

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	1 OF 08	
	P055AZOR-3476-C-004	REV.: 0	

HVAC

34 SAT UNIT OPERATOR SHELTER 34-B-01

CALCULATION REPORT

REVISION CONTROL PAGE

MAIN DOCUMENT

<u>REV.</u>	<u>DATE</u>	<u>DESCRIPTION</u>	<u>COMMENTS</u>
O	23-Mar-2016	Issued For Approval	

ATTACHMENTS

<u>DOCUMENT CODE</u>	<u>DESCRIPTION</u>	<u>REV.</u>
NA		

TEMPLATES

<u>DOCUMENT CODE</u>	<u>DESCRIPTION</u>	<u>REV.</u>
NA		

PREPARED:	REVIEWED:	APPROVED:
N.Y.Kim	L.C.Choi	P.M.Ko

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	2 OF 08	
	P055AZOR-3476-C-004	REV.: 0	

TABLE OF CONTENTS

1. GENERAL NOTE	3
1.1 SCOPE	3
1.2 REFERENCE DOCUMENTS	3
1.2.1 Applicable Codes	3
1.2.2 Local Regulations	4
1.2.3 Project and Engineering Practice (DEP)	4
1.2.4 NRP Project Specifications	5
1.2.5 Project Variations	5
1.2.6 Reference Documents and Drawing	6
2. GENERAL COOLING AND HEATING CALCULATION	6
2.1 INTRODUCTION	6
2.2 OUTDOOR DESIGN CONDITIONS	6
2.3 INDOOR DESIGN CONDITIONS	7
2.4 BUILDING TRANSMISSION COEFFICIENT	7
3. CALCULATION MODEL	8
4. THERMAL LOAD CALCULATION HAP SOFTWARE OUTPUT REPORTS	8
5. ADDENDUM 1 HAP REPORTS	8

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	3 OF 08	
	P055AZOR-3476-C-004	REV.: 0	

1. GENERAL NOTE

1.1 SCOPE

The scope of this calculation is the heating and cooling load evaluation, for HVAC system of the building "OPERATOR SHELTER 34-B-01" of the Kuwait National Petroleum Company's New Refinery Project (KNPC-NRP) located at the Al-Zour site in Kuwait. Transmission Load Analysis is made with HAP-version 4.61 software by CARRIER.

1.2 REFERENCE DOCUMENTS

Design of HVAC system shall be in accordance and referenced to the documents listed below.

1.2.1 Applicable Codes

ASHRAE STD 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE STD 52	Method of Testing General Ventilation Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE STD 52.2	Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE STD 55	Thermal Environmental Conditions for Human Occupancy
ASHRAE HANDBOOK	Fundamentals Handbook Fundamentals, Chapter 26 (Cooling Load) Handbook Fundamentals, Chapter 25 (Heating Load)
ASHRAE HANDBOOK	HVAC Applications
ASHRAE HANDBOOK	Systems and Equipment
EN 13779	Ventilation for non-residential buildings – Performance requirements ventilation and room-conditioning systems
EN 15241	Ventilation for buildings – Calculation methods for energy losses due to ventilation and infiltration in commercial buildings
EN-ISO 13789	Thermal Performance of Buildings – Transmission and ventilation heat transfer coefficients –Calculation method

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	4 OF 08	
	P055AZOR-3476-C-004	REV.: 0	

EN 15242	Ventilation for buildings – Calculation methods for the determination of air flow rates in buildings including infiltration
EN 15243	Ventilation for buildings – Calculation of room temperatures and of load and energy for buildings with room conditioning systems
EN 15255	Energy Performance of Buildings – Sensible room cooling load calculation– General criteria and validation procedures
EN 12831	Heating systems in buildings. Method for calculation of the design heat load

1.2.2 Local Regulations

MEW/R-6/2014	Kuwait Ministry of Electricity & Water Energy Conversation Program
MEW/R-7	Kuwait Ministry of Electricity & Water Energy Rules and Regulations for the design of air-conditioning systems under Kuwait

1.2.3 Project and Engineering Practice (DEP)

DEP 31.76.10.11-Gen	Installation, Testing and Balancing, and Commissioning of HVAC Systems
DEP 00.00.20.10-Gen	The Use of SI Quantities and Units
DEP 31.10.00.31-Gen	Noise Control (amendments/supplements to ISO 15664)
DEP 34.17.00.32-Gen	Design and Engineering of Buildings
DEP 32.30.20.11-Gen	Fire, Gas and Smoke Detection Systems

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	5 OF 08	
	P055AZOR-3476-C-004	REV.: 0	

