Base Load Power Hub (BLPH)

B-200 HVAC CALCULATION REPORT
(Incl HVAC SYS CALC and HEAT DISSIPATION CALC)
E&I SHELTERS

Document Number: 1724000049-HV-CA-00036

Document Class: 2

03	09/12/2024	Accepted for Construction (AFC)	S.Z.	S.S.	M.G.
02	17/06/2024	Accepted for Construction (AFC)	S.Z.	S.S.	M.G.
01	23/05/2024	Accepted for Construction (AFC)	S.Z.	S.S.	M.G.
00	07/05/2024	Issue for Review (IFR)	S.Z.	S.S.	M.G.
Rev.	Date	Description	Prepared	Reviewed	Approved

ALEXSISTEMI spa

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Revision / Change Log

Rev.	Description
00	Issue for Review (IFR)
01	Accepted for Construction (AFC)
02	Accepted for Construction (AFC)
03	Accepted for Construction (AFC)

HOLDS LIST

No.	Description
1	
2	
3	
4	

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

INDEX

1 introduction 4

1.1 PURPOSE OF THE PROJECT 4

1.2 MEASURING SYSTEM 4

1.3 dESIGN INPUT DATA 4

Outdoor design conditions: 4

Indoor design conditions: 4

2 system description 5

2.1 Architectural data 5

2.2 room pressurization 5

3 air flow required to cool the room by means of forced ventilation 6

4 WINTER SEASON 8

5 Weater report from hap carrier 9

6 system design report from hap carrier 10

7 system summary 17

8 duct pressure drop 17

9 CONCLUSION 21

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

1 INTRODUCTION

1.1 PURPOSE OF THE PROJECT

Scope of this document is to report the Cooling and Heating Loads calculations, of the HVAC system provided for the Technical Shelter B-200.

Cooling and Heating loads calculations have been carried out by means of CARRIER II 20 Hourly Analysis Program Version 5.11.

1.2 MEASURING SYSTEM

Length	m, mm
Area	m2, mm2
Volume	3, mm3
Mass	Kg
Airflow	l/s
Pressure	Pa = N/m2, kPa = kN/m2
Temperature	° C
Thermal Load	W, kW
Specific Enthalpy	kJ/kg
Specific Volume	m3/kg

1.3 DESIGN INPUT DATA

Outdoor design conditions:

Summer temperature:	+25°C D.B. (Dry Bulb) with RH 90%
Winter temperature:	-8,4°C D.B. (Dry Bulb) with RH 100%
Shelter U-Value:	0,450 W/(m^2 K).
Safe Area	

Indoor design conditions:

Room Pressurization:	+50 Pa
Summer temperature:	+35°C D.B. (Dry Bulb) with RH 30÷70%.
Winter temperature:	+5°C D.B. (Dry Bulb) with RH 30÷70%.
Internal Load Equipment:	4,5 kW
ACH Min.:	6
Safe Area	

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

2 SYSTEM DESCRIPTION

To guarantee the necessary overpressure and the internal design temperatures in the summer and winter seasons, two AHU have been provided, one for service and one for stand-by, which introduce external air directly into the Shelter.

In the winter season, to guarantee the minimum temperature inside the shelter, two electric heating batteries will be installed inside the pressurization fans.

2.1 ARCHITECTURAL DATA

Geometric data are based on document listed below:

1724000049-AR-DA-00015 Base load power HUB (BLPH) B-200 general arrangement drawing.

2.2 ROOM PRESSURIZATION

In order to guarantee the pressurization, where external doors are provided, fresh air flow requirement to maintain specified positive pressure shall be calculated based on following formula in accord to

ASHRAE:

$Q = Cd * A * Vp = m^3/s$

where ΔP = pressure difference across opening, Pa

Q = Airflow rate, m3/s

Cd = Discharge coefficient for opening, dimensionless (0,625 assumed)

Generally general 0.5 for large gaps and 0,625 for small openings.

A = Leakage area (m^2).

Vp: Velocity through crack area to maintain required pressure (2 ΔP/d) ^0.5

d = Density of air (kg/m^3) assumed 1.225 kg/m^3.

Note:

Leakage area for double leaf door = 0,03 m^2
Leakage area for single leaf door = 0,02 m^2

Container structures, walls, floor and the ceiling are joined together by continuous welding.

