附件：

清远市区暴雨强度公式及计算图表

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二零一七年十二月

说　　　　　明

1. 本计算图表以清远国家气象观测站 37 年（1980～2016 年）连续自记雨量记录为基础，利用国内先进的"降水数字化处理系统"得到高精度的原始数据，采用年最大值法进行编制，适用范围为清城区、清新区。

2. 以重现期 2、3、5、10、20、30、50、100（年）相应的单一重现期暴雨强度公式制表。设计暴雨强度可按选定重现期直接查用表列数值（单一重现期暴雨强度公式见表一）。

3. 若采用其它重现期，设计暴雨强度可用重现期区间参数公式计算：

$$q = \frac{167A}{(t+b)^n}$$

式中：q—设计暴雨强度［L/（s•hm²）］

t—降雨历时（min）

A—雨力

b、n—地方常数

（A、b、n 按重现期区间参数公式计算，公式见表二）

4. 考虑到绘制全国城市暴雨强度公式等值线图，列出包含重现期在内的暴雨强度总公式：

$$q = \frac{4071.713 \times (1+0.633LgP)}{(t+16.852)^{0.756}}$$

因总公式精度不及重现期区间参数公式，故建议推求其它重现期设计暴雨强度时使用区间参数公式。

应用重现期区间参数公式计算暴雨强度实例：求 P=25 年，t=50min 的暴雨强度 q。

从重现期区间参数公式 II，得：

n=0.724+0.007Ln(P － 7.842)

　=0.743897（取 0.744）

b=14.378+0.214Ln(P － 7.842)

　=14.98629（取 14.986）

A=20.517+6.796Ln(P － 2.317)

　=41.7315（取 41.732）

配得 P=25 年的暴雨强度计算公式如下：

$$q = \frac{167 \times 41.732}{(t+14.986)^{0.744}}$$

可按上式计算 1～180min 中任何时段的暴雨强度。

当 t=50：

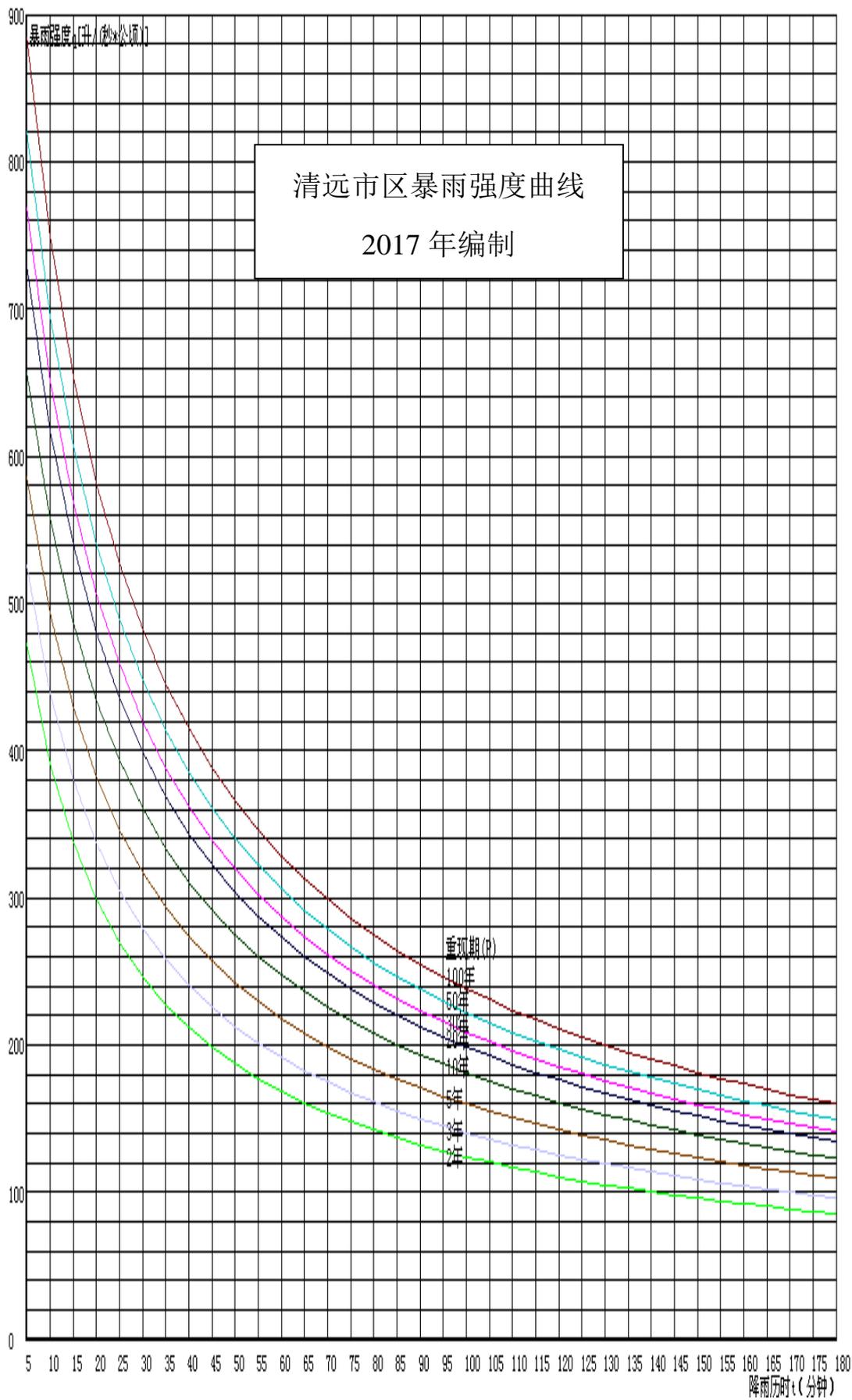$$q = \frac{167 \times 41.732}{(50+14.986)^{0.744}} = 312.340［L/（s•hm²）］$$

5. 公式误差

重现期 2～20 年的暴雨强度公式算得的平均绝对均方差为：0.048（mm/min），平均相对均方差为：2.86%。精度符合《室外排水设计规范》（GB50014—2006，2014 年版）提出的要求。

