The Innovation Hub

for Affordable Heating and Cooling

Knowledge sharing report - Energy use reduction, improving value of onsite generation

Increasing the value of onsite renewables in Darwin through data driven analytics

Project DCH10

31 May 2022

Charles Darwin University

About i-Hub

The Innovation Hub for Affordable Heating and Cooling (i-Hub) is an initiative led by the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) in conjunction with CSIRO, Queensland University of Technology (QUT), the University of Melbourne and the University of Wollongong and supported by Australian Renewable Energy Agency (ARENA) to facilitate the heating, ventilation, air conditioning and refrigeration (HVAC&R) industry's transition to a low emissions future, stimulate jobs growth, and showcase HVAC&R innovation in buildings.

The objective of i-Hub is to support the broader HVAC&R industry with knowledge dissemination, skills-development and capacity-building. By facilitating a collaborative approach to innovation, i-Hub brings together leading universities, researchers, consultants, building owners and equipment manufacturers to create a connected research and development community in Australia.

This Project received funding from ARENA as part of ARENA's Advancing Renewables Program.
The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

Primary Project Partner

Charles Darwin University

i-Hub Knowledge sharing report - Energy use reduction, improving value of onsite generation

Lead organisation	Charles Darwin University		
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Energy use reduction, improving value of onsite generation

Overview

In this report, we have provided an overview regarding the energy simulation of the two buildings (Blue1 and Pink 9) at Charles Darwin University which have been considered as case studies for this project. These buildings have been onboarded to the DCH in the current project. The objective of the analysis in this report is to:

- Energy use analysis of pilot buildings to inform net zero pathway for these buildings
- insights on parameters such as HVAC energy use and PV generation.

In this project, the cooling load of each building including all spaces within the buildings have been simulated using Hourly Analysis Program 5.11 (HAP 5.11), and a comprehensive report has been provided. For each space of the buildings, the contribution of different factors such as windows, walls, roofs, floors, doors, partitions, lighting, electric equipment and people on the cooling load (sensible, latent and total) of each space with a safety factor of 10% are simulated. In this project, the central chilled water has been considered in the simulation. In the following, we have provided more details about the simulation of building Blue1 and Pink 9.

Results

Building Blue1

As has been explained above, the cooling load of building Blue1 has been simulated using HAP 5.11, and the contribution of different factors such as windows, walls, roofs, floors, doors, partitions, lighting, electric equipment and people on the cooling load of each space with a safety factor of 10% are calculated. The input data is provided in Appendix A1, and a comprehensive report about the cooling load of the building is provided in Appendix A2.

The floor area of the building is 1820.6 m^2, and the total coil load that is simulated is 166.3KW (144KW sensible coil load and 22.3KW latent cooling load), and no heating coil load occurred during the calculation. A summary of the space loads, airflows and the time of peak sensible load for each space has been provided in Appendix A2 on page 3. A summary of the contribution of each factor on the cooling load of whole building is provided in Appendix A2 on page 7.

As the building has a number of lecture rooms, computer labs and offices, the total cooling load due to electric equipment (mainly due to computers and laptops) and people is significant. However, these internal factors are not related to the building features. The results have shown that among the cooling load elements that are related to the building features such as windows, walls, roofs, doors, floor and partitions, the highest contribution is related to window solar loads which is more than 17KW, and the second main factor is the roof which has more than 12KW cooling load.

The results also have shown that windows transmission, wall transmission, partitions and door loads are 7.8 KW, 1.8 KW, 0.68 KW and 0.3KW, respectively. The latent cooling load for all factors except people (20.3KW; without considering the safety factor) is 0. Please be noted that these are the results for total cooling load of the whole building at the peak of cooling load which occurs in January at 4PM, and the data for each space can be varied (the

details of the cooling load of each space is provided on pages 9-72 of Appendix A2). Moreover, the System Psychrometrics information of the building is provided in Appendix A2 on pages 75-80. The plan of the building and the information about each space are provided in Appendix A3. The Monthly, daily and hourly system design report is provided in Appendix A4.

Building Pink9

The same as Building Blue1, the cooling load of building Pink 9 has been simulated using HAP5.11, and the contribution of different factors such as windows, walls, roofs, floors, doors, partitions, lighting, electric equipment and people on the cooling load of each space with a safety factor of 10% are calculated. A comprehensive report about the cooling load of the building is provided in Appendices B2 and B4.

The floor area of the building is 2167.2 m^2, and the total coil load that is simulated is 83.2 KW (5.6 KW and 8.4 KW are related to Comms rooms and the kitchen, respectively. 80 KW sensible coil load and 3.2 KW latent cooling load), and no heating coil load occurred during the calculation. A summary of the contribution of each factor on the cooling load of whole building is provided in Appendices B2 on page 4 and B4 on pages 4, 18 and 32.

The results have shown that among the cooling load elements that are related to the building features such as windows, walls, roofs, doors, floor and partitions, the highest contribution is related to roof transmission which is more than 14.63 KW, and the second main factor is the partitions which is more than 13.57 KW cooling load. The results also have shown that windows transmission, wall transmission, window solar loads and door loads are about 2.8 KW, 2.8 KW, 6.4 KW and 1.2KW, respectively. The latent cooling load for all factors except people (2.9 KW; without considering the safety factor) is 0.

Please note that these are the results for total cooling load of the whole building at the peak of cooling load which occurs in January at 3PM (the peak of cooling loads for Comms room of the first floor and the kitchen occur in December at 3PM), and the data for each space can be varied (the details of the cooling load of each space is provided on pages 6-27 of Appendix B2 and 6, 20 and 34 of Appendix B4). Moreover, the System Psychrometrics information and hourly air system design of the building is provided in Appendix B2 on pages 30-35 and 7-14, 21-28 and 35-42 of Appendix B4. The plan of the building and the information about each space are provided in Appendix B3. The Monthly, daily and hourly system design report is provided in Appendices B5 and B6.

Next steps

This report has provided insights on the factors that influence energy demand in selected pilot buildings. The intention of the simulation was for calibration with observed data through the DCH, which could then inform the assessment of strategies that could provide pathway to net zero emissions for these buildings, such as optimising HVAC operation to reduce energy demand or maximising the use of onsite solar PV generation.

At present the data available from the onboarded buildings (see lessons learnt report) is not providing meaningful and robust data for the analysis. We are still working to resolve this. The simulation set-up and parameterisations mean that there is now the ability to evaluate the influence of building changes (operations or physical layout) on energy demand in selected pilot buildings.

