

珠海市暴雨强度公式及计算图表

(近 50 年)

珠海市气象局

广东省气候中心

二〇一五年四月

说

1. 本计算图表以珠海国家地面气象观测站 53 年(1962~2014 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。

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设计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(升/秒·公顷)

t —降雨历时(分钟)

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:

$$q = \frac{847.172(1 + 0.659 \ln P)}{(t + 5.373)^{0.391}}$$

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。

明

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

从重现期区间参数公式 II,得:

$$n = 0.466 - 0.041 \ln(P - 5.080)$$

$$= 0.34334 \text{ (取 } 0.343 \text{)}$$

$$b = 8.474 - 1.313 \ln(P - 5.080)$$

$$= 4.54587 \text{ (取 } 4.546 \text{)}$$

$$A = 9.295 - 0.409 \ln(P - 6.737)$$

$$= 8.10691 \text{ (取 } 8.107 \text{)}$$

配得 $P=25$ 年的暴雨强度计算公式如下:

$$q = \frac{167 \times 8.107}{(t + 4.546)^{0.343}}$$

可按上式计算 1~200 分钟中任何时段的暴雨强度。

当 $t=50$:

$$q = \frac{167 \times 8.107}{(t + 4.546)^{0.343}} = 343.453 \text{ (升/秒/公顷)}$$

5. 公式误差

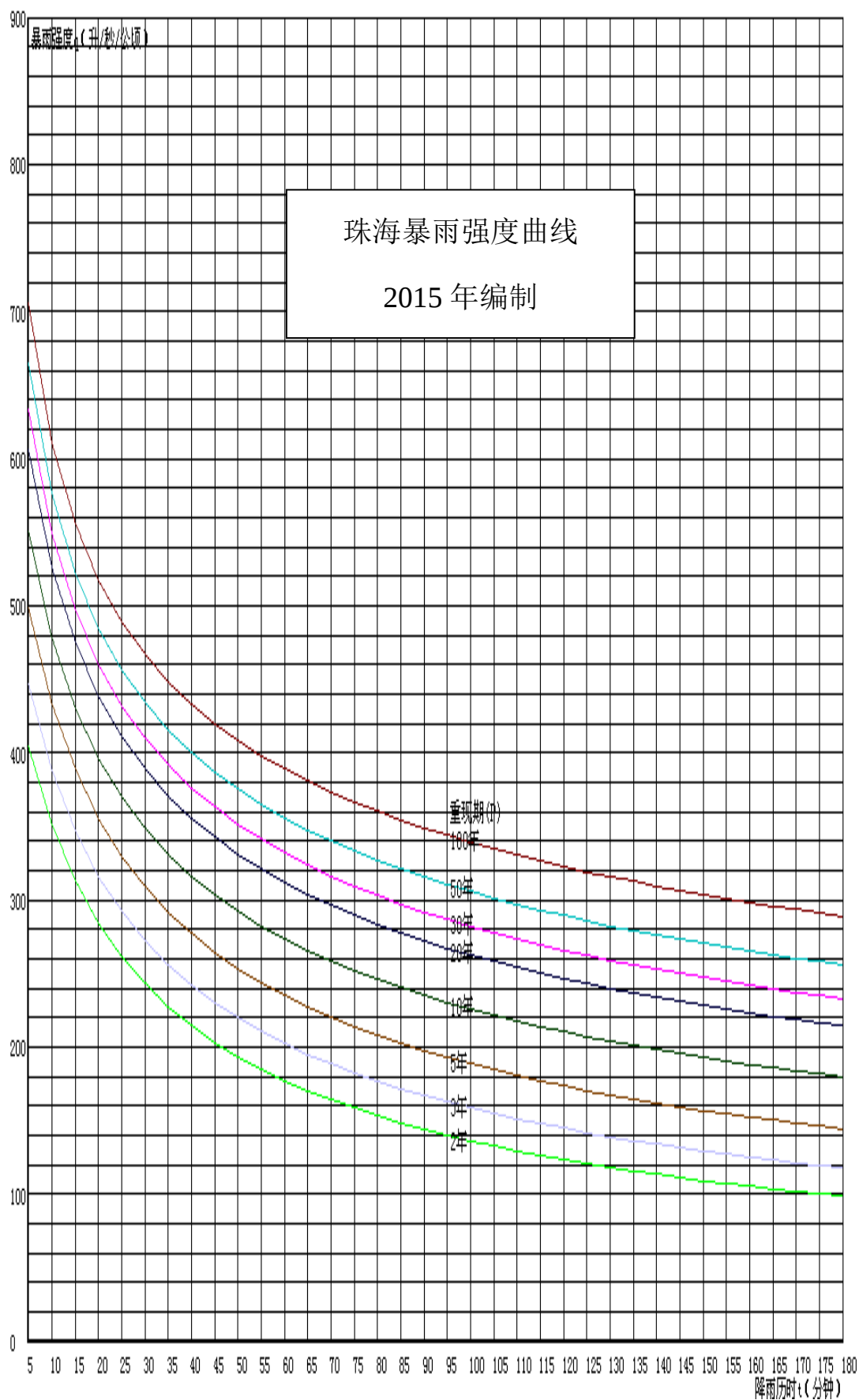
重现期 2~20 年的暴雨强度公式算得的平均绝对均方差为: 0.023 (mm/min), 平均相对均方差为: 1.65%。精度符合《室外排水设计规范》(GB50014—2006, 2014 年版)提出的要求。

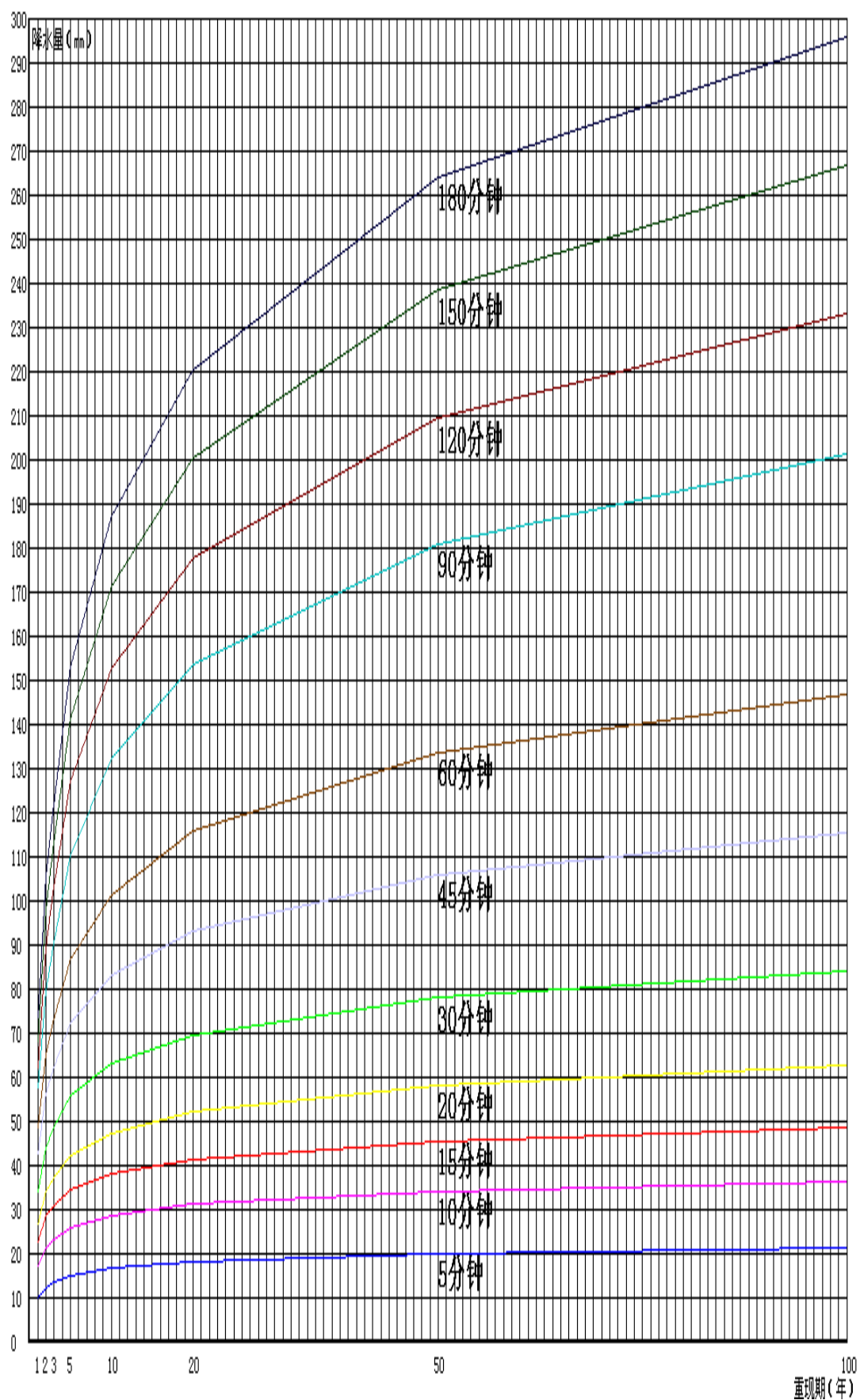
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=2	$2552.261 / (t + 14.226)^{0.616}$
P=3	$2165.99 / (t + 11.802)^{0.552}$
P=5	$1750.494 / (t + 8.978)^{0.477}$
P=10	$1471.437 / (t + 6.382)^{0.401}$
P=20	$1375.746 / (t + 4.925)^{0.355}$
P=30	$1337.336 / (t + 4.252)^{0.334}$
P=50	$1294.918 / (t + 3.478)^{0.310}$
P=100	$1242.48 / (t + 2.496)^{0.279}$

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	$0.673 - 0.129\text{Ln}(P - 0.444)$
		b	$16.386 - 4.885\text{Ln}(P - 0.444)$
		A	$16.084 - 3.885\text{Ln}(P - 0.771)$
10—100	II	n	$0.466 - 0.041\text{Ln}(P - 5.080)$
		b	$8.474 - 1.313\text{Ln}(P - 5.080)$
		A	$9.295 - 0.409\text{Ln}(P - 6.737)$





延长样本资料后的降水量与重现期曲线图

P=2 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	476.927	27	258.214	53	191.057	79	156.203	105	134.240	131	118.879	157	107.410
2	458.601	28	254.430	54	189.327	80	155.180	106	133.551	132	118.378	158	107.026
3	442.013	29	250.788	55	187.637	81	154.174	107	132.871	133	117.882	159	106.645
4	426.913	30	247.279	56	185.987	82	153.185	108	132.200	134	117.391	160	106.267
5	413.095	31	243.897	57	184.374	83	152.213	109	131.538	135	116.906	161	105.893
6	400.391	32	240.633	58	182.797	84	151.256	110	130.885	136	116.426	162	105.523
7	388.664	33	237.481	59	181.256	85	150.316	111	130.240	137	115.951	163	105.156
8	377.797	34	234.436	60	179.747	86	149.390	112	129.604	138	115.481	164	104.792
9	367.693	35	231.491	61	178.272	87	148.479	113	128.975	139	115.017	165	104.431
10	358.268	36	228.640	62	176.827	88	147.583	114	128.355	140	114.557	166	104.074
11	349.451	37	225.881	63	175.413	89	146.700	115	127.742	141	114.101	167	103.720
12	341.182	38	223.206	64	174.029	90	145.832	116	127.137	142	113.651	168	103.369
13	333.407	39	220.614	65	172.672	91	144.976	117	126.539	143	113.205	169	103.021
14	326.081	40	218.099	66	171.343	92	144.134	118	125.949	144	112.764	170	102.676
15	319.162	41	215.658	67	170.041	93	143.305	119	125.366	145	112.327	171	102.334
16	312.616	42	213.287	68	168.764	94	142.488	120	124.789	146	111.895	172	101.995
17	306.410	43	210.983	69	167.512	95	141.683	121	124.220	147	111.467	173	101.659
18	300.518	44	208.744	70	166.284	96	140.889	122	123.658	148	111.043	174	101.326
19	294.913	45	206.565	71	165.079	97	140.108	123	123.102	149	110.623	175	100.996
20	289.575	46	204.446	72	163.897	98	139.337	124	122.552	150	110.208	176	100.669
21	284.484	47	202.382	73	162.737	99	138.578	125	122.009	151	109.797	177	100.344
22	279.620	48	200.373	74	161.599	100	137.829	126	121.473	152	109.389	178	100.022
23	274.969	49	198.414	75	160.481	101	137.091	127	120.942	153	108.986	179	99.703
24	270.515	50	196.506	76	159.383	102	136.364	128	120.418	154	108.586	180	99.387
25	266.246	51	194.644	77	158.304	103	135.646	129	119.899	155	108.191	181	99.073
26	262.149	52	192.829	78	157.244	104	134.938	130	119.386	156	107.799	182	98.761

P=3 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	530.199	27	287.481	53	216.601	79	179.799	105	156.467	131	140.037	157	127.686
2	508.638	28	283.471	54	214.777	80	178.715	106	155.733	132	139.499	158	127.271
3	489.373	29	279.615	55	212.997	81	177.650	107	155.008	133	138.966	159	126.859
4	472.028	30	275.903	56	211.257	82	176.602	108	154.292	134	138.439	160	126.451
5	456.307	31	272.325	57	209.556	83	175.571	109	153.586	135	137.918	161	126.046
6	441.975	32	268.876	58	207.894	84	174.557	110	152.889	136	137.402	162	125.645
7	428.841	33	265.546	59	206.268	85	173.559	111	152.200	137	136.891	163	125.248
8	416.748	34	262.330	60	204.677	86	172.578	112	151.520	138	136.386	164	124.854
9	405.567	35	259.221	61	203.120	87	171.611	113	150.849	139	135.886	165	124.464
10	395.190	36	256.214	62	201.596	88	170.660	114	150.186	140	135.391	166	124.077
11	385.528	37	253.302	63	200.104	89	169.723	115	149.531	141	134.902	167	123.694
12	376.501	38	250.482	64	198.643	90	168.801	116	148.884	142	134.417	168	123.313
13	368.044	39	247.748	65	197.211	91	167.893	117	148.245	143	133.937	169	122.936
14	360.101	40	245.097	66	195.808	92	166.998	118	147.613	144	133.462	170	122.563
15	352.621	41	242.523	67	194.432	93	166.116	119	146.989	145	132.991	171	122.192
16	345.562	42	240.025	68	193.083	94	165.248	120	146.373	146	132.525	172	121.825
17	338.887	43	237.597	69	191.761	95	164.392	121	145.763	147	132.064	173	121.460
18	332.562	44	235.237	70	190.463	96	163.548	122	145.161	148	131.607	174	121.099
19	326.558	45	232.942	71	189.190	97	162.717	123	144.565	149	131.155	175	120.741
20	320.850	46	230.709	72	187.940	98	161.897	124	143.977	150	130.707	176	120.385
21	315.413	47	228.535	73	186.714	99	161.089	125	143.395	151	130.263	177	120.033
22	310.227	48	226.417	74	185.509	100	160.292	126	142.819	152	129.823	178	119.684
23	305.275	49	224.354	75	184.327	101	159.506	127	142.251	153	129.388	179	119.337
24	300.538	50	222.343	76	183.165	102	158.731	128	141.688	154	128.956	180	118.993
25	296.003	51	220.381	77	182.023	103	157.966	129	141.132	155	128.529	181	118.652
26	291.654	52	218.468	78	180.902	104	157.212	130	140.581	156	128.106	182	118.314

