MEP451

Cooling Load Calculation

RTS

Radiant Time Series Method

Aug. 2009

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Steps for performing the RTS method

1- Calculate the heat gain due to all sources [Externally and internally]

2-Split the heat gains into convective and radiative part according to the type of the heat gain

3-Treat the radiative heat gain using RTS to convert it to cooling load

4-Sum the convective heat gain plus the cooling load due to the radiative heat gain to get the total cooling load

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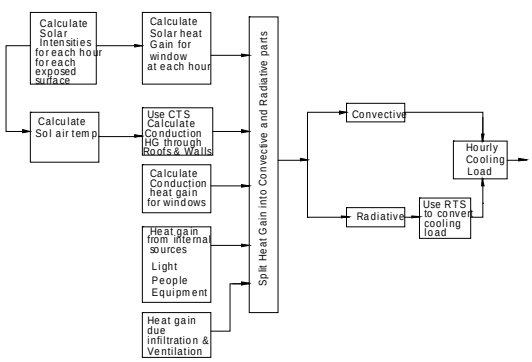

Idea of RTS Method

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Converting Radiative heat gain into cooling load

Radiant time factor

$$Q_{CL,r,q} = \sum_{n=0}^{n=23} r_n Q_{HG,r,q-nd} = r_0 Q_{HG,r,q} + r_1 Q_{HG,r,q-1} + r_2 Q_{HG,r,q-2} + \ldots$$

Cooling Load

At time θ

Radiative Heat Gains

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Hourly outdoor temperature & Sol-air temperature

$$t_o = t_d - DR*(X)$$

Long wave radiation correction

$$t_e(hr) = t_o(hr) + a\ G_t / h_o - edR / h_o$$

0 for vertical surface

7° F (3.9°C)for horizontal surface

α(Around) =0.9,

h_o=34 W/m^2.K

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Example 12.1 Hourly outdoor temperature

td=40.2° C, DR=12.2° C [Jeddah 0.4 % design]

Solar time	Outdoor Temp. t_o	Solar time	Outdoor Temp. t_o	Solar time	Outdoor Temp. t_o	Solar time	Outdoor Temp. t_o
1	29.6	7	28.9	13	38.9	19	36.1
2	29.0	8	30.0	14	39.8	20	34.5
3	28.5	9	31.5	15	40.2	21	33.1
4	28.1	10	33.4	16	39.8	22	31.9
5	28.0	11	35.4	17	39.0	23	30.9
6	28.2	12	37.4	18	37.6	24	30.2

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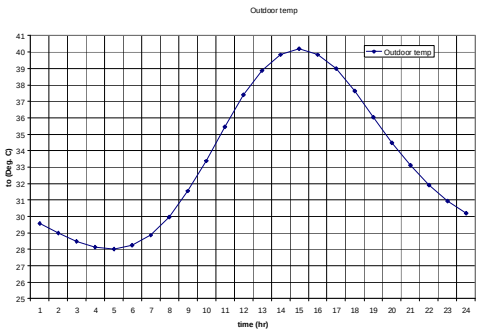

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Heat Gains

- ØConduction through exposed walls and roofs
- ØConduction through un-exposed (Partitions) walls
- ØWindows
- ØLights
- ØPeople
- ØEquipment
- ØInfiltration & Ventilation

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Conduction Heat Gain due to sunlit walls and roofs

Conduction Heat Gain

$$Q_{HG,q} = \sum_{n=0}^{n=23} c_n Q_{i,q-nd} = c_0 Q_{i,q} + c_1 Q_{i,q-1} + c_2 Q_{i,q-2} + \ldots$$

Heat input

$$Q_{i,q} = UA(t_{e,q} - t_r)$$

Conduction Time series CTS

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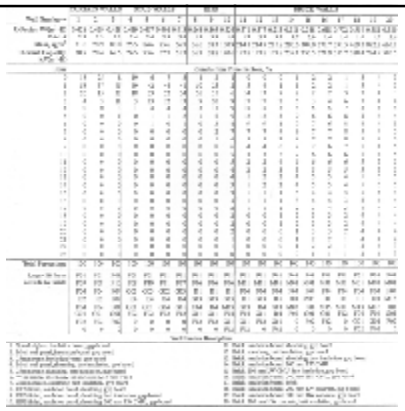
CTS for Walls



