TABLES

FOR

Estimating the Cost of Laying Cast-Iron Water Pipe

OF THE

"PROVIDENCE PATTERN," ETC.

BY

EDMUND B. WESTON,

M. AM. SOC. C. E ; M. INST. C. E.; ENGINEER IN CHARGE OF WATER DEPARTMENT, CITY ENGINEER'S OFFICE, PROVIDENCE, R. I.

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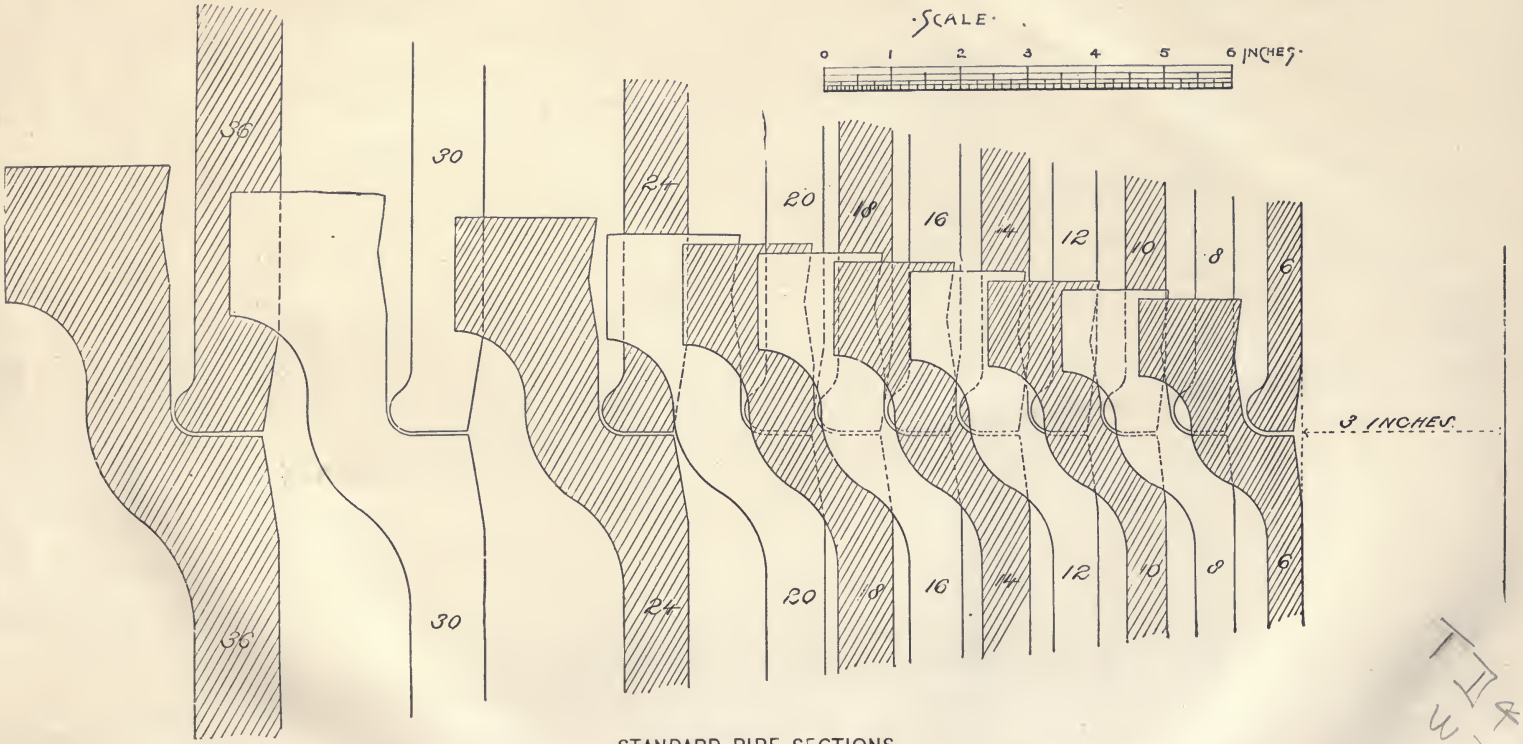

STANDARD PIPE SECTIONS.

Municipal Engineering. Providence, R. I., From Engineering News April 24, 1886.

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M. AM. SOC. C. E.; ASSOC. M. INST. C. E.: ENGINEER IN CHARGE OF WATER DEPARTMENT, CITY ENGINEER'S OFFICE, PROVIDENCE, R. I.

MISCELLANEOUS DATA RELATING TO LAYING WATER PIPE, ETC., NOT INCLUDING THE COST OF THE PIPE.

Ordinary labor was considered at $1.50 per day.

Short lengths.---Total cost of laying 6-in. pipe per lin. ft. from 15 to 50 ft., including excavating and back-filling for the same; in easy digging, $0.34; in medium digging, $0.45.

Extra Excavation.---In easy digging, $0.20 per cu. yd.

Rock.---Average cost of blasting rock per cu. yd., $2.00
Maximum " " " " " 3.00

Bridges.---Cost of crossing bridges, laying pipe, boxing, etc., 12 in., $1.50 per. lin. ft.; cost of crossing bridges, laying pipe, boxing, etc., 8 in. $1.32 per lin. ft.

Railroads.---Cost per lin. ft. of laying 374 ft. of 16-in. pipe that passed under two railroad tracks $0.50.

Work of one man.---The average proportion of work that an ordinary laborer will perform in one day, at excavating, refilling and laying pipe (not including calking, etc.), is as follows:

In easy digging	21	lineal	feet	of	6	inch
" medium "	17.2	"	"	"	"	"
" hard "	10.3	"	"	"	"	"
" easy "	19.3	"	"	"	8	"
" medium "	13.4	"	"	"	12	"
" easy "	9.0	"	"	"	20	"
" medium "	4.4	"	"	"	24	"

Average cost of excavation for a 24-in. pipe.---The average cost of excavating and back-filling in medium digging, for a line of 24-in. pipe 19,416 ft. long (the average depth of the trench being 6.60 ft. in depth), with ordinary labor at $1.50 per day, was $0.32 per cu. yd.

