OBRA: HOTEL CACUPÉ

PROJETO DE CLIMATIZAÇÃO

MEMÓRIA DE CÁLCULO

Porto Alegre, outubro de 2023.

Índice:

1. OBJETIVO 3
2. NORMAS APLICÁVEIS....3
3. BASES DE CÁLCULO....3
3.1 Condições Externas....3
3.2 Condições Internas....4
3.3 Ar Exterior....4
3.4 Coeficiente Global de Transferência de Calor (U) 4
3.5 Dissipação de Calor – Equipamentos 6
3.6 Dissipação de Calor – Luminárias....6
3.7 Dissipação de Calor – Pessoas 6
3.8 População....7
4. CÁLCULO DA CARGA TÉRMICA....7
4.1 Cargas dos Ambientes....7
5. Seleção Ventiladores Ar Exterior....7

1. OBJETIVO

Este documento tem por objetivo apresentar a metodologia utilizada e os resultados obtidos no dimensionamento do sistema de ar-condicionado para a construção do Hotel Cacupé, unidade Sesc, localizado em Cacupé, Florianópolis - SC.

2. NORMAS APLICÁVEIS

Foram seguidas as recomendações das seguintes normas e entidades nos cálculos apresentados no presente documento:

- ABNT NBR-16401:2008 – Instalações de Ar-Condicionado – Sistemas Centrais e Unitários;
- Portaria n° 3.523, de 28/08/98 do Ministério da Saúde (incluindo resolução 176 de outubro de 2000 e a resolução 9 de janeiro de 2003);
- ABNT NBR 7256:2021 – Tratamento de ar em estabelecimentos assistenciais de saúde (EAS) – Requisitos para projeto e execução das instalações;
- NBR 10152 - Níveis de Ruído para Conforto Acústico;
- Catálogos, ITs e Recomendações de fabricantes dos materiais e equipamentos;

Estes documentos são complementados pelas normas e artigos abaixo, emitidos por organizações internacionais reconhecidas, não estando limitado a esta lista. São utilizados para situações não previstas nas normas nacionais ou onde, a cargo do projetista ou solicitação do cliente, julgar-se necessário aplicar diretrizes de maior exigência.

- AHRI - Air-Conditioning, Heating and Refrigeration Institute;
- ANSI - American National Standards Institute;
- ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers;
- ASME - American Society of Mechanical Engineers;
- SMACNA - Sheet Metal and Air Conditioning Contractors' National Association;
- Catálogos e Instruções técnicas de fabricantes.

3. BASES DE CÁLCULO

Na sequência são apresentadas as condições e parâmetros principais utilizados no dimensionamento do sistema de ar-condicionado para a edificação em estudo.

3.1 Condições Externas

Os dados climáticos de projeto (*) utilizados nos cálculos foram os seguintes:

Temperatura de bulbo seco (verão).....32,2 °C
Temperatura de bulbo úmido coincidente (verão).....25,5 °C

Segue no Apêndice A os parâmetros climáticos e geográficos declarados ao *software* de cálculo de carga térmica.

* Conforme ABNT NBR 16401-1 (Tabela A.7 – Região SUL; SC, Florianópolis).

3.2 Condições Internas

Foi considerada a seguinte condição de temperatura para os ambientes internos climatizados:

Temperatura de bulbo seco.....24,0 ± 2°C

3.3 Ar Exterior

Para o dimensionamento do sistema de renovação de ar, consideram-se as taxas de renovação de ar estipuladas pela ANVISA.

- Espaços condicionados: 27 (m³/h) /pessoa;
- Espaços condicionados com alta densidade de pessoas: 17 (m³/h) /pessoa.

3.4 Coeficiente Global de Transferência de Calor (U)

A obtenção dos coeficientes globais de transferência de calor para as superfícies de trocas térmicas com o ambiente externo, dados em W/(m².K), é demonstrada a seguir.