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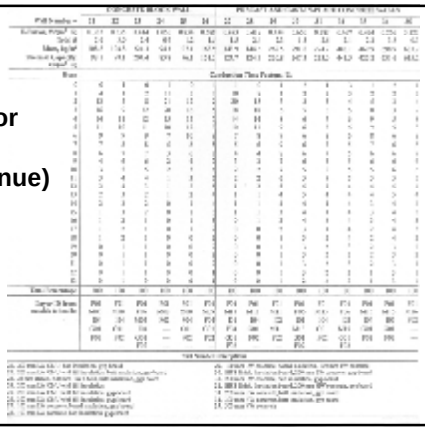
CTS for Walls (continue)



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CTS for Roofs

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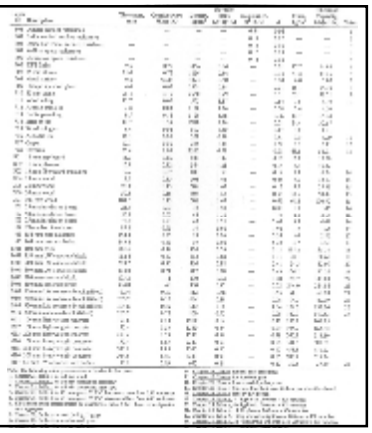
New ASHRAE layer Definition



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Example 12.3 Given t_e, G, Wall #21, Find Heat input and heat gain

hr	Gt		hr	G_t
1	0		13	377.8
2	0		14	484.2
3	0		15	534.6
4	0		16	513.6
5	0		17	399.2
6	22		18	126.7
7	81.5		19	0
8	125		20	0
9	158.8		21	0
10	183.7		22	0
11	203.4		23	0
12	230.4		24	0

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Ts [hr]	t_o	G_t	t_e	CTS		Heat input [W/m²]	Heat gain[W/m²]
1	29.4	0	29.4	0		2.06	5.00
2	28.8	0	28.8	0.04		1.83	4.46
3	28.3	0	28.3	0.13		1.64	4.01
4	27.9	0	27.9	0.16		1.50	3.60
5	27.8	0	27.8	0.14		1.46	3.23
6	28.0	22	28.6	0.11		1.77	2.89
7	28.7	81.5	30.8	0.09		2.61	2.62
8	29.8	125	33.1	0.07		3.47	2.43
9	31.3	158.8	35.5	0.06		4.42	2.41
10	33.2	183.7	38.0	0.04		5.37	2.57
11	35.2	203.4	40.6	0.03		6.37	2.87
12	37.2	230.4	29.4	0.03		7.39	3.31
13	38.7	377.8	48.7	0.02		9.44	3.88
14	39.6	484.2	52.5	0.02		10.90	4.60
15	40.0	534.6	54.2	0.02		11.55	5.51
16	39.6	513.6	53.2	0.01		11.19	6.53
17	38.8	399.2	49.3	0.01		9.71	7.49
18	37.4	126.7	40.8	0.01		6.43	8.22
19	35.9	0	35.9	0.01		4.54	8.51
20	34.3	0	34.3	0		3.93	8.26
21	32.9	0	32.9	0		3.42	7.66
22	31.7	0	31.7	0		2.95	6.94
23	30.7	0	30.7	0		2.58	6.24
24	30.0	0	30.0	0		2.30	5.59

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Converting Radiative Heat Gain into Cooling Load

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Zone Types

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Converting Radiative heat gain into cooling load

Radiant time Series (RST)

$$Q_{CL,r,q} = \sum_{n=0}^{n=23} r_n Q_{HG,r,q-nd} = r_0 Q_{HG,r,q} + r_1 Q_{HG,r,q-1} + r_2 Q_{HG,r,q-2} + \ldots$$

