction of energy cost, AZN
Hotel	25 028	19 219	23.21	192 589
Office	11 264	8 307	26.26	102 516
Residential	7 165	5 366	25.11	40 222

Flame Towers



Section 3

CFD Modeling Flame Towers

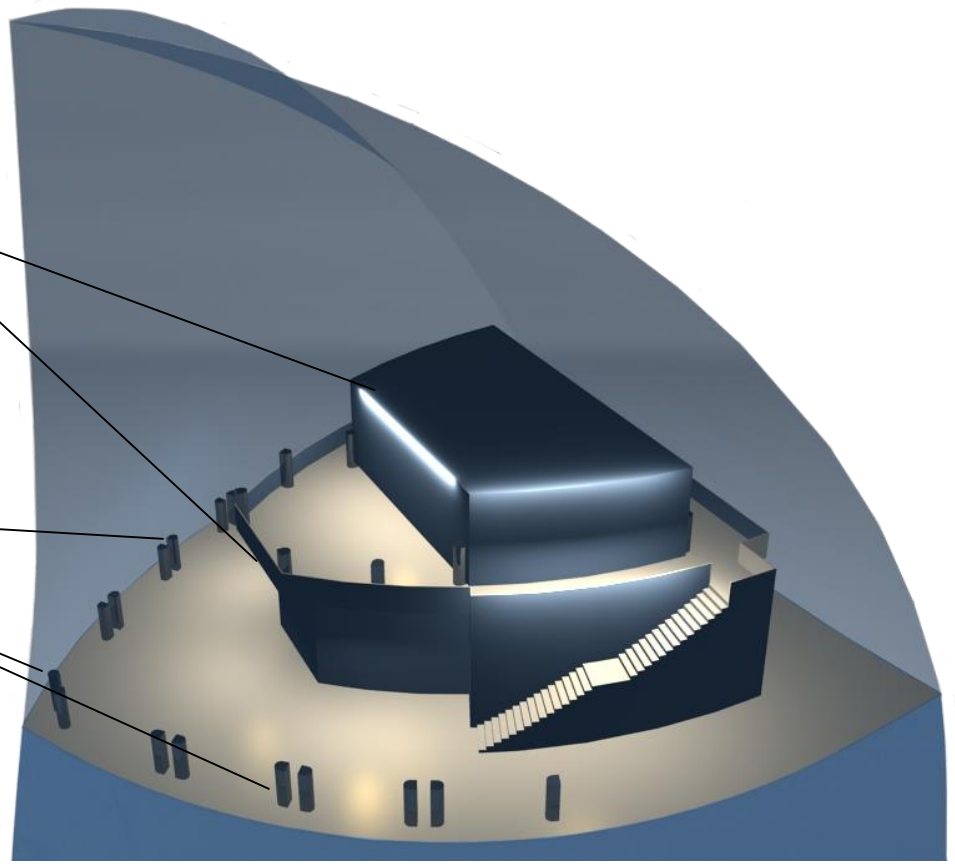
Restaurant
Hotel room

Restaurant

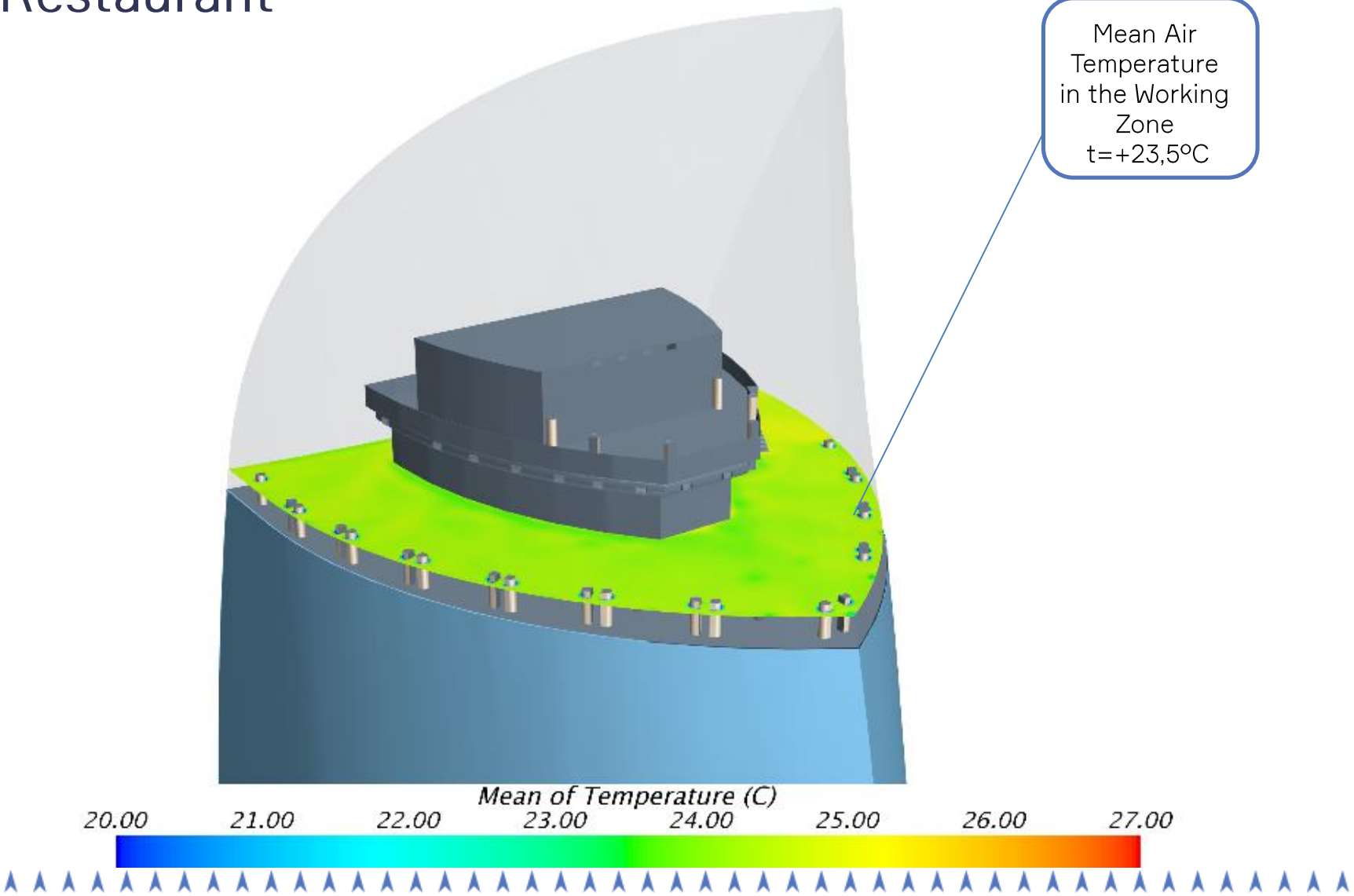
Scope of Work – Provide comfortable microclimate parameters in the Visitor`s zone of the Restaurant.