- Paredes Externas

Consideraram-se para a composição física das paredes externas – com insolação à norte, sul, leste e oeste - os seguintes elementos: Paredes de aço galvanizado.

Wall Constructions

SESC SC - HOTEL CACUPÉ
CBR ENGENHARIA SS LTDA
10/11/2023
05:23

Parede

Wall Details
Outside Surface Color ..... Medium
Absorptivity 0,675
Overall U-Value ..... 2,366 W/(m²·K)

Wall Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m³	Specific Ht. kJ / (kg K)	R-Value (m²·K)/W	Weight kg/m²
Inside surface resistance	0,000	0,0	0,00	0,13000	0,0
Reboco 2cm	20,000	1950,0	1,00	0,01700	39,0
Tijolo furado 11cm	110,000	985,0	1,00	0,21856	108,4
Reboco 2cm	20,000	1950,0	1,00	0,01700	39,0
Outside surface resistance	0,000	0,0	0,00	0,04000	0,0
Totals	**150,000**	-		**0,42256**	**186,4**

Figura 3.1 – Parâmetros para a obtenção do coeficiente U das paredes com insolação à norte, nordeste, noroeste, sul, sudeste, sudoeste, leste e oeste.

O coeficiente U é dado pelo inverso da soma das resistências de condução R, ou seja:

$$U = \frac{1}{\sum R} = \frac{1}{0{,}42256\ (m^2K)/W} = 2{,}366\ W/m^2K$$

- Cobertura

Para a obtenção do coeficiente global de transferência de calor para a cobertura, considerou-se a seguinte composição: telha metálica com isolamento, além das resistências de convecção e das películas de ar.

Nas figuras 3.2 e são apresentados os parâmetros utilizados na obtenção do coeficiente global de transferência de calor para a cobertura.

Roof Constructions

SESC SC - HOTEL CACUPÉ
CBR ENGENHARIA SS LTDA
10/11/2023
05:24

Cobertura SUPERIOR

Roof Details
Outside Surface Color ..... Medium
Absorptivity 0,675
Overall U-Value ..... 0,704 W/(m²·K)

Roof Layers Details (Inside to Outside)

Layers	Thickness mm	Density kg/m³	Specific Ht. kJ / (kg K)	R-Value (m²·K)/W	Weight kg/m²
Inside surface resistance	0,000	0,0	0,00	0,17000	0,0
Espaço de ar	0,000	0,0	0,00	0,21000	0,0
Telha	1,500	7689,0	0,41	0,00003	11,5
Poliuretano	30,000	35,0	1,67	1,00000	1,1
Air space	1,500	7689,0	0,41	0,00003	11,5
Outside surface resistance	0,000	0,0	0,00	0,04000	0,0
Totals	**33,000**	-		**1,42006**	**24,1**

Figura 3.2 – Parâmetros para a obtenção do coeficiente U da cobertura sem forro mineral

O coeficiente U é dado pelo inverso da soma das resistências de condução R, ou seja:

$$U = \frac{1}{\sum R} = \frac{1}{1{,}42006\ (m^2K)/W} = 0{,}704\ W/m^2K$$

- Janelas

Para o cálculo da carga térmica foram declaradas as janelas com variados tamanhos de cada ambiente, com as mesmas apresentando as seguintes características:

- vidro simples com 6 mm de espessura;

Nas figuras 3.4 são apresentados os principais parâmetros declarados para as janelas, tais como dimensão, coeficiente de sombra e coeficiente global de transferência de calor.