P=5 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	584.274	27	316.906	53	244.491	79	206.868	105	182.834	131	165.764	157	152.826
2	558.253	28	312.789	54	242.632	80	205.756	106	182.074	132	165.202	158	152.388
3	535.515	29	308.833	55	240.815	81	204.662	107	181.323	133	164.646	159	151.955
4	515.419	30	305.028	56	239.040	82	203.586	108	180.582	134	164.096	160	151.525
5	497.489	31	301.364	57	237.305	83	202.527	109	179.850	135	163.551	161	151.100
6	481.359	32	297.834	58	235.609	84	201.485	110	179.128	136	163.012	162	150.677
7	466.746	33	294.428	59	233.949	85	200.460	111	178.414	137	162.478	163	150.259
8	453.424	34	291.140	60	232.325	86	199.450	112	177.709	138	161.950	164	149.844
9	441.214	35	287.963	61	230.735	87	198.456	113	177.013	139	161.427	165	149.432
10	429.967	36	284.892	62	229.179	88	197.477	114	176.325	140	160.909	166	149.024
11	419.563	37	281.919	63	227.655	89	196.513	115	175.645	141	160.397	167	148.620
12	409.901	38	279.040	64	226.161	90	195.564	116	174.973	142	159.889	168	148.219
13	400.897	39	276.251	65	224.698	91	194.628	117	174.309	143	159.386	169	147.821
14	392.477	40	273.546	66	223.263	92	193.707	118	173.653	144	158.889	170	147.426
15	384.583	41	270.921	67	221.857	93	192.798	119	173.004	145	158.395	171	147.035
16	377.160	42	268.373	68	220.477	94	191.903	120	172.363	146	157.907	172	146.647
17	370.164	43	265.898	69	219.124	95	191.020	121	171.729	147	157.423	173	146.262
18	363.554	44	263.492	70	217.796	96	190.150	122	171.103	148	156.944	174	145.880
19	357.297	45	261.152	71	216.493	97	189.292	123	170.483	149	156.470	175	145.501
20	351.361	46	258.875	72	215.214	98	188.446	124	169.870	150	155.999	176	145.126
21	345.721	47	256.659	73	213.957	99	187.612	125	169.264	151	155.533	177	144.753
22	340.352	48	254.500	74	212.723	100	186.788	126	168.665	152	155.072	178	144.383
23	335.233	49	252.397	75	211.511	101	185.976	127	168.072	153	154.614	179	144.016
24	330.345	50	250.346	76	210.320	102	185.175	128	167.486	154	154.161	180	143.652
25	325.671	51	248.347	77	209.150	103	184.384	129	166.906	155	153.712	181	143.291
26	321.196	52	246.396	78	208.000	104	183.604	130	166.332	156	153.267	182	142.933

P=10 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	660.091	27	360.424	53	286.092	79	247.323	105	222.315	131	204.377	157	190.654
2	627.306	28	356.183	54	284.183	80	246.170	106	221.520	132	203.783	158	190.188
3	599.586	29	352.111	55	282.317	81	245.037	107	220.734	133	203.196	159	189.726
4	575.722	30	348.198	56	280.494	82	243.921	108	219.958	134	202.614	160	189.268
5	554.879	31	344.432	57	278.711	83	242.823	109	219.192	135	202.038	161	188.814
6	536.454	32	340.805	58	276.966	84	241.742	110	218.435	136	201.468	162	188.364
7	520.004	33	337.308	59	275.260	85	240.678	111	217.686	137	200.903	163	187.917
8	505.192	34	333.934	60	273.590	86	239.630	112	216.947	138	200.344	164	187.474
9	491.756	35	330.674	61	271.954	87	238.598	113	216.217	139	199.791	165	187.034
10	479.491	36	327.523	62	270.352	88	237.581	114	215.495	140	199.242	166	186.599
11	468.233	37	324.474	63	268.783	89	236.579	115	214.781	141	198.699	167	186.166
12	457.847	38	321.523	64	267.245	90	235.591	116	214.075	142	198.161	168	185.737
13	448.224	39	318.663	65	265.737	91	234.618	117	213.378	143	197.628	169	185.312
14	439.272	40	315.890	66	264.259	92	233.659	118	212.688	144	197.100	170	184.890
15	430.916	41	313.199	67	262.809	93	232.713	119	212.007	145	196.577	171	184.471
16	423.089	42	310.587	68	261.386	94	231.781	120	211.332	146	196.058	172	184.056
17	415.738	43	308.050	69	259.990	95	230.861	121	210.665	147	195.545	173	183.644
18	408.815	44	305.583	70	258.620	96	229.955	122	210.006	148	195.036	174	183.235
19	402.278	45	303.184	71	257.275	97	229.060	123	209.354	149	194.532	175	182.829
20	396.093	46	300.850	72	255.953	98	228.177	124	208.708	150	194.032	176	182.426
21	390.228	47	298.577	73	254.656	99	227.307	125	208.070	151	193.536	177	182.027
22	384.655	48	296.363	74	253.380	100	226.448	126	207.438	152	193.045	178	181.630
23	379.351	49	294.206	75	252.127	101	225.600	127	206.813	153	192.559	179	181.237
24	374.294	50	292.102	76	250.896	102	224.762	128	206.194	154	192.077	180	180.846
25	369.465	51	290.050	77	249.685	103	223.936	129	205.582	155	191.598	181	180.459
26	364.846	52	288.047	78	248.494	104	223.120	130	204.977	156	191.124	182	180.074

P=20 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	731.533	27	402.320	53	325.627	79	285.468	105	259.387	131	240.556	157	226.064
2	692.132	28	397.939	54	323.655	80	284.270	106	258.555	132	239.931	158	225.571
3	659.771	29	393.735	55	321.727	81	283.091	107	257.732	133	239.312	159	225.081
4	632.517	30	389.695	56	319.842	82	281.930	108	256.920	134	238.699	160	224.596
5	609.114	31	385.809	57	317.999	83	280.788	109	256.117	135	238.092	161	224.114
6	588.706	32	382.067	58	316.196	84	279.663	110	255.324	136	237.491	162	223.637
7	570.684	33	378.460	59	314.431	85	278.555	111	254.540	137	236.896	163	223.163
8	554.601	34	374.979	60	312.703	86	277.463	112	253.765	138	236.306	164	222.693
9	540.121	35	371.618	61	311.011	87	276.388	113	252.999	139	235.722	165	222.227
10	526.986	36	368.368	62	309.353	88	275.329	114	252.241	140	235.143	166	221.765
11	514.991	37	365.225	63	307.729	89	274.284	115	251.493	141	234.570	167	221.306
12	503.977	38	362.181	64	306.136	90	273.255	116	250.752	142	234.002	168	220.851
13	493.810	39	359.232	65	304.575	91	272.240	117	250.020	143	233.439	169	220.399
14	484.385	40	356.373	66	303.043	92	271.240	118	249.296	144	232.881	170	219.951
15	475.611	41	353.599	67	301.541	93	270.253	119	248.580	145	232.329	171	219.506
16	467.414	42	350.905	68	300.066	94	269.280	120	247.872	146	231.781	172	219.065
17	459.732	43	348.288	69	298.619	95	268.321	121	247.172	147	231.238	173	218.627
18	452.510	44	345.744	70	297.198	96	267.374	122	246.478	148	230.700	174	218.193
19	445.703	45	343.270	71	295.802	97	266.439	123	245.793	149	230.167	175	217.761
20	439.271	46	340.861	72	294.432	98	265.518	124	245.114	150	229.639	176	217.333
21	433.180	47	338.516	73	293.085	99	264.608	125	244.443	151	229.115	177	216.908
22	427.398	48	336.232	74	291.761	100	263.710	126	243.778	152	228.595	178	216.487
23	421.901	49	334.005	75	290.460	101	262.823	127	243.121	153	228.081	179	216.068
24	416.664	50	331.833	76	289.180	102	261.948	128	242.470	154	227.570	180	215.653
25	411.667	51	329.715	77	287.922	103	261.084	129	241.826	155	227.064	181	215.240
26	406.891	52	327.647	78	286.685	104	260.230	130	241.188	156	226.562	182	214.831

P=30 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	768.515	27	423.596	53	346.050	79	305.372	105	278.872	131	259.680	157	244.869
2	725.054	28	419.163	54	344.054	80	304.156	106	278.025	132	259.042	158	244.364
3	689.998	29	414.910	55	342.104	81	302.960	107	277.188	133	258.410	159	243.863
4	660.860	30	410.824	56	340.197	82	301.782	108	276.360	134	257.784	160	243.366
5	636.089	31	406.894	57	338.331	83	300.623	109	275.543	135	257.164	161	242.873
6	614.654	32	403.110	58	336.506	84	299.480	110	274.735	136	256.551	162	242.384
7	595.840	33	399.463	59	334.720	85	298.356	111	273.937	137	255.942	163	241.899
8	579.134	34	395.944	60	332.971	86	297.247	112	273.147	138	255.340	164	241.418
9	564.155	35	392.546	61	331.258	87	296.155	113	272.367	139	254.743	165	240.941
10	550.612	36	389.262	62	329.579	88	295.079	114	271.595	140	254.152	166	240.467
11	538.281	37	386.084	63	327.934	89	294.019	115	270.833	141	253.566	167	239.997
12	526.984	38	383.008	64	326.322	90	292.973	116	270.078	142	252.986	168	239.531
13	516.578	39	380.027	65	324.740	91	291.942	117	269.332	143	252.411	169	239.068
14	506.947	40	377.137	66	323.189	92	290.925	118	268.594	144	251.841	170	238.609
15	497.996	41	374.332	67	321.667	93	289.923	119	267.865	145	251.276	171	238.154
16	489.644	42	371.610	68	320.173	94	288.934	120	267.143	146	250.716	172	237.701
17	481.825	43	368.964	69	318.706	95	287.958	121	266.428	147	250.161	173	237.253
18	474.481	44	366.392	70	317.266	96	286.996	122	265.722	148	249.611	174	236.807
19	467.566	45	363.891	71	315.852	97	286.046	123	265.022	149	249.066	175	236.365
20	461.036	46	361.456	72	314.462	98	285.108	124	264.330	150	248.526	176	235.926
21	454.856	47	359.085	73	313.097	99	284.183	125	263.646	151	247.990	177	235.491
22	448.994	48	356.775	74	311.755	100	283.270	126	262.968	152	247.459	178	235.059
23	443.422	49	354.523	75	310.435	101	282.368	127	262.297	153	246.932	179	234.629
24	438.117	50	352.327	76	309.138	102	281.478	128	261.633	154	246.410	180	234.203
25	433.057	51	350.184	77	307.862	103	280.598	129	260.975	155	245.892	181	233.780
26	428.222	52	348.092	78	306.607	104	279.730	130	260.324	156	245.378	182	233.360

P=50 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	813.591	27	448.959	53	370.817	79	329.744	105	302.891	131	283.374	157	268.265
2	764.310	28	444.488	54	368.805	80	328.515	106	302.031	132	282.724	158	267.749
3	725.597	29	440.200	55	366.838	81	327.304	107	301.180	133	282.080	159	267.237
4	694.015	30	436.081	56	364.915	82	326.112	108	300.340	134	281.443	160	266.729
5	667.531	31	432.120	57	363.034	83	324.939	109	299.510	135	280.811	161	266.225
6	644.852	32	428.307	58	361.193	84	323.783	110	298.689	136	280.185	162	265.725
7	625.109	33	424.632	59	359.391	85	322.644	111	297.878	137	279.566	163	265.229
8	607.692	34	421.087	60	357.626	86	321.522	112	297.076	138	278.952	164	264.737
9	592.158	35	417.663	61	355.897	87	320.416	113	296.283	139	278.343	165	264.249
10	578.174	36	414.355	62	354.203	88	319.326	114	295.499	140	277.740	166	263.765
11	565.487	37	411.154	63	352.543	89	318.251	115	294.723	141	277.143	167	263.284
12	553.899	38	408.055	64	350.915	90	317.192	116	293.956	142	276.551	168	262.807
13	543.253	39	405.053	65	349.318	91	316.148	117	293.198	143	275.964	169	262.334
14	533.421	40	402.141	66	347.752	92	315.117	118	292.448	144	275.383	170	261.864
15	524.299	41	399.316	67	346.215	93	314.101	119	291.705	145	274.807	171	261.398
16	515.803	42	396.574	68	344.706	94	313.099	120	290.971	146	274.235	172	260.936
17	507.859	43	393.909	69	343.225	95	312.110	121	290.244	147	273.669	173	260.476
18	500.408	44	391.318	70	341.770	96	311.134	122	289.525	148	273.108	174	260.020
19	493.398	45	388.797	71	340.340	97	310.170	123	288.814	149	272.551	175	259.568
20	486.785	46	386.344	72	338.936	98	309.220	124	288.109	150	271.999	176	259.119
21	480.531	47	383.955	73	337.556	99	308.281	125	287.412	151	271.452	177	258.673
22	474.604	48	381.627	74	336.199	100	307.354	126	286.722	152	270.910	178	258.230
23	468.973	49	379.358	75	334.866	101	306.439	127	286.039	153	270.372	179	257.791
24	463.614	50	377.145	76	333.554	102	305.536	128	285.363	154	269.839	180	257.354
25	458.505	51	374.985	77	332.263	103	304.643	129	284.694	155	269.310	181	256.921
26	453.626	52	372.876	78	330.994	104	303.762	130	284.031	156	268.785	182	256.491

P=100 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	876.260	27	483.310	53	405.173	79	363.984	105	336.923	131	317.164	157	301.802
2	816.866	28	478.835	54	403.159	80	362.748	106	336.054	132	316.504	158	301.276
3	772.354	29	474.544	55	401.190	81	361.530	107	335.195	133	315.851	159	300.755
4	737.159	30	470.423	56	399.265	82	360.331	108	334.346	134	315.203	160	300.237
5	708.291	31	466.462	57	397.381	83	359.151	109	333.506	135	314.562	161	299.724
6	683.972	32	462.649	58	395.538	84	357.987	110	332.677	136	313.927	162	299.214
7	663.064	33	458.975	59	393.732	85	356.841	111	331.856	137	313.297	163	298.709
8	644.798	34	455.431	60	391.964	86	355.711	112	331.045	138	312.674	164	298.207
9	628.633	35	452.010	61	390.232	87	354.598	113	330.243	139	312.055	165	297.709
10	614.172	36	448.702	62	388.535	88	353.500	114	329.449	140	311.443	166	297.215
11	601.121	37	445.503	63	386.870	89	352.418	115	328.665	141	310.836	167	296.725
12	589.252	38	442.406	64	385.238	90	351.351	116	327.888	142	310.234	168	296.238
13	578.386	39	439.406	65	383.637	91	350.298	117	327.121	143	309.638	169	295.755
14	568.383	40	436.496	66	382.066	92	349.260	118	326.361	144	309.047	170	295.276
15	559.126	41	433.673	67	380.524	93	348.236	119	325.609	145	308.461	171	294.800
16	550.522	42	430.931	68	379.011	94	347.225	120	324.865	146	307.880	172	294.328
17	542.494	43	428.267	69	377.524	95	346.228	121	324.129	147	307.304	173	293.859
18	534.975	44	425.677	70	376.064	96	345.244	122	323.401	148	306.733	174	293.393
19	527.912	45	423.158	71	374.629	97	344.272	123	322.680	149	306.166	175	292.931
20	521.257	46	420.705	72	373.219	98	343.313	124	321.966	150	305.605	176	292.473
21	514.970	47	418.316	73	371.834	99	342.366	125	321.259	151	305.048	177	292.017
22	509.016	48	415.988	74	370.471	100	341.430	126	320.560	152	304.496	178	291.565
23	503.366	49	413.718	75	369.131	101	340.507	127	319.867	153	303.948	179	291.116
24	497.992	50	411.504	76	367.813	102	339.594	128	319.182	154	303.405	180	290.670
25	492.871	51	409.343	77	366.516	103	338.693	129	318.502	155	302.866	181	290.227
26	487.983	52	407.234	78	365.240	104	337.803	130	317.830	156	302.332	182	289.787