TABLE NO. 1.

WEIGHT OF WATER PIPES, OF THE "PROVIDENCE PATTERN."

Length, 12 ft. over all.

Nominal diameter in ins.	Class.	Thickness of shell in ins.	Length that pipe will lay.	Depth of bell in ins.	Weight in pounds. per running ft. as laid.	Weight in pounds. per running ft. of shell.	Standard weight in lbs.	Greatest proposed head in ft.
4	*a*	13-32	11.83	2.00	19.61	18.11	232	60
	A	7-16	"	"	20.88	19.37	247	100
	b	7-16	"	"	20.88	19.37	247	140
	B	15-32	"	"	22.06	20.61	261	180
	C	15-32	"	"	22.06	20.61	261	220
	D	15-32	"	"	22.06	20 61	261	260
6	*a*	7 16	11.83	2.00	30.25	28.25	358	60
	A	15-32	"	"	32.11	30.12	380	100
	b	½	"	"	33.98	31.99	402	140
	B	½	"	"	33.98	31.99	402	180
	C	17-32	"	"	35.75	33.81	423	220
	D	17-32	"	"	35.75	33.81	423	260
8	*a*	15-32	11.82	2.15	42.64	39.93	504	60
	A	½	"	"	45.09	42.43	533	100
	b	17-32	"	"	47.63	44.92	563	140
	B	9 16	"	"	49.92	47.39	590	180
	C	19 32	"	"	52.53	49.84	621	220
	D	19 32	"	"	52.53	49.84	621	260
10	*a*	½	11.81	2 27	56.13	52.58	663	60
	A	17-32	"	"	59.27	55.70	700	100
	b	9-16	"	"	62.31	58.80	736	140
	B	19-32	"	"	65.37	61.89	772	180
	C	9/8	"	"	68.50	64.95	809	220
	D	21 32	"	"	71.54	68.00	845	260
12	*a*	17-32	11.80	2.40	71.19	66.81	840	60
	A	9-16	"	"	75.00	70.57	885	100
	b	9/8	"	"	82.37	78.02	972	140
	B	21-32	"	"	83.10	81.72	1,016	180
	C	11-16	"	"	89 75	85.40	1,059	220
	D	23-32	"	"	93.47	89.06	1,103	260
16	*a*	19-32	11.78	2.70	105.31	93.77	1,240	60
	A	21-32	"	"	115.28	108.76	1,358	100
	b	11-16	"	"	120.34	113.73	1,417	140
	B	¾	"	"	130.14	123.61	1,533	180
	C	13 16	"	"	139.96	133.41	1,648	220
	D	27-32	"	"	144.88	138.28	1,706	260
20	*a*	21 32	11.75	2.95	145.14	135.80	1,706	60
	A	23-32	"	"	157.62	148.29	1,852	100
	b	25-32	"	"	169.98	160.70	1,998	140
	B	27-32	"	"	182.38	173.05	2,143	180
	C	29-32	"	"	194.99	185.30	2,292	220
	D	31-32	"	"	207.24	197.49	2,436	260
24	*a*	23 32	11.73	3.20	190.83	177.91	2,239	60
	A	13.16	"	"	213.30	200.36	2,502	100
	b	7/8	"	"	228.16	215.24	2,677	140
	B	15 16	"	"	242.97	230.03	2,850	180
	C	1 1-32	"	"	266.00	252.09	3,121	220
	D	1 3-32	"	"	280.66	266.70	3,293	260
30	*a*	13-16	11.70	3.60	269.66	250.33	3,155	60
	A	29-32	"	"	297.78	278.38	3,484	100
	b	1	"	"	325.56	306.25	3,809	140
	B	1 1-16	"	"	344.10	324.74	4,026	180
	C	1 3-16	"	"	382.56	361.48	4,476	220
	D	1 9-32	"	"	409.91	388.83	4,796	260
36	*a*	7/8	11.67	4.00	351.41	323.93	4,101	60
	A	1	"	"	396.49	368.98	4,627	100
	b	1⅛	"	"	441.13	413.72	5,148	140
	B	1¼	"	"	485.60	458.15	5,667	180
	C	1 11-32	"	"	522.07	491.27	6,091	220
	D	1 15-32	"	"	566.04	535.17	6,604	260
48	*a*	1 5-32	11.54	5.50	672.06	569.93	7,295	60
	A	1 5 16	"	"	707.09	644.91	8.161	100
	b	1 15-32	"	"	781.60	719.42	9,021	140
	B	1⅝	"	"	855.68	793.49	9,876	180
	C	1 25-32	"	"	939.20	867.00	10,840	220
	D	1 15-16	"	"	1,012.33	940.10	11,684	260

The thickness of the cast-iron pipes given in this table were calculated by the following formulas:

For diameters greater than 36 ins., $t = .00008\ H\ D + .0125\ D + .33$; for diameters of 36 ins. and less, $t = .00003\ H\ D + .01\ D + .36$; t = thickness in decimals of an inch; D = diameter in inches; H = head in feet.

TABLE No. 2.

ESTIMATED AVERAGE COST PER LINEAL FOOT OF LAYING CLASSES A AND B, OF CAST-IRON WATER PIPE OF THE "PROVIDENCE PATTERN," AND EXCAVATING AND BACK-FILLING FOR THE SAME, IN MEDIUM DIGGING, WHEN THE MARKET VALUE OF THE PIPE, IS AT DIFFERENT RATES PER TON. GATES AND "SPECIALS" ARE INCLUDED, BUT NOT HYDRANTS.