Window Constructions

SESC SC - HOTEL CACUPÉ 10/11/2023
CBR ENGENHARIA SS LTDA 05:27

JANELA 1,0X1,0

WindowDetails:

Detailed Input	Sim	
Height	1,00	m
Width	1,00	m
Frame Type	Aluminum with thermal breaks	
Internal Shade Type	None	
Overall U-Value	6,117	W/(m²·K)
Overall Shade Coefficient	0,845	

Glass Details:

Gap Type ..... 6mm Air Space

Glazing	Glass Type	Transmissivity	Reflectivity	Absorptivity
Outer Glazing	6mm clear	0,792	0,079	0,129
Glazing #2	not used	1,000	0,000	0,000
Glazing #3	not used	1,000	0,000	0,000

3.5 Dissipação de Calor – Equipamentos

Para a dissipação de calor nos ambientes, devido aos equipamentos eletro-eletrônicos, considerou-se o *layout* dos ambientes e seguiu-se as informações apresentadas na ABNT NBR 16401-1:2008.

3.6 Dissipação de Calor – Luminárias

Considerou-se uma taxa de 16 W/m² como dissipação de calor das luminárias nos ambientes em análise.

3.7 Dissipação de Calor – Pessoas

Para as taxas de calor sensível e latente dissipada pelas pessoas – conforme o nível de atividade das mesmas – considerou-se os valores recomendados pela ABNT NBR 16401-1:2008.

3.8 População

Para a ocupação dos ambientes do prédio, considerou-se o *layout* fornecido no projeto arquitetônico. Nos ambientes onde o *layout* não foi apresentado, consideraram-se as densidades populacionais recomendadas pela ABNT NBR 16401-1.

4. CÁLCULO DA CARGA TÉRMICA

O cálculo de carga térmica foi feito através do *software* E-20II da Carrier Company.

4.1 Cargas dos Ambientes

O Apêndice A mostra tabela de carga térmica resumida. Na tabelas são apresentadas todas as cargas discriminadas (vidros, paredes, iluminação, pessoas, equipamentos, etc.), assim como os valores totais, permitindo uma perfeita compreensão da carga térmica calculada.

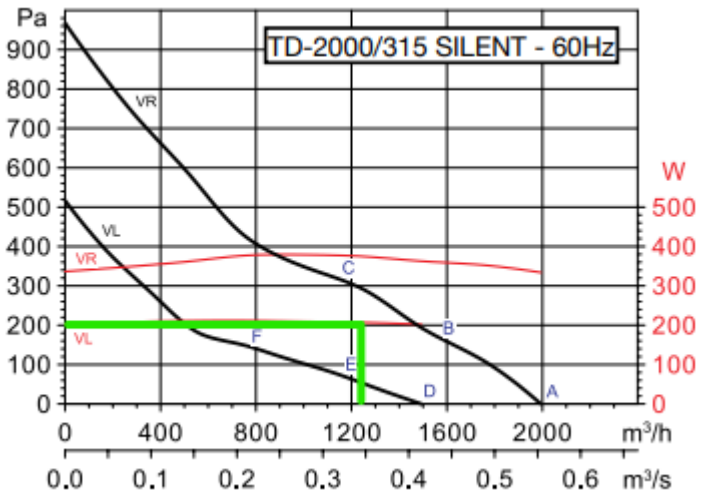
5. SISTEMA DE RENOVAÇÃO DO AR

5.1 Seleção Ventiladores Ar Exterior

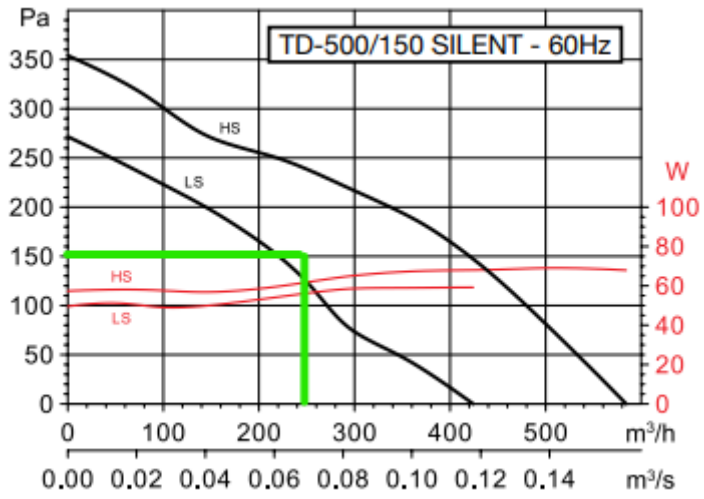
Para a ventilação foram adotados ventiladores centrífugos em linha (Exaustor para duto – série TD-Silent), selecionados conforme catálogo técnico, disponibilizado pela fabricante de ventiladores Soler&Palau.