Cooling Load

At time θ

Radiative Heat Gains

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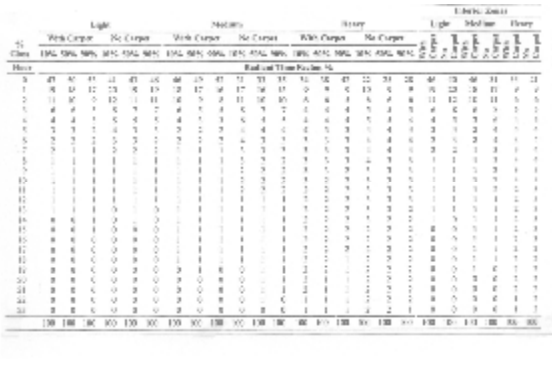
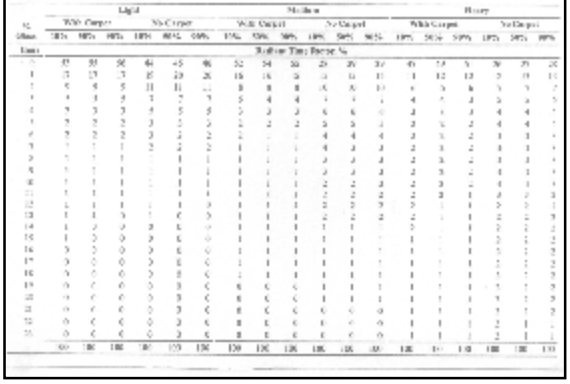
RTS Non Solar



RTS Solar



Example 12.4

Given t_e, G, Heat gain, Wall #21 in Example 12.3
Find hourly cooling load, Wall area=45 m²

Zone: heavy, carpeted with 10% glass.

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Splitting Heat gain into convective and radiative portions

Table 12.11

Heat Gain Source	Radiant Heat, %	Convective Heat, %
Transmitted solar, no inside shade	100	0
Window solar, with inside shade	63	37
Absorbed (by fenestration) solar	63	37
Fluorescent lights, suspended, unvented	67	33
recessed, vented to return air	59	41
recessed, vented to return air and supply air	19	81
Incandescent lights	80	20
Conduction, exterior walls	63	37
exterior roofs	84	16
Infiltration and ventilation	0	100
Machinery and appliances (see Table 13)	20 to 80	80 to 20

Sources: Pedersen et al. (1998), Hosni et al. (1999).

Ts, hr	t_o	G_t	t_e	CTS		Heat input, W/m²	Heat gain, W/m²
1	29.4	0	29.4	0		2.06	5.00
2	28.8	0	28.8	0.04		1.83	4.46
3	28.3	0	28.3	0.13		1.64	4.01
4	27.9	0	27.9	0.16		1.50	3.60
5	27.8	0	27.8	0.14		1.46	3.23
6	28.0	22	28.6	0.11		1.77	2.89
7	28.7	81.5	30.8	0.09		2.61	2.62
8	29.8	125	33.1	0.07		3.47	2.43
9	31.3	158.8	35.5	0.06		4.42	2.41
10	33.2	183.7	38.0	0.04		5.37	2.57
11	35.2	203.4	40.6	0.03		6.37	2.87
12	37.2	230.4	29.4	0.03		7.39	3.31
13	38.7	377.8	48.7	0.02		9.44	3.88
14	39.6	484.2	52.5	0.02		10.90	4.60
15	40.0	534.6	54.2	0.02		11.55	5.51
16	39.6	513.6	53.2	0.01		11.19	6.53
17	38.8	399.2	49.3	0.01		9.71	7.49
18	37.4	126.7	40.8	0.01		6.43	8.22
19	35.9	0	35.9	0.01		4.54	8.51
20	34.3	0	34.3	0		3.93	8.26
21	32.9	0	32.9	0		3.42	7.66
22	31.7	0	31.7	0		2.95	6.94
23	30.7	0	30.7	0		2.58	6.24
24	30.0	0	30.0	0		2.30	5.59