Exhaust Air Terminals

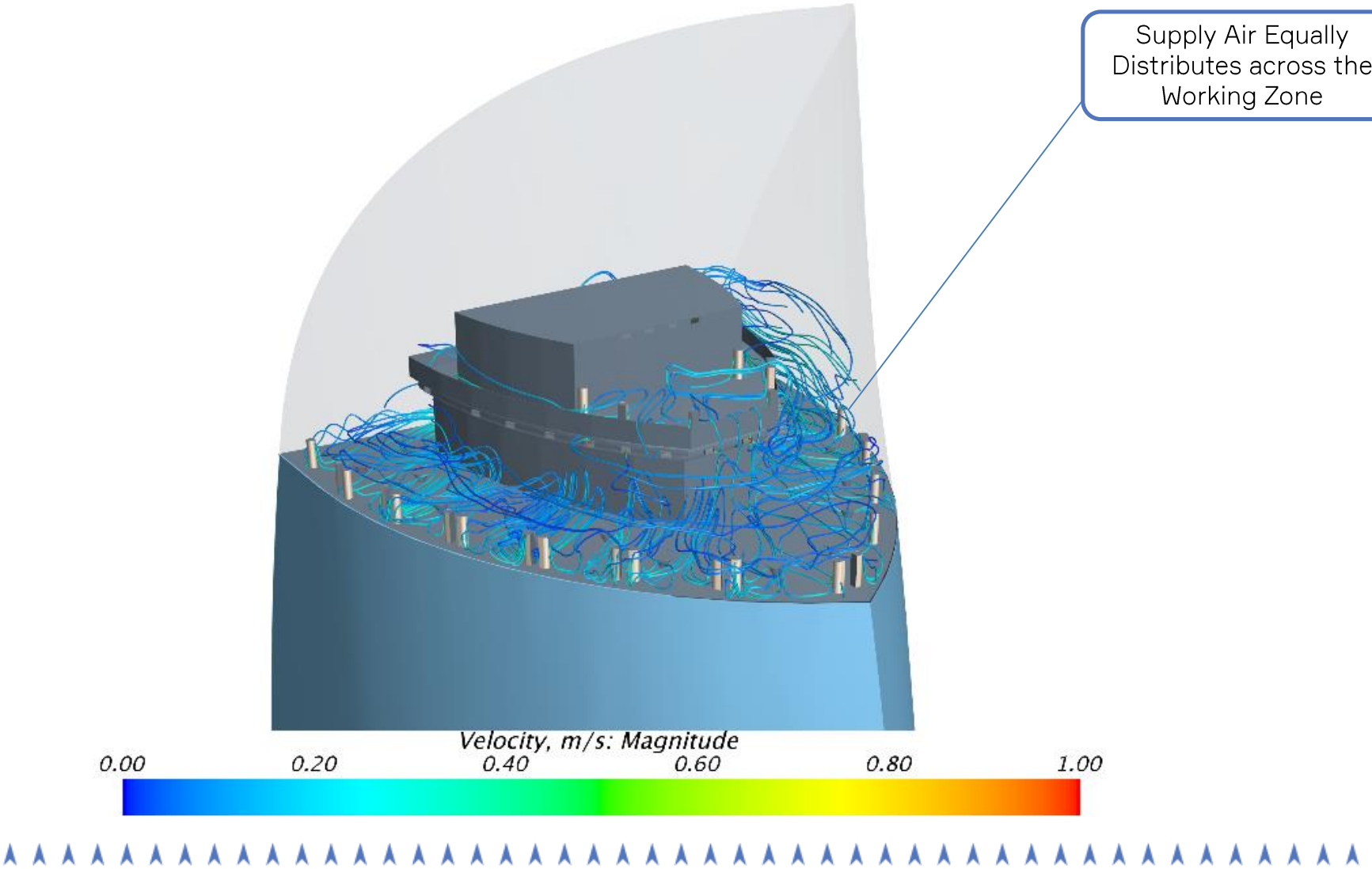
Low-speed Air Diffusers



Restaurant


Mean Air Temperature in the Working Zone t=+23,5ºC
Mean of Temperature (C)
20.00
21.00
22.00
23.00
24.00
25.00
26.00
27.00