Nas figuras abaixo são apresentadas as curvas de desempenho para as unidades de ventilação selecionadas para a renovação de ar dos ambientes do Refeitório e Área do colaborador.

- **VL-AE-01**



- **VL-AE-02**



Apêndice A

Air System Sizing Summary for REFEITÓRIO

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:37

Air System Information

Air System Name	REFEITÓRIO		Number of zones	1
Equipment Class	UNDEF		Floor Area	72,0 m²
Air System Type	SZCAV		Location	FLORIANÓPOLIS, Brazil

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

Total coil load	16,3	kW	Load occurs at	Aug 1600	
Sensible coil load	10,8	kW	OA DB / WB	31,9 / 25,4	°C
Coil L/s at Aug 1600	828	L/s	Entering DB / WB	26,2 / 20,4	°C
Max block L/s	828	L/s	Leaving DB / WB	15,5 / 15,0	°C
Sum of peak zone L/s	828	L/s	Coil ADP	14,3	°C
Sensible heat ratio	0,661		Bypass Factor	0,100	
m²/kW	4,4		Resulting RH	58	%
W/m²	226,1		Design supply temp.	14,4	°C
Water flow @ 5,6 K rise	0,70	L/s	Zone T-stat Check	1 of 1	OK
			Max zone temperature deviation	0,0	K

Central Heating Coil Sizing Data

Max coil load	9,3	kW	Load occurs at	Des Htg	
Coil L/s at Des Htg	828	L/s	W/m²	128,5	
Max coil L/s	828	L/s	Ent. DB / Lvg DB	16,6 / 25,9	°C
Water flow @ 11,1 K drop	0,20	L/s			

Supply Fan Sizing Data

Actual max L/s	828	L/s	Fan motor BHP	0,00	BHP
Standard L/s	828	L/s	Fan motor kW	0,00	kW
Actual max L/(s·m²)	11,50	L/(s·m²)	Fan static	0	Pa

Outdoor Ventilation Air Data

Design airflow L/s	188	L/s	L/s/person	4,70	L/s/person
L/(s·m²)	2,61	L/(s·m²)			

Hourly Analysis Program v5.01 Page 1 of 5

Zone Sizing Summary for REFEITÓRIO

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:37

Air System Information

Air System Name ..... REFEITÓRIO
Equipment Class ..... UNDEF
Air System Type ..... SZCAV
Number of zones 1
Floor Area ..... 72,0 m²
Location ..... FLORIANÓPOLIS, Brazil

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)
REFEITÓRIO	828	828	11,50	0,0	0,00	0,0	0,00	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)
REFEITÓRIO	9,4	Jul 1700	5,2	72,0

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)
REFEITÓRIO							
REFEITÓRIO	1	9,4	Jul 1700	828	5,2	72,0	11,50

Hourly Analysis Program v5.01 Page 2 of 5

Ventilation Sizing Summary for REFEITÓRIO

Project Name: SESC SC - HOTEL CACUPÉ
Prepared by: CBR ENGENHARIA SS LTDA

10/11/2023
05:42

1. Summary

Ventilation Sizing Method ..... Sum of Space OA Airflows
Design Ventilation Airflow Rate ..... 188 L/s

