AR-6. Structural Calculation Sheets for Outdoor Equipment Foundations

CONTENTS

		Page
6-1	GENERAL	1
6-2	FLUE GAS DUCT SUPPORT	4
6-3	TURBINE OIL STRAGE TANK	7
6-4	FUEL OIL SERVICE TANK	9

6.1.1 APPLICABLE CODES AND STANDARDS

1) For design and allowable stress of structural materials

Reinforced concrete structure

AIJ : "Standards for calculation of reinforced concrete structures"

Foundation

AIJ : "Standards for structural design of building foundation"

* AIJ : Architectural Institute of Japan

6.1.2 STRUCTURAL MATERIALS TO BE USED AND ALLOWABLE UNIT STRESS

1) Qualities of materials

Concrete ; Comperessive strength of 28 days

$Fc' = 210\ kg/cm^2$

Reinforcement ; Deformed reinforcement

ASTM A615 Grade 40

$fy = 2,812\ kg/cm^2$

2) Physical constants for structural materials

Modulus of elasticity

Concrete	$210\ t/cm^2$
Reinforcement	$2100\ t/cm^2$

3) ALLOWABLE UNIT STRESS

i) Allowable Unit Stress of Concrete (kg/cm^2)

Materials \ stresses		Permanent Stresses					Temporary Stresses		
		Compress	Shear	Bond			Compress	shear	Bond
				A	B	C			
Normal concrete Fc-210	Plain bar	70	7.0	8.4	12.6	8.4	Permanent Stresses x 2.0	Permanent Stresses x 1.5	
	Deformed bar			14.0	21.0	14.0			

* Remarks A ; Top bar of flexural members

B : Bar, except "Item A", of flexural members

C : Anchors and lap splices

ii) Allowable Unit Stress of Reinforcing Bars (kg/cm^2)

Stresses / Materials	Permanent Stresses		Temporary Stresses	
	Tension Compression	Shear Reinforcement	Tension Compression	shear Reinforcement
Deformed bar ASTM A615 Grade 40	1,870	1,870	2,812	2,812

944

6.1.3 LOAD COMBINATION

1) Load combination for steel and concrete structure

Long term loading

i) D.L+L.L+M.L+C.L

Short term loading

i) D.L+L.L+M.L+C.D+W.L

ii) D.L+L.L+M.L+C.D+S.L

where;

D.L ; Dead load

L.L ; Live load and over burden load

M.L ; Machine load

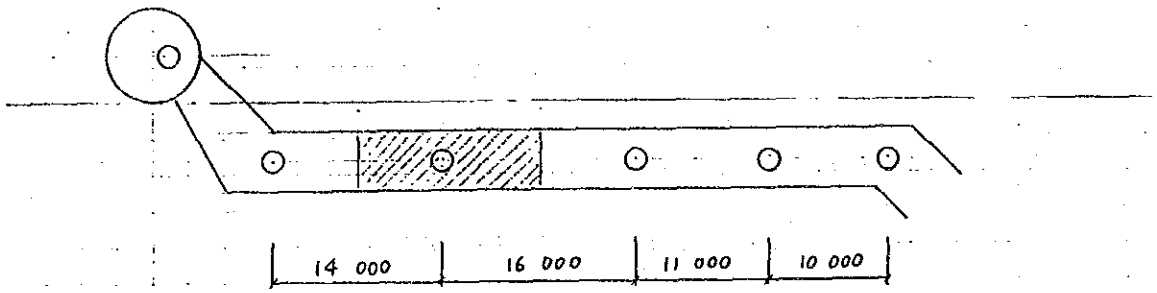
C.L ; Crane operation load

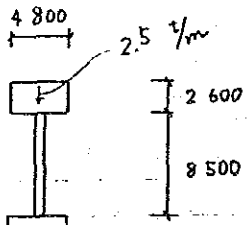
C.D.L ; Crane dead load

W.L ; Wind load

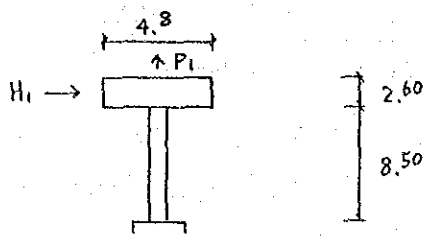
S.L ; Seismic load

§1. GENERAL DRAWING





§2. LOADING DATA



SEISMIC FORCE

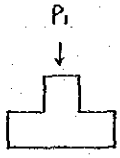
$H_1 = 0.1 \times 2.5 \times 15.0 = 3.75$ t

WIND FORCE

$H_1 = 0.15 \times (0.8+0.4) \times 15.0 \times 2.6 = 7.02$ t

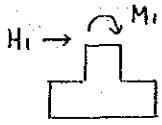
$P_1 = 0.15 \times 0.7 \times 15.0 \times 4.8 = 7.56$ t

D.L



$P_1 = 2.50 \times 15.0 = 37.5$ t

E.L

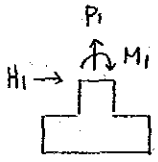


$H_1 = 3.75$ t

$M_1 = 3.75 \times (8.50 + 2.60/2) = 36.75$ t-m

9.80

W.L



$H_1 = 7.02$ t

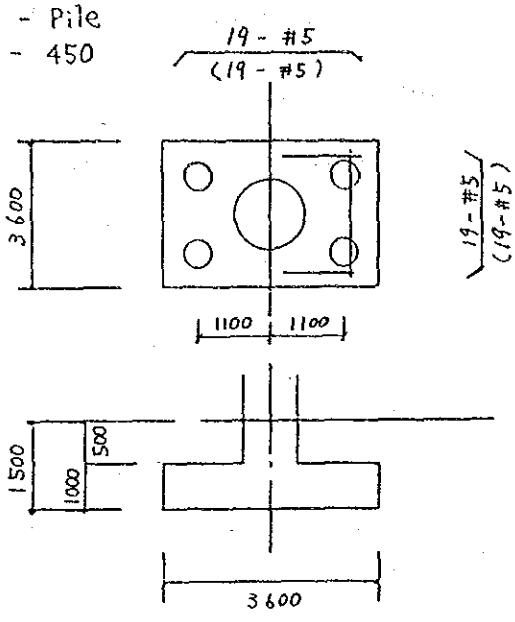
$P_1 = 7.56$ t

$M_1 = 7.02 \times 9.80 = 68.80$ t-m

§3. DESIGN OF FOUNDATION

OUTLINE OF FOUNDATION

RC - Pile
4 - 450



Foundation weight

$$Nf = 2.4 \times (3.6 \times 3.6 \times 1.0 + 1.0 \times 1.0 \times \pi \times 0.7) + 1.8 \times (3.6 \times 3.6 - 1.0 \times 1.0 \times \pi) \times 0.5 = 45.22\ t$$

LOADING

	N (t)	Hx (t)	Hy (t)
D.L	37.50		
L.L			
S.Lx	0	3.75	
S.Ly	0		3.75
W.Lx	-7.56	7.02	
W.Ly			

Stress at bottom of foundation

$$N = 37.50 - 7.56 + 45.22 = 75.16\ t$$

$$M = 68.80 + 7.02 \times 1.70 = 80.73\ t\cdot m$$

CHECK OF BEARING PRESSURE

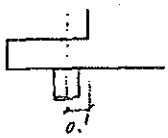
Check of Pile Reaction

$$P_1 = 75.16/4 + 80.73/(2.2 \times 2) = 37.14\ t/Pile < 35.0 \times 1.5$$

$$P_1' = 29.94/4 + 80.73/(2.2 \times 2) = 25.83\ t/Pile$$

DESIGN OF FOOTING

Load case	Factored Load ΣN (t)	Factored Load ΣM (t,m)	Pile Reaction P1 (t/n)	Pile Reaction P1' (t/n)
D.L + L.L	37.50			
D.L + L.L + W.L				
D.L + L.L + S.L				
D.L + W.L	29.94	80.73	37.14	25.83



Stress

$$Q_F = 25.83\ t$$

$$M_F = 25.83 \times 0.1 = 2.58\ t\cdot m$$

Reinforcement

D = 100 cm, d = 85 cm, j = 7/8d = 74.38 cm

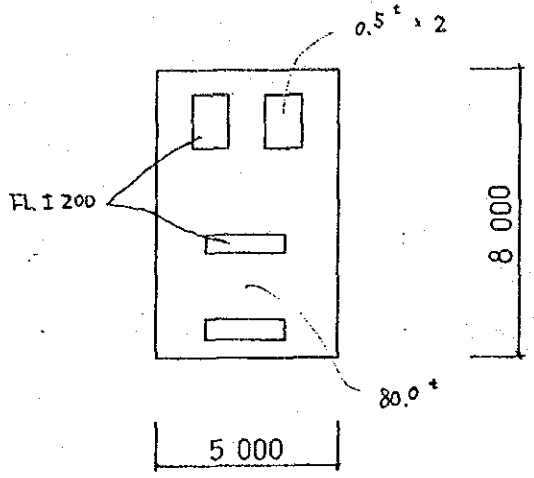
$$\text{nec } At = \frac{M_F}{f_t \cdot j} = 1.23\ cm^2$$

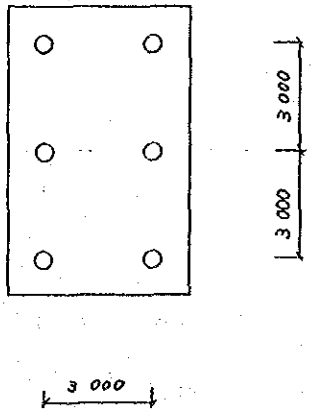
$$\phi = \frac{Q}{f_a \cdot j} = 11.02\ cm$$

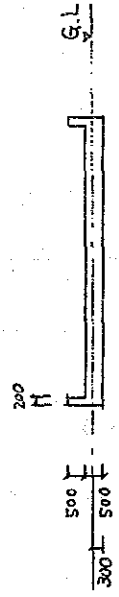
19 - #5 ($a_t = 38.0\ cm^2$, $\phi = 95.0\ cm$)

$$\tau = \frac{Q}{b \cdot j} = 0.96 < 7.0\ kg/cm^2$$

§1 FOUNDATION PLAN AND SECTION







2-1. DESIGN OF CONCRETE PILE

Foundation weight

$N_f = 2.4 \times \{0.5 \times 5.0 \times 8.0 + 0.2 \times 0.5 \times (8.0 + 5.0) \times 2\}$

$= 54.24$ t

LOADING

D.L $N = 80.0 + 0.5 \times 2 = 81.0$ t

Stress at bottom of foundation

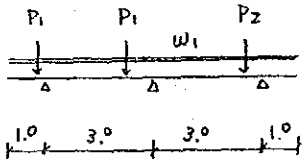
$N = 81.0 + 54.24 = 135.24$ t

$M =$ ——

Check of Pile Reaction

$P_1 = 135.24 / 6 = 22.54$ t/Pile $<$ 35 t/Pile OK

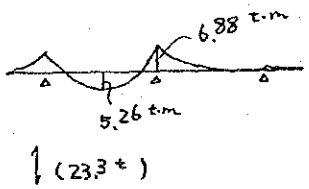
2-2. DESIGN OF FOOTING

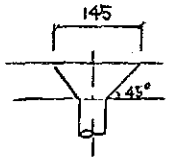


$w_1 = 2.4 \times 0.5 \times 2.5 = 3.00$ t/m (Footing weight)

$P_1 = 80.0/2 \times 1/2 + 2.4 \times 0.2 \times 0.5 \times 2.2/2 = 20.26$ t

$P_2 = 0.5 + 2.4 \times 0.2 \times 1.0 \times 1.5 = 1.22$ t





$D = 50$ cm $d = 40$ cm $j = 35.0$ cm

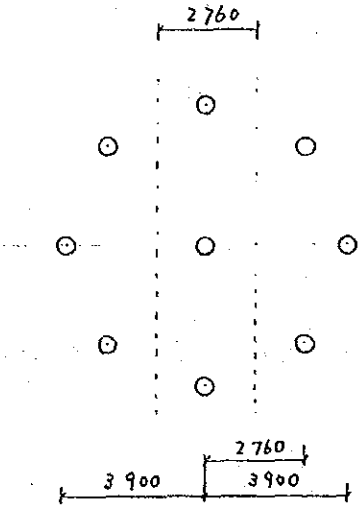
$A_t = \frac{M}{f_t \cdot j} = \frac{6.88 \times 10^5}{1870 \times 35} = 10.51$ cm^2

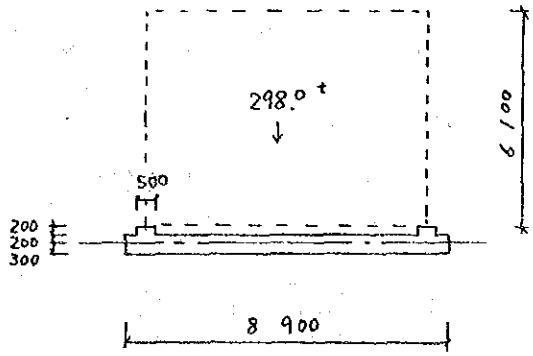
$\phi = \frac{Q}{f_a \cdot j} = \frac{23.3 \times 10^3}{21 \times 35} = 31.70$ cm

($\ell = 145$ cm)
#5 @200
($A_s = 16.0$ cm^2, $\phi = 40.0$ cm)

$\tau = \frac{Q}{b \cdot j} = \frac{23.3 \times 10^3}{145 \times 35} = 4.59 < 7.0$

§1. FOUNDATION PLAN AND SECTION





§2. DESIGN OF FOUNDATION

2-1 DESIGN OF CONCRETE PILE

Foundation weight

$$N_f = 2.4 \times (8.9/2 \times 8.9/2 \times \pi \times 0.5 + 3.9 \times 3.9 \times \pi \times 0.2)$$

$$= 97.59 \text{ t}$$

Seismic force

$$H = 0.1 \times 298.0 = 29.8 \text{ t}$$

Stress at bottom of foundation

LONG TERM

$$N = 298.0 + 97.59 = 395.59 \text{ t}$$

$$M = \text{——}$$

SHORT TERM

$$N = 395.59 \text{ t}$$

$$M = 29.8 \times (6.1/2 + 0.7) = 111.75 \text{ t·m}$$

Check of Pile Reaction

LONG TERM

$P_1 = 395.59 / 9 = 43.95$ t/Pile $<$ 45 t/Pile

SHORT TERM

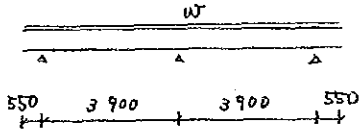
$$Z = \frac{(3.9^2 + 2.76^2 \times 2) \times 2}{3.9} = 15.61$$

$$P_1 = \frac{395.59}{9} \pm \frac{111.75}{15.61} = 51.11 \text{ t/Pile} < 45 \times 2, \quad 36.80 \text{ t/Pile} > 0$$

OK.

2-2. DESIGN OF FOOTING

LONG TERM



$$w = 298.0 / (8.9/2 \times 8.9/2 \times \pi) \times 2.76 = 13.22 \text{ t/m}$$

$$\text{L } 4.79$$

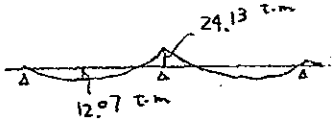
SHORT TERM

$$w = \left(4.79 + \frac{111.75}{46.59}\right) \times 2.76 = 19.84 \text{ t/m}$$

$$Z = \frac{\pi \times 7.8^3}{32} = 46.59$$

LONG TERM

$D = 50.0$ cm $d = 40.0$ cm $j = 35.0$ cm



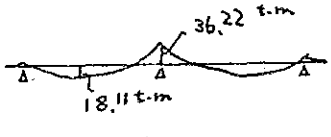
$$A_t = \frac{M}{f_t \cdot j} = 36.89 \text{ cm}^2$$

$$\phi = \frac{Q}{f_a \cdot j} = 42.86 \text{ cm}$$

$$\tau = \frac{Q}{b \cdot j} = 3.26 < 7.0$$

$\ell = 276$ cm
#6 @200
($A_S = 39.76$ cm^2, $\Phi = 84.0$ cm)

SHORT TERM



$A_t = 36.80$ cm^2

$\phi = 42.81$ cm

$\tau = 4.89 < 7.0 \times 1.5$

#6 @ 200
($A_S = 39.76$ cm^2, $\Phi = 84.0$ cm)

AR-7. Calculation Sheets For Air Conditioning and Ventilation System For Main Powerhouse

C O N T E N T S

1. DESIGN CRITERIA ------ 1

2. DATA ------ 2

3. HEAT TRANSMISSION ------ 4

4. ROOM LOAD SUMMRY ------ 7

5. EQUIPMENT LOAD ------ 21

6. SELECTION OF
COOLING EQUIPMENT ------ 29

7. VENTILATION ------ 39

1. DESIGN CRITERIA

1 - 1 DESIGN CONDITION

1) For air conditioning system

(a) Outdoor air

Summer : 42.2°C DB, 28.6°C WB, 37%RH

(b) Room

Summer : 24°C±2°C DB, 50%RH

Winter : Not more than the condition in summer

2) Minimum ventilation air vol.

