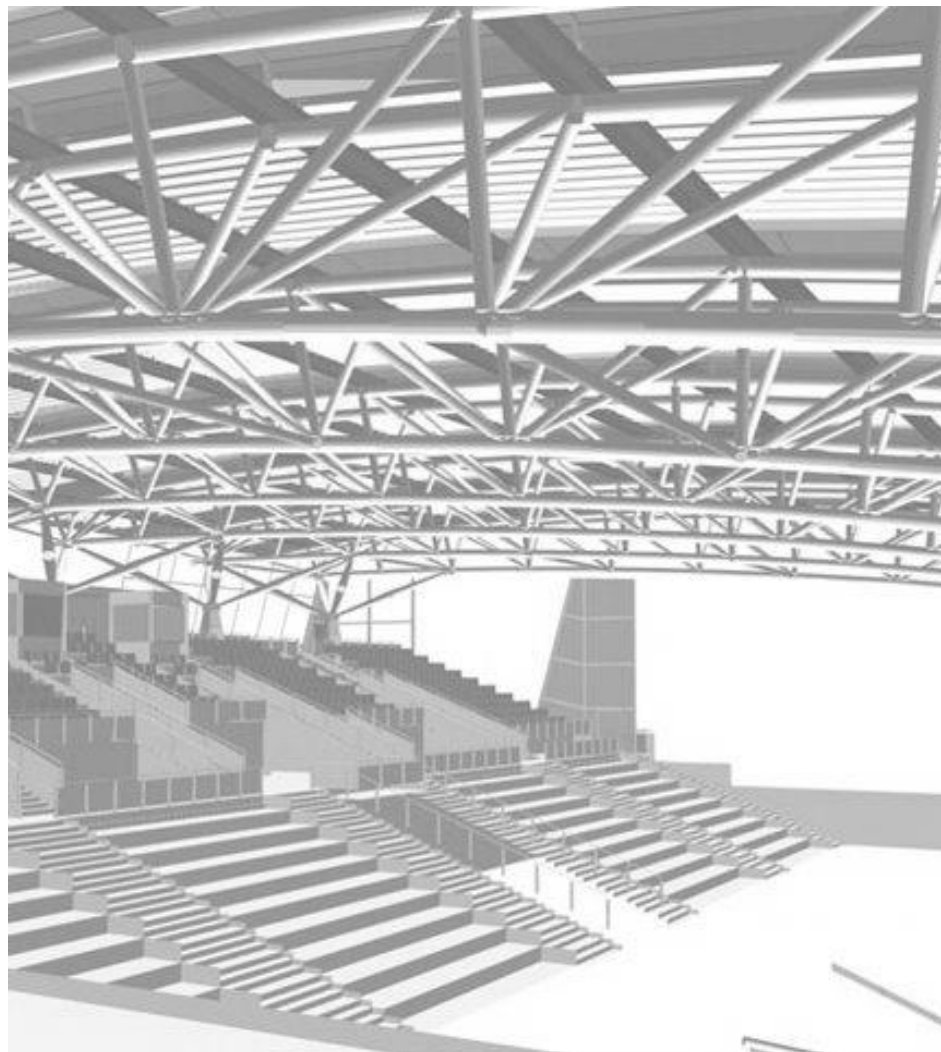




System solutions air distribution for Sports halls

Components for Sports Halls



Swirl diffusers
OD-11/TR



Supply air
nozzles VŠ-5/TR



Air
displacement
units SD



Swirl diffusers
OD-5



Ventilating
towers SP



Steel weather
louvres JZR-6



Fire damper



Mechanical air
flow volume
controller



Variable air flow
volume
controller



Floor
convectors



Sound
absorbers

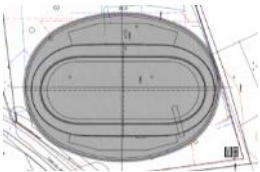


Air handling
units

Sports Halls

Key object characteristics

Large room dimensions, large amount of users



Occupancy of the building varies greatly: very large number of visitors or completely empty facility.

Rational use of energy is very important.

Sports halls are mostly multi-purpose objects (for sports events, concerts, theatre events...) with a high representative value.

Key tasks for designers

- Choosing air distribution elements with large throw distances, that ensure the supply of adequate amounts of fresh air and a pleasant indoor climate for visitors and players
- Rational choice of energy saving air conditioning systems with a high degree of heat recuperation and centralized control of different regimes, depending on the current occupancy of the building is obligatory.
- In order to meet the requirements of different events, the equipment of sports halls must be both flexible and aesthetically pleasing.

AHU for Sports Halls



AHU TopAir

- new model with improved heat transfer and thermal bridge coefficient
- selection software AirCalc++
- better air tightness and mechanical stability
- high level of heat recuperation
- EUROVENT certificate
- integrated automation



Air Supply Elements for Sports Halls



Supply air nozzles, VŠ-4

- for rooms with large throw distance requirements
- **VŠ-4** – adjustable within a $\pm 30^\circ$ range, either manually or by means of a motor drive



Supply air nozzles VŠ-5

- can be adjusted in the same way as VŠ-4 – manually or motor-driven
- supply air nozzle is integrated in the housing and does not protrude into the room.



Air Distribution Elements for Sports Halls



Swirl diffuser OD-11

- designed for rooms with 3-10 m height
- suitable for large temperature differences between supply and room air
- various regulation options, also thermostatic regulation is possible



**THERMOSTATIC
REGULATION**

Square diffuser OD-5

- for air supply and exhaust
- low static pressure drop and low noise level



Air displacement units

- suitable for larger rooms with high heat loads
- the supplied air forms a "fresh air pool" in the occupied zone
- even temperature field, without draught
- various installation options



VAV and CAV Regulation for Sports Halls



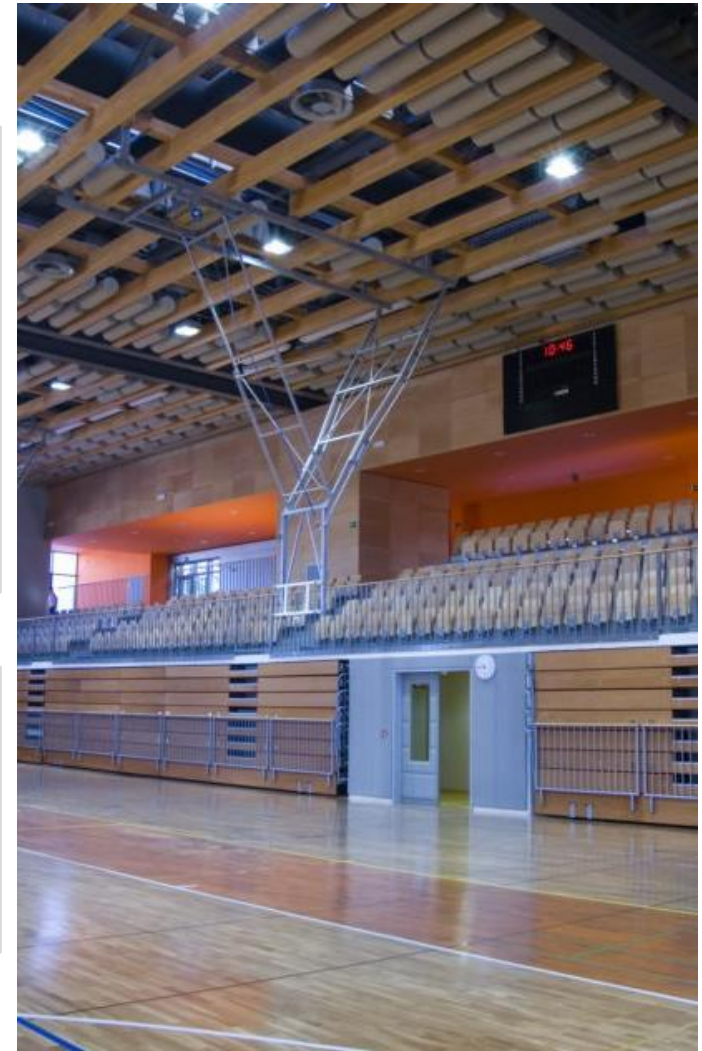
Electronic flow rate controller ERP-1

- VAV (variable air volume) or CAV (constant air volume)
- easy setting of the parameters on the site
- option: LONWORKS with integrated MP BUS protocol



Mechanical flow-rate controller MRP-5

- designed for CAV only
- easy maintenance and manual setting of the air flow
- optional installation of an actuator



Fire Protection and External Elements



Fire damper WK and WH

- installation in rectangular or circular ventilation ducts
- tested and certified for different markets (A, PL, SLO, SRB, RU, UKR, RO, ...)
- acc. to CE - EN15650, EN1366-2 and EN13501-3 and local standards



Ventilating towers SP

- supply and exhaust of air from rooms
- can be fitted with sound attenuator
- available in circular and square versions
- materials (aluminium, steel, inox,...) and dimensions are determined by the customer



Business Excellence



Standardisation of business processes and certificates of suitability

Quality management system

Business processes according to standards ISO 9001:2000 and ISO 14001



Certification of products:

International certificates: CE, TÜV, Eurovent, Solar Keymark

National certificates: GOST, SPF, ZAG

Software for the equipment selection

Klima ADE 5.8

Klima ADE 5.8 - Air Distribution Design Program

Project Data Space Definition Grilles Diffusers Variable Diffusers Slot Diffusers Duct Diffusers

Space length [m] 6,0

Space width [m] 4,5

Space height [m] 3,0

Floor area [m²] 27,0

Space volume [m³] 81,0

Occupied zone above floor level [m] 1,8

Space definition

Klima ADE 5.8 - Air Distribution Design Program

Project Data Space Definition Grilles Diffusers Variable Diffusers Slot Diffusers Duct Diffusers Nozzles

Optimal operative temperature [°C] 24,0

Supply air temperature [°C] 18,0

Permissible mean air velocity [m/s] 0,20

Required supply air flow rate [l/s m² floor] 4,6

Required supply air flow rate in space [l/s] 125,000

Air change coefficient [1/h] 5,6

Permissible sound pressure level [dB(A)] 35

Air flow rate in m³/h Acoustic Environment

Diffuser type LD-14 SLOT DIFFUSER

Number of slots LD-14/2

Supply Cooling - Alternate sided (horizontal)

Length [m] 1,5

Calculate

Close

Ceiling Regulation

Distance from wall:

X1 [m] 1,00 X2 [m] 1,00

X3 [m] 1,50 X4 [m] 1,50

Number of diffusers:

on long side - nl 3

on broad side - nb 1

Distance between the diffusers:

dl [m] 2,00

Distance along broad side:

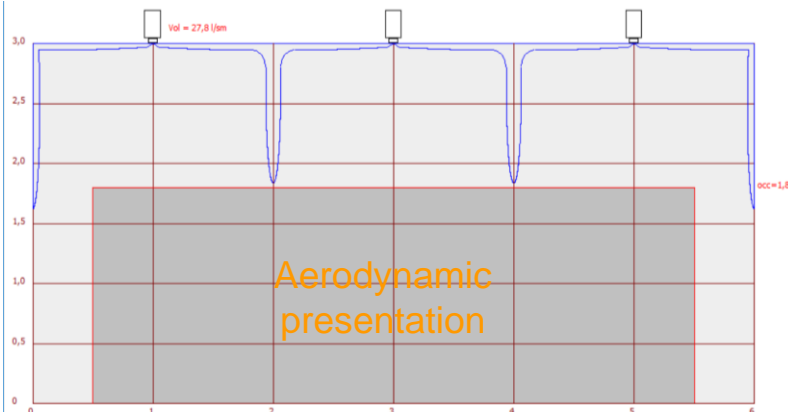
db [m] 0,00

Diffuser air flow per meter:

Vol [l/s m] 27,8

Show Placement

Input data



Air distribution design

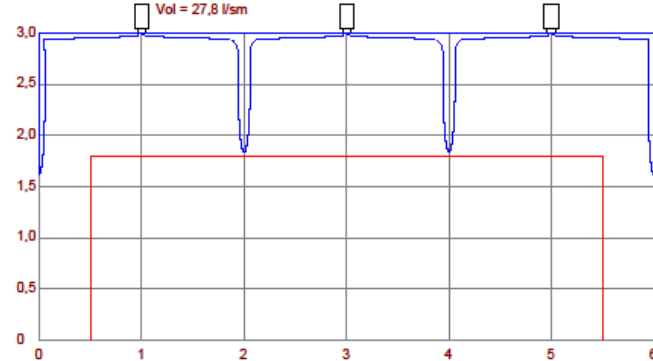


Report

Project data :

Name of the project : Kongres Podgorica
Customer : Inženjerska komora Crne Gore
Reference :
Designed by : Aleksandar Pjevic
Information :

Air diffusion :



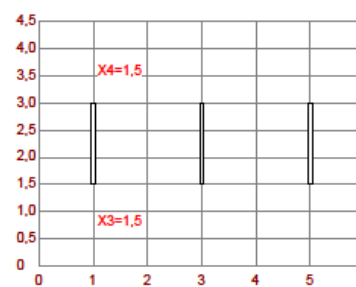
Space :

height = 3,0 m
length = 6,0 m
width = 4,5 m
floor = 27,0 m²
volume = 81,0 m³

Placement :

dl = 2,00 m
db = 0,00 m
X1 = 1,00 m
X2 = 1,00 m
X3 = 1,50 m
X4 = 1,50 m
nl = 3
nb = 1

Placement of diffusers :



Definitions :

Vol [l/s m] : Air flow rate at the diffuser per meter
dl [m] : Distance between the diffusers
X1,X2,X3,X4 [m] : Distance between the diffuser and the wall
H1 [m] : Distance between the diffuser and the stand level
H [m] : Installation height of the diffuser
h1 [m] : Vertical throw of the diffuser for heating
h1max [m] : Maximum throw of the diffuser for heating
vH1 [m/s] : Air velocity between the diffusers at the distance H1
vL [m/s] : Air velocity by the wall at the distance L
LwA [dB(A)] : A-weighted sound power level
LpA [dB(A)] : A-weighted sound pressure level in room
dpt [Pa] : Pressure drop at the diffuser

Placement :

dl [m] : Distance along long side of the space
db [m] : Distance along broad side of the space
X1 [m] : Distance from the left wall
X2 [m] : Distance from the right wall
X3 [m] : Distance from the lower wall
X4 [m] : Distance from the upper wall
nl [] : Number of diffusers along long side of the space
nb [] : Number of diffusers along broad side of the space

Design criteria :

Optimal operative temperature : 24,0 °C
Supply air temperature : 18,0 °C
Temperature difference : -6,0 K
Permissible mean air velocity in occupied zone : 0,20 m/s
Required supply air flow rate : 4,6 l/s m² floor
Required supply air flow rate in space : 125 l/s
Air change coefficient : 5,6 1/h
Sound pressure level : 35 dB(A)
Sound increment : 0 dB
Reverberation time : 1,0 s
Occupied zone : 1,8 m

Diffuser :

Supply : Cooling (Coanda effect) - Alternate sided
length = 1,5 m

Calculation results for cooling :

Diffuser type : LD-14/2
Diffuser air flow rate : Vol = 27,8 l/s m (100,0 m³/h m)
Mean air velocity between the diffusers at the distance H1 (H1=1,2m) : vH1 = 0,24 m/s
Mean air velocity by the left wall at the occupied zone level (L=2,2m) : vL = 0,21 m/s
Mean air velocity by the left wall at the floor level (L=4,0m) : vL = 0,16 m/s
Mean air velocity by the right wall at the occupied zone level (L=2,2m) : vL = 0,21 m/s
Mean air velocity by the right wall at the floor level (L=4,0m) : vL = 0,16 m/s
Pressure drop on the diffuser (regulation=100%) : dpt = 2,6 Pa

Sound power level of the diffuser (regulation=100%) :
Lw63 = 32 dB Lw125 = 25 dB Lw250 = 22 dB Lw500 = 16 dB Lw1000 = 10 dB
Lw2000 = 7 dB Lw4000 = 6 dB Lw8000 = 7 dB LwA = 18,9 dB(A) NR = 15
Sound pressure level in space at 1,8 m :
Lp63 = 36 dB Lp125 = 28 dB Lp250 = 25 dB Lp500 = 19 dB Lp1000 = 14 dB
Lp2000 = 11 dB Lp4000 = 10 dB Lp8000 = 10 dB LpA = 22,2 dB(A) NR = 18

Software for the equipment selection

Floor convector selection

tkSoft 1.1

Calculation based on
☐ Power ☒ Length

Water
☒ Outlet temperature ☐ Flow

Connections
☒ Right ☐ Left

Calculate Heating
Fan Speed Med

Type TKV-S
Fan choice 2-4
Width 200
Height 140
System 2-pipe

Heating
Length - L [mm] 2000
Air on temperature - Ton [°C] 20
Water inlet temperature - Tin [°C] 70
Water outlet temperature - Tout [°C] 60

Cooling
Length - L [mm]
Air on temperature - Ton [°C]
Relative humidity - RH [%]
Water inlet temperature - Tin [°C]
Water outlet temperature - Tout [°C]

Radius
Radius - R [mm]
Discount
Discount - D [%]


OC IMP KLIMA Slovenia
Floor Convectors

	Qh[W]	L[mm]	dL[mm]	m[kg/h]	dp[kPa]	Lpa[dB]	Price[EUR]
TKV-S-13 200x20x14/R/N/24 Additional: 114D,09S	1785	2000	0	153.4	0.37	38	

Grille colour D - natural aluminum colour (CO)
Selection Standard

02 - Thermostat valve, angular, R1/2 or R3/4
03 - Radiator shutt-off cock, straight, R1/2 or R3/4
04 - Radiator shutt-off cock, angular, R1/2 or R3/4
09S - Three speed regulator
010 - Corner design of convector and grille
017 - Housing thermal insulation
018 - Wooden protection cover for convector protection during installation
020 - Level adjustment base, leveling height 20, 30, 40 mm

Project Calculate Drawing Print Export to Excel Close



Sound absorber selection

Klima DZ 3.2

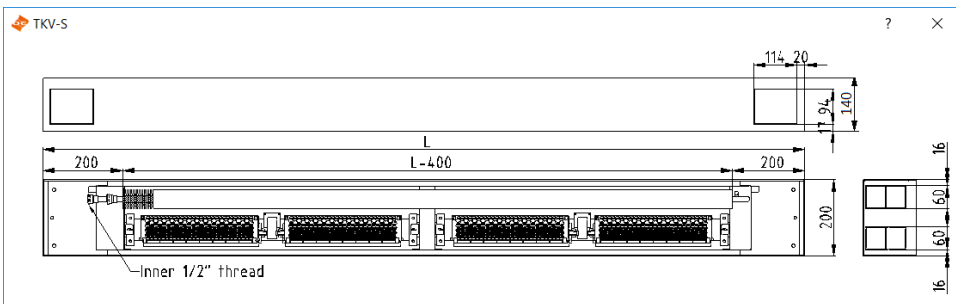

File Project Settings Help

Silencer type
☒ DZ-2 ☐ DZ-3

Thickness of the splitter - d [mm] 100
Width of the silencer - B [mm] 600
Height of the silencer - H [mm] 400
Length of the silencer - L [mm] 1500
Number of splitters - n [] 4
Distance between the splitters - s [mm] 50,0
Air volume flow rate - V [m3/h] 2000
Maximum air velocity - vsmax [m/s]
Maximum pressure drop - dpmax [Pa] 50,0
A-weighted sound power level - LwA [dB(A)]
Requested attenuation - De250 [dB] 20

Additional requests
☐ Installation of perforated galvanised sheet
☐ Installation of polyethylene foil and protection screen
☐ Installation of splitter guide rails at inlet and outlet

De Data
Fan Noise
s
B
L min
Calculate
De 250
De Graph
Nr Graph
Geometry
Print Preview
Save
List
Close



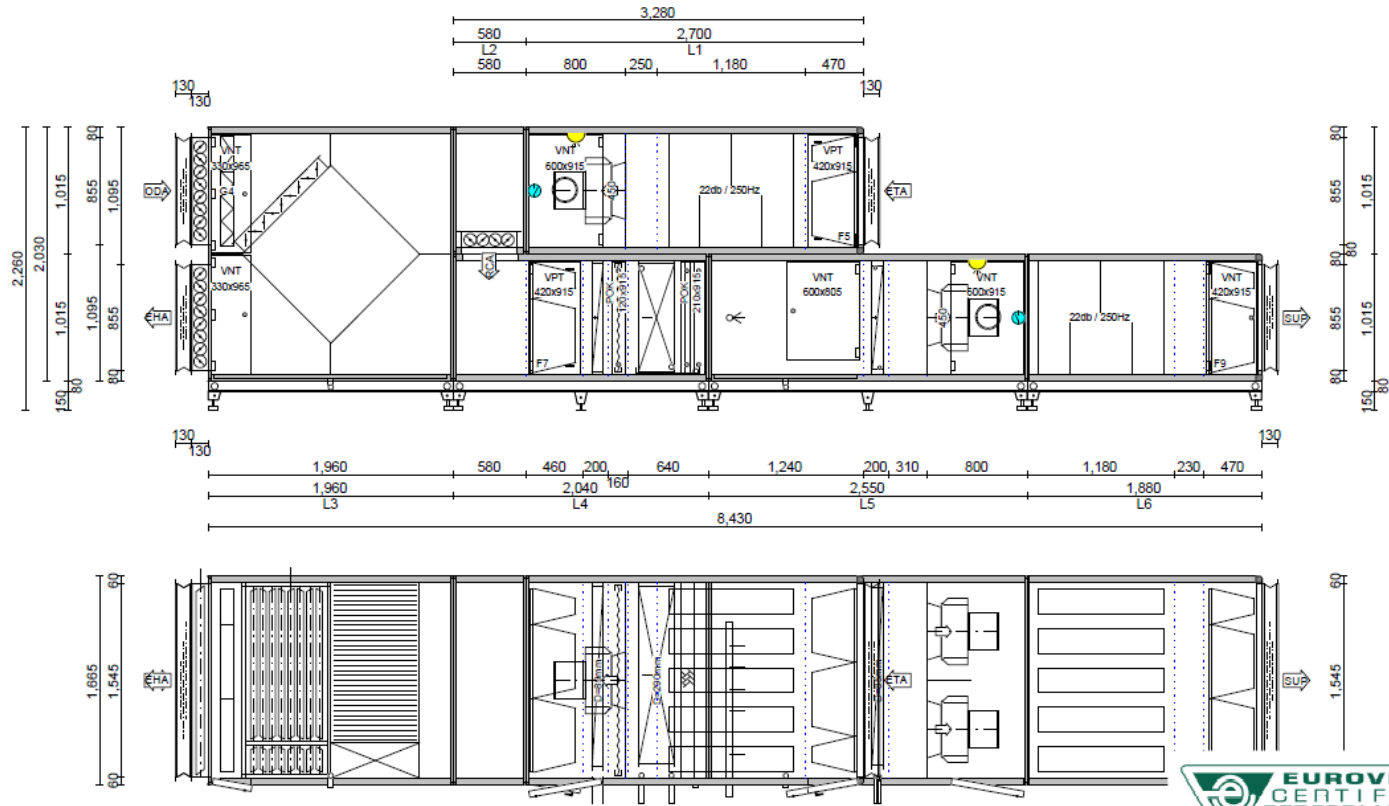
De 250

Attenuation at the frequency of 250 Hz :

Silencer type is DZ-2 .
Air velocity through the silencer is 6.9 m/s .
Pressure drop across the silencer is 44 Pa .
The A-weighted sound power level LwA is 27.6 dB(A) .
Attenuation at the frequency of 250 Hz is 27 dB .