表一　　单一重现期暴雨强度公式

重现期 P（年）	公　　式
P＝1	$1981.622 / (t + 7.069)^{0.650}$
P＝2	$3148.618 / (t + 10.800)^{0.687}$
P＝3	$3805.095 / (t + 11.981)^{0.699}$
P＝5	$4617.550 / (t + 13.227)^{0.711}$
P＝10	$5740.458 / (t + 14.543)^{0.729}$
P＝20	$6686.513 / (t + 14.913)^{0.741}$
P＝30	$7195.195 / (t + 15.041)^{0.746}$
P＝40	$7545.227 / (t + 15.121)^{0.748}$
P＝50	$7812.427 / (t + 15.179)^{0.750}$
P＝60	$8028.525 / (t + 15.224)^{0.752}$
P＝70	$8209.887 / (t + 15.262)^{0.753}$
P＝80	$8366.366 / (t + 15.294)^{0.754}$
P＝90	$8503.640 / (t + 15.321)^{0.755}$
P＝100	$8626.218 / (t + 15.346)^{0.756}$

表二　　重现期区间暴雨强度公式

P（年）	区间	参数	公　　式
1 — 10	I	n	$0.684+0.019Ln(P - 0.836)$
		b	$10.511+1.904Ln(P - 0.836)$
		A	$13.005+9.234Ln(P - 0.116)$
10—100	II	n	$0.724+0.007Ln(P - 7.842)$
		b	$14.378+0.214Ln(P - 7.842)$
		A	$20.517+6.796Ln(P - 2.317)$

清远市区暴雨强度曲线
2017 年编制

暴雨强度q[升/(秒*公顷)]