1.2.4 NRP Project Specifications

P4049N.0000.BA30.DCN.0747	Basic Engineering Design Data (BEDD)
P4049NRP.00.10.76.001	HVAC Design Criteria
P4001NRP.00.10.76.002	HVAC Installation Specification
P4001NRP.00.10.76.004	HVAC Central Station Air Handling Units
P4049NRP.00.10.76.005	HVAC Fan Coil Units
P4001NRP.00.10.76.006	HVAC Air Cooled Condensing Units
P4001NRP.00.10.76.008	HVAC Fans
P4001NRP.00.10.76.009	HVAC Chemical Filter Units
P4001NRP.00.10.76.010	HVAC Control Systems
P4001NRP.00.10.76.011	HVAC Equipment Numbering
P4001NRP.00.10.76.012	HVAC Instrumentation and Control Component Numbering
P4049NRP.00.10.17.030	Building Design Description: Operator Shelter Buildings

1.2.5 Project Variations

02.00.00.10-P4049NRP-00-PV	Preparation and Microfilming of Technical Documents
30.48.00.31-P4049NRP-00-PV	Painting and Coating of New Equipment
31.76.10.10-P4049NRP-00-PV	Heating, ventilation and air conditioning for Plant Buildings
32.30.20.11-P4049NRP-00-PV	Fire, gas and smoke detection systems
33.64.10.10-P4049NRP-00-PV	Electrical Engineering Guidelines

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	6 OF 08	
	P055AZOR-3476-C-004	REV.: O	

33.66.05.31-P4049NRP-00-PV	Electric Machines – Cage Induction Types
34.17.00.32-P4049NRP-00-PV	Design and Engineering of Buildings
80.00.10.10-P4049NRP-00-PV	Area Classification (Amendment/Supplements to IP15)

1.2.6 Reference Documents and Drawing

P055AZOR-00.10.76.001	HVAC DESIGN SPECIFICATION
P055AZOR-34-76-2-H004-M001	HVAC 34 SAT UNIT OPERATOR SHELTER 34-SS-01 FLOW & SIGNAL DIAGRAM
P055AZOR-34-76-2-H004-M002	HVAC 34 SAT UNIT OPERATOR SHELTER 34-SS-01 EQUIPMENT AND DUCT DISTRIBUTION LAYOUT

2. GENERAL COOLING AND HEATING CALCULATION

2.1 INTRODUCTION

Thermal calculation load and main equipment sizing have been carried out on the basis of the design condition, as per KNPC specification. P4049NRP.00.10.76.001 HVAC Design Criteria.

2.2 OUTDOOR DESIGN CONDITIONS

The following ambient condition shall be used when computing the heating and cooling load requirements of HVAC system.

<u>Seasons</u>	<u>Summer</u>	<u>Winter</u>
Dry Bulb Temperature (°C)	47.4 °C	4.5 °C
Wet Bulb Temperature (°C)	31.8 °C	2 °C
Daily Range (°C)	13.3 °C	13.3 °C

Air Condensing Unit (CU) will be installed outdoor over concrete pads.
Materials shall be suitable for industrial ambient with slight corrosive atmosphere and dust presence and shall comply with all the requirements of project documentation.

 شركة البترول الوطنية الكويتية Kuwait National Petroleum Corporation	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	7 OF 08	
	P055AZOR-3476-C-004	REV.: O	

2.3 INDOOR DESIGN CONDITIONS

Indoor requirements and heat dissipation to be considered in each area are summarize in next table, as indicated in reference document Building HVAC Condition Parameters.

OPERATOR SHELTER

Room	Normal DB Temp.		Normal RH		Over-Pressure (Pa)	Max Noise level HVAC dB(A)	Dissipated Load [W/(m ² floor)] (Note5)	Number of Persons	Remarks
	Winter (°C)	Summer (°C)	Min. (%)	Max. (%)					
Operator Room	> 20	< 24	35	75	25	25-35	30	1@10m2	

Note 5: The "Dissipated Load" from above tables will be used, if the heat dissipation will be not obtained by electrical department or instrumentation department. The real value will be used in HAP program for calculation.