Appendix A1 – Blue 1 Input Data

pdf linked below -3-page appendix attached

Blue 1 Input Data

Project Name: CDU_Blue 1
Prepared by: Charles Darwin University

05/17/2022
01:48AM

1. General Details:

Air System Name: Blue 1
Equipment Type: Chilled Water AHU
Air System Type: VAV
Number of zones: 2

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control: Proportional
Ventilation Sizing Method: Sum of Space OA Airflows
Minimum Airflow: 0 %
Unocc. Damper Position: Closed
Damper Leak Rate: 0 %
Outdoor Air CO2 Level: 400 ppm

Preheat Coil Data:

Setpoint: 10.0 °C
Heating Source: Hot Water
Schedule: JFMAMJJASOND
Coil position: Downstream of Mixing Point

Central Cooling Data:

Supply Air Temperature: 13.5 °C
Coil Bypass Factor: 0.100
Cooling Source: Chilled Water
Schedule: JFMAMJJASOND
Capacity Control: Constant Temperature - Fan On

Supply Fan Data:

Fan Type: Forward Curved
Configuration: Draw-thru
Fan Performance: 0 Pa
Overall Efficiency: 54 %

% Airflow	100	90	80	70	60	50
% kW	100	91	81	72	61	54

% Airflow	40	30	20	10	0
% kW	46	40	33	27	21

Duct System Data:

Supply Duct Data:

Duct Heat Gain: 5 %
Duct Leakage: 5 %

Return Duct or Plenum Data:

Return Air Via: Ducted Return

3. Zone Components:

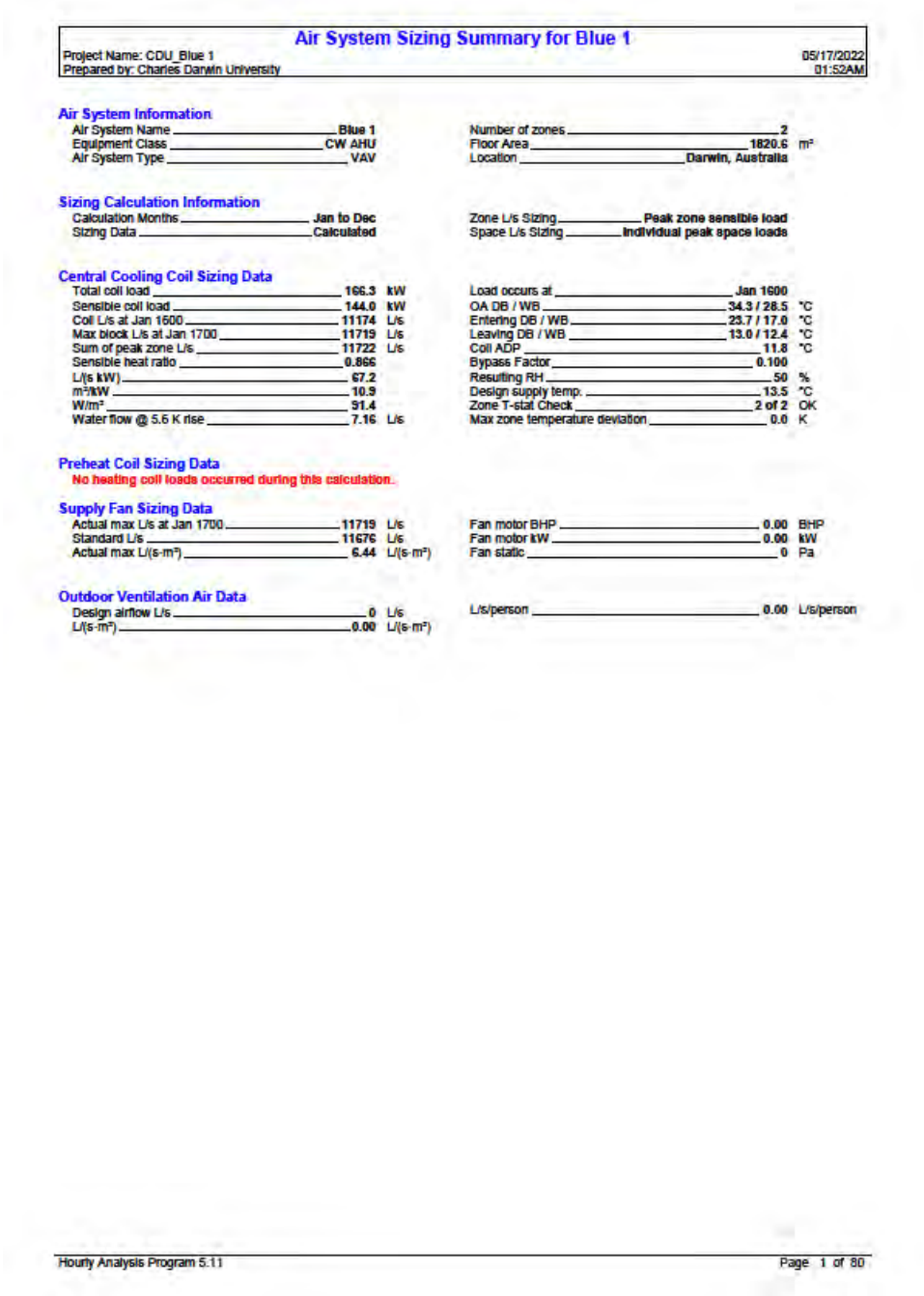
Space Assignments:

Zone 1: Zone 1	
1.01_Lecture Theatre	x1
1.14_Lecture Room	x1
1.15_Lecture Room	x1
1.35_Lecture room	x1
1.36 Office & lobby	x1
1.37_LLID manager office	x1
1.38_BSID manager office	x1
1.39_BG team lead office	x1
1.40_BA team lead office	x1
1.41_CSH Lecture office	x1
1.42_Lecture room	x1
1.43_CSH Lecture office	x1
1.44_CSH Store	x1
1.44a_CSH lecture office	x1
1.44b_CSH lecture office	x1
1.45_CSH Lecture office	x1
1.46_Sports & rec	x1
1.47_Computer lab	x1
1.47_CSH Lecture office	x1

Hourly Analysis Program 5.11 — Page 1 of 3

Appendix A2 – Air System Sizing Blue 1

pdf linked below -80-page appendix attached



Air System Sizing Summary for Blue 1

Project Name: CDU_Blue 1
Prepared by: Charles Darwin University

05/17/2022
01:52AM

Air System Information

Air System Name	Blue 1		Number of zones	2	
Equipment Class	CW AHU		Floor Area	1820.6	m²
Air System Type	VAV		Location	Darwin, Australia	

Sizing Calculation Information

Calculation Months	Jan to Dec		Zone L/s Sizing	Peak zone sensible load	
Sizing Data	Calculated		Space L/s Sizing	Individual peak space loads	