2. Space Ventilation Analysis

Zone Name / Space Name	Mult.	Floor Area (m²)	Maximum Occupants	Maximum Supply Air (L/s)	Required Outdoor Air (L/s/person)	Required Outdoor Air (L/(s·m²))	Required Outdoor Air (L/s)	Required Outdoor Air (% of supply)	Uncorrected Outdoor Air (L/s)
REFEITÓRIO									
REFEITÓRIO	1	72.0	40.0	828.3	4.70	0.00	0.0	0.0	188.0
Totals (Incl. Space Multipliers)				828.3					188.0

Hourly Analysis Program v5.01

Page 8 of 8

Air System Design Load Summary for REFEITÓRIO

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:42

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 31,9 °C / 25,4 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 2,2 °C / -1,2 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	65 m²	1693	-	65 m²	2887	-
Roof Transmission	72 m²	946	-	72 m²	958	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	72 m²	0	-	72 m²	0	-
Partitions	9 m²	46	-	9 m²	138	-
Ceiling	72 m²	393	-	72 m²	1168	-
Overhead Lighting	1244 W	1042	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2000 W	1870	-	0	0	-
People	40	2290	1800	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	1120	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	9400	1800	-	5151	0
Zone Conditioning	-	9091	1800	-	5056	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	828 L/s	0	-	828 L/s	0	-
Ventilation Load	188 L/s	1667	3724	188 L/s	4224	0
Supply Fan Load	828 L/s	0	-	828 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0		0%	0	-
>> Total System Loads	-	10758	5524	-	9280	0
Central Cooling Coil	-	10758	5524	-	0	0
Central Heating Coil	-	0	-	-	9280	-
>> Total Conditioning	-	10758	5524	-	9280	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Hourly Analysis Program v5.01 Page 8 of 8

Zone Design Load Summary for REFEITÓRIO

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:42

REFEITÓRIO	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700			HEATING DATA AT DES HTG		
	COOLING OA DB / WB 31,2 °C / 25,3 °C			HEATING OA DB / WB 2,2 °C / -1,2 °C		
	OCCUPIED T-STAT 23,9 °C			OCCUPIED T-STAT 21,1 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	65 m²	1828	-	65 m²	2687	-
Roof Transmission	72 m²	805	-	72 m²	958	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	72 m²	0	-	72 m²	0	-
Partitions	9 m²	43	-	9 m²	138	-
Ceiling	72 m²	367	-	72 m²	1168	-
Overhead Lighting	1244 W	1060	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2000 W	1881	-	0	0	-
People	40	2334	1800	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	1120	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	9438	1800	-	5151	0

Hourly Analysis Program v5.01 Page 5 of 5

Air System Design Load Summary for REFEITÓRIO

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:42

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 31,9 °C / 25,4 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 2,2 °C / -1,2 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	65 m²	1693	-	65 m²	2887	-
Roof Transmission	72 m²	946	-	72 m²	958	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	72 m²	0	-	72 m²	0	-
Partitions	9 m²	46	-	9 m²	138	-
Ceiling	72 m²	393	-	72 m²	1168	-
Overhead Lighting	1244 W	1042	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2000 W	1870	-	0	0	-
People	40	2290	1800	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	1120	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	9400	1800	-	5151	0
Zone Conditioning	-	9091	1800	-	5056	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	828 L/s	0	-	828 L/s	0	-
Ventilation Load	188 L/s	1667	3724	188 L/s	4224	0
Supply Fan Load	828 L/s	0	-	828 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0		0%	0	-
>> Total System Loads	-	10758	5524	-	9280	0
Central Cooling Coil	-	10758	5524	-	0	0
Central Heating Coil	-	0	-	-	9280	-
>> Total Conditioning	-	10758	5524	-	9280	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Hourly Analysis Program v5.01 Page 8 of 8

Air System Sizing Summary for COPA

Project Name: SESC SC - HOTEL CACUPÉ
Prepared by: CBR ENGENHARIA SS LTDA
10/11/2023 05:39