珠海市暴雨强度公式及计算图表

(近 30 年)

珠海市气象局

广东省气候中心

二零一五年四月

说

1. 本计算图表以珠海国家地面气象观测站 30 年(1985～2014 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。

2. 以重现期 1、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设计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(升/秒·公顷)

t —降雨历时(分钟)

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:

$$q = \frac{822.407(1+0.776LnP)}{(t+5.000)^{0.390}}$$

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。

明

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

从重现期区间参数公式 II, 得:

$$n=0.490-0.051Ln(P-4.527)$$

$$=0.33361 \text{ (取 } 0.334 \text{)}$$

$$b=8.706-1.472Ln(P-5.080)$$

$$=4.30218 \text{ (取 } 4.302 \text{)}$$

$$A=10.023-0.550Ln(P-6.737)$$

$$=8.42532 \text{ (取 } 8.425 \text{)}$$

配得 $P=25$ 年的暴雨强度计算公式如下:

$$q = \frac{167 \times 8.425}{(t+4.302)^{0.334}}$$

可按上式计算 1～200 分钟中任何时段的暴雨强度。

当 $t=50$:

$$q = \frac{167 \times 8.425}{(t+4.302)^{0.334}} = 370.559 \text{ (升/秒/公顷)}$$

5. 公式误差

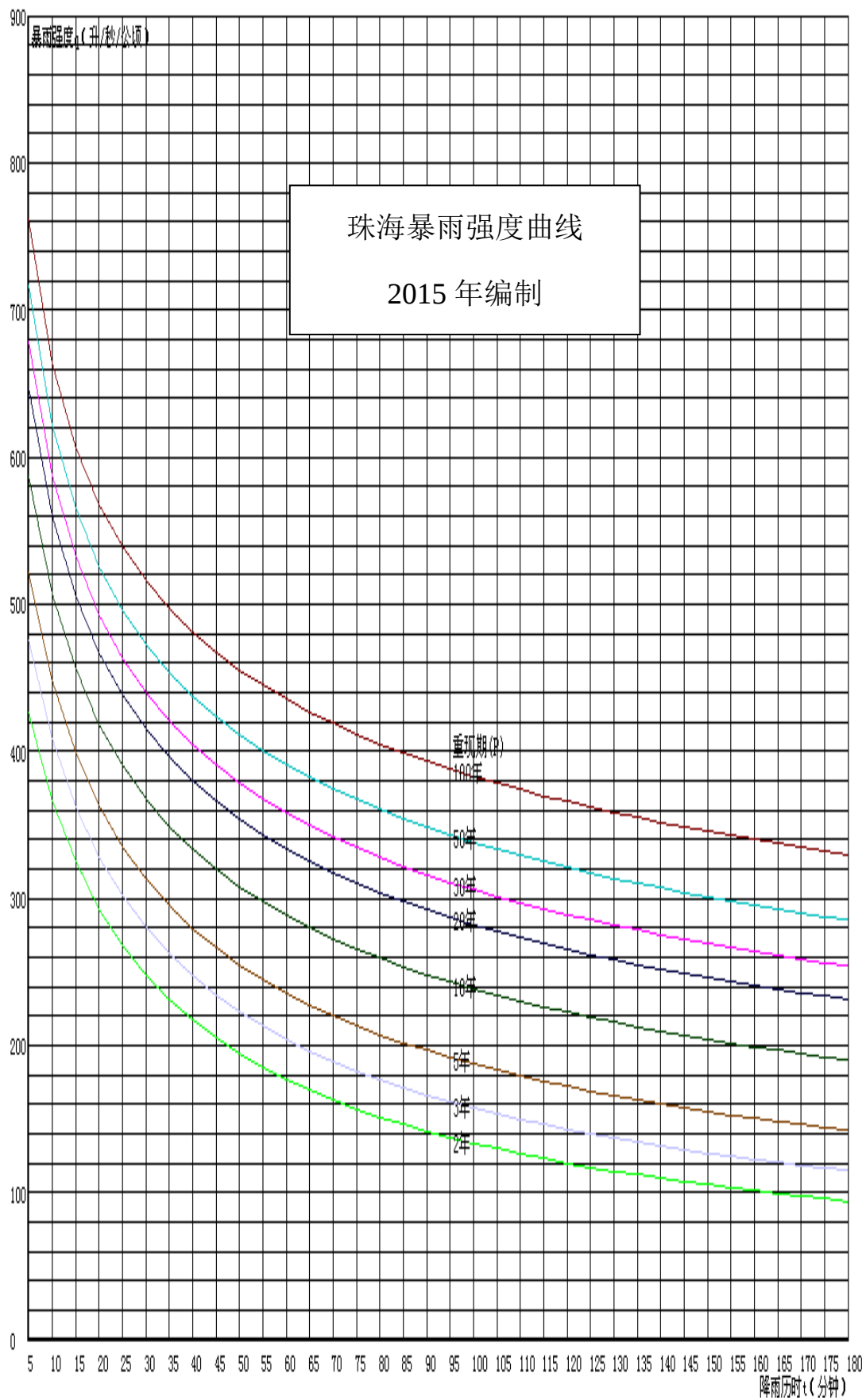
重现期 2～20 年的暴雨强度公式算得的平均绝对均方差为: 0.039 (mm/min), 平均相对均方差为: 2.89%。精度符合《室外排水设计规范》(GB50014—2006, 2014 年版) 提出的要求。

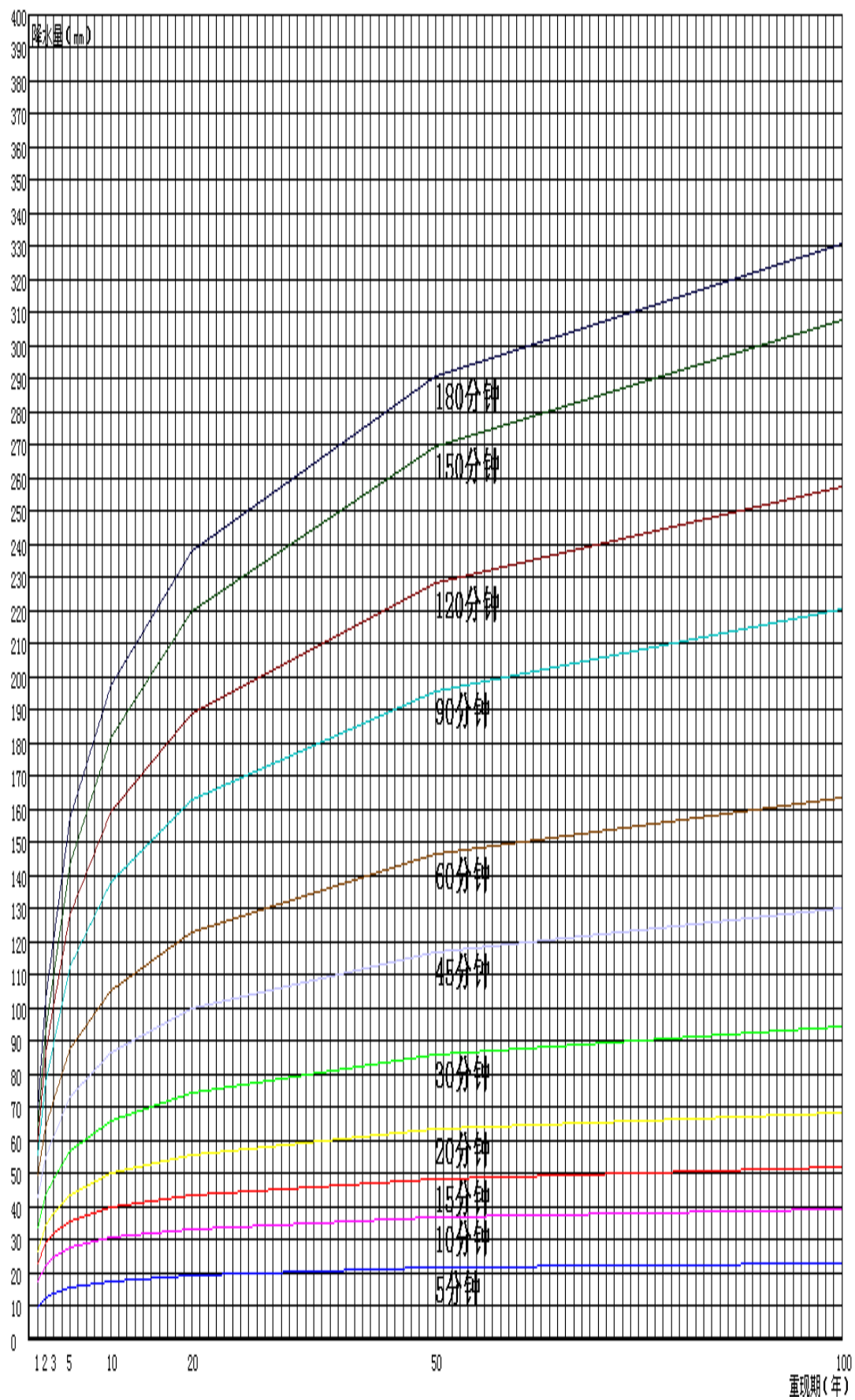
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=2	$3008.839 / (t + 14.589)^{0.657}$
P=3	$2502.662 / (t + 11.977)^{0.586}$
P=5	$1958.242 / (t + 9.068)^{0.500}$
P=10	$1565.291 / (t + 6.361)^{0.403}$
P=20	$1436.367 / (t + 4.728)^{0.350}$
P=30	$1384.764 / (t + 3.973)^{0.325}$
P=50	$1327.817 / (t + 3.105)^{0.295}$
P=100	$1257.343 / (t + 2.004)^{0.257}$

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	$0.746 - 0.158\text{Ln}(P - 0.247)$
		B	$16.046 - 4.739\text{Ln}(P - 0.640)$
		A	$19.067 - 5.091\text{Ln}(P - 0.771)$
10—100	II	n	$0.490 - 0.051\text{Ln}(P - 4.527)$
		b	$8.706 - 1.472\text{Ln}(P - 5.080)$
		A	$10.023 - 0.550\text{Ln}(P - 6.737)$





延长样本资料后的降水量与重现期曲线图

P=2 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	495.128	27	259.854	53	188.873	79	152.512	105	129.824	131	114.084	157	102.409
2	475.310	28	255.829	54	187.059	80	151.451	106	129.116	132	113.572	158	102.019
3	457.378	29	251.958	55	185.289	81	150.408	107	128.417	133	113.066	159	101.633
4	441.060	30	248.231	56	183.560	82	149.383	108	127.728	134	112.565	160	101.250
5	426.135	31	244.640	57	181.872	83	148.376	109	127.048	135	112.070	161	100.871
6	412.421	32	241.177	58	180.222	84	147.385	110	126.377	136	111.581	162	100.495
7	399.768	33	237.836	59	178.609	85	146.411	111	125.715	137	111.096	163	100.123
8	388.051	34	234.608	60	177.032	86	145.453	112	125.062	138	110.618	164	99.754
9	377.163	35	231.489	61	175.490	87	144.511	113	124.417	139	110.144	165	99.389
10	367.014	36	228.473	62	173.981	88	143.584	114	123.780	140	109.675	166	99.027
11	357.526	37	225.553	63	172.504	89	142.672	115	123.152	141	109.212	167	98.668
12	348.634	38	222.726	64	171.059	90	141.774	116	122.532	142	108.753	168	98.313
13	340.279	39	219.987	65	169.644	91	140.890	117	121.919	143	108.299	169	97.961
14	332.412	40	217.331	66	168.258	92	140.021	118	121.314	144	107.850	170	97.612
15	324.987	41	214.754	67	166.900	93	139.164	119	120.717	145	107.405	171	97.266
16	317.967	42	212.253	68	165.570	94	138.321	120	120.127	146	106.965	172	96.923
17	311.318	43	209.824	69	164.266	95	137.490	121	119.544	147	106.530	173	96.583
18	305.008	44	207.464	70	162.987	96	136.672	122	118.968	148	106.099	174	96.246
19	299.011	45	205.170	71	161.734	97	135.866	123	118.399	149	105.673	175	95.913
20	293.303	46	202.939	72	160.504	98	135.072	124	117.837	150	105.250	176	95.582
21	287.862	47	200.768	73	159.298	99	134.290	125	117.282	151	104.832	177	95.254
22	282.669	48	198.655	74	158.114	100	133.519	126	116.733	152	104.418	178	94.928
23	277.705	49	196.597	75	156.952	101	132.759	127	116.191	153	104.009	179	94.606
24	272.956	50	194.592	76	155.812	102	132.009	128	115.655	154	103.603	180	94.286
25	268.406	51	192.638	77	154.692	103	131.271	129	115.125	155	103.201	181	93.969
26	264.043	52	190.732	78	153.592	104	130.542	130	114.601	156	102.803	182	93.655

P=3 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	557.291	27	292.542	53	216.833	79	178.020	105	153.637	131	136.589	157	123.850
2	533.568	28	288.231	54	214.901	80	176.883	106	152.872	132	136.032	158	123.422
3	512.393	29	284.089	55	213.015	81	175.766	107	152.118	133	135.482	159	122.999
4	493.349	30	280.103	56	211.173	82	174.667	108	151.374	134	134.937	160	122.579
5	476.106	31	276.265	57	209.373	83	173.587	109	150.639	135	134.398	161	122.163
6	460.403	32	272.566	58	207.615	84	172.525	110	149.914	136	133.865	162	121.751
7	446.027	33	268.998	59	205.896	85	171.480	111	149.199	137	133.338	163	121.343
8	432.804	34	265.554	60	204.215	86	170.453	112	148.492	138	132.816	164	120.939
9	420.592	35	262.227	61	202.570	87	169.441	113	147.795	139	132.300	165	120.538
10	409.269	36	259.010	62	200.961	88	168.446	114	147.106	140	131.789	166	120.140
11	398.735	37	255.898	63	199.386	89	167.466	115	146.426	141	131.284	167	119.747
12	388.904	38	252.885	64	197.844	90	166.502	116	145.755	142	130.784	168	119.356
13	379.703	39	249.966	65	196.334	91	165.553	117	145.092	143	130.288	169	118.969
14	371.068	40	247.136	66	194.854	92	164.618	118	144.436	144	129.798	170	118.586
15	362.944	41	244.392	67	193.405	93	163.697	119	143.789	145	129.313	171	118.206
16	355.285	42	241.729	68	191.984	94	162.790	120	143.150	146	128.833	172	117.829
17	348.048	43	239.142	69	190.591	95	161.897	121	142.518	147	128.357	173	117.455
18	341.196	44	236.629	70	189.225	96	161.016	122	141.893	148	127.886	174	117.084
19	334.698	45	234.187	71	187.885	97	160.149	123	141.277	149	127.420	175	116.717
20	328.524	46	231.811	72	186.571	98	159.294	124	140.667	150	126.959	176	116.353
21	322.649	47	229.500	73	185.281	99	158.451	125	140.064	151	126.502	177	115.992
22	317.050	48	227.250	74	184.015	100	157.621	126	139.468	152	126.049	178	115.633
23	311.706	49	225.058	75	182.773	101	156.801	127	138.879	153	125.601	179	115.278
24	306.600	50	222.923	76	181.552	102	155.994	128	138.297	154	125.157	180	114.926
25	301.713	51	220.842	77	180.354	103	155.197	129	137.721	155	124.717	181	114.577
26	297.032	52	218.813	78	179.177	104	154.412	130	137.152	156	124.281	182	114.230

