



MEMORIA DE CÁLCULO

CLIMATIZAÇÃO E EXAUSTÃO DE AR

**INSTITUTO BRASILEIRO DO MEIO AMBIENTE E DOS RECURSOS NATURAIS
RENOVÁVEIS – IBAMA**

V000 - Agosto 2017

Engº Mec. Fernando Fittipaldi Bombonato – CREA 321.843/D-SP

BASE DE CALCULO – CARGA TERMICA

Condições externas

- Temperatura de bulbo seco de verão = 32,10° C
- Temperatura de bulbo úmido de verão = 18,0° C

Condições internas

- Temperatura de bulbo seco = 24° C \pm 2° C
- Umidade relativa = 55 % \pm 5% (Sem controle)

Taxa de ocupação

- Conforme ABNT NBR 16401: Parte 3 - Tabela 1

Taxa de iluminação

- 15 W /m²

Taxa de Equipamentos

- Conforme Layout de arquitetura

Metodologia

A carga térmica foi calculada para determinar a carga máxima de cada zona e as cargas máximas simultâneas de cada unidade de tratamento de ar e do conjunto do sistema, bem como as épocas de suas respectivas ocorrências.

Para determinação da carga, foi usado o do programa de computador. Hourly Analysis Program v4.70, O programa baseado nos métodos da *ASHRAE (TFM – Transfer Function Method)*, Programa descrito detalhadamente conforme abaixo:

O HAP é um programa de dupla função - estimativa de carga e dimensionamento do sistema completo para edifícios comerciais. As cargas térmicas são calculadas usando o método de carga da função de transferência endossado ASHRAE®1. Os componentes do sistema são dimensionados usando o conceito System-Based Design, que aplica a metodologia de extração de calor aprovada pela ASHRAE para vincular o desempenho do sistema às cargas térmicas de construção.

Air System Sizing Summary for IBAMA - DF

Project Name: IBAMA - DF
Prepared by: Bombonato Projetos e Consultoria S/S Ltda

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Air System Information

Air System Name **IBAMA - DF**
Equipment Class **TERM**
Air System Type **SPLT-FC**

Number of zones **21**
Floor Area **918,9** m²
Location **Brasilia, Brazil**

Sizing Calculation Information

Zone and Space Sizing Method:

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

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

Zone Sizing Summary for IBAMA - DF

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Sizing Calculation Information

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

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

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (kW)	Design Air Flow (L/s)	Minimum Air Flow (L/s)	Time of Peak Load	Maximum Heating Load (kW)	Zone Floor Area (m ²)	Zone L/(s-m ²)
AUDITÓRIO	18,6	1746	1746	Jan 1700	2,4	147,0	11,88
CABINE SOM	1,8	170	170	Jan 1600	0,2	5,0	34,01
SEGURANÇA	2,0	191	191	Jan 1800	0,2	5,1	37,46
SALA DE REUNIÃO 01	7,2	680	680	Dec 1700	1,4	33,1	20,56
REFEITORIO	8,5	802	802	Dec 1600	1,0	53,2	15,07
SALA ADM	3,4	324	324	Jan 1600	0,0	23,4	13,86
SALA DO CHEFE	4,9	458	458	Feb 1500	1,4	19,3	23,71
SALA CHEFE SUBST.	5,1	480	480	Feb 1400	0,8	22,5	21,33
SL. ADM 08 - NPA	9,6	900	900	Feb 1400	1,7	46,2	19,48
SL. ADM 07	11,9	1124	1124	Mar 1500	2,1	53,6	20,96
SL TÉCNICA	3,3	314	314	Jan 1500	0,1	5,4	58,12
SL ADM 09 - NCEA	13,3	1253	1253	Jan 1600	3,2	60,5	20,71
SALA ADM 06-NCAB	10,7	1011	1011	Dec 1600	1,7	45,9	22,03
SL ADM 05-NCT	10,7	1011	1011	Dec 1600	1,7	45,9	22,03
SALA ADM 04-NIC	10,7	1011	1011	Dec 1600	1,7	45,9	22,03
SALA ADM 03 - NOC	14,1	1327	1327	Jan 1400	3,6	72,0	18,43
SALA REUNIÃO 2	4,3	404	404	Jan 1400	0,2	17,0	23,75
SALA SITUAÇÃO	14,7	1039	1039	Jan 1400	2,1	88,2	11,78
SALA ADM 02-NPM	13,1	1235	1235	Feb 1400	3,3	69,7	17,72
FOYER	8,0	756	756	Feb 2100	0,6	47,2	16,02
OFICINA	9,9	933	933	Feb 1600	3,2	42,3	22,06