OK

AirCalc++

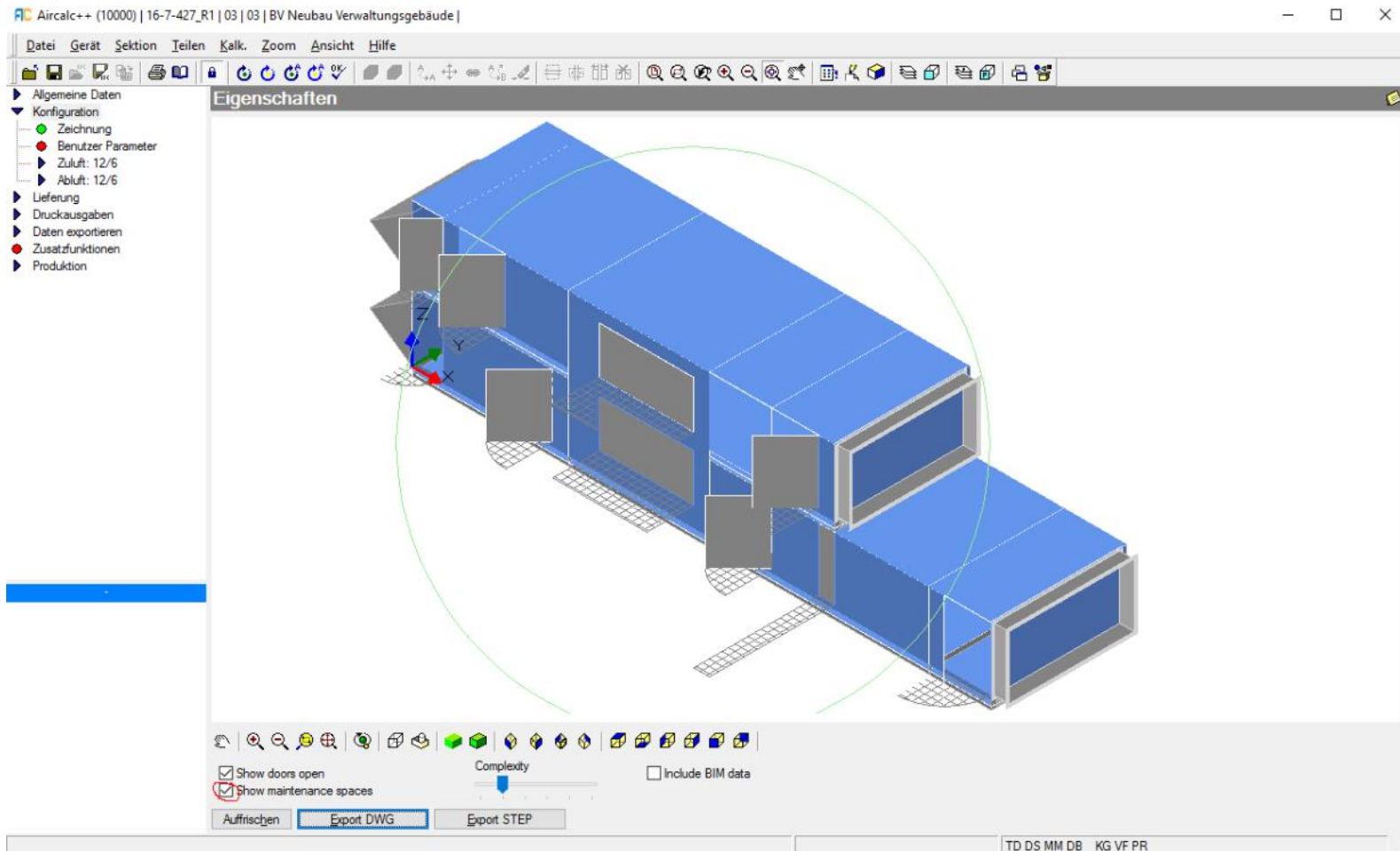


For information only!

AirCalc++ 3.20.171/1 - D.V.3.9.076 - 10001 - 9/6/2019

	pos. no.	Description			Supply	Exhaust	Order no		
	01	PB1			Unit size	15/9 d50	15/9 d50	500008452	
	Project		Client		Airflow [m³/h]	9,000	9,000	Designed by Aleksandar Pjevic	
	Yuriya Pharm, Cherkassy		EMC LeoCon-Group Ltd.		Tot. press. drop [Pa]	1,695	1,259	Date 9/6/2019	
arrangement:		KHND d50 15/9 - RPDKF, U, FTT, EW, FR, KWTA, BD, EW, L, VF, S, L, FTT *** 15/9 - FTT, S, L, VF, U, RPDKF						Weight netto/brutto [kg]	2393 / 2523

Export in 3D



Case Studies

- a) Velodrome, Novo mesto, Slovenia
- b) Sports Complex, Ljubljana, Slovenia,
- c) Belgrade arena, Belgrade, Serbia
- d) "Iceberg" Palace, Sochi, Russia
- e) Rhythmic gymnastics centre, Moscow, Russia

a)



b)



c)



d)



e)



Case Study – Velodrome Novo mesto



General data:

Surface area: 8.000 m²

Height: 13 m

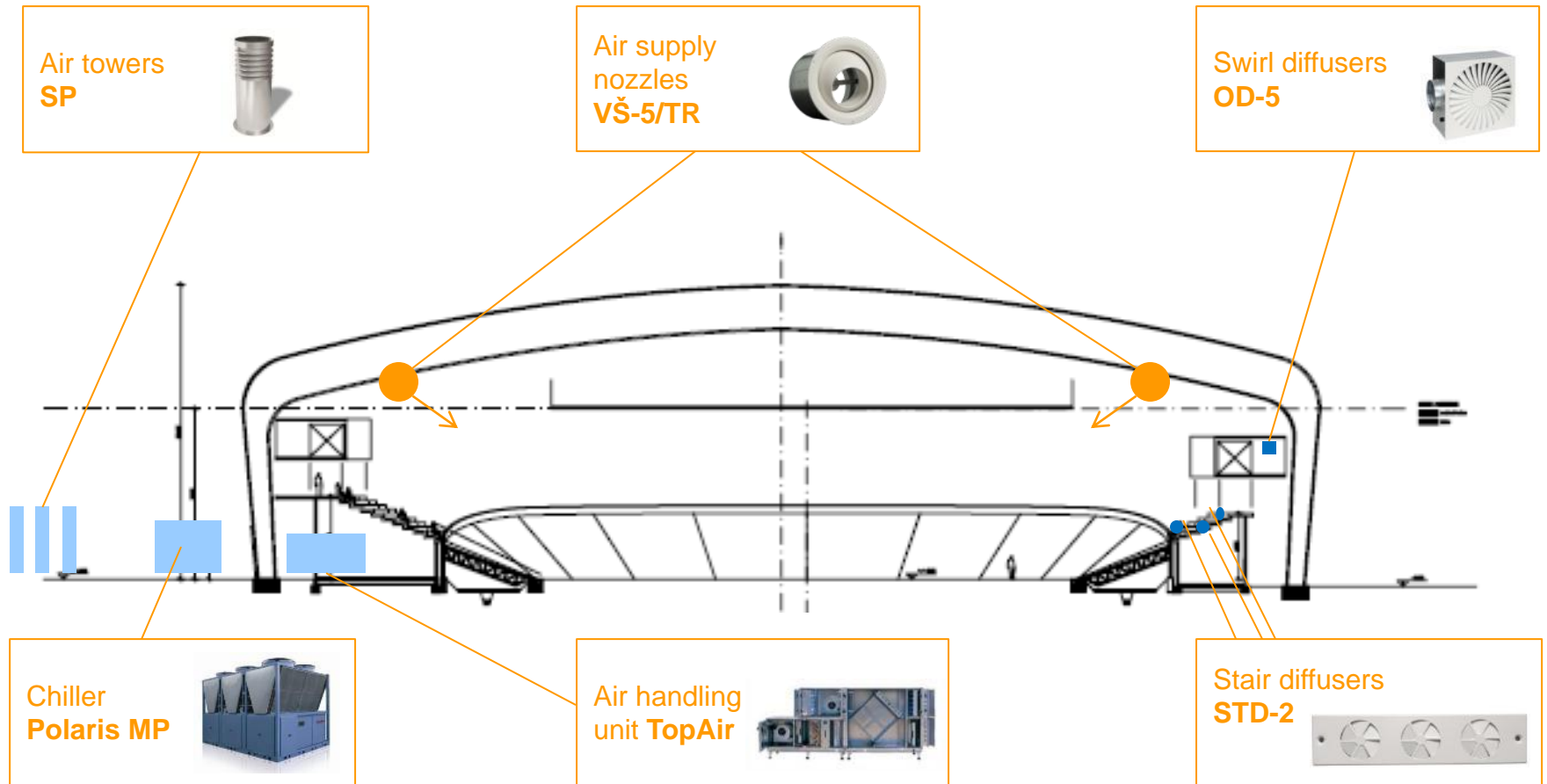
Steel construction, covered with technical tilt.