Central Cooling Coil Sizing Data

Total coil load	166.3	kW	Load occurs at	Jan 1600	
Sensible coil load	144.0	kW	OA DB / WB	34.3 / 28.5	°C
Coil L/s at Jan 1600	11174	L/s	Entering DB / WB	23.7 / 17.0	°C
Max block L/s at Jan 1700	11719	L/s	Leaving DB / WB	13.0 / 12.4	°C
Sum of peak zone L/s	11722	L/s	Coil ADP	11.8	°C
Sensible heat ratio	0.866		Bypass Factor	0.100	
L/(s kW)	67.2		Resulting RH	50	%
m³/kW	10.9		Design supply temp.	13.5	°C
W/m²	91.4		Zone T-stat Check	2 of 2	OK
Water flow @ 5.6 K rise	7.16	L/s	Max zone temperature deviation	0.0	K

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max L/s at Jan 1700	11719	L/s	Fan motor BHP	0.00	BHP
Standard L/s	11676	L/s	Fan motor kW	0.00	kW
Actual max L/(s·m²)	6.44	L/(s·m²)	Fan static	0	Pa

Outdoor Ventilation Air Data

Design airflow L/s	0	L/s	L/s/person	0.00	L/s/person
L/(s·m²)	0.00	L/(s·m²)			

Hourly Analysis Program 5.11

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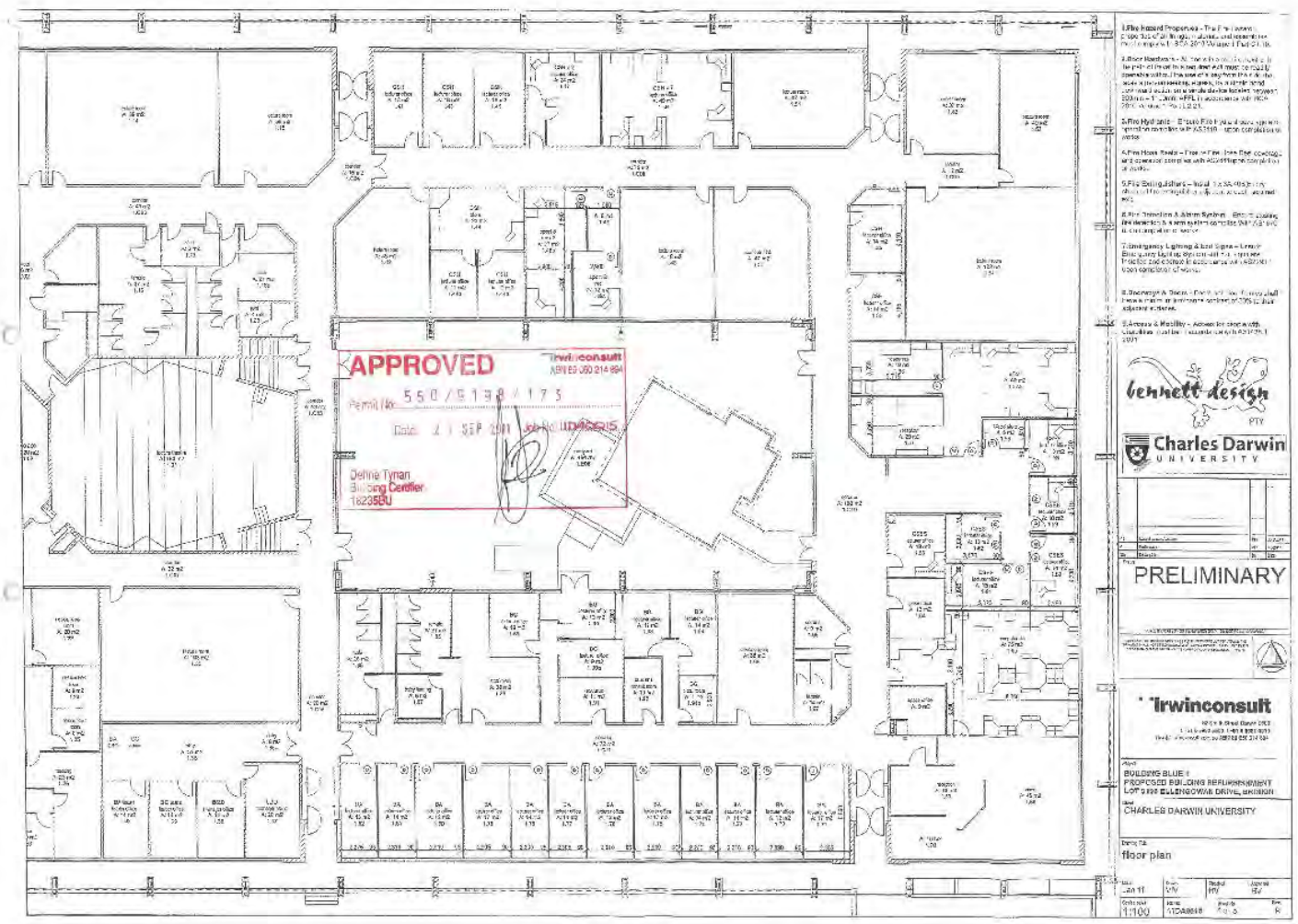
Appendix A3 – Plans and HAP mark-ups Blue 1

pdf linked below -12-page appendix attached



Appendix A4 – Simulation results Blue 1

pdf linked below -6-page appendix attached

Monthly Simulation Results for Blue 1

Project Name: CDU_Blue 1
Prepared by: Lucid Consulting Australia

05/30/2022
01:22PM

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kWh)	Central Cooling Coil Load (kWh)	Terminal Heating Coil Load (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	107881	0	0	10836	31973
February	0	97103	0	0	9788	28879
March	0	107237	0	0	10836	31973
April	0	102484	0	0	10487	30942
May	0	103416	0	0	10836	31973
June	0	97119	0	0	10487	30942
July	0	99712	0	0	10836	31973
August	0	102218	0	0	10836	31973
September	0	101872	0	0	10487	30942
October	0	108110	0	0	10836	31973
November	0	105922	0	0	10487	30942
December	0	108402	0	0	10836	31973
Total	0	1241477	0	0	127587	376459