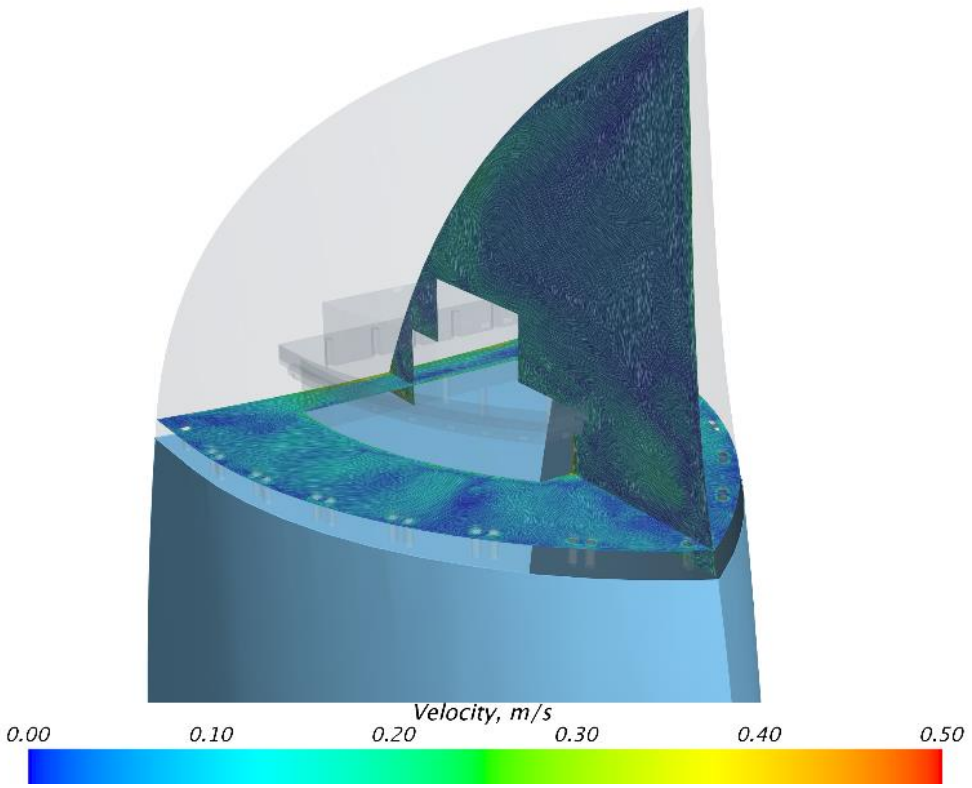
Restaurant


Supply Air Equally Distributes across the Working Zone
Velocity, m/s: Magnitude
0.00
0.20
0.40
0.60
0.80
1.00

Restaurant

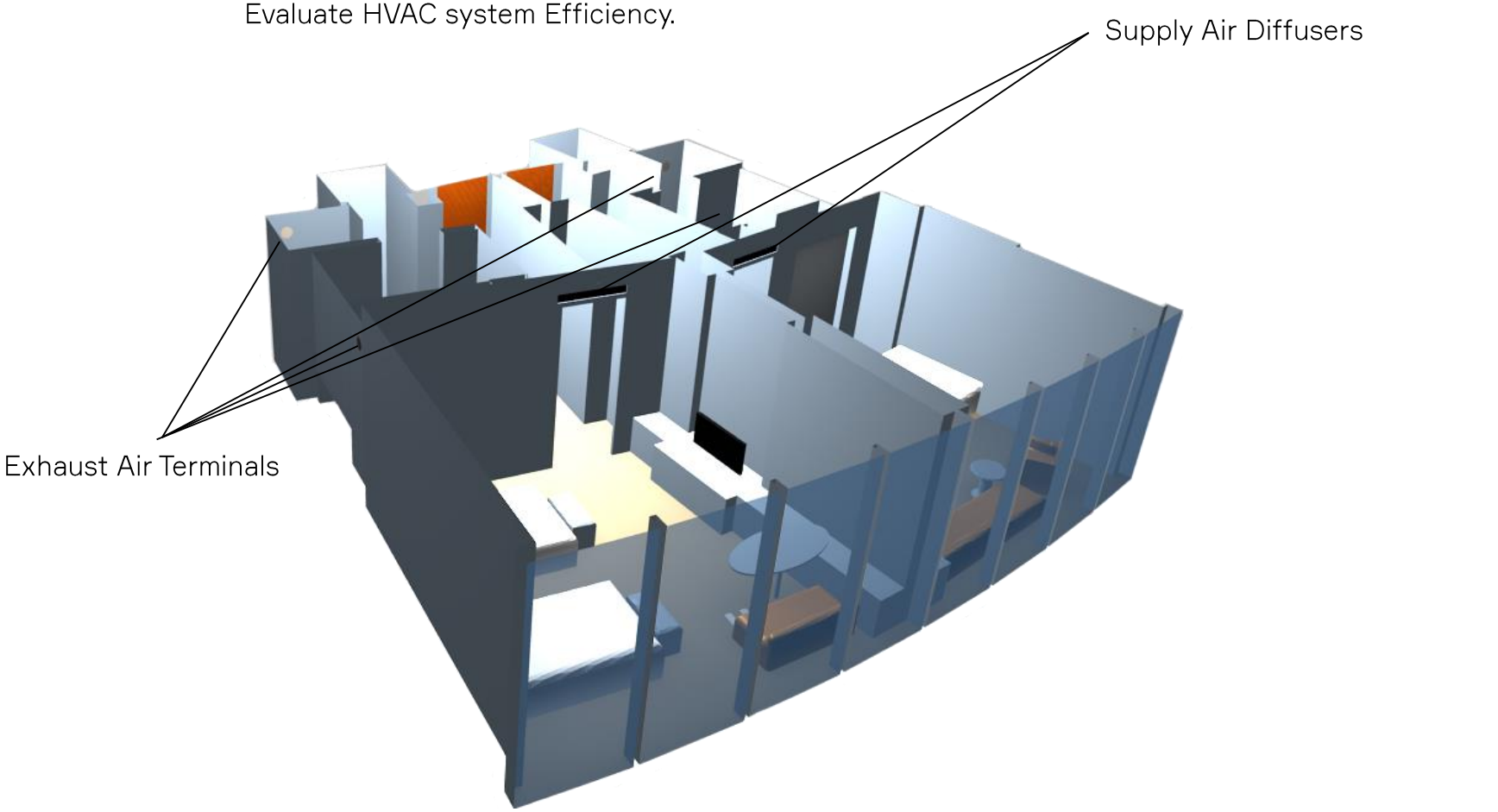
Conclusion:

- The results of the Mathematical Modeling provide with opportunity to establish comfortable temperature conditions in the Working Zone.
- Mean Air Temperature in the Visitor`s area equals to +23,5ºC.
- Air Velocity in the whole area volume situated in the acceptable values and does not increase 0,2 m/s.
- Set Microclimate parameters situated in the area of acceptable values.

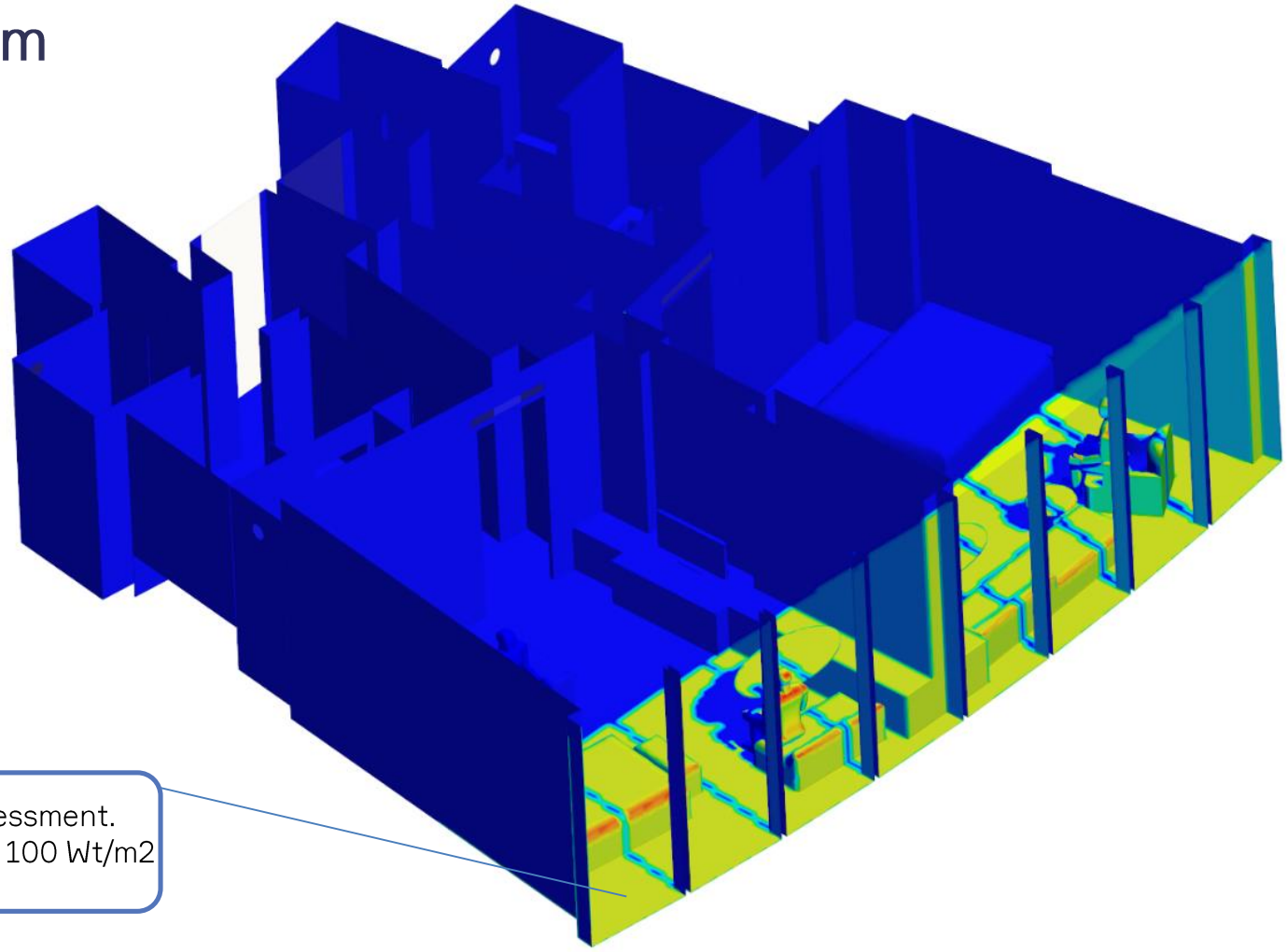


Hotel room

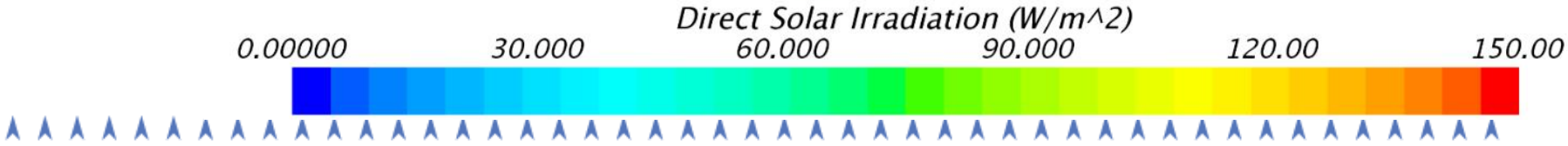
Scope of Work – Evaluate set indoor microclimate parameters.
Evaluate HVAC system Efficiency.