Therefore, there isn't air leakage.

Vp for overpressure required 50 Pa = (2 x 50 / 1,225) ^0,5 = 9,03

Single Door overpressure required: (0,625x0,02x9,03) = 0,112 m^3/s that become 0,112x 3600 = 403 m^3/h

Double Door overpressure required: (0,625x0,03x9,03) = 0,169 m^3/s that become 0,112 x 3600 = 608 m^3/h

Total pressurization air flow equal to 403 m^3/h + 608 m^3/h = 1011 m^3/h -> 280,8 l/s

Air change required for room: (B 30 m^2 x H 4) x 6 = 720 m^3/h -> 200 l/s

3 AIR FLOW REQUIRED TO COOL THE ROOM BY MEANS OF FORCED VENTILATION

The calculation will be performed with the following equation:

Q = [q / (r x Cp x ΔT)] x 60

Where:

Q= air flow (m^3 / min)

Zone Design Load Summary for B-200

q = amount of heat to dissipate (W) -> 4009 W from HAP Carrier.

r= Air Density at +25°C D.B. (Dry Bulb) with RH 90 % -> 1,177 kg/m^3

Cp = specific air heat (1005 Joule / kg • K)

ΔT = air temperature rises from 25°C to 35°C (10°C)

Q= [4009 / (1,171 x 1005 x 10)] x 60 = 20,43 m^3/min.

that become 20,43 m^3/min x 60 = 1225,8 m^3/h -> 340,5 l/s

As per above calculations the pressurization air flow rate is less than the air flow required to cool the room by means forced ventilation.

Therefore, the minimum external air flow rate to ventilate and maintain the room under overpressure is equal to 340,5 l/s.

Below checking the room temperature by introducing 340,5 l/s of external air at +25°C.

Heat losses transmission from HAP Carrier

Zone Design Load Summary for B-200

Project Name: 4112 - B 200 — 05/06/2024
Prepared by: Frigotermica — 01:35

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 24.8 °C / 23.6 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C		
	OCCUPIED T-STAT 35.0 °C			OCCUPIED T-STAT 5.0 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	113 m²	-579	-	113 m²	682	-
Roof Transmission	30 m²	-154	-	30 m²	181	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	8 m²	-176	-	8 m²	207	-
Floor Transmission	30 m²	-306	-	30 m²	181	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	360 W	360	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4500 W	4500	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 0%	364	0	10%	125	0
>> Total Zone Loads	-	4009	0	-	1376	0

t_A = Ambient temperature = 25°C

v_{imm} = Air Specific volume = 0,85 m^3/kg

P_s = Sensible heat to dissipate = 4,009 kW

Q_{imm} = Total air flow = 0,340 m^3/s

c_p [kJ/kgK] air specific heat

t_{imm} = Air temperature entering the envelope = +25°C

$$t_A = \frac{v_{imm} * P_s}{Q_{imm} * c_p} + t_{imm}$$

$$t_A = \frac{0.85 * 4{,}009}{0{,}340 * 1} + 25 = 35\ °C$$

The internal air temperature with the given conditions will be 35 °C.

4 WINTER SEASON

To calculate the thermal power necessary to heat the rooms it is necessary to add heat load of fresh air to the heat losses transmission through boundaries.

Heat losses transmission from HAP Carrier equal to 1376 Watt.

To calculate the heat load of fresh air to heat rooms from -8,4°C (external ambient temperature) to +5°C (winter design temperature) we used the following formula:

(Q / 3600) x (r x Cp x ΔT) = Watt

Where:

Q = air flow (m^3/h),

r = air density at -8,4°C (1,332 kg/m^3)

Cp = specific air heat (1005 Joule / kg • K)

ΔT = air temperature rises from -8,4°C to +5°C (13,4°C)

(1225,8 / 3600) x (1,332 x 1005 x 13,4) = 6107,9 Watt

The heating coil capacity to install equal to 6107,9 + 1376 = 7483,9 Watt -> assumed 8,5 kW as per HAP carrier calculation.