Capacity: up to 5.000 visitors

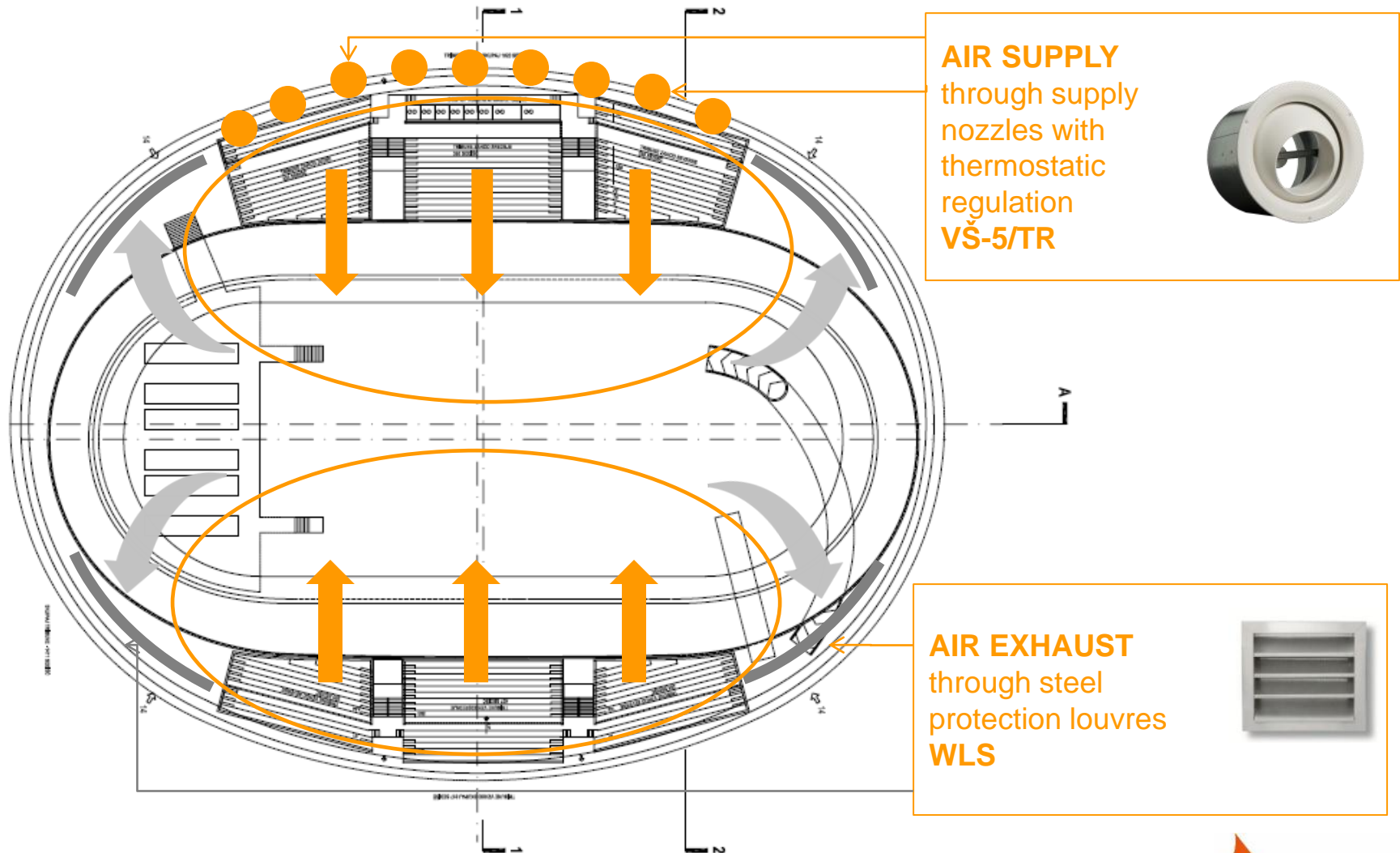
Investment: 13. mio. €.

Architector/designer: M. Zupanc jr.

Case Study – Velodrome Novo mesto



Case Study – Velodrome Novo mesto



Case Study – Sports Complex Stožice



General data:

Surface area: 14.164 m² (arena)
24.694 m² (stadium)
Seat capacity: 12,500 (arena)
16,000 (stadium)

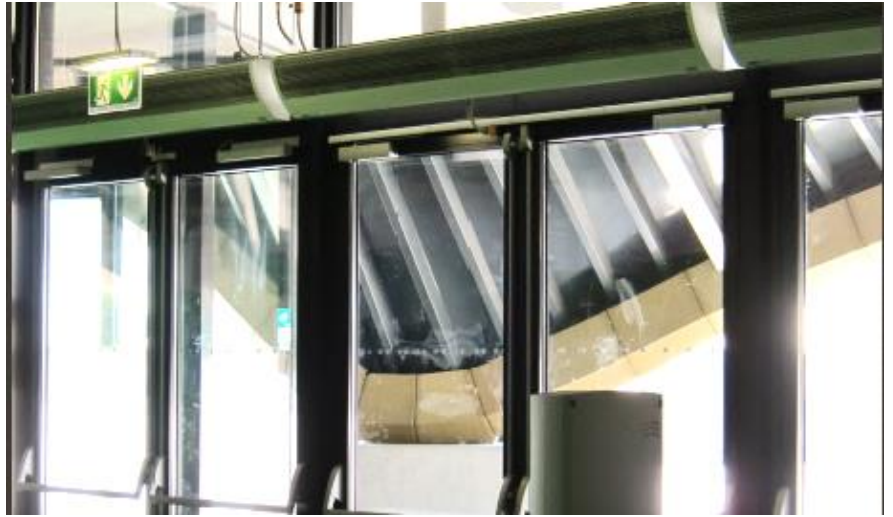
Case Study – Sports Complex Stožice



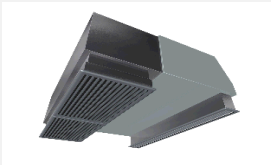
The air flow volume in Stožice is maintained by **94 square and circular electronic air flow volume control units** from the SimpLY family, which enable not only the very precise regulation of desired air speeds, but also the possibility of subsequently resetting any of the desired parameters.

Nine air handling units (indoor double-stage versions with rotary wheel, bypass, mixing block, water heater and cooler, cassette filter EU4) have been built in, with a total flow rate of 306.000 m³/h, which ventilate the change rooms, corridors and entrance hall, the VIP lounges, conference areas for journalists and the banquet hall, and rooms for doping control and judges – all together an area of 5,900 m².

Case Study – Sports Complex Stožice



The secondary air preparation and diffusion is carried out by **ceiling cassette convectors**.



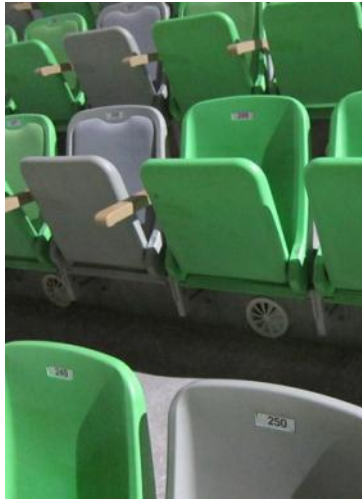
Intrusion of cold outside air is prevented by **air curtains** at all arena entrances.

Case Study – Sports Complex Stožice



In central part the sporting arena of the complex, a suitable quantity of fresh air is supplied by **supply nozzles VŠ-5**

Case Study – Sports Complex Stožice



air displacement units approximately 30% of the energy, needed for heating and cooling could be saved.

it was
supply
e of the
ne
means of

Case study – Belgrade arena



General data:

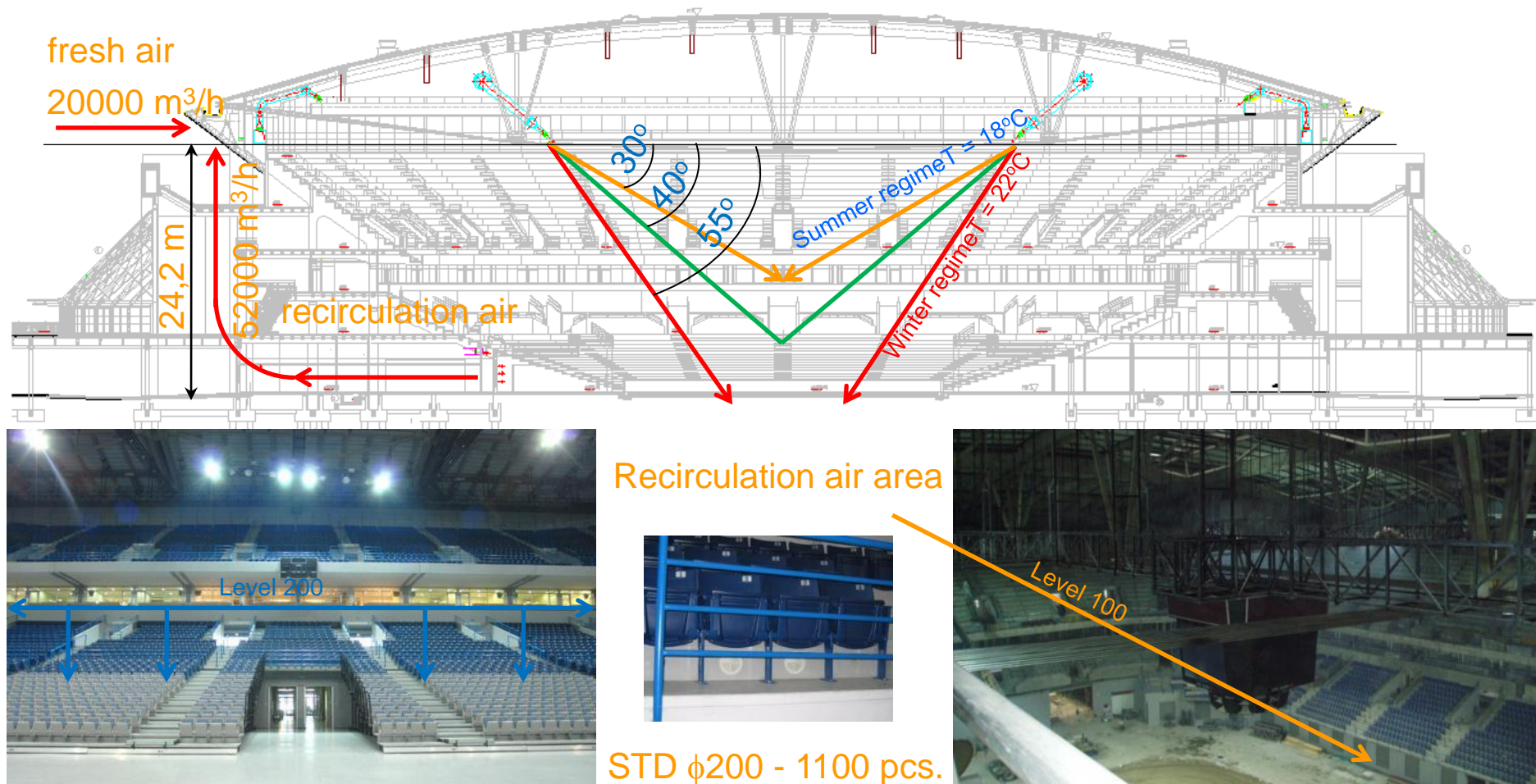
Surface area: 48.000 m²

Capacity: 22,680 seats

Built-in Lindab equipment :