重现期(P)
100年
50年
30年
20年
10年
5年
3年
2年

降雨历时:(分钟)
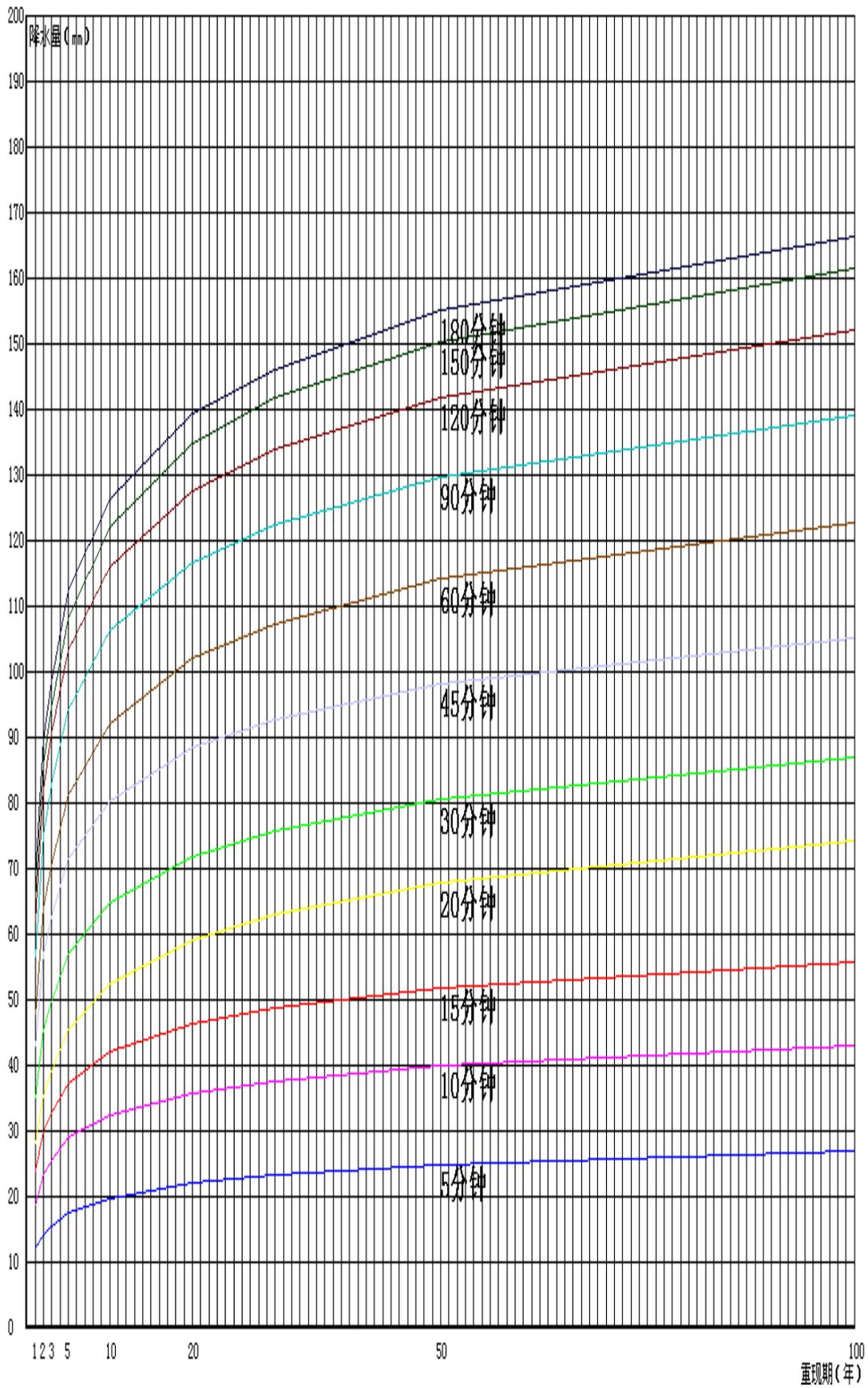
各历时降水量与重现期曲线图

P=1（a）　　　　　　　　　　　　　　　　　　　　　　　　　　　　　t: min；q: L/（s·hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	510.021	27	199.980	53	138.324	79	109.489	105	92.226	131	80.530	157	71.987
2	472.724	28	196.255	54	136.848	80	108.670	106	91.695	132	80.153	158	71.703
3	441.651	29	192.701	55	135.410	81	107.866	107	91.172	133	79.781	159	71.422
4	415.289	30	189.306	56	134.011	82	107.078	108	90.656	134	79.413	160	71.144
5	392.586	31	186.058	57	132.648	83	106.303	109	90.148	135	79.049	161	70.869
6	372.789	32	182.949	58	131.319	84	105.543	110	89.647	136	78.689	162	70.596
7	355.345	33	179.968	59	130.024	85	104.797	111	89.152	137	78.334	163	70.326
8	339.833	34	177.107	60	128.760	86	104.063	112	88.665	138	77.983	164	70.058
9	325.933	35	174.359	61	127.527	87	103.343	113	88.184	139	77.635	165	69.793
10	313.390	36	171.717	62	126.324	88	102.635	114	87.710	140	77.292	166	69.531
11	302.005	37	169.174	63	125.149	89	101.939	115	87.242	141	76.952	167	69.271
12	291.614	38	166.725	64	124.002	90	101.255	116	86.781	142	76.616	168	69.014
13	282.084	39	164.363	65	122.881	91	100.583	117	86.326	143	76.284	169	68.759
14	273.308	40	162.085	66	121.785	92	99.922	118	85.876	144	75.955	170	68.506
15	265.193	41	159.885	67	120.714	93	99.272	119	85.433	145	75.630	171	68.256
16	257.663	42	157.760	68	119.666	94	98.632	120	84.995	146	75.309	172	68.008
17	250.653	43	155.704	69	118.641	95	98.003	121	84.563	147	74.990	173	67.762
18	244.108	44	153.716	70	117.638	96	97.384	122	84.137	148	74.676	174	67.518
19	237.980	45	151.790	71	116.657	97	96.775	123	83.716	149	74.364	175	67.277
20	232.228	46	149.925	72	115.696	98	96.175	124	83.300	150	74.056	176	67.038
21	226.816	47	148.117	73	114.754	99	95.585	125	82.890	151	73.751	177	66.801
22	221.713	48	146.363	74	113.832	100	95.003	126	82.484	152	73.450	178	66.566
23	216.892	49	144.661	75	112.929	101	94.431	127	82.084	153	73.151	179	66.333
24	212.328	50	143.008	76	112.043	102	93.867	128	81.688	154	72.856	180	66.103
25	208.001	51	141.402	77	111.175	103	93.312	129	81.298	155	72.563	181	65.874
26	203.891	52	139.842	78	110.324	104	92.765	130	80.912	156	72.274	182	65.647

P=2（a） t: min; q: L/（s·hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	577.746	27	259.647	53	181.221	79	143.291	105	120.324	131	104.693	157	93.258		
2	546.345	28	255.031	54	179.295	80	142.205	106	119.615	132	104.189	158	92.878		
3	518.828	29	250.611	55	177.418	81	141.139	107	118.917	133	103.691	159	92.502		
4	494.482	30	246.375	56	175.590	82	140.092	108	118.228	134	103.198	160	92.130		
5	472.762	31	242.310	57	173.806	83	139.065	109	117.549	135	102.711	161	91.761		
6	453.244	32	238.407	58	172.067	84	138.055	110	116.880	136	102.230	162	91.396		
7	435.594	33	234.654	59	170.369	85	137.064	111	116.220	137	101.755	163	91.034		
8	419.540	34	231.043	60	168.712	86	136.089	112	115.569	138	101.284	164	90.676		
9	404.866	35	227.565	61	167.095	87	135.132	113	114.927	139	100.819	165	90.322		
10	391.391	36	224.213	62	165.514	88	134.191	114	114.293	140	100.359	166	89.970		
11	378.966	37	220.980	63	163.970	89	133.265	115	113.668	141	99.905	167	89.622		
12	367.467	38	217.859	64	162.461	90	132.356	116	113.052	142	99.455	168	89.278		
13	356.789	39	214.844	65	160.986	91	131.461	117	112.443	143	99.010	169	88.936		
14	346.842	40	211.930	66	159.543	92	130.581	118	111.843	144	98.571	170	88.598		
15	337.549	41	209.110	67	158.131	93	129.716	119	111.250	145	98.135	171	88.263		
16	328.845	42	206.381	68	156.750	94	128.864	120	110.665	146	97.705	172	87.931		
17	320.672	43	203.738	69	155.397	95	128.026	121	110.088	147	97.279	173	87.602		
18	312.981	44	201.177	70	154.074	96	127.201	122	109.517	148	96.858	174	87.276		
19	305.727	45	198.693	71	152.777	97	126.389	123	108.954	149	96.441	175	86.953		
20	298.872	46	196.283	72	151.507	98	125.590	124	108.398	150	96.029	176	86.633		
21	292.383	47	193.944	73	150.263	99	124.803	125	107.849	151	95.621	177	86.316		
22	286.230	48	191.672	74	149.043	100	124.028	126	107.307	152	95.217	178	86.002		
23	280.385	49	189.464	75	147.848	101	123.265	127	106.772	153	94.817	179	85.690		
24	274.824	50	187.317	76	146.675	102	122.513	128	106.243	154	94.421	180	85.381		
25	269.527	51	185.230	77	145.526	103	121.773	129	105.720	155	94.030	181	85.075		
26	264.474	52	183.198	78	144.398	104	121.043	130	105.203	156	93.642	182	84.772		

P=3（a）   t: min; q: L/（s•hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	634.108	27	294.008	53	205.697	79	162.577	105	136.381	131	118.529	157	105.465
2	602.052	28	288.848	54	203.513	80	161.339	106	135.572	132	117.953	158	105.031
3	573.670	29	283.903	55	201.384	81	160.125	107	134.774	133	117.384	159	104.601
4	548.335	30	279.159	56	199.309	82	158.932	108	133.988	134	116.821	160	104.175
5	525.559	31	274.603	57	197.285	83	157.760	109	133.213	135	116.265	161	103.754
6	504.953	32	270.224	58	195.310	84	156.609	110	132.449	136	115.716	162	103.337
7	486.206	33	266.010	59	193.382	85	155.479	111	131.695	137	115.172	163	102.924
8	469.066	34	261.953	60	191.501	86	154.368	112	130.951	138	114.635	164	102.514
9	453.324	35	258.043	61	189.663	87	153.276	113	130.218	139	114.103	165	102.109
10	438.808	36	254.272	62	187.867	88	152.203	114	129.495	140	113.578	166	101.708
11	425.372	37	250.632	63	186.112	89	151.148	115	128.781	141	113.059	167	101.310
12	412.894	38	247.116	64	184.397	90	150.110	116	128.077	142	112.545	168	100.916
13	401.270	39	243.718	65	182.719	91	149.090	117	127.382	143	112.037	169	100.526
14	390.410	40	240.431	66	181.078	92	148.086	118	126.696	144	111.534	170	100.140
15	380.238	41	237.250	67	179.472	93	147.099	119	126.019	145	111.037	171	99.757
16	370.688	42	234.169	68	177.901	94	146.127	120	125.351	146	110.545	172	99.378
17	361.700	43	231.184	69	176.362	95	145.171	121	124.691	147	110.059	173	99.002
18	353.224	44	228.289	70	174.856	96	144.230	122	124.040	148	109.578	174	98.630
19	345.215	45	225.481	71	173.380	97	143.304	123	123.397	149	109.101	175	98.261
20	337.634	46	222.756	72	171.934	98	142.392	124	122.762	150	108.630	176	97.895
21	330.445	47	220.109	73	170.518	99	141.494	125	122.135	151	108.164	177	97.532
22	323.617	48	217.537	74	169.129	100	140.609	126	121.516	152	107.702	178	97.173
23	317.122	49	215.038	75	167.768	101	139.738	127	120.904	153	107.246	179	96.817
24	310.936	50	212.607	76	166.432	102	138.880	128	120.299	154	106.793	180	96.465
25	305.034	51	210.241	77	165.123	103	138.035	129	119.702	155	106.346	181	96.115
26	299.398	52	207.939	78	163.838	104	137.202	130	119.112	156	105.903	182	95.768