Hourly Analysis Program 5.11

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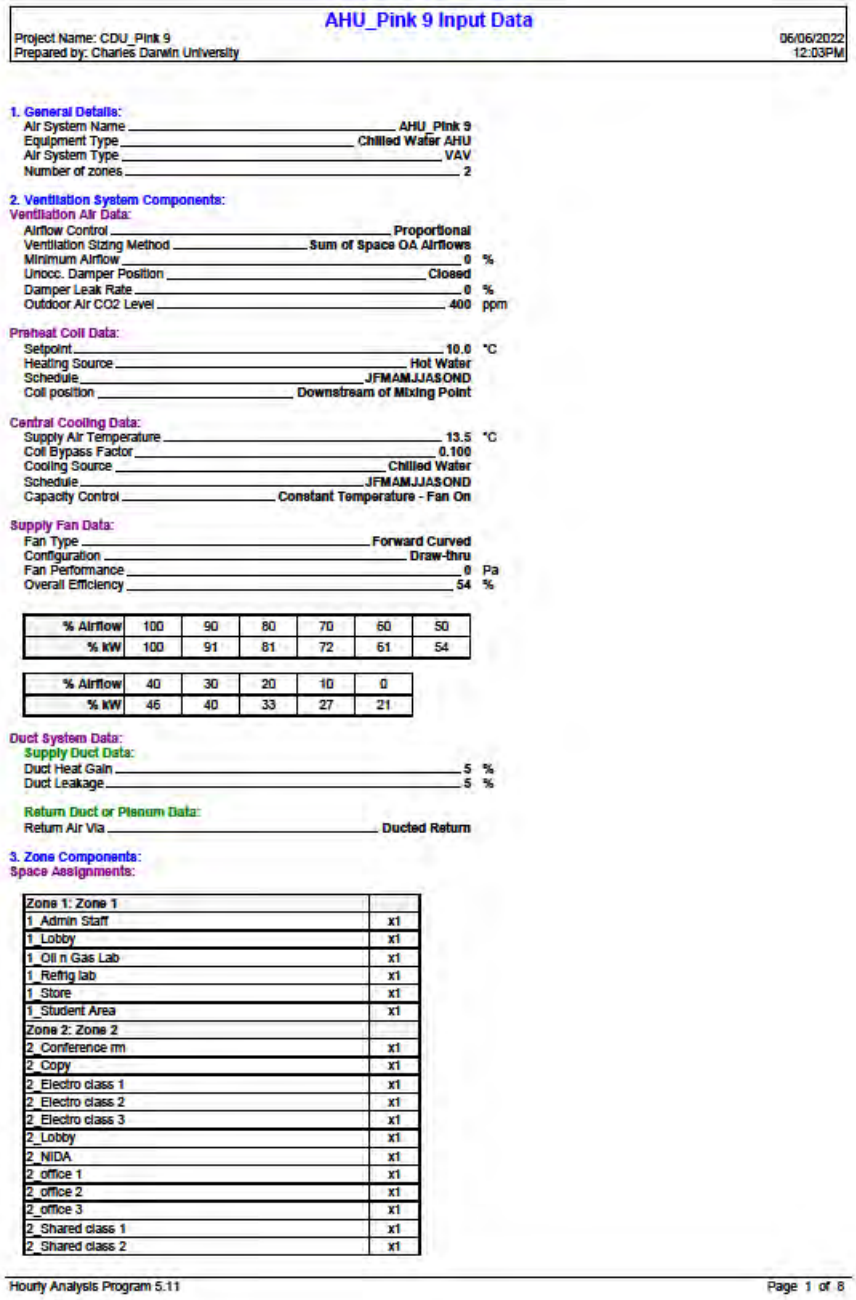
Appendix B1– Input Data Pink 9

pdf linked below -8-page appendix attached



AHU_Pink 9 Input Data

Project Name: CDU_Pink 9
Prepared by: Charles Darwin University

06/06/2022
12:03PM

1. General Details:

Air System Name	AHU_Pink 9
Equipment Type	Chilled Water AHU
Air System Type	VAV
Number of zones	2

2. Ventilation System Components:

Ventilation Air Data:

Airflow Control	Proportional	
Ventilation Sizing Method	Sum of Space OA Airflows	
Minimum Airflow	0	%
Unocc. Damper Position	Closed	
Damper Leak Rate	0	%
Outdoor Air CO2 Level	400	ppm

Preheat Coil Data:

Setpoint	10.0	°C
Heating Source	Hot Water	
Schedule	JFMAMJJASOND	
Coil position	Downstream of Mixing Point	

Central Cooling Data:

Supply Air Temperature	13.5	°C
Coil Bypass Factor	0.100	
Cooling Source	Chilled Water	
Schedule	JFMAMJJASOND	
Capacity Control	Constant Temperature - Fan On	

Supply Fan Data:

Fan Type	Forward Curved	
Configuration	Draw-thru	
Fan Performance	0	Pa
Overall Efficiency	54	%

% Airflow	100	90	80	70	60	50
% kW	100	91	81	72	61	54

% Airflow	40	30	20	10	0
% kW	46	40	33	27	21

Duct System Data:

Supply Duct Data:

Duct Heat Gain	5	%
Duct Leakage	5	%

Return Duct or Plenum Data:

Return Air Via	Ducted Return

3. Zone Components:

Space Assignments:

Zone 1: Zone 1	
1_Admin Staff	x1
1_Lobby	x1
1_Oil n Gas Lab	x1
1_Refrig lab	x1
1_Store	x1
1_Student Area	x1
Zone 2: Zone 2	
2_Conference rm	x1
2_Copy	x1
2_Electro class 1	x1
2_Electro class 2	x1
2_Electro class 3	x1
2_Lobby	x1
2_NIDA	x1
2_office 1	x1
2_office 2	x1
2_office 3	x1
2_Shared class 1	x1
2_Shared class 2	x1

Hourly Analysis Program 5.11

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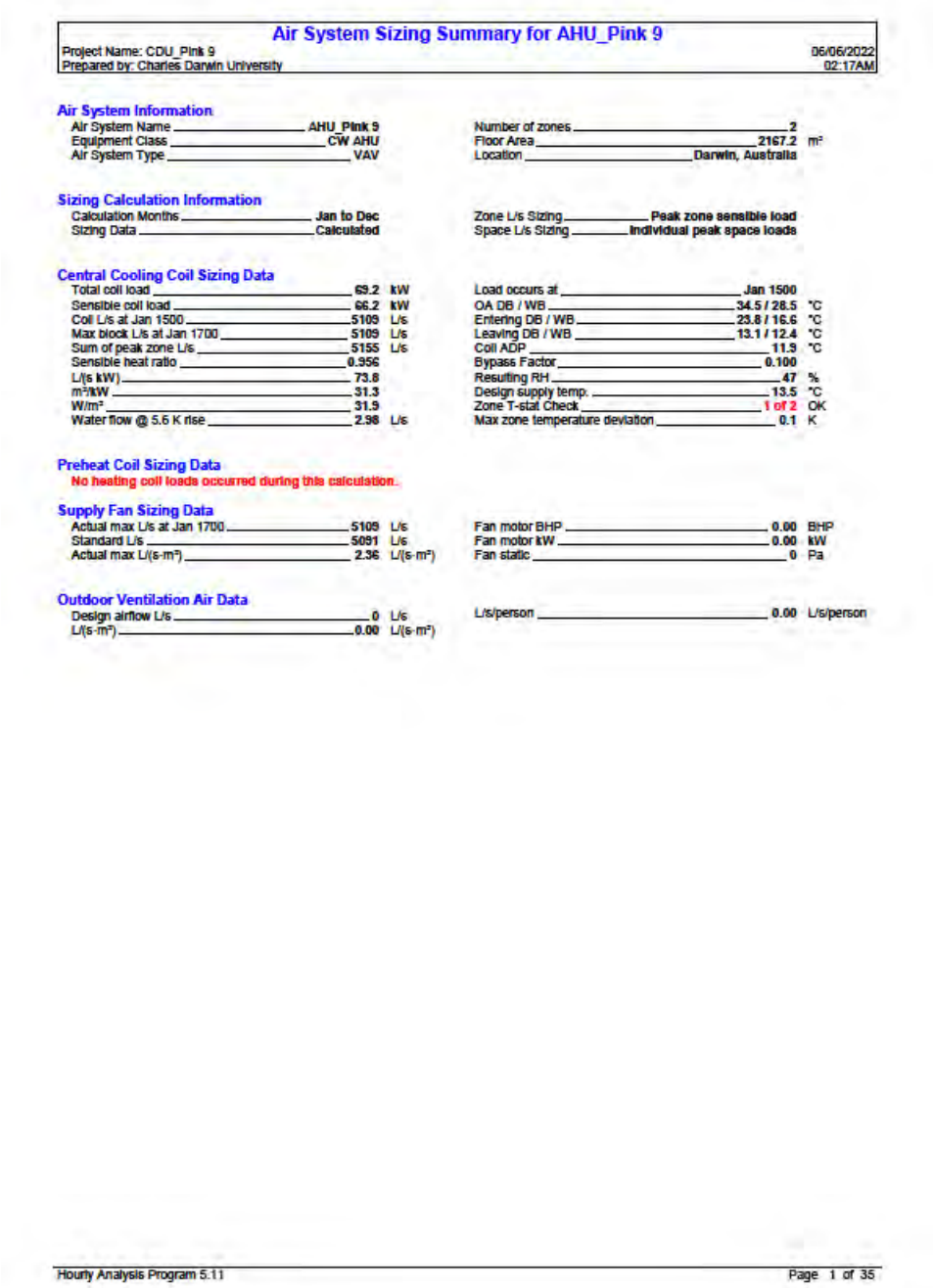
Appendix B2– System Summary Pink 9