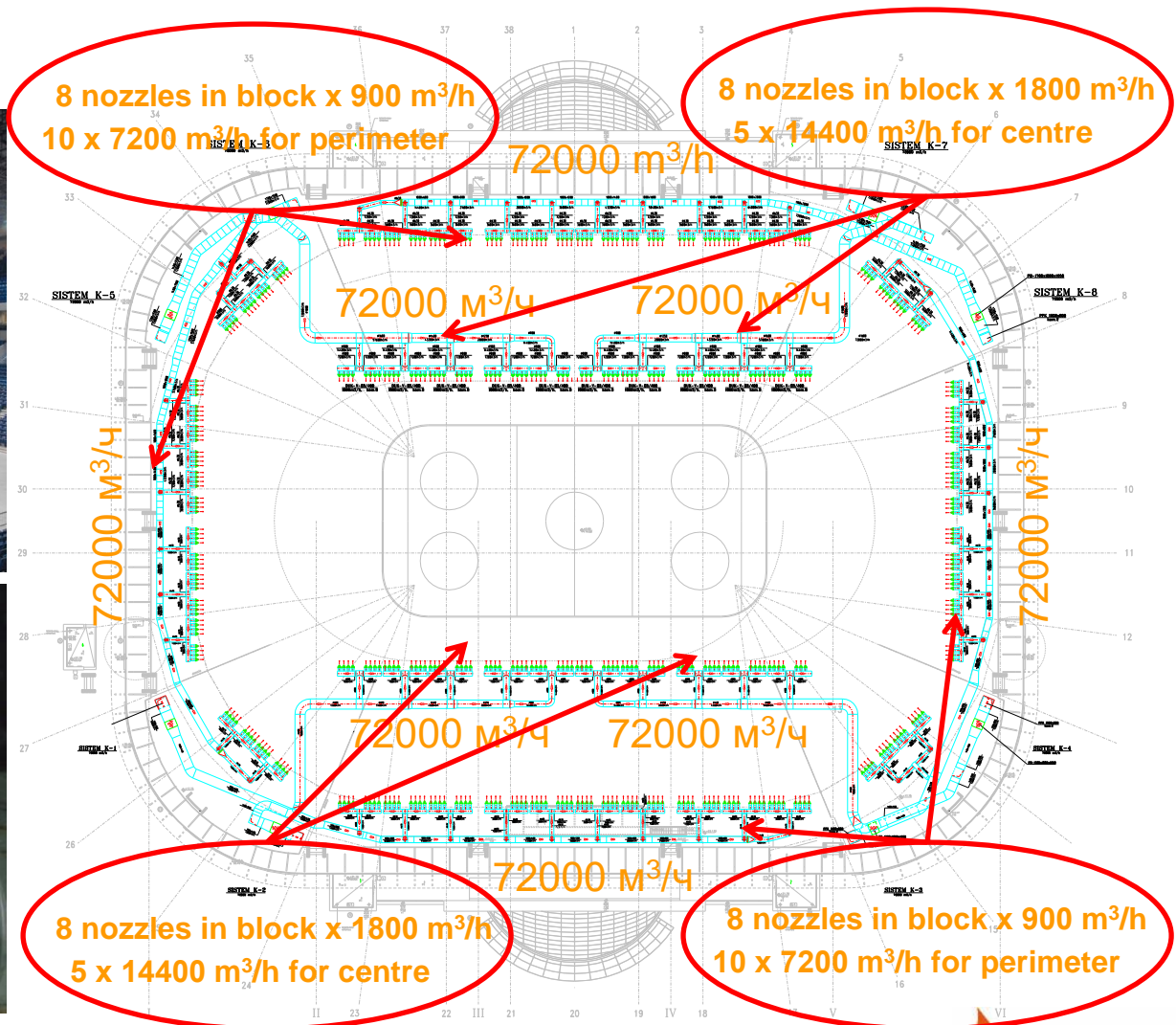
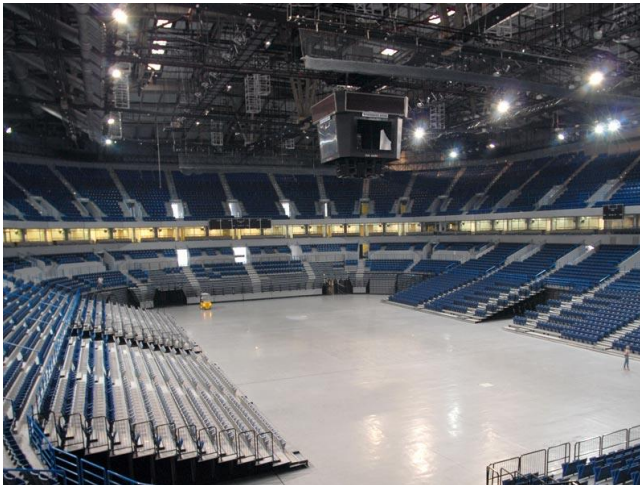
- 1200 supply air nozzles VŠ-4
- 600 fire dampers
- 5 chillers
- various air distribution units

Belgrade arena – central part of the arena

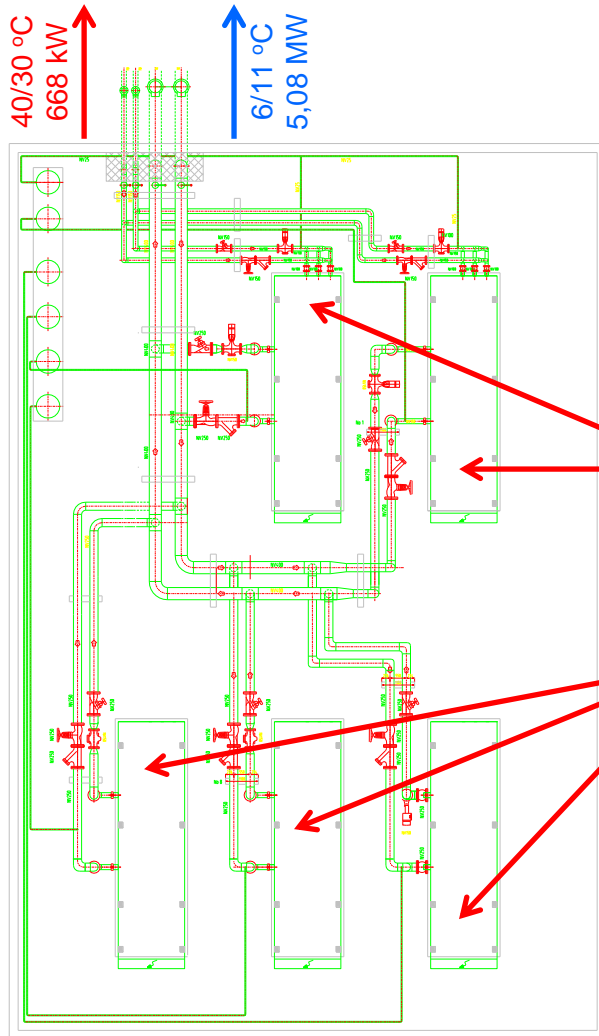


Belgrade arena – central part of the arena

Level 600



Belgrade arena - chillers



3 scroll compressors with possibility to regulate the cooling capacity in the range from 8,5 up to 100 %

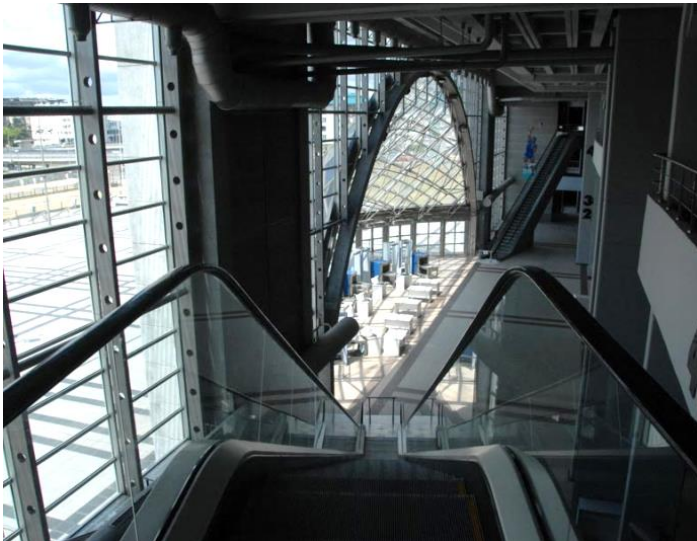
2 chillers with recuperation:
6/11 °C each 1016 kW
40/30 °C each 334 kW
for humidity regulation in the summer period

3 chillers without recuperation:
6/11 °C each 1016 kW



Belgrade arena – Air Distribution Units

Main entrance



Belgrade arena – Events



Eurovision Song Contest 2008



Basketball EuroLeague, Partizan – Panathinaikos, 2009, 22.536 spectators



Water polo, European Championship, 2016



Tennis Davis cup



Concerts



Case study – "Iceberg" Palace, Sochi



General data:

Surface area: 20,917 m²

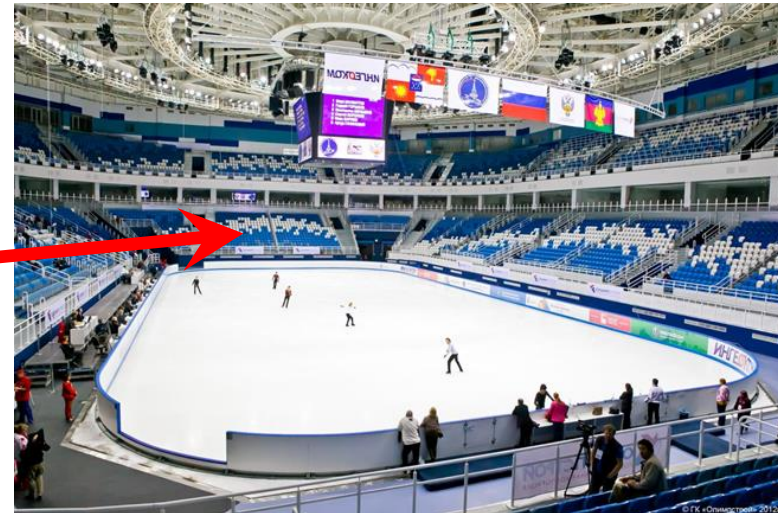
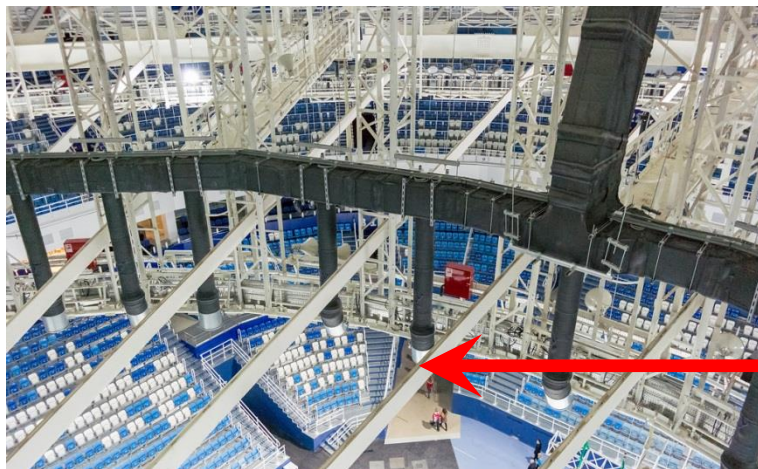
Height: 37,5 m

Capacity: 12.000-seat multi-purpose arena, mainly for figure skating and short track speed skating