P=5（a） t: min; q: L/（s•hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	699.114	27	333.887	53	234.237	79	185.096	105	155.135	131	134.688	157	119.715		
2	666.151	28	328.108	54	231.754	80	183.682	106	154.209	132	134.028	158	119.218		
3	636.696	29	322.565	55	229.334	81	182.294	107	153.296	133	133.376	159	118.725		
4	610.192	30	317.241	56	226.974	82	180.931	108	152.396	134	132.731	160	118.238		
5	586.196	31	312.124	57	224.671	83	179.592	109	151.508	135	132.094	161	117.755		
6	564.353	32	307.202	58	222.424	84	178.277	110	150.633	136	131.464	162	117.277		
7	544.370	33	302.462	59	220.230	85	176.985	111	149.770	137	130.841	163	116.803		
8	526.010	34	297.894	60	218.087	86	175.715	112	148.918	138	130.225	164	116.334		
9	509.072	35	293.489	61	215.994	87	174.466	113	148.079	139	129.616	165	115.870		
10	493.390	36	289.238	62	213.949	88	173.239	114	147.250	140	129.014	166	115.410		
11	478.823	37	285.132	63	211.949	89	172.032	115	146.433	141	128.419	167	114.954		
12	465.249	38	281.163	64	209.994	90	170.846	116	145.626	142	127.830	168	114.503		
13	452.565	39	277.324	65	208.082	91	169.679	117	144.830	143	127.248	169	114.055		
14	440.683	40	273.610	66	206.211	92	168.531	118	144.045	144	126.672	170	113.612		
15	429.526	41	270.013	67	204.381	93	167.401	119	143.269	145	126.102	171	113.174		
16	419.024	42	266.527	68	202.588	94	166.290	120	142.504	146	125.539	172	112.739		
17	409.120	43	263.148	69	200.834	95	165.196	121	141.748	147	124.981	173	112.308		
18	399.761	44	259.871	70	199.115	96	164.119	122	141.002	148	124.429	174	111.881		
19	390.901	45	256.690	71	197.431	97	163.059	123	140.265	149	123.884	175	111.458		
20	382.500	46	253.600	72	195.781	98	162.015	124	139.538	150	123.344	176	111.039		
21	374.520	47	250.599	73	194.164	99	160.988	125	138.819	151	122.809	177	110.624		
22	366.930	48	247.682	74	192.579	100	159.975	126	138.110	152	122.280	178	110.212		
23	359.699	49	244.846	75	191.024	101	158.978	127	137.409	153	121.757	179	109.804		
24	352.802	50	242.086	76	189.500	102	157.996	128	136.716	154	121.239	180	109.400		
25	346.215	51	239.400	77	188.004	103	157.028	129	136.032	155	120.726	181	108.999		
26	339.917	52	236.785	78	186.537	104	156.075	130	135.356	156	120.218	182	108.602		

P=10（a）　　　　　　　　　　　　　　　　　　　　　　　　　　　t: min; q: L/（s·hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	776.815	27	379.369	53	266.184	79	209.932	105	175.562	131	152.099	157	134.924
2	742.295	28	372.847	54	263.348	80	208.311	106	174.499	132	151.341	158	134.353
3	711.205	29	366.585	55	260.582	81	206.720	107	173.452	133	150.593	159	133.788
4	683.036	30	360.567	56	257.884	82	205.156	108	172.419	134	149.853	160	133.229
5	657.376	31	354.778	57	255.251	83	203.621	109	171.400	135	149.122	161	132.676
6	633.891	32	349.205	58	252.681	84	202.113	110	170.396	136	148.399	162	132.127
7	612.303	33	343.835	59	250.172	85	200.630	111	169.405	137	147.685	163	131.584
8	592.381	34	338.657	60	247.720	86	199.174	112	168.428	138	146.978	164	131.047
9	573.930	35	333.660	61	245.326	87	197.742	113	167.465	139	146.280	165	130.514
10	556.787	36	328.835	62	242.985	88	196.334	114	166.514	140	145.589	166	129.987
11	540.811	37	324.172	63	240.697	89	194.950	115	165.576	141	144.906	167	129.464
12	525.880	38	319.662	64	238.459	90	193.589	116	164.650	142	144.231	168	128.947
13	511.892	39	315.299	65	236.270	91	192.250	117	163.737	143	143.563	169	128.434
14	498.755	40	311.074	66	234.127	92	190.933	118	162.835	144	142.902	170	127.927
15	486.391	41	306.981	67	232.031	93	189.637	119	161.945	145	142.249	171	127.424
16	474.729	42	303.014	68	229.978	94	188.362	120	161.067	146	141.602	172	126.925
17	463.710	43	299.166	69	227.968	95	187.107	121	160.200	147	140.963	173	126.432
18	453.278	44	295.432	70	225.999	96	185.871	122	159.344	148	140.330	174	125.943
19	443.387	45	291.806	71	224.070	97	184.655	123	158.498	149	139.704	175	125.458
20	433.992	46	288.285	72	222.180	98	183.457	124	157.664	150	139.085	176	124.977
21	425.057	47	284.863	73	220.327	99	182.278	125	156.839	151	138.472	177	124.501
22	416.545	48	281.535	74	218.510	100	181.117	126	156.025	152	137.865	178	124.030
23	408.427	49	278.298	75	216.728	101	179.973	127	155.220	153	137.265	179	123.562
24	400.675	50	275.148	76	214.981	102	178.846	128	154.426	154	136.670	180	123.099
25	393.263	51	272.081	77	213.266	103	177.735	129	153.641	155	136.082	181	122.640
26	386.168	52	269.095	78	211.584	104	176.641	130	152.865	156	135.500	182	122.184