P=5 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	617.156	27	326.066	53	248.561	79	208.669	105	183.351	131	165.461	157	151.958
2	588.616	28	321.638	54	246.582	80	207.494	106	182.553	132	164.874	158	151.502
3	563.701	29	317.385	55	244.650	81	206.339	107	181.765	133	164.293	159	151.051
4	541.704	30	313.297	56	242.763	82	205.203	108	180.987	134	163.718	160	150.604
5	522.096	31	309.362	57	240.919	83	204.085	109	180.219	135	163.148	161	150.160
6	504.474	32	305.573	58	239.116	84	202.986	110	179.460	136	162.585	162	149.721
7	488.523	33	301.919	59	237.353	85	201.904	111	178.712	137	162.028	163	149.285
8	473.996	34	298.393	60	235.629	86	200.840	112	177.972	138	161.476	164	148.853
9	460.693	35	294.988	61	233.941	87	199.791	113	177.242	139	160.930	165	148.425
10	448.450	36	291.697	62	232.289	88	198.760	114	176.520	140	160.389	166	148.000
11	437.134	37	288.514	63	230.672	89	197.744	115	175.807	141	159.854	167	147.580
12	426.633	38	285.433	64	229.088	90	196.743	116	175.103	142	159.324	168	147.162
13	416.855	39	282.448	65	227.536	91	195.758	117	174.407	143	158.799	169	146.748
14	407.719	40	279.555	66	226.016	92	194.787	118	173.719	144	158.279	170	146.338
15	399.159	41	276.749	67	224.525	93	193.830	119	173.040	145	157.765	171	145.931
16	391.117	42	274.026	68	223.064	94	192.888	120	172.368	146	157.255	172	145.528
17	383.542	43	271.382	69	221.631	95	191.959	121	171.704	147	156.751	173	145.127
18	376.390	44	268.813	70	220.225	96	191.043	122	171.048	148	156.251	174	144.731
19	369.624	45	266.315	71	218.845	97	190.140	123	170.399	149	155.756	175	144.337
20	363.211	46	263.886	72	217.491	98	189.250	124	169.758	150	155.265	176	143.946
21	357.120	47	261.522	73	216.162	99	188.373	125	169.123	151	154.780	177	143.559
22	351.326	48	259.221	74	214.857	100	187.507	126	168.496	152	154.299	178	143.175
23	345.804	49	256.979	75	213.575	101	186.653	127	167.876	153	153.822	179	142.794
24	340.536	50	254.795	76	212.316	102	185.811	128	167.262	154	153.349	180	142.416
25	335.500	51	252.665	77	211.079	103	184.980	129	166.656	155	152.881	181	142.040
26	330.682	52	250.588	78	209.864	104	184.161	130	166.055	156	152.418	182	141.668

P=10(年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	700.196	27	380.829	53	301.908	79	260.794	105	234.294	131	215.296	157	200.769
2	665.158	28	376.323	54	299.882	80	259.573	106	233.452	132	214.668	158	200.276
3	635.554	29	371.997	55	297.903	81	258.371	107	232.620	133	214.046	159	199.787
4	610.082	30	367.840	56	295.968	82	257.189	108	231.798	134	213.430	160	199.302
5	587.844	31	363.840	57	294.077	83	256.025	109	230.986	135	212.820	161	198.821
6	568.195	32	359.988	58	292.227	84	254.879	110	230.184	136	212.216	162	198.344
7	550.658	33	356.273	59	290.417	85	253.751	111	229.391	137	211.618	163	197.872
8	534.872	34	352.689	60	288.645	86	252.641	112	228.608	138	211.026	164	197.403
9	520.557	35	349.228	61	286.911	87	251.547	113	227.835	139	210.440	165	196.938
10	507.493	36	345.882	62	285.212	88	250.469	114	227.070	140	209.860	166	196.476
11	495.503	37	342.645	63	283.547	89	249.407	115	226.314	141	209.284	167	196.019
12	484.445	38	339.511	64	281.916	90	248.361	116	225.567	142	208.715	168	195.565
13	474.202	39	336.474	65	280.318	91	247.330	117	224.828	143	208.151	169	195.115
14	464.675	40	333.530	66	278.750	92	246.313	118	224.098	144	207.592	170	194.668
15	455.782	41	330.674	67	277.212	93	245.311	119	223.376	145	207.038	171	194.225
16	447.456	42	327.902	68	275.704	94	244.323	120	222.661	146	206.489	172	193.785
17	439.636	43	325.208	69	274.224	95	243.349	121	221.955	147	205.945	173	193.349
18	432.272	44	322.590	70	272.771	96	242.388	122	221.257	148	205.407	174	192.917
19	425.320	45	320.044	71	271.344	97	241.440	123	220.566	149	204.873	175	192.487
20	418.743	46	317.567	72	269.943	98	240.505	124	219.882	150	204.344	176	192.061
21	412.507	47	315.155	73	268.567	99	239.583	125	219.206	151	203.819	177	191.638
22	406.582	48	312.805	74	267.216	100	238.672	126	218.537	152	203.300	178	191.219
23	400.944	49	310.516	75	265.887	101	237.774	127	217.876	153	202.785	179	190.802
24	395.569	50	308.284	76	264.581	102	236.887	128	217.221	154	202.274	180	190.389
25	390.436	51	306.107	77	263.298	103	236.012	129	216.572	155	201.768	181	189.979
26	385.528	52	303.982	78	262.035	104	235.148	130	215.931	156	201.266	182	189.572

P=20 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	779.766	27	428.312	53	347.360	79	304.972	105	277.431	131	257.532	157	242.209
2	737.064	28	423.686	54	345.279	80	303.708	106	276.551	132	256.871	158	241.687
3	702.169	29	419.246	55	343.244	81	302.463	107	275.682	133	256.217	159	241.170
4	672.892	30	414.980	56	341.255	82	301.238	108	274.824	134	255.569	160	240.656
5	647.824	31	410.878	57	339.310	83	300.032	109	273.976	135	254.927	161	240.147
6	626.014	32	406.927	58	337.407	84	298.844	110	273.137	136	254.292	162	239.642
7	606.788	33	403.119	59	335.544	85	297.674	111	272.309	137	253.662	163	239.141
8	589.657	34	399.445	60	333.721	86	296.521	112	271.490	138	253.039	164	238.644
9	574.252	35	395.896	61	331.935	87	295.386	113	270.681	139	252.421	165	238.151
10	560.293	36	392.467	62	330.185	88	294.267	114	269.881	140	251.809	166	237.661
11	547.557	37	389.149	63	328.471	89	293.164	115	269.090	141	251.203	167	237.176
12	535.871	38	385.937	64	326.790	90	292.077	116	268.307	142	250.603	168	236.695
13	525.091	39	382.824	65	325.142	91	291.006	117	267.534	143	250.008	169	236.217
14	515.102	40	379.807	66	323.525	92	289.949	118	266.769	144	249.418	170	235.743
15	505.809	41	376.879	67	321.940	93	288.907	119	266.012	145	248.834	171	235.272
16	497.130	42	374.036	68	320.383	94	287.880	120	265.264	146	248.255	172	234.806
17	489.000	43	371.274	69	318.856	95	286.866	121	264.523	147	247.681	173	234.342
18	481.359	44	368.589	70	317.356	96	285.866	122	263.791	148	247.112	174	233.883
19	474.159	45	365.978	71	315.883	97	284.880	123	263.066	149	246.548	175	233.426
20	467.358	46	363.437	72	314.435	98	283.906	124	262.349	150	245.989	176	232.973
21	460.918	47	360.962	73	313.014	99	282.945	125	261.640	151	245.435	177	232.524
22	454.807	48	358.551	74	311.616	100	281.996	126	260.937	152	244.886	178	232.078
23	448.998	49	356.201	75	310.243	101	281.060	127	260.242	153	244.342	179	231.635
24	443.464	50	353.909	76	308.892	102	280.135	128	259.554	154	243.802	180	231.195
25	438.185	51	351.674	77	307.564	103	279.222	129	258.874	155	243.266	181	230.759
26	433.140	52	349.491	78	306.258	104	278.321	130	258.199	156	242.736	182	230.326

P=30 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	822.195	27	453.739	53	372.206	79	329.398	105	301.472	131	281.220	157	265.571
2	774.664	28	449.077	54	370.107	80	328.118	106	300.578	132	280.546	158	265.037
3	736.655	29	444.605	55	368.056	81	326.858	107	299.695	133	279.878	159	264.508
4	705.259	30	440.309	56	366.050	82	325.618	108	298.823	134	279.218	160	263.982
5	678.689	31	436.177	57	364.088	83	324.396	109	297.961	135	278.563	161	263.461
6	655.779	32	432.199	58	362.168	84	323.193	110	297.109	136	277.915	162	262.944
7	635.726	33	428.364	59	360.289	85	322.008	111	296.266	137	277.272	163	262.431
8	617.959	34	424.665	60	358.449	86	320.841	112	295.434	138	276.636	164	261.923
9	602.057	35	421.093	61	356.646	87	319.690	113	294.610	139	276.006	165	261.418
10	587.701	36	417.640	62	354.880	88	318.556	114	293.796	140	275.381	166	260.917
11	574.646	37	414.299	63	353.149	89	317.439	115	292.992	141	274.762	167	260.420
12	562.698	38	411.065	64	351.452	90	316.337	116	292.196	142	274.149	168	259.927
13	551.702	39	407.931	65	349.788	91	315.250	117	291.408	143	273.542	169	259.438
14	541.532	40	404.893	66	348.156	92	314.179	118	290.630	144	272.940	170	258.952
15	532.086	41	401.945	67	346.554	93	313.122	119	289.860	145	272.343	171	258.470
16	523.277	42	399.082	68	344.981	94	312.080	120	289.098	146	271.751	172	257.992
17	515.034	43	396.301	69	343.438	95	311.052	121	288.344	147	271.165	173	257.517
18	507.296	44	393.597	70	341.922	96	310.037	122	287.598	148	270.584	174	257.046
19	500.012	45	390.967	71	340.433	97	309.036	123	286.860	149	270.008	175	256.578
20	493.135	46	388.407	72	338.970	98	308.048	124	286.129	150	269.436	176	256.114
21	486.629	47	385.914	73	337.533	99	307.072	125	285.406	151	268.870	177	255.653
22	480.459	48	383.485	74	336.120	100	306.109	126	284.691	152	268.309	178	255.196
23	474.596	49	381.117	75	334.730	101	305.159	127	283.983	153	267.752	179	254.742
24	469.014	50	378.807	76	333.364	102	304.220	128	283.281	154	267.200	180	254.291
25	463.690	51	376.554	77	332.021	103	303.292	129	282.587	155	266.653	181	253.843
26	458.605	52	374.354	78	330.699	104	302.377	130	281.900	156	266.110	182	253.399

P=50 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	875.409	27	486.340	53	404.746	79	361.742	105	333.544	131	312.998	157	297.056
2	820.880	28	481.674	54	402.642	80	360.453	106	332.640	132	312.313	158	296.511
3	778.683	29	477.199	55	400.586	81	359.183	107	331.746	133	311.634	159	295.970
4	744.606	30	472.900	56	398.574	82	357.933	108	330.862	134	310.962	160	295.434
5	716.236	31	468.767	57	396.606	83	356.701	109	329.989	135	310.296	161	294.902
6	692.071	32	464.787	58	394.680	84	355.488	110	329.125	136	309.636	162	294.374
7	671.120	33	460.952	59	392.795	85	354.293	111	328.272	137	308.983	163	293.850
8	652.695	34	457.252	60	390.948	86	353.116	112	327.428	138	308.335	164	293.330
9	636.302	35	453.679	61	389.139	87	351.955	113	326.593	139	307.694	165	292.814
10	621.576	36	450.225	62	387.366	88	350.811	114	325.768	140	307.058	166	292.302
11	608.237	37	446.884	63	385.628	89	349.683	115	324.952	141	306.428	167	291.794
12	596.070	38	443.649	64	383.924	90	348.571	116	324.145	142	305.803	168	291.290
13	584.904	39	440.514	65	382.253	91	347.474	117	323.346	143	305.184	169	290.790
14	574.602	40	437.474	66	380.612	92	346.392	118	322.556	144	304.571	170	290.293
15	565.051	41	434.525	67	379.003	93	345.325	119	321.775	145	303.963	171	289.800
16	556.160	42	431.660	68	377.422	94	344.272	120	321.001	146	303.360	172	289.311
17	547.852	43	428.877	69	375.871	95	343.233	121	320.236	147	302.762	173	288.826
18	540.063	44	426.171	70	374.347	96	342.208	122	319.479	148	302.170	174	288.343
19	532.738	45	423.538	71	372.849	97	341.196	123	318.729	149	301.582	175	287.865
20	525.830	46	420.975	72	371.378	98	340.197	124	317.988	150	301.000	176	287.390
21	519.298	47	418.479	73	369.932	99	339.211	125	317.253	151	300.422	177	286.918
22	513.108	48	416.046	74	368.510	100	338.237	126	316.526	152	299.850	178	286.450
23	507.230	49	413.675	75	367.111	101	337.275	127	315.807	153	299.282	179	285.985
24	501.636	50	411.361	76	365.736	102	336.325	128	315.094	154	298.719	180	285.523
25	496.303	51	409.103	77	364.383	103	335.387	129	314.389	155	298.160	181	285.065
26	491.211	52	406.899	78	363.052	104	334.460	130	313.690	156	297.606	182	284.610

P=100 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	947.731	27	529.178	53	448.924	79	406.413	105	378.354	131	357.784	157	341.737
2	880.264	28	524.588	54	446.850	80	405.134	106	377.450	132	357.096	158	341.187
3	831.245	29	520.187	55	444.822	81	403.873	107	376.557	133	356.414	159	340.641
4	793.222	30	515.960	56	442.838	82	402.632	108	375.675	134	355.739	160	340.099
5	762.430	31	511.896	57	440.897	83	401.410	109	374.802	135	355.069	161	339.562
6	736.722	32	507.985	58	438.997	84	400.205	110	373.939	136	354.406	162	339.028
7	714.766	33	504.215	59	437.136	85	399.018	111	373.086	137	353.749	163	338.499
8	695.679	34	500.578	60	435.313	86	397.848	112	372.242	138	353.098	164	337.974
9	678.852	35	497.066	61	433.527	87	396.694	113	371.407	139	352.453	165	337.453
10	663.845	36	493.671	62	431.776	88	395.556	114	370.582	140	351.814	166	336.935
11	650.333	37	490.387	63	430.059	89	394.435	115	369.765	141	351.180	167	336.422
12	638.068	38	487.207	64	428.375	90	393.329	116	368.957	142	350.551	168	335.912
13	626.857	39	484.125	65	426.723	91	392.237	117	368.158	143	349.928	169	335.406
14	616.548	40	481.136	66	425.101	92	391.161	118	367.367	144	349.311	170	334.904
15	607.019	41	478.236	67	423.509	93	390.098	119	366.585	145	348.699	171	334.405
16	598.169	42	475.419	68	421.946	94	389.050	120	365.810	146	348.092	172	333.910
17	589.917	43	472.681	69	420.411	95	388.015	121	365.043	147	347.490	173	333.419
18	582.193	44	470.019	70	418.903	96	386.994	122	364.285	148	346.893	174	332.931
19	574.940	45	467.428	71	417.420	97	385.986	123	363.533	149	346.301	175	332.447
20	568.108	46	464.906	72	415.963	98	384.990	124	362.790	150	345.714	176	331.966
21	561.656	47	462.449	73	414.531	99	384.007	125	362.053	151	345.132	177	331.488
22	555.547	48	460.055	74	413.122	100	383.036	126	361.324	152	344.555	178	331.014
23	549.750	49	457.720	75	411.737	101	382.076	127	360.603	153	343.982	179	330.543
24	544.237	50	455.441	76	410.374	102	381.129	128	359.888	154	343.414	180	330.075
25	538.985	51	453.217	77	409.033	103	380.193	129	359.180	155	342.850	181	329.611
26	533.972	52	451.045	78	407.713	104	379.268	130	358.478	156	342.291	182	329.149

13.2 斗门暴雨强度公式及计算图表

珠海市斗门区暴雨强度公式及计算图表

(近 50 年)