2.4 BUILDING TRANSMISSION COEFFICIENT

The overall heat transmission coefficients for buildings requiring heating, air conditioning or ventilation shall comply with DEP 34.17.00.32-Gen, point 4.5. The different U values for this building shall be:

External Wall	
Outside Surface Color	Medium
Absorptivity	0.675
Overall U-Value W/(m ² .°K)	0.875

Roof	
Outside Surface Color	Medium
Absorptivity	0.675
Overall U-Value W/(m ² .°K)	0.384

	Al-Zour Refinery Project (Contract No.: ZOR/EPC-0055-A - Main Process Units)		
	HVAC 34 SAT UNIT OPERATOR SHELTER 34-B-01 CALCULATION REPORT	8 OF 08	
	P055AZOR-3476-C-004	REV.: 0	

3. CALCULATION MODEL

Cooling and heating loads and equipment sizing calculation of this building is performed using Carrier's Hourly Analysis Program (HAP), version 4.61.

HAP uses the ASHRAE-endorsed transfer function method for cooling and heating loads calculation. Refer to ASHRAE Fundamentals Handbook.

Fresh air quantities are established in accordance with minimum requirements/recommend for acceptable indoor air quality for occupants, ventilation and also to provide space overpressure. Calculation is performed using ASHRAE Leakage Function through effective air leakage areas of external walls and doors of each considered room (refer to ASHRAE Fundamentals Handbook).

4. THERMAL LOAD CALCULATION HAP SOFTWARE OUTPUT REPORTS

Find attached *Addendum 1 "HAP Reports"* with the results obtained from HAP Software.

5. ADDENDUM 1 HAP REPORTS

In this addendum are included next reports from HAP:

- Design Weather Parameters & MSHGs
- Space Input Data
- Air System Sizing Summary
- Zone Sizing Summary
- Ventilation Sizing Summary
- Space Design Load Summary
- Psychometric Chart and data tables

Design Weather Parameters & MSHGs

0226-UNIT 34 OPERATION SHELTER
HEC

03-15-2016
06:11

Design Parameters:

City Name..... **Al-Zour**
 Location..... **Kuwait**
 Latitude..... **29.2** Deg.
 Longitude..... **-48.0** Deg.
 Elevation..... **9.62** m
 Summer Design Dry-Bulb..... **47.4** °C
 Summer Coincident Wet-Bulb..... **31.8** °C
 Summer Daily Range..... **13.3** °K
 Winter Design Dry-Bulb..... **4.5** °C
 Winter Design Wet-Bulb..... **2.0** °C
 Atmospheric Clearness Number..... **1.00**
 Average Ground Reflectance..... **0.33**
 Soil Conductivity..... **0.800** W/(m·°K)
 Local Time Zone (GMT +/- N hours)..... **-3.0** hours
 Consider Daylight Savings Time..... **No**
 Simulation Weather Data..... **noneN/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	114.4	114.4	114.4	370.9	602.5	739.9	825.7	817.6	790.4
February	132.6	132.6	245.1	490.7	695.8	795.3	808.8	751.7	705.3
March	150.6	150.6	395.9	601.1	738.1	790.2	725.4	623.0	558.7
April	165.6	261.4	508.4	671.2	735.8	711.3	606.9	451.7	367.4
May	177.9	364.1	573.6	696.4	719.1	641.1	504.4	321.9	248.0
June	183.0	404.9	594.9	697.4	699.9	610.1	456.4	272.0	214.2
July	180.1	371.7	569.7	682.4	696.9	632.6	489.5	310.6	241.2
August	169.5	265.9	498.1	647.6	703.3	690.1	583.6	434.6	354.7
September	153.3	153.3	371.2	579.3	698.2	752.9	705.7	608.4	549.4
October	135.4	135.4	234.6	484.8	649.5	771.5	779.2	728.6	692.1
November	116.3	116.3	118.6	355.7	588.2	745.7	805.2	798.0	785.7
December	106.9	106.9	106.9	307.7	558.6	714.4	816.1	826.7	813.9
Month	SSW	SW	WSW	W	WNW	NW	NNW	HOR	Mult
January	817.7	825.7	741.7	601.7	372.3	114.4	114.4	592.3	1.00
February	750.5	807.0	798.1	694.2	485.0	247.9	132.6	714.3	1.00
March	626.3	730.7	789.9	744.9	590.3	393.7	150.6	817.1	1.00
April	450.9	603.1	717.3	740.1	655.5	504.2	276.9	867.9	1.00
May	320.5	496.9	651.6	717.1	680.8	570.8	378.8	879.2	1.00
June	271.1	450.4	617.9	696.0	686.6	593.3	413.9	873.8	1.00
July	308.9	485.1	636.2	697.3	674.7	567.8	377.1	864.2	1.00
August	434.6	581.4	692.4	715.1	635.7	491.7	276.0	848.3	1.00
September	611.4	709.7	743.8	714.0	578.7	351.4	153.3	795.4	1.00
October	729.9	781.5	769.4	655.3	486.7	230.8	135.4	707.8	1.00
November	801.8	800.5	746.2	579.2	367.9	116.3	116.3	595.9	1.00
December	826.7	809.0	727.0	534.5	323.3	106.9	106.9	543.6	1.00

Mult. = User-defined solar multiplier factor.