t: min; q: L/（s•hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	860.402	27	419.797	53	293.577	79	230.893	105	192.646	131	166.574	157	147.515
2	822.410	28	412.526	54	290.415	80	229.087	106	191.464	132	165.733	158	146.882
3	788.137	29	405.544	55	287.331	81	227.315	107	190.299	133	164.902	159	146.256
4	757.042	30	398.834	56	284.323	82	225.575	108	189.151	134	164.080	160	145.636
5	728.684	31	392.379	57	281.388	83	223.865	109	188.018	135	163.269	161	145.022
6	702.702	32	386.164	58	278.523	84	222.186	110	186.902	136	162.466	162	144.414
7	678.797	33	380.175	59	275.726	85	220.536	111	185.801	137	161.673	163	143.812
8	656.718	34	374.400	60	272.994	86	218.915	112	184.715	138	160.889	164	143.216
9	636.256	35	368.828	61	270.325	87	217.321	113	183.644	139	160.114	165	142.626
10	617.231	36	363.446	62	267.716	88	215.754	114	182.587	140	159.347	166	142.041
11	599.492	37	358.245	63	265.165	89	214.214	115	181.545	141	158.589	167	141.462
12	582.905	38	353.216	64	262.671	90	212.699	116	180.516	142	157.840	168	140.889
13	567.358	39	348.349	65	260.232	91	211.209	117	179.501	143	157.099	169	140.321
14	552.751	40	343.637	66	257.845	92	209.743	118	178.499	144	156.365	170	139.758
15	538.998	41	339.073	67	255.508	93	208.301	119	177.510	145	155.640	171	139.201
16	526.023	42	334.648	68	253.221	94	206.882	120	176.535	146	154.923	172	138.648
17	513.759	43	330.356	69	250.982	95	205.486	121	175.571	147	154.213	173	138.101
18	502.146	44	326.192	70	248.788	96	204.112	122	174.620	148	153.511	174	137.559
19	491.132	45	322.149	71	246.639	97	202.759	123	173.681	149	152.817	175	137.022
20	480.669	46	318.222	72	244.533	98	201.426	124	172.754	150	152.130	176	136.490
21	470.715	47	314.405	73	242.469	99	200.115	125	171.838	151	151.450	177	135.963
22	461.232	48	310.694	74	240.445	100	198.823	126	170.933	152	150.777	178	135.440
23	452.187	49	307.085	75	238.461	101	197.550	127	170.040	153	150.111	179	134.922
24	443.547	50	303.572	76	236.515	102	196.297	128	169.158	154	149.452	180	134.409
25	435.285	51	300.153	77	234.605	103	195.062	129	168.286	155	148.800	181	133.900
26	427.376	52	296.822	78	232.731	104	193.845	130	167.425	156	148.154	182	133.396

P=30（a）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	907.695	27	442.367	53	308.884	79	242.632	105	202.238	131	174.721	157	154.618
2	867.655	28	434.677	54	305.540	80	240.725	106	200.990	132	173.834	158	153.951
3	831.519	29	427.292	55	302.280	81	238.853	107	199.760	133	172.957	159	153.291
4	798.719	30	420.195	56	299.100	82	237.014	108	198.548	134	172.090	160	152.637
5	768.795	31	413.368	57	295.998	83	235.208	109	197.353	135	171.234	161	151.990
6	741.370	32	406.794	58	292.969	84	233.434	110	196.174	136	170.388	162	151.349
7	716.130	33	400.461	59	290.012	85	231.691	111	195.012	137	169.551	163	150.714
8	692.814	34	394.353	60	287.124	86	229.979	112	193.865	138	168.724	164	150.086
9	671.200	35	388.459	61	284.303	87	228.295	113	192.735	139	167.906	165	149.464
10	651.101	36	382.767	62	281.545	88	226.640	114	191.619	140	167.097	166	148.847
11	632.356	37	377.267	63	278.849	89	225.013	115	190.519	141	166.298	167	148.237
12	614.828	38	371.948	64	276.213	90	223.413	116	189.434	142	165.507	168	147.632
13	598.396	39	366.801	65	273.635	91	221.840	117	188.362	143	164.725	169	147.033
14	582.956	40	361.818	66	271.112	92	220.292	118	187.305	144	163.952	170	146.440
15	568.418	41	356.991	67	268.643	93	218.769	119	186.262	145	163.187	171	145.853
16	554.700	42	352.312	68	266.226	94	217.270	120	185.232	146	162.431	172	145.271
17	541.734	43	347.773	69	263.859	95	215.796	121	184.215	147	161.682	173	144.694
18	529.455	44	343.370	70	261.541	96	214.344	122	183.211	148	160.942	174	144.123
19	517.808	45	339.094	71	259.270	97	212.916	123	182.220	149	160.209	175	143.556
20	506.744	46	334.941	72	257.045	98	211.509	124	181.242	150	159.485	176	142.995
21	496.218	47	330.906	73	254.863	99	210.124	125	180.275	151	158.768	177	142.440
22	486.189	48	326.982	74	252.725	100	208.760	126	179.321	152	158.058	178	141.889
23	476.623	49	323.165	75	250.628	101	207.416	127	178.378	153	157.356	179	141.343
24	467.485	50	319.451	76	248.572	102	206.093	128	177.447	154	156.661	180	140.802
25	458.748	51	315.836	77	246.554	103	204.789	129	176.527	155	155.973	181	140.266
26	450.383	52	312.315	78	244.575	104	203.504	130	175.619	156	155.292	182	139.734