Air System Information

Air System Name	COPA		Number of zones	1
Equipment Class	UNDEF		Floor Area	11,0 m²
Air System Type	SZCAV		Location	FLORIANÓPOLIS, Brazil

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

Total coil load	3,4	kW	Load occurs at	Aug 1800	
Sensible coil load	3,1	kW	OA DB / WB	30,2 / 25,0	°C
Coil L/s at Aug 1800	281	L/s	Entering DB / WB	24,5 / 18,2	°C
Max block L/s	281	L/s	Leaving DB / WB	15,3 / 14,6	°C
Sum of peak zone L/s	281	L/s	Coil ADP	14,2	°C
Sensible heat ratio	0,929		Bypass Factor	0,100	
m²/kW	3,2		Resulting RH	54	%
W/m²	307,8		Design supply temp.	14,4	°C
Water flow @ 5,6 K rise	0,15	L/s	Zone T-stat Check	1 of 1	OK
			Max zone temperature deviation	0,0	K

Central Heating Coil Sizing Data

Max coil load	1,6	kW	Load occurs at	Des Htg	
Coil L/s at Des Htg	281	L/s	W/m²	146,5	
Max coil L/s	281	L/s	Ent. DB / Lvg DB	20,5 / 25,3	°C
Water flow @ 11,1 K drop	0,03	L/s			

Supply Fan Sizing Data

Actual max L/s	281	L/s	Fan motor BHP	0,00	BHP
Standard L/s	281	L/s	Fan motor kW	0,00	kW
Actual max L/(s·m²)	25,52	L/(s·m²)	Fan static	0	Pa

Outdoor Ventilation Air Data

Design airflow L/s	5	L/s	L/s/person	1,57	L/s/person
L/(s·m²)	0,43	L/(s·m²)			

Hourly Analysis Program v5.01 Page 1 of 1

Zone Sizing Summary for COPA

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:39

Air System Information

Air System Name ..... COPA
Equipment Class ..... UNDEF
Air System Type ..... SZCAV
Number of zones 1
Floor Area ..... 11,0 m²
Location ..... FLORIANOPOLIS, Brazil

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)
COPA	281	281	25,52	0,0	0,00	0,0	0,00	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)
COPA	3,2	Jul 1800	1,5	11,0

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)
COPA							
COPA	1	3,2	Jul 1800	281	1,5	11,0	25,52

CBR ENGENHARIA
Rua Washington Luiz, 1118 Cj. 901 – Centro, CEP 90010-460 – Porto Alegre/RS - Tel/Fax (51) 3092.3800

Ventilation Sizing Summary for COPA

Project Name: SESC SC - HOTEL CACUPÉ
Prepared by: CBR ENGENHARIA S.S LTDA
10/11/2023
05:39

1. Summary

Ventilation Sizing Method ..... Sum of Space OA Airflows
Design Ventilation Airflow Rate ..... 5 L/s

2. Space Ventilation Analysis

Zone Name / Space Name	Mult.	Floor Area (m²)	Maximum Occupants	Maximum Supply Air (L/s)	Required Outdoor Air (L/s/person)	Required Outdoor Air (L/(s·m²))	Required Outdoor Air (L/s)	Required Outdoor Air (% of supply)	Uncorrected Outdoor Air (L/s)
COPA									
COPA	1	11,0	3,0	280,8	0,00	0,00	4,7	0,0	4,7
Totals (Incl. Space Multipliers)				280,8					4,7

Air System Design Load Summary for COPA

Project Name: SESC SC - HOTEL CACUPÉ
Prepared by: CBR ENGENHARIA SS LTDA
10/11/2023 05:39