pdf linked below -35-page appendix attached



Air System Sizing Summary for AHU_Pink 9

Project Name: CDU_Pink 9
Prepared by: Charles Darwin University

06/06/2022
02:17AM

Air System Information

Air System Name	AHU_Pink 9	Number of zones	2
Equipment Class	CW AHU	Floor Area	2167.2 m²
Air System Type	VAV	Location	Darwin, Australia

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone L/s Sizing	Peak zone sensible load
Sizing Data	Calculated	Space L/s Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	69.2	kW	Load occurs at	Jan 1500	
Sensible coil load	66.2	kW	OA DB / WB	34.5 / 28.5	°C
Coil L/s at Jan 1500	5109	L/s	Entering DB / WB	23.8 / 16.6	°C
Max block L/s at Jan 1700	5109	L/s	Leaving DB / WB	13.1 / 12.4	°C
Sum of peak zone L/s	5155	L/s	Coil ADP	11.9	°C
Sensible heat ratio	0.956		Bypass Factor	0.100	
L/(s kW)	73.8		Resulting RH	47	%
m³/kW	31.3		Design supply temp.	13.5	°C
W/m²	31.9		Zone T-stat Check	1 of 2	OK
Water flow @ 5.6 K rise	2.98	L/s	Max zone temperature deviation	0.1	K

Preheat Coil Sizing Data

No heating coil loads occurred during this calculation.

Supply Fan Sizing Data

Actual max L/s at Jan 1700	5109	L/s	Fan motor BHP	0.00	BHP
Standard L/s	5091	L/s	Fan motor kW	0.00	kW
Actual max L/(s·m²)	2.36	L/(s·m²)	Fan static	0	Pa

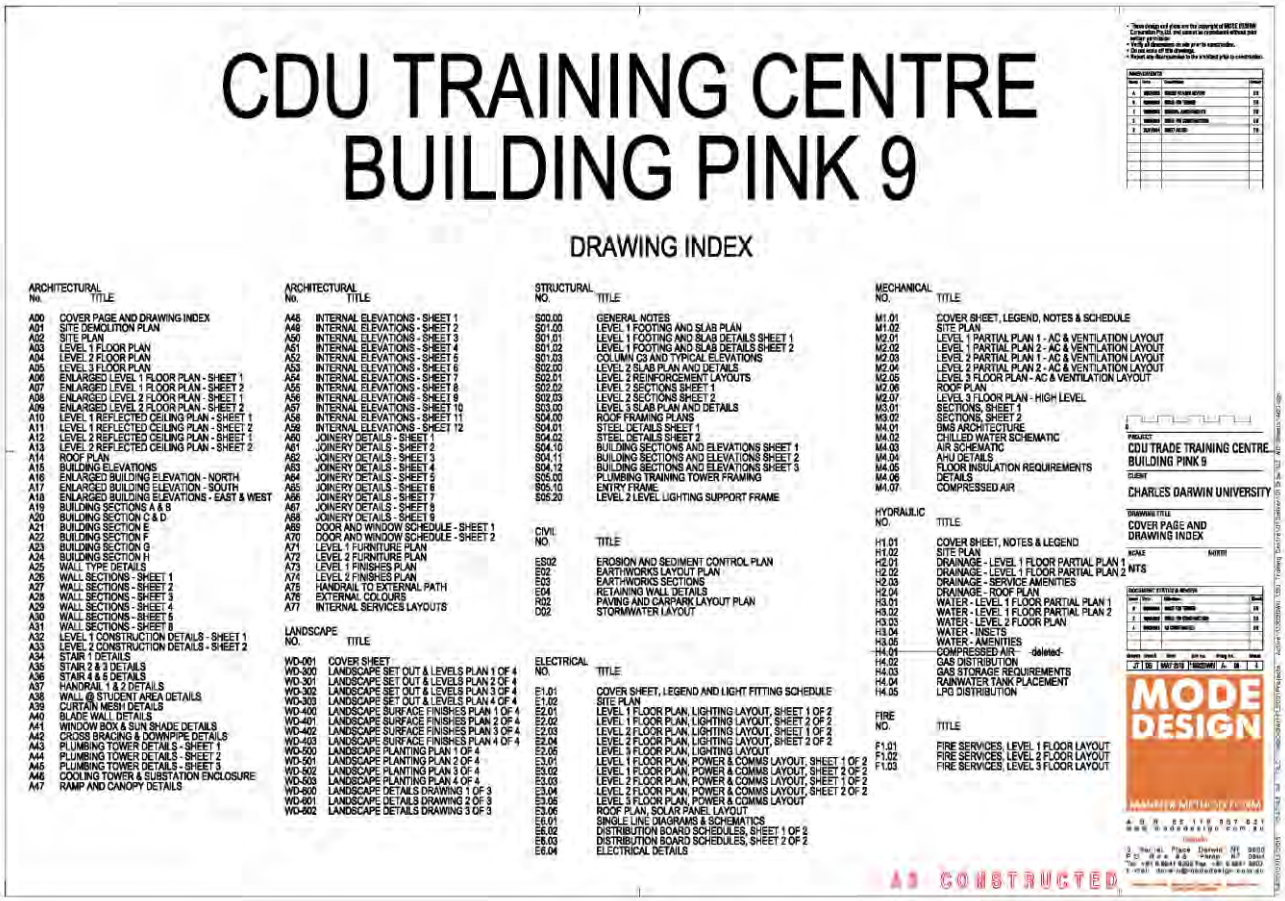
Outdoor Ventilation Air Data

Design airflow L/s	0	L/s	L/s/person	0.00	L/s/person
L/(s·m²)	0.00	L/(s·m²)			