Terminal Unit Sizing Data - Cooling

Zone Name	Total Coil Load (kW)	Sens Coil Load (kW)	Coil Entering DB / WB (°C)	Coil Leaving DB / WB (°C)	Water Flow @ 5,6 °K (L/s)	Time of Peak Load
AUDITÓRIO	26,2	23,9	25,2 / 16,5	12,3 / 11,5	-	Jan 1500
CABINE SOM	2,0	1,9	22,9 / 15,7	12,4 / 11,7	-	Jan 1700
SEGURANÇA	2,2	2,1	22,9 / 15,8	12,6 / 12,0	-	Jan 1700
SALA DE REUNIÃO 01	8,2	7,6	23,7 / 16,4	13,1 / 12,4	-	Dec 1600
REFEITORIO	10,2	9,3	23,8 / 16,4	12,9 / 12,2	-	Dec 1600
SALA ADM	4,1	3,7	23,5 / 16,2	12,6 / 11,9	-	Feb 1400
SALA DO CHEFE	5,3	4,9	23,2 / 16,2	13,1 / 12,4	-	Feb 1500
SALA CHEFE SUBST.	5,7	5,3	23,0 / 15,9	12,5 / 11,9	-	Feb 1400
SL. ADM 08 - NPA	10,8	9,9	22,9 / 15,9	12,6 / 11,9	-	Feb 1300
SL. ADM 07	12,9	12,1	23,2 / 16,2	13,1 / 12,4	-	Mar 1600
SL TÉCNICA	3,5	3,3	22,5 / 15,5	12,5 / 11,8	-	Feb 1500
SL ADM 09 - NCEA	14,6	13,6	23,2 / 16,2	13,0 / 12,4	-	Jan 1600
SALA ADM 06-NCAB	11,6	10,7	23,2 / 16,3	13,2 / 12,5	-	Dec 1600
SL ADM 05-NCT	11,6	10,7	23,2 / 16,3	13,2 / 12,5	-	Dec 1600
SALA ADM 04-NIC	11,6	10,7	23,2 / 16,3	13,2 / 12,5	-	Dec 1600
SALA ADM 03 - NOC	15,6	14,4	23,2 / 16,2	13,0 / 12,3	-	Jan 1400
SALA REUNIÃO 2	4,8	4,5	23,6 / 16,3	13,1 / 12,4	-	Jan 1400

Zone Sizing Summary for IBAMA - DF

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Zone Name	Total Coil Load (kW)	Sens Coil Load (kW)	Coil Entering DB / WB (°C)	Coil Leaving DB / WB (°C)	Water Flow @ 5,6 °K (L/s)	Time of Peak Load
SALA SITUAÇÃO	16,2	14,7	23,3 / 16,1	12,7 / 12,0	-	Jan 1300
SALA ADM 02-NPM	14,6	13,4	23,2 / 16,3	13,0 / 12,4	-	Feb 1400
FOYER	11,0	10,2	24,9 / 16,3	12,3 / 11,5	-	Feb 1400
OFICINA	11,1	10,4	23,6 / 16,3	13,1 / 12,4	-	Feb 1600