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1800 COOLING OA DB / WB 30,2 °C / 25,0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 2,2 °C / -1,2 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	23 m²	767	-	23 m²	1033	-
Roof Transmission	11 m²	75	-	11 m²	146	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	11 m²	0	-	11 m²	0	-
Partitions	11 m²	48	-	11 m²	175	-
Ceiling	11 m²	49	-	11 m²	178	-
Overhead Lighting	190 W	164	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2000 W	1891	-	0	0	-
People	3	178	135	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	3173	135	-	1532	0
Zone Conditioning	-	3113	135	-	1506	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	281 L/s	0	-	281 L/s	0	-
Ventilation Load	5 L/s	32	104	5 L/s	106	0
Supply Fan Load	281 L/s	0	-	281 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	3145	239	-	1612	0
Central Cooling Coil	-	3145	241	-	0	0
Central Heating Coil	-	0	-	-	1612	-
>> Total Conditioning	-	3145	241	-	1612	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Hourly Analysis Program v5.01 Page ▮ of ▮

Zone Design Load Summary for COPA

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:39

COPA	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1800 COOLING OA DB / WB 30,2 °C / 25,0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 2,2 °C / -1,2 °C		
	OCCUPIED T-STAT 23,9 °C			OCCUPIED T-STAT 21,1 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	23 m²	782	-	23 m²	1033	-
Roof Transmission	11 m²	86	-	11 m²	146	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	11 m²	0	-	11 m²	0	-
Partitions	11 m²	48	-	11 m²	175	-
Ceiling	11 m²	49	-	11 m²	178	-
Overhead Lighting	190 W	164	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	2000 W	1891	-	0	0	-
People	3	178	135	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	3199	135	-	1532	0

Hourly Analysis Program v5.01 Page 8 of 8

Air System Sizing Summary for ÁREA DO COLABORADOR

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:45

Air System Information

Air System Name	ÁREA DO COLABORADOR		Number of zones	1	
Equipment Class	UNDEF		Floor Area	20,0	m²
Air System Type	SZCAV		Location	FLORIANÓPOLIS, Brazil	

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

Total coil load	4,5	kW	Load occurs at	Aug 1600	
Sensible coil load	2,8	kW	OA DB / WB	31,9 / 25,4	°C
Coil L/s at Aug 1600	203	L/s	Entering DB / WB	27,1 / 21,3	°C
Max block L/s	203	L/s	Leaving DB / WB	15,8 / 15,3	°C
Sum of peak zone L/s	203	L/s	Coil ADP	14,6	°C
Sensible heat ratio	0,618		Bypass Factor	0,100	
m²/kW	4,5		Resulting RH	58	%
W/m²	222,9		Design supply temp.	14,4	°C
Water flow @ 5,6 K rise	0,19	L/s	Zone T-stat Check	1 of 1	OK
			Max zone temperature deviation	0,0	K

Central Heating Coil Sizing Data

Max coil load	3,5	kW	Load occurs at	Des Htg	
Coil L/s at Des Htg	203	L/s	W/m²	172,6	
Max coil L/s	203	L/s	Ent. DB / Lvg DB	14,5 / 28,6	°C
Water flow @ 11,1 K drop	0,07	L/s			

Supply Fan Sizing Data

Actual max L/s	203	L/s	Fan motor BHP	0,00	BHP
Standard L/s	203	L/s	Fan motor kW	0,00	kW
Actual max L/(s·m²)	10,17	L/(s·m²)	Fan static	0	Pa

Outdoor Ventilation Air Data

Design airflow L/s	68	L/s	L/s/person	7,50	L/s/person
L/(s·m²)	3,38	L/(s·m²)			

Hourly Analysis Program v5.01 Page 1 of 1

Zone Sizing Summary for ÁREA DO COLABORADOR

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:45

Air System Information

Air System Name ..... ÁREA DO COLABORADOR
Equipment Class ..... UNDEF
Air System Type ..... SZCAV
Number of zones 1
Floor Area ..... 20,0 m²
Location ..... FLORIANÓPOLIS, Brazil

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)
ÁREA DO COLABORADOR	203	203	10,17	0,0	0,00	0,0	0,00	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)
ÁREA DO COLABORADOR	2,3	Jul 1700	2,0	20,0