For Control Room 25 m^3/Hr person

3) Lighting 20 w/m^2

4) People

Refer to "Cooling and dehumidifying estimate sheets"

5) LOcation

25.4°(N), 68.3°(E)

2. DATA

Data used for load estimation is based on Carrier,s Design Manual of the newest condition.

2 - 1 Outdoor air

1) Dry Bulb

Time / Dry Bulb	8	9	10	11	12	13	14	15	16	17	18
°C	28.2	30.3	32.8	35.7	38.4	40.4	41.7	42.2	41.7	40.5	38.7

2) HUmidity Ratio

Time / Humidity Ratio	8	9	10	11	12	13	14	15	16	17	18
g/Kg	19.1	19.0	19.0	19.2	18.9	19.0	18.8	19.0	18.8	18.9	18.8

2.- 2 Solar heat gain

1) Peak solar heat gain thru ordinary glass

EXPOSORE / HEAT	NL	NE	SE	SW	NW	HORIZONTAL	SHADE
Kcal/h m^2		366	252	252	366	674	47

2) Solar gain correction factors

for steel sash : 1/0.85

for dew point : 0.94

3) Load storage factors , solar heat gain thru ordinary glass

TIME / EXPOSURE	8	9	10	11	12	13	14	15	16	17	18
NE	0.57	0.46	0.30	0.24	0.20	0.19	0.17	0.16	0.15	0.13	0.11
SE	0.47	0.61	0.67	0.65	0.57	0.44	0.29	0.24	0.21	0.18	0.15
SW	0.08	0.08	0.10	0.24	0.40	0.55	0.66	0.70	0.64	0.50	0.26
NW	0.09	0.09	0.10	0.10	0.10	0.10	0.16	0.34	0.52	0.65	0.64

NOTE : Venetian blind to be located on the inside of glass.
(Overall factor is 0.65)

2 - 3 Equivalent temperature difference

1) For wall

TIME / EXPOSURE	8	9	10	11	12	13	14	15	16	17	18
NE	4.6	7.9	16.8	16.0	15.3	13.3	11.3	11.9	12.6	13.0	13.5
SE	5.4	8.6	11.1	12.4	13.6	13.8	13.9	12.9	12.4	11.8	11.5
SW	2.6	3.1	3.7	5.0	5.9	9.8	12.1	15.8	18.6	19.2	19.5
NW	3.7	4.5	5.3	6.6	7.9	10.1	11.3	13.5	15.4	19.5	23.2

These figures are basing on medium color, outside air temperature at 42.2°C DB, inside air temperature at 24°C DB daily range of 16.7°C and specific weight of wall 200Kg/m^2.

2) For wall

TIME / EXPOSURE	8	9	10	11	12	13	14	15	16	17	18
NE	15.7	16.2	16.8	14.8	12.8	12.7	12.4	13.0	13.7	13.6	13.5
SE	7.4	9.6	12.1	13.1	14.1	14.4	14.2	13.1	12.6	12.0	11.5
SW	1.9	2.8	3.7	5.7	7.0	12.2	14.9	17.9	20.3	20.4	20.5
NW	3.7	4.7	5.7	7.4	9.1	11.3	12.4	15.8	18.3	22.4	25.5

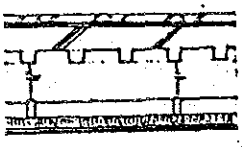
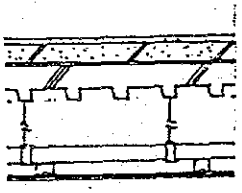
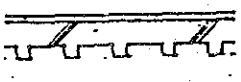
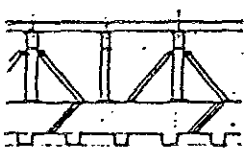
These figures are basing on medium color, outside air temperature at 42.2°C DB, inside air temperature at 24°C DB daily range of 16.7°C and specific weight of wall 100Kg/m^2.

3) For roof

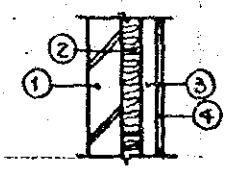
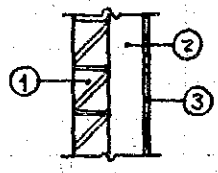
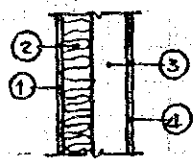
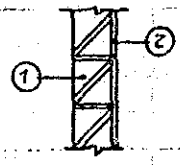
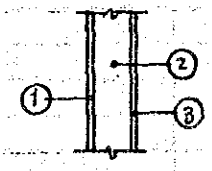
TIME / For roof	8	9	10	11	12	13	14	15	16	17	18
°C	10.3	10.2	10.8	12.4	14.9	18.0	21.2	24.0	26.2	27.8	28.5

These figures are basing on medium color, outside air temperature at 42.2°C DB, inside air temperature at 24°C DB daily range of 16.7°C and specific weight of wall 300Kg/m^2.

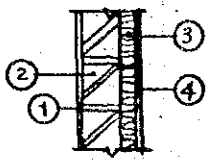
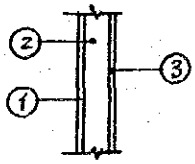
3 HEAT TRANSMISSION : K-Value

TYPE OF STRUCTURE	MATERIALS	THICKNESS (mm)	RESISTANCE ($m^2H°C/Kcal$)	AIR FILM ($m^2H°C/Kcal$)	K-Value ($Kcal/m^2H°C$)
ROOF 1. 				$\gamma_o = 0.05$	
	① CONCRETE BLOCK	30	0.067		
	② SAND	10	0.015		
	③ ASPHALT ROOFING	10	0.108		
	④ CONCRETE	100	0.071		
	⑤ DECK PLATE	1.2	—		
	⑥ AIR SPACE			0.2	
	⑦ GLASS WOOL	50	1.36		
	⑧ CEILING	25	0.132		
				$\gamma_i' = 0.189$ (2.192)	0.46
CEILING 1 FLOOR 1 				$\gamma_i' = 0.125$	
	① CEMENT MORTAL	30	0.023		
	② CINDER CONCRETE	60	0.084		
	③ ASPHALT WATER PROOF	10	0.108		
	④ CONCRETE	100	0.071		
	⑤ DECK PLATE	1.2	—		
	⑥ AIR SPACE			0.2	
	⑦ CEILING	25.0	0.132		
				$\gamma_i' = 0.125$ (0.868)	1.16
FLOOR 2 CEILING 2 				$\gamma_i = 0.125$	
	① VINYL ASBESTOS TILE	2	0.054		
	② CEMENT MORTAL	28	0.022		
	③ CONCRETE	100	0.071		
	④ DECK PLATE	1.2	—		
				$\gamma_i = 0.125$ (0.397)	2.52
FLOOR 3. 				$\gamma_i = 0.125$	
	① FLOORING	12	0.086		
	② AIR SPACE			0.2	
	③ CONCRETE	130	0.093		
	④ DECK PLATE	1.2	—		
				$\gamma_i = 0.125$	
				(0.629)	1.59

HEAT TRANSMISSION : K-Value

TYPE OF STRUCTURE	MATERIALS	THICKNESS (mm)	RESISTANCE ($m^2H°C/Kcal$)	AIR FILM ($m^2H°C/Kcal$)	K-Value ($Kcal/m^2H°C$)
WALL 1 				r_o = 0.05	
	① PRECAST CONCRETE	120	0.086		
	② GLASS WOOL	50	1.36		
	③ AIR SPACE			0.2	
	④ PLASTER BOAD	12	0.064		
				r_i = 0.133	
				(1.893)	0.53
WALL 2 				r_o = 0.05	
	① CONCRETE BLOCK	150	0.334		
	② AIR SPACE			0.2	
	③ PLASTER BOAD	12	0.064		
				r_i = 0.133	
				(0.781)	1.29
WALL 3 				r_o = 0.05	
	① STEEL	—	—		
	② GLASS WOOL	50	1.36		
	③ AIR SPACE			0.2	
	④ PLASTER BOAD	12	0.064		
				r_i = 0.133	
				(1.807)	0.56
PARTITION 1 				r_i = 0.133	
	① CONCRETE BLOCK	150	0.334		
	② PLASTER BOAD	12	0.064		
				r_i = 0.133	
				(0.664)	1.51
PARTITION 2 				r_i = 0.133	
	① PLASTER BOAD	12	0.064		
	② AIR SPACE			0.2	
	③ PLASTER BOAD	12	0.064		
				r_i = 0.133	
				(0.594)	1.69

HEAT TRANSMISSION : K-Value

TYPE OF STRUCTURE	MATERIALS	THICKNESS (mm)	RESISTANCE ($m^2H°C/Kcal$)	AIR FIIM ($m^2H°C/Kcal$)	K-Value ($Kcal/m^2H°C$)
PARTITION 3 				$\gamma i = 0.133$	
	① PLASTER BOAD	12	0.064		
	② CONCRETE BLOCK	150	0.334		
	③ GLASS WOOL	50	1.36		
	④ PLASTER BOAD	12	0.064		
				$\gamma i = 0.133$	
				(2.088)	0.48
DOOR 				$\gamma i = 0.133$	
	① STEEL	1.2	—		
	② AIR SPACE			0.2	
	③ STEEL	1.2	—		
				$\gamma i = 0.133$	
				(0.466)	2.15
WINDOW (OUT)					
	ORDINARY GLASS	3			5.1
WINDOW (IN)					
	ORDINARY GLASS	3			3.8

4. ROOM LOAD SUMMARY

4-1. AC-2

1) ROOM PEAK LOAD

NO	ROOM NAME	AREA (m^2)	VOLUME (m^3)	PEOPLE	PEAK LOAD R.S.H (Kcal/H)	PEAK LOAD R.T.H (Kcal/H)	INDICATED A.D.P(°C)	DEHUM. AIR (m^3/H)	OUT AIR (m^3/H)
OPER. FLOOR O-2	CENTRAL CONTROL ROOM	328.29	978.87	5	42.936	43.656	12.9		650
	SUB TOTAL				42.936	43.656	12.6	14.500	650
FORTH FLOOR F-1	SHIFT ROOM	56.0	156.8	6	4.365	4.791	12.2	1470	150
F-2	REST ROOM	19.6	54.88	2	1.273	1.415	12.1	450	50
F-3	CONFERENCE RM.	88.0	246.4	10	5.358	6.169	11.8	1.850	400
F-4	ELECTRICAL & INSTRUMENT REPAIR ROOM	198.0	554.4	6	10.023	10.551	12.5	3.400	300
F-5	PABX ROOM	67.68	189.5	4	3.938	4.223	12.4	1.330	100
	SUB TOTAL				24.957	27.149		8.500	1000
	TOTAL				67.893	70.805	12.6	23,000	1.650
					∴ SHF = 0.96				

2). LOAD SUMMARY (TIME)

NO.	ROOM NAME	3:00 E.R.S.H (Kcal/h)	3:00 E.R.T.H (Kcal/h)	4:00 E.R.S.H (Kcal/h)	4:00 E.R.T.H (Kcal/h)	5:00 E.R.S.H (Kcal/h)	5:00 E.R.T.H (Kcal/h)
OPER.							
O-2	CENTRAL CONTROL ROOM	* 42.936	* 43.656	42.568	43.278	41.670	42.380
	SUB TOTAL	42.936	43.656	42.568	43.278	41.670	42.380
4F							
F-1	SHIFT ROOM	4.358	4.786	* 4.365	* 4.791	4.215	4.641
F-2	REST ROOM	1.175	1.318	* 1.273	* 1.415	1.166	1.308
F-3	CONFERENCE ROOM	5.331	6.159	* 5.358	* 6169	5.307	6.118
F-4	ELECTRICAL & INSTRUMENT REPAIR ROOM	9.905	10.437	* 10.023	* 10.551	10013	10.541
F-5	PABX ROOM	3.811	4096	3.926	4.220	* 3.938	* 4.223
	SUB TOTAL	24.580	26.796	24.945	27.146	24.639	26.831
AC-2	TOTAL	* 67.516	* 70.452	67.513	70.424	66.309	69.211

RSP

4 – 2 AC-1

3100

NO	ROOM NAME	AREA (m^2)	VOLUME (m^3)	PEOPLE	R.S.H (Kcal/H)	R.T.H (Kcal/H)	INDICATED A.D.P(°C)	DEHUM.AIR (m^3/H)	OUT.AIR (m^3/H)
OPER. FLOOR O-1	COMPUTER ROOM UNIT NO. 2	84.0	252	4	23.754	24.040	13.0	8.400	100
O-3	COMPUTER ROOM UNIT NO. 1	127.21	381.63	6	35.257	35.685	13.0	12.300	150
TOTAL		211.21	633.63	10	59.011	59.725	13.0	20.700	250

SHF = 0.99.

4 – 3 AC-3

NO	ROOM NAME	AREA (m^2)	VOLUME (m^3)	PEOPLE	R.S.H (Kcal/H)	R.T.H (Kcal/H)	INDICATED A.D.P(°C)	DEHUM.AIR (m^3/H)	OUT.AIR (m^3/H)
MEZZ. FLOOR M-1	UNIT NO.1 & NO.2 CONTROL EQUIPMENT ROOM	216.33	605.73	6	41.732	42.160	13	14.600	150
TOTAL		216.33	605.73	6	41.732	42.160	13	14600	150

SHF = 0.99

4 – 4 AC-4

NO	ROOM NAME	AREA (m^2)	VOLUME (m^3)	PEOPLE	R.S.H (Kcal/H)	R.T.H (Kcal/H)	INDICATED A.D.P(°C)	DEHUM.AIR (m^3/H)	OUT.AIR (m^3/H)
MEZZ FLOOR M-1	FUEL LABORATORY	65.57	183.60	4	6.265	6605	12.5	2.200	100
M-2	WATER ANALITICAL ANALITIAL INSTRUMENT ROOM	134.75	377.3	7	12.970	13.464	12.6	4.400	210
TOTAL				11	19.235	20.069	12.6	6.600	310

SHF = 0.96

096

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 10
Job Name | Address | Date Original
Space Used For CENTRAL CONTROL ROOM (0-2.) | System | Revision
Size m× m= 328.29 m² × 3 m(H)= 978.87 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff	Factor	Kcal/h 3:00	Correction 4:00	Correction 5:00
SOLAR GAIN — GLASS						
(SE)	3.0 m²	× 252×0.24/0.85	× 0.94 × 0.65	131	115	98
	m²	×	×			
	m²	×	×			
	m²	×	×			
	m²	×	×			
SOLAR & TRANS GAIN—WALLS & ROOF						
Wall (SE)	132.° m²	× 13.1	× 0.56	969	932	887
	m²	×	×			
	m²	×	×			
	m²	×	×			
Roof—Sun	m²	×	×			
Roof—Shaded	m²	×	×			
TRANS. GAIN—EXCEPT WALLS & ROOF						
Glass	3.0 m²	× 18.2	× 5.1	279	271	258
Ceiling	76.04 m²	× 9.1	× 1.16	793	771	719
Floor	328.29 m²	× 9.1	× 2.52	7529	7322	6826
Partition (1)	73.74 m²	× 9.1	× 1.51	1014	986	919
(2)	2.7 m²	× 9.1	× 1.69	42	41	38
Door (IN)	5.4 m²	× 9.1	× 2.15	106	103	96
Glass (IN)	3.66 m²	× 9.1	× 5.8	127	123	115
INTERNAL HEAT						
People	5 People	× 41		205	205	205
Kw	29.7 Kw	× 0.8	× 860	20434	20434	20434
Lights	328.29	× 20 W×	1.08	7091	7091	7091
Appliances etc.						
Credit for Thermal Storage	m²	× deg	×	(-)	(-)	
			Sub Total			
Safety Factor			%			
Room Sensible Heat Sub Total				38720	38394	37681
Supply Duct Heat Gain	Supply Duct +Leak Loss		+HP =10%	3872	3840	3769
Bypass outside air	650 CMH	× 18.2 deg × 0.1 BF × 0.29		344	334	215
Effective Room Sensible Heat				42936	42568	41670
ROOM LATENT HEAT						
Infiltration	CMH×	g/kg×	0.72			
People	5 People	× 49		245		
Steam		kg/h×	540			
Appliances etc.						
Vapor trans.						
			Sub Total			
Safety Factor			%			
Room Latent Heat Sub Total				245	245	245
Supply Duct Leakage Loss			10 %	25	25	25
Bypass Outside Air	650 CMH	× 9.6 g/kg × 0.1 BF × 0.72		450	440	440
Effective Room Latent Heat				720	910	710
Effective Room Total Heat				43656	43278	42380
OUTSIDE AIR HEAT						
Sensible:	CMH×	deg × (1− BF) × 0.29				
Latent:	CMH×	g/kg × (1− BF) × 0.72				
Grand Total Heat Sub Total						
Return Duct Heat Gain +	Return Duct Leak Gain −	Pump H.P −	Pipe Gain = %			
(U.S.R.T) Grand Total Heat						