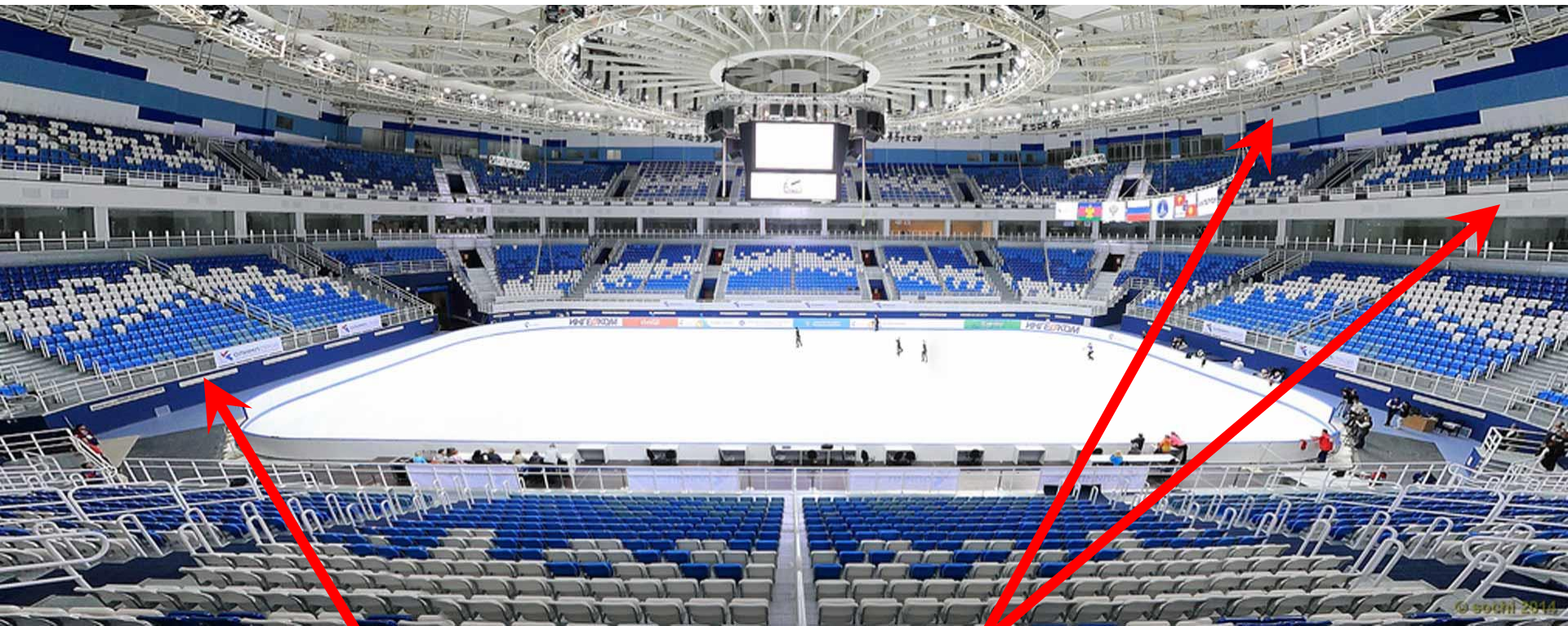
Case study – "Iceberg" Palace, Sochi

Supply air

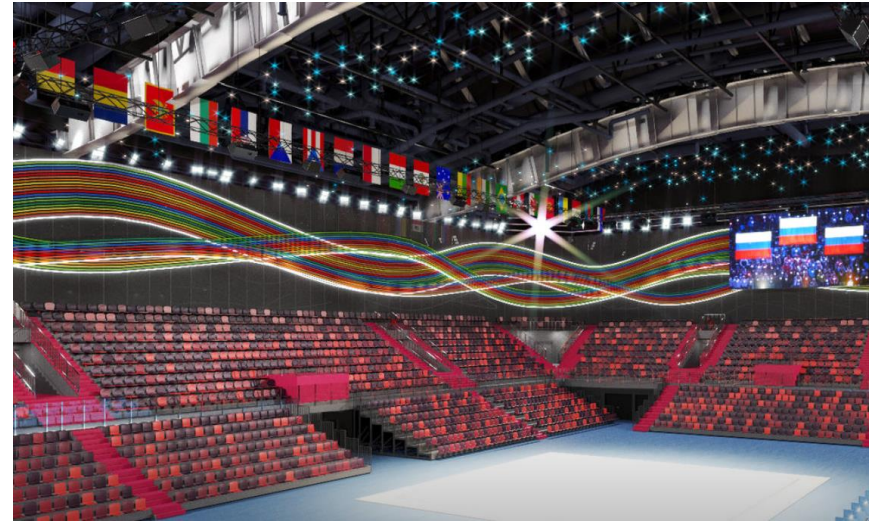
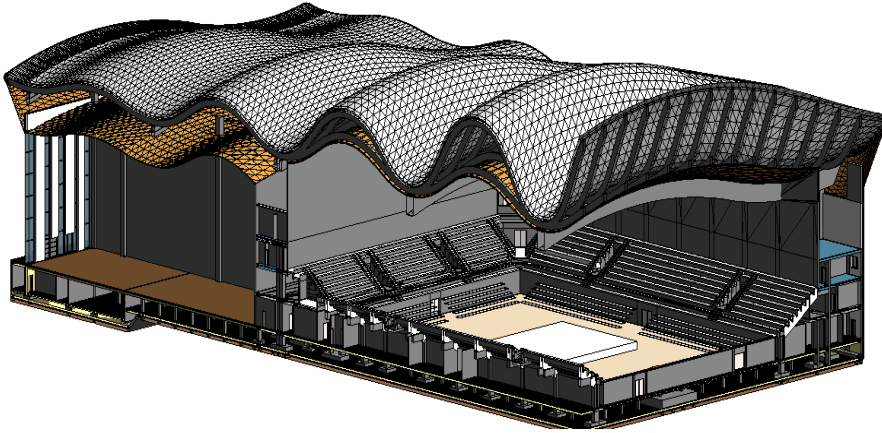


Case study – "Iceberg" Palace, Sochi

Exhaust air



Case study - Rhythmic gymnastics centre, Moscow



General data:

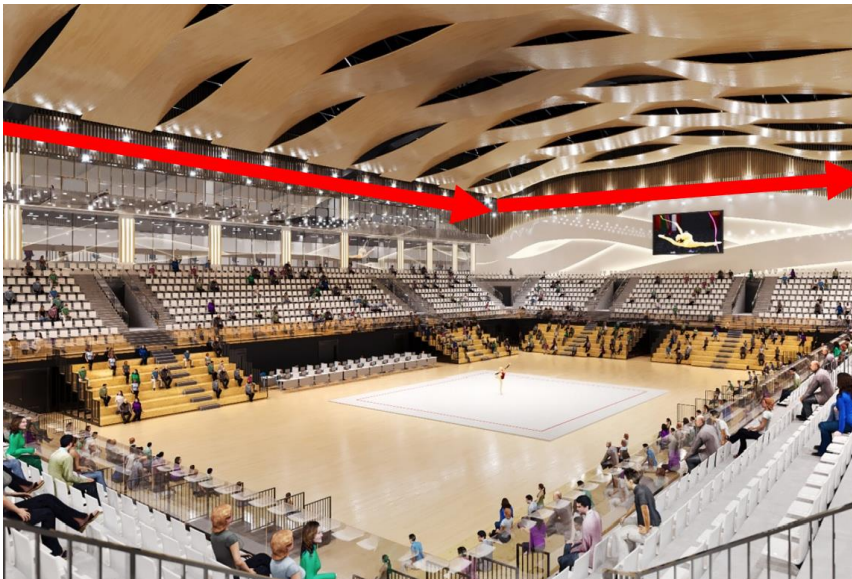
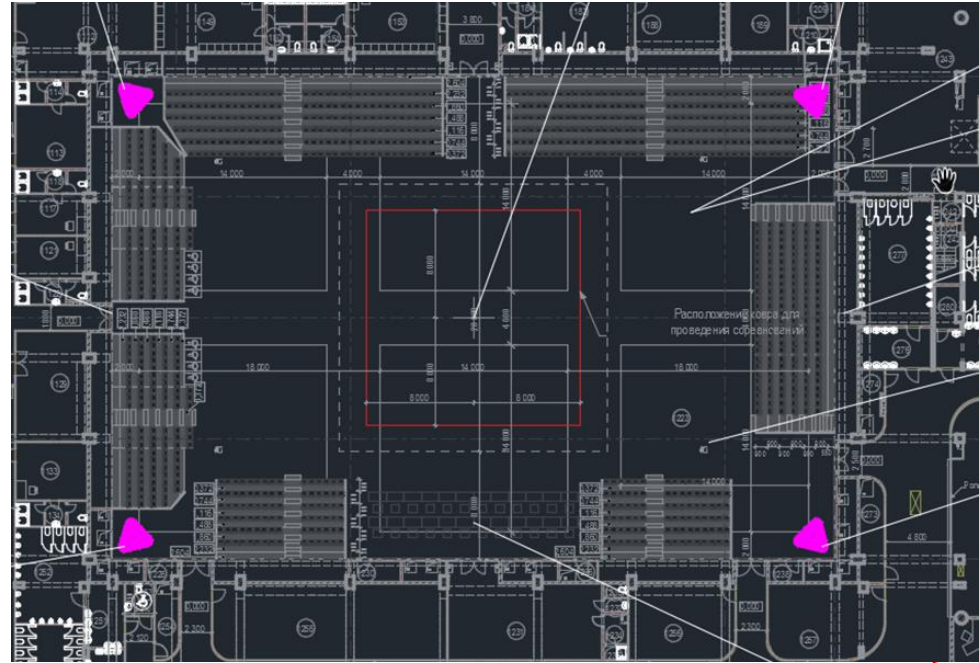
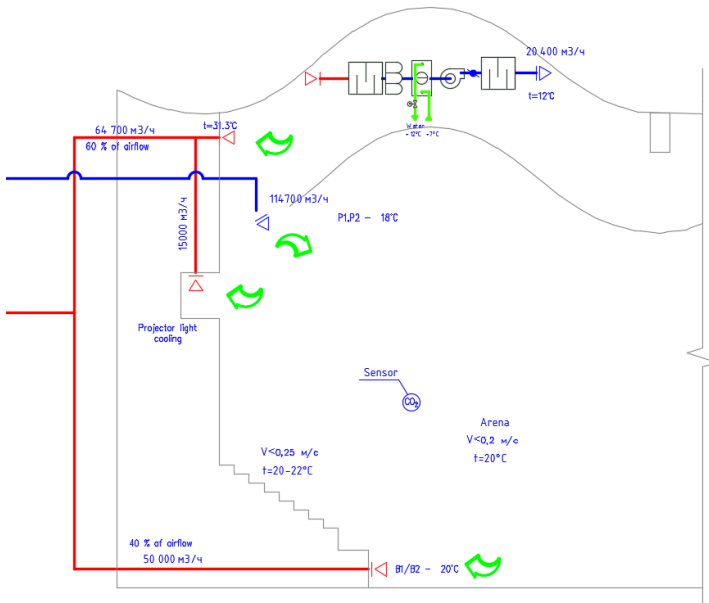
Surface area: 23.500 m²

Height: 40 m

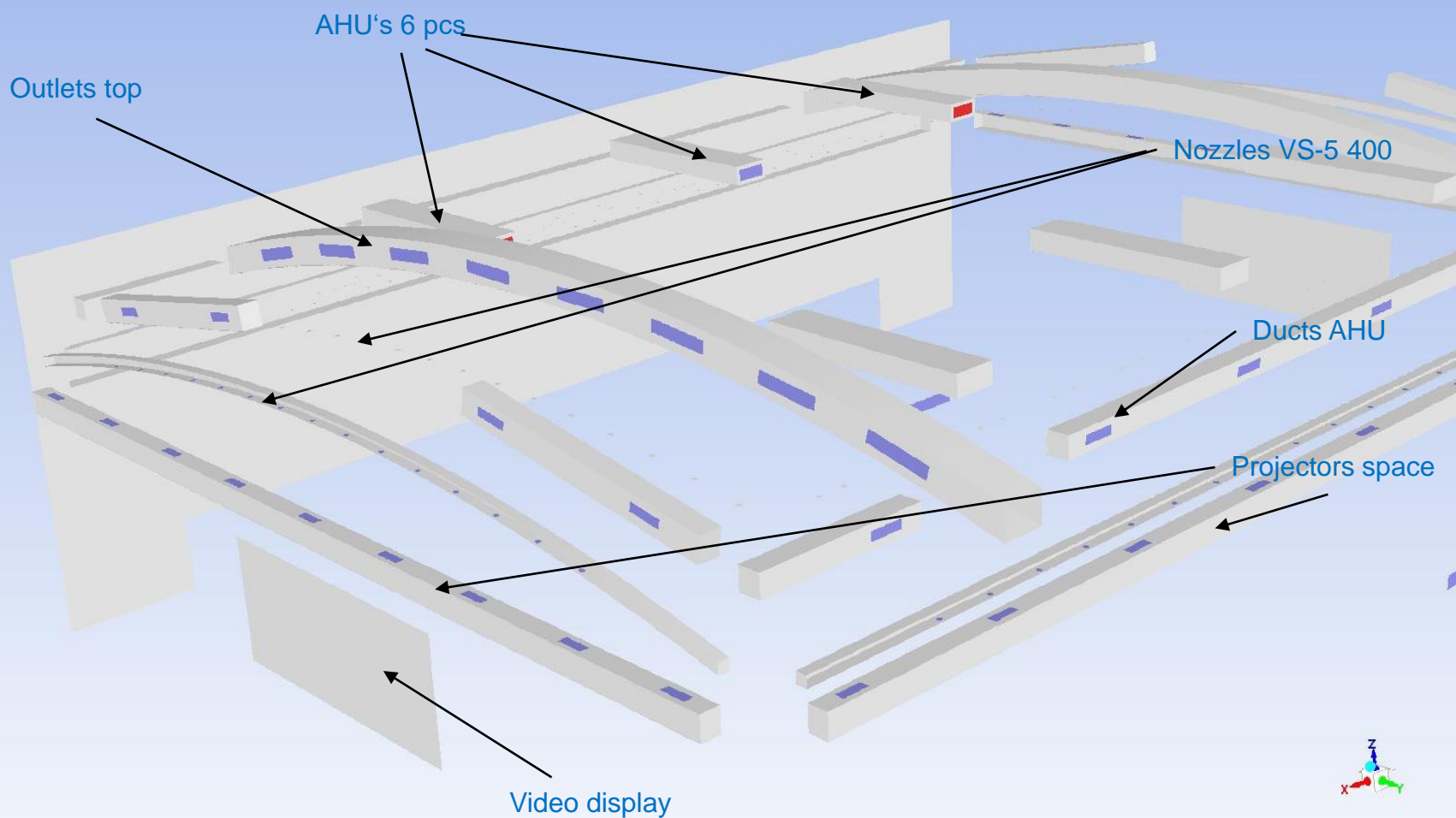
Capacity: up to 4.000 visitors during competitions and 250 sportsman