Cost per Ton, and Class.	Diameter of Pipe in inches.											Cost per Ton, and Class.
	4	6	8	10	12	16	20	24	30	36	48	
$25 A.	0.426	0.610	0.789	1.008	1.245	1.839	2.604	3.502	4.949	6.360	11.007	A. $25
$25 B.	0.440	0.635	0.848	1.079	1.377	2.076	2.902	3.855	5.500	7.396	12.735	B. $25
26 A.	0.437	0 627	0.812	1.038	1.283	1.957	2.684	3 608	5.096	6.547	11.341	A. 26
26 B.	0.452	0.653	0.873	1.112	1.420	2.142	2.993	3.975	5.670	7.625	13.138	B. 26
27 A.	0.448	0.644	0.835	1.068	1.320	2.015	2.763	3.714	5.243	6.734	11.675	A. 27
27 B.	0.463	0.671	0.898	1.145	1.463	2.207	3.085	4.095	5.839	7.854	13.541	B. 27
28 A.	0 459	0.651	0.858	1.098	1.358	2.074	2.843	3.819	5.391	6.921	12.009	A. 28
28 B.	0.475	0.689	0.923	1.178	1.506	2.272	3.176	4.215	6.009	8.082	13.944	B. 28
29 A.	0.470	0.678	0.880	1.128	1.396	2.132	2.923	3.925	5.538	7.109	12.343	A. 29
29 B.	0.486	0.707	0.948	1.211	1.550	2.338	3.268	4.334	6.178	8.311	14.347	B. 29
30 A.	0 481	0.695	0.903	1.153	1.434	2.190	3.002	4.030	5.686	7 296	12.677	A. 30
30 B.	0.493	0.725	0 973	1.214	1.593	2.403	3 359	4.454	6.348	8.540	14.750	B. 30
31 A.	0.492	0.712	0.926	1.188	1.472	2.248	3.082	4.136	5.833	7 483	13.011	A. 31
31 B.	0.510	0.743	0.998	1.276	1.636	2.468	3.451	4.574	6.517	8.768	15.154	B. 31
32 A.	0.503	0.729	0.948	1.213	1.510	2.307	3.162	4 241	5.980	7.671	13.345	A. 32
32 B.	0.521	0.761	1.023	1.309	1.679	2.534	3.542	4.693	6.686	8.997	15.557	B. 32
33 A.	0.514	0.746	0.971	1.248	1.548	2.365	3 211	4.347	6.128	7 858	13.679	A. 33
33 B.	0.533	0.779	1.048	1.342	1.722	2.599	3.634	4.813	6.856	9.226	15.960	B. 33
34 A.	0.525	0.762	0.994	1.278	1.586	2.423	3.321	4 453	6.275	8.045	14.013	A. 34
34 B.	0.544	0.797	1.073	1.375	1 765	2.664	3 726	4.933	7.025	9.454	16.363	B. 34
35 A.	0.536	0.779	1.017	1.308	1.624	2.481	3 400	4.558	6 423	8 232	14.347	A. 35
35 B.	0.556	0 815	1.098	1.408	1.809	2.730	3.817	5.052	7.1 5	9.683	16 766	B. 35
36 A.	0.547	0.795	1.039	1.338	1.662	2.540	3.480	4 664	6.570	8.420	14.681	A. 36
36 B.	0.568	0.833	1.121	1.440	1.852	2.795	3.909	5.172	7 364	9.9:2	17.169	B. 36
37 A.	0.558	0.813	1.032	1.368	1.699	2.598	3.569	4.769	6 717	8.607	15.015	A. 37
37 B.	0.579	0.851	1.149	1.473	1 895	2.869	4.000	5.292	7.534	10.141	17.572	B. 37
38 A.	0.570	0.830	1.085	1.398	1.737	2.653	3.639	4.875	6.865	8 794	15.349	A. 38
38 B.	0.591	0 869	1.171	1.503	1.938	2.926	4.092	5 412	7.703	10.369	17.975	B. 38
39 A.	0.581	0.847	1 108	1.427	1.775	2 714	3.719	4.981	7.012	8.981	15.683	A. 39
39 B.	0.602	0.837	1.199	1.539	1.981	2.991	4.183	5.531	7.873	10.598	18.579	B. 39
40 A.	0.592	0.864	1.130	1.457	1.813	2.773	3.798	5.086	7 160	9.169	16.017	A. 40
40 B.	0.614	0.905	1.224	1.572	2.025	3.056	4.275	5.651	8.042	10.827	18.782	B. 40
41 A.	0.603	0.881	1.153	1.487	1.851	2.831	3.878	5.192	7.307	9.356	16.351	A. 41
41 B.	0.625	0.923	1.249	1.605	2.068	3.122	4.366	5 771	8.211	11.055	19.185	B. 41
42 A.	0.614	0 893	1.176	1.517	1.889	2.889	3.958	5.297	7.454	9.543	16 685	A. 42
42 B.	0.637	0.941	1.274	1.637	2.111	3.187	4.458	5.890	8.281	11.284	19 588	B. 42
43 A.	0.625	0.915	1.198	1.547	1.927	2.947	4.037	5 403	7.702	9.731	17 019	A. 43
43 B.	0.649	0 959	1.299	1.670	2.154	3.252	4.519	6.010	8.550	11 513	19.991	B. 43
44 A.	0.636	0.932	1.221	1.577	1.965	3.005	4.117	5.508	7.749	9.918	17.353	A. 44
44 B.	0.660	0.977	1.324	1.703	2.197	3.318	4.611	6.130	8.720	11.741	20.394	B. 44
45 A.	0.647	0.949	1.244	1.607	2.003	3.064	4.137	5.614	7.896	10.105	17 687	A. 45
45 B.	0.672	0.995	1.349	1.733	2.241	3.383	4.732	6 249	8 889	11 970	20 797	B. 45
46 A.	0.658	0.966	1 237	1.647	2.040	3 122	4.276	5 720	8 044	10 292	18 021	A. 46
46 B.	0 684	1.013	1.374	1.769	2.284	3.448	4.824	6 369	9 059	12 199	21.200	B. 46
47 A.	0.669	0.983	1.289	1.687	2.078	3 180	4.356	5 824	8 191	10 480	18 355	A. 47
47 B.	0.695	1.031	1 390	1.812	2.327	3.514	4.915	6 489	9.228	12 428	21 604	B. 47
48 A.	0.680	1.0 0	1.312	1.697	2 116	3.:39	4 435	5 931	8 339	10 667	18 6:0	A. 48
48 B.	0.707	1 029	1.424	1.834	2.370	3.579	5 007	6 609	9.398	12 656	22 007	B. 48
49 A.	0.691	1.017	1.335	1.727	2.154	3.297	4.515	6 036	8 486	10 854	19 024	A. 49
49 B.	0 718	1 037	1.449	1.867	2.413	3.644	5 098	6 728	9 567	12 885	22 410	B. 49
50 A.	0 702	1.034	1 358	1.757	2.192	3.355	4 595	6 142	8 633	11 041	19 358	A. 50
50 B.	0.730	1.085	1.475	1.903	2 456	3 719	5 196	6 848	9 737	13.114	22 813	B. 50