Estimate For	AM	PM	Peak Load	AM	PM 3
Hours of Operation	Hour (	~	)		
Outside Design Conditions			°CDB	°CWB	%RH
Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	42.2	28.6	37		19.0
Room	24.0		50		9.4
Difference	18.2	×××	×××	×××	9.6
Blind	Non-existence (Outside, Inside) L M D				
Glass	Ordinary. Thick. Absorbent. % Double				
Color	Light. Medium. Dark.				
Weight	kg/m² (Floor)			kg/m² (Wall)	
Internal Heat	W/m²			m²/People	

Infiltration			
Swinging			
Revolving Doors	Peoplex	CMH/Per.	
Open Doors	Doors×	CMH/Door	
Exhaust Air			
Crack	m×	CMH/m	
Infiltration		CMH ■	
Ventilation			
5 People×	25	CMH/Per.	125
m²×		CMH/m²	ψ
Ventilation		CMH ■	650

Sensible Heat Factor

E.S.H.F = $\frac{42.936\ (ERSH)}{43.656\ (ERTH)}$ = 0.98 (12.5°C)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

$\frac{42.936\ (ERSH)}{(24RM - 12.6ADP)(1 - {}_{6.1}BF) \times 0.29}$ = 14.500 CMH

NOTES

SR = $23.0 \times 13.75 + 6.0 + \frac{(3.05+5.0) \times 1.5}{2}$ = 328.29

GLASS (SE): 1.5 × 1.0 × 2 = 3.0

WALL (SE): 27.° × 5.° − 3.0 = 132.°

PARTITION (1): 27.° × 3.° − (3.66 + 3.6) = 73.74

(2): 1.5 × 3.° − 1.8 = 2.7

DOOR (IN): 0.9 × 2.0 × 3 = 5.4

GLASS (IN): 3.05 × 1.2 = 3.66

CEILING: $23.0 \times 3.0 + \frac{(3.05+5.0) \times 1.5}{2}$ = 75.04

FLOOR: SR

FORM E-20E

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 11
Job Name | Address | Date Original
Space Used For SHIFT ROOM (E-1) | System | Revision
Size m × m = 56.0 m² × 2.8 m(H) = 156.8 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 4:00	Correction 5:00	Correction 3:00
SOLAR GAIN — GLASS						
(SE)	3.0 m²	× 253 × 0.21/0.85	× 0.94 × 0.65	115	98	131
(NE)	1.5 m²	× 366 × 0.15/0.85	× 0.94 × 0.65	60	52	64
	m²	×	×			
	m²	×	×			
	m²	×	×			
SOLAR & TRANS GAIN—WALLS & ROOF						
Wall (SE)	32.48 m²	× 12.6	× 0.56	230	219	239
(NE)	32.52 m²	× 13.7	× 0.56	250	248	237
	m²	×	×			
	m²	×	×			
Roof—Sun	56.0 m²	× 26.2	× 0.46	675	717	619
Roof—Shaded	m²	×	×			
TRANS. GAIN—EXCEPT WALLS & ROOF						
Glass	4.5 m²	× 17.7	× 5.1	407	379	418
Ceiling	m²	×	×			
Floor	25.65 m²	× 8.85	× 1.16	264	246	271
Partition (1)	12.76 m²	× 8.85	× 1.51	171	123	176
(2)	15.68 m²	× 8.85	× 1.69	235	196	242
Door (IN)	1.8 m²	× 8.85	× 2.15	35	32	36
Infiltration	CMH	× deg	× 0.29			
INTERNAL HEAT						
People	6 People	× 41		246	246	246
Kw	Kw	×	× 860			
Lights	56.0	× 20 W	× 1.08	1210	1210	1210
Appliances Etc.						
Credit for Thermal Storage	m²	× deg	×	(−)	(−)	
			Sub Total			
Safety Factor			%			
Room Sensible Heat Sub Total				3898	3766	3889
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	390	377	389
Bypass Outside Air	150 CMH	× 17.7 deg	× 0.1 B.F × 0.29	77	72	80
Effective Room Sensible Heat				4365	4215	4358
ROOM LATENT HEAT						
Infiltration	CMH	× g/kg	× 0.72			
People	6 People	× 49		294		294
Steam		kg/h	× 540			
Appliances etc.						
Vapor trans.						
			Sub Total			
Safety Factor			%			
Room Latent Heat Sub Total				294	294	294
Supply Duct Leakage Loss			10 %	30	30	30
Bypass Outside Air	150 CMH	× 9.4 g/kg	× 0.1 BF × 0.72	102	102	104
Effective Room Latent Heat				426	426	428
Effective Room Total Heat				4791	4641	4786
OUTSIDE AIR HEAT						
Sensible:	CMH	× deg	× (1 − BF) × 0.29			
Latent:	CMH	× g/kg	× (1 − BF) × 0.72			
Grand Total Heat Sub Total						
Return Duct Heat Gain + Return Duct Leak Gain + Pump H.P + Pipe Gain			= %			
(U.S.R.T) Grand Total Heat						

Estimate For.	AM / PM	Peak Load	AM / PM 4
Hours of Operation	Hour (	–	)

Outside Design Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	41.7	28.4	38		18.8
Room	24.0		50		9.4
Difference	17.7	×××	×××	×××	9.4

Blind	(Non-Existence/Outside, Inside)	L. M. D
Glass	(Ordinary. Thick. Absorbent.	%, Double
Color	(Light. Medium. Dark.	
Weight	kg/m²(Floor)	kg/m²(Wall)
Internal Heat	W/m²	m²/People

Infiltration		
Swinging		
Revolving Doors	People × CMH/Per	
Open Doors	Doors × CMH/Door	
Exhaust Air		
Crack	m × CMH/m	
Infiltration	CMH ■	
Ventilation		
6 People ×	25 CMH/Per.	150
m² ×	CMH/m²	
Ventilation	CMH ■	150

Sensible Heat Factor

E.S.H.F = 4365 (ERSH) / 4791 (ERTH) = 0.91 (12.2)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

4365 (ERSH) / (24 RM − 126 ADP)(1 − 0.1 BF) × 0.29 = 1470 CMH

NOTES

GLASS (SE) : 1.0 × 1.5 × 2 = 3.0
(NE) : 1.0 × 1.5 = 1.5

WALL (SE) : 7.3 × 4.8 − 3.0 = 32.48
(NE) : 7.0 × 4.8 − 1.5 = 32.52

PARTITION (1) : 5.2 × 2.8 − 1.8 = 12.76
(2) : 5.6 × 2.8 = 15.68

DOOR (IN) : 0.9 × 2.0 = 1.8

FLOOR : 3.3 × 7.0 + 1.7 × 1.5 = 25.65

ROOF : SR.

SR = 7.3 × 7.0 + 1.4 × 3.5 = 56.0

FORM E-20E

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 12
Job Name | Address | Date Original
Space Used For REST ROOM (F-2) | System | Revision
Size 5.6 m × 3.5 m = 19.6 m² × 2.8 m(H) = 54.88 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 4:00	Correction 5:00	Correction 3:00
SOLAR GAIN — GLASS						
(SE) 1.5	m² × 252 × 0.21 / 0.25 × 0.94 × 0.65			58	49	66
	m² ×		×			
	m² ×		×			
	m² ×		×			
	m² ×		×			
SOLAR & TRANS GAIN—WALLS & ROOF						
Wall (SE) 15.51	m² ×	12.6	× 0.56	196	105	114
	m² ×		×			
	m² ×		×			
	m² ×		×			
Roof—Sun 19.6	m² ×	26.2	× 0.46	237	251	217
Roof—Shaded	m² ×		×			
TRANS. GAIN—EXCEPT WALLS & ROOF						
Glass 1.5	m² ×	17.7	× 5.1	136	127	140
Ceiling	m² ×		×			
Floor	m² ×		×			
Partition	m² ×		×			
Infiltration	CMH ×	deg ×	0.29			
INTERNAL HEAT						
People	2 People × 41			82	82	82
Kw	Kw ×		× 860			
Lights	19.6 × 20	W ×	1.08	424	424	424
Appliances Etc.						
Credit for Thermal Storage	m² ×	deg ×		(−)	(−)	
			Sub Total			
Safety Factor			%			
Room Sensible Heat Sub Total				1 133	1038	1043
Supply Duct Heat Gain	Supply Duct +Leak Loss		+HP =10%	114	104	105
Bypass Outside Air	50 CMH × 17.7 deg × 0.1 B.F × 0.29			26	24	27
Effective Room Sensible Heat	■			1273	1.166	1.195
ROOM LATENT HEAT						
Infiltration	CMH ×	g/kg ×	0.72			
People	2 People × 49			98		98
Steam		kg/h ×	540			
Appliances Etc.						
Vapor Trans.						
			Sub Total			
Safety Factor			%			
Room Latent Heat Sub Total				98	98	98
Supply Duct Leakage Loss			10 %	10	10	10
Bypass Outside Air	25 CMH × 9.4 g/kg × 0.1 BF × 0.72			34	34	35
Effective Room Latent Heat	■			142	142	143
Effective Room Total Heat	■			1415	1308	1318
OUTSIDE AIR HEAT						
Sensible:	CMH ×	deg × (1 − BF) × 0.29				
Latent:	CMH ×	g/kg × (1 − BF) × 0.72				
Grand Total Heat Sub Total						
Return Duct Heat Gain + Return Duct Leak Gain		− Pump H.P	+ Pipe Gain = %			
(U.S.R.T) Grand Total Heat	■					

Estimate For.	AM / PM	Peak Load	AM / PM
Hours of Operation	Hour (~)		

Outside Design Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Conditions					
Outside	41.7	28.4	38		18.8
Room	24.0		50		9.4
Difference	17.7	×××	×××	×××	9.4

Blind	Non-existence (outside, inside) L. M. D
Glass	Ordinary. Thick. Absorbent. % . Double
Color	Light. Medium. Dark.
Weight	kg/m² (floor) kg/m² (wall)
Internal Heat	W/m² m²/People

Infiltration

Swinging		
Revolving Doors	People × CMH/Per.	
Open Doors	Doors × CMH/Door	
Exhaust Air		
Crack	m × CMH/m	
Infiltration	CMH ■	

Ventilation

2 People ×	25 CMH/Per.	50
m² ×	CMH/m²	
Ventilation	CMH ■	50

Sensible Heat Factor

E.S.H.F = 1.273 (ERSH) / 1415 (ERTH) = 0.9 (12.1)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

1.273 (ERSH) / (12 RM − 12.6 (ADP)(1 − 0.1 BF) × 0.29) = 430 CMH

NOTES

GLASS (SE) : 1.0 × 1.5 = 1.5

WALL (SE) : 3.5 × 4.86 − 1.5 = 15.51

FORM E-205

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 13
Job Name | Address | Date Original
Space Used For CONFERENCE Room (F-3) | System | Revision
Size 8.0 m × 11 m = 88 m² × 2.8 m(H) = 246.4 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp Diff.	Factor	Kcal/h	Correction	
				4:00	5:00	3:00
SOLAR GAIN — GLASS						
(SE) 4.5 m² × 252 × 0.21/0.85 × 0.94 × 0.65				172	147	196
m² ×		×				
m² ×		×				
m² ×		×				
m² ×		×				
SOLAR & TRANS GAIN—WALLS & ROOF						
Wall (SE) 34.38 m² ×	12.6	×	0.56	243	231	253
m² ×		×				
m² ×		×				
m² ×		×				
Roof—Sun 88 m² ×	26.2	×	0.46	1061	1126	972
Roof—Shaded m² ×		×				
TRANS. GAIN—EXCEPT WALLS & ROOF						
Glass 4.5 m² ×	17.7	×	5.1	407	379	418
Ceiling m² ×		×				
Floor m² ×		×				
Partition (1) 18.8 m² ×	8.85	×	1.51	252	235	259
(2) 11.2 m² ×	8.85	×	1.69	168	157	173
Door 3.6 m² ×	8.85	×	2.15	69	64	71
Infiltration CMH ×		deg ×	0.29			
INTERNAL HEAT						
People 10 People × 41				416	410	410
Kw Kw ×		×	860			
Lights 88.0 × 20 W ×			1.08	1901	1901	1901
Appliances etc.						
Credit for Thermal Storage m² ×		deg ×		(−)	(−)	
			Sub Total			
Safety Factor			%			
Room Sensible Heat Sub Total				4683	4650	4653
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	469	465	466
Bypass Outside Air 400 CMH × 19.7 deg × 0.1 B.F × 0.29				206	192	212
Effective Room Sensible Heat ■				5358	5307	5331
ROOM LATENT HEAT						
Infiltration CMH ×		g/kg ×	0.72			
People 10 People × 49				490		490
Steam kg/h ×			540			
Appliances etc.						
Vapor Trans.						
			Sub Total			
Safety Factor			%			
Room Latent Heat Sub Total				490	490	490
Supply Duct Leakage Loss			10%	50	50	50
Bypass Outside Air 400 CMH × 9.4 g/kg × 0.1 BF × 0.72				271	271	288
Effective Room Latent Heat ■				811	811	828
Effective Room Total Heat ▣				6169	6118	6159
OUTSIDE AIR HEAT						
Sensible: CMH ×	deg × (1 − BF) × 0.29					
Latent: CMH ×	g/kg × (1 − BF) × 0.72					
Grand Total Heat Sub Total						
Return Duct Heat Gain + Return Duct Leak Gain	+ Pump H.P	+ Pipe Gain	= %			
(U.S.R.T) GRAND TOTAL HEAT ▣						

Estimate For.	AM / PM	Peak Load	AM / PM 4
Hours of Operation	Hour (	~	)

Outside Design Conditions	°CDB	°CWB	%RH
Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	41.7	28.4	38		18.8
Room	24.0		50		9.4
Difference	17.7	×××	×××	×××	9.4

Blind	Non-existence (Outside, Inside) L M D
Glass	Ordinary, Thick, Absorbent, % Double
Color	Light, Medium, Dark.
Weight	kg/m²(Floor) kg/m²(Wall)
Internal Heat	W/m² m²/People

Infiltration

Swinging		
Revolving Doors	People ×	CMH/Per.
Open Doors	Doors ×	CMH/Door
Exhaust Air		
Crack	m ×	CMH/m
Infiltration		CMH ■

Ventilation

10 People ×	25	CMH/Per.	250
m² ×		CMH/m²	↓
Ventilation		CMH ■	400

Sensible Heat Factor

E.S.H.F = 5358 (ERSH) / 6169 (ERTH) = 0.87 (11.8°C)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

5358 (ERSH) / [24 RM − 12.6 (ADP)(1 − BF/0.1) × 0.29] = 1800 CMH

NOTES

GLASS (SE): 1.0 × 1.5 × 3 = 4.5

WALL (SE): 8.0 × 4.86 − 4.5 = 34.38

PARTITION (1): 8.0 × 2.8 − 3.6 = 18.8

(2): 4.0 × 2.8 = 11.2

ROOF: SR

DOOR (IN): 1.8 × 2.0 = 3.6

FORM E-20E

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 14
Job Name | Address | Date Original | Revision | Person in Charge
Space Used For ELECTRICAL & INSTRUMENT REPAIR ROOM (F-d) SYSTEM
Size 18.0 m × 11.0 m = 198.0 m² × 2.8 m(H) = 554.4 m³