Terminal Unit Sizing Data - Heating, Fan, Ventilation

Zone Name	Heating Coil Load (kW)	Heating Coil Ent/Lvg DB (°C)	Htg Coil Water Flow @11,1 °K (L/s)	Fan Design AirFlow (L/s)	Fan Motor (BHP)	Fan Motor (kW)	OA Vent Design AirFlow (L/s)
AUDITÓRIO	8,4	17,5 / 22,1	-	1746	0,000	0,000	493
CABINE SOM	0,3	20,6 / 22,3	-	170	0,000	0,000	9
SEGURANÇA	0,4	20,6 / 22,3	-	191	0,000	0,000	9
SALA DE REUNIÃO 01	2,1	19,8 / 22,7	-	680	0,000	0,000	63
REFEITORIO	2,2	19,5 / 22,1	-	802	0,000	0,000	98
SALA ADM	0,4	20,1 / 21,1	-	324	0,000	0,000	28
SALA DO CHEFE	1,6	20,3 / 23,6	-	458	0,000	0,000	19
SALA CHEFE SUBST.	1,1	20,7 / 22,9	-	480	0,000	0,000	19
SL. ADM 08 - NPA	2,2	20,6 / 22,9	-	900	0,000	0,000	38
SL. ADM 07	2,5	20,3 / 22,5	-	1124	0,000	0,000	50
SL TÉCNICA	0,1	21,2 / 21,4	-	314	0,000	0,000	0
SL ADM 09 - NCEA	4,0	20,5 / 23,6	-	1253	0,000	0,000	58
SALA ADM 06-NCAB	2,2	20,9 / 22,9	-	1011	0,000	0,000	28
SL ADM 05-NCT	2,2	20,9 / 22,9	-	1011	0,000	0,000	28
SALA ADM 04-NIC	2,2	20,9 / 22,9	-	1011	0,000	0,000	28
SALA ADM 03 - NOC	3,9	20,3 / 23,1	-	1327	0,000	0,000	54
SALA REUNIÃO 2	0,5	20,0 / 21,2	-	404	0,000	0,000	32
SALA SITUAÇÃO	3,7	20,2 / 22,8	-	1301	0,000	0,000	105
SALA ADM 02-NPM	3,7	20,3 / 23,2	-	1235	0,000	0,000	54
FOYER	3,1	18,2 / 22,0	-	756	0,000	0,000	190
OFICINA	4,1	19,9 / 24,1	-	933	0,000	0,000	77

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s-m²)
AUDITÓRIO							
01-TER-AUDITORIO	1	18,6	Jan 1700	1746	2,4	147,0	11,88
CABINE SOM							
02-TER-CABINE SOM	1	1,8	Jan 1600	170	0,2	5,0	34,01
SEGURANÇA							
03-TER-SEGURANÇA	1	2,0	Jan 1800	191	0,2	5,1	37,46
SALA DE REUNIÃO 01							
04-TER-SL REUNIÃO 1	1	7,2	Dec 1700	680	1,4	33,1	20,56
REFEITORIO							
05-TER-REFEITORIO	1	8,5	Dec 1600	802	1,0	53,2	15,07
SALA ADM							
06-TER-SL ADMIN 01	1	3,4	Jan 1600	324	0,0	23,4	13,86
SALA DO CHEFE							
07-SUP-SALA CHEFE	1	4,9	Feb 1500	458	1,4	19,3	23,71
SALA CHEFE SUBST.							
08-SUP-SL CHEFE SUBSTIT	1	5,1	Feb 1400	480	0,8	22,5	21,33

Zone Sizing Summary for IBAMA - DF

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Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s-m²)
SL. ADM 08 - NPA							
09-SUP-SL ADM 08 - NPA	1	9,6	Feb 1400	900	1,7	46,2	19,48
SL. ADM 07							
10-SUP-SL ADM 07-APOIO	1	11,9	Mar 1500	1124	2,1	53,6	20,96
SL TÉCNICA							
11-SUP-SL TÉCNICA	1	3,3	Jan 1500	314	0,1	5,4	58,12
SL ADM 09 - NCEA							
12-SUP-SL ADM 09-NCEA	1	13,3	Jan 1600	1253	3,2	60,5	20,71
SALA ADM 06-NCAB							
13-SUP-SL ADM 06-NCAB	1	10,7	Dec 1600	1011	1,7	45,9	22,03
SL ADM 05-NCT							
14-SUP-SL ADM 05-NCT	1	10,7	Dec 1600	1011	1,7	45,9	22,03
SALA ADM 04-NIC							
15-SUP-SL ADM 04-NIC	1	10,7	Dec 1600	1011	1,7	45,9	22,03
SALA ADM 03 - NOC							
16-SUP-SL ADM 03-NOC	1	14,1	Jan 1400	1327	3,6	72,0	18,43
SALA REUNIÃO 2							
17-SUP-SL REUNIÃO 2	1	4,3	Jan 1400	404	0,2	17,0	23,75
SALA SITUAÇÃO							
18-SUP-SL SITUAÇÃO	1	14,7	Jan 1400	1301	2,1	88,2	14,75
SALA ADM 02-NPM							
19-SUP-SL ADM 02-NPM	1	13,1	Feb 1400	1235	3,3	69,7	17,72
FOYER							
01A-TER-FOYER	1	8,0	Feb 2100	756	0,6	47,2	16,02
OFICINA							
00-TER-OFFICINA	1	9,9	Feb 1600	933	3,2	42,3	22,06