P=40（a） t: min; q: L/（s•hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	942.310	27	459.274	53	320.509	79	251.637	105	209.656	131	181.064	157	160.181
2	900.815	28	451.280	54	317.033	80	249.655	106	208.359	132	180.142	158	159.488
3	863.351	29	443.605	55	313.644	81	247.709	107	207.081	133	179.231	159	158.802
4	829.336	30	436.227	56	310.338	82	245.798	108	205.821	134	178.331	160	158.123
5	798.296	31	429.130	57	307.112	83	243.921	109	204.579	135	177.441	161	157.451
6	769.841	32	422.297	58	303.964	84	242.077	110	203.354	136	176.562	162	156.785
7	743.648	33	415.713	59	300.890	85	240.266	111	202.146	137	175.693	163	156.126
8	719.446	34	409.363	60	297.888	86	238.486	112	200.955	138	174.833	164	155.474
9	697.009	35	403.236	61	294.954	87	236.736	113	199.780	139	173.984	165	154.827
10	676.140	36	397.319	62	292.088	88	235.016	114	198.622	140	173.144	166	154.187
11	656.676	37	391.601	63	289.285	89	233.325	115	197.478	141	172.313	167	153.553
12	638.472	38	386.071	64	286.545	90	231.662	116	196.350	142	171.492	168	152.925
13	621.405	39	380.721	65	283.865	91	230.027	117	195.237	143	170.680	169	152.303
14	605.367	40	375.540	66	281.242	92	228.418	118	194.139	144	169.876	170	151.687
15	590.264	41	370.522	67	278.675	93	226.835	119	193.054	145	169.082	171	151.077
16	576.013	42	365.657	68	276.163	94	225.278	120	191.984	146	168.296	172	150.472
17	562.541	43	360.939	69	273.702	95	223.745	121	190.928	147	167.519	173	149.873
18	549.782	44	356.361	70	271.293	96	222.237	122	189.885	148	166.750	174	149.280
19	537.680	45	351.916	71	268.932	97	220.752	123	188.855	149	165.989	175	148.692
20	526.183	46	347.599	72	266.619	98	219.290	124	187.839	150	165.236	176	148.110
21	515.244	47	343.403	73	264.352	99	217.850	125	186.835	151	164.491	177	147.532
22	504.821	48	339.324	74	262.129	100	216.433	126	185.843	152	163.754	178	146.960
23	494.879	49	335.356	75	259.949	101	215.037	127	184.864	153	163.025	179	146.393
24	485.382	50	331.495	76	257.812	102	213.661	128	183.896	154	162.303	180	145.832
25	476.301	51	327.736	77	255.714	103	212.306	129	182.941	155	161.588	181	145.275
26	467.606	52	324.076	78	253.657	104	210.971	130	181.996	156	160.881	182	144.723

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	968.439	27	472.024	53	329.267	79	258.417	105	215.236	131	185.833	157	164.362
2	925.843	28	463.801	54	325.691	80	256.378	106	213.902	132	184.885	158	163.649
3	887.378	29	455.905	55	322.204	81	254.376	107	212.588	133	183.948	159	162.944
4	852.445	30	448.315	56	318.803	82	252.410	108	211.292	134	183.023	160	162.246
5	820.562	31	441.014	57	315.484	83	250.479	109	210.015	135	182.108	161	161.555
6	791.329	32	433.985	58	312.245	84	248.583	110	208.755	136	181.204	162	160.871
7	764.416	33	427.211	59	309.083	85	246.719	111	207.513	137	180.310	163	160.193
8	739.546	34	420.679	60	305.994	86	244.888	112	206.288	138	179.426	164	159.522
9	716.485	35	414.376	61	302.977	87	243.089	113	205.080	139	178.553	165	158.858
10	695.036	36	408.288	62	300.028	88	241.320	114	203.888	140	177.689	166	158.199
11	675.027	37	402.406	63	297.145	89	239.580	115	202.712	141	176.835	167	157.548
12	656.313	38	396.717	64	294.326	90	237.870	116	201.552	142	175.991	168	156.902
13	638.766	39	391.213	65	291.568	91	236.188	117	200.408	143	175.156	169	156.263
14	622.276	40	385.883	66	288.871	92	234.533	118	199.278	144	174.330	170	155.630
15	606.747	41	380.720	67	286.230	93	232.905	119	198.163	145	173.513	171	155.002
16	592.092	42	375.715	68	283.645	94	231.303	120	197.063	146	172.705	172	154.381
17	578.238	43	370.861	69	281.114	95	229.727	121	195.976	147	171.906	173	153.765
18	565.117	44	366.151	70	278.636	96	228.175	122	194.904	148	171.115	174	153.155
19	552.671	45	361.578	71	276.207	97	226.648	123	193.845	149	170.333	175	152.551
20	540.846	46	357.136	72	273.827	98	225.145	124	192.799	150	169.559	176	151.952
21	529.595	47	352.820	73	271.495	99	223.664	125	191.767	151	168.793	177	151.358
22	518.875	48	348.623	74	269.209	100	222.206	126	190.747	152	168.035	178	150.770
23	508.648	49	344.541	75	266.967	101	220.770	127	189.740	153	167.285	179	150.188
24	498.880	50	340.569	76	264.768	102	219.356	128	188.745	154	166.543	180	149.610
25	489.538	51	336.702	77	262.610	103	217.962	129	187.763	155	165.808	181	149.038
26	480.595	52	332.936	78	260.494	104	216.589	130	186.792	156	165.081	182	148.471