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Time (hr)	Heat gain flux [W/m²]	Total heat gain [W]	RTS [Heavy, carpeted, 10 % glass	Convective (0.37)	Radiative (0.63)	Radiative Cooling load [W]	Total cooling load [W]
1	5.00	224.78	0.34	83.2	141.6	151.7	234.9
2	4.46	200.76	0.09	74.3	126.5	144.8	219.1
3	4.01	180.31	0.06	66.7	113.6	138.3	205.1
4	3.60	162.16	0.04	60.0	102.2	132.1	192.1
5	3.23	145.24	0.04	53.7	91.5	126.0	179.7
6	2.89	130.22	0.04	48.2	82.0	120.2	168.3
7	2.62	117.70	0.03	43.5	74.1	114.9	158.4
8	2.43	109.39	0.03	40.5	68.9	110.6	151.1
9	2.41	108.65	0.03	40.2	68.4	108.2	148.4
10	2.57	115.51	0.03	42.7	72.8	107.8	150.6
11	2.87	129.09	0.03	47.8	81.3	109.5	157.2
12	3.31	148.81	0.02	55.1	93.8	113.0	168.0
13	3.88	174.66	0.02	64.6	110.0	118.4	183.0
14	4.60	207.10	0.02	76.6	130.5	125.8	202.4
15	5.51	247.88	0.02	91.7	156.2	135.7	227.4
16	6.53	293.64	0.02	108.6	185.0	147.6	256.3
17	7.49	337.13	0.02	124.7	212.4	160.1	284.9
18	8.22	369.94	0.02	136.9	233.1	171.3	308.1
19	8.51	383.12	0.02	141.8	241.4	178.6	320.4
20	8.26	371.86	0.02	137.6	234.3	180.4	318.0
21	7.66	344.57	0.02	127.5	217.1	177.5	305.0
22	6.94	312.36	0.02	115.6	196.8	172.1	287.6
23	6.24	280.88	0.01	103.9	177.0	165.6	269.5

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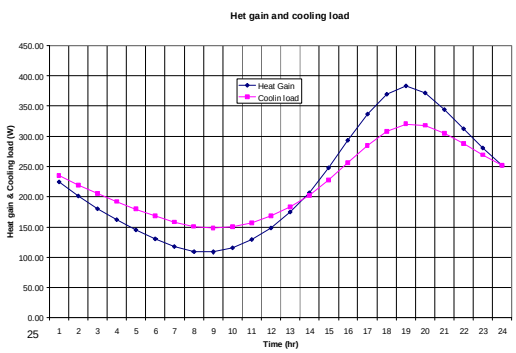

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Heat gain due to a window

Solar heat gain

Chapter 11

Un-shaded window

Shaded externally

Shaded internally

Conduction heat gain

$$UA(t_o - t_r)$$

U value for window. Ch 10

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Calculation of heat gains

Conduction Heat gain through windows including the frame

$$Q = (U_g A_g + U_f A_f)(t_o - t_r)$$

Window U value, Table 10.6

Frame U, Table 10.8

Split conduction heat gain into convective and radiative parts

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Calculation of heat gains

Solar Heat Gain due to a window

$$\dot{Q}_{SHG} = [SHGC_{g,D} A_{sl,g} + SHGC_f A_{sl,f}] G_D + [SHGC_{gd} A_g + SHGC_f A_f] G_d$$

$$SHGC_f = a_f \left[\frac{U_f A_f}{h_o A_{surf}} \right]$$

Table 11.3

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Calculation of heat gains

Solar Heat Gain for internally shaded window

$$\dot{Q}_{SHG} = [SHGC_f A_{sl,f} G_D + SHGC_f A_f G_d] + [SHGC_{gD} A_{sl,g} G_D + SHGC_{gd} A_g G_d] IAC$$

IAC=Interior Attenuation Coefficient

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Solar radiation

Direct

Direct Solar Heat Gain

$$SHG_D = A_{sl,g} SHGC_D G_D$$

100% radiative

Convert to cooling load using Solar RTS

Diffuse

Diffuse Solar Heat Gain

$$SHG_d = A_g SHGC_d G_d$$

0.37 Conv.

0.63 Rad.

Convert to cooling load using Non-Solar RTS

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Case with indoor shade

- Add all heat gains i.e. direct diffuse and conduction heat.
- Separate heat gain into conductive and radiative
- Treat the radiative HG using non solar RTS