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)
ÁREA DO COLABORADOR							
ÁREA DO COLABORADOR	1	2,3	Jul 1700	203	2,0	20,0	10,17

Ventilation Sizing Summary for ÁREA DO COLABORADOR

Project Name: SESC SC - HOTEL CACUPÉ
Prepared by: CBR ENGENHARIA SS LTDA

10/11/2023
05:45

1. Summary

Ventilation Sizing Method ..... Sum of Space OA Airflows
Design Ventilation Airflow Rate ..... 68 L/s

2. Space Ventilation Analysis

Zone Name / Space Name	Mult.	Floor Area (m²)	Maximum Occupants	Maximum Supply Air (L/s)	Required Outdoor Air (L/s/person)	Required Outdoor Air (L/(s·m²))	Required Outdoor Air (L/s)	Required Outdoor Air (% of supply)	Uncorrected Outdoor Air (L/s)
ÁREA DO COLABORADOR									
ÁREA DO COLABORADOR	1	20,0	9,0	203,3	7,50	0,00	0,0	0,0	67,5
Totals (Incl. Space Multipliers)				**203,3**					**67,5**

CBR ENGENHARIA
Rua Washington Luiz, 1118 Cj. 901 – Centro, CEP 90010-460 – Porto Alegre/RS - Tel/Fax (51) 3092.3800

Air System Design Load Summary for ÁREA DO COLABORADOR

Project Name: SESC SC - HOTEL CACUPÉ
Prepared by: CBR ENGENHARIA SS LTDA
10/11/2023
05:45

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1600 COOLING OA DB / WB 31,9 °C / 25,4 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 2,2 °C / -1,2 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	26 m²	583	-	26 m²	1162	-
Roof Transmission	20 m²	283	-	20 m²	266	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	15 m²	0	-	15 m²	0	-
Partitions	16 m²	87	-	16 m²	260	-
Ceiling	20 m²	109	-	20 m²	324	-
Overhead Lighting	346 W	289	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	500 W	467	-	0	0	-
People	9	515	405	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	2314	405	-	2012	0
Zone Conditioning	-	2165	405	-	1951	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	203 L/s	0	-	203 L/s	0	-
Ventilation Load	68 L/s	592	1297	68 L/s	1501	0
Supply Fan Load	203 L/s	0	-	203 L/s	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	2757	1702	-	3453	0
Central Cooling Coil	-	2757	1702	-	0	0
Central Heating Coil	-	0	-	-	3453	-
>> Total Conditioning	-	2757	1702	-	3453	0
Key:	Positive values are clg loads Negative values are htg loads			Positive values are htg loads Negative values are clg loads		

Zone Design Load Summary for ÁREA DO COLABORADOR

Project Name: SESC SC - HOTEL CACUPÉ 10/11/2023
Prepared by: CBR ENGENHARIA SS LTDA 05:45

ÁREA DO COLABORADOR	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700 COOLING OA DB / WB 31,2 °C / 25,3 °C			HEATING DATA AT DES HTG HEATING OA DB / WB 2,2 °C / -1,2 °C		
	OCCUPIED T-STAT 23,9 °C			OCCUPIED T-STAT 21,1 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	26 m²	620	-	26 m²	1162	-
Roof Transmission	20 m²	223	-	20 m²	266	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	15 m²	0	-	15 m²	0	-
Partitions	16 m²	82	-	16 m²	260	-
Ceiling	20 m²	102	-	20 m²	324	-
Overhead Lighting	346 W	294	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	500 W	470	-	0	0	-
People	9	525	405	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	2317	405	-	2012	0

Hourly Analysis Program v5.01 Page 8 of 8

_____

Eng. Leandro P. Lindenmeyer

CREA RS 116.761

_____

Eng. Beatriz P. Gluz

CREA RS 217.081

Porto Alegre, Outubro de 2023.

CBR Engenharia SS Ltda.