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 4:00	Correction 5:00	Correction 3:00
SOLAR GAIN — GLASS						
(SE)	6.0 m²	× 252 × 0.21 / 0.85 ×	0.94 × 0.65	229	196	261
	m²	×	×			
	m²	×	×			
	m²	×	×			
	m²	×	×			
SOLAR & TRANS GAIN—WALLS & ROOF						
Wall (SE)	81.48 m²	× 12.6	× 0.56	575	548	598
	m²	×	×			
	m²	×	×			
	m²	×	×			
Roof—Sun	198.0 m²	× 26.2	× 0.46	2387	2532	2186
Roof—Shaded	m²	×	×			
TRANS. GAIN—EXCEPT WALLS & ROOF						
Glass	6.0 m²	× 17.7	× 5.1	542	505	557
Ceiling	m²	×	×			
Floor	m²	×	×			
Partition	43.2 m²	× 8.85	× 1.51	578	539	594
Door	7.2 m²	× 8.85	× 2.15	137	128	141
Infiltration	CMH ×	deg ×	0.29			
INTERNAL HEAT						
People	6 People ×	41		246	246	246
Kw	Kw ×	×	860			
Lights	198.0 × 20 W ×		1.08	4277	4277	4277
Appliances Etc.						
Credit for Thermal Storage	m² ×	deg ×	(−)		(−)	
		Sub Total				
Safety Factor		%				
Room Sensible Heat Sub Total				8971	897	8860
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	898	898	886
Bypass Outside Air	300 CMH × 17.7 deg × 0.1 B.F × 0.29			154	144	159
Effective Room Sensible Heat				10023	10013	9905
ROOM LATENT HEAT						
Infiltration	CMH ×	g/kg ×	0.72			
People	6 People ×	49		294		294
Steam	kg/h ×		540			
Appliances etc.						
Vapor Trans.						
		Sub Total				
Safety Factor		%				
Room Latent Heat Sub Total				294	294	294
Supply Duct Leakage Loss			10 %	30	30	30
Bypass Outside Air	300 CMH × 9.4 g/kg × 0.1 BF × 0.72			204	204	208
Effective Room Latent Heat				528	528	532
Effective Room Total Heat				10551	10541	10937
OUTSIDE AIR HEAT						
Sensible:	CMH ×	deg × (1 − BF) × 0.29				
Latent:	CMH ×	g/kg × (1 − BF) × 0.72				
Grand Total Heat Sub Total						
Return Duct Heat Gain + Return Duct Leak Gain		Pump H.P + Pipe Gain	= %			
(U.S.R.T) Grand Total Heat						

Estimate For	AM	PM	Peak Load	AM	PM 4
Hours of Operation	Hour (	~	)		
Outside Design Conditions	°CDB	°CWB	%RH		
Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	41.7	28.4	38		18.8
Room	24.0		50		9.4
Difference	17.7	×××	×××	×××	9.4
Blind	Non-existence (outside, inside) L. M. D				
Glass	Ordinary, Thick, Absorbent, % , Double				
Color	Light, Medium, Dark.				
Weight	kg/m² (Floor)			kg/m² (Wall)	
Internal Heat	W/m²			m²/People	

Infiltration		
Swinging		
Revolving Doors	People ×	CMH/Per.
Open Doors	Doors ×	CMH/Door
Exhaust Air		
Crack	m ×	CMH/m
Infiltration	CMH	
Ventilation		
6 People ×	25	CMH/Per. 150
m² ×		CMH/m² ↓
Ventilation	CMH	300

Sensible Heat Factor

E.S.H.F = 10.023 (ERSH) / 10.551 (ERTH) = 0.95 (12.5° C)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

10023 (ERSH) / (24 RM − 12.6 ADP)(1 − 0.1 BF) × 0.29 = 3.400 CMH

Notes

GLASS (SE): 1.0 × 1.5 × 4 = 6.0
WALL (SE): 18.0 × 4.86 − 6.0 = 81.48
PARTITION: 18.0 × 2.8 − 7.2 = 43.2
DOOR (IN): 1.8 × 2.0 × 2 = 7.2
ROOF : SR

FORM E-20E

COOLING AND DEHUMIDIFYING ESTIMATE(METRIC)

INQUIRING NO. | INQUIRED BY | SHEET NO. 15
JOB NAME | ADDRESS | DATE ORIGINAL
SPACE USED FOR PABX ROOM (F-5) | SYSTEM | REVISION
SIZE mX m= 67.68 m² × 2.8 m(H)= 189.50 m³ | PERSON IN CHARGE

ITEM	AREA OR QUANTITY	SUN GAIN OR TEMP. DIFF.	FACTOR	Kcal/h 5:00	CORRECTION 3:00	4:00
SOLAR GAIN — GLASS						
m²×		×				
m²×		×				
m²×		×				
m²×		×				
m²×		×				
SOLAR & TRANS GAIN—WALLS & ROOF						
WALL (SE) 33.05 m²×	12.0	×	0.56	222	243	234
(SW) 41.80 m²×	20.4	×	0.56	478	419	476
m²×		×				
m²×		×				
ROOF—SUN 67.68 m²×	27.8	×	0.46	866	748	816
ROOF—SHADED m²×		×				
TRANS. GAIN—EXCEPT WALLS & ROOF						
GLASS m²×		×				
CEILING m²×		×				
FLOOR m²×		×				
PARTITION 22.44 m²×	8.25	×	1.51	280	309	300
DOOR (IN) 36 m² ×	8.25	×	2.15	64	71	69
INFILTRATION CMH×		deg×	0.29			
INTERNAL HEAT						
PEOPLE 4 PEOPLE× 41				164	164	164
KW KW×		×	860			
LIGHTS 67.68 × 20 W×			1.08	1462	1462	1462
APPLIANCES ETC.						
CREDIT FOR THERMAL STORAGE m²×		deg×		(—)		(—)
SUB TOTAL						
SAFETY FACTOR %						
ROOM SENSIBLE HEAT SUB TOTAL				3536	3418	3521
SUPPLY DUCT HEAT GAIN	SUPPLY DUCT +LEAK LOSS	FAN +HP	=10%	354	342	353
BYPASS OUTSIDE AIR 100 CMH×	16.5 deg×	0.1 B.F×	0.29	48	53	52
EFFECTIVE ROOM SENSIBLE HEAT ■				3938	3811	3926
ROOM LATENT HEAT						
INFILTRATION CMH×		g/kg×	0.72			
PEOPLE 4 PEOPLE× 49				196	196	196
STEAM kg/h×			540			
APPLIANCES ETC.						
VAPOR TRANS.						
SUB TOTAL						
SAFETY FACTOR %						
ROOM LATENT HEAT SUB TOTAL				196	196	196
SUPPLY DUCT LEAKAGE LOSS 10%				20	20	20
BYPASS OUTSIDE AIR 100 CMH× 9.5 g/kg× 0.1 BF× 0.72				69	69	68
EFFECTIVE ROOM LATENT HEAT ■				285	285	284
EFFECTIVE ROOM TOTAL HEAT ■				4223	4096	4220
OUTSIDE AIR HEAT						
SENSIBLE: CMH×	deg× (1− BF)× 0.29					
LATENT: CMH×	g/kg× (1− BF)× 0.72					
GRAND TOTAL HEAT SUB TOTAL						
RETURN DUCT HEAT GAIN + RETURN DUCT LEAK GAIN − PUMP H.P + PIPE GAIN = %						
(U.S.R.T) GRAND TOTAL HEAT ■						

ESTIMATE FOR.	AM / PM	PEAK LOAD	AM / PM 5
HOURS OF OPERATION	Hour (~)		

CONDITIONS	DB °C	WB °C	%RH	DP °C	g/kg
OUTSIDE	40.5	28.2	39		18.9
ROOM	24.5		50		9.4
DIFFERENCE	16.5	×××	×××	×××	9.5

OUTSIDE DESIGN CONDITIONS °CDB °CWB %RH

BLIND	NON-EXISTENCE(OUTSIDE, INSIDE)	L. M. D
GLASS	ORDINARY. THICK. ABSORBENT.	%. DOUBLE
COLOR	LIGHT. MEDIUM. DARK.	
WEIGHT	kg/m²(FLOOR)	kg/m²(WALL)
INTERNAL HEAT	W/m²	m³/PEOPLE

INFILTRATION
SWINGING
REVOLVING DOORS PEOPLE× CMH/PER.
OPEN DOORS DOORS× CMH/DOOR
EXHAUST AIR
CRACK m× CMH/m
INFILTRATION CMH ■

VENTILATION
4 PEOPLE× 25 CMH/PER. 100
m²× CMH/m²
VENTILATION CMH ■ 100

SENSIBLE HEAT FACTOR
E.S.H.F = 3938 (ERSH) / 4223 (ERTH) = 0.93 (12.4)

DEHUMIDIFIED AIR
APPARATUS DEWPOINT 12.6 °C
3.938 (ERSH) / (24 RM-12.6 ADP)(1-0.1 BF)×0.29 = 1336 CMH

NOTES
SR = 6.8 × 11.0 − 2.85 × 2.5 = 67.68
WALL (SE) : 6.8 × 4.86 = 33.05
(SW) : 8.6 × 4.86 = 41.80
PARTITION : 9.3 × 2.8 − 3.6 = 22.44
DOOR (IN) : 1.8 × 2.0 = 3.6
ROOF : SR

FORM E-20E

COOLING AND DEHUMIDIFYING ESTIMATE(METRIC)

Inquiring No. | Inquired By | Sheet No. 16
Job Name | Address | Date Original
Space Used For COMPUTER RM. UNIT No.2 (0-1) | System | Revision
Size 12.0 m × 7.0 m = 84 m² × 3.0 m(H) = 252 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 3:00	Correction
SOLAR GAIN — GLASS					
	m² ×		×		
	m² ×		×		
	m² ×		×		
	m² ×		×		
	m² ×		×		
SOLAR & TRANS GAIN—WALLS & ROOF					
Wall	m² ×		×		
	m² ×		×		
	m² ×		×		
	m² ×		×		
Roof—Sun	m² ×		×		
Roof—Shaded	m² ×		×		
TRANS. GAIN—EXCEPT WALLS & ROOF					
Glass	m² ×		×		
Ceiling	49.0 m² ×	9.1	× 1.16	518	
Floor	84.0 m² ×	9.1	× 1.59	1,216	
Partition(1)	13.5 m² ×	9.1	× 1.51	186	
(2)	50.4 m² ×	9.1	× 1.69	776	
Door(IN)	3.6 m² ×	9.1	× 2.15	71	
Infiltration	CMH ×	deg ×	0.29		
INTERNAL HEAT					
People	4 People × 41			164	
Kw	Kw ×		× 860	16,800	
Lights	84.0 × 20 W ×		1.08	1,815	
Appliances etc.					
Credit for Thermal Storage	m² ×	deg ×		(–)	(–)
			Sub Total		
Safety Factor			%		
Room Sensible Heat Sub Total				21,546	
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	2,155	
Bypass Outside Air	160 CMH × 18.2 deg × 0.1 B.F × 0.29			53	
Effective Room Sensible Heat ■				23,754	
ROOM LATENT HEAT					
Infiltration	CMH ×	g/kg ×	0.72		
People	4 People × 49			196	
Steam		kg/h ×	540		
Appliances etc.					
Vapor Trans.					
			Sub Total		
Safety Factor			%		
Room Latent Heat Sub Total				196	
Supply Duct Leakage Loss			10%	20	
Bypass Outside Air	100 CMH × 9.6 g/kg × 0.1 BF × 0.72			70	
Effective Room Latent Heat ■				286	
Effective Room Total Heat ▣				24,040	
OUTSIDE AIR HEAT					
Sensible:	CMH ×	deg × (1 − BF) × 0.29			
Latent:	CMH ×	g/kg × (1 − BF) × 0.72			
Grand Total Heat Sub Total					
Return Duct Heat Gain	+ Return Duct Leak Gain	− Pump H.P	− Pipe Gain = %		
(U.S.R.T) Grand Total Heat ▣					

Estimate For	AM / PM	Peak Load	AM / PM3
Hours of Operation	Hour (–)		

Outside Design Conditions	°CDB	°CWB	%RH	
Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	42.2	28.6	37		19.0
Room	24.0		50		9.4
Difference	18.2	×××	×××	×××	9.6

Blind	Non-Existence(Outside, Inside) L M D
Glass	Ordinary, Thick, Absorbent, % Double
Color	Light, Medium, Dark.
Weight	kg/m²(Floor) kg/m²(Wall)
Internal Heat	W/m² m²/People

INFILTRATION

Swinging		
Revolving Doors	People × CMH/Per	
Open Doors	Doors × CMH/Door	
Exhaust Air		
Crack	m × CMH/m	
Infiltration	CMH ■	

VENTILATION

4 People ×	25 CMH/Per.	100
m² ×	CMH/m²	
Ventilation	CMH ■	100

SENSIBLE HEAT FACTOR

E.S.H.F = 23,754 (ERSH) / 24040 (ERTH) = 0.99 (13°C)

DEHUMIDIFIED AIR

Apparatus Dewpoint 13°C t

23,754 (ERSH) / [24 RM − 13 ADP)(1 − 0.1 BF) × 0.29] = 8400 CMH

NOTES

PARTITION(1) : 4.5 × 3.0 = 13.5
(2) : 18.0 × 3.0 − 3.6 = 50.4

DOOR(IN) : 1.8 × 2.0 = 3.6

CEILING : 7.0 × 7.0 = 49.0

FLOOR : SR

FORM E-2RE

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 17
Job Name | Address | Date Original
Space Used For COMPUTER ROOM UNIT NO.1 (0-3) | System | Revision
Size ' mX ' m = 127.21 m² × 3.0 m(H) = 381.63 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h	Correction
SOLAR GAIN — GLASS					
	m²×	×			
	m²×	×			
	m²×	×			
	m²×	×			
	m²×	×			
SOLAR & TRANS GAIN—WALLS & ROOF					
Wall (SE)	51.5 m²×	13.1 ×	0.56	378	
(SW)	43.0 m²×	17.9 ×	0.56	431	
	m²×	×			
	m²×	×			
Roof—Sun	m²×	×			
Roof—Shaded	m²×	×			
TRANS. GAIN—EXCEPT WALLS & ROOF					
Glass	m²×	×			
Ceiling	22.35 m²×	9.1 ×	1.16	236	
Floor	127.21 m²×	9.1 ×	1.59	1841	
Partition	42.75 m²×	9.1 ×	1.51	588	
Door	3.6 m²×	9.1 ×	7.15	71	
Infiltration	CMH×	deg×	0.29		
INTERNAL HEAT					
People	6 People×	41		246	
Kw	Kw×	×	860	25440	
Lights	127.21×20 W×		1.08	2748	
Appliances etc.					
Credit for Thermal Storage	m²×	deg×		(—)	(—)
			Sub Total		
Safety Factor			%		
Room Sensible Heat Sub Total				31979	
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	3198	
Bypass Outside Air	150 CMH×	18.2 deg×	0.1 B.F.×0.29	80	
Effective Room Sensible Heat ■				35257	
ROOM LATENT HEAT					
Infiltration	CMH×	g/kg×	0.72		
People	6 People×	49		294	
Steam	kg/h×		540		
Appliances etc.					
Vapor Trans.					
			Sub Total		
Safety Factor			%		
Room Latent Heat Sub Total				1294	
Supply Duct Leakage Loss			%	30	
Bypass Outside Air	150 CMH×9.6 g/kg×		BF×0.72	104	
Effective Room Latent Heat ■				428	
Effective Room Total Heat ▣				351685	
OUTSIDE AIR HEAT					
Sensible:	CMH×	deg×(1−	BF)×0.29		
Latent:	CMH×	g/kg×(1−	BF)×0.72		
Grand Total Heat Sub Total					
Return Duct Heat Gain + Return Duct Leak Gain		− Pump H.P	Pipe Gain = %		
(U.S.R.T) Grand Total Heat ▣					

Estimate For.	AM / PM	Peak Load			AM / PM 3
Hours of Operation	Hour (	~)			
Outside Design Conditions		°CDB	°CWB	%RH	
Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	42.2	28.6	37		19.0
Room	24.0		50		9.4
Difference	18.2	×××	×××	×××	9.6
Blind	Non-existence (outside, inside)				L. M. D
Glass	Ordinary. Thick. Absorbent.				%. Double
Color	Light. Medium. Dark.				
Weight	kg/m²(floor)				kg/m²(wall)
Internal Heat	W/m²				m²/People

INFILTRATION

Swinging		
Revolving Doors	People× CMH/per	
Open Doors	Doors× CMH/door	
Exhaust Air		
Crack	m× CMH/m	
Infiltration	CMH ■	

VENTILATION

6 People×	25 CMH/per.	150
m²×	CMH/m²	
Ventilation	CMH ■	150

SENSIBLE HEAT FACTOR

E.S.H.F = 35257 (ERSH) / 35685 (ERTH) = 099 (13°C)