The thickness of the Class A pipe was based upon a static pressure of 106 ft., and the Class B pipe upon a static pressure of 180 ft.

The figures include the cost of pipe, gates and "specials," the cost of carting, laying and setting, and excavating and back-filling for the same, and all other expenses generally incurred in ordinary water pipe laying, with the exception of the cost of hydrants.

The cost of "specials" was based upon $0.025 per pound, with pipe at $30 per ton, the cost of air-cocks (used only with pipes having a diameter larger than 20 in.), at $10 each, and the cost of the gates the same as given in Table No. 3.

Ordinary labor was considered at $1.50 per day.

Depth of Pipe.—The depth of the axis of the pipe below the surface of the ground has been considered in all cases as 4.67 ft.

TABLE No. 3.

OR ESTIMATING THE COST IN DETAIL OF LAYING CAST-IRON WATER PIPE OF THE "PROVIDENCE PATTERN," AND EXCAVATING AND BACK-FILLING FOR THE SAME.

Diameter of pipe in inches.	Cost per lineal foot of laying pipe, etc.				Cost of pipe per lineal foot at $1.00 per ton.						Per cent. of the cost of pipe to be added for "specials."†	Cost of gates and boxes. (including carting).			Lead per joint (calculated).		Diameter of pipe in inches.
	Excavation.	Labor. $	Lead * $	Total. $	Class a. h = 60.	Class A. h = 100.	Class b. h = 140.	Class B. h = 180.	Class C. h = 220.	Class D. h = 260.		Gates. $	Boxes. @ $0.03.	Total. $	Width in inches.	Weight in pounds.	
4	Easy	.0976	.0224	0.120	.0038	0093	.0093	0098	0098	.0098	5.12	13.00	5.75	18.75	1⅛	3.31	4
	Medium	.1276		0.150													
	Hard	.1726		0.195													
6	Easy	.1234	.0320	0.155	.0135	0143	.0152	.0152	0160	0160	5.12	21.25	5.75	27.00	1⅛	4 73	6
	Medium	.1534		0.185													
	Hard	.1984		0.230													
8	Easy	.1480	.0431	0.191	.0190	.0201	.0213	.0223	.0235	0235	5.12	28.25	7.25	35.50	1¼	6.58	8
	Medium	.1779		0.221													
	Hard	.2230		0.266													
10	Easy	.1733	.0553	0.229	.0251	.0265	.0278	.0292	.0306	.0319	5.12	45.50	7.25	52.75	1⅜	8.56	10
	Medium	.2033		0.259													
	Hard	.2483		0.304													
12	Easy	.1992	.0683	0.268	.0318	.0335	.0368	0384	.0401	0417	5.12	56.50	7.25	63.75	1⅜	10.84	12
	Medium	.2292		0.298													
	Hard	.2825		0.351													
16	Easy	.3132	.0950	0.408	.0470	0515	.0537	0581	0621	.0647	5.12	107.00	28.00	135.00	1⅝	15.85	16
	Medium	.3524		0.447													
	Hard	.4360		0.525													
20	Easy	.4399	.1203	0.560	.0648	.0704	.0759	.0814	.0871	.0926	3.98	169.00	28.00	197.00	1⅞	21.14	20
	Medium	.4827		0.613													
	Hard	.5931		0.713													
24	Easy	.6429	.1600	0.803	.0852	.0952	.1019	.1085	.1188	.1253	3.98	242.00	28.00	270.00	2	28.33	24
	Medium	.7033		0.863													
	Hard	.8450		1. 05													
30	Easy	.9620	.2093	1.171	.1204	.1329	.1453	.1536	.1708	1830	3.98	423 00	28.00	451.00	2¼	37.32	30
	Medium	1.055		1.264													
	Hard	1.2 6		1.478													
36	Easy	1.277	.2783	1.555	.1569	.1770	.1969	.2168	.2331	.2527	2.20	764.00	28.00	792.00	2⅛	50.45	36
	Medium	1.100		1.678													
	Hard	1.680		1.958													
48	Easy	1.917	.5570	2.474	.2822	.3157	.3489	.3820	.4193	.4519	2 20	1,526.00	28.00	1,554.00	3	105.83	48
	Medium	2.100		2.657													
	Hard	2.517		3.074													

The price of the **"Providence Flush Hydrants"** is for each, including carting, $150.00. The price of 4-inch **Post Hydrants** (which are sometimes used for special purposes) is for each including gate, connection and carting, $55.00.

*The figures in this column allow for extra joints and an excess of 25 per cent, over the calculated weight.

†The figures in this column are necessarily approximate. The cost of specials in detail is given in Table No. 4.

The figures under the head of **labor** include all work relative to the laying of the pipe and "specials," and setting gates and hydrants, etc., such as excavating and back-filling, laying and calking pipe, etc., blocks and wedges for pipes having diameters larger than 20 ins., carting pipes, specials and hydrants, etc., and cleaning up the streets after the work has been completed, and all other expenses generally incurred in ordinary water-pipe laying, which is not mentioned elsewhere in detail in the table.

