

Cooling Load

Introduction

Aug. 2008

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 - (partition, ceiling & floors, People, Lights, Equipment, Infiltration, Ventilation)

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Definition

Heat Gain

Instantaneous heat admitted to space

Cooling Load

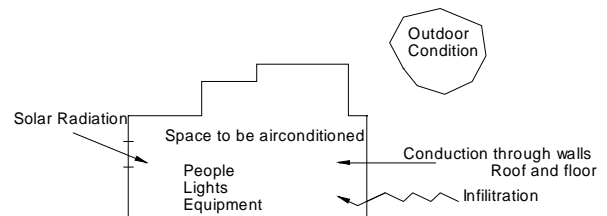
Amount of heat that must be removed from air to keep its temperature at room condition

Heat Extraction Rate

Amount of heat removed by the air conditioning system

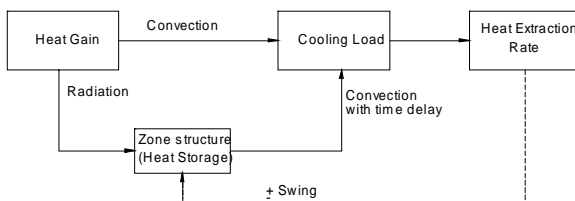
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Typical Loads on a building



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Conversion of Heat Gain to Cooling Load



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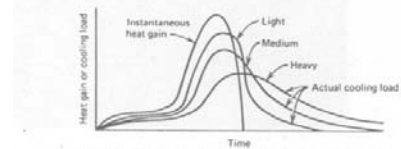


Figure 8-2 Actual cooling load and solar heat gain for light, medium, and heavy construction.

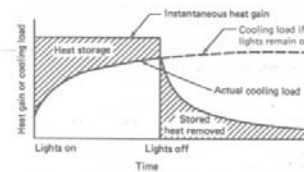


Figure 8-3 Actual cooling load from fluorescent lights.

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Station	WHOM	Lat.	Long.	Elev. ft	SNP psia	Extreme Wind					Coldest Month		MWS/MWD to DB				Annual Daily Extreme				
						Heating DB Speed, mph					0.4%	1%	99.6%	0.4%	Mean DB		Std DB				
						0.4%	1%	99.6%	0.4%	1%					99.6%	0.4%		1%	99.6%		
SAUDI ARABIA																					
Abha	411120	13.23 N	42.65 E	6837	11.413	8293	41	44	23	21	19	25	59	22	60	2 180	13 20	92	35	5.6	2.9
Al Jawf	403610	29.78 N	40.10 E	2244	13.546	8293	32	35	26	22	19	26	49	22	52	5 50	9 320	111	29	4.5	3.6
Al Madinah	404000	24.55 N	39.70 E	2070	13.633	8293	48	50	20	18	16	19	65	17	67	7 90	9 300	114	42	2.2	4.0
Al Waha	404000	26.20 N	36.47 E	52	14.672	8293	53	55	28	25	23	27	68	24	69	7 20	13 270	105	47	3.4	4.7
Ar'ar	403670	30.60 N	41.13 E	1811	13.763	8293	32	34	22	19	17	21	51	18	52	4 270	7 240	111	23	2.0	3.1
Al Ta'if	410260	21.48 N	40.55 E	4753	12.344	8293	42	45	23	21	19	24	65	22	65	5 90	10 50	101	35	3.2	2.9
Az Zahran	404160	28.27 N	36.15 E	55	14.679	8293	45	47	26	23	20	22	61	19	61	9 230	13 300	116	43	2.3	3.3
Ha'il	403940	27.43 N	41.68 E	3323	13.018	8293	31	34	23	20	18	23	57	20	60	4 180	8 180	108	25	3.6	4.9
Hafuf	403730	28.33 N	46.17 E	1165	14.002	8293	36	39	27	23	21	24	56	22	56	6 270	10 240	117	31	2.3	1.8
Jeddah	410240	21.67 N	39.15 E	39	14.678	8293	69	71	23	21	19	23	78	21	77	8 30	13 300	114	54	4.5	3.4
Jizan	411400	16.00 N	42.80 E	9	14.095	8293	68	70	20	18	16	17	82	16	82	5 100	10 230	107	53	4.5	10.3
Khamis Mushayt	411140	18.30 N	42.80 E	6738	11.456	8293	40	43	21	18	16	22	61	20	61	2 150	10 30	97	33	6.8	4.1
Makkah	410800	21.48 N	39.83 E	1017	14.168	8293	59	62	14	12	11	15	77	13	78	4 20	8 300	118	53	2.6	4.3
Qatif	404050	26.30 N	43.77 E	2132	13.602	8293	37	39	21	18	16	20	60	17	57	2 30	5 90	115	32	3.6	3.2
Rabha	403920	25.63 N	43.48 E	1486	13.937	8293	33	35	25	22	20	24	54	22	56	4 270	9 300	115	27	2.7	2.7
Riyadh	404380	24.72 N	46.72 E	2007	13.664	8293	41	44	22	19	17	21	60	18	60	4 320	11 360	115	35	1.4	2.7
Tabuk	403750	26.37 N	36.63 E	2526	13.407	8293	34	37	25	22	17	25	60	20	60	2 110	10 270	107	33	2.2	2.3
Tamaf	403590	31.68 N	38.67 E	2667	13.337	8293	29	32	25	22	20	26	46	22	46	6 270	9 270	108	25	2.3	3.4
Yamou' al Dahr	404390	24.15 N	38.67 E	3	14.056	8293	52	54	25	23	21	25	72	22	72	3 10	17 270	114	47	1.8	2.0