Air System Design Load Summary for IBAMA - DF

Project Name: IBAMA - DF
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	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jan 1500 COOLING OA DB / WB 31,7 °C / 18,3 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 8,9 °C / 4,3 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	152 m²	23792	-	152 m²	-	-
Wall Transmission	383 m²	12240	-	383 m²	15249	-
Roof Transmission	634 m²	22809	-	634 m²	6111	-
Window Transmission	152 m²	6804	-	152 m²	11334	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	592 m²	12349	-	592 m²	0	-
Partitions	967 m²	23137	-	967 m²	0	-
Ceiling	267 m²	3199	-	267 m²	0	-
Overhead Lighting	16409 W	15166	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	26400 W	24794	-	0	0	-
People	339	19489	15543	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	16378	1554	0%	0	0
>> Total Zone Loads	-	180158	17098	-	32694	0
Zone Conditioning	-	179568	17098	-	31882	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Exhaust Fan Load	0 L/s	0	-	0 L/s	0	-
Ventilation Load	1480 L/s	13948	-2575	1480 L/s	19066	0
Ventilation Fan Load	0 L/s	0	-	0 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	193516	14522	-	50948	0
Terminal Unit Cooling	-	193516	14519	-	0	0
Terminal Unit Heating	-	0	-	-	50948	-
>> Total Conditioning	-	193516	14519	-	50948	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

System Psychrometrics for IBAMA - DF

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January DESIGN COOLING DAY, 1500

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	31,7	0,00950	1480	400	13948	-2575
Vent - Return Mixing	Outlet	-17,8	0,00000	0	0	-	-
Ventilation Fan	Outlet	-17,8	0,00000	0	0	0	-
Zone Air	-	22,9	0,01035	17431	96	179568	17098
Return Plenum	Outlet	-17,8	0,01035	17431	96	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1,207; At site altitude = 1,063 W/(L/s-K)

Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947,6; At site altitude = 2595,3 W/(L/s)

Site Altitude = 1060,7 m

System Psychrometrics for IBAMA - DF

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TABLE 2: ZONE DATA

Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
AUDITÓRIO (Cooling)							
Ventilation Air	-	-	-	493	-	-	-
Cooling Coil Inlet	-	25,2	0,00977	1746	0	-	-
Cooling Coil Outlet	-	12,3	0,00926	1746	0	23931	2275
Heating Coil Inlet	-	12,3	0,00926	1746	0	-	-
Heating Coil Outlet	-	12,3	0,00926	1746	0	0	-
Zone Air	-	22,7	0,00986	1746	0	19210	-
CABINE SOM (Cooling)							
Ventilation Air	-	-	-	9	-	-	-
Cooling Coil Inlet	-	23,3	0,00990	170	0	-	-
Cooling Coil Outlet	-	12,8	0,00971	170	0	1890	85
Heating Coil Inlet	-	12,8	0,00971	170	0	-	-
Heating Coil Outlet	-	12,8	0,00971	170	0	0	-
Zone Air	-	22,8	0,00992	170	0	1805	-
SEGURANÇA (Cooling)							
Ventilation Air	-	-	-	9	-	-	-
Cooling Coil Inlet	-	23,0	0,01021	191	0	-	-
Cooling Coil Outlet	-	13,2	0,01006	191	0	1989	78
Heating Coil Inlet	-	13,2	0,01006	191	0	-	-
Heating Coil Outlet	-	13,2	0,01006	191	0	0	-
Zone Air	-	22,6	0,01024	191	0	1903	-
SALA DE REUNIÃO 01 (Cooling)							
Ventilation Air	-	-	-	63	-	-	-
Cooling Coil Inlet	-	23,7	0,01028	680	0	-	-
Cooling Coil Outlet	-	13,2	0,01000	680	0	7596	488
Heating Coil Inlet	-	13,2	0,01000	680	0	-	-
Heating Coil Outlet	-	13,2	0,01000	680	0	0	-
Zone Air	-	22,9	0,01035	680	0	7011	-
REFEITÓRIO (Cooling)							
Ventilation Air	-	-	-	98	-	-	-
Cooling Coil Inlet	-	23,9	0,01041	802	0	-	-
Cooling Coil Outlet	-	13,3	0,01007	802	0	9013	707
Heating Coil Inlet	-	13,3	0,01007	802	0	-	-
Heating Coil Outlet	-	13,3	0,01007	802	0	0	-
Zone Air	-	22,8	0,01054	802	0	8092	-
SALA ADM (Cooling)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	23,6	0,01011	324	0	-	-
Cooling Coil Outlet	-	12,7	0,00965	324	0	3742	388
Heating Coil Inlet	-	12,7	0,00965	324	0	-	-
Heating Coil Outlet	-	12,7	0,00965	324	0	0	-
Zone Air	-	22,8	0,01016	324	0	3478	-
SALA DO CHEFE (Cooling)							
Ventilation Air	-	-	-	19	-	-	-
Cooling Coil Inlet	-	23,3	0,01048	458	0	-	-
Cooling Coil Outlet	-	13,5	0,01023	458	0	4755	299
Heating Coil Inlet	-	13,5	0,01023	458	0	-	-
Heating Coil Outlet	-	13,5	0,01023	458	0	0	-
Zone Air	-	22,9	0,01053	458	0	4578	-
SALA CHEFE SUBST. (Cooling)							
Ventilation Air	-	-	-	19	-	-	-
Cooling Coil Inlet	-	23,0	0,01019	480	0	-	-