The h's in the columns relating to the cost of pipe at $1.00 per ton indicate the greatest static pressure under which the pipe is to be used. The percentage of the cost of **specials** was based upon $0.025 with pipe at $30.00 per ton, and the cost of **air cocks**, which are included in this percentage for pipes having diameters larger than 20 ins. at $10.00.

The cost of lead was considered at $0.05 per pound and ordinary labor at $1.50 per day.

TABLE NO. 4.

WEIGHT AND COST OF SPECIAL CASTINGS, ETC.

To be used in connection with Table No 3 when greater accuracy with regard to "specials" is required.

Nature of "special" (in inches).	Length that "special" will lay.	Weight in pounds.	Cost at $.03 per pound.
Branches.	Feet.		$
6 × 4	3.22	190	5.70
6 × 6	3.22	190	5.70
6 × 6 × 6	3 22	235	7.05
6 × 8	3.22	218	6.54
6 × 6 × 8	3 22	265	7.95
8 × 4	3.20	239	7 17
8 × 6	3.20	243	7.29
8 × 8	3.56	287	8.61
8 × 8 × 8	3 20	362	10.86
8 × 8 × 6	3.20	315	9.45
8 × 6 × 6	3.20	284	8.52
10 × 6	3 36	353	10.59
10 × 6 × 6	3.36	360	10.80
10 × 8 × 6	3.36	426	12.78
10 × 8	3.36	356	10.68
10 × 8 × 8	3.36	446	13.38
12 × 6	3.22	394	11.82
12 × 6 × 6	3.22	469	14.07
12 × 8 × 6	3.22	581	17.43
12 × 8	3.22	428	12.84
12 × 8 × 8	3.22	481	14.43
12 × 10	3.39	535	16.05
12 × 12	3.22	453	13.59
16 × 6	3.03	588	17.64
16 × 6 × 6	3.03	660	19.80
16 × 8 × 6	3.03	661	19.83
16 × 8	3.20	641	19.23
16 × 8 × 8	3.20	733	21.99
16 × 10	3.20	638	19 14
16 × 12	3.20	627	18.81
16 × 12 × 12	3.20	800	24.00
16 × 16	3.20	845	25.35
20 × 6	4.84	1123	33.69
20 × 6 × 6	4.84	1202	36.06
20 × 8	4.84	1183	35.49
20 × 8 × 6	4.84	1190	35.70
20 × 10	4.84	1112	33.36
20 × 10 × 8	4.84	1250	37.50
20 × 12	4.84	1233	36.99
20 × 16	4.84	1383	41.49
24 × 6	4.53	1082	32.46
24 × 6 × 6	4.53	1153	43.59
24 × 8	4.53	1345	40.35
24 × 8 × 8	4.53	1540	46.20
24 × 10	4.53	1463	43.89
24 × 12	4.53	1408	42.24
24 × 16	4.53	1537	46.11
24 × 24	4.53	1656	49.68
30 × 6	5.04	1955	58.65
30 × 8	5.04	1980	59.40
30 × 8 × 6	5.04	2150	64.50
30 × 8 × 8	5.04	2145	64.35
30 × 10	5.04	2078	62.34
30 × 12	5.04	2048	61.44
30 × 12 × 8	5.04	2210	66 30
30 × 16	5.04	2290	68.70
30 × 20	5.04	2288	68.64
30 × 24	5.04	2560	71.80
30 × 24 × 12	5.04	2695	80 85
30 × 30	5.04	2478	74.34
Blow offs....			
24 × 6	4.53	1377	41.31
30 × 8	5.04	2055	61.65
Manholes....			
24	4.53	1625	48.75
30	5.04	2020	60.60
36	4.00	2015	60.45
Hydrant		1010	
Hydrant box		491	14.73
Frame and cover.....		102	3.06

Nature of "special" (in inches).	Length that "special" will lay.	Weight in pounds.	Cost at $.03 per pound.
Reducers.	Feet.		$
6 to 4	1 63	65	1 95
8 to 6	1.95	105	3.15
10 to 8	1.65	148	4 44
12 to 8	2.61	205	6.15
16 to 12	2.70	338	10.14
20 to 16	4.17	863	25.89
24 to 12	4.59	923	27.69
30 to 24	3.04	1158	34.74
Turns.			
4—1-16	1.55	48	1.44
4—⅛	1.33	47	1.41
4—¼	1.89	61	1.83
6—1-16	1.58	90	2.70
6—⅛	1.42	92	2.76
6—¼	1.38	109	3.27
8—1-16	3.57	233	6.99
8 -⅛	3.32	239	7.17
8—¼	2.25	136	4.08
10—1-16	3.48	291	8.73
10—⅛	3.23	296	8.88
12 - ⅛	3.22	443	13.29
Bevel hubs			
6	1 75	90	2.70
8	1.74	130	3.90
10	3.93	316	9.48
12	1.72	219	6.57
Spig't caps			
6		39	1.17
8		57	1.71
10		78	2.31
12		110	3.30
16		155	4.65
Bell caps.			
6		41	1.23
8		63	1.89
10		78	2.34
12		118	3.54
16		160	4.80
20		220	6.60
24		342	10.26
30		548	16.44
Plugs.			
4		10	.30
6		15	.45
8		27	.81
12		67	2.01
Sleeves.			
4		38	1.14
6		56	1.68
8		80	2.40
10		107	3.21
12		131	3.93
16		207	6.21
20		319	9.57
24		457	13.71
30		637	19.11
36		907	27.21
Gate boxes			
Large "		689	20.67
" rings.		142	4.26
" cov'rs		83	2 49
Small box (6")		137	4.11
" cover (6")		19	.57
" box (8")		160	4.80
" cover (8")		38	1.14

TABLE No. 5.

COST IN DETAIL OF LAYING WATER PIPE OF THE "PROVIDENCE PATTERN," INCLUDING EXCAVATING AND BACK-FILLING FOR THE SAME.

Excavation (Easy Digging).