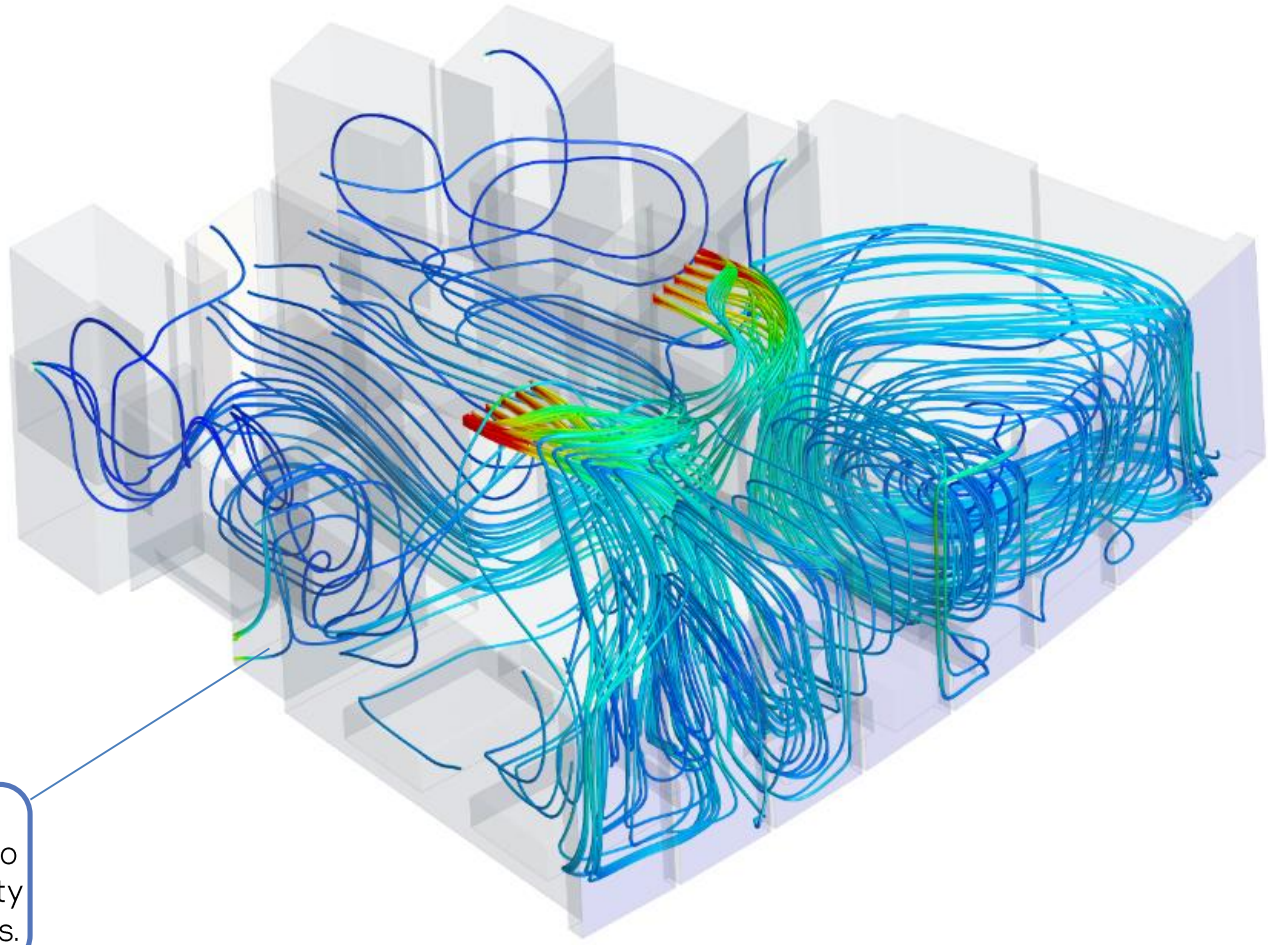
Hotel room



Solar Irradiation Assessment.
Mean Solar Insolation – 100 Wt/m2

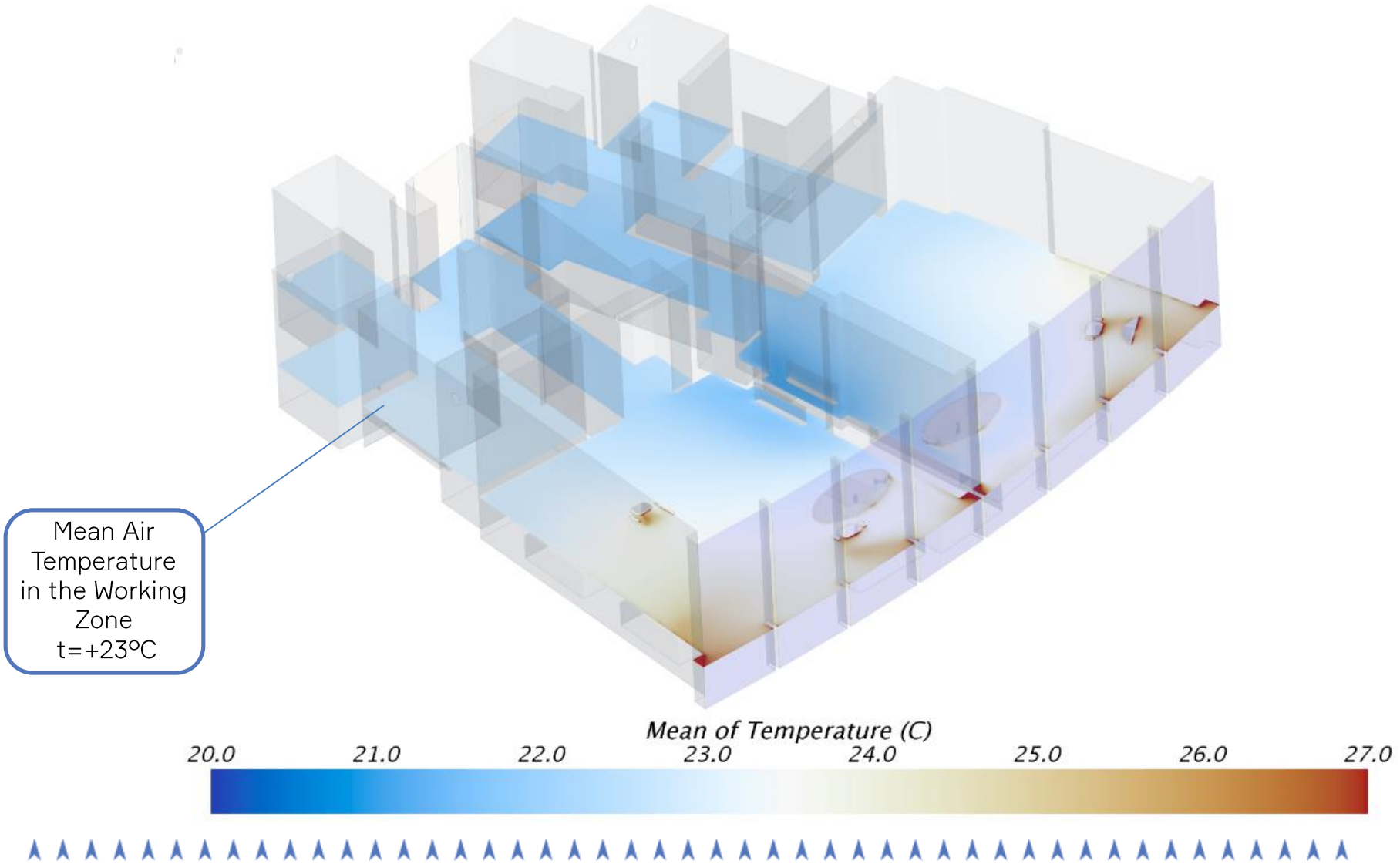


Hotel room



The Ventilation System completely provides air to the Room. The Air Velocity does not increase 0,2 m/s.

Hotel room