System Psychrometrics for IBAMA - DF

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Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
Cooling Coil Outlet	-	13,0	0,00988	480	0	5103	385
Heating Coil Inlet	-	13,0	0,00988	480	0	-	-
Heating Coil Outlet	-	13,0	0,00988	480	0	0	-
Zone Air	-	22,6	0,01021	480	0	4921	-
SL. ADM 08 - NPA (Cooling)							
Ventilation Air	-	-	-	38	-	-	-
Cooling Coil Inlet	-	23,3	0,01059	900	0	-	-
Cooling Coil Outlet	-	13,5	0,01027	900	0	9330	744
Heating Coil Inlet	-	13,5	0,01027	900	0	-	-
Heating Coil Outlet	-	13,5	0,01027	900	0	0	-
Zone Air	-	22,9	0,01063	900	0	8977	-
SL. ADM 07 (Cooling)							
Ventilation Air	-	-	-	50	-	-	-
Cooling Coil Inlet	-	23,3	0,01065	1124	0	-	-
Cooling Coil Outlet	-	13,7	0,01037	1124	0	11456	834
Heating Coil Inlet	-	13,7	0,01037	1124	0	-	-
Heating Coil Outlet	-	13,7	0,01037	1124	0	0	-
Zone Air	-	22,9	0,01071	1124	0	10989	-
SL TÉCNICA (Cooling)							
Ventilation Air	-	-	-	0	-	-	-
Cooling Coil Inlet	-	22,8	0,00993	314	0	-	-
Cooling Coil Outlet	-	12,9	0,00980	314	0	3310	104
Heating Coil Inlet	-	12,9	0,00980	314	0	-	-
Heating Coil Outlet	-	12,9	0,00980	314	0	0	-
Zone Air	-	22,8	0,00992	314	0	3310	-
SL ADM 09 - NCEA (Cooling)							
Ventilation Air	-	-	-	58	-	-	-
Cooling Coil Inlet	-	23,2	0,01026	1253	0	-	-
Cooling Coil Outlet	-	13,1	0,00995	1253	0	13446	1010
Heating Coil Inlet	-	13,1	0,00995	1253	0	-	-
Heating Coil Outlet	-	13,1	0,00995	1253	0	0	-
Zone Air	-	22,8	0,01029	1253	0	12898	-
SALA ADM 06-NCAB (Cooling)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	23,2	0,01044	1011	0	-	-
Cooling Coil Outlet	-	13,4	0,01014	1011	0	10607	775
Heating Coil Inlet	-	13,4	0,01014	1011	0	-	-
Heating Coil Outlet	-	13,4	0,01014	1011	0	0	-
Zone Air	-	23,0	0,01047	1011	0	10349	-
SL ADM 05-NCT (Cooling)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	23,2	0,01044	1011	0	-	-
Cooling Coil Outlet	-	13,4	0,01014	1011	0	10607	775
Heating Coil Inlet	-	13,4	0,01014	1011	0	-	-
Heating Coil Outlet	-	13,4	0,01014	1011	0	0	-
Zone Air	-	23,0	0,01047	1011	0	10349	-
SALA ADM 04-NIC (Cooling)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	23,2	0,01044	1011	0	-	-
Cooling Coil Outlet	-	13,4	0,01014	1011	0	10607	775
Heating Coil Inlet	-	13,4	0,01014	1011	0	-	-
Heating Coil Outlet	-	13,4	0,01014	1011	0	0	-
Zone Air	-	23,0	0,01047	1011	0	10349	-
SALA ADM 03 - NOC (Cooling)							