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

5 WEATER REPORT FROM HAP CARRIER

Design Weather Parameters & MSHGs

4112 - B 200
Frigotermica

05/06/2024
01:33

Design Parameters:

City Name	..	
Location	..	
Latitude	52.3	Deg.
Longitude	-4.8	Deg.
Elevation	30.0	m
Summer Design Dry-Bulb	25.0	°C
Summer Coincident Wet-Bulb	23.7	°C
Summer Daily Range	8.2	K
Winter Design Dry-Bulb	-8.4	°C
Winter Design Wet-Bulb	-8.4	°C
Atmospheric Clearness Number	1.00	
Average Ground Reflectance	0.20	
Soil Conductivity	1.385	W/(m K)
Local Time Zone (GMT +/- N hours)	1.0	hours
Consider Daylight Savings Time	No	
Simulation Weather Data	N/A	
Current Data is	User Modified	
Design Cooling Months	January to December	

Design Day Maximum Solar Heat Gains

(The MSHG values are expressed in W/m²)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	38.8	38.8	38.8	98.7	308.2	473.1	618.1	687.5	715.2
February	55.8	55.8	72.2	288.0	480.0	639.4	730.3	775.6	780.0
March	74.7	74.7	242.5	454.2	611.0	724.2	761.7	755.4	742.3
April	94.1	186.7	400.6	555.9	679.0	712.3	689.8	650.0	629.4
May	113.0	305.1	487.7	621.3	687.3	680.1	627.5	556.8	529.7
June	156.7	346.4	514.5	633.8	681.4	657.2	591.6	514.4	481.4
July	121.5	292.0	483.9	602.9	676.6	664.8	608.7	547.0	515.0
August	99.5	190.3	383.3	541.5	652.7	690.1	668.2	630.2	608.5
September	78.4	78.4	207.4	425.5	567.6	686.1	722.0	721.7	716.9
October	58.7	58.7	84.1	257.4	462.4	607.7	708.1	747.1	757.4
November	40.0	40.0	40.0	117.9	278.2	473.7	589.8	681.0	706.2
December	31.5	31.5	31.5	44.3	228.7	378.7	538.8	614.4	652.4
Month	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**HOR**	**Mult**
January	695.2	617.9	473.7	306.6	106.1	38.8	38.8	185.7	1.00
February	770.8	727.7	643.5	465.5	291.7	68.1	55.8	353.1	1.00
March	752.0	759.6	711.4	622.6	440.4	251.6	74.7	526.9	1.00
April	649.4	697.7	714.0	674.0	564.6	399.0	191.9	661.6	1.00
May	559.0	630.7	685.8	678.1	624.4	477.2	311.6	738.6	1.00
June	516.8	595.8	664.1	679.6	633.7	511.7	348.8	760.6	1.00
July	548.1	616.6	672.1	670.4	611.6	473.1	308.7	731.3	1.00
August	629.1	674.2	688.9	648.8	544.4	385.3	190.6	652.5	1.00
September	719.3	718.7	685.0	574.3	424.7	206.4	78.4	511.0	1.00
October	748.8	707.9	596.6	464.8	253.0	86.0	58.7	352.7	1.00
November	679.4	594.2	473.7	285.1	117.6	40.0	40.0	189.4	1.00
December	623.5	529.5	397.8	216.4	62.0	31.5	31.5	128.0	1.00

Mult. = User-defined solar multiplier factor.

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

6 SYSTEM DESIGN REPORT FROM HAP CARRIER

Air System Sizing Summary for B-200

Project Name: 4112 - B 200 — 05/06/2024
Prepared by: Frigotermica — 01:35

Air System Information

Air System Name	**B-200**	Number of zones	**1**	
Equipment Class	**SPLT AHU**	Floor Area	**30.0**	m²
Air System Type	**SZCAV**	Location	**.., ..**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone L/s Sizing	**Sum of space airflow rates**
Sizing Data	**Calculated**	Space L/s Sizing	**Individual peak space loads**

Central Cooling Coil Sizing Data

No central cooling coil loads occurred during this calculation.