Hourly Analysis Program 5.11 — Page 1 of 35

Appendix B3– Building layout and HAP markup Pink 9

pdf linked below -17-page appendix attached



CDU TRAINING CENTRE BUILDING PINK 9

DRAWING INDEX

ARCHITECTURAL

No.	TITLE
A00	COVER PAGE AND DRAWING INDEX
A01	SITE DEMOLITION PLAN
A02	SITE PLAN
A03	LEVEL 1 FLOOR PLAN
A04	LEVEL 2 FLOOR PLAN
A05	LEVEL 3 FLOOR PLAN
A06	ENLARGED LEVEL 1 FLOOR PLAN - SHEET 1
A07	ENLARGED LEVEL 1 FLOOR PLAN - SHEET 2
A08	ENLARGED LEVEL 2 FLOOR PLAN - SHEET 1
A09	ENLARGED LEVEL 2 FLOOR PLAN - SHEET 2
A10	LEVEL 1 REFLECTED CEILING PLAN - SHEET 1
A11	LEVEL 1 REFLECTED CEILING PLAN - SHEET 2
A12	LEVEL 2 REFLECTED CEILING PLAN - SHEET 1
A13	LEVEL 2 REFLECTED CEILING PLAN - SHEET 2
A14	ROOF PLAN
A15	BUILDING ELEVATIONS
A16	ENLARGED BUILDING ELEVATION - NORTH
A17	ENLARGED BUILDING ELEVATION - SOUTH
A18	ENLARGED BUILDING ELEVATIONS - EAST & WEST
A19	BUILDING SECTIONS A & B
A20	BUILDING SECTION C & D
A21	BUILDING SECTION E
A22	BUILDING SECTION F
A23	BUILDING SECTION G
A24	BUILDING SECTION H
A25	WALL TYPE DETAILS
A26	WALL SECTIONS - SHEET 1
A27	WALL SECTIONS - SHEET 2
A28	WALL SECTIONS - SHEET 3
A29	WALL SECTIONS - SHEET 4
A30	WALL SECTIONS - SHEET 5
A31	WALL SECTIONS - SHEET 6
A32	LEVEL 1 CONSTRUCTION DETAILS - SHEET 1
A33	LEVEL 2 CONSTRUCTION DETAILS - SHEET 2
A34	STAIR 1 DETAILS
A35	STAIR 2 & 3 DETAILS
A36	STAIR 4 & 5 DETAILS
A37	HANDRAIL 1 & 2 DETAILS
A38	WALL @ STUDENT AREA DETAILS
A39	CURTAIN MESH DETAILS
A40	BLADE WALL DETAILS
A41	WINDOW BOX & SUN SHADE DETAILS
A42	CROSS BRACING & DOWNPIPE DETAILS
A43	PLUMBING TOWER DETAILS - SHEET 1
A44	PLUMBING TOWER DETAILS - SHEET 2
A45	PLUMBING TOWER DETAILS - SHEET 3
A46	COOLING TOWER & SUBSTATION ENCLOSURE
A47	RAMP AND CANOPY DETAILS

ARCHITECTURAL

No.	TITLE
A48	INTERNAL ELEVATIONS - SHEET 1
A49	INTERNAL ELEVATIONS - SHEET 2
A50	INTERNAL ELEVATIONS - SHEET 3
A51	INTERNAL ELEVATIONS - SHEET 4
A52	INTERNAL ELEVATIONS - SHEET 5
A53	INTERNAL ELEVATIONS - SHEET 6
A54	INTERNAL ELEVATIONS - SHEET 7
A55	INTERNAL ELEVATIONS - SHEET 8
A56	INTERNAL ELEVATIONS - SHEET 9
A57	INTERNAL ELEVATIONS - SHEET 10
A58	INTERNAL ELEVATIONS - SHEET 11
A59	INTERNAL ELEVATIONS - SHEET 12
A60	JOINERY DETAILS - SHEET 1
A61	JOINERY DETAILS - SHEET 2
A62	JOINERY DETAILS - SHEET 3
A63	JOINERY DETAILS - SHEET 4
A64	JOINERY DETAILS - SHEET 5
A65	JOINERY DETAILS - SHEET 6
A66	JOINERY DETAILS - SHEET 7
A67	JOINERY DETAILS - SHEET 8
A68	JOINERY DETAILS - SHEET 9
A69	DOOR AND WINDOW SCHEDULE - SHEET 1
A70	DOOR AND WINDOW SCHEDULE - SHEET 2
A71	LEVEL 1 FURNITURE PLAN
A72	LEVEL 2 FURNITURE PLAN
A73	LEVEL 1 FINISHES PLAN
A74	LEVEL 2 FINISHES PLAN
A75	HANDRAIL TO EXTERNAL PATH
A76	EXTERNAL COLOURS
A77	INTERNAL SERVICES LAYOUTS

LANDSCAPE

No.	TITLE
WD-001	COVER SHEET
WD-300	LANDSCAPE SET OUT & LEVELS PLAN 1 OF 4
WD-301	LANDSCAPE SET OUT & LEVELS PLAN 2 OF 4
WD-302	LANDSCAPE SET OUT & LEVELS PLAN 3 OF 4
WD-303	LANDSCAPE SET OUT & LEVELS PLAN 4 OF 4
WD-400	LANDSCAPE SURFACE FINISHES PLAN 1 OF 4
WD-401	LANDSCAPE SURFACE FINISHES PLAN 2 OF 4
WD-402	LANDSCAPE SURFACE FINISHES PLAN 3 OF 4
WD-403	LANDSCAPE SURFACE FINISHES PLAN 4 OF 4
WD-500	LANDSCAPE PLANTING PLAN 1 OF 4
WD-501	LANDSCAPE PLANTING PLAN 2 OF 4
WD-502	LANDSCAPE PLANTING PLAN 3 OF 4
WD-503	LANDSCAPE PLANTING PLAN 4 OF 4
WD-600	LANDSCAPE DETAILS DRAWING 1 OF 3
WD-601	LANDSCAPE DETAILS DRAWING 2 OF 3
WD-602	LANDSCAPE DETAILS DRAWING 3 OF 3