珠海市气象局

广东省气候中心

二零一五年四月

说

1. 本计算图表以斗门国家地面气象观测站 48 年(1967~2014 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。

2. 以重现期 1、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设计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(升/秒·公顷)

t —降雨历时(分钟)

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:

$$q = \frac{4288.206(1 + 0.658LnP)}{(t + 30.945)^{0.736}}$$

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。

明

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

从重现期区间参数公式 III,得:

$$n = 0.732 + 0.006Ln(P - 7.842)$$

$$= 0.74905 \text{ (取 } 0.749 \text{)}$$

$$b = 30.663 + 0.591Ln(P - 7.842)$$

$$= 32.34290 \text{ (取 } 32.343 \text{)}$$

$$A = 28.687 + 7.927Ln(P - 3.422)$$

$$= 53.03616 \text{ (取 } 53.036 \text{)}$$

配得 $P=25$ 年的暴雨强度计算公式如下:

$$q = \frac{167 \times 53.036}{(t + 32.343)^{0.749}}$$

可按上式计算 1~200 分钟中任何时段的暴雨强度。

当 $t=50$:

$$q = \frac{167 \times 53.036}{(t + 32.343)^{0.749}} = 325.449 \text{ (升/秒/公顷)}$$

5. 公式误差

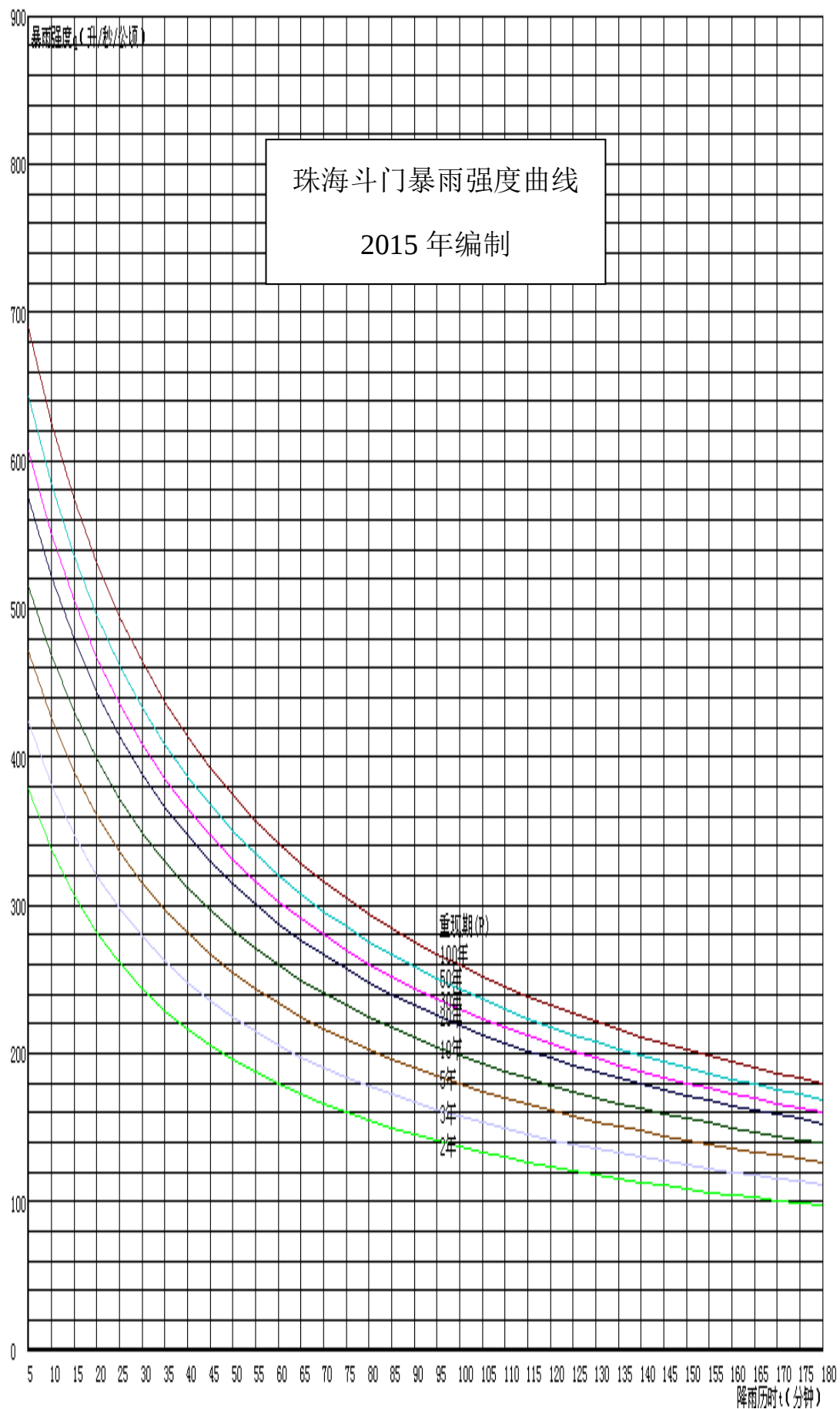
重现期 2~20 年的暴雨强度公式算得的平均绝对均方差为: 0.032 (mm/min), 平均相对均方差为: 2.05%。精度符合《室外排水设计规范》(GB50014—2006, 2014 年版)提出的要求。

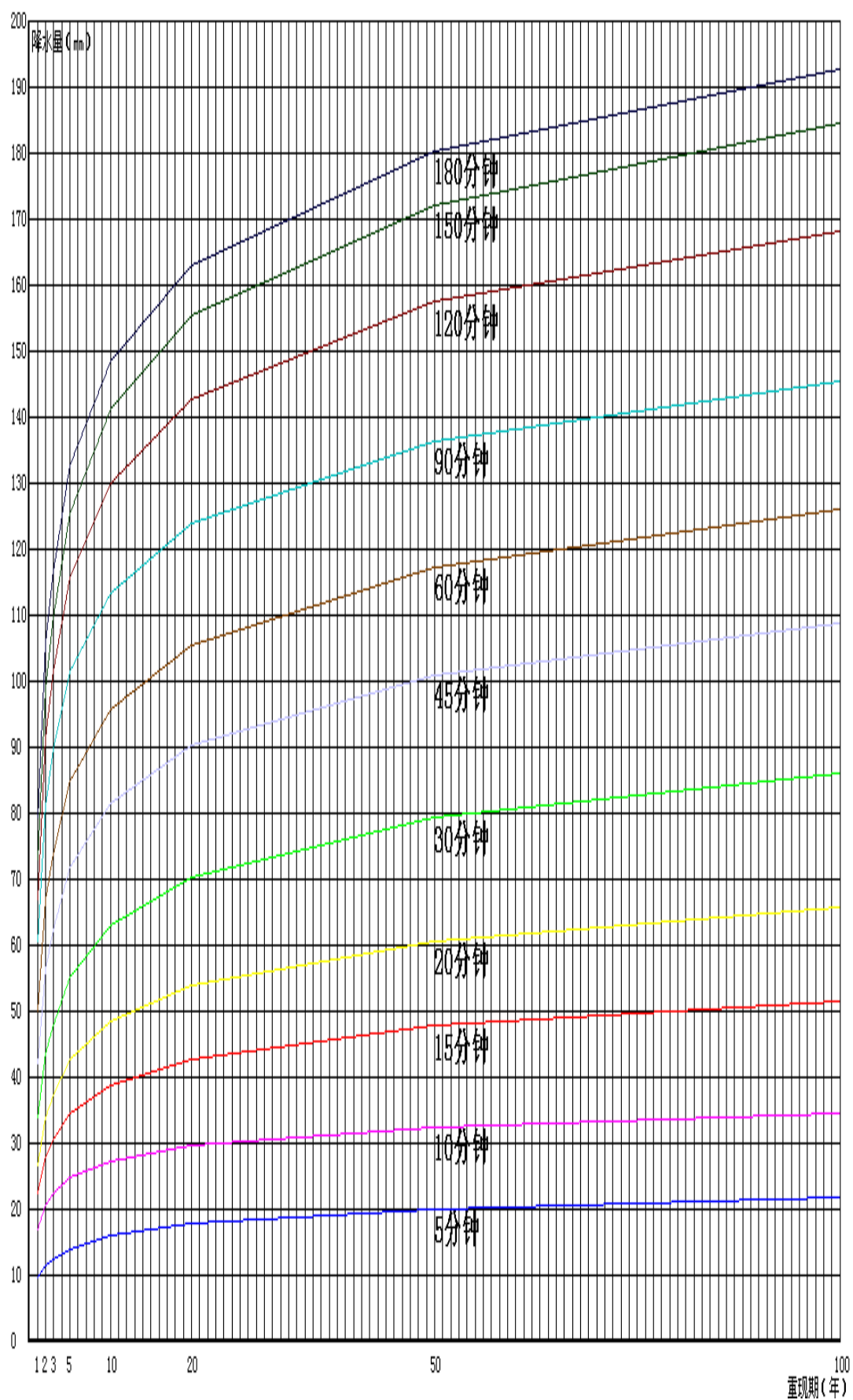
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=2	$3639.097 / (t + 22.434)^{0.682}$
P=3	$4549.915 / (t + 25.092)^{0.697}$
P=5	$5676.831 / (t + 27.898)^{0.714}$
P=10	$7284.373 / (t + 31.118)^{0.737}$
P=20	$8508.149 / (t + 32.139)^{0.747}$
P=30	$9132.896 / (t + 32.494)^{0.751}$
P=50	$9875.712 / (t + 32.874)^{0.754}$
P=100	$10840.972 / (t + 33.336)^{0.759}$

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	$0.678+0.025\text{Ln}(P - 0.836)$
		b	$21.783+4.287\text{Ln}(P - 0.836)$
		A	$13.677+12.810\text{Ln}(P- 0.116)$
10—100	II	n	$0.732+0.006\text{Ln}(P - 7.842)$
		b	$30.663+0.591\text{Ln}(P - 7.842)$
		A	$28.687+7.927\text{Ln}(P - 3.422)$





延长样本资料后的降水量与重现期曲线图

P=2 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	423.407	27	254.488	53	190.762	79	155.875	105	133.410	131	117.543	157	105.641
2	411.511	28	251.036	54	189.057	80	154.836	106	132.701	132	117.023	158	105.241
3	400.406	29	247.697	55	187.388	81	153.813	107	132.001	133	116.509	159	104.845
4	390.013	30	244.465	56	185.755	82	152.807	108	131.310	134	116.000	160	104.453
5	380.260	31	241.336	57	184.157	83	151.817	109	130.628	135	115.497	161	104.064
6	371.087	32	238.303	58	182.593	84	150.843	110	129.954	136	115.000	162	103.679
7	362.442	33	235.363	59	181.061	85	149.884	111	129.289	137	114.507	163	103.297
8	354.277	34	232.511	60	179.560	86	148.940	112	128.632	138	114.020	164	102.919
9	346.551	35	229.742	61	178.089	87	148.010	113	127.984	139	113.538	165	102.544
10	339.228	36	227.053	62	176.648	88	147.095	114	127.343	140	113.061	166	102.173
11	332.275	37	224.441	63	175.235	89	146.193	115	126.711	141	112.589	167	101.805
12	325.663	38	221.901	64	173.850	90	145.305	116	126.086	142	112.121	168	101.440
13	319.366	39	219.431	65	172.491	91	144.430	117	125.468	143	111.658	169	101.078
14	313.362	40	217.028	66	171.159	92	143.568	118	124.858	144	111.200	170	100.719
15	307.628	41	214.689	67	169.851	93	142.719	119	124.256	145	110.747	171	100.364
16	302.147	42	212.411	68	168.568	94	141.882	120	123.660	146	110.298	172	100.012
17	296.900	43	210.192	69	167.309	95	141.057	121	123.071	147	109.854	173	99.662
18	291.872	44	208.029	70	166.072	96	140.243	122	122.490	148	109.414	174	99.316
19	287.049	45	205.920	71	164.858	97	139.442	123	121.915	149	108.978	175	98.973
20	282.418	46	203.863	72	163.665	98	138.651	124	121.346	150	108.547	176	98.632
21	277.967	47	201.856	73	162.494	99	137.871	125	120.784	151	108.120	177	98.295
22	273.685	48	199.897	74	161.342	100	137.102	126	120.229	152	107.696	178	97.960
23	269.563	49	197.984	75	160.211	101	136.344	127	119.679	153	107.277	179	97.628
24	265.590	50	196.116	76	159.099	102	135.595	128	119.136	154	106.862	180	97.299
25	261.758	51	194.291	77	158.006	103	134.857	129	118.599	155	106.451	181	96.973
26	258.060	52	192.507	78	156.932	104	134.129	130	118.068	156	106.044	182	96.649

P=3 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	468.487	27	289.344	53	218.201	79	178.593	105	152.887	131	134.653	157	120.943
2	456.366	28	285.534	54	216.274	80	177.406	106	152.073	132	134.055	158	120.482
3	444.981	29	281.844	55	214.389	81	176.239	107	151.270	133	133.464	159	120.026
4	434.263	30	278.269	56	212.542	82	175.091	108	150.477	134	132.878	160	119.573
5	424.153	31	274.802	57	210.734	83	173.960	109	149.694	135	132.299	161	119.125
6	414.598	32	271.438	58	208.964	84	172.847	110	148.920	136	131.726	162	118.681
7	405.550	33	268.172	59	207.228	85	171.751	111	148.157	137	131.159	163	118.241
8	396.969	34	265.001	60	205.528	86	170.672	112	147.403	138	130.598	164	117.805
9	388.816	35	261.920	61	203.861	87	169.609	113	146.658	139	130.043	165	117.372
10	381.060	36	258.924	62	202.227	88	168.563	114	145.922	140	129.494	166	116.944
11	373.670	37	256.010	63	200.624	89	167.531	115	145.196	141	128.950	167	116.519
12	366.619	38	253.175	64	199.052	90	166.516	116	144.477	142	128.411	168	116.098
13	359.884	39	250.415	65	197.509	91	165.515	117	143.768	143	127.878	169	115.681
14	353.442	40	247.728	66	195.995	92	164.528	118	143.067	144	127.351	170	115.267
15	347.274	41	245.109	67	194.509	93	163.556	119	142.374	145	126.828	171	114.857
16	341.361	42	242.557	68	193.051	94	162.597	120	141.690	146	126.311	172	114.451
17	335.688	43	240.069	69	191.618	95	161.652	121	141.013	147	125.799	173	114.048
18	330.239	44	237.641	70	190.212	96	160.721	122	140.344	148	125.292	174	113.648
19	325.001	45	235.273	71	188.830	97	159.802	123	139.683	149	124.790	175	113.252
20	319.960	46	232.962	72	187.472	98	158.896	124	139.029	150	124.293	176	112.859
21	315.106	47	230.704	73	186.138	99	158.002	125	138.383	151	123.801	177	112.470
22	310.427	48	228.500	74	184.827	100	157.121	126	137.744	152	123.313	178	112.083
23	305.913	49	226.346	75	183.538	101	156.251	127	137.112	153	122.830	179	111.700
24	301.557	50	224.241	76	182.270	102	155.394	128	136.487	154	122.351	180	111.320
25	297.348	51	222.183	77	181.024	103	154.547	129	135.869	155	121.878	181	110.944
26	293.279	52	220.170	78	179.798	104	153.712	130	135.258	156	121.408	182	110.570