Central Heating Coil Sizing Data

Max coil load	**8.5**	kW	Load occurs at	**Des Htg**	
Coil L/s at Des Htg	**341**	L/s	W/m²	**284.2**	
Max coil L/s	**341**	L/s	Ent. DB / Lvg DB	**-8.4 / 12.4**	°C
Water flow @ 11.1 K drop	**N/A**				

Supply Fan Sizing Data

Actual max L/s	**341**	L/s	Fan motor BHP	**0.20**	BHP
Standard L/s	**339**	L/s	Fan motor kW	**0.16**	kW
Actual max L/(s·m²)	**11.35**	L/(s·m²)	Fan static	**300**	Pa

Outdoor Ventilation Air Data

Design airflow L/s	**341**	L/s	L/s/person	**0.00**	L/s/person
L/(s·m²)	**11.35**	L/(s·m²)			

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Zone Sizing Summary for B-200

Project Name: 4112 - B 200 05/06/2024
Prepared by: Frigotermica 01:35

Air System Information

Air System Name **B-200**
Equipment Class ..... **SPLT AHU**
Air System Type ..... **SZCAV**

Number of zones **1**
Floor Area ..... **30.0** m²
Location ..... **.., ..**

Sizing Calculation Information

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Zone L/s Sizing ..... **Sum of space airflow rates**
Space L/s Sizing ..... **Individual peak space loads**

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (L/s)	Minimum Supply Airflow (L/s)	Zone L/(s·m²)	Reheat Coil Load (kW)	Reheat Coil Water L/s @ 11.1 K	Zone Htg Unit Coil Load (kW)	Zone Htg Unit Water L/s @ 11.1 K	Mixing Box Fan Airflow (L/s)
Zone 1	341	341	11.35	0.0	-	0.0	-	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (kW)	Time of Peak Sensible Cooling Load	Zone Heating Load (kW)	Zone Floor Area (m²)
Zone 1	4.0	Jul 1600	1.4	30.0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Peak Sensible Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s·m²)
Zone 1							
B 200	1	4.0	Jul 1600	341	1.4	30.0	11.35

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Ventilation Sizing Summary for B-200

Project Name: 4112 - B 200
Prepared by: Frigotermica

05/06/2024
01:35

1. Summary

Ventilation Sizing Method ..... **Sum of Space OA Airflows**
Design Ventilation Airflow Rate ..... **341** L/s

2. Space Ventilation Analysis

Zone Name / Space Name	Mult.	Floor Area (m^2)	Maximum Occupants	Maximum Supply Air (L/s)	Required Outdoor Air (L/s/person)	Required Outdoor Air (L/(s·m^2))	Required Outdoor Air (L/s)	Required Outdoor Air (% of supply)	Uncorrected Outdoor Air (L/s)
Zone 1									
B 200	1	30.0	0.0	340.5	0.00	0.00	340.5	0.0	340.5
Totals (incl. Space Multipliers)				**340.5**					**340.5**

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Air System Design Load Summary for B-200

Project Name: 4112 - B 200
Prepared by: Frigotermica

05/06/2024
01:35

	DESIGN COOLING			DESIGN HEATING		
	NO COOLING DATA NO COOLING OA DB / WB			HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C		
ZONE LOADS	**Details**	**Sensible (W)**	**Latent (W)**	**Details**	**Sensible (W)**	**Latent (W)**
Window & Skylight Solar Loads	0 m²	-	-	0 m²	-	-
Wall Transmission	113 m²	-	-	113 m²	682	-
Roof Transmission	30 m²	-	-	30 m²	181	-
Window Transmission	0 m²	-	-	0 m²	0	-
Skylight Transmission	0 m²	-	-	0 m²	0	-
Door Loads	8 m²	-	-	8 m²	207	-
Floor Transmission	30 m²	-	-	30 m²	181	-
Partitions	0 m²	-	-	0 m²	0	-
Ceiling	0 m²	-	-	0 m²	0	-
Overhead Lighting	-	-	-	0	0	-
Task Lighting	-	-	-	0	0	-
Electric Equipment	-	-	-	0	0	-
People	-	-	-	0	0	0
Infiltration	-	-	-	-	0	0
Miscellaneous	-	-	-	-	0	0
Safety Factor	10% / 0%	-	-	10%	125	0
>> Total Zone Loads	-	-	-	-	**1376**	**0**
Zone Conditioning	-	-	-	-	1435	0
Plenum Wall Load	0%	-	-	0	0	-
Plenum Roof Load	0%	-	-	0	0	-
Plenum Lighting Load	0%	-	-	0	0	-
Return Fan Load	-	-	-	0 L/s	0	-
Ventilation Load	-	-	-	341 L/s	5536	0
Supply Fan Load	-	-	-	341 L/s	-157	-
Space Fan Coil Fans	-	-	-	-	0	-
Duct Heat Gain / Loss	0%	-	-	0%	0	-
>> Total System Loads	-	-	-	-	**6814**	**0**
Central Cooling Coil	-	-	-	-	0	0
Central Heating Coil	-	-	-	-	8526	-
>> Total Conditioning	-	-	-	-	**8526**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Zone Design Load Summary for B-200