STRUCTURAL

NO.	TITLE
S00.00	GENERAL NOTES
S01.00	LEVEL 1 FOOTING AND SLAB PLAN
S01.01	LEVEL 1 FOOTING AND SLAB DETAILS SHEET 1
S01.02	LEVEL 1 FOOTING AND SLAB DETAILS SHEET 2
S01.03	COLUMN C3 AND TYPICAL ELEVATIONS
S02.00	LEVEL 2 SLAB PLAN AND DETAILS
S02.01	LEVEL 2 REINFORCEMENT LAYOUTS
S02.02	LEVEL 2 SECTIONS SHEET 1
S02.03	LEVEL 2 SECTIONS SHEET 2
S03.00	LEVEL 3 SLAB PLAN AND DETAILS
S04.00	ROOF FRAMING PLANS
S04.01	STEEL DETAILS SHEET 1
S04.02	STEEL DETAILS SHEET 2
S04.10	BUILDING SECTIONS AND ELEVATIONS SHEET 1
S04.11	BUILDING SECTIONS AND ELEVATIONS SHEET 2
S04.12	BUILDING SECTIONS AND ELEVATIONS SHEET 3
S05.00	PLUMBING TRAINING TOWER FRAMING
S05.10	ENTRY FRAME
S05.20	LEVEL 2 LEVEL LIGHTING SUPPORT FRAME

CIVIL

NO.	TITLE
ES02	EROSION AND SEDIMENT CONTROL PLAN
E02	EARTHWORKS LAYOUT PLAN
E03	EARTHWORKS SECTIONS
E04	RETAINING WALL DETAILS
R02	PAVING AND CARPARK LAYOUT PLAN
C02	STORMWATER LAYOUT

ELECTRICAL

NO.	TITLE
E1.01	COVER SHEET, LEGEND AND LIGHT FITTING SCHEDULE
E1.02	SITE PLAN
E2.01	LEVEL 1 FLOOR PLAN, LIGHTING LAYOUT, SHEET 1 OF 2
E2.02	LEVEL 1 FLOOR PLAN, LIGHTING LAYOUT, SHEET 2 OF 2
E2.03	LEVEL 2 FLOOR PLAN, LIGHTING LAYOUT, SHEET 1 OF 2
E2.04	LEVEL 2 FLOOR PLAN, LIGHTING LAYOUT, SHEET 2 OF 2
E2.05	LEVEL 3 FLOOR PLAN, LIGHTING LAYOUT
E3.01	LEVEL 1 FLOOR PLAN, POWER & COMMS LAYOUT, SHEET 1 OF 2
E3.02	LEVEL 1 FLOOR PLAN, POWER & COMMS LAYOUT, SHEET 2 OF 2
E3.03	LEVEL 2 FLOOR PLAN, POWER & COMMS LAYOUT, SHEET 1 OF 2
E3.04	LEVEL 2 FLOOR PLAN, POWER & COMMS LAYOUT, SHEET 2 OF 2
E3.05	LEVEL 3 FLOOR PLAN, POWER & COMMS LAYOUT
E3.06	ROOF PLAN, SOLAR PANEL LAYOUT
E6.01	SINGLE LINE DIAGRAMS & SCHEMATICS
E6.02	DISTRIBUTION BOARD SCHEDULES, SHEET 1 OF 2
E6.03	DISTRIBUTION BOARD SCHEDULES, SHEET 2 OF 2
E6.04	ELECTRICAL DETAILS

MECHANICAL

NO.	TITLE
M1.01	COVER SHEET, LEGEND, NOTES & SCHEDULE
M1.02	SITE PLAN
M2.01	LEVEL 1 PARTIAL PLAN 1 - AC & VENTILATION LAYOUT
M2.02	LEVEL 1 PARTIAL PLAN 2 - AC & VENTILATION LAYOUT
M2.03	LEVEL 2 PARTIAL PLAN 1 - AC & VENTILATION LAYOUT
M2.04	LEVEL 2 PARTIAL PLAN 2 - AC & VENTILATION LAYOUT
M2.05	LEVEL 3 FLOOR PLAN - AC & VENTILATION LAYOUT
M2.06	ROOF PLAN
M2.07	LEVEL 3 FLOOR PLAN - HIGH LEVEL
M3.01	SECTIONS, SHEET 1
M3.02	SECTIONS, SHEET 2
M4.01	BMS ARCHITECTURE
M4.02	CHILLED WATER SCHEMATIC
M4.03	AIR SCHEMATIC
M4.04	AHU DETAILS
M4.05	FLOOR INSULATION REQUIREMENTS
M4.06	DETAILS
M4.07	COMPRESSED AIR

HYDRAULIC

NO.	TITLE
H1.01	COVER SHEET, NOTES & LEGEND
H1.02	SITE PLAN
H2.01	DRAINAGE - LEVEL 1 FLOOR PARTIAL PLAN 1
H2.02	DRAINAGE - LEVEL 1 FLOOR PARTIAL PLAN 2
H2.03	DRAINAGE - SERVICE AMENITIES
H2.04	DRAINAGE - ROOF PLAN
H3.01	WATER - LEVEL 1 FLOOR PARTIAL PLAN 1
H3.02	WATER - LEVEL 1 FLOOR PARTIAL PLAN 2
H3.03	WATER - LEVEL 2 FLOOR PLAN
H3.04	WATER - INSETS
H3.05	WATER - AMENITIES
H4.01	COMPRESSED AIR - deleted-
H4.02	GAS DISTRIBUTION
H4.03	GAS STORAGE REQUIREMENTS
H4.04	RAINWATER TANK PLACEMENT
H4.05	LPG DISTRIBUTION

FIRE

NO.	TITLE
F1.01	FIRE SERVICES, LEVEL 1 FLOOR LAYOUT
F1.02	FIRE SERVICES, LEVEL 2 FLOOR LAYOUT
F1.03	FIRE SERVICES, LEVEL 3 FLOOR LAYOUT