DEHUMIDIFIED AIR

Apparatus Dewpoint 13.0 °C

35257 (ERSH) / (74RM − 13ADP)(1 − BF)×0.29 = 17,300 CMH

NOTES

SR = 10.3×8.6 + 5.15×7.5 = 127.21

WALL (SE) : 10.3×5.0 = 51.5

(SW) : 8.6×5.0 = 43.0

PARTITION : 15.45×3.0 − 3.6 = 42.75

DOOR (IN) : 1.8×2.0 = 3.6

CEILING : 7.45×3.0 = 22.35

FLOOR : SR

FORM E-20E

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. 18
Job Name | Address | Date Original
Space Used For UNITS No.1 & No.2 CONTROL EQUIPMENT ROOM (M-3) SYSTEM | Revision
Size m × m = 216.33 m² × 2.8 m(H) = 605.73 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 9:00	Correction
SOLAR GAIN — GLASS					
	m² ×	×			
	m² ×	×			
	m² ×	×			
	m² ×	×			
	m² ×	×			
SOLAR & TRANS GAIN—WALLS & ROOF					
Wall (SE)	51.24 m² ×	12.9 ×	0.53	351	
(SW)	26.23 m² ×	15.8 ×	0.53	220	
	m² ×	×			
	m² ×	×			
Roof—Sun	m² ×	×			
Roof—Shaded	m² ×	×			
TRANS. GAIN—EXCEPT WALLS & ROOF					
Glass	m² ×	×			
Ceiling	216.33 m² ×	9.1 ×	2.52	4961	
Floor	216.33 m² ×	9.1 ×	2.52	4961	
Partition (1)	56.06 m² ×	9.1 ×	1.51	771	
(2)	38.5 m² ×	9.1 ×	1.69	592	
Door (IN)	5.4 m² ×	9.1 ×	2.15	106	
Infiltration	CMH ×	deg ×	0.29		
INTERNAL HEAT					
People	6 People ×	41		246	
Kw	36.5 Kw ×	0.8 ×	860	20.984	
Lights	216.33 ×	20 W ×	1.08	4673	
Appliances etc.					
Credit for Thermal Storage	m² ×	deg ×		(—)	(—)
			Sub Total		
Safety Factor			%		
Room Sensible Heat Sub Total				37 865	
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	3787	
Bypass Outside Air	150 CMH × 18 deg × 0.1 B.F × 0.29			80	
Effective Room Sensible Heat ■				41 732	
ROOM LATENT HEAT					
Infiltration	CMH ×	g/kg ×	0.72		
People	6 People ×	49		294	
Steam		kg/h ×	540		
Appliances etc.					
Vapor Trans.					
			Sub Total		
Safety Factor			%		
Room Latent Heat Sub Total				294	
Supply Duct Leakage Loss			10 %	30	
Bypass Outside Air	150 CMH × 9.6 g/kg ×	BF × 0.72		104	
Effective Room Latent Heat ■				428	
Effective Room Total Heat ◙				42 160	
OUTSIDE AIR HEAT					
Sensible:	CMH ×	deg × (1 − BF) × 0.29			
Latent:	CMH ×	g/kg × (1 − BF) × 0.72			
Grand Total Heat Sub Total					
Return Duct Heat Gain + Return Duct Leak Gain	− Pump H.P	− Pipe Gain	= %		
(U.S.R.T) Grand Total Heat ◙					

Estimate For:	AM / PM	Peak Load	AM / PM 3
Hours of Operation	Hour (—)		

Outside Design Conditions:	°CDB	°CWB	%RH

Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Outside	42.2	28.6	37		19.0
Room	24.0		50		9.4
Difference	18.2	×××	×××	×××	9.6

Blind	(Non-Existence/Outside, Inside)	L. M. D
Glass	(Ordinary, Thick, Absorbent.	%, Double
Color	(Light, Medium, Dark.	
Weight	kg/m² (Floor)	kg/m² (Wall)
Internal Heat	W/m²	m²/People

Infiltration		
Swinging		
Revolving Doors	People × CMH/Per.	
Open Doors	Doors × CMH/Door	
Exhaust Air		
Crack	m × CMH/m	
Infiltration	CMH ■	
Ventilation		
6 People ×	25 CMH/Per.	150
m² ×	CMH/m²	
Ventilation	CMH ■	150

SENSIBLE HEAT FACTOR

E.S.H.F = 41.732 (ERSH) / 42.160 (ERTH) = 0.99 (13.2°C)

DEHUMIDIFIED AIR

Apparatus Dewpoint 13.0 °C

41.732 (ERSH) / (24 RM − 13 ADP)(1 − 0.1 BF) × 0.29 = 14600 CMH

NOTES

WALL (SE): 16.8 × 3.05 = 51.24
(SW): 8.6 × 3.05 = 26.23

CEILING : SR
FLOOR : SR
PARTITION (1): 21.95 × 2.8 − 5.4 = 56.06
(2): 13.75 × 2.8 = 38.5

DOOR (IN): (1.8 + 0.9) × 2.0 = 5.4

SR = 16.8 × 13.75 − 2.85 × 5.15 = 216.33

FORM E-20

9

COOLING AND DEHUMIDIFYING ESTIMATE(METRIC)

Inquiring No. | Inquired By | Sheet No. 19
Job Name | Address | Date Original
Space Used For FUEL LABORATORY (M-1.) | System | Revision
Size 8.3 m × 7.9 m = 65.57 m² × 2.8 m(H) = 183.60 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 3:00	Correction
SOLAR GAIN — GLASS					
(SE)	3.0 m²	× 752 × 0.24/685 × 0.94 × 0.65		131	
	m²	×	×		
	m²	×	×		
	m²	×	×		
	m²	×	×		
SOLAR & TRANS. GAIN—WALLS & ROOF					
Wall (SE)	22.32 m²	× 12.9	× 0.53	153	
(NE)	24.10 m²	× 11.9	× 0.53	152	
	m²	×	×		
	m²	×	×		
Roof—Sun	m²	×	×		
Roof—Shaded	m²	×	×		
TRANS. GAIN—EXCEPT WALLS & ROOF					
Glass	3.0 m²	× 18.2	× 5.1	279	
Ceiling	65.57 m²	× 9.1	× 2.52	1504	
Floor	65.57 m²	× 9.1	× 2.62	1504	
Partition (1)	7.98 m²	× 9.1	× 1.51	110	
(2)	15.12 m²	× 9.1	× 1.69	233	
Infiltration	CMH ×	deg ×	0.29		
INTERNAL HEAT					
People	4 People ×	41		164	
Kw	Kw ×	×	860		
Lights	65.57 ×	20 W ×	1.08	1417	
Appliances etc.					
Credit for Thermal Storage	m² ×	deg ×		(—)	(—)
			Sub Total		
Safety Factor			%		
Room Sensible Heat Sub Total				5647	
Supply Duct Heat Gain	Supply Duct +Leak Loss	Fan +HP	=10%	565	
Bypass Outside Air	100 CMH × 18.2 deg × 0.1 BF × 0.29			53	
Effective Room Sensible Heat				6265	
ROOM LATENT HEAT					
Infiltration	CMH ×	g/kg ×	0.72		
People	5 People ×	49		245	
Steam		kg/h ×	540		
Appliances etc.					
Vapor Trans.					
			Sub Total		
Safety Factor			%		
Room Latent Heat Sub Total				245	
Supply Duct Leakage Loss			%	25	
Bypass Outside Air	100 CMH × 9.6 g/kg × 0.1 BF × 0.72			70	
Effective Room Latent Heat				340	
Effective Room Total Heat				6605	
OUTSIDE AIR HEAT					
Sensible:	CMH ×	deg × (1 − BF) × 0.29			
Latent:	CMH ×	g/kg × (1 − BF) × 0.72			
Grand Total Heat Sub Total					
Return Duct Heat Gain + Return Duct Leak Gain + Pump H.P + Pipe Gain			= %		
(U.S.R.T) Grand Total Heat					

Estimate For	AM / PM	Peak Load	AM / PM 3
Hours of Operation	Hour (	~	)

Outside Design Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Conditions	°CDB	°CWB	%RH		
Outside	42.2	28.6	37		19.0
Room	24.0		50		9.4
Difference	18.2	×××	×××	×××	9.6

Blind	Non-existence(outside, inside) L. H. D
Glass	Ordinary. Thick. Absorbent. %. Double
Color	Light. Medium. Dark.
Weight	kg/m²(Floor) kg/m²(Wall)
Internal Heat	W/m² m²/People

Infiltration

Swinging			
Revolving Doors	People ×	CMH/Per.	
Open Doors	Doors ×	CMH/Door	
Exhaust Air			
Crack	m ×	CMH/m	
Infiltration	CMH		

Ventilation

4 People ×	25	CMH/Per.	100
m² ×		CMH/m²	
Ventilation	CMH		

Sensible Heat Factor

E.S.H.F = 6.265 (ERSH) / 6.605 (ERTH) = 0.95 (12.5°C)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

6265 (ERSH) / (24 RM − 12.6 ADP)(1 − 0.1 BF) × 0.29 = 2.200 CMH

NOTES

GLASS (SE): 1.0 × 1.5 × 2 = 3.0
WALL (SE): 8.3 × 3.05 − 3.0 = 22.32
(NE): 7.9 × 3.05 = 24.1
CEILING: SR
FLOOR: SR
PARTITION (1) 2.85 × 2.8 = 7.98
(2) 5.4 × 2.8 = 15.12

FORM E-201

COOLING AND DEHUMIDIFYING ESTIMATE (METRIC)

Inquiring No. | Inquired By | Sheet No. - 20
Job Name | Address (M-2.) | Date Original
Space Used For WATER ANALYSIS & ANALITICAL INSTRUMENT ROOM SYSTEM | Revision
Size m × m = 134.75 m² × 2.8 m(H) = 377.3 m³ | Person in Charge

Item	Area or Quantity	Sun Gain or Temp. Diff.	Factor	Kcal/h 3:00	Correction
SOLAR GAIN — GLASS					
(SE)	3.0 m²	× 252 × 0.24/0.85 ×	0.94 × 0.65	131	
	m²	×	×		
	m²	×	×		
	m²	×	×		
	m²	×	×		
SOLAR & TRANS GAIN—WALLS & ROOF					
Wall (SE)	23.23 m²	× 12.9	× 0.53	159	
	m²	×	×		
	m²	×	×		
	m²	×	×		
Roof—Sun	m²	×	×		
Roof—Shaded	m²	×	×		
TRANS. GAIN—EXCEPT WALLS & ROOF					
Glass	3.0 m²	× 18.2	× 5.1	279	
Ceiling	134.75 m²	× 9.1	× 2.5²	3090	
Floor	134.76 m²	× 9.1	× 2.5²	3090	
Partition (1)	30.24 m²	× 9.1	× 1.51	688	
(2)	20.88 m²	× 9.1	× 1.69	322	
(3)	38.5 m²	× 9.1	× 1.69	592	
Door (IN)	7.2 m²	× 9.1	× 2.15	141	
INTERNAL HEAT					
People	7 People	× 41		287	
Kw	Kw	×	860		
Lights	134.75	× 20 W ×	1.08	2911	
Appliances etc.					
Credit for Thermal Storage	m²	× deg	×	(-)	(-)
			Sub Total		
Safety Factor			%		
Room Sensible Heat Sub Total				11690	
Supply Duct Heat Gain	Supply Duct +Leak Loss		+HP =10%	1169	
Bypass Outside Air	210 CMH	× 18.2 deg	× 0.1 B.F × 0.29	111	
Effective Room Sensible Heat ■				12970	
ROOM LATENT HEAT					
Infiltration	CMH	× g/kg	× 0.72		
People	7 People	× 49		343	
Steam	kg/h	×	540		
Appliances etc.					
Vapor Trans.					
			Sub Total		
Safety Factor			%		
Room Latent Heat Sub Total				343	
Supply Duct Leakage Loss			10 %	35	
Bypass Outside Air	219 CMH	× 9.6 g/kg	× 0.1 BF × 0.72	146	
Effective Room Latent Heat ■				524	
Effective Room Total Heat ▣				13494	
OUTSIDE AIR HEAT					
Sensible:	CMH	× deg	× (1 − BF) × 0.29		
Latent:	CMH	× g/kg	× (1 − BF) × 0.72		
Grand Total Heat Sub Total					
Return Duct Heat Gain ÷ Return Duct Leak Gain		Pump H.P	Pipe Gain = %		
(U.S.R.T) Grand Total Heat ▣					

Estimate For.	AM / PM	Peak Load	AM / PM 3
Hours of Operation	Hour (	~	)

Outside Design Conditions	DB °C	WB °C	%RH	DP °C	g/kg
Conditions					
Outside	42.2	28.6	37		19.0
Room	24.0		50		9.4
Difference	18.2	×××	×××	×××	9.6

Blind	Non-Existence (Outside, Inside)	L. M. D
Glass	Ordinary. Thick. Absorbent.	%. Double
Color	Light. Medium. Dark.	
Weight	kg/m² (Floor)	kg/m² (Wall)
Internal Heat	W/m²	m²/People

Infiltration

Swinging		
Revolving Doors	People × CMH/Per.	
Open Doors	Doors × CMH/Door	
Exhaust Air		
Crack	m × CMH/m	
Infiltration	CMH ■	

Ventilation

7 People ×	25 CMH/Per.	175
m² ×	CMH/m²	↓
Ventilation	CMH ■	210

Sensible Heat Factor

E.S.H.F = 12.970 (ERSH) / 13494 (ERTH) = 0.96 (12.6°C)

Dehumidified Air

Apparatus Dewpoint 12.6 °C

12.970 (ERSH) / (24RM − 12.6(ADP))(1 − BF)/0.1 × 0.29 = 4400 CMH

NOTES

SR = 13.75 × 8.6 + 5.5 × 3.0 = 134.75

GLASS (SE) : 1.0 × 1.5 × 2 = 3.0

WALL (SE) : 8.6 × 3.05 − 3.0 = 23.23

CEILING : SR

FLOOR : SR

PARTITION (1) : 19.8 × 2.8 − 5.4 = 50.04

(2) : 8.1 × 2.8 − 1.8 = 20.88

(3) : 13.75 × 2.8 = 38.5

DOOR (IN) : 1.8 × 2.0 + 0.9 × 2.0 × 2 = 7.2

FORM E-205

5. EQUIPMENT LOAD

5-1 AHU-1 x 2ea (100% STANBY)

(1) CONDITIONS

		D.B	W.B	ENTHALPY
ROOM	:	24.0°C	17.1°C	11.5 kcal/kg
OUTSIDE	:	42.2°C	28.6°C	22.0 kcal/kg
R S.H	:	59.011 kcal/H		
S.H.F	:	0.99		
DEHUMIDIFIED AIR	:	20.700 m³/H		
OUT AIR	:	250 m³/H		
RETURN AIR	:	20.450		

(2) REQUIRED COOLING CAPACITY

$$\text{MIX POINT} = \frac{250\ m^3/H \times 22.0\ kcal/kg + 20450\ m^3/H \times 11.5\ kcal/kg}{20.700\ m^3/H} = 11.6\ kcal/kg$$

$$\therefore [\ 20.700\ m^3/H \times 1.2\ kg/m^3 \times (11.6 - 8.7)\ kcal/kg \times (1 - 0.1)\ BF \times 1.05$$

$$= 68.000\ kcal/H$$

⊙ PEAK LOAD (PM 3:00)

E.R.T.H : 59.725 kcal/H

OUTSIDE AIR HEAT : $250\ m^3/h \times 18.2 \times (1-0.1) \times 0.29 = 1.188\ kcal/h$ ... ②

$250\ m^3/H \times 9.6 \times (1-0.1) \times 0.72 = 1.556\ kcal/h$ ... ③

TOTAL = ① + ② + ③

$= (59.725 + 1.188 + 1556) \times 1.05 = 66.000\ kcal/h$

PSYCHROMETRIC CHART

ZONE NAME : COMPUTER ROOM (AC-1)