Items.	Diameter in inches.								Average prices of labor, etc.
	4	6	8	10	12	13	20	24	
1 Trenching	.0422	.0518	.0611	.0707	.0798	.1445	.2088	.....	$1.50
2 Laying	.0129	.0162	.0191	.0219	.0249	.0370	.0497	.....	1.50
3 Foreman	.0130	.0158	.0188	.0216	.0244	.0303	.0360	.....	3.00
4 Tools, etc., etc	.0041	.0050	.0059	.0069	.0078	.0134	.0191	.....	7.4% of 1 and 2.
5 Calking	.0106	.0107	.0108	.0111	.0118	.0159	.0301	.....	$2.25
6 Lead	.0224	.0320	.0431	.0553	.0683	.0950	.1203	.....	5c. per pound.
7 Teams	.0070	.0090	.0115	.0136	.0160	.0203	.0216	.....	$2.25
8 Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.....	$1 per ton.
Total	.1200	.1554	.1911	.2286	.2676	.4082	.5602	.....	

Cost of Easy Digging reduced to $1 and 1c.

Trenching	0281	.0345	.0407	.0471	.0532	.0963	.1392	...	$1.00
Laying	.0086	.0108	.0127	.0146	.0166	.0247	.0331	.....	1.00
Foreman	.0043	.0053	.0063	.0072	.0081	.0101	.0120	.....	1.00
Tools, etc., etc	.0006	0007	.0008	.0009	.0011	.0018	.0026	.....	1%
Calking	.0047	.0047	.0048	.0049	.0052	.0071	.0134	.....	$1.00
Lead	.0045	.0064	.0086	.0111	.0137	.0190	.0241	.....	.01
Teams	.0031	.0040	.0051	.0060	.0071	.0090	.0096	.....	1.00
Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.....	1.00

Excavation (Medium Digging)

1 Trenching	.0597	.0697	.0790	.0883	.0974	1700	.2400	.3091	$1.50
2 Laying	.0189	.0220	.0249	.0279	.0307	.0440	.0577	.0639	1.50
3 Foreman	.0180	.0206	.0234	.0265	.0294	.0350	.0373	.0395	3.00
4 Tools, etc., etc	.0056	.0065	.0075	.0084	.0093	0154	.0214	.0602	7.2% of 1 and 2*
5 Calking	.0106	.0107	.0108	.0111	.0118	.0159	.0301	.0757	$2.25
6 Lead	.0224	.0320	.0431	.0553	.0683	.0950	.1203	.1600	5c. per pound.
7 Teams	.0070	.0090	.0115	.0136	.0160	.0203	.0216	.0228	$2.25
8 Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.1317	$1 per ton.
Total	.1500	.1854	.2210	.2586	2975	.4474	.6030	.867 0	

Cost of Medium Digging reduced to $1 and 1c.

Trenching	.0331	.0465	.0527	.0589	.0694	.1133	.1600	.2061	$1.00
Laying	.0126	.0147	.0166	.0186	.0205	.0293	.0385	.0426	1.00
Foreman	.0060	.0069	.0078	.0088	.0098	.0117	.0124	.0132	1.00
Tools, etc., etc	.0008	.0009	.0010	.0012	.0013	.0021	.0030	.0037	1%*
Calking	0047	.0047	.0048	.0049	.0052	.0071	.0134	.0336	$1.00
Lead	.0045	.0064	.0086	.0111	.0137	.0190	.0241	.0320	.01
Teams	.0031	.0040	.0051	.0060	.0071	.0090	.0096	.0101	1 00
Carting	.0078	.0149	.0208	.0275	.0346	.0518	.0746	.1317	1.00

Excavation (Hard Digging).

1 Trenching	.0860	.0959	.1053	.1147	.1300	.2261	.3264	.....	$1.50
2 Laying	0271	.0303	0333	.0362	.0411	.0530	.0669	.....	1.50
3 Foreman	.0260	.0286	.0314	.0343	.0372	.0428	.0452	.....	3.00
4 Tools, etc., etc	.0081	.0090	.0099	0109	.0118	.0201	.0283	.....	7.2% of 1 and 2
5 Calking	.0106	.0107	.0108	.0111	.0118	.0159	.0301	.....	$2.25
6 Lead	.0224	.0320	.0431	.0553	.0683	.0950	.1203	.....	5c. per pound.
7 Teams	.0070	.0090	.0115	.0136	.0160	.0203	.0216	.....	$2.25
8 Carting	.0078	.0149	.0208	.0275	.0346	.0513	.0746	.....	$1 per ton.
Total	.1950	.2304	.2661	.3036	.3508	.5250	.7134	.....	

Cost of Hard Digging reduced to $1 and 1c.

Trenching	.0573	.0639	.0702	.0765	.0867	.1507	.2176	.....	$1 00
Laying	.0181	0202	.0222	.0241	.0274	.0353	.0446	.....	1.00
Foreman	.0087	.0095	0105	.0114	.0124	.0143	.0151	.....	1.00
Tools, etc., etc	.0011	.0013	.0014	.0015	.0016	.0028	.0039	.....	1%
Calking	.0047	0047	.0048	.0049	.0052	.0071	.0134	.....	$1.00
Lead	.0045	.0064	.0086	.0111	.0137	.0190	.0241	.....	.01
Teams	.0031	.0040	.0051	.0060	.0071	.0090	.0096	.....	1.00
Carting	.0078	.0149	0208	.0275	.0346	.0518	.0746	.....	1.00

* The percentage for 24-inch includes blocks and wedges, and is 16·1%.

This table, No. 5, contains the items in detail from which the cost of the labor of laying water pipe, from 4 to 24 in. in diameter, given in Table No. 3, were obtained.

The word "Trenching" is used for excavating and back-filling.

Throughout these tables **Easy Digging** is intended to correspond to excavation in sand, etc.; **Medium Digging** to excavation in sand and gravel, etc.; and **Hard Digging** to excavation in hard or moist clay, etc. The figures relating to medium excavation are probably the most reliable for pipes that have a diameter greater than 8 ins.

