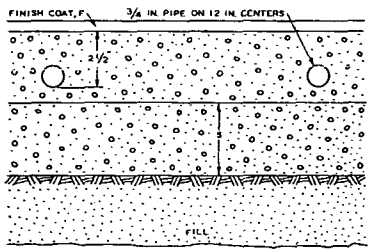

F = Depth of Finish Coat—Assumed as ¾ in. of concrete. Finish Coat may be asphalt but then cover slab should be reduced from 3 in. Depth of slab should always keep thermal resistance equal to 3 in. of concrete.
S = Depth required by structural design (should be a minimum of 2 in. of concrete).

Fig. 1 .... Detail of Snow Melting Panel

trace quantities about twice as often as there are for measurable quantities of 0.01 in. or more. It is assumed that these light falls can be handled by the *idling load*.

The remaining columns of Table 1 represent the frequency distribution of required heat output. This distribution is based on the solution to the basic equation for two values of the free area ratio, A_r. This distribution represents the basis of the analysis and is also the basis for Tables 3 and 4.

For specific conditions, or for cities other than those given in Table 1, the solutions to Equation 2 are given in Table 2.

Table 2 ....Heat Output and Fluid Temperature for Snow-Melting System

Rate of Snowfall, s	A_r		t_a = 0 F			t_a = 10 F			t_a = 20 F			t_a = 30 F		
			Speed v			Speed v			Speed v			Speed v		
			5	10	15	5	10	15	5	10	15	5	10	15
0.08	1.0	q_o	151	205	260	127	168	209	102	128	154	75	84	94
		t_m	108	135	162	97	117	138	85	97	110	70	75	79
	0.0	q_o	66	66	66	64	64	64	62	62	62	60	60	60
		t_m	66	66	66	65	65	65	64	64	64	63	63	63
0.16	1.0	q_o	218	273	327	193	233	274	165	191	217	135	144	154
		t_m	142	169	198	129	149	170	117	129	142	100	105	109
	0.0	q_o	133	133	133	129	129	129	125	125	125	121	121	121
		t_m	99	99	99	97	97	97	95	95	95	93	93	93
0.25	1.0	q_o	292	347	401	265	305	346	235	261	287	203	212	221
		t_m	179	206	234	165	186	206	151	163	176	134	139	144
	0.0	q_o	208	208	208	202	202	202	195	195	195	188	188	188
		t_m	137	137	137	134	134	134	131	131	131	127	127	127

Note: This table is based on a relative humidity of 80 percent for all air temperatures.

s = rate of snowfall, inches of water equivalent per hour.
A_r = free area ratio.
q_o = slab output, Btu per (hour) (square foot).
t_a = air temperature, Fahrenheit.
t_m = fluid temperature, Fahrenheit. Based on construction as shown in Fig. 1.
v = wind speed, miles per hour.

Table 3 ....Design Data for Three Classes of Snow-Melting System*

City	Design Output, Btu per (Hr) (Sq Ft)		
	Class I system[1]	Class II system[2]	Class III system[3]
Albuquerque, N. M.	71	82	167
Amarillo, Tex.	98	143	241
Boston, Mass.	107	231	255
Buffalo-Niagara Falls, N. Y.	80	192	307
Burlington, Vt.	90	142	244
Caribou-Limestone, Me.	89 (93)	138	307
Cheyenne, Wyo.	83	129	425
Chicago, Ill.	89	165	350
Colorado Springs, Colo.	49 (63)	63	293
Columbus, Ohio	52	72	253
Detroit, Mich.	69	140	255
Duluth, Minn.	83 (114)	206	374
Falmouth, Mass.	93	144	165
Great Falls, Mont.	84 (112)	138	372
Hartford, Conn.	115	254	260
Lincoln, Neb.	64 (67)	202	246
Memphis, Tenn.	134	144	212
Minneapolis-St. Paul, Minn.	63 (95)	155	254
Mt. Home, Idaho	50	90	140
New York, N. Y.	121	298	342
Ogden, Utah	98	216	217
Oklahoma City, Okla.	66	81	350
Philadelphia, Pa.	97	229	263
Pittsburgh, Pa.	89	157	275
Portland, Ore.	86	97	111
Rapid City, S. D.	58 (86)	102	447
Reno, Nev.	98	154	155
St. Louis, Mo.	122	152	198
Salina, Kan.	85	120	228
Sault Ste. Marie, Mich.	52 (78)	144	213
Seattle-Tacoma, Wash.	92	128	133
Spokane, Wash.	87	127	189
Washington, D. C.	117	121	144

From *Air Conditioning, Heating and Ventilating*, August 1957, p. 92.

* Where idling rate is greater than Class I design rate, idling rate is given in parenthesis and should be used as Class I design output.

[1] For Class I (residential) Systems, the design output is set at that required heat output (see Table 1) when A_r = 0 at the 98th percentile of the frequency distribution; that is where 98% of the hours have this output or less.

[2] For Class II (commercial) Systems, the design output is the maximum output when A_r = 0 in Table 1 (last column).

[3] For Class III (industrial) Systems the design output is determined by the following four requirements: (1) Output is never exceeded for two consecutive hours; (2) Output for A_r = 1; Table 1, is at least 1 Btu per hour per sq ft greater than maximum output for A_r = 0; (3) A_r is greater than or equal to 0.5 maximum requirement shown in Table 1 for A_r = 1. That is, $q_o = q_r + q_m + 0.5(q_f + q_s)$ for the conditions where $q_r = q_r + q_m + q_f + q_s$ are a maximum; (4) The free area ratio A_r is unity for at least 98% of the hours listed in Table 1.