SA : 20.700 CMH

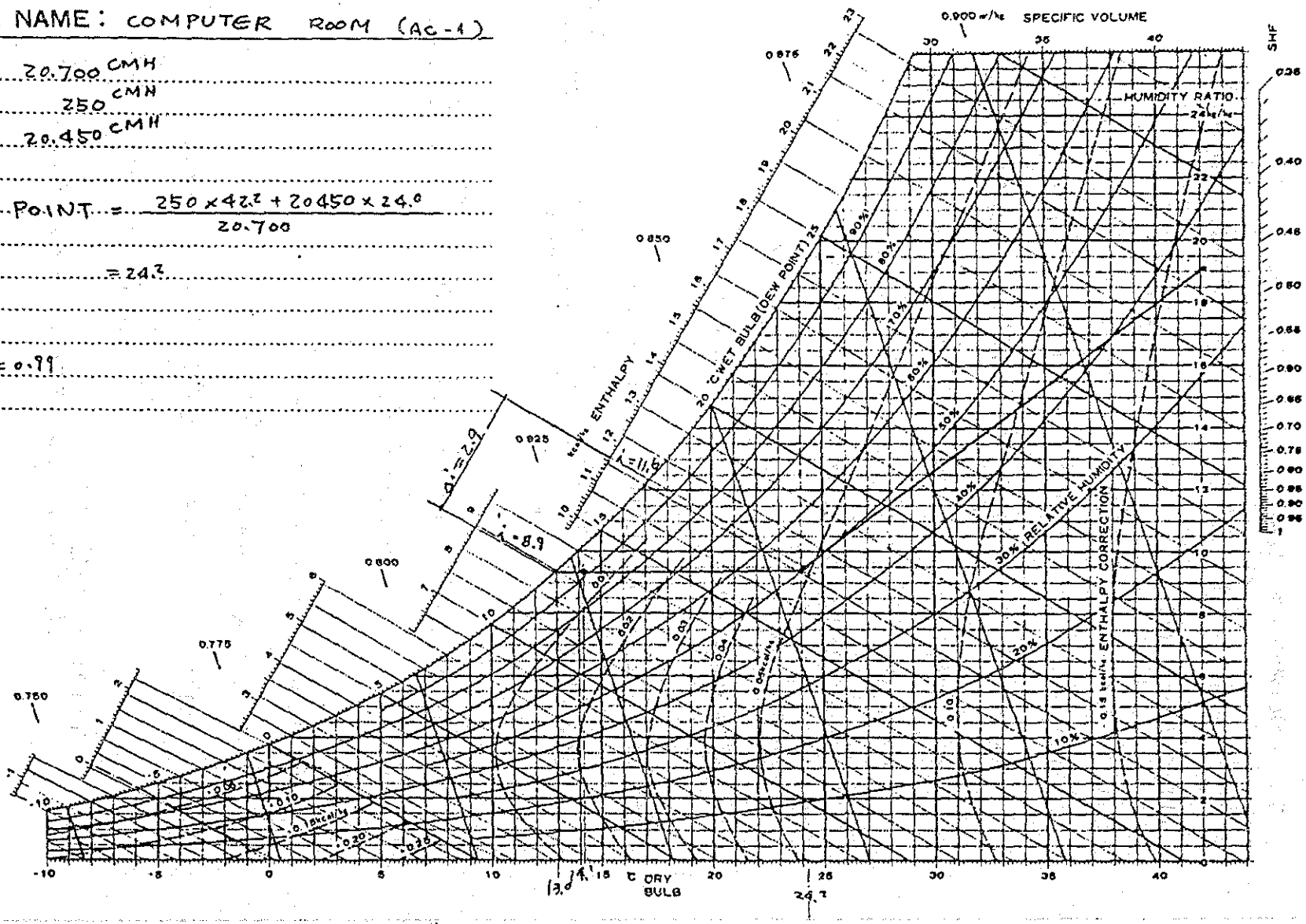
OA : 250 CMH

RA : 20.450 CMH

MIX POINT = $\frac{250 \times 42.2 + 20450 \times 24.0}{20.700}$

= 24.2

SHF = 0.99



P73

22

5 - 2 AHU - 2 x2 ea (50% x 2)

(1) CONDITIONS

		D.B	W.B	ENTHALPY
ROOM	:	24.0 °C	17.1 °C	11.5 kcal/kg
OUTSIDE	:	42.2 °C	28.6 °C	22.0 kcal/kg
R S.H	:	67.893 kcal/H /2 = 33.947 kcal/H		
S.H.F	:	0.9		
DEHUMIDIFIED AIR	:	23000 m³/H /2 = 11500 m³/H		
OUT AIR	:	1.650 m³/H /2 = 825		
RETURN AIR	:	21.350 m³/H /2 = 10675		

(2) REQUIRED COOLING CAPACITY

$$\text{MIX POINT} = \frac{825^{m^3/H} \times 22.0^{kcal/kg} + 10675^{m^3/H} \times 11.5^{kcal/kg}}{11.500} = 12.3\ kcal/kg$$

$$\therefore [\ 11500^{m^3/H} \times 1.2^{kg/m^3} \times (12.3 - 8.6)^{kcal/kg} \times (1 - 0.1)^{BF} \times 1.05$$

$$= 48.000\ kcal/H$$

⊙ PEAK LOAD (PM 3:00)

E.R.T.H : 70452 kcal/H ...①

OUTSIDE AIR HEAT : $1650^{m^3/H} \times 18.2 \times (1-0.1) \times 0.29 = 7.838^{kcal/H}$ ...②

$1650^{m^3/H} \times 9.6 \times (1-0.1) \times 0.72 = 10.265^{kcal/H}$ ...③

TOTAL = ① + ② + ③

= (70452 + 7838 + 10265) × 1.05 /2 = 47.000 kcal/H

PSYCHROMETRIC CHART

ZONE NAME: CENTRAL CONTROL ROOM etc (AC-2 x 2)

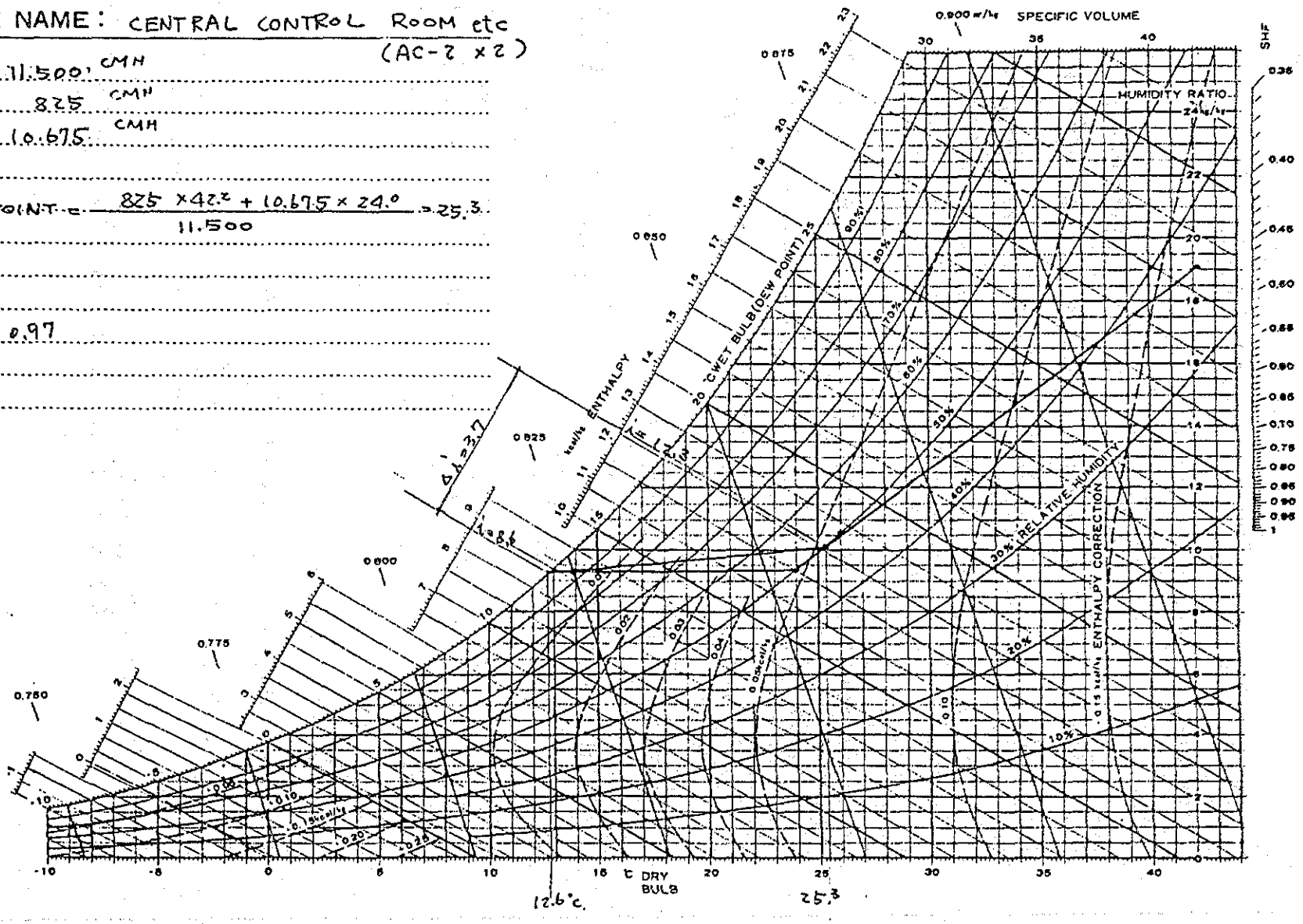
SA : 11.500 CMH

OA : 825 CMH

RA : 10.675 CMH

MIX POINT = $\frac{825 \times 42.2 + 10.675 \times 24.0}{11.500} = 25.3$

SHF = 0.97



P75

5 - 3 AHU - 3 × 2ea (50% × 2)

(1) CONDITIONS

		D.B	W.B	ENTHALPY
ROOM	:	24.0 °C	17.1 °C.	11.5 Kcal/kg
OUTSIDE	:	42.2 °C	28.6 °C	22.0 Kcal/kg
R S.H	:	41.733	Kcal/H /2 = 20.867 Kcal/H	
S.H.F	:	0.99		
DEHUMIDIFIED AIR	:	14.600 m^3/H	/2 = 7300 m^3/H	
OUT AIR	:	150 m^3/H	/2 = 75	
RETURN AIR	:	14.450 m^3/H	/2 = 7.225	

(2) REQUIRED COOLING CAPACITY

$$\text{MIX POINT} = \frac{75\ m^3/H \times 22.0\ Kcal/kg + 7.225\ m^3/H \times 11.5\ Kcal/kg}{7.300} = 11.6\ Kcal/kg$$

$$\therefore \{ 7.300\ m^3/H \times 1.2\ kg/m^3 \times (11.6 - 8.7)\ Kcal/kg \times (1 - 0.1) \times 1.05 \quad BF$$

$$= 24.000\ Kcal/H$$

⊙ PEAK LOAD (PM 3:00)

E.R.T.H = 42.160 Kcal/H ... ①

OUTSIDE AIR HEAT : $150\ m^3/H \times 18.2 \times (1 - 0.1) \times 0.29 = 713\ Kcal/H$ ... ②

$150\ m^3/H \times 9.6 \times (1 - 0.1) \times 0.72 = 934\ Kcal/H$ ... ③

TOTAL = ① + ② + ③

$= (42.160 + 713 + 934) \times 1.05 / 2 = 23.000\ Kcal/H$

906

PSYCHROMETRIC CHART

ZONE NAME : UNIT NO.1 & NO.2 CONTROL EQUIPMENT ROOM (AC-3×2)

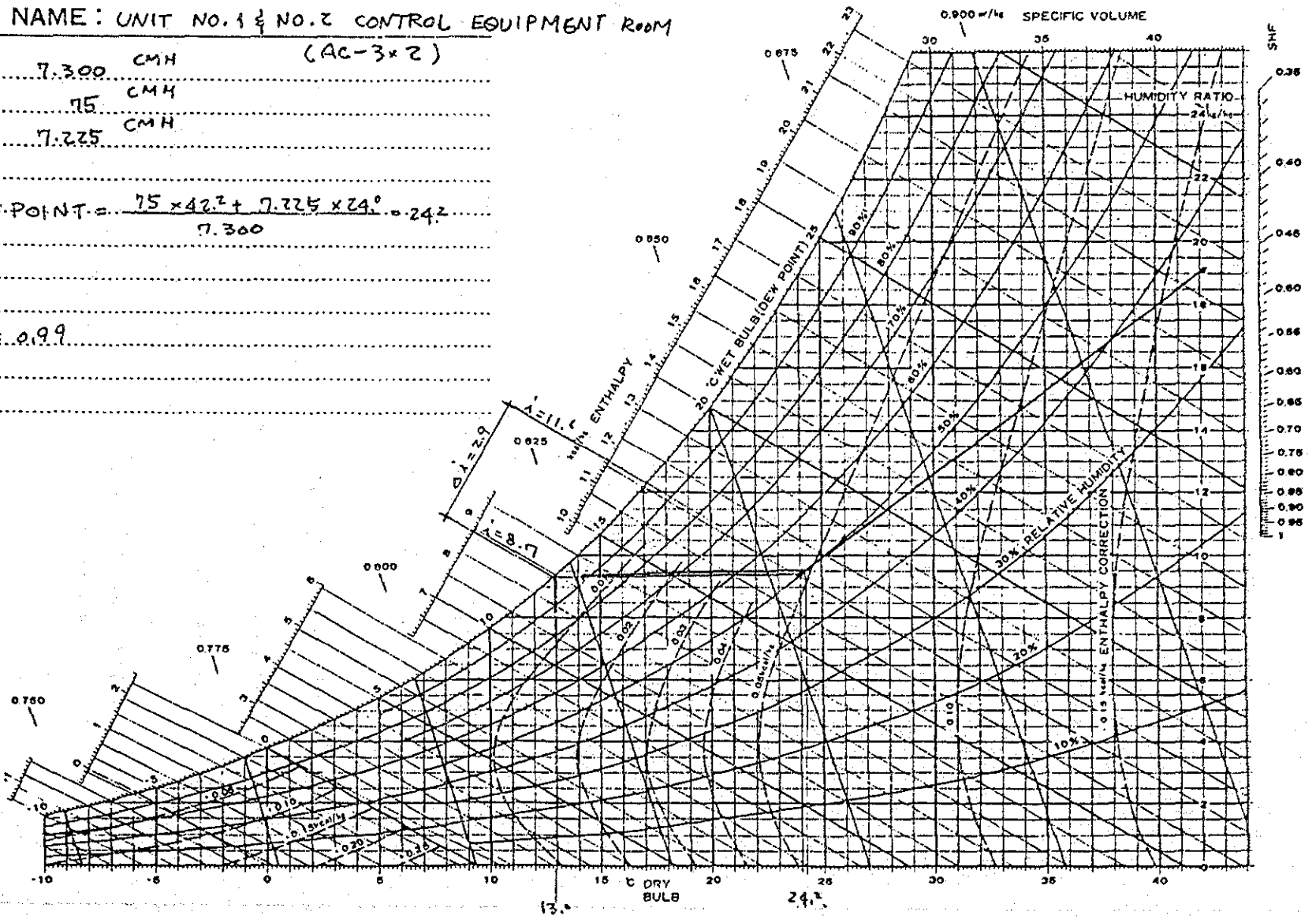
SA : 7.300 CMH

OA : 75 CMH

RA : 7.225 CMH

MIX POINT = $\frac{75 \times 42.2 + 7.225 \times 24^{\circ}}{7.300} = 24.2$

SHF = 0.99



877

5 - 4 AHU - 4 x 2 ea (50% x 2)

(1) CONDITIONS

		D.B	W.B	ENTHALPY
ROOM	:	24.0°C	17.1°C.	11.5 Kcal/kg
OUTSIDE	:	42.2°C	28.6°C	22.0 Kcal/kg
R S.H	:	19.235	Kcal/H/2 = 9.618 Kcal/H	
S.H.F	:	0.96		
DEHUMIDIFIED AIR	:	6.600 m^3/H /2 = 3.300		
OUT AIR	:	310 m^3/H /2 = 155		
RETURN AIR	:	6.290 m^3/H /2 = 3.145		

(2) REQUIRED COOLING CAPACITY

$$\text{MIX POINT} = \frac{155\ m^3/H \times 22.0\ Kcal/kg + 3.145\ m^3/H \times 11.5\ Kcal/kg}{3.300} = 12.0\ Kcal/kg$$

$$\therefore [\ 3.300\ m^3/H \times 1.2\ kg/m^3 \times (12.0 - 8.5)\ Kcal/kg \times (1 - 0.1)\ BF \times 1.05 = 13.000\ Kcal/H$$

① PEAK LOAD (PM 3:00)

E.R.T.H = 20.069 Kcal/H ... ①

OUTSIDE AIR HEAT : $310\ m^3/H \times 18.2 \times (1-0.1) \times 0.29 = 1.473$ Kcal/H ... ②

$310\ m^3/H \times 9.6 \times (1-0.1) \times 0.72 = 1.929$ ... ③

TOTAL = ① + ② + ③

= (20.069 + 1.473 + 1.929) x 1.05/2 = 13.000 Kcal/H

PSYCHROMETRIC CHART

ZONE NAME : FUEL LABORATORY
WATER ANALYSIS & ANALITICAL INSTRUMENT RM

(AC-4)