The prices given in any of the tables do not include the cost of engineering and inspection.

SUPPLEMENT TO TABLES NOS. 2, 3, AND 5.

The following table gives the items of the actual cost of the labor of laying water pipe and excavating and back-filling for the same, upon which Tables Nos. 2, 3 and 5 were based, with the exception of the cost of carting pipe, which was considered at $1.00 per ton. The table also shows a comparison of the items of actual cost with the amounts that correspond to them in Tables Nos. 2, 3 and 5. The table was computed from records kept in Providence, with the exception of the data that refers to the 48-inch pipe, which was obtained elsewhere.

Length of pipe used in feet.	Excavating, back-filling and laying.				3. Calking.	4. Teaming	Total of 1, 2, 3 and 4.	Total corresponding to 1, 2, 3 and 4, from Table No. 5, etc.
	1.‡ Excavating, etc.	2.‡ Laying, etc.	Total of 1 and 2.	Total corresponding to 1 and 2 from Table No. 5, etc.				
				4-inch, Medium Digging.				
1,214	.....	.....	$.09460	$.09660	$.01300	$.00650	.....	.....
Ave., etc..	.....	.....	$.09460	$.09660	$.01300	$.00650	$.11410	$.11420
				6-inch, Easy Digging.				
480	$.06781	$.00959	.....	.....	$.00938	$.01171	.....	.....
422	.10147	.02177	.....	.....	.01173	.01173	.....	.....
380	.06374	.02253	.....	.....	.01067	.01067	.....	.....
533	.07576	.01444	.....	.....	.01098	.01098	.....	.....
201	.09127	.01975	.....	.....	.00564	.01237	.....	.....
378	.06874	.02063	.....	.....	.01518	.01518	.....	.....
401	.06039	.01376	.....	.....	.00899	.01011	.....	.....
416	.07416	.01696	.....	.....	.01083	.01083	.....	.....
364	.05818	.01922	.....	.....	.00925	.00928	.....	.....
181	.08057	.01362	.....	.....	.01373	.01373	.....	.....
320	.05778	.01906	.....	.....	.01053	.01056	.....	.....
711	.05108	.01293	.....	.....	.00854	.00886	.....	.....
545	.05771	.01686	.....	.....	.00950	.00872	.....	.....
1,501	.07488	.02037	.....	.....	.00480	.00524	.....	.....
228	.07017	.01211	.....	.....	.00294	.00496	.....	.....
265	.06566	.01389	.....	.....	.00426	.00423	.....	.....
485	.05567	.01136	.....	.....	.00324	.00326	.....	.....
266	.05677	.01038	.....	.....	.00338	.00338	.....	.....
442	.06193	.01040	.....	.....	.00355	.00358	.....	.....
Ave., etc..	$.06825	$.01577	$.08402	$.08380	$.00827	$.00891	$.10120	$.10350
				6-inch, Medium Digging.				
526	$.09366	$.02319	.....	.....	$.01198	$.01198	.....	.....
666	.08989	.01477	.....	.....	.01117	.00981	.....	.....
242	.04996	.01901	.....	.....	.00930	.01115	.....	.....
732	.07204	.01883	.....	.....	.00922	.01014	.....	.....
727	.10241	.01264	.....	.....	.01362	.01208	.....	.....
144	.12185	.04756	.....	.....	.02027	.02034	.....	.....
318	.14775	.01448	.....	.....	.01416	.00919	.....	.....
164	.06288	.01413	.....	.....	.00960	.00966	.....	.....
428	.06301	.01998	.....	.....	.01157	.01157	.....	.....
1,039	.09476	.01625	.....	.....	.01474	.01278	.....	.....
138	.06594	.02638	.....	.....	.01138	.01145	.....	.....
597	.05717	.01540	.....	.....	.01131	.01040	.....	.....
129	.10310	.02155	.....	.....	.01566	.01217	.....	.....
131	.08992	.01637	.....	.....	.01055	.01055	.....	.....
311	.07180	.01479	.....	.....	.00868	.00868	.....	.....
273	.14300	.02817	.....	.....	.01564	.01399	.....	.....
406	.08701	.02227	.....	.....	.00999	.00777	.....	.....
Ave., etc..	$.08918	$.02034	$.10952	$.11230	$.01333	$.01140	$.13425	$.13200

Supplement to Tables Nos. 2, 3, and 5. (Continued.)

Length of pipe used in feet.	Excavating, back-filling and laying.				3 Calking.	4. Teaming	Total of 1, 2, 3 and 4.	Total corresponding to 1, 2, 3 and 4, from Table No. 5, etc.
	1.‡ Excavating, etc.	2.‡ Laying, etc.	Total of 1 and 2.	Total corresponding to 1 and 2 from Table No. 5, etc.				
				6-inch, Hard Digging.				
265	$.08276	$.02301	.....	.....	$.01275	$.01698	.....	.....
307	.14378	.01645	.....	.....	.01098	.01101	.....	....
Ave., etc..	$.11327	$.01973	$.13300	$.15480	$.01186	$.01399	$.15885	$.17450
				8-inch, Medium Digging.				
496	$.08794	$.02458	.....	.....	$.00907	$.00544	.....	....
3,743	.06898	.01654	.....	.....	.00541	.00421	.....	.....
529	.07656	.01272	. .	....	.00425	.....	.....	.....
82	.03756	.01122	.....	....	.01098	.....	.....	.....
Ave., etc..	$.08276	$.01626	$.09902	$.12730	$.00743	$.00483	$.11130	$.14960
				8-inch, Hard Digging.				
157	$.12540	$.02924	.....	.....	$.02147	$.01433	.....	.....
Ave., etc	$.12540	$.02924	$.15464	$.17000	$.02147	$.01433	$.19044	$.19230
				12-inch, Easy Digging.				
1,255	$.09207	$.02388	.....	..	$.01147	$.00609	.....	.....
Ave., etc	$.09207	$.02388	$.11595	$.12910	$.01147	$.00609	$.13351	$.15690
				12-inch, Medium Digging.				
1,132	$.09627	$.01595	$.11220	.....	$.01193	$.00569	.....	.....
2,161	.....	.....	.12400	.....	....	.01030	.....	.....
4,283	.....	.....	.10070	.....	.....	.01650	.....	....
1,785	.....	.....	.13350	.....	.....	.....	....	.....
589	....	.....	.16930	.. ..	.....	.0210)	.....	.. ....
Ave., etc..	.....	.....	$.13394	$.15750	$.01193	$.01337	$.15920	$.18530
				16-inch, Medium Digging.				
374	$.22818	$.04904	$.27720	.....	$.02107	$.02045	.....	.....
2,839	.....	... ..	.25830	..... .	.....	.01820	.....	.....
Ave., etc..	.....	.....	$.26780	$.24900	$.02107	$.01933	$.30820	$.28520
				20-inch, Easy Digging.				
242	$.15876	$.04417	.....	.....	$.02508	$.02513	.....	....
1,450	.15820	.06383	.....	.....	.03010	.04310	.....	.....
Ave., etc..	$.15848	$.05400	$.21250	$.29450	$.02759	$.03411	$.27420	$.34620
				24-inch, Medium Digging. *(1)				
19,416	$.32820	$.07310	.....	.....	$.07570	$.02280	.....	.....
Ave , etc..	$.32820	$.07310	$.40130	$.41260	$.07570	$ 02280	$.49980	$.51110