P=5 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	514.099	27	325.134	53	246.512	79	202.033	105	172.947	131	152.233	157	136.621
2	501.762	28	320.970	54	244.359	80	200.694	106	172.024	132	151.552	158	136.096
3	490.112	29	316.932	55	242.251	81	199.376	107	171.113	133	150.879	159	135.575
4	479.092	30	313.014	56	240.186	82	198.079	108	170.213	134	150.213	160	135.060
5	468.648	31	309.210	57	238.162	83	196.802	109	169.324	135	149.554	161	134.549
6	458.735	32	305.516	58	236.179	84	195.545	110	168.446	136	148.902	162	134.042
7	449.310	33	301.925	59	234.236	85	194.307	111	167.580	137	148.257	163	133.541
8	440.338	34	298.434	60	232.330	86	193.087	112	166.723	138	147.618	164	133.044
9	431.783	35	295.039	61	230.461	87	191.886	113	165.878	139	146.986	165	132.551
10	423.618	36	291.735	62	228.627	88	190.702	114	165.042	140	146.360	166	132.062
11	415.813	37	288.518	63	226.829	89	189.536	115	164.217	141	145.741	167	131.578
12	408.345	38	285.385	64	225.064	90	188.387	116	163.401	142	145.128	168	131.098
13	401.191	39	282.333	65	223.331	91	187.254	117	162.595	143	144.521	169	130.622
14	394.330	40	279.357	66	221.630	92	186.138	118	161.799	144	143.920	170	130.151
15	387.745	41	276.456	67	219.960	93	185.037	119	161.011	145	143.326	171	129.683
16	381.417	42	273.626	68	218.320	94	183.952	120	160.233	146	142.737	172	129.220
17	375.332	43	270.865	69	216.709	95	182.882	121	159.464	147	142.154	173	128.760
18	369.475	44	268.170	70	215.126	96	181.827	122	158.704	148	141.576	174	128.304
19	363.833	45	265.538	71	213.571	97	180.786	123	157.952	149	141.004	175	127.853
20	358.393	46	262.968	72	212.042	98	179.760	124	157.209	150	140.438	176	127.405
21	353.144	47	260.456	73	210.540	99	178.747	125	156.474	151	139.877	177	126.960
22	348.076	48	258.001	74	209.062	100	177.748	126	155.748	152	139.321	178	126.520
23	343.180	49	255.601	75	207.610	101	176.763	127	155.029	153	138.771	179	126.083
24	338.445	50	253.254	76	206.181	102	175.790	128	154.318	154	138.226	180	125.650
25	333.865	51	250.958	77	204.776	103	174.830	129	153.616	155	137.686	181	125.220
26	329.430	52	248.711	78	203.393	104	173.883	130	152.920	156	137.151	182	124.794

P=10 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	564.831	27	364.834	53	277.811	79	227.794	105	194.848	131	171.296	157	153.510
2	552.211	28	360.276	54	275.402	80	226.282	106	193.800	132	170.521	158	152.911
3	540.236	29	355.849	55	273.041	81	224.792	107	192.765	133	169.755	159	152.318
4	528.855	30	351.549	56	270.728	82	223.326	108	191.743	134	168.996	160	151.731
5	518.024	31	347.369	57	268.460	83	221.882	109	190.733	135	168.246	161	151.148
6	507.701	32	343.304	58	266.237	84	220.460	110	189.736	136	167.504	162	150.571
7	497.851	33	339.350	59	264.056	85	219.059	111	188.751	137	166.769	163	149.999
8	488.439	34	335.502	60	261.917	86	217.679	112	187.778	138	166.041	164	149.432
9	479.437	35	331.754	61	259.819	87	216.319	113	186.817	139	165.321	165	148.870
10	470.815	36	328.104	62	257.759	88	214.979	114	185.868	140	164.609	166	148.313
11	462.551	37	324.547	63	255.738	89	213.659	115	184.929	141	163.903	167	147.761
12	454.620	38	321.080	64	253.754	90	212.357	116	184.002	142	163.205	168	147.214
13	447.003	39	317.699	65	251.805	91	211.074	117	183.086	143	162.514	169	146.671
14	439.680	40	314.401	66	249.892	92	209.810	118	182.180	144	161.829	170	146.133
15	432.633	41	311.182	67	248.012	93	208.562	119	181.285	145	161.152	171	145.600
16	425.847	42	308.039	68	246.166	94	207.333	120	180.400	146	160.481	172	145.071
17	419.306	43	304.971	69	244.351	95	206.120	121	179.525	147	159.816	173	144.547
18	412.998	44	301.974	70	242.568	96	204.923	122	178.660	148	159.158	174	144.027
19	406.909	45	299.045	71	240.815	97	203.743	123	177.805	149	158.506	175	143.512
20	401.027	46	296.182	72	239.092	98	202.579	124	176.960	150	157.861	176	143.001
21	395.341	47	293.383	73	237.397	99	201.431	125	176.124	151	157.222	177	142.494
22	389.842	48	290.645	74	235.731	100	200.297	126	175.297	152	156.588	178	141.992
23	384.520	49	287.967	75	234.091	101	199.179	127	174.479	153	155.961	179	141.494
24	379.366	50	285.347	76	232.479	102	198.075	128	173.670	154	155.340	180	140.999
25	374.372	51	282.782	77	230.892	103	196.985	129	172.870	155	154.724	181	140.509
26	369.531	52	280.270	78	229.331	104	195.910	130	172.079	156	154.114	182	140.023

P=20 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	622.503	27	403.873	53	307.630	79	252.100	105	215.465	131	189.258	157	169.465
2	608.831	28	398.846	54	304.959	80	250.419	106	214.298	132	188.396	158	168.799
3	595.841	29	393.963	55	302.340	81	248.764	107	213.147	133	187.543	159	168.138
4	583.481	30	389.217	56	299.774	82	247.134	108	212.010	134	186.699	160	167.484
5	571.705	31	384.603	57	297.259	83	245.529	109	210.886	135	185.864	161	166.836
6	560.470	32	380.115	58	294.792	84	243.948	110	209.777	136	185.038	162	166.194
7	549.738	33	375.747	59	292.372	85	242.390	111	208.681	137	184.220	163	165.557
8	539.474	34	371.495	60	289.999	86	240.856	112	207.599	138	183.411	164	164.926
9	529.648	35	367.354	61	287.669	87	239.344	113	206.530	139	182.610	165	164.301
10	520.231	36	363.319	62	285.384	88	237.854	114	205.473	140	181.816	166	163.681
11	511.196	37	359.387	63	283.140	89	236.386	115	204.429	141	181.031	167	163.067
12	502.519	38	355.552	64	280.937	90	234.939	116	203.397	142	180.254	168	162.458
13	494.180	39	351.812	65	278.774	91	233.512	117	202.378	143	179.485	169	161.854
14	486.157	40	348.163	66	276.649	92	232.106	118	201.370	144	178.723	170	161.255
15	478.432	41	344.600	67	274.562	93	230.719	119	200.374	145	177.969	171	160.662
16	470.988	42	341.122	68	272.511	94	229.351	120	199.389	146	177.222	172	160.074
17	463.809	43	337.725	69	270.496	95	228.002	121	198.416	147	176.483	173	159.491
18	456.882	44	334.406	70	268.515	96	226.672	122	197.453	148	175.750	174	158.912
19	450.191	45	331.163	71	266.568	97	225.359	123	196.502	149	175.025	175	158.339
20	443.726	46	327.992	72	264.654	98	224.064	124	195.561	150	174.307	176	157.770
21	437.473	47	324.891	73	262.771	99	222.787	125	194.631	151	173.595	177	157.206
22	431.423	48	321.858	74	260.919	100	221.526	126	193.710	152	172.891	178	156.647
23	425.564	49	318.890	75	259.098	101	220.282	127	192.800	153	172.192	179	156.093
24	419.889	50	315.985	76	257.306	102	219.054	128	191.900	154	171.501	180	155.543
25	414.387	51	313.142	77	255.543	103	217.842	129	191.010	155	170.816	181	154.997
26	409.051	52	310.357	78	253.808	104	216.646	130	190.129	156	170.137	182	154.456

P=30 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	653.670	27	424.599	53	323.389	79	264.925	105	226.338	131	198.732	157	177.883
2	639.386	28	419.317	54	320.577	80	263.154	106	225.110	132	197.824	158	177.181
3	625.809	29	414.186	55	317.821	81	261.411	107	223.897	133	196.926	159	176.486
4	612.887	30	409.198	56	315.120	82	259.694	108	222.699	134	196.037	160	175.797
5	600.569	31	404.349	57	312.472	83	258.004	109	221.516	135	195.157	161	175.114
6	588.814	32	399.631	58	309.875	84	256.339	110	220.347	136	194.287	162	174.438
7	577.582	33	395.040	59	307.328	85	254.699	111	219.193	137	193.425	163	173.767
8	566.837	34	390.570	60	304.830	86	253.083	112	218.053	138	192.573	164	173.102
9	556.547	35	386.216	61	302.378	87	251.491	113	216.926	139	191.729	165	172.444
10	546.682	36	381.974	62	299.971	88	249.921	114	215.813	140	190.894	166	171.791
11	537.215	37	377.838	63	297.609	89	248.375	115	214.713	141	190.067	167	171.144
12	528.122	38	373.806	64	295.290	90	246.851	116	213.626	142	189.248	168	170.502
13	519.380	39	369.873	65	293.012	91	245.348	117	212.552	143	188.438	169	169.866
14	510.968	40	366.034	66	290.775	92	243.866	118	211.491	144	187.635	170	169.236
15	502.867	41	362.287	67	288.578	93	242.406	119	210.442	145	186.841	171	168.611
16	495.059	42	358.629	68	286.419	94	240.965	120	209.404	146	186.054	172	167.992
17	487.528	43	355.056	69	284.297	95	239.544	121	208.379	147	185.275	173	167.377
18	480.259	44	351.564	70	282.211	96	238.143	122	207.365	148	184.504	174	166.768
19	473.238	45	348.151	71	280.161	97	236.760	123	206.363	149	183.740	175	166.164
20	466.451	46	344.815	72	278.145	98	235.397	124	205.372	150	182.983	176	165.565
21	459.887	47	341.552	73	276.162	99	234.051	125	204.392	151	182.234	177	164.971
22	453.535	48	338.361	74	274.213	100	232.723	126	203.422	152	181.491	178	164.382
23	447.383	49	335.238	75	272.295	101	231.412	127	202.464	153	180.756	179	163.798
24	441.423	50	332.181	76	270.408	102	230.119	128	201.516	154	180.028	180	163.219
25	435.644	51	329.189	77	268.551	103	228.842	129	200.578	155	179.306	181	162.645
26	430.039	52	326.259	78	266.723	104	227.582	130	199.650	156	178.591	182	162.075

P=50 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	693.504	27	451.368	53	343.904	79	281.726	105	240.657	131	211.265	157	189.063
2	678.457	28	445.766	54	340.915	80	279.842	106	239.349	132	210.298	158	188.315
3	664.147	29	440.323	55	337.985	81	277.987	107	238.058	133	209.342	159	187.575
4	650.521	30	435.032	56	335.114	82	276.160	108	236.783	134	208.395	160	186.841
5	637.528	31	429.887	57	332.298	83	274.361	109	235.523	135	207.458	161	186.114
6	625.123	32	424.881	58	329.538	84	272.589	110	234.279	136	206.531	162	185.393
7	613.265	33	420.008	59	326.829	85	270.844	111	233.050	137	205.614	163	184.679
8	601.918	34	415.264	60	324.173	86	269.124	112	231.836	138	204.706	164	183.971
9	591.047	35	410.643	61	321.565	87	267.430	113	230.637	139	203.807	165	183.270
10	580.623	36	406.139	62	319.006	88	265.760	114	229.452	140	202.918	166	182.575
11	570.616	37	401.749	63	316.494	89	264.114	115	228.281	141	202.037	167	181.886
12	561.002	38	397.467	64	314.028	90	262.492	116	227.124	142	201.166	168	181.202
13	551.756	39	393.290	65	311.606	91	260.892	117	225.980	143	200.303	169	180.525
14	542.857	40	389.214	66	309.226	92	259.316	118	224.850	144	199.448	170	179.854
15	534.285	41	385.235	67	306.889	93	257.761	119	223.733	145	198.602	171	179.188
16	526.022	42	381.349	68	304.592	94	256.227	120	222.629	146	197.764	172	178.528
17	518.050	43	377.553	69	302.335	95	254.715	121	221.537	147	196.935	173	177.874
18	510.353	44	373.844	70	300.117	96	253.223	122	220.457	148	196.113	174	177.225
19	502.917	45	370.219	71	297.935	97	251.752	123	219.390	149	195.300	175	176.582
20	495.728	46	366.674	72	295.791	98	250.300	124	218.335	150	194.494	176	175.944
21	488.774	47	363.207	73	293.682	99	248.868	125	217.291	151	193.696	177	175.312
22	482.043	48	359.816	74	291.608	100	247.454	126	216.259	152	192.905	178	174.685
23	475.524	49	356.497	75	289.567	101	246.059	127	215.238	153	192.122	179	174.063
24	469.206	50	353.249	76	287.559	102	244.682	128	214.229	154	191.347	180	173.446
25	463.080	51	350.069	77	285.584	103	243.323	129	213.230	155	190.578	181	172.834
26	457.137	52	346.954	78	283.640	104	241.982	130	212.242	156	189.817	182	172.227

P=100(年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	740.345	27	482.626	53	367.704	79	301.109	105	257.098	131	225.594	157	201.796
2	724.388	28	476.642	54	364.504	80	299.091	106	255.696	132	224.557	158	200.995
3	709.206	29	470.827	55	361.368	81	297.103	107	254.312	133	223.532	159	200.201
4	694.741	30	465.174	56	358.294	82	295.146	108	252.945	134	222.517	160	199.415
5	680.943	31	459.676	57	355.279	83	293.218	109	251.595	135	221.513	161	198.635
6	667.763	32	454.326	58	352.323	84	291.320	110	250.262	136	220.520	162	197.863
7	655.160	33	449.118	59	349.423	85	289.449	111	248.945	137	219.536	163	197.098
8	643.095	34	444.047	60	346.578	86	287.606	112	247.644	138	218.563	164	196.339
9	631.532	35	439.106	61	343.786	87	285.791	113	246.358	139	217.600	165	195.587
10	620.440	36	434.291	62	341.045	88	284.001	114	245.088	140	216.646	166	194.842
11	609.790	37	429.596	63	338.355	89	282.237	115	243.833	141	215.703	167	194.103
12	599.553	38	425.018	64	335.713	90	280.499	116	242.592	142	214.768	168	193.371
13	589.707	39	420.551	65	333.119	91	278.785	117	241.367	143	213.843	169	192.645
14	580.227	40	416.191	66	330.571	92	277.095	118	240.155	144	212.927	170	191.926
15	571.093	41	411.934	67	328.067	93	275.429	119	238.958	145	212.020	171	191.213
16	562.285	42	407.778	68	325.607	94	273.785	120	237.774	146	211.123	172	190.505
17	553.786	43	403.717	69	323.189	95	272.165	121	236.604	147	210.233	173	189.804
18	545.579	44	399.748	70	320.812	96	270.566	122	235.447	148	209.353	174	189.109
19	537.649	45	395.869	71	318.476	97	268.989	123	234.303	149	208.481	175	188.420
20	529.980	46	392.076	72	316.179	98	267.433	124	233.172	150	207.617	176	187.736
21	522.561	47	388.366	73	313.919	99	265.898	125	232.053	151	206.762	177	187.058
22	515.377	48	384.737	74	311.697	100	264.383	126	230.947	152	205.914	178	186.386
23	508.419	49	381.185	75	309.511	101	262.888	127	229.853	153	205.075	179	185.719
24	501.674	50	377.708	76	307.360	102	261.412	128	228.771	154	204.244	180	185.058
25	495.133	51	374.304	77	305.243	103	259.955	129	227.700	155	203.420	181	184.403
26	488.787	52	370.970	78	303.160	104	258.517	130	226.641	156	202.604	182	183.752

珠海市斗门区暴雨强度公式及计算图表

(近 30 年)