Space Input Data

0226-UNIT 34 OPERATION SHELTER
HEC

03-15-2016
06:11

OPERATION SHELTER

1. General Details:

Floor Area **8.2** m²
Avg. Ceiling Height..... **2.7** m
Building Weight **341.8** kg/m²

1.1. OA Ventilation Requirements:

Space Usage..... **User-Defined**
OA Requirement 1 **43.0** L/s
OA Requirement 2 **0.0** L/s
Space Usage Defaults **ASHRAE Std 62.1-2007**

2. Internals:

2.1. Overhead Lighting:

Fixture Type **Recessed (Unvented)**
Wattage **15.00** W/m²
Ballast Multiplier **1.00**
Schedule **OPERATOR SHELTER**

2.2. Task Lighting:

Wattage **0.00** W/m²
Schedule **None**

2.3. Electrical Equipment:

Wattage **30.00** W/m²
Schedule **OPERATOR SHELTER**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m ²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	14.0	0	0	1
E	10.5	0	0	0
S	14.0	0	0	0
W	10.5	1	0	0

3.1. Construction Types for Exposure N

Wall Type **W-1(OPERATOR SHELTER)**
Door Type **D-1(OPERATOR SHELTER)**

3.2. Construction Types for Exposure E

Wall Type **W-1(OPERATOR SHELTER)**

3.3. Construction Types for Exposure S

Wall Type **W-1(OPERATOR SHELTER)**

3.4. Construction Types for Exposure W

Wall Type **W-1(OPERATOR SHELTER)**
1st Window Type..... **W-1(OPERATOR SHELTER)**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m ²)	Roof Slope (deg.)	Skylight Qty.
H	8.2	0	0

4.1. Construction Types for Exposure H

Roof Type..... **R-1(OPERATOR SHELTER)**

5. Infiltration:

Design Cooling..... **0.00** L/s
Design Heating..... **0.00** L/s
Energy Analysis **0.00** L/s
Infiltration occurs only when the fan is off.

6. Floors:

Type **Slab Floor On Grade**
Floor Area **8.2** m²
Total Floor U-Value **0.580** W/(m²-°K)
Exposed Perimeter..... **0.0** m
Edge Insulation R-Value **0.00** (m²-°K)/W

7. Partitions:

(No partition data).

2.4. People:

Occupancy **1.0** Person
Activity Level **Office Work**
Sensible..... **71.8** W/person
Latent **60.1** W/person
Schedule **OPERATOR SHELTER**

2.5. Miscellaneous Loads:

Sensible..... **0** W
Schedule **None**
Latent **0** W
Schedule **None**

Air System Sizing Summary for OS1(34-B-01)REVO

Project Name: 0226-UNIT 34 OPERATION SHELTER
Prepared by: HEC

03-21-2016
10:15

Air System Information

Air System Name **OS1(34-B-01)REVO**
Equipment Class **TERM**
Air System Type **PKG-FC**

Number of zones **1**
Floor Area **8.2** m²
Location **Al-Zour**

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**

Ventilation Fan Sizing Data

Actual max L/s **43** L/s
Standard L/s **43** L/s
Actual max L/(s-m²) **5.24** L/(s-m²)

Fan motor BHP **0.04** BHP
Fan motor kW **0.03** kW
Fan static **800** Pa

Outdoor Ventilation Air Data

Design airflow L/s **43** L/s
L/(s-m²) **5.24** L/(s-m²)

L/s/person **43.00** L/s/person

Zone Sizing Summary for OS1(34-B-01)REVO

Project Name: 0226-UNIT 34 OPERATION SHELTER
Prepared by: HEC

03-21-2016
10:15

Air System Information

Air System Name OS1(34-B-01)REVO
Equipment Class TERM
Air System Type PKG-FC

Number of zones 1
Floor Area 8.2 m²
Location Al-Zour

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 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)
Zone 1	2.1	185	185	Jul 1700	0.9	8.2	22.56

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
Zone 1	5.3	3.5	31.2 / 22.4	15.4 / 14.7	-	Aug 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)
Zone 1	1.4	17.4 / 23.6	-	185	0.311	0.247	43

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m ²)	Space L/(s-m ²)
Zone 1							
OPERATION SHELTER	1	2.1	Jul 1700	185	0.9	8.2	22.56