Project Name: 4112 - B 200
Prepared by: Frigotermica

05/06/2024
01:35

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 24.8 °C / 23.6 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C		
	OCCUPIED T-STAT 35.0 °C			OCCUPIED T-STAT 5.0 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	113 m²	-579	-	113 m²	682	-
Roof Transmission	30 m²	-154	-	30 m²	181	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	8 m²	-176	-	8 m²	207	-
Floor Transmission	30 m²	-306	-	30 m²	181	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	360 W	360	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4500 W	4500	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 0%	364	0	10%	125	0
>> Total Zone Loads	-	4009	0	-	1376	0

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

Space Design Load Summary for B-200

Project Name: 4112 - B 200
Prepared by: Frigotermica

05/06/2024
01:35

TABLE 1.1.A. Component Loads For Space "B 200" In Zone "Zone 1"

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 24.8 °C / 23.6 °C OCCUPIED T-STAT 35.0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C OCCUPIED T-STAT 5.0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	113 m²	-579	-	113 m²	682	-
Roof Transmission	30 m²	-154	-	30 m²	181	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	8 m²	-176	-	8 m²	207	-
Floor Transmission	30 m²	-306	-	30 m²	181	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	360 W	360	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	4500 W	4500	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 0%	364	0	10%	125	0
>> Total Zone Loads	**-**	**4009**	**0**	**-**	**1376**	**0**

TABLE 1.1.B. Envelope Loads For Space "B 200" In Zone "Zone 1"

				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²·K))	Coeff.	(W)	(W)	(W)
N EXPOSURE						
WALL	45	0.450	-	-231	-	272
E EXPOSURE						
WALL	13	0.450	-	-68	-	80
DOOR	2	1.930	-	-48	-	57
S EXPOSURE						
WALL	45	0.450	-	-231	-	272
W EXPOSURE						
WALL	10	0.450	-	-49	-	58
DOOR	6	1.930	-	-128	-	150
H EXPOSURE						
ROOF	30	0.450	-	-154	-	181

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

System Psychrometrics for B-200

Project Name: 4112 - B 200
Prepared by: Frigotermica

05/06/2024
01:35

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
Ventilation Air	Inlet	-8.4	0.00185	341	400	-5536	0
Vent - Return Mixing	Outlet	-8.4	0.00185	341	400	-	-
Central Cooling Coil	Outlet	-8.4	0.00185	341	400	0	0
Central Heating Coil	Outlet	12.4	0.00185	341	400	8526	-
Supply Fan	Outlet	12.8	0.00185	341	400	157	-
Cold Supply Duct	Outlet	8.6	0.00185	341	400	-	-
Zone Air	-	5.1	0.00185	341	0	-1435	0
Zone Direct Exhaust	Outlet	5.1	0.00185	341	0	-	-
Return Plenum	Outlet	5.1	0.00185	0	0	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.203 W/(L/s-K)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2937.1 W/(L/s)
Site Altitude = 30.0 m

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (W)	T-stat Mode	Zone Cond (W)	Zone Temp (°C)	Zone Airflow (L/s)	CO2 Level (ppm)	Terminal Heating Coil (W)	Zone Heating Unit (W)
Zone 1	-1376	Deadband	-1435	5.1	341	400	0	0

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

7 SYSTEM SUMMARY

Below is the system performance:

Pressurizing air flow rate: 1226 m³/h (each fan)

Heating coil capacity: 8,5 kW (for each fan)

8 DUCT PRESSURE DROP

The HVAC Ducts, have been sized with the criterion of constant pressure drop.

In this paper we have calculated the static pressure drop of the most unfavorable sections of the air duct distribution according to ASHRAE standards.