P=60(a)   t: min; q: L/（s·hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	988.498	27	481.648	53	335.812	79	263.447	105	219.353	131	189.335	157	167.419
2	945.040	28	473.247	54	332.159	80	261.365	106	217.991	132	188.367	158	166.692
3	905.789	29	465.181	55	328.598	81	259.320	107	216.649	133	187.411	159	165.972
4	870.138	30	457.427	56	325.124	82	257.313	108	215.326	134	186.466	160	165.260
5	837.595	31	449.969	57	321.734	83	255.341	109	214.022	135	185.532	161	164.554
6	807.753	32	442.788	58	318.426	84	253.404	110	212.736	136	184.609	162	163.856
7	780.277	33	435.868	59	315.195	85	251.501	111	211.468	137	183.697	163	163.164
8	754.885	34	429.195	60	312.041	86	249.632	112	210.217	138	182.795	164	162.479
9	731.339	35	422.755	61	308.958	87	247.794	113	208.984	139	181.904	165	161.801
10	709.436	36	416.537	62	305.946	88	245.987	114	207.767	140	181.022	166	161.130
11	689.003	37	410.527	63	303.002	89	244.211	115	206.567	141	180.150	167	160.465
12	669.891	38	404.715	64	300.122	90	242.464	116	205.382	142	179.288	168	159.806
13	651.971	39	399.092	65	297.306	91	240.746	117	204.214	143	178.436	169	159.153
14	635.129	40	393.648	66	294.550	92	239.057	118	203.060	144	177.593	170	158.507
15	619.267	41	388.373	67	291.853	93	237.394	119	201.922	145	176.759	171	157.867
16	604.299	42	383.260	68	289.213	94	235.759	120	200.799	146	175.934	172	157.233
17	590.148	43	378.302	69	286.628	95	234.149	121	199.690	147	175.118	173	156.604
18	576.746	44	373.490	70	284.097	96	232.565	122	198.595	148	174.311	174	155.982
19	564.032	45	368.819	71	281.616	97	231.006	123	197.514	149	173.513	175	155.365
20	551.953	46	364.282	72	279.186	98	229.470	124	196.446	150	172.723	176	154.754
21	540.460	47	359.872	73	276.804	99	227.959	125	195.392	151	171.941	177	154.148
22	529.509	48	355.585	74	274.469	100	226.470	126	194.351	152	171.168	178	153.548
23	519.062	49	351.415	75	272.179	101	225.004	127	193.323	153	170.402	179	152.954
24	509.083	50	347.358	76	269.933	102	223.559	128	192.308	154	169.645	180	152.364
25	499.540	51	343.407	77	267.730	103	222.136	129	191.305	155	168.895	181	151.780
26	490.404	52	339.560	78	265.568	104	220.734	130	190.314	156	168.153	182	151.201

P=70（a）

t: min; q: L/（s·hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	1005.634	27	489.947	53	341.484	79	267.821	105	222.943	131	192.395	157	170.096
2	961.450	28	481.395	54	337.766	80	265.702	106	221.557	132	191.410	158	169.356
3	921.536	29	473.184	55	334.140	81	263.621	107	220.191	133	190.438	159	168.624
4	885.279	30	465.291	56	330.603	82	261.577	108	218.845	134	189.476	160	167.899
5	852.178	31	457.698	57	327.153	83	259.571	109	217.518	135	188.526	161	167.181
6	821.822	32	450.387	58	323.785	84	257.599	110	216.209	136	187.587	162	166.471
7	793.870	33	443.343	59	320.497	85	255.663	111	214.918	137	186.659	163	165.767
8	768.036	34	436.550	60	317.285	86	253.759	112	213.646	138	185.741	164	165.070
9	744.078	35	429.994	61	314.148	87	251.889	113	212.390	139	184.834	165	164.380
10	721.791	36	423.663	62	311.082	88	250.050	114	211.152	140	183.936	166	163.697
11	700.999	37	417.545	63	308.084	89	248.242	115	209.930	141	183.050	167	163.020
12	681.550	38	411.629	64	305.153	90	246.464	116	208.725	142	182.172	168	162.350
13	663.313	39	405.904	65	302.286	91	244.716	117	207.536	143	181.305	169	161.686
14	646.172	40	400.362	66	299.481	92	242.996	118	206.362	144	180.447	170	161.029
15	630.029	41	394.992	67	296.736	93	241.304	119	205.204	145	179.599	171	160.378
16	614.795	42	389.787	68	294.049	94	239.640	120	204.061	146	178.760	172	159.732
17	600.391	43	384.739	69	291.417	95	238.002	121	202.932	147	177.930	173	159.093
18	586.750	44	379.841	70	288.840	96	236.389	122	201.818	148	177.109	174	158.460
19	573.809	45	375.085	71	286.315	97	234.802	123	200.718	149	176.296	175	157.832
20	561.514	46	370.466	72	283.842	98	233.240	124	199.632	150	175.492	176	157.211
21	549.815	47	365.977	73	281.417	99	231.701	125	198.559	151	174.697	177	156.595
22	538.668	48	361.613	74	279.040	100	230.186	126	197.500	152	173.910	178	155.984
23	528.033	49	357.368	75	276.709	101	228.694	127	196.454	153	173.131	179	155.379
24	517.875	50	353.237	76	274.423	102	227.224	128	195.421	154	172.361	180	154.780
25	508.161	51	349.216	77	272.181	103	225.775	129	194.400	155	171.598	181	154.186
26	498.860	52	345.300	78	269.980	104	224.349	130	193.391	156	170.843	182	153.597

P=80（a） 　　　　　　　　　　　　　　　　　　　　　　　　t: min; q: L/（s•hm^2）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	1020.301	27	497.049	53	346.336	79	271.561	105	226.011	131	195.010	157	172.382
2	975.495	28	488.368	54	342.561	80	269.410	106	224.605	132	194.011	158	171.632
3	935.014	29	480.032	55	338.880	81	267.298	107	223.219	133	193.024	159	170.889
4	898.238	30	472.019	56	335.290	82	265.224	108	221.852	134	192.048	160	170.153
5	864.660	31	464.311	57	331.788	83	263.187	109	220.505	135	191.084	161	169.425
6	833.864	32	456.890	58	328.369	84	261.186	110	219.177	136	190.131	162	168.704
7	805.505	33	449.739	59	325.031	85	259.220	111	217.867	137	189.189	163	167.990
8	779.293	34	442.843	60	321.771	86	257.288	112	216.576	138	188.258	164	167.283
9	754.983	35	436.188	61	318.586	87	255.390	113	215.302	139	187.337	165	166.583
10	732.367	36	429.761	62	315.473	88	253.523	114	214.045	140	186.427	166	165.890
11	711.267	37	423.550	63	312.431	89	251.688	115	212.805	141	185.527	167	165.204
12	691.530	38	417.544	64	309.455	90	249.884	116	211.582	142	184.637	168	164.524
13	673.021	39	411.732	65	306.545	91	248.109	117	210.375	143	183.756	169	163.850
14	655.625	40	406.106	66	303.698	92	246.364	118	209.184	144	182.886	170	163.183
15	639.241	41	400.655	67	300.911	93	244.647	119	208.008	145	182.025	171	162.522
16	623.778	42	395.371	68	298.183	94	242.957	120	206.848	146	181.174	172	161.867
17	609.159	43	390.246	69	295.512	95	241.295	121	205.703	147	180.331	173	161.219
18	595.312	44	385.274	70	292.896	96	239.658	122	204.572	148	179.498	174	160.576
19	582.177	45	380.446	71	290.334	97	238.047	123	203.456	149	178.674	175	159.940
20	569.696	46	375.757	72	287.823	98	236.461	124	202.354	150	177.858	176	159.309
21	557.821	47	371.200	73	285.361	99	234.900	125	201.265	151	177.051	177	158.684
22	546.506	48	366.770	74	282.949	100	233.362	126	200.190	152	176.253	178	158.064
23	535.711	49	362.460	75	280.583	101	231.848	127	199.129	153	175.463	179	157.451
24	525.400	50	358.267	76	278.262	102	230.356	128	198.080	154	174.681	180	156.842
25	515.538	51	354.185	77	275.986	103	228.886	129	197.044	155	173.907	181	156.240
26	506.097	52	350.209	78	273.753	104	227.438	130	196.021	156	173.141	182	155.642