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Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
Ventilation Air	-	-	-	54	-	-	-
Cooling Coil Inlet	-	23,2	0,01032	1327	0	-	-
Cooling Coil Outlet	-	13,1	0,00996	1327	0	14294	1246
Heating Coil Inlet	-	13,1	0,00996	1327	0	-	-
Heating Coil Outlet	-	13,1	0,00996	1327	0	0	-
Zone Air	-	22,9	0,01034	1327	0	13790	-
SALA REUNIÃO 2 (Cooling)							
Ventilation Air	-	-	-	32	-	-	-
Cooling Coil Inlet	-	23,7	0,01027	404	0	-	-
Cooling Coil Outlet	-	13,3	0,01003	404	0	4469	255
Heating Coil Inlet	-	13,3	0,01003	404	0	-	-
Heating Coil Outlet	-	13,3	0,01003	404	0	0	-
Zone Air	-	23,0	0,01033	404	0	4174	-
SALA SITUAÇÃO (Cooling)							
Ventilation Air	-	-	-	105	-	-	-
Cooling Coil Inlet	-	23,6	0,01042	1301	0	-	-
Cooling Coil Outlet	-	13,2	0,01004	1301	0	14269	1290
Heating Coil Inlet	-	13,2	0,01004	1301	0	-	-
Heating Coil Outlet	-	13,2	0,01004	1301	0	0	-
Zone Air	-	22,9	0,01051	1301	0	13286	-
SALA ADM 02-NPM (Cooling)							
Ventilation Air	-	-	-	54	-	-	-
Cooling Coil Inlet	-	23,3	0,01056	1235	0	-	-
Cooling Coil Outlet	-	13,4	0,01021	1235	0	12906	1136
Heating Coil Inlet	-	13,4	0,01021	1235	0	-	-
Heating Coil Outlet	-	13,4	0,01021	1235	0	0	-
Zone Air	-	22,9	0,01061	1235	0	12402	-
FOYER (Cooling)							
Ventilation Air	-	-	-	190	-	-	-
Cooling Coil Inlet	-	25,1	0,00981	756	0	-	-
Cooling Coil Outlet	-	12,6	0,00946	756	0	10063	680
Heating Coil Inlet	-	12,6	0,00946	756	0	-	-
Heating Coil Outlet	-	12,6	0,00946	756	0	0	-
Zone Air	-	22,9	0,00991	756	0	8300	-
OFICINA (Cooling)							
Ventilation Air	-	-	-	77	-	-	-
Cooling Coil Inlet	-	23,5	0,01029	933	0	-	-
Cooling Coil Outlet	-	13,2	0,01003	933	0	10133	630
Heating Coil Inlet	-	13,2	0,01003	933	0	-	-
Heating Coil Outlet	-	13,2	0,01003	933	0	0	-
Zone Air	-	22,7	0,01035	933	0	9401	-

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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	8,9	0,00400	1480	400	-19066	0
Vent - Return Mixing	Outlet	-17,8	0,00000	0	0	-	-
Ventilation Fan	Outlet	-17,8	0,00000	0	0	0	-
Zone Air	-	21,0	0,00400	17431	0	-31882	0
Return Plenum	Outlet	-17,8	0,00400	17431	0	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1,207; At site altitude = 1,063 W/(L/s-K)

Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947,6; At site altitude = 2595,3 W/(L/s)