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Calculation of heat gains

Heat gain due to lights

a) When the total wattage, use factor, and special allowance factor are given

$$Q = W * F_u * F_s \qquad [W]$$

W = Total wattage

F_u Use factor=% of lights that are in operation

F_s=Special allowance factor. F_s=1. for tungsten lights, F_s=1.2 for Fluorescent lights

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Calculation of heat gains

Heat gain due to lights

b) When the density (Watt per unit area) of lights is known

$$Q = Flux\ density * A$$

A= Plan area

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Calculation of heat gains

Heat gain due people

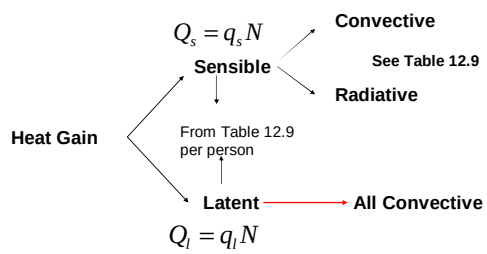

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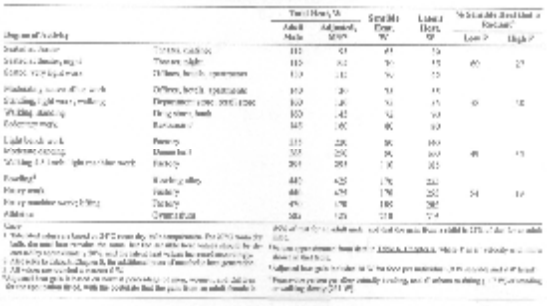
Table 12.9 Heat gain due to people



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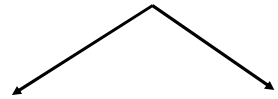
Heat gain due equipment in space



Un-Hooded

Both sensible and latent

Treat latent as direct cooling load

Hooded

Only sensible

Split sensible into convective and radiative. Treat radiative with non-solar RTS

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See Appendix B for typical of values of heat gains from equipment

Calculation of heat gains

Cooling Load due to Infiltration

Heat Gain $\dot{Q}_t = \dot{m}_a (h_o - h_r)$

$\dot{m}_a$ Mass flow rate of infiltration air

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Calculation of heat gains

Cooling Load due to Infiltration

Heat Gain
- **Sensible** → **100 % Convective**
- **Latent** → **100 % Convective**

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Calculation of heat gains

Cooling Load due to Infiltration

Heat Gain [W]

Sensible

$$\dot{Q}_s = \dot{m}_a C_p (t_o - t_i)$$

$$\dot{Q}_s = \frac{\dot{V}}{v} * 1.0 * (t_o - t_i)$$

$$\dot{Q}_s = 1.2 * \dot{V} * (t_o - t_r)$$

Latent

$$\dot{Q}_l = \dot{m}_a (W_o - W_i) h_{fg}$$

$$\dot{Q}_l = \frac{\dot{V}}{v} (W_o - W_i) * 2500$$

$$\dot{Q}_l = 3010 * \dot{V} * (W_o - W_r)$$

V in l/s

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Calculation of heat gains

Cooling Load due to Infiltration

ACH=Air Change per Hour=No of times the air changes in a building per hour

[l/s]=(ACH*V)*1000/3600

V in m^3

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Calculation of heat gains

Cooling Load Due to Infiltration

$$ACH = a + bV + c(t_o - t_r)$$

Bldg. Construction	a	b	c
Tight	0.15	0.010	0.007
Average	0.20	0.015	0.014
Loose	0.25	0.020	0.022

T must be in deg C, and V must be in m/s

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Calculation of heat gains

Cooling Load Due to Infiltration

$$\dot{V}[L/s] = ACH * V * 1000/3600$$

Sensible

$$\dot{Q}_s = 1.2 * \dot{V} * (t_o - t_r)$$ **Watts**

Latent

$$\dot{Q}_l = 3010 * \dot{V} * (W_o - W_r)$$ **Watts**

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Cooling Load Due to Ventilation