METHOD:

To calculate the friction losses, the following equation have been used as detailed below. These equations have a wide and internationally recognised application for this kind of calculation.
The friction losses (Dp) in terms of specific energy (mm w.g.) have been evaluated by means of the below equation:

$$Dp = k \times pd$$

where:

- K Accidental Resistance (see value attach in table 1)
- pd Dynamic Pressure (mm w.g) $pd = \frac{c^2 \times \gamma}{2 \times g}$

Where:

- γ: Air density (1,22 Kg/m^3)
- c velocity of air m/s

If the Duct are linear the Dp are independent of Dynamic Pressure but depend of:

$$Dp = 0{,}00117722 \frac{c^{1,9}}{{d_{eq}}^{1,22}}$$

This value is for each meter of linear duct

where:

- c velocity of air m/s
- d_{eq} Diameter of equivalent duct

$$d_{eq} = \frac{4{,}5 \times A}{P}$$

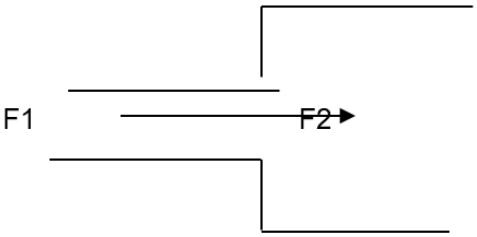
where:

- A Cross section of duct
- P Perimeter

Tab. 1

Pos	Description	K for special peace
1	Linear duct	0
2	Bend 90°	0,1
3	Outlet	1
4	Inlet	0,35
5	Section reduction	0,35

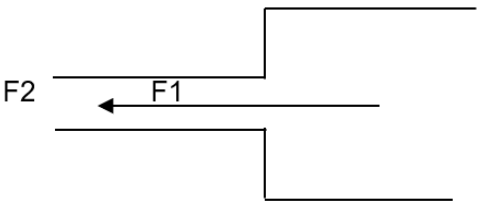
POS .6 Inlet in the Plenum



See detail

AxB/A1xB1	0,1	0,2	0,4	0,6	0,8
K	1	0,7	0,4	0,2	0,1

POS.7 Outlet from Plenum



See detail

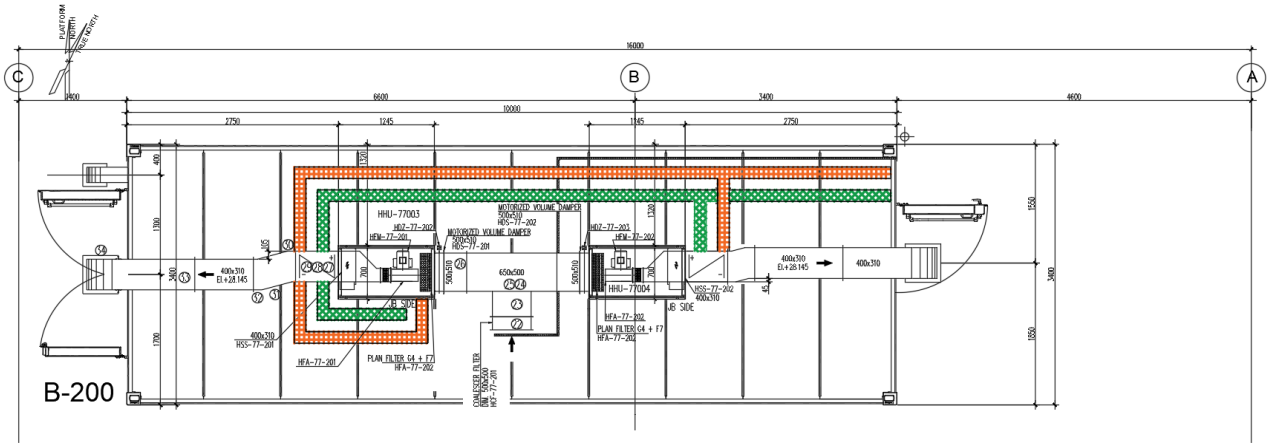
AxB/A1xB1	0,2	0,4	0,6	0,8
K	0,45	0,3	0,2	0,1