Site Altitude = 1060,7 m

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TABLE 2: ZONE DATA

Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
AUDITÓRIO (Heating)							
Ventilation Air	-	-	-	493	-	-	-
Cooling Coil Inlet	-	17,5	0,00401	1746	0	-	-
Cooling Coil Outlet	-	17,5	0,00401	1746	0	0	0
Heating Coil Inlet	-	17,5	0,00401	1746	0	-	-
Heating Coil Outlet	-	22,1	0,00401	1746	0	8438	-
Zone Air	-	20,9	0,00400	1746	0	-2142	-
CABINE SOM (Deadband)							
Ventilation Air	-	-	-	9	-	-	-
Cooling Coil Inlet	-	20,6	0,00401	170	0	-	-
Cooling Coil Outlet	-	20,6	0,00401	170	0	0	0
Heating Coil Inlet	-	20,6	0,00401	170	0	-	-
Heating Coil Outlet	-	22,3	0,00401	170	0	303	-
Zone Air	-	21,3	0,00400	170	0	-185	-
SEGURANÇA (Deadband)							
Ventilation Air	-	-	-	9	-	-	-
Cooling Coil Inlet	-	20,6	0,00401	191	0	-	-
Cooling Coil Outlet	-	20,6	0,00401	191	0	0	0
Heating Coil Inlet	-	20,6	0,00401	191	0	-	-
Heating Coil Outlet	-	22,3	0,00401	191	0	358	-
Zone Air	-	21,1	0,00400	191	0	-240	-
SALA DE REUNIÃO 01 (Heating)							
Ventilation Air	-	-	-	63	-	-	-
Cooling Coil Inlet	-	19,8	0,00401	680	0	-	-
Cooling Coil Outlet	-	19,8	0,00401	680	0	0	0
Heating Coil Inlet	-	19,8	0,00401	680	0	-	-
Heating Coil Outlet	-	22,7	0,00401	680	0	2107	-
Zone Air	-	20,9	0,00400	680	0	-1304	-
REFEITÓRIO (Heating)							
Ventilation Air	-	-	-	98	-	-	-
Cooling Coil Inlet	-	19,5	0,00401	802	0	-	-
Cooling Coil Outlet	-	19,5	0,00401	802	0	0	0
Heating Coil Inlet	-	19,5	0,00401	802	0	-	-
Heating Coil Outlet	-	22,1	0,00401	802	0	2202	-
Zone Air	-	21,0	0,00400	802	0	-938	-
SALA ADM (Deadband)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	20,1	0,00401	324	0	-	-
Cooling Coil Outlet	-	20,1	0,00401	324	0	0	0
Heating Coil Inlet	-	20,1	0,00401	324	0	-	-
Heating Coil Outlet	-	21,1	0,00401	324	0	364	-
Zone Air	-	21,1	0,00400	324	0	0	-
SALA DO CHEFE (Heating)							
Ventilation Air	-	-	-	19	-	-	-
Cooling Coil Inlet	-	20,3	0,00401	458	0	-	-
Cooling Coil Outlet	-	20,3	0,00401	458	0	0	0
Heating Coil Inlet	-	20,3	0,00401	458	0	-	-
Heating Coil Outlet	-	23,6	0,00401	458	0	1595	-
Zone Air	-	20,8	0,00400	458	0	-1354	-
SALA CHEFE SUBST. (Deadband)							
Ventilation Air	-	-	-	19	-	-	-
Cooling Coil Inlet	-	20,7	0,00401	480	0	-	-

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Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
Cooling Coil Outlet	-	20,7	0,00401	480	0	0	0
Heating Coil Inlet	-	20,7	0,00401	480	0	-	-
Heating Coil Outlet	-	22,9	0,00401	480	0	1118	-
Zone Air	-	21,1	0,00400	480	0	-871	-
SL. ADM 08 - NPA (Deadband)							
Ventilation Air	-	-	-	38	-	-	-
Cooling Coil Inlet	-	20,6	0,00401	900	0	-	-
Cooling Coil Outlet	-	20,6	0,00401	900	0	0	0
Heating Coil Inlet	-	20,6	0,00401	900	0	-	-
Heating Coil Outlet	-	22,9	0,00401	900	0	2211	-
Zone Air	-	21,1	0,00400	900	0	-1716	-
SL. ADM 07 (Heating)							
Ventilation Air	-	-	-	50	-	-	-
Cooling Coil Inlet	-	20,3	0,00401	1124	0	-	-
Cooling Coil Outlet	-	20,3	0,00401	1124	0	0	0
Heating Coil Inlet	-	20,3	0,00401	1124	0	-	-
Heating Coil Outlet	-	22,5	0,00401	1124	0	2536	-
Zone Air	-	20,9	0,00400	1124	0	-1900	-
SL TÉCNICA (Deadband)							
Ventilation Air	-	-	-	0	-	-	-
Cooling Coil Inlet	-	21,2	0,00401	314	0	-	-
Cooling Coil Outlet	-	21,2	0,00401	314	0	0	0
Heating Coil Inlet	-	21,2	0,00401	314	0	-	-
Heating Coil Outlet	-	21,4	0,00401	314	0	65	-
Zone Air	-	21,2	0,00400	314	0	-65	-
SL ADM 09 - NCEA (Heating)							
Ventilation Air	-	-	-	58	-	-	-
Cooling Coil Inlet	-	20,5	0,00401	1253	0	-	-
Cooling Coil Outlet	-	20,5	0,00401	1253	0	0	0
Heating Coil Inlet	-	20,5	0,00401	1253	0	-	-
Heating Coil Outlet	-	23,6	0,00401	1253	0	4021	-
Zone Air	-	21,1	0,00400	1253	0	-3268	-
SALA ADM 06-NCAB (Deadband)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	20,9	0,00401	1011	0	-	-
Cooling Coil Outlet	-	20,9	0,00401	1011	0	0	0
Heating Coil Inlet	-	20,9	0,00401	1011	0	-	-
Heating Coil Outlet	-	22,9	0,00401	1011	0	2184	-
Zone Air	-	21,2	0,00400	1011	0	-1817	-
SL ADM 05-NCT (Deadband)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	20,9	0,00401	1011	0	-	-
Cooling Coil Outlet	-	20,9	0,00401	1011	0	0	0
Heating Coil Inlet	-	20,9	0,00401	1011	0	-	-
Heating Coil Outlet	-	22,9	0,00401	1011	0	2184	-
Zone Air	-	21,2	0,00400	1011	0	-1817	-
SALA ADM 04-NIC (Deadband)							
Ventilation Air	-	-	-	28	-	-	-
Cooling Coil Inlet	-	20,9	0,00401	1011	0	-	-
Cooling Coil Outlet	-	20,9	0,00401	1011	0	0	0
Heating Coil Inlet	-	20,9	0,00401	1011	0	-	-
Heating Coil Outlet	-	22,9	0,00401	1011	0	2184	-
Zone Air	-	21,2	0,00400	1011	0	-1817	-