Sensible $\dot{q}_s = 1.2 * \dot{V} * (t_o - t_r)$ **Watts**

Latent $\dot{q}_l = 3010 * \dot{V} * (W_o - W_r)$ **Watts**

V = Volume flow rate in L/s

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Cooling Load Due to Partitions, Ceilings, & Floors

$$\dot{q} = UA\,TD$$

TD=Temperature difference across the partition or floor

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Example 12.5

Lights on at 7AM and off at 7PM

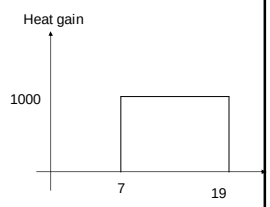
Heat due lights is 1000 W

Zone type =Medium, carpeted 50% glass

Lights: Un-vented suspended fluorescent lights

Radiative HG=0.67 HG

Convective HG=0.33 HG



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Splitting Heat gain into convective and radiative portions

Heat Gain Source	Radiant Heat, %	Convective Heat, %
Transmitted solar, no inside shade	100	0
Window solar, with inside shade	63	37
Absorbed (by fenestration) solar	63	37
Fluorescent lights, suspended, unvented	67	33
recessed, vented to return air	59	41
recessed, vented to return air and supply air	19	81
Incandescent lights	80	20
Conduction, exterior walls	63	37
exterior roofs	84	16
Infiltration and ventilation	0	100
Machinery and appliances (see Table 13)	20 to 80	80 to 20

Source: Pedersen et al. (1998), Hosni et al. (1999).

ts (hr)	Lights HG	Conv. HG [W] 0.33	Rad. HG [W] 0.67	RTS [Medium, Carpeted, 50 % glass]	Rad, CL [W]	Total CL [W]
1	0.0	0	0	0.49	80	80
2	0.0	0	0	0.17	80	80
3	0.0	0	0	0.09	74	74
4	0.0	0	0	0.05	67	67
5	0.0	0	0	0.03	60	60
6	0.0	0	0	0.02	54	54
7	1000	330	670	0.02	375	705
8	1000	330	670	0.01	482	812
9	1000	330	670	0.01	536	866
10	1000	330	670	0.01	563	893
11	1000	330	670	0.01	576	906
12	1000	330	670	0.01	583	913
13	1000	330	670	0.01	590	920
14	1000	330	670	0.01	590	920
15	1000	330	670	0.01	596	926
16	1000	330	670	0.01	603	933
17	1000	330	670	0.01	610	940
18	1000	330	670	0.01	616	946
19	0.0	0	0	0.01	295	295
20	0.0	0	0	0.01	188	188
21	0.0	0	0	0	134	134
22	0.0	0	0	0	107	107
23	0.0	0	0	0	94	94

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ts (hr)	Lights HG	Conv. HG [W] 0.33	Rad. HG [W] 0.67	RTS [Medium, Carpeted, 50 % glass]	Rad, CL [W]	Total CL [W]
1	0.0	0	0	0.49	80	80
2	0.0	0	0	0.17	80	80
3	0.0	0	0	0.09	74	74
4	0.0	0	0	0.05	67	67
5	0.0	0	0	0.03	60	60
6	0.0	0	0	0.02	54	54
7	1000	330	670	0.02	375	705
8	1000	330	670	0.01	482	812
9	1000	330	670	0.01	536	866
10	1000	330	670	0.01	563	893
11	1000	330	670	0.01	576	906
12	1000	330	670	0.01	583	913
13	1000	330	670	0.01	590	920
14	1000	330	670	0.01	590	920
15	1000	330	670	0.01	596	926
16	1000	330	670	0.01	603	933
17	1000	330	670	0.01	610	940
18	1000	330	670	0.01	616	946
19	0.0	0	0	0.01	295	295
20	0.0	0	0	0.01	188	188
21	0.0	0	0	0	134	134
22	0.0	0	0	0	107	107