Ventilation Sizing Summary for OS1(34-B-01)REVO

Project Name: 0226-UNIT 34 OPERATION SHELTER

Prepared by: HEC

03-21-2016

10:15

1. Summary

Ventilation Sizing Method..... Sum of Space OA Airflows

Design Ventilation Airflow Rate 43 L/s

2. Space Ventilation Analysis Table

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)
Zone 1									
OPERATION SHELTER	1	8.2	1.0	185.0	0.00	0.00	43.0	0.0	43.0
Totals (incl. Space Multipliers)				185.0					43.0

Space Design Load Summary for OS1(34-B-01)REVO

Project Name: 0226-UNIT 34 OPERATION SHELTER
Prepared by: HEC

03-21-2016
10:15

TABLE 1.1.A. COMPONENT LOADS FOR SPACE " OPERATION SHELTER " IN ZONE " Zone 1 "						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1700			HEATING DATA AT DES HTG		
	COOLING OA DB / WB 46.1 °C / 31.5 °C			HEATING OA DB / WB 4.5 °C / 2.0 °C		
	OCCUPIED T-STAT 24.0 °C			OCCUPIED T-STAT 20.0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	Details	(W)	(W)	Details	(W)	(W)
Window & Skylight Solar Loads	1 m²	256	-	1 m²	-	-
Wall Transmission	46 m²	953	-	46 m²	621	-
Roof Transmission	8 m²	78	-	8 m²	49	-
Window Transmission	1 m²	129	-	1 m²	98	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	2 m²	81	-	2 m²	61	-
Floor Transmission	8 m²	0	-	8 m²	0	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	123 W	123	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	246 W	246	-	0	0	-
People	1	72	60	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 10%	194	6	10%	83	0
>> Total Zone Loads	-	2132	66	-	912	0

TABLE 1.1.B. ENVELOPE LOADS FOR SPACE " OPERATION SHELTER " 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	12	0.875	-	222	-	160
DOOR	2	1.800	-	81	-	61
E EXPOSURE						
WALL	11	0.875	-	245	-	142
S EXPOSURE						
WALL	14	0.875	-	272	-	190
W EXPOSURE						
WALL	10	0.875	-	214	-	129
WINDOW 1	1	6.310	0.867	129	256	98
H EXPOSURE						
ROOF	8	0.384	-	78	-	49

August DESIGN COOLING DAY, 1600

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	47.0	0.02357	43	400	1154	1685
Vent - Return Mixing	Outlet	-17.8	0.00000	0	0	-	-
Ventilation Fan	Outlet	47.7	0.02357	43	400	34	-
Cold Supply Duct	Outlet	47.7	0.02357	43	400	0	-
Zone Air	-	24.7	0.01026	43	532	2073	66
Return Plenum	Outlet	24.7	0.01026	43	532	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.206 W/(L/s-K)

Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2944.2 W/(L/s)

Site Altitude = 9.6 m

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)
Zone 1 (Cooling)							
Ventilation Air	-	-	-	43	-	-	-
Cooling Coil Inlet	-	31.2	0.01336	185	0	-	-
Cooling Coil Outlet	-	15.4	0.01014	185	0	3508	1751
Heating Coil Inlet	-	15.4	0.01014	185	0	-	-
Heating Coil Outlet	-	15.4	0.01014	185	0	0	-
Zone Air	-	24.7	0.01026	185	532	2073	-

System Psychrometrics for OS1(34-B-01)REVO

Project Name: 0226-UNIT 34 OPERATION SHELTER
Prepared by: HEC

03-21-2016
10:15

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	4.5	0.00335	43	400	-786	0
Vent - Return Mixing	Outlet	-17.8	0.00000	0	0	-	-
Ventilation Fan	Outlet	5.2	0.00335	43	400	34	-
Cold Supply Duct	Outlet	5.2	0.00335	43	400	0	-
Zone Air	-	19.7	0.00335	43	400	-878	0
Return Plenum	Outlet	19.7	0.00335	43	400	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.206 W/(L/s-K)

Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2944.2 W/(L/s)

Site Altitude = 9.6 m

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)
Zone 1 (Heating)							
Ventilation Air	-	-	-	43	-	-	-
Cooling Coil Inlet	-	17.4	0.00336	185	0	-	-
Cooling Coil Outlet	-	17.4	0.00336	185	0	0	0
Heating Coil Inlet	-	17.4	0.00336	185	0	-	-
Heating Coil Outlet	-	23.6	0.00336	185	0	1383	-
Zone Air	-	19.7	0.00335	185	400	-878	-