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Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
SALA ADM 03 - NOC (Heating)							
Ventilation Air	-	-	-	54	-	-	-
Cooling Coil Inlet	-	20,3	0,00401	1327	0	-	-
Cooling Coil Outlet	-	20,3	0,00401	1327	0	0	0
Heating Coil Inlet	-	20,3	0,00401	1327	0	-	-
Heating Coil Outlet	-	23,1	0,00401	1327	0	3908	-
Zone Air	-	20,8	0,00400	1327	0	-3226	-
SALA REUNIÃO 2 (Heating)							
Ventilation Air	-	-	-	32	-	-	-
Cooling Coil Inlet	-	20,0	0,00401	404	0	-	-
Cooling Coil Outlet	-	20,0	0,00401	404	0	0	0
Heating Coil Inlet	-	20,0	0,00401	404	0	-	-
Heating Coil Outlet	-	21,2	0,00401	404	0	528	-
Zone Air	-	21,0	0,00400	404	0	-118	-
SALA SITUAÇÃO (Heating)							
Ventilation Air	-	-	-	105	-	-	-
Cooling Coil Inlet	-	20,2	0,00401	1301	0	-	-
Cooling Coil Outlet	-	20,2	0,00401	1301	0	0	0
Heating Coil Inlet	-	20,2	0,00401	1301	0	-	-
Heating Coil Outlet	-	22,8	0,00401	1301	0	3671	-
Zone Air	-	21,2	0,00400	1301	0	-2302	-
SALA ADM 02-NPM (Heating)							
Ventilation Air	-	-	-	54	-	-	-
Cooling Coil Inlet	-	20,3	0,00401	1235	0	-	-
Cooling Coil Outlet	-	20,3	0,00401	1235	0	0	0
Heating Coil Inlet	-	20,3	0,00401	1235	0	-	-
Heating Coil Outlet	-	23,2	0,00401	1235	0	3739	-
Zone Air	-	20,9	0,00400	1235	0	-3051	-
FOYER (Deadband)							
Ventilation Air	-	-	-	190	-	-	-
Cooling Coil Inlet	-	18,2	0,00401	756	0	-	-
Cooling Coil Outlet	-	18,2	0,00401	756	0	0	0
Heating Coil Inlet	-	18,2	0,00401	756	0	-	-
Heating Coil Outlet	-	22,0	0,00401	756	0	3108	-
Zone Air	-	21,3	0,00400	756	0	-609	-
OFICINA (Heating)							
Ventilation Air	-	-	-	77	-	-	-
Cooling Coil Inlet	-	19,9	0,00401	933	0	-	-
Cooling Coil Outlet	-	19,9	0,00401	933	0	0	0
Heating Coil Inlet	-	19,9	0,00401	933	0	-	-
Heating Coil Outlet	-	24,1	0,00401	933	0	4125	-
Zone Air	-	20,9	0,00400	933	0	-3142	-

Psychrometric Analysis for IBAMA - DF

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