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WHOM = World Meteorological Organization no.; Elev. = elevation, ft; WS = wind speed, mph; MWS = mean coincident wet-bulb temp., °F; DB = dry-bulb temp., °F;
Lat. = North latitude, °; Long. = West longitude, °; SNP = standard pressure at station elev, psia; MWSD = mean coincident wind speed, mph; MWSD = mean wind speed, mph;
Std DB = standard deviation, °F

Station	DB/MWB						WB/DB						DP/HR and HR						Range of DB	
	0.4%		1%		2%		0.4%		1%		2%		0.4%		1%		2%			
	DB MWB	DB MWB	DB MWB	DB MWB	WB MWS	WB MWS	WB MWS	WB MWS	DP	HR	DB	DP	HR	DB	DP	HR	DB	DP		HR
Saudi Arabia																				
Abha	87	55	85	56	84	56	67	76	65	74	65	119	72	63	111	71	62	105	71	214
Al Jawf	100	63	103	62	101	61	65	68	64	65	63	107	57	76	56	62	63	67	57	20.5
Al Madinah	113	65	110	65	106	64	65	67	68	62	91	74	60	75	78	70	73	78	70	23.4
Al Waha	95	72	93	70	91	70	83	90	82	89	82	167	88	81	159	88	79	152	87	13.1
Ar'ar	107	68	105	63	103	67	73	80	71	100	69	68	62	90	62	81	90	57	75	25.6
Al Ta'if	97	65	95	60	94	60	72	80	70	87	69	67	67	117	80	65	100	80	63	102
Az Zahran	111	71	109	71	107	72	86	94	84	94	83	92	84	180	91	82	168	90	108	100
Ha'il	100	65	104	64	102	64	68	66	67	67	65	67	59	85	71	57	80	72	65	74
Jeddah Al Balad	113	67	112	66	110	66	71	89	69	100	67	100	64	94	81	85	72	89	78	27.5
Jizan	104	72	102	73	100	74	83	94	82	94	81	92	81	159	83	79	151	89	79	120
Khamis	102	63	100	63	99	63	67	68	68	68	65	67	64	178	96	83	171	96	82	168
Makkah	88	57	87	57	86	56	66	75	65	74	64	74	63	111	71	62	106	71	61	102
Rabha	113	76	111	76	105	75	82	94	81	102	80	101	77	147	90	78	139	94	78	133
Riyadh	119	67	109	65	107	64	74	87	70	96	68	96	111	84	63	62	85	89	61	79
Tamaf	111	69	108	68	107	67	72	104	70	104	69	103	63	90	75	61	83	72	58	75
Tabuk	111	64	110	64	108	64	69	66	67	66	66	62	91	73	60	63	72	57	76	72
Tamaf	104	64	102	63	100	63	68	65	67	65	65	64	59	80	77	58	74	77	56	71
Tamaf	102	61	99	63	97	62	68	65	66	65	65	60	67	78	58	75	56	73	74	27.4
Yamou' al Dahr	109	76	101	75	104	76	81	96	82	95	81	94	81	159	80	79	152	89	77	142

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DB = dry-bulb temperature, °F; WB = wet-bulb temperature, °F; HR = humidity ratio, grains (water vapor)/lb (dry air);
MWB = mean coincident wet-bulb temp., °F; MWS = mean coincident dry-bulb temp., °F; DP = dew-point temperature, °F; Std = standard deviation, °F

Hourly Outdoor Temperature

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

t_d =Design temperature

DR=Daily range

X=Percentage of daily range

Average outdoor temp.

$$t_{om} = t_d - 0.5 * DR$$

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Percentage of daily range (X)

hr	% Daily range (X)	hr	% Daily range (X)
1	87	13	11
2	92	14	3
3	96	15	0
4	99	16	3
5	100	17	10
6	98	18	21
7	93	19	34
8	84	20	47
9	71	21	58
10	56	22	68
11	39	23	76
12	23	24	82

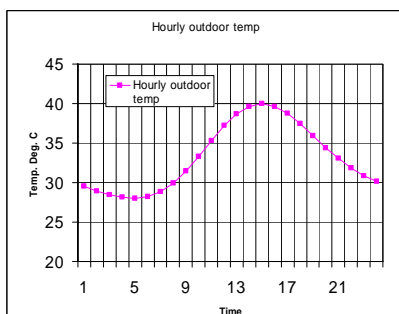
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Variation of hourly outdoor temperature

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

$T_d=40$ C

DR=12



Type of Loads

•External Loads

- Roof and walls
- Windows (Conduction + Solar)

•Internal Loads

- Partitions
- People
- Lights
- Equipment
- Infiltration
- Ventilation

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