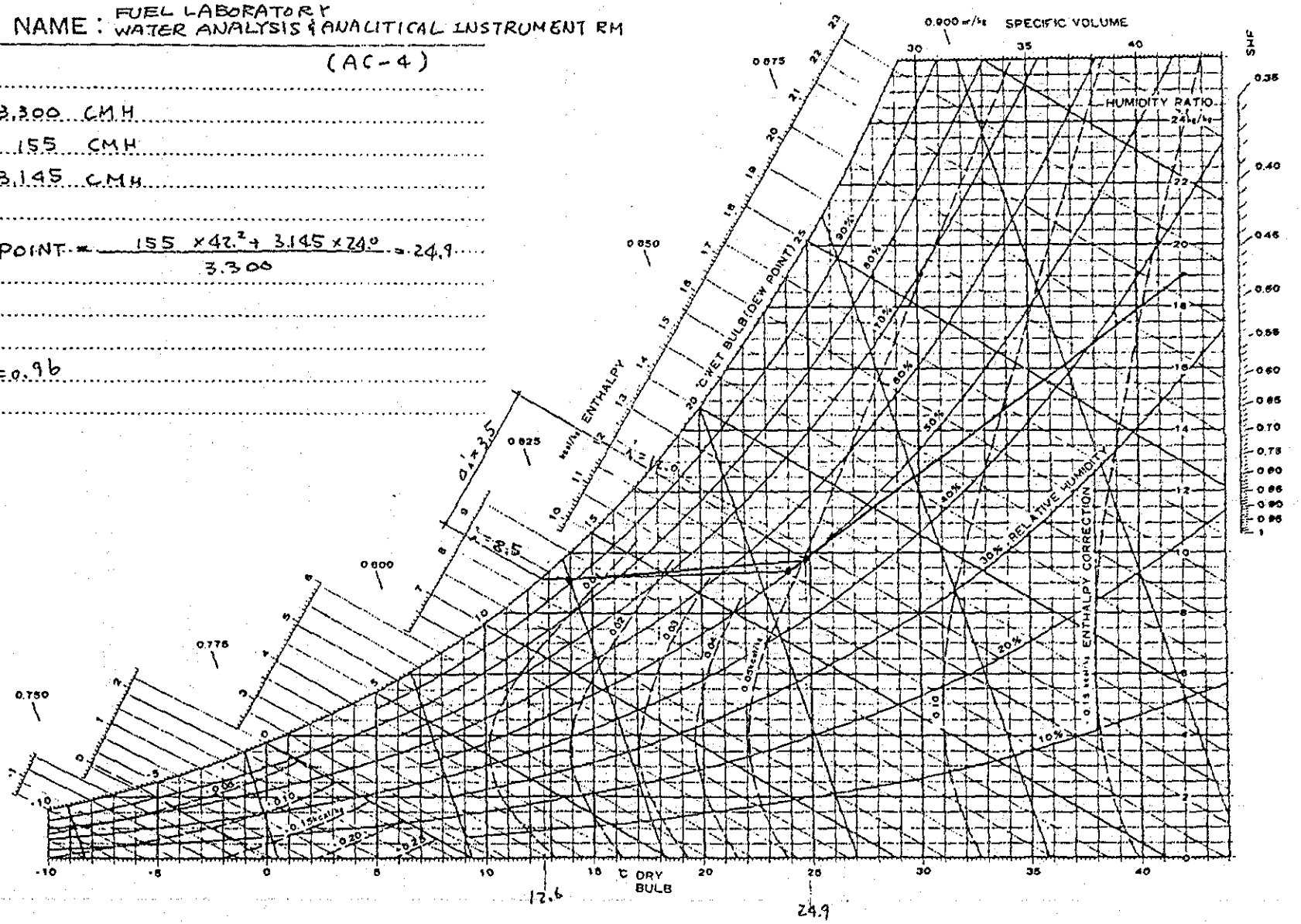
SA : 3,300 CMH

OA : 155 CMH

RA : 3,145 CMH

MIX POINT = $\frac{155 \times 42.^{2} + 3,145 \times 24.^{0}}{3,300} = 24.9$

SHF = 0.96



25

6. SELECTION OF COOLING EQUIPMENT

6-1. TOTAL LOAD SAMMARY

AHU-1 66.000 Kcal/H/2 (REHEAT 20.000 kal/H)

AHU-2. 94 000 Kcal/H/2

AHU-3 46 000 Kcal/H/2

AHU-4 26.000 Kcal/H/2

TOTAL 116.000 Kcal/H ..... RT-2 (50% x 2 ea)

• CAPACITY , CHILLED WATER.

RT-1. FOR AHU-1

66.000 Kcal/H /3024 = 22 RT

66.000 Kcal/H /5x60 = 220 l/min

RT-2. FOR AHU-1 ~ 4.

116.000 Kcal/H/3024 = 39 RT

116.000 Kcal/H /5x60 = 387 l/min

6.-2 EQUIPMENT

(1) AIR COOLED
PACKAGED, LIQUID CHILLER UNIT

R-1

COOLING LOAD CAPACITY : 66,000 Kcal/Hr (22 RT)

CHILLED WATER

WATER TEMP. : IN 12 - OUT 7 °C

WATER FLOW RATE : 220 lit/min

WATER FRICTION LOSS : 0.8 m (COIL SECTION)

CONNECTION PIPE DIA. : ϕ 65 (GAS STEEL PIPE)

REFRIGERANT TYPE : R- 22

ELECTRIC POWER(OUTPUT)

COMPRESSOR : 30 Kw (3ϕ - V)

FAN : 0.75x3 Kw (-do-)

: Kw (-do-)

: Kw (-do-)

DIMENSION : W 3,300 x D 1,200 x H 2000 (mm)

WEIGHT : Kg (OPERATING 1,810 Kg)

Mfr. MODEL NO : 30AE040 (or equal)
(CARRIER)

NOTE : TON IS REFGIGERATION(U.S) IS 3,024 Kcal/Hr.

AIR COOLED
PACKAGED LIQUID CHILLER UNIT

R - 2 x 2 ea

COOLING LOAD CAPACITY : 116.000 Kcal/Hr (39 RT)

CHILLED WATER

WATER TEMP. : IN 12 - OUT 7 °C

WATER FLOW RATE : 387 lit/min

WATER FRICTION LOSS : 2.1 m (COIL SECTION)

CONNECTION PIPE DIA. : ϕ 80 (GAS STEEL PIPE)

REFRIGERANT TYPE : R- 22

ELECTRIC POWER(OUTPUT)

COMPRESSOR : 30 x 2 Kw (3ϕ - 380 V)

FAN : 0.75 x 6 Kw (-do-)

: Kw (-do-)

: Kw (-do-)

DIMENSION : W 3.690 x D 2.000 x H 2.300 (mm)

WEIGHT : Kg (OPERATING 2.810 Kg)

Mfr. MODEL NO : 30AE 080 (or equal)
(CARRIER)

NOTE : TON IS REFGIGERATION(U.S) IS 3,024 Kcal/Hr.

202

(2) PUMP

PUMP / VOLUTE CWP - 1 x 20A

WATER RATE FLOW	:	220	lit/min
WATER FLOW PIPE DIA.	:	ϕ 65	
WATER FLOW SPEED	:	1.1	m/sec
PIPE FRICTION LOSS(R)	:	40	mmAq/m
PIPE EQUIVALENT LENGTH (Le)			
STRAIGHT PIPE	:	150	m
ELBOW	:	ea x m/ea=	150 m
GATE VALVE	:	ea x m/ea=	x m
CHECK VALVE	:	ea x m/ea=	0.5 m
OTHERS	:	=	= 75 m
TOTAL (Le)			225 m

PIPE HEAD LOSS(*1) : (Le) 225 m x (R) 0.04 = 9 m

LIFT HEAD(*2) : 5 m

EQUIPMENT or OTHERS HEAD LOSS

1. R-1 Coil	:	0.8	m
2. AHU coil	:	2	m
3. Reheater	:	2	m
4.	:		m
TOTAL (*3)		4.8	m

TOTAL PIPE HEAD LOSS : (*1)+(*2)+(*3) = 18.8 m x 10%
= 20 m

SELECTION OF PUMP

TYPE	:	(VOLUTE) / TURBINE / IN_LINE
DIA.	:	ϕ 50x40
WATER FLOW RATE	:	220 lit/min
POWER OUTPUT	:	2.2 Kw (ϕ 3 - 380 V)
NUMBER	:	2 ea
WEIGHT	:	81 Kg
Mfr. MODEL NO.	:	50x40 FS4J 52.2 or equal (EBARA)

NOTE :

PUMP / VOLUTE CWP-2 x2eq

WATER RATE FLOW	:		387	lit/min
WATER FLOW PIPE DIA.	:	ϕ 80		
WATER FLOW SPEED	:		1.2	m/sec
PIPE FRICTION LOSS(R)	:		40	mmAq/m
PIPE EQUIVALENT LENGTH (Le)				
STRAIGHT PIPE	:		160	m
ELBOW	:	ea x	m/ea=	m
GATE VALVE	:	ea x	m/ea=	160 x 0.5 m
CHECK VALVE	:	ea x	m/ea=	m
OTHERS	:		=	= 80 m
TOTAL (Le)				240 m
PIPE HEAD LOSS(*1)	:	(Le) 240 m x(R)0.04		= 9.6 m
LIFT HEAD(*2)	:		5	m
EQUIPMENT or OTHERS HEAD LOSS				
1. R-1 Coil	:		2.1	m
2. AHU Coil	:		2	m
3.	:			m
4.	:			m
TOTAL (*3)			4.1	m

TOTAL PIPE HEAD LOSS :(*1)+(*2)+(*3)= 18.7 m x 10%
= 20 m

SELECTION OF PUMP

TYPE	: (VOLUTE) / TURBINE / IN_LINE	
DIA.	: ϕ 65x50	
WATER FLOW RATE	: 387	lit/min
POWER OUTPUT	: 3.7	Kw (ϕ 3 - 380 V)
NUMBER	: 2	ea
WEIGHT	: 130	Kg
Mfr. MODEL NO.	: 65x50FS4J53.7 (EBARA)	or equal

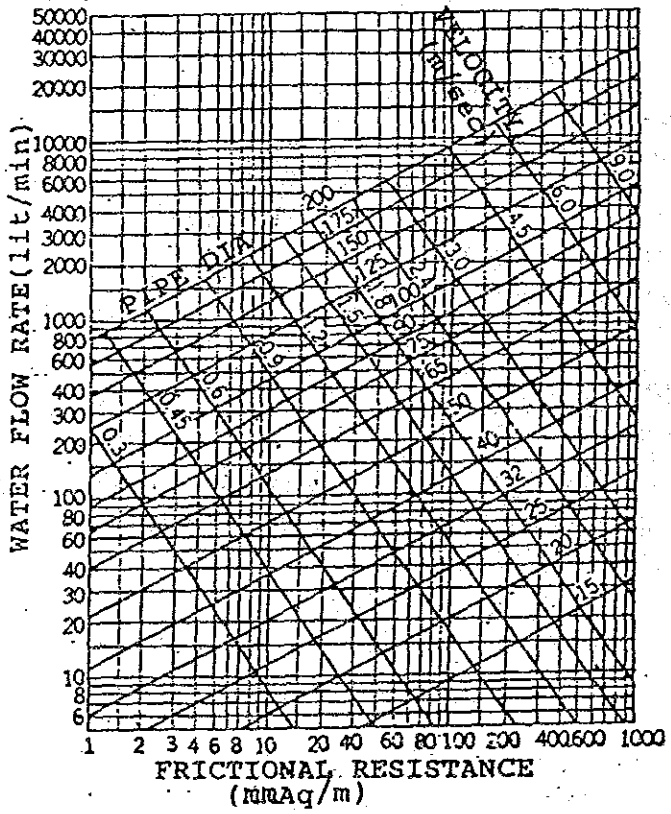
NOTE :

* EQUIVALENT LENGTH OF PIPE FITTINGS & VALVES

DIA	90°ELBOW	90°TEE	GATE VALVE	GLOVE VALVE	CHECK VALVE
20	0.75	1.2	0.15	6.0	1.6
25	0.9	1.5	0.18	7.5	2.0
32	1.2	1.8	0.24	10.5	2.5
40	1.5	2.1	0.3	13.5	3.1
50	2.1	3.0	0.39	16.5	4.0
65	2.4	3.6	0.48	19.5	4.6
80	3.0	4.5	0.63	24.0	5.7
100	4.2	6.3	0.81	37.5	7.6
125	5.1	7.5	0.99	42.0	10.0
150	6.0	9.0	1.20	49.5	12.0
200	6.5	14.0	1.40	70.0	15.0
250	8.0	20.0	1.70	90.0	19.0

* FRICTIONAL RESISTANCE CHART OF PIPING

(at GALVANIZED STEEL PIPE)



(3) AIR HANDLING UNIT

AHU-1 x 2ea (one for stand by)

AIR FLOW RATE : 20.700 m^3/H (345 m^3/min)

COOLING LOAD : 66.000 Kcal/H (REHEAT LOAD : 20.000 Kcal/H)

FAN MOTOR : 11 KW

EXTERNAL STATIC PRES. : 70 mmAq

AIR INLET : 24.2°C DB , 17.2°C WB , 11.6 Kcal/Kg

OUTLET : 14.1°C DB , 13.4°C WB , 9.0 Kcal/Kg

CHILLED WATER : 220 lit/min (66.000 /5x60)

TYPE	:	VERTICAL
AIR FLOW RATE	:	20.700 m^3/H
COOLING COIL	:	1 x 26
FAN MOTOR	:	11 Kw , REHEATER : 24 KW
POWER	:	Ø3- 380 V, 50Hz
TAPPING SIZE	:	CHILLED WATER 65Ax2, DRAIN 20A
DIMENSION	:	3000 x 845 x 1.930 H (mm)
WEIGHT	:	1.660 Kg

MODEL : 39 ACJ 11 (CARRIER)

988

AIR HANDLING UNIT

AHU-2 x 2 ea

AIR FLOW RATE	:	11.500 m^3/H (192 m^3/min)
COOLING LOAD	:	47.000 Kcal/H
FAN MOTOR	:	3.7 KW
EXTERNAL STATIC PRES.	:	60 mmAq
AIR INLET	:	25.3°C DB , 17.3°C WB , 12.3 Kcal/Kg
OUTLET		13.9°C DB , 13.4°C WB , 9.° Kcal/Kg
CHILLED WATER	:	157 lit/min (47.000/6x60)

TYPE	:	VERTICAL
AIR FLOW RATE	:	11.500 m^3/H
COOLING COIL	:	1x22
FAN MOTOR	:	3.7 Kw
POWER	:	Ø3-380 V, 50Hz
TAPPING SIZE	:	CHILLED WATER 40 Ax2, DRAIN 20 A
DIMENSION	:	2090 x 780 x 1.790 H (mm)
WEIGHT	:	1.060 Kg

MODEL : 39ACJ 9 (CARRIER)

AIR HANDLING UNIT

AHU-3 x 2 ea

AIR FLOW RATE	:	7.300 m^3/H (122 m^3/min)
COOLING LOAD	:	23.000 Kcal/H
FAN MOTOR	:	2.2KW
EXTERNAL STATIC PRES.	:	60 mmAq
AIR INLET	:	24.2°C DB , 17.2°C WB , 11.6 Kcal/Kg
OUTLET		14.1 °C DB , 13.4 °C WB , 9.0 Kcal/Kg
CHILLED WATER	:	77 lit/min (23.000 /5x60)

TYPE	:	VERTICAL
AIR FLOW RATE	:	7.300 m^3/H
COOLING COIL	:	1 x 22
FAN MOTOR	:	2.2 Kw
POWER	:	Ø3-380 V, 50Hz
TAPPING SIZE	:	CHILLED WATER 40 Ax2, DRAIN 20 A
DIMENSION	:	1.580 x 780 x 1.790 H (mm)
WEIGHT	:	810 Kg

MODEL : 39 ACJ 8 (CARRIER)

888

AIR HANDLING UNIT

AHU - 4 x 2ea

AIR FLOW RATE	:	3.300 m^3/H (55 m^3/min)
COOLING LOAD	:	13.000 Kcal/H
FAN MOTOR	:	1.5 KW
EXTERNAL STATIC PRES.	:	60 mmAq
AIR INLET	:	24.9 °C DB, 17.7 °C WB, 12.0 Kcal/Kg
OUTLET		13.8 °C DB, 13.1 °C WB, 8.8 Kcal/Kg
CHILLED WATER	:	44 lit/min (13.000 / 5x60)

TYPE	:	VERTICAL
AIR FLOW RATE	:	3.300 m^3/H
COOLING COIL	:	1 x 16
FAN MOTOR	:	1.5 Kw
POWER	:	Ø3 - 380 V, 50Hz
TAPPING SIZE	:	CHILLED WATER 32 Ax2, DRAIN 20 A
DIMENSION	:	1.125 x 670 x 1.550 H (mm)
WEIGHT	:	360 Kg

MODEL : 39 ACJ 6 (CARRIER)