Mean Air Temperature in the Working Zone t=+23°C
Mean of Temperature (C)
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0

Hotel room

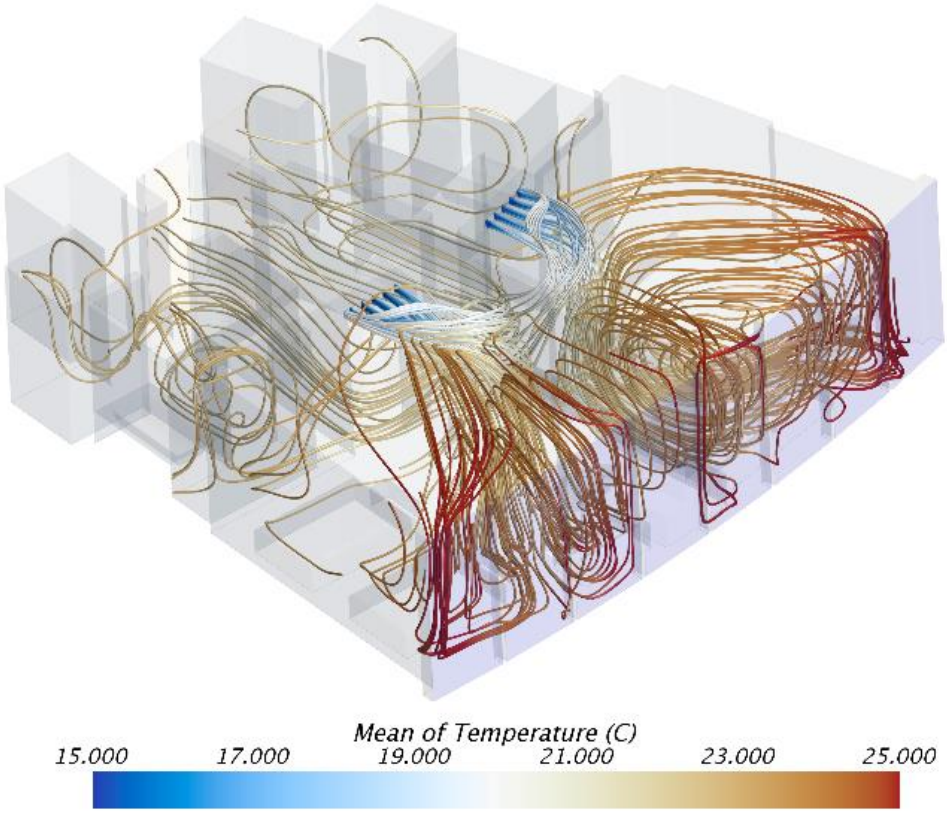
Conclusion:

- Various Energy Modeling of the indoor temperature, air velocity and indoor humidity parameters of the Hotel represents high efficiency operation of the HVAC systems.

- Mean Indoor Air Temperature equals to +23ºC, Mean Air Velocity does not increase 0,2 m/s.

- HVAC Systems provides the space with high indoor air quality.

- Set Microclimate parameters situated in the area of acceptable values.



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