珠海市气象局

广东省气候中心

二 零 一 五 年 四 月

说

1. 本计算图表以斗门国家地面气象观测站 30 年(1985～2014 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。

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设计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(升/秒·公顷)

t —降雨历时(分钟)

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:

$$q = \frac{3932.790(1+0.568LnP)}{(t+27.331)^{0.706}}$$

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。

明

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

从重现期区间参数公式 III,得:

$$n=0.728+0.008Ln(P-7.842)$$

$$=0.75074 \text{ (取 } 0.751 \text{)}$$

$$b=29.050+2.021Ln(P-7.842)$$

$$=34.79462 \text{ (取 } 34.795 \text{)}$$

$$A=22.384+11.013Ln(P-3.422)$$

$$=56.21235 \text{ (取 } 56.212 \text{)}$$

配得 $P=25$ 年的暴雨强度计算公式如下:

$$q = \frac{167 \times 56.212}{(t+34.795)^{0.751}}$$

可按上式计算 1～200 分钟中任何时段的暴雨强度。

当 $t=50$:

$$q = \frac{167 \times 56.212}{(t+34.795)^{0.751}} = 334.456 \text{ (升/秒/公顷)}$$

5. 公式误差

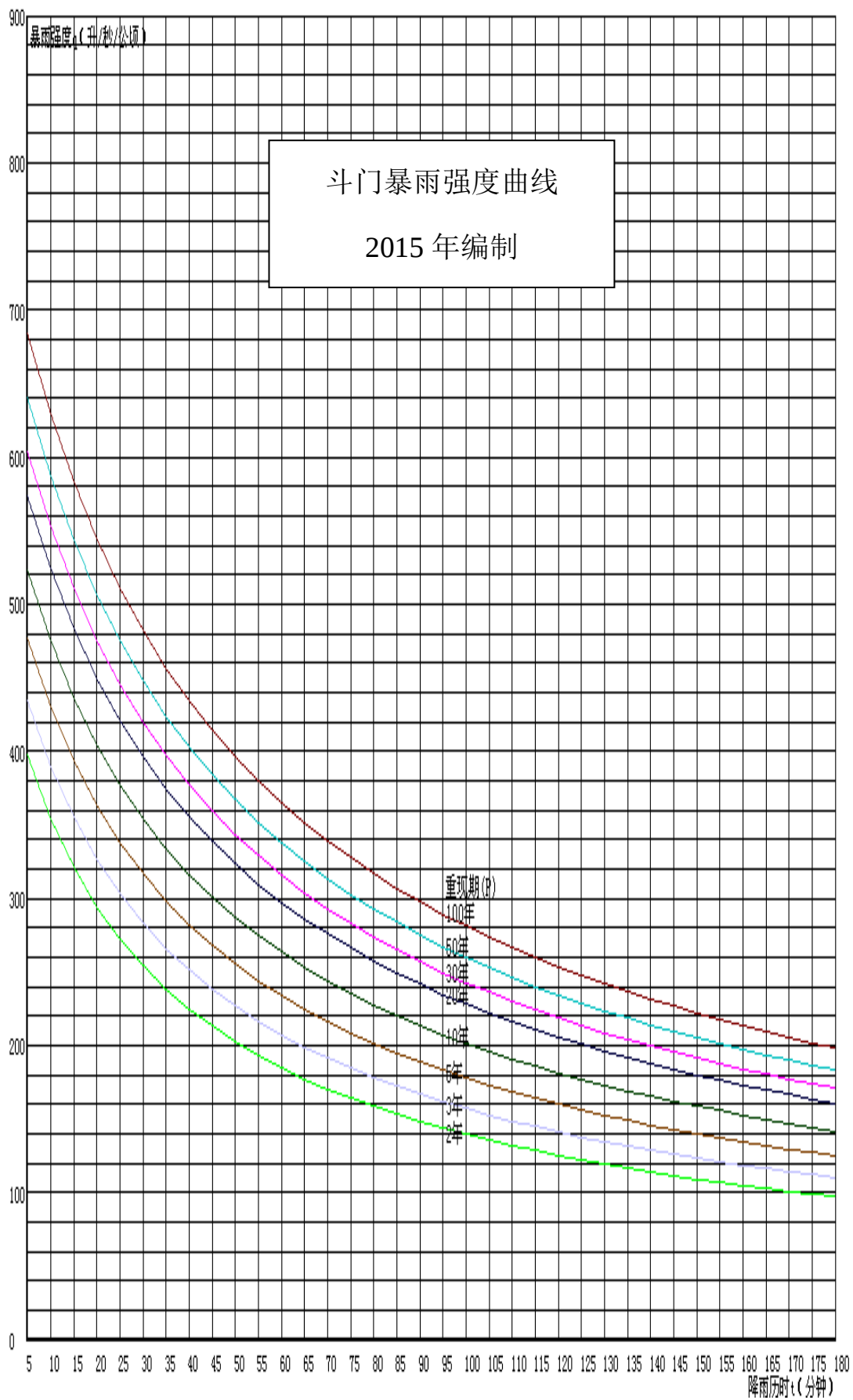
重现期 2～20 年的暴雨强度公式算得的平均绝对均方差为: 0.022 (mm/min), 平均相对均方差为: 1.12%。精度符合《室外排水设计规范》(GB50014—2006, 2014 年版)提出的要求。

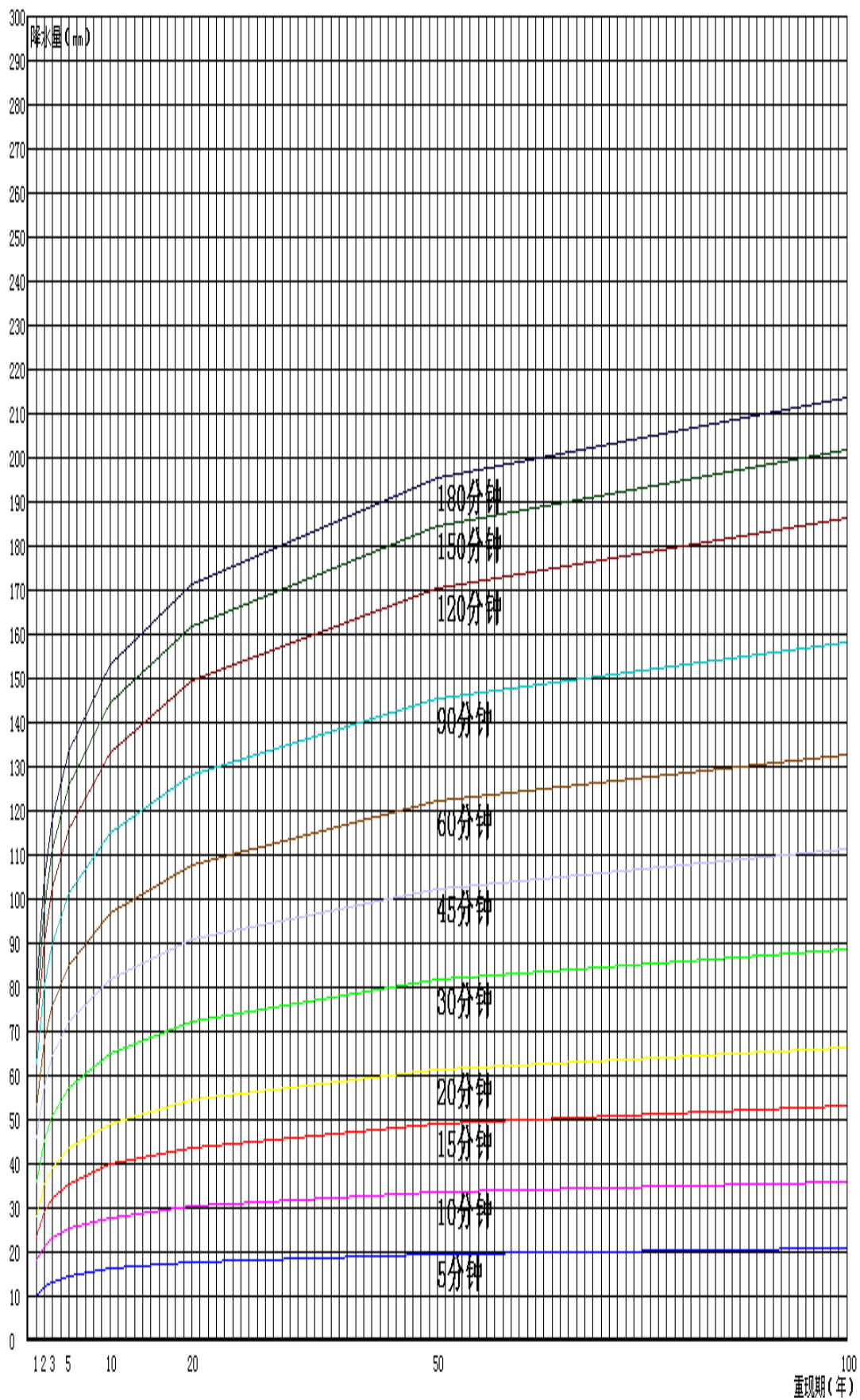
表一 单一重现期暴雨强度公式

重现期 P (年)	公 式
P=2	$4580.476 / (t + 24.262)^{0.724}$
P=3	$5269.685 / (t + 26.103)^{0.726}$
P=5	$6122.22 / (t + 28.153)^{0.729}$
P=10	$7202.71 / (t + 30.605)^{0.734}$
P=20	$8902.603 / (t + 34.098)^{0.748}$
P=30	$9770.836 / (t + 35.311)^{0.753}$
P=50	$10802.562 / (t + 36.611)^{0.758}$
P=100	$12143.739 / (t + 38.192)^{0.764}$

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	$0.723+0.004\text{Ln}(P - 0.640)$
		b	$23.235+3.340\text{Ln}(P - 0.640)$
		A	$21.289+9.692\text{Ln}(P - 0.116)$
10—100	II	n	$0.728+0.008\text{Ln}(P - 7.842)$
		b	$29.050+2.021\text{Ln}(P - 7.842)$
		A	$22.384+11.013\text{Ln}(P- 3.422)$





延长样本资料后的降水量与重现期曲线图

P=2 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	442.104	27	264.861	53	196.799	79	159.521	105	135.583	131	118.735	157	106.144
2	429.850	28	261.182	54	194.975	80	158.412	106	134.829	132	118.185	158	105.722
3	418.376	29	257.623	55	193.191	81	157.321	107	134.084	133	117.640	159	105.304
4	407.605	30	254.177	56	191.446	82	156.247	108	133.350	134	117.101	160	104.890
5	397.472	31	250.838	57	189.737	83	155.191	109	132.624	135	116.569	161	104.480
6	387.919	32	247.602	58	188.064	84	154.152	110	131.908	136	116.041	162	104.074
7	378.895	33	244.464	59	186.426	85	153.130	111	131.202	137	115.520	163	103.671
8	370.355	34	241.419	60	184.822	86	152.123	112	130.504	138	115.004	164	103.272
9	362.260	35	238.463	61	183.250	87	151.132	113	129.815	139	114.494	165	102.877
10	354.573	36	235.591	62	181.709	88	150.156	114	129.134	140	113.989	166	102.485
11	347.264	37	232.801	63	180.199	89	149.195	115	128.462	141	113.489	167	102.097
12	340.304	38	230.088	64	178.719	90	148.248	116	127.799	142	112.994	168	101.712
13	333.668	39	227.449	65	177.267	91	147.316	117	127.143	143	112.505	169	101.331
14	327.331	40	224.880	66	175.843	92	146.397	118	126.495	144	112.020	170	100.953
15	321.273	41	222.380	67	174.446	93	145.493	119	125.855	145	111.541	171	100.578
16	315.476	42	219.946	68	173.075	94	144.601	120	125.223	146	111.066	172	100.207
17	309.922	43	217.573	69	171.729	95	143.722	121	124.598	147	110.596	173	99.839
18	304.595	44	215.261	70	170.408	96	142.856	122	123.981	148	110.131	174	99.474
19	299.481	45	213.006	71	169.111	97	142.002	123	123.371	149	109.670	175	99.112
20	294.567	46	210.807	72	167.838	98	141.160	124	122.768	150	109.214	176	98.754
21	289.841	47	208.661	73	166.586	99	140.330	125	122.172	151	108.763	177	98.398
22	285.291	48	206.566	74	165.357	100	139.511	126	121.583	152	108.316	178	98.046
23	280.908	49	204.521	75	164.150	101	138.704	127	121.000	153	107.873	179	97.696
24	276.682	50	202.524	76	162.963	102	137.908	128	120.424	154	107.435	180	97.350
25	272.604	51	200.572	77	161.796	103	137.122	129	119.855	155	107.000	181	97.006
26	268.666	52	198.664	78	160.649	104	136.348	130	119.292	156	106.570	182	96.665

P=3 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	480.191	27	294.678	53	220.646	79	179.511	105	152.897	131	134.077	157	119.969
2	467.725	28	290.714	54	218.643	80	178.282	106	152.055	132	133.461	158	119.495
3	456.001	29	286.874	55	216.683	81	177.072	107	151.225	133	132.851	159	119.026
4	444.953	30	283.153	56	214.763	82	175.881	108	150.406	134	132.248	160	118.562
5	434.520	31	279.544	57	212.884	83	174.709	109	149.597	135	131.652	161	118.101
6	424.651	32	276.043	58	211.043	84	173.556	110	148.798	136	131.062	162	117.645
7	415.299	33	272.644	59	209.240	85	172.420	111	148.009	137	130.478	163	117.193
8	406.422	34	269.343	60	207.473	86	171.302	112	147.230	138	129.900	164	116.745
9	397.983	35	266.136	61	205.741	87	170.201	113	146.461	139	129.329	165	116.301
10	389.949	36	263.018	62	204.043	88	169.117	114	145.701	140	128.763	166	115.861
11	382.291	37	259.985	63	202.378	89	168.049	115	144.951	141	128.203	167	115.426
12	374.980	38	257.034	64	200.745	90	166.997	116	144.210	142	127.649	168	114.993
13	367.993	39	254.162	65	199.142	91	165.960	117	143.477	143	127.100	169	114.565
14	361.309	40	251.365	66	197.570	92	164.939	118	142.754	144	126.557	170	114.141
15	354.905	41	248.639	67	196.028	93	163.932	119	142.039	145	126.020	171	113.720
16	348.765	42	245.983	68	194.513	94	162.940	120	141.333	146	125.488	172	113.303
17	342.872	43	243.394	69	193.026	95	161.962	121	140.634	147	124.961	173	112.890
18	337.210	44	240.868	70	191.566	96	160.998	122	139.944	148	124.440	174	112.480
19	331.766	45	238.404	71	190.131	97	160.048	123	139.262	149	123.923	175	112.073
20	326.526	46	235.999	72	188.722	98	159.110	124	138.588	150	123.412	176	111.671
21	321.478	47	233.651	73	187.338	99	158.186	125	137.922	151	122.906	177	111.271
22	316.612	48	231.358	74	185.977	100	157.274	126	137.263	152	122.404	178	110.875
23	311.918	49	229.117	75	184.640	101	156.375	127	136.611	153	121.908	179	110.482
24	307.386	50	226.927	76	183.325	102	155.488	128	135.967	154	121.416	180	110.093
25	303.007	51	224.787	77	182.033	103	154.613	129	135.330	155	120.929	181	109.707
26	298.774	52	222.694	78	180.762	104	153.749	130	134.700	156	120.447	182	109.324