989

7.7 換 気

7. VENTILATION SYSTEM

7-1 ESTIMATE OF VENTILATION AIR VOLUME

FLOOR	ROOM NAME	AREA (m^2)	VOL. (m^3)	AIR CHANGE (T/Hr)	AIR FLOW (m^3/Hr)	EXHAUST AIR (m^3/Hr)	SUPPLY AIR (m^3/Hr)	
MEZZANINE FLOOR	STORAGE ROOM	14.6	40.9	5	205	210 *	-	(III) VF-4
	BATTERY ROOM	144.5	404.6	10	4046	-		(I)
				35 m^3/m^3	5058 *	5060	5060	OAG EF-3
	SUB TOTAL					5.270	5060	
CABLE TREATMENT FLOOR	CABLE TREATMENT AREA	628.9	1509	10	15090	15100	15100	OF-1 (I) EF-1
	SUB TOTAL					15.100		
OPERATING FLOOR	KITCHEN	5.4	16.2	10	162	170		(III) VF-5
	LAVATORY	19.1	57.3	10	573	600 *	650	(III) VF-2
	JAN	2.3	6.9	5	35	50 *		(III) VF-7
	SUB TOTAL					820		
FORTH FLOOR	LOCKER ROOM	22.4	62.7	10	627	630 *	1000	(III) VF-1
	KITCHEN	5.3	14.8	10	14.8	150		(III) VF-6
	JAN	2.3	6.4	5	32	50 *		(III) VF-7
	LAVATORY	11.5	32.2	10	322	320 *		(III) VF-3
	AIR CONDITIONING MACHINE ROOM	310	1500	10	15000	15000		(III) EF-2
	SUB TOTAL					16.150		
ROOF	TURBINE ROOM	$\frac{200.000\ KW \times 0.003 \times 860\ Kcal/KW}{0.29 \times 5}$			=355.862 ≒356.000 /16 = 22.300 /EA			(III) RF-1
		VR = 22.0×111.6×15.5 + 10.0×111.6×5 = 43,435 m^3		7	305.450			

900

7-2 SELECTION OF VENTILATION EQUIPMENT

V - 1

MEZZANINE FLOOR STORAGE ROOM

MACHINE NO	VF-4	
TYPE OF VENTILATOR	: CEILING	x 1 ea
AIR FLOW RATE	: 210 m^3/Hr	x 8 mmAq
FAN MOTOR	: ~~KW~~ or 35 w	
POWER	: 1φ 220v / ~~3φ ——— v~~	(50/~~60~~ Hz)
SIZE	: 308 x 308 x 226H	(mm)
ACCESSORY	: 150φ VENT CAP	

V - 2

MEZZANINE FLOOR BATTERY ROOM

MACHINE NO	EF-2 SS #2½	
TYPE OF VENTILATOR	: CENTIFUGAL MULTI-BANE	x 1 ea
AIR FLOW RATE	: 5060 m^3/Hr	x 25 mmAq
FAN MOTOR	: 1.5 KW or	w
POWER	: ~~1φ 220v~~ / 3φ 580v	(50/~~60~~ Hz)
SIZE	: 960L x 360W x 805H.	(mm)
ACCESSORY	:	

V - 3

CABLE TREATMENT AREA

MACHINE NO	EF-1 (OF-1) SS #4	
TYPE OF VENTILATOR	: DITTO	x 1+1 ea
AIR FLOW RATE	: 15100 m^3/Hr	x 25 mmAq
FAN MOTOR	: 3.7 KW or	w
POWER	: ~~1φ 220v~~ / 3φ 380v	(50/~~60~~ Hz)
SIZE	: 1540L x 545W x 1.140H	(mm)
ACCESSORY	:	

V - 4

OPERATING FLOOR KITCHEN

MACHINE NO		VF-5
TYPE OF VENTILATOR	:	CEILING x 1 ea
AIR FLOW RATE	:	170 m^3/Hr x 8 mmAq
FAN MOTOR	:	~~KW~~ or 35 w
POWER	:	1φ 220v / ~~3φ 380v~~ (50/~~60~~ Hz)
SIZE	:	308 x 308 x 226" (mm)
ACCESSORY	:	150φ VENT CAP

V - 5

OPERATING FLOOR LAVATORY

MACHINE NO		VF-2
TYPE OF VENTILATOR	:	CEILING x 1 ea
AIR FLOW RATE	:	600 m^3/Hr x 8 mmAq
FAN MOTOR	:	~~KW~~ or 95 w
POWER	:	1φ 220v / ~~3φ 380v~~ (50/~~60~~ Hz)
SIZE	:	464 x 464 x 278" (mm)
ACCESSORY	:	150φ VENT CAP

V - 6

OPERATING FLOOR JAN (= FORTH FLOOR JAN)

MACHINE NO		VF-7
TYPE OF VENTILATOR	:	CEILING x 2 ea
AIR FLOW RATE	:	50 m^3/Hr x 6 mmAq
FAN MOTOR	:	~~KW~~ or 18 w
POWER	:	1φ 220v / ~~3φ 380v~~ (50/~~60~~ Hz)
SIZE	:	223 x 223 x 165.5 (mm)
ACCESSORY	:	100φ VENT CAP

V - 7

FORTH FLOOR LOCKER ROOM

MACHINE NO	VF - 1	
TYPE OF VENTILATOR	: CEILING	x 1 ea
AIR FLOW RATE	:	630 m^3/Hr x 8 mmAq
FAN MOTOR	:	~~xx~~ or 95 w
POWER	:	1ϕ 220v / ~~3ϕ 380v~~ (50/60 Hz)
SIZE	:	464 x 464 x 278H (mm)
ACCESSORY	:	150ϕ VENT CAP

V - 8

FORTH FLOOR KITCHEN

MACHINE NO	VF - 6	
TYPE OF VENTILATOR	: CEILING	x 1 ea
AIR FLOW RATE	:	150 m^3/Hr x 8 mmAq
FAN MOTOR	:	~~xx~~ or 35 w
POWER	:	1ϕ 220v / ~~3ϕ 380v~~ (50/60 Hz)
SIZE	:	308 x 308 x 243H (mm)
ACCESSORY	:	150ϕ VENT CAP

V - 9

FORTH FLOOR LAVATORY

MACHINE NO	VF - 3	
TYPE OF VENTILATOR	: CEILING	x 1 ea
AIR FLOW RATE	:	320 m^3/Hr x 7 mmAq
FAN MOTOR	:	~~xx~~ or 46 w
POWER	:	1ϕ 220v / ~~3ϕ 380v~~ (50/60 Hz)
SIZE	:	345 x 345 x 243H (mm)
ACCESSORY	:	150ϕ VENT CAP

P23

V - 10

FORTH FLOOR AIR CONDITIONING MACHINE ROOM

MACHINE NO	EF-3	
TYPE OF VENTILATOR	: AXIAL.	x 1 ea
AIR FLOW RATE	: 15.000 m^3/Hr	x 15 mmAq
FAN MOTOR	: 2.2 KW or	w
POWER	: ~~1ϕ 220v~~ / 3ϕ 380v	(50/60 Hz)
SIZE	: x x	(mm)
ACCESSORY	:	

V - 11

ROOF TURBINE ROOM.

MACHINE NO	RF-1.	
TYPE OF VENTILATOR	: ROOF VENTILATOR	x 16 ea
AIR FLOW RATE	: 22.300 m^3/Hr	x 10 mmAq (+1200)
FAN MOTOR	: 3.7 KW or	w
POWER	: ~~1ϕ 220v~~ / 3ϕ 380v	(50/~~60~~ Hz)
SIZE	: 2.250 x 2.250 x 1520H.	(mm)
ACCESSORY	:	

V - 1

MACHINE NO		
TYPE OF VENTILATOR	:	x ea
AIR FLOW RATE	:	m^3/Hr
FAN MOTOR	:	KW or w
POWER	: 1ϕ 220v / 3ϕ	v (50/60 Hz)
SIZE	: x x	(mm)
ACCESSORY	:	

V - 12.

FORTH FLOOR : AIR CONDITIONING MACHINE ROOM

MACHINE NO	EF-4	<FOR AHU-1>
TYPE OF VENTILATOR	:	AXIAL x 1 ea
AIR FLOW RATE	:	250 m^3/Hr x 10 mmAq
FAN MOTOR	:	~~xxW~~ or 80 W
POWER	:	1ϕ 220v / ~~3ϕ xxx~~ (50/~~60~~ Hz)
SIZE	:	375$^{\phi}$ x 320^{L} x (mm)
ACCESSORY	:	

V - 13

MACHINE NO	EF-5	<FOR AHU-3>
TYPE OF VENTILATOR	:	AXIAL x 1 ea
AIR FLOW RATE	:	150 m^3/Hr x 10 mmAq
FAN MOTOR	:	~~xxW~~ or 12 W
POWER	:	1ϕ 220v / ~~3ϕ xxx~~ (50/60 Hz)
SIZE	:	250$^{\phi}$ x 220^{L} x 274^{H} (mm)
ACCESSORY	:	

V - 14

MACHINE NO	EF-6	<FOR AHU-4>
TYPE OF VENTILATOR	:	AXAL x 1 ea
AIR FLOW RATE	:	100 m^3/Hr x 7 mmAq
FAN MOTOR	:	~~xxW~~ or 12 W
POWER	:	1ϕ 220v / ~~3ϕ xxx~~ (50/~~60~~ Hz)
SIZE	:	250$^{\phi}$ x 220^{L} x 274^{H} (mm)
ACCESSORY	:	

AR-8. Calculation Sheets For Air Conditioning and Ventilation System For Administration Building

C O N T E N T S

1. DESIGN CRITERIA ——— 1

2. DATA ——— 2

3. HEAT TRANSMISSION ——— 4

4. ROOM LOAD SUMMRY ——— 6

5. EQUIPMENT LOAD ——— 43

6. SELECTION OF
COOLING EQUIPMENT ——— 47

7. VENTILATION ——— 49

1. DESIGN CRITERIA

1 - 1 DESIGN CONDITION

1) For air conditioning system

(a) Outdoor air

Summer : 42.2°C DB, 28.6°C WB, 37%RH

(b) Room

Summer : 24°C±2°C DB, 50%RH

Winter : Not more than the condition in summer

2) Minimum ventilation air vol.

For Control Room 25 m^3/Hr person

3) Lighting 20 W/m^2

4) People

Refer to "Cooling and dehumidifying estimate sheets"

5) LOcation

25.4°(N), 68.3°(E)

2. DATA

Data used for load estimation is based on Carrier,s Design Manual of the newest condition.

2 - 1 Outdoor air

1) Dry Bulb

Time / Dry Bulb	8	9	10	11	12	13	14	15	16	17	18
°C	28.2	30.3	32.8	35.7	38.4	40.4	41.7	42.2	41.7	40.5	38.7

2) HUmidity Ratio

Time / Humidity Ratio	8	9	10	11	12	13	14	15	16	17	18
g/Kg	19.1	19.0	19.0	19.2	18.9	19.0	18.8	19.0	18.8	18.9	18.8

2 - 2 Solar heat gain

1) Peak solar heat gain thru ordinary glass

EXPOSORE / HEAT	NL	NE	SE	SW	NW	HORIZONTAL	SHADE
Kcal/h m^2		366	252	252	366	674	47

2) Solar gain correction factors

for steel sash : 1/0.85

for dew point : 0.94

3) Load storage factors , solar heat gain thru ordinary glass

TIME / EXPOSURE	8	9	10	11	12	13	14	15	16	17	18
NE	0.57	0.46	0.30	0.24	0.20	0.19	0.17	0.16	0.15	0.13	0.11
SE	0.47	0.61	0.67	0.65	0.57	0.44	0.29	0.24	0.21	0.18	0.15
SW	0.08	0.08	0.10	0.24	0.40	0.55	0.66	0.70	0.64	0.50	0.26
NW	0.09	0.09	0.10	0.10	0.10	0.10	0.16	0.34	0.52	0.65	0.64

NOTE : Venetian blind to be located on the inside of glass.
(Overall factor is 0.65)

2 - 3 Equivalent temperature difference

1) For wall

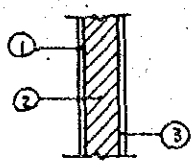
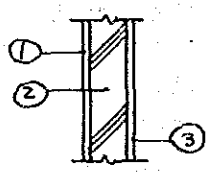
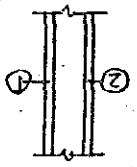
TIME / EXPOSURE	8	9	10	11	12	13	14	15	16	17	18
NE	4.6	7.9	16.8	16.0	15.3	13.3	11.3	11.9	12.6	13.0	13.5
SE	5.4	8.6	11.1	12.4	13.6	13.8	13.9	12.9	12.4	11.8	11.5
SW	2.6	3.1	3.7	5.0	5.9	9.8	12.1	15.8	18.6	19.2	19.5
NW	3.7	4.5	5.3	6.6	7.9	10.1	11.3	13.5	15.4	19.5	23.2

These figures are basing on medium color, outside air temperature at 42.2°C DB, inside air temperature at 24°C DB daily range of 16.7°C and specific weight of wall 200Kg/m^2.

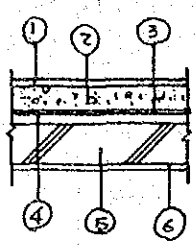
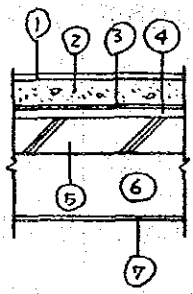
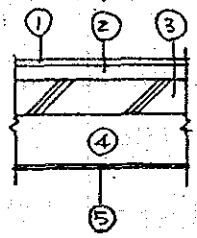
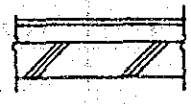
2) For roof

TIME / For roof	8	9	10	11	12	13	14	15	16	17	18
°C	10.3	10.2	10.8	12.4	14.9	18.0	21.2	24.0	26.2	27.8	28.5

These figures are basing on medium color, outside air temperature at 42.2°C DB, inside air temperature at 24°C DB daily range of 16.7°C and specific weight of wall 300Kg/m^2.

TYPE OF STRUCTURE	MATERIALS	THICKNESS (mm)	RESISTANCE ($m^2H°C/Kcal$)	AIR FILM ($m^2H°C/Kcal$)	K-Value ($Kcal/m^2H°C$)
WALL 				$r_0 = 0.05$	
	① CEMENT PLASTER	10	0.016		
	② BRICK	150	0.283		
	③ CEMENT PLASTER	10	0.016		
				$r_i = 0.133$ (0.498)	$2.008 \Rightarrow 2.1$
PARTITION 1. DITTO				$r_i = 0.133$	
	① CEMENT PLASTER	10	0.016		
	② BRICK	150	0.283		
	③ CEMENT PLASTER	10	0.016		
				$r_i = 0.133$ (0.581)	$1.722 \Rightarrow 1.8$
PARTITION 2 				$r_i = 0.133$	
	① CEMENT PLASTER	10	0.016		
	② CONCRETE	150	0.107		
	③ CEMENT PLASTER	10	0.016		
				$r_i = 0.133$ (0.405)	$2.47 \Rightarrow 2.5$
DOOR (IN) 				$r_i = 0.133$	
	① WOOD	12	0.092		
	② AIR SPACE		0.200		
	③ WOOD	12	0.092		
				$r_i = 0.133$ (0.650)	$1.539 \Rightarrow 1.6$
WINDOW (OUT)	ORDINARY GLASS	3			5.1
WINDOW (IN)	ORDINARY GLASS	3			3.8

ADMINISTRATION BUILDING

TYPE OF STRUCTURE	MATERIALS	THICKNESS (mm)	RESISTANCE ($m^2H°C/Kcal$)	AIR FILM ($m^2H°C/Kcal$)	K-Value ($Kcal/m^2H°C$)
ROOF 1 				$Y_o = 0.05$	
	① BLICK TILE	10	0.019		
	② SAND	30	0.057		
	③ POLYETHYLENE FILM	1	0.034		
	④ ROOFING	10	0.112		
	⑤ CONCRETE	150	0.107		
	⑥ CEMENT PLASTER	25	0.040		
				$Y_i = 0.189$	
				(0.608)	$1.645 \Rightarrow 1.7$
ROOF 2 				$Y_o = 0.05$	
	① BLICK TILE	10	0.019		
	② SAND	30	0.057		
	③ POLYETHYLENE FILM	1	0.034		
	④ ROOFING	10	0.112		
	⑤ CONCRETE	150	0.107		
	⑥ AIR SPACE		0.200		
	⑦ ACOUSTICAL TILE BOARD	12	0.187		
				$Y_i = 0.189$	
				(0.955)	$1.048 \Rightarrow 1.1$
CEILING 1 				$Y_i = 0.189$	
	① TERRAZZO	30	0.020		
	② MORTAR	40	0.031		
	③ CONCRETE	150	0.107		
	④ AIR SPACE		0.200		
	⑤ ALUM SHEET	2	—		
				$Y_i = 0.189$	
				(0.736)	$1.359 \Rightarrow 1.4$
FLOOR 1 DITTO	DITTO	DITTO	DITTO	$Y_i = 0.125$ (0.608)	$1.645 \Rightarrow 1.7$
CEILING 2 				$Y_i = 0.189$	
	① TERRAZZO	30	0.020		
	② MORTAR	40	0.031		
	③ CONCRETE	150	0.107		
				$Y_i = 0.189$	
				(0.536)	$1.866 \Rightarrow 1.9$
FLOOR 2 DITTO	DITTO	DITTO	DITTO	$Y_i = 0.125$ (0.403)	$2.482 \Rightarrow 2.5$