PROJECT
CDU TRADE TRAINING CENTRE BUILDING PINK 9

CLIENT
CHARLES DARWIN UNIVERSITY

DRAWING TITLE
COVER PAGE AND DRAWING INDEX

SCALE
NTS

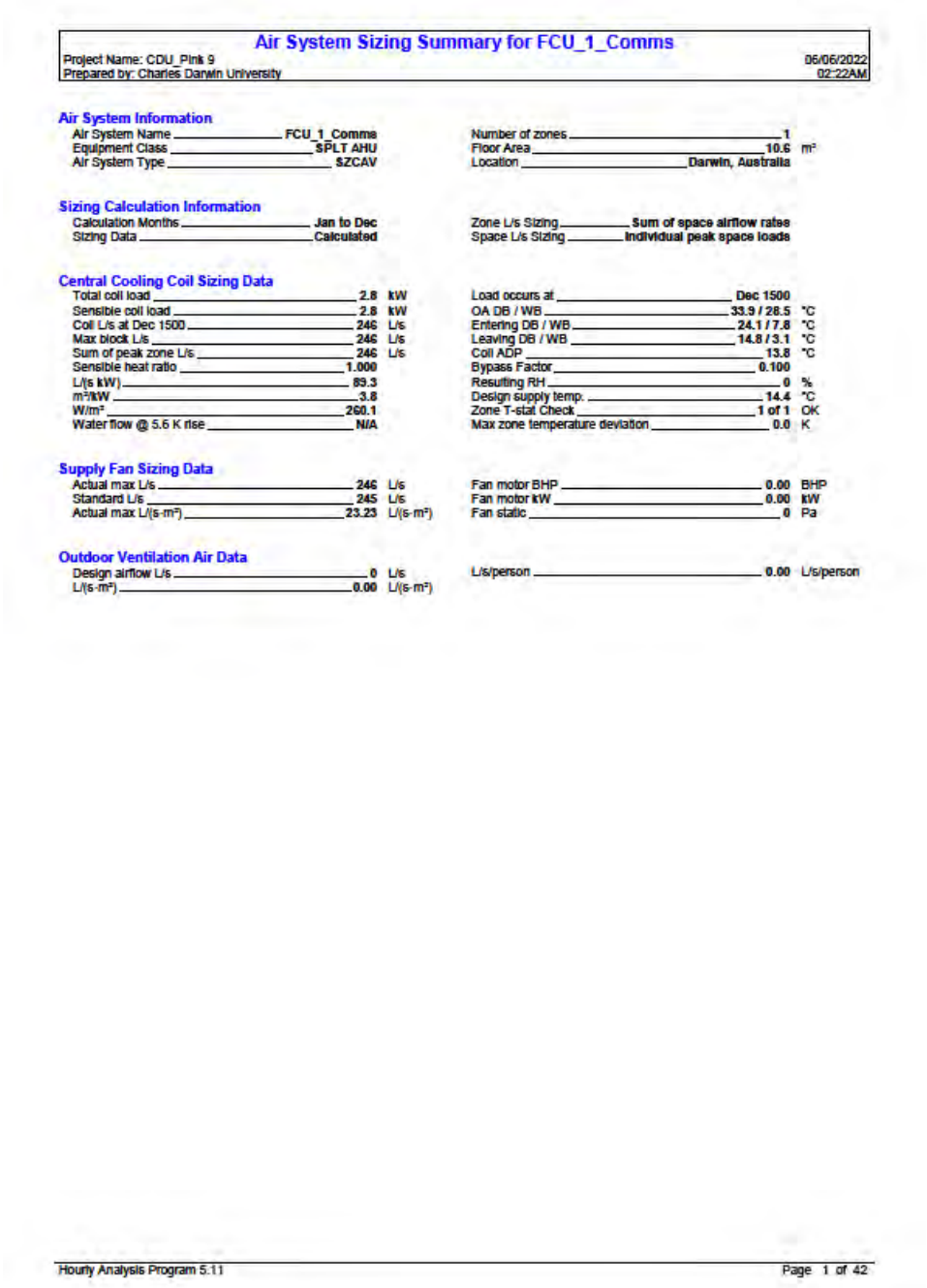
NORTH

MODE DESIGN

AS CONSTRUCTED

Appendix B4– System sizing summary Pink 9

pdf linked below -42-page appendix attached



Air System Sizing Summary for FCU_1_Comms

Project Name: CDU_Pink 9
Prepared by: Charles Darwin University

06/06/2022
02:22AM

Air System Information

Air System Name	FCU_1_Comms	Number of zones	1
Equipment Class	SPLT AHU	Floor Area	10.6 m²
Air System Type	SZCAV	Location	Darwin, Australia

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	2.8	kW	Load occurs at	Dec 1500
Sensible coil load	2.8	kW	OA DB / WB	33.9 / 28.5 °C
Coil L/s at Dec 1500	246	L/s	Entering DB / WB	24.1 / 7.8 °C
Max block L/s	246	L/s	Leaving DB / WB	14.8 / 3.1 °C
Sum of peak zone L/s	246	L/s	Coil ADP	13.8 °C
Sensible heat ratio	1.000		Bypass Factor	0.100
L/(s kW)	89.3		Resulting RH	0 %
m²/kW	3.8		Design supply temp.	14.4 °C
W/m²	260.1		Zone T-stat Check	1 of 1 OK
Water flow @ 5.6 K rise	N/A		Max zone temperature deviation	0.0 K

Supply Fan Sizing Data

Actual max L/s	246	L/s	Fan motor BHP	0.00 BHP
Standard L/s	245	L/s	Fan motor kW	0.00 kW
Actual max L/(s-m²)	23.23	L/(s-m²)	Fan static	0 Pa

Outdoor Ventilation Air Data

Design airflow L/s	0	L/s	L/s/person	0.00 L/s/person
L/(s-m²)	0.00	L/(s-m²)		

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Appendix B5– Results AHU Pink 9

pdf linked below -8-page appendix attached

Monthly Simulation Results for AHU_Pink 9

Project Name: CDU_Pink 9 — 06/06/2022 02:20AM
Prepared by: Charles Darwin University

Air System Simulation Results (Table 1) :

Month	Preheat Coil Load (kWh)	Central Cooling Coil Load (kWh)	Terminal Heating Coil Load (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	0	38726	0	0	8062	4910
February	0	34900	0	0	7282	4435
March	0	39111	0	0	8062	4910
April	0	36980	0	0	7802	4752
May	0	36364	0	0	8062	4910
June	0	31864	0	0	7802	4752
July	0	32082	0	0	8062	4910
August	0	35322	0	0	8062	4910
September	0	37148	0	0	7802	4752
October	0	40707	0	0	8062	4910
November	0	40020	0	0	7802	4752
December	0	39292	0	0	8062	4910
Total	0	442514	0	0	94923	57816

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Appendix B6– Results FCU Pink 9

pdf linked below -15-page appendix attached

Monthly Simulation Results for FCU_1_Comms

Project Name: CDU_Pink 9 — 06/06/2022 02:24AM
Prepared by: Charles Darwin University

Air System Simulation Results (Table 1) :

Month	Central Cooling Coil Load (kWh)	Central Cooling Eqpt Load (kWh)	Central Unit Clg Input (kWh)	Supply Fan (kWh)	Lighting (kWh)	Electric Equipment (kWh)
January	2426	2098	556	0	39	2232
February	2190	1897	501	0	36	2016
March	2434	2095	558	0	39	2232
April	2354	2027	540	0	38	2160
May	2400	2114	545	0	39	2232
June	2272	2060	507	0	38	2160
July	2338	2132	521	0	39	2232
August	2373	2127	533	0	39	2232
September	2342	2037	533	0	38	2160
October	2455	2084	565	0	39	2232
November	2384	2012	550	0	38	2160
December	2437	2093	559	0	39	2232
Total	28405	24775	6469	0	464	26280

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