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ts (hr)	Lights HG	Conv. HG [W] 0.33	Rad. HG [W] 0.67	RTS [Medium, Carpeted, 50 % glass]	Rad, CL [W]	Total CL [W]
1	0.0	0	0	0.49	80	80
2	0.0	0	0	0.17	80	80
3	0.0	0	0	0.09	74	74
4	0.0	0	0	0.05	67	67
5	0.0	0	0	0.03	60	60
6	0.0	0	0	0.02	54	54
7	1000	330	670	0.02	375	705
8	1000	330	670	0.01	482	812
9	1000	330	670	0.01	536	866
10	1000	330	670	0.01	563	893
11	1000	330	670	0.01	576	906
12	1000	330	670	0.01	583	913
13	1000	330	670	0.01	590	920
14	1000	330	670	0.01	590	920
15	1000	330	670	0.01	596	926
16	1000	330	670	0.01	603	933
17	1000	330	670	0.01	610	940
18	1000	330	670	0.01	616	946
19	0.0	0	0	0.01	295	295
20	0.0	0	0	0.01	188	188
21	0.0	0	0	0	134	134
22	0.0	0	0	0	107	107

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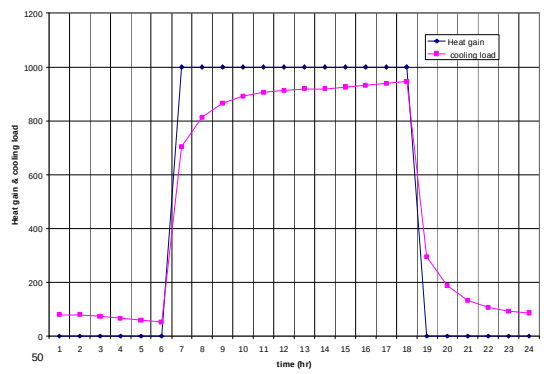

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Example 12.6 Solar heat gain and cooling load

The cooling load due a SSW window is to be calculated. The window is located in Jeddah, Saudi Arabia (July 21). 0.4% design outdoor conditions are assumed. Window is double one pane is bronze and the other is clear (type 5d). Window area is 10 m^2, U value is 3.24 W/m2.K. The incidence angle, the beam radiation and the diffuse radiation are as given in the table below. Indoor and outdoor temperatures are also given.

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Time (hr)	t_o	t_i	θ	G_{D} [W/m^2]	G_d [W/m^2]
1	29.6	25	>90	0	0
2	29.0	25	>90	0	0
3	28.5	25	>90	0	0
4	28.1	25	>90	0	0
5	28.0	25	131.2	0	0
6	28.2	25	124.3	0	22
7	28.9	25	116.8	0	81.5
8	30.0	25	109.1	0	125
9	31.5	25	101.7	0	158.8
10	33.4	25	95.0	0	183.7
11	35.4	25	88.9	0	206
12	37.4	25	84.2	14.5	217.3
13	38.9	25	81	89.1	216.7
14	39.8	25	79.6	134.1	204
15	40.2	25	80.2	147.7	179.9
16	39.8	25	82.6	128.2	143.8
17	39.0	25	>90	78.2	94.8
18	37.6	25	>90	12.8	25.8
19	36.1	25	>90	0	0
20	34.5	25	>90	0	
21	33.1	25	>90	0	
22	31.9	25	>90	0	
23	30.9	25	>90	0	

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Time (hr)	t_o	t_i	G_{D} [W/m^2]	SHGC$_D$	Direct HG	RTS Solar	Cooling load (Direct Solar)	G_d [W/m^2]	SHGCd
1	29.6	25	0	0	0	0.54	9	0	0.414
2	29.0	25	0	0	0	0.16	9	0	0.414
3	28.5	25	0	0	0	0.08	9	0	0.414
4	28.1	25	0	0	0	0.04	9	0	0.414
5	28.0	25	0	0	0	0.03	9	0	0.414
6	28.2	25	0	0	0	0.02	9	22	0.414
7	28.9	25	0	0	0	0.01	8	81.5	0.414
8	30.0	25	0	0	0	0.01	6	125	0.414
9	31.5	25	0	0	0	0.01	3	158.8	0.414
10	33.4	25	0	0	0	0.01	1	183.7	0.414
11	35.4	25	0	0	0	0.01	0	206	0.414
12	37.4	25	14.5	0.05	7	0.01	4	217.3	0.414
13	38.9	25	89.1	0.11	98	0.01	54	216.7	0.414
14	39.8	25	134.1	0.16	215	0.01	132	204	0.414
15	40.2	25	147.7	0.17	251	0.01	178	179.9	0.414
16	39.8	25	128.2	0.17	218	0.01	179	143.8	0.414
17	39.0	25	78.2	0.13	102	0.01	122	94.8	0.414
18	37.6	25	12.8	0.09	12	0.01	58	25.8	0.414
19	36.1	25	0	0	0	0	32	0	0.414
20	34.5	25	0		0	0	20		0.414
21	33.1	25	0		0	0	14		0.414
22	31.9	25	0		0	0	10		0.414
23	[illegible]	25	[illegible]		[illegible]	[illegible]	[illegible]		[illegible]