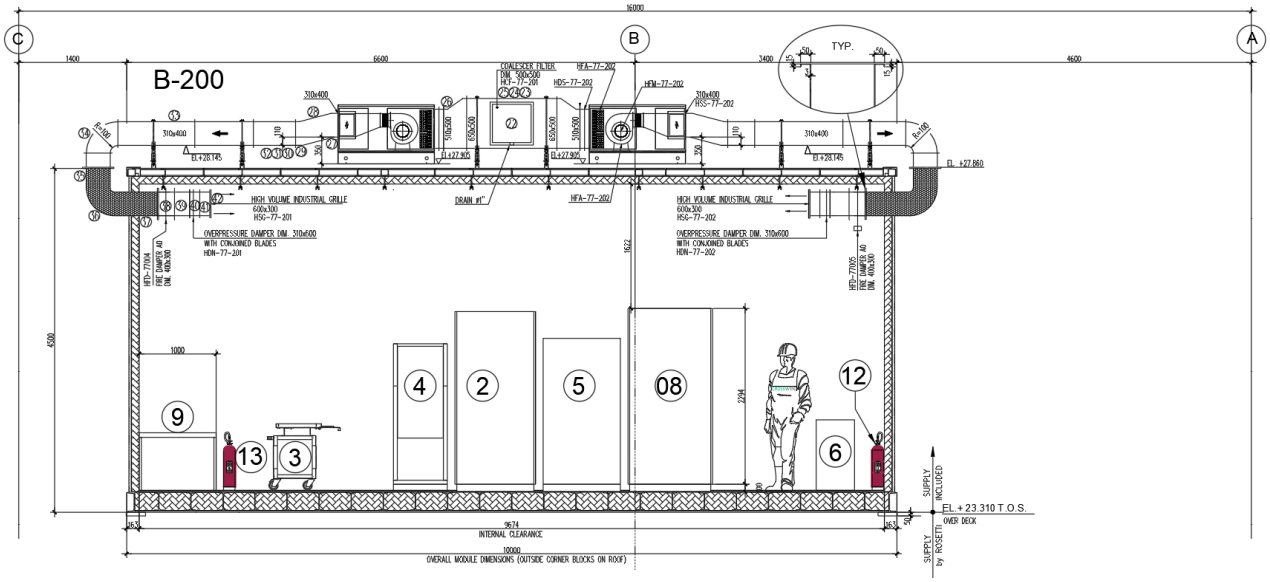
B-200 duct layout pressure drop:

	B-200				Duct pressure loss calculation					
	POS.	Inlet air dimens. (mm)		Outlet air dimens. (mm)		Lenght	Air Flow	Velocity	POS.	Dp for linear duct	DP for special pieces
		A	B	A1	B1	L (mm)	mc/h	m/s		mm w.g.	mm w.g.
HHU-77003 / 77004	22	COALESCER FILTER 500 x 500					1226			0,00	2,04
	23	500	500	500	500	350	1226	1	1	0,00	0,00
	24	500	500	500	500	350	1226	1	1	0,00	0,00
	25	650	500	650	500	585	1226	1	1	0,00	0,00
	26	650	500	500	510	300	1226	1	5	0,00	0,00
	27	400	310	400	310	0	1226	3	7	0,00	0,06
	28	400	310	400	310	420	1226	3	1	0,01	0,00
	29	400	310	400	310	0	1226	3	7	0,00	0,06
	30	400	310	400	310	0	1226	3	7	0,00	0,06
	31	400	310	400	310	330	1226	3	1	0,01	0,00
	32	400	310	400	310	0	1226	3	7	0,00	0,06
	33	400	310	400	310	3430	1226	3	1	0,10	0,00
	34	400	310	400	310	0	1226	3	2	0,00	0,28
	35	400	310	400	310	985	1226	3	1	0,03	0,00
	36	400	310	400	310	0	1226	3	2	0,00	0,28
	37	400	310	400	310	780	1226	3	1	0,02	0,00
	38	FIRE DAMPER					1226			0,00	1,02
	39	400	310	600	300	250	1226	3	5	0,00	0,20
	40	OVERPRESSURE DAMPER					1226			0,00	2,35
	41	600	300	600	300	130	1226	2	1	0,00	0,00
	42	SUPPLY GRILLE					1226			0,00	0,71
									1	0,18	7,10
									TOTAL LOSS Pa	71,40	

This document undergoes an issuance cycle within EDMS Fusionlive". Its distribution is electronically controlled. Once printed shall be considered as "NOT CONTROLLED" copy

B-200 →DUCT LAYOUT:





9 CONCLUSION

The pressure drop duct layout of the B-200 loss: 71,40 Pa

The ducts were built based on the flow rate required by the thermal calculation and the fans were sized based on the pressure loss, obtained with the calculation sheet illustrated above.

The fan's air flow is sufficient to guarantee the required overpressure of 50 Pa.