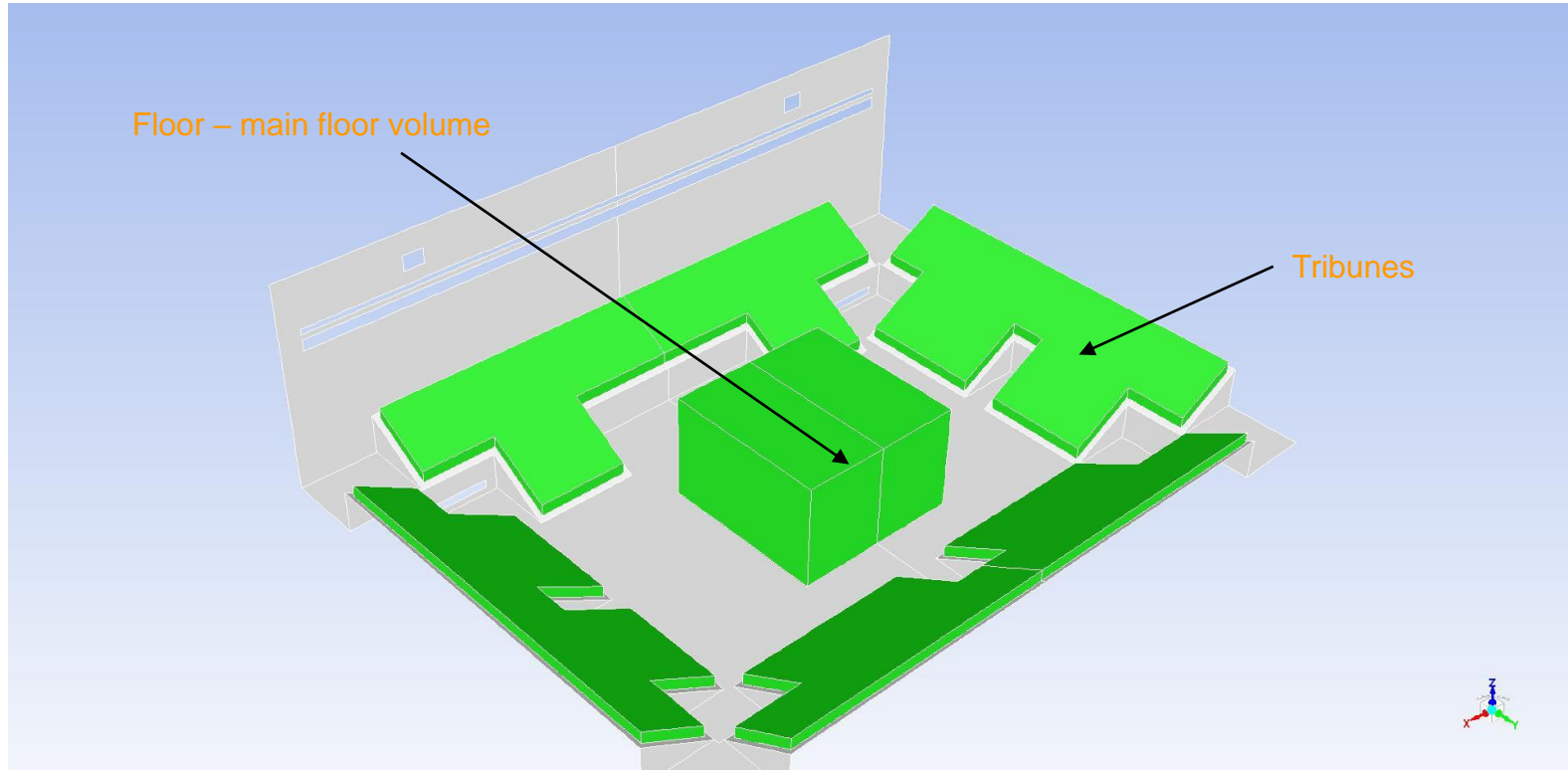
Case study - Rhythmic gymnastics centre, Moscow



Case study - Rhythmic gymnastics centre, Moscow



Case study - Rhythmic gymnastics centre, Moscow



Inlets:

- Nozzles VS-5 400, 70 pieces (40 pcs per long side on both sides – **65500** m³/h, direction angle 50 ° down, 30 pcs per short side curved position with suspended ceiling on both sides – **49200** m³/h, direction angle 65 ° down)
- Total volume airflow: 114700 m³/h (1640 m³/h per nozzle)
- Temperature: summer regime: 16 °C

Inlets/Outlets – ceiling

- AHU, 6 pieces, 3400 m³/h
- Total volume airflow: 20400 m³/h
- Temperature: 12 °C

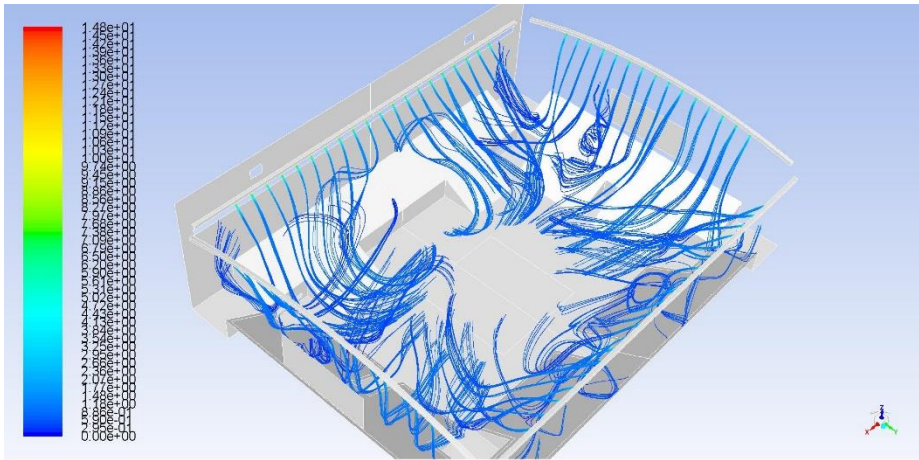
Heat loads:

Tribunes: 281600 W (volumetric heat generation, sensible)
 Projectors space: 75100 W (heat flux heat generation)
 Ceiling: 44900 W (heat flux heat generation)
 Video display 2pcs: 29000 W (heat flux heat generation)
 Total heat load: 430600 W

Outlets:

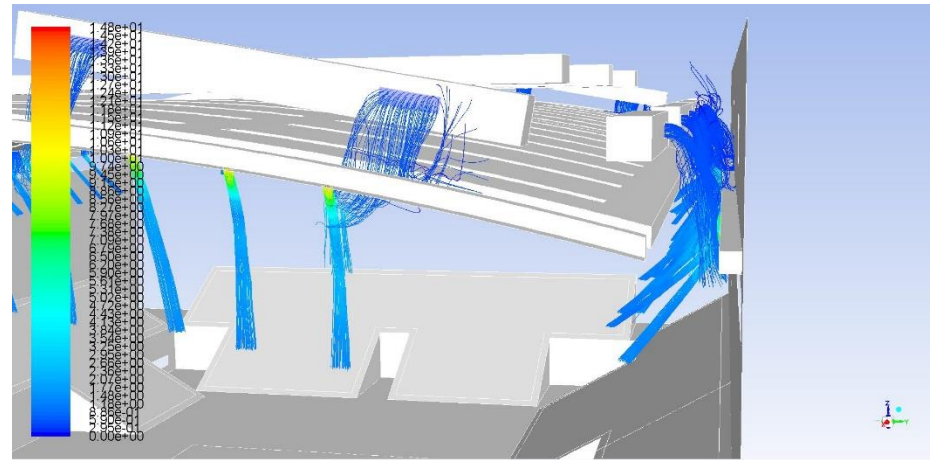
- Outlets bottom: Grille 5400 x 800, 4 pcs; Total volume airflow: 40000 m³/h (10000 m³/h per grill)
- Outlets middle: Grille 1200 x 400, 36 pcs; Total volume airflow: 25000 m³/h (694 m³/h per grill)
- Outlets top: Grille 1800 x 600, 16 pcs; Total volume airflow: 49700 m³/h (3106 m³/h per grill)

Case study - Rhythmic gymnastics centre, Moscow



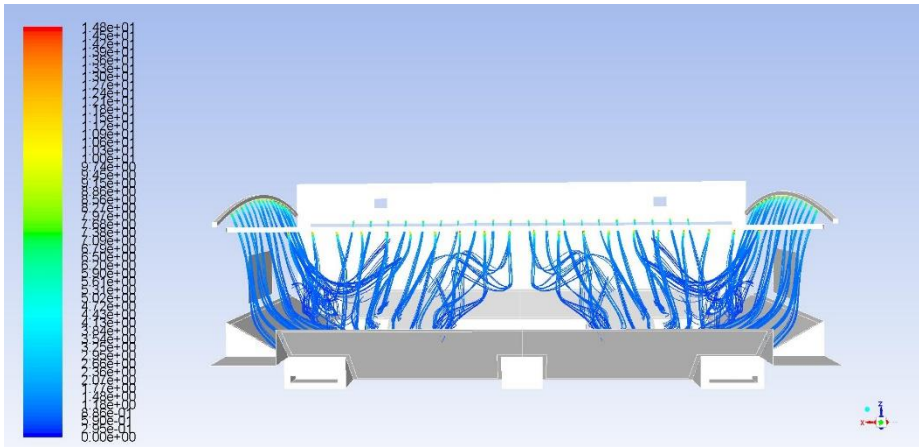
Pathlines Colored by Velocity Magnitude (m/s) (Time=6.3739e+03)