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hr	t_o	t_i	G_d [W/m^2]	SHGCd	Diff HG	Conduction	Cond + Diff HG	Conv (0.37)	Rad (0.63)	Cl_Rad (cond+diff)	CL (Cond+Diff)	Total Cooling load
1	29.6	25	0	0.414	0	149	149	55	94	171	226	235
2	29.0	25	0	0.414	0	129	129	48	81	160	207	216
3	28.5	25	0	0.414	0	113	113	42	71	148	190	199
4	28.1	25	0	0.414	0	101	101	37	64	137	175	184
5	28.0	25	0	0.414	0	97	97	36	61	128	164	173
6	28.2	25	22	0.414	91	105	196	73	124	151	223	232
7	28.9	25	81.5	0.414	337	125	462	171	291	236	407	415
8	30.0	25	125	0.414	518	160	678	251	427	328	579	585
9	31.5	25	158.8	0.414	657	212	869	322	548	421	742	746
10	33.4	25	183.7	0.414	761	271	1032	382	650	506	888	889
11	35.4	25	206	0.414	853	338	1191	441	750	589	1030	1030
12	37.4	25	217.3	0.414	900	402	1301	481	820	658	1139	1143
13	38.9	25	216.7	0.414	897	449	1346	498	848	703	1202	1256
14	39.8	25	204	0.414	845	481	1325	490	835	721	1211	1343
15	40.2	25	179.9	0.414	745	492	1237	458	779	707	1165	1343
16	39.8	25	143.8	0.414	595	481	1076	398	678	658	1056	1235
17	39.0	25	94.8	0.414	392	453	845	313	533	573	886	1007
18	37.6	25	25.8	0.414	107	409	516	191	325	442	633	692
19	36.1	25	0	0.414	0	358	358	132	226	346	478	510
20	34.5	25		0.414	0	307	307	113	193	290	403	423
21	33.1	25		0.414	0	263	263	97	166	251	349	362
22	31.9	25		0.414	0	224	224	83	141	223	305	316
23	30.9	25		0.414	0	192	192	71	121	201	272	281
24	30.2	25		0.414	0	168	168	62	106	184	246	255

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Heat Gain Source	Radiant Heat, %	Convective Heat, %
Transmitted solar, no inside shade	100	0
Window solar, with inside shade	63	37
Absorbed (by fenestration) solar	63	37
Fluorescent lights, suspended, unvented	67	33
recessed, vented to return air	59	41
recessed, vented to return air and supply air	19	81
Incandescent lights	80	20
Conduction, exterior walls	63	37
exterior roofs	84	16
Infiltration and ventilation	0	100
Machinery and appliances (see Table 13)	20 to 80	80 to 20

Sources: Pedersen et al. (1998), Hiom et al. (1999).

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Heat Gain Type	Recommended Radiative Fraction	Recommended Convective Fraction
Occupants (60)	0.7	0.3
Lighting (65):		
Recessed fluorescent—vented	0.67	0.33
Recessed fluorescent—vented to return air	0.59	0.41
Recessed fluorescent—vented to supply and return air	0.19	0.81
Incandescent	0.8	0.2
Equipment:		
General (typ/fudge for equipment not internally cooled with fans)	0.7	0.3
Computer/electronic equipment with internal fans	0.2	0.8
Conductive heat gain through walls (1)	0.63	0.37
Conductive heat gain through roofs (1)	0.84	0.16
Transmitted solar radiation	1.0	0.0
Attached solar radiation	0.63	0.37
Infiltration	0.0	1.0

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