P=90（a） t: min; q: L/（s·hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	1033.106	27	503.248	53	350.569	79	274.823	105	228.686	131	197.289	157	174.375
2	987.758	28	494.454	54	346.745	80	272.644	106	227.262	132	196.277	158	173.615
3	946.783	29	486.010	55	343.017	81	270.505	107	225.858	133	195.278	159	172.863
4	909.553	30	477.893	56	339.380	82	268.404	108	224.474	134	194.290	160	172.118
5	875.559	31	470.084	57	335.831	83	266.341	109	223.110	135	193.313	161	171.381
6	844.379	32	462.566	58	332.368	84	264.314	110	221.765	136	192.348	162	170.651
7	815.664	33	455.321	59	328.987	85	262.323	111	220.438	137	191.394	163	169.928
8	789.122	34	448.335	60	325.684	86	260.366	112	219.130	138	190.451	164	169.212
9	764.504	35	441.593	61	322.458	87	258.443	113	217.840	139	189.519	165	168.503
10	741.602	36	435.083	62	319.305	88	256.552	114	216.567	140	188.597	166	167.801
11	720.233	37	428.791	63	316.223	89	254.694	115	215.311	141	187.686	167	167.106
12	700.243	38	422.706	64	313.209	90	252.866	116	214.072	142	186.784	168	166.417
13	681.497	39	416.819	65	310.261	91	251.069	117	212.850	143	185.893	169	165.735
14	663.878	40	411.119	66	307.376	92	249.301	118	211.644	144	185.012	170	165.060
15	647.283	41	405.597	67	304.554	93	247.562	119	210.453	145	184.140	171	164.391
16	631.621	42	400.244	68	301.790	94	245.850	120	209.278	146	183.278	172	163.728
17	616.813	43	395.052	69	299.085	95	244.166	121	208.118	147	182.425	173	163.071
18	602.788	44	390.015	70	296.435	96	242.509	122	206.973	148	181.581	174	162.420
19	589.482	45	385.124	71	293.839	97	240.877	123	205.843	149	180.746	175	161.776
20	576.840	46	380.374	72	291.295	98	239.271	124	204.727	150	179.920	176	161.137
21	564.811	47	375.758	73	288.802	99	237.689	125	203.624	151	179.103	177	160.504
22	553.349	48	371.269	74	286.358	100	236.132	126	202.536	152	178.294	178	159.877
23	542.414	49	366.904	75	283.961	101	234.598	127	201.461	153	177.494	179	159.256
24	531.968	50	362.656	76	281.611	102	233.087	128	200.399	154	176.702	180	158.640
25	521.979	51	358.521	77	279.305	103	231.598	129	199.349	155	175.919	181	158.029
26	512.415	52	354.493	78	277.043	104	230.131	130	198.313	156	175.143	182	157.424

P=100（a）   t: min；q: L/（s•hm²）

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	1043.473	27	508.101	53	353.816	79	277.287	105	230.682	131	198.972	157	175.833
2	997.667	28	499.214	54	349.952	80	275.086	106	229.244	132	197.951	158	175.066
3	956.276	29	490.680	55	346.184	81	272.924	107	227.826	133	196.941	159	174.306
4	918.666	30	482.477	56	342.510	82	270.802	108	226.428	134	195.943	160	173.554
5	884.322	31	474.586	57	338.925	83	268.718	109	225.050	135	194.957	161	172.810
6	852.820	32	466.989	58	335.425	84	266.670	110	223.691	136	193.982	162	172.072
7	823.807	33	459.668	59	332.009	85	264.659	111	222.351	137	193.019	163	171.343
8	796.988	34	452.608	60	328.672	86	262.682	112	221.030	138	192.067	164	170.620
9	772.114	35	445.795	61	325.412	87	260.740	113	219.727	139	191.125	165	169.904
10	748.971	36	439.215	62	322.227	88	258.830	114	218.442	140	190.194	166	169.195
11	727.378	37	432.857	63	319.112	89	256.952	115	217.173	141	189.274	167	168.493
12	707.178	38	426.709	64	316.067	90	255.106	116	215.922	142	188.364	168	167.798
13	688.235	39	420.759	65	313.089	91	253.291	117	214.688	143	187.464	169	167.110
14	670.430	40	414.999	66	310.175	92	251.505	118	213.469	144	186.574	170	166.428
15	653.660	41	409.419	67	307.323	93	249.748	119	212.267	145	185.693	171	165.752
16	637.833	42	404.010	68	304.531	94	248.019	120	211.080	146	184.823	172	165.083
17	622.868	43	398.764	69	301.798	95	246.318	121	209.909	147	183.961	173	164.420
18	608.694	44	393.674	70	299.120	96	244.644	122	208.752	148	183.109	174	163.763
19	595.248	45	388.732	71	296.498	97	242.996	123	207.611	149	182.266	175	163.112
20	582.472	46	383.932	72	293.928	98	241.373	124	206.483	150	181.432	176	162.467
21	570.316	47	379.267	73	291.409	99	239.776	125	205.370	151	180.607	177	161.828
22	558.732	48	374.732	74	288.940	100	238.203	126	204.271	152	179.791	178	161.195
23	547.681	49	370.321	75	286.519	101	236.653	127	203.185	153	178.983	179	160.567
24	537.125	50	366.028	76	284.144	102	235.127	128	202.112	154	178.183	180	159.946
25	527.030	51	361.850	77	281.815	103	233.623	129	201.053	155	177.392	181	159.329
26	517.365	52	357.781	78	279.530	104	232.142	130	200.006	156	176.609	182	158.719