ANSYS Fluent Release 17.0 (3d, pbns, sstkw, transient)
Oct 24, 2017



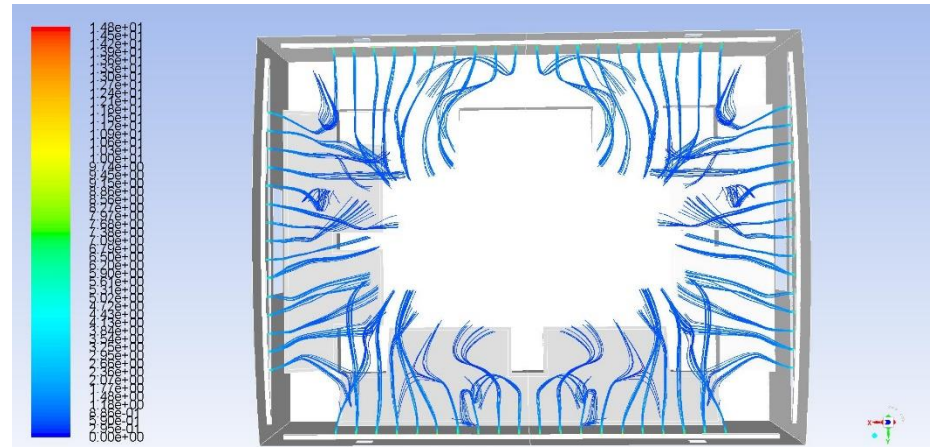
Pathlines Colored by Velocity Magnitude (m/s) (Time=6.3739e+03)

ANSYS Fluent Release 17.0 (3d, pbns, sstkw, transient)
Oct 24, 2017



Pathlines Colored by Velocity Magnitude (m/s) (Time=6.3739e+03)

ANSYS Fluent Release 17.0 (3d, pbns, sstkw, transient)
Oct 24, 2017



Pathlines Colored by Velocity Magnitude (m/s) (Time=6.3739e+03)

ANSYS Fluent Release 17.0 (3d, pbns, sstkw, transient)
Oct 24, 2017

Case study - Rhythmic gymnastics centre, Moscow

Nozzles 40 pcs. 65500 m³/h, angle 50 degree down (longside)

Nozzles 30 pcs. 49200 m³/h, angle 65 degree down (shortside)

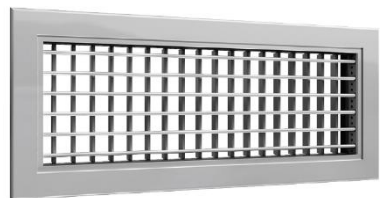
<u>Floor Area 10x10x16</u>	<u>Velocity (m/s)</u>	<u>Temperature (°C)</u>
MAX	1.08	24.4
<u>Average</u>	0.55	23.6
MIN	0.01	23.3

<u>Tribunes</u>	<u>Velocity (m/s)</u>	<u>Temperature (°C)</u>
MAX	1.15	27.2
<u>Average</u>	0.57	24.1
MIN	0.01	22.5

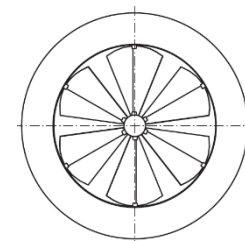
Case study - Rhythmic gymnastics centre, Moscow



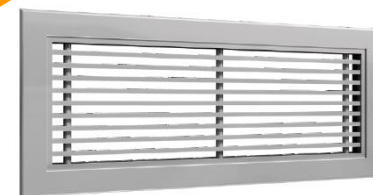
RCW 315



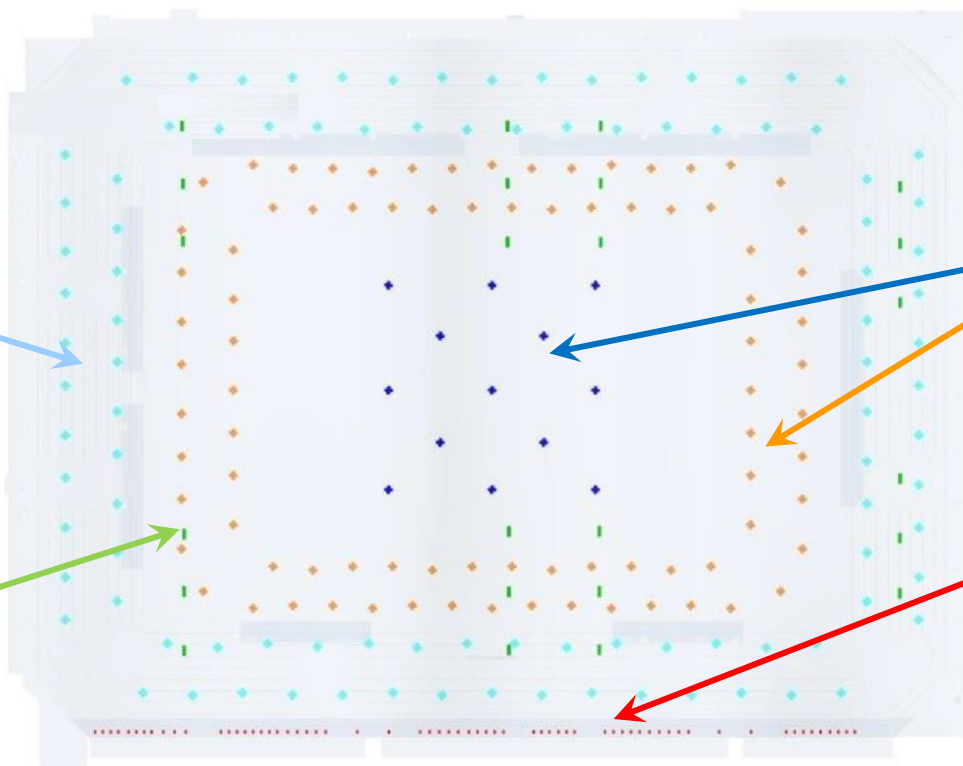
AD-21-HM



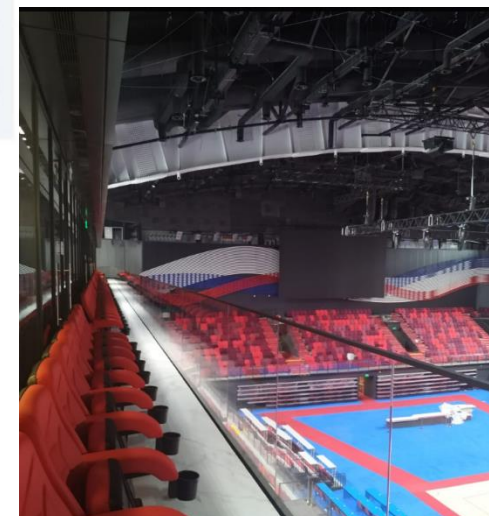
RCW 250



AL, 50 m



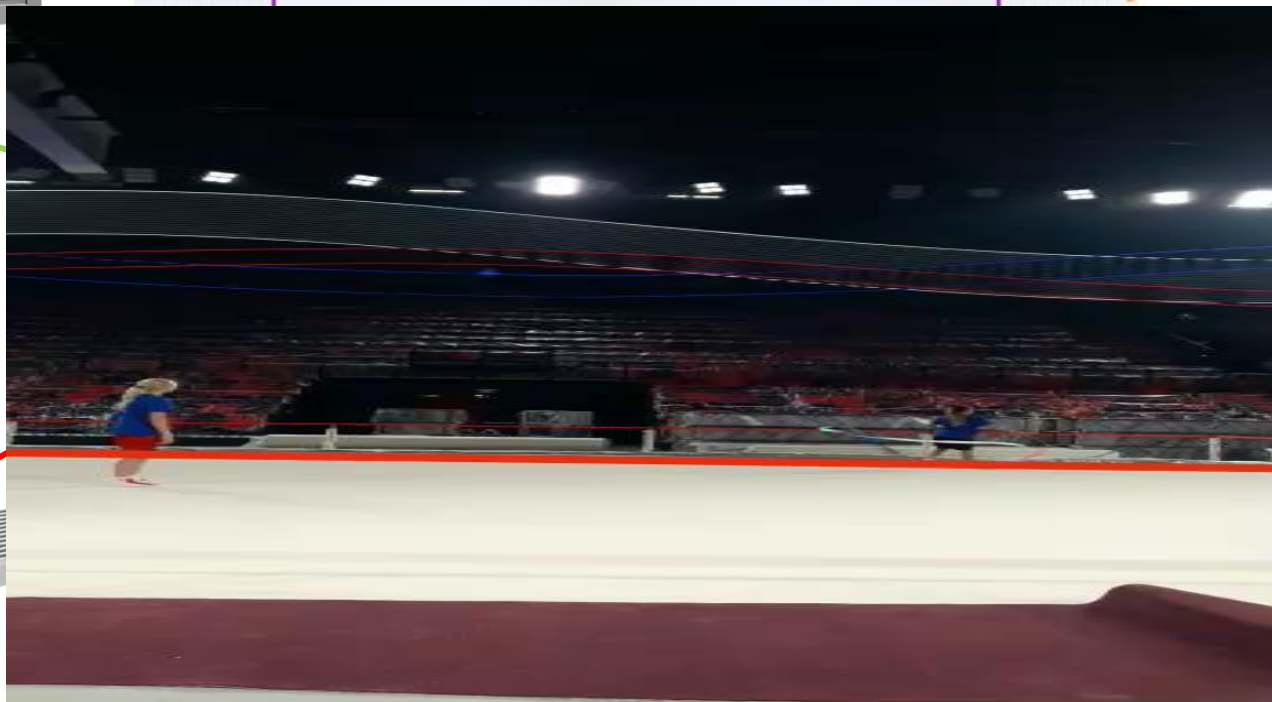
AHU	Distributor Colour	Distributor type	Q-ty pcs.	Total airflow m³/h	T °C
P1	Red	AL	63	5.000	20
P2	Blue	RCW 250	13	5.200	20
P3	Green	AD-21-HM	24	10.000	16
P4, P5	Orange	RCW 250	84	42.000	16
P6, P7, P8	Cyan	RCW 315	100	70.560	14



Case study - Rhythmic gymnastics centre, Moscow



AR-11-HM



AD-21-HM

AG-10

Cyan	AD-21-HM	30	15.000
Orange	AD-21-HM	50	40.000
Green	AR-11-HM	4	5.000
Red	AG-10	48	10.800
Magenta		8	56.700

Exhaust airflow for arena 127.500 m³/h

References – Sports halls



Serbia

- Sports Hall, Smederevo
- Sports Hall, Subotica
- Sports Hall, Indjija
- Sports Hall, Senta



References – Sports halls



Slovenia

- Sports Hall Golovec, Celje
- Sports centre Koper
- Sports centre Kranj
- Sports Hall Velenje
- Ice Hall Zalog, Ljubljana
- Ice Hall Maribor
- Sports Hall Nova Gorica
- Fitness centre Sunny Studio, Lj.



References – ErgoArena, Gdansk



Ergo Arena, Sopot-Gdańsk, Poland

The multi-purpose hall of Ergo Arena in Poland, which will have its official opening this year, can seat 11.409 people for sporting events, and up to 15.000 people, including standing areas, for concerts and other events.

One of the unique aspects of this sporting facility is that the boundary between the towns Sopot and Gdańsk runs right down its centre, meaning that technically, the people of Poland can watch the same event live in two different towns. Presenting an ideal solution for this building's ventilation needs are **Lindab OD-8 swirl diffusers**.

References – Sports halls



Greece

- Olympic Hyppodrome, Athens
- Stadium for Teakwondo, Athens

Netherlands

- Sportsaal, Rotterdam

Russia

- Ice Palace Cherepovci
- Ice Palace Ioshkar Ola
- Sports-rehabilitation center, Kazan
- Ice palace, Moscow
- Bowling center, Moscow
- Cultural sport center, Krasnoyarsk

Thank you!