P=5 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	523.787	27	329.083	53	248.328	79	202.785	105	173.084	131	151.980	157	136.107
2	511.066	28	324.800	54	246.121	80	201.416	106	172.143	132	151.287	158	135.573
3	499.054	29	320.647	55	243.960	81	200.070	107	171.213	133	150.602	159	135.045
4	487.691	30	316.618	56	241.843	82	198.744	108	170.295	134	149.925	160	134.521
5	476.922	31	312.707	57	239.769	83	197.439	109	169.389	135	149.254	161	134.002
6	466.702	32	308.909	58	237.737	84	196.154	110	168.495	136	148.591	162	133.488
7	456.985	33	305.218	59	235.745	85	194.889	111	167.611	137	147.935	163	132.979
8	447.736	34	301.630	60	233.793	86	193.642	112	166.738	138	147.285	164	132.474
9	438.918	35	298.141	61	231.878	87	192.415	113	165.876	139	146.642	165	131.974
10	430.501	36	294.746	62	230.000	88	191.206	114	165.025	140	146.006	166	131.478
11	422.458	37	291.441	63	228.158	89	190.015	115	164.184	141	145.376	167	130.986
12	414.762	38	288.223	64	226.351	90	188.841	116	163.353	142	144.753	168	130.499
13	407.390	39	285.088	65	224.577	91	187.684	117	162.532	143	144.136	169	130.016
14	400.322	40	282.032	66	222.835	92	186.544	118	161.720	144	143.525	170	129.537
15	393.537	41	279.053	67	221.126	93	185.421	119	160.918	145	142.920	171	129.063
16	387.020	42	276.148	68	219.447	94	184.313	120	160.126	146	142.321	172	128.593
17	380.752	43	273.313	69	217.798	95	183.221	121	159.342	147	141.729	173	128.126
18	374.720	44	270.546	70	216.178	96	182.144	122	158.568	148	141.142	174	127.664
19	368.910	45	267.845	71	214.586	97	181.082	123	157.803	149	140.560	175	127.205
20	363.309	46	265.207	72	213.022	98	180.034	124	157.046	150	139.985	176	126.751
21	357.906	47	262.630	73	211.485	99	179.001	125	156.298	151	139.415	177	126.300
22	352.689	48	260.111	74	209.974	100	177.981	126	155.558	152	138.850	178	125.853
23	347.650	49	257.649	75	208.488	101	176.976	127	154.826	153	138.291	179	125.410
24	342.778	50	255.242	76	207.027	102	175.983	128	154.103	154	137.737	180	124.971
25	338.064	51	252.887	77	205.590	103	175.004	129	153.387	155	137.188	181	124.535
26	333.502	52	250.583	78	204.176	104	174.038	130	152.680	156	136.645	182	124.102

P=10 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	571.051	27	367.551	53	279.626	79	229.224	105	196.067	131	172.381	157	154.502
2	558.143	28	362.938	54	277.196	80	227.701	106	195.013	132	171.603	158	153.900
3	545.903	29	358.458	55	274.816	81	226.202	107	193.972	133	170.832	159	153.304
4	534.279	30	354.107	56	272.483	82	224.726	108	192.944	134	170.070	160	152.713
5	523.223	31	349.879	57	270.197	83	223.272	109	191.928	135	169.315	161	152.128
6	512.693	32	345.768	58	267.955	84	221.840	110	190.925	136	168.569	162	151.548
7	502.650	33	341.770	59	265.757	85	220.430	111	189.935	137	167.830	163	150.973
8	493.060	34	337.879	60	263.601	86	219.041	112	188.956	138	167.099	164	150.403
9	483.891	35	334.091	61	261.485	87	217.672	113	187.989	139	166.375	165	149.838
10	475.115	36	330.401	62	259.410	88	216.324	114	187.034	140	165.659	166	149.279
11	466.706	37	326.807	63	257.373	89	214.995	115	186.091	141	164.949	167	148.724
12	458.640	38	323.304	64	255.373	90	213.685	116	185.158	142	164.247	168	148.174
13	450.896	39	319.888	65	253.410	91	212.394	117	184.237	143	163.553	169	147.628
14	443.454	40	316.556	66	251.482	92	211.121	118	183.326	144	162.864	170	147.088
15	436.296	41	313.305	67	249.588	93	209.866	119	182.425	145	162.183	171	146.552
16	429.404	42	310.132	68	247.727	94	208.628	120	181.536	146	161.509	172	146.021
17	422.765	43	307.034	69	245.899	95	207.408	121	180.656	147	160.841	173	145.494
18	416.363	44	304.007	70	244.103	96	206.204	122	179.786	148	160.179	174	144.972
19	410.185	45	301.051	71	242.337	97	205.017	123	178.926	149	159.524	175	144.454
20	404.220	46	298.161	72	240.601	98	203.845	124	178.076	150	158.875	176	143.940
21	398.456	47	295.336	73	238.895	99	202.690	125	177.235	151	158.233	177	143.431
22	392.882	48	292.574	74	237.216	100	201.549	126	176.404	152	157.596	178	142.926
23	387.489	49	289.872	75	235.565	101	200.424	127	175.582	153	156.966	179	142.425
24	382.267	50	287.228	76	233.941	102	199.314	128	174.769	154	156.341	180	141.929
25	377.209	51	284.640	77	232.344	103	198.218	129	173.964	155	155.722	181	141.436
26	372.306	52	282.107	78	230.771	104	197.136	130	173.168	156	155.109	182	140.947

P=20 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	621.793	27	410.742	53	315.058	79	259.139	105	221.980	131	195.275	157	175.040
2	608.863	28	405.784	54	312.379	80	257.438	106	220.793	132	194.395	158	174.358
3	596.544	29	400.964	55	309.753	81	255.763	107	219.622	133	193.524	159	173.682
4	584.793	30	396.276	56	307.178	82	254.114	108	218.465	134	192.662	160	173.012
5	573.569	31	391.713	57	304.652	83	252.489	109	217.322	135	191.809	161	172.349
6	562.835	32	387.272	58	302.175	84	250.888	110	216.193	136	190.965	162	171.691
7	552.560	33	382.947	59	299.743	85	249.310	111	215.077	137	190.130	163	171.039
8	542.712	34	378.732	60	297.357	86	247.756	112	213.975	138	189.303	164	170.393
9	533.265	35	374.625	61	295.015	87	246.224	113	212.886	139	188.484	165	169.752
10	524.194	36	370.620	62	292.716	88	244.714	114	211.810	140	187.674	166	169.117
11	515.475	37	366.714	63	290.458	89	243.226	115	210.746	141	186.871	167	168.488
12	507.087	38	362.903	64	288.241	90	241.758	116	209.695	142	186.077	168	167.864
13	499.012	39	359.183	65	286.062	91	240.311	117	208.656	143	185.291	169	167.245
14	491.231	40	355.551	66	283.922	92	238.884	118	207.629	144	184.512	170	166.632
15	483.728	41	352.004	67	281.819	93	237.477	119	206.614	145	183.741	171	166.024
16	476.487	42	348.538	68	279.751	94	236.089	120	205.610	146	182.977	172	165.421
17	469.495	43	345.151	69	277.719	95	234.720	121	204.618	147	182.221	173	164.823
18	462.738	44	341.840	70	275.721	96	233.369	122	203.637	148	181.472	174	164.230
19	456.203	45	338.602	71	273.756	97	232.036	123	202.666	149	180.730	175	163.642
20	449.881	46	335.435	72	271.824	98	230.721	124	201.707	150	179.995	176	163.059
21	443.759	47	332.336	73	269.923	99	229.423	125	200.758	151	179.267	177	162.481
22	437.829	48	329.303	74	268.053	100	228.142	126	199.819	152	178.546	178	161.908
23	432.080	49	326.335	75	266.213	101	226.878	127	198.890	153	177.832	179	161.339
24	426.505	50	323.428	76	264.403	102	225.630	128	197.972	154	177.124	180	160.775
25	421.095	51	320.581	77	262.621	103	224.397	129	197.063	155	176.423	181	160.216
26	415.843	52	317.791	78	260.866	104	223.181	130	196.164	156	175.728	182	159.661

P=30 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	653.466	27	435.135	53	334.644	79	275.544	105	236.141	131	207.768	157	186.242
2	640.234	28	429.950	54	331.818	80	273.743	106	234.882	132	206.832	158	185.516
3	627.609	29	424.906	55	329.048	81	271.969	107	233.638	133	205.906	159	184.796
4	615.549	30	419.998	56	326.331	82	270.221	108	232.409	134	204.990	160	184.083
5	604.015	31	415.220	57	323.665	83	268.500	109	231.195	135	204.083	161	183.377
6	592.972	32	410.566	58	321.050	84	266.803	110	229.996	136	203.185	162	182.677
7	582.388	33	406.032	59	318.483	85	265.132	111	228.812	137	202.296	163	181.982
8	572.233	34	401.613	60	315.964	86	263.484	112	227.641	138	201.417	164	181.295
9	562.482	35	397.304	61	313.490	87	261.861	113	226.484	139	200.546	165	180.613
10	553.109	36	393.102	62	311.061	88	260.260	114	225.341	140	199.684	166	179.937
11	544.091	37	389.001	63	308.676	89	258.682	115	224.211	141	198.831	167	179.266
12	535.408	38	384.999	64	306.332	90	257.126	116	223.095	142	197.986	168	178.602
13	527.042	39	381.091	65	304.030	91	255.592	117	221.991	143	197.149	169	177.943
14	518.973	40	377.274	66	301.767	92	254.078	118	220.900	144	196.321	170	177.290
15	511.187	41	373.546	67	299.544	93	252.586	119	219.821	145	195.500	171	176.643
16	503.667	42	369.901	68	297.358	94	251.114	120	218.754	146	194.688	172	176.001
17	496.399	43	366.339	69	295.209	95	249.661	121	217.700	147	193.883	173	175.364
18	489.371	44	362.855	70	293.095	96	248.228	122	216.657	148	193.086	174	174.733
19	482.571	45	359.448	71	291.017	97	246.814	123	215.625	149	192.297	175	174.107
20	475.987	46	356.114	72	288.973	98	245.419	124	214.605	150	191.515	176	173.486
21	469.607	47	352.851	73	286.961	99	244.042	125	213.597	151	190.740	177	172.871
22	463.424	48	349.658	74	284.982	100	242.682	126	212.599	152	189.973	178	172.260
23	457.427	49	346.530	75	283.035	101	241.340	127	211.612	153	189.213	179	171.655
24	451.607	50	343.467	76	281.118	102	240.016	128	210.635	154	188.460	180	171.054
25	445.957	51	340.466	77	279.231	103	238.708	129	209.669	155	187.713	181	170.458
26	440.469	52	337.526	78	277.373	104	237.416	130	208.713	156	186.974	182	169.867

P=50 (年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	690.936	27	463.927	53	357.797	79	294.967	105	252.927	131	222.590	157	199.542
2	677.329	28	458.474	54	354.800	80	293.048	106	251.582	132	221.589	158	198.764
3	664.328	29	453.167	55	351.860	81	291.157	107	250.253	133	220.598	159	197.993
4	651.891	30	448.001	56	348.977	82	289.294	108	248.940	134	219.617	160	197.230
5	639.981	31	442.969	57	346.147	83	287.459	109	247.643	135	218.646	161	196.473
6	628.564	32	438.067	58	343.371	84	285.651	110	246.361	136	217.685	162	195.722
7	617.608	33	433.288	59	340.645	85	283.869	111	245.095	137	216.734	163	194.979
8	607.085	34	428.629	60	337.969	86	282.112	112	243.844	138	215.793	164	194.241
9	596.969	35	424.084	61	335.341	87	280.380	113	242.608	139	214.860	165	193.511
10	587.236	36	419.650	62	332.760	88	278.673	114	241.386	140	213.938	166	192.786
11	577.863	37	415.321	63	330.225	89	276.990	115	240.178	141	213.024	167	192.068
12	568.829	38	411.095	64	327.734	90	275.330	116	238.984	142	212.119	168	191.356
13	560.117	39	406.967	65	325.286	91	273.693	117	237.804	143	211.224	169	190.650
14	551.708	40	402.934	66	322.880	92	272.078	118	236.637	144	210.337	170	189.951
15	543.586	41	398.993	67	320.516	93	270.486	119	235.483	145	209.458	171	189.257
16	535.736	42	395.139	68	318.190	94	268.914	120	234.343	146	208.588	172	188.569
17	528.144	43	391.371	69	315.904	95	267.364	121	233.215	147	207.726	173	187.886
18	520.797	44	387.686	70	313.655	96	265.835	122	232.099	148	206.873	174	187.210
19	513.683	45	384.080	71	311.444	97	264.325	123	230.996	149	206.027	175	186.539
20	506.790	46	380.550	72	309.268	98	262.835	124	229.905	150	205.190	176	185.873
21	500.108	47	377.095	73	307.127	99	261.365	125	228.826	151	204.361	177	185.213
22	493.627	48	373.712	74	305.020	100	259.913	126	227.759	152	203.539	178	184.559
23	487.337	49	370.399	75	302.946	101	258.480	127	226.703	153	202.724	179	183.910
24	481.230	50	367.152	76	300.904	102	257.066	128	225.658	154	201.918	180	183.266
25	475.298	51	363.971	77	298.895	103	255.669	129	224.625	155	201.119	181	182.627
26	469.532	52	360.854	78	296.916	104	254.289	130	223.602	156	200.327	182	181.993

P=100(年)

t: 分钟; q: 升/秒/公顷

t	q	t	q	t	q	t	q	t	q	t	q	t	q
1	736.461	27	499.238	53	386.318	79	318.944	105	273.672	131	240.919	157	215.993
2	722.420	28	493.466	54	383.113	80	316.880	106	272.221	132	239.836	158	215.151
3	708.982	29	487.845	55	379.968	81	314.847	107	270.787	133	238.765	159	214.317
4	696.108	30	482.370	56	376.882	82	312.844	108	269.371	134	237.705	160	213.491
5	683.761	31	477.034	57	373.854	83	310.870	109	267.972	135	236.656	161	212.671
6	671.908	32	471.833	58	370.881	84	308.924	110	266.589	136	235.617	162	211.859
7	660.519	33	466.761	59	367.962	85	307.006	111	265.223	137	234.589	163	211.054
8	649.566	34	461.814	60	365.095	86	305.116	112	263.873	138	233.571	164	210.256
9	639.024	35	456.985	61	362.280	87	303.252	113	262.538	139	232.563	165	209.465
10	628.868	36	452.272	62	359.514	88	301.414	114	261.219	140	231.565	166	208.681
11	619.078	37	447.669	63	356.797	89	299.602	115	259.915	141	230.578	167	207.904
12	609.632	38	443.173	64	354.126	90	297.815	116	258.627	142	229.599	168	207.133
13	600.512	39	438.780	65	351.501	91	296.052	117	257.352	143	228.631	169	206.369
14	591.702	40	434.487	66	348.921	92	294.313	118	256.093	144	227.671	170	205.611
15	583.184	41	430.289	67	346.384	93	292.598	119	254.847	145	226.721	171	204.859
16	574.945	42	426.183	68	343.889	94	290.905	120	253.615	146	225.780	172	204.114
17	566.969	43	422.167	69	341.435	95	289.235	121	252.397	147	224.848	173	203.376
18	559.244	44	418.237	70	339.022	96	287.587	122	251.193	148	223.925	174	202.643
19	551.758	45	414.391	71	336.647	97	285.960	123	250.001	149	223.010	175	201.916
20	544.499	46	410.625	72	334.310	98	284.355	124	248.823	150	222.104	176	201.196
21	537.457	47	406.938	73	332.011	99	282.770	125	247.657	151	221.207	177	200.481
22	530.621	48	403.325	74	329.748	100	281.205	126	246.504	152	220.318	178	199.772
23	523.984	49	399.787	75	327.520	101	279.660	127	245.363	153	219.437	179	199.069
24	517.534	50	396.319	76	325.326	102	278.135	128	244.234	154	218.564	180	198.372
25	511.266	51	392.919	77	323.166	103	276.629	129	243.117	155	217.699	181	197.680
26	505.169	52	389.587	78	321.039	104	275.141	130	242.012	156	216.842	182	196.994