Table 4 .... Yearly Operating Data

City	Idling			Melting			City	Idling			Melting		
	Time,[1] hr per year	Rate,[2] Btu per (hr) (sq ft)	Output,[3] Btu per (year) (sq ft)	Time,[4] hr per year	Class[5]	Output,[6] Btu per (year) (sq ft)		Time,[1] hr per year	Rate,[2] Btu per (hr) (sq ft)	Output,[3] Btu per (year) (sq ft)	Time,[4] hr per year	Class[5]	Output,[6] Btu per (year) (sq ft)
Albuquerque, N. M.	897	32.5	29100	22	I	908	Mt. Home, Idaho	1546	41.9	64800	40	I	1260
					II	969						II	1530
					III	1150						III	1590
Amarillo, Tex.	944	51.1	48200	33	I	2150	New York, N. Y.	1532	50.7	77700	76	I	4180
					II	2520						II	4690
					III	2770						III	4710
Boston, Mass.	1140	52.1	59400	145	I	8000	Ogden, Utah	1655	44.6	73800	160	I	7050
					II	9080						II	7370
					III	9100						III	7370
Buffalo-Niagara Falls, N. Y.	1702	50.2	85500	240	I	11800	Oklahoma City, Okla.	719	56.2	40400	44	I	2380
					II	14600						II	2800
					III	14900						III	5400
Burlington, Vt.	1978	76.9	152000	236	I	11800	Philadelphia, Pa.	820	31.4	25700	58	I	2710
					II	13500						II	3100
					III	13800						III	3110
Caribou-Limestone, Me.	2563	93.0	238000	290	I	17800*	Pittsburgh, Pa.	1445	49.5	71500	182	I	9050
					II	20600						II	10700
					III	22500						III	11100
Cheyenne, Wyo.	1808	77.7	140000	138	I	9730	Portland, Ore.	221	17.4	3840	36	I	1300
					II	13200						II	1330
					III	20200						III	1360
Chicago, Ill.	1848	67.8	125000	134	I	7200	Rapid City, S. D.	1873	86.4	162000	116	I	7450*
					II	8390						II	8250
					III	8700						III	13400
Colorado Springs, Colo.	1583	63.4	100000	76	I	3960*	Reno, Nev.	1510	36.9	55700	87	I	2970
					II	3960						II	3030
				---	III	7390						III	3030
Columbus, Ohio	1383	45.0	62200	105	I	3590	St. Louis, Mo.	1104	44.8	4950	33	I	2190
					II	4180						II	2290
					III	5350						III	2380
Detroit, Mich.	1790	49.0	87600	134	I	5540	Salina, Kan.	1398	53.9	75400	54	I	2920
					II	6850						II	3370
					III	7070						III	3810
Duluth, Minn.	2922	113.8	332000	250	I	33200*	Sault Ste. Marie, Mich.	2512	77.7	195000	345	I	17600*
					II	38100						II	22200
					III	39500						III	23200
Falmouth, Mass.	1071	44.2	47400	73	I	3830	Seattle-Tacoma, Wash.	392	17.2	6750	44	I	1410
					II	4250						II	1430
					III	4290						III	1430
Great Falls, Mont.	1677	111.6	187000	174	I	13700*	Spokane, Wash.	1673	39.1	65500	196	I	8650
					II	15400						II	9350
					III	19100						III	9560
Hartford, Conn.	1412	41.9	59200	171	I	9830	Washington, D. C.	770	30.6	23600	33	I	1650
					II	10800						II	1660
					III	10810						III	1690
Lincoln, Neb.	1906	67.2	128000	91	I	4750*							
					II	8350							
				---	III	8520							
Memphis, Tenn.	454	32.0	14500	11	I	702							
					II	721							
					III	792							
Minneapolis-St. Paul, Minn.	2570	95.1	244000	203	I	14200*							
					II	17600							
					III	18400							

[1] From Table 1, Column 3 × 3620 (hr per year).
[2] Rate when idling, Btu per (Hr) (Sq Ft) = $(0.37v + 2.2)(33 - t)$, where v = wind speed from Column 5, Table 1, and t = air temperature from Column 4, Table 1.
[3] Product of the two preceding columns.
[4] Hours of Snowfall, from Column 7, Table 1.
[5] See footnote for Table 3.
[6] Based on the condition that surface temperature is maintained at 32 deg until required output exceeds designed output, at which time design output is used regardless of required output. Distribution of required output based on Table 1.
* Based on Idling Rate rather than Design Rate.

Air Conditioning, Heating and Ventilating, August 1957, p. 94.

Notice that these solutions are for a relative humidity of 80 percent. For other values of relative humidity, corrections can be obtained by using Equations 8 and 9 as follows:

$$\frac{dq_o}{dp_{ss}} = -A_r(0.0201v + 0.055)h_{fs} \qquad (8)$$

$$\frac{dt_m}{dp_{ss}} = \frac{-A_r}{2}(0.0201v + 0.055)h_{fs} \qquad (9)$$

Snow-melting installations are classified in Table 3 according to types as Class I, II, or III. These classes have been discussed thoroughly in Reference 3, and are defined in