Supplement to Tables Nos. 2, 3, and 5. (Continued.)

Length of pipe used in feet.	Excavating, back-filling and laying				3. Calking.	4. Teaming	Total of 1, 2, 3 and 4.	Total corresponding to 1. 2, 3 and 4, from Table No. 5, etc.
	1.‡ Excavating, etc.	2.‡ Laying, etc.	Total of 1 and 2.	Total corresponding to 1 and 2 from Table No. 5, etc.				
24-inch, Medium Digging (2.)								
19,416	$.36940	$.08180	.....	.....	$.07570	$.02280	.....	.....
Ave., etc..	$.36940	$.08180	$.45120	.....	$.07570	$.02280	$.54970	.....
30-inch, Easy Digging.								
561	.....	.....	$.37000	.....	$.08420	.....	.....	.....
Ave., etc..	.....	.....	$.37000	.....	$.08420	.....	.....	.....
48-inch, Medium Digging.								
.....	.....	.....	$1.950†	$1.650†	.....	.....	.....	.....

‡ Including foreman.

* (1) Reduced by proportion to correspond to a depth of 4.67, from (2) 5.43 feet the actual depth.

† These figures include calking. The $1.95 is based upon ordinary labor at $1.75 per day, and $2.00 per day for laying. The $1.65 is based upon labor at $1.50 per day, and was reduced by proportion from $1.95, assuming that the number of layers was as 1-10 the number of other laborers.

TABLE NO. 6.

COMPARISON BETWEEN THE TOTAL COST PER LINEAL FOOT OF THE LABOR OF LAYING WATER PIPE AND EXCAVATING AND BACK-FILLING FOR THE SAME, ETC., GIVEN IN THE PRECEDING TABLES, FOR MEDIUM DIGGING, AND WHAT THE TOTAL COST WOULD BE IF THE TRENCHING, ETC., HAD BEEN BASED UPON $0.30 PER CUBIC YARD INSTEAD OF THE AMOUNTS CHARGED TO TRENCHING, ETC., IN TABLE NO. 5. THE COST OF LAYING, ETC., HAS BEEN CONSIDERED THE SAME IN BOTH CASES.

Diameter of pipe in inches.	At $0.30 per cubic yard.			From Table No. 5.			Difference from the amounts in Table No 5.
	Laying, etc.	Trenching, etc.	Total.	Laying, etc.	Trenching, etc.	Total.	
4	$.0676	$.1382	$.2058	$ 0676	$.0833	$.1509	+$.0549
6	.0886	.1506	.2392	.0886	.0968	.1854	+ .0538
8	.1099	.1632	.2731	.1099	.1111	.2210	+ .0521
10	.1334	1758	.3092	.1334	.1252	.2586	+ .0506
12	.1583	.1890	.3474	.1583	.1392	.2975	+ .0498
16	.2235	.2160	.4395	.2235	.2239	.4474	- .0079
20	.3035	.2447	.5482	.3035	.3154	.6189	- .0707
24	.4876	.2742	.7618	.4876	.3754	8630	- .1012

In this table, under the division headed "At $0.30 per Cubic Yard," the cost per lineal foot of **Trenching**, etc., is based upon the excavation at $0.30 per cubic yard, measured in the trench, instead of the actual cost, and takes the place of the amounts charged in Table No. 5, for medium digging, to trenching, teaming, and ⅜ the amount charged to foreman and tools, etc. (exclusive of the cost of blocks and wedges, which are included in the cost of Tools, etc., for 24-inch pipe, in Table No. 5). The figures relating to laying, etc., are the same as those charged in Table No. 5 for medium digging, to laying, calking, lead, carting, and ⅛ the amount charged to foreman and tools, etc. (exclusive of the cost of blocks and wedges, which are included in the cost of tools, etc., for 24-inch pipe, in Table No. 5). In each instance, in calculating the cubic contents of the trench, the width was considered as 2 feet more than the diameter of the pipe and ⅓ of a foot deeper than the water line of the same.

TABLE NO. 7.

AMOUNT PER LINEAL FOOT TO BE ADDED TO THE FIGURES GIVEN IN THE PRECEDING TABLES FOR RELAYING PAVING, ETC., IN CASES WHEN THE STREETS ARE PAVED BEFORE THE WATER PIPE IS LAID.

Diameter of pipe in inches	4	6	8	10	12	16	20	24	30	36	48
Cobble stones	$0.12	$0.12	$0.12	$0.13	$0.13	$0.14	$0.16	$0.17	$0.18	$0.20	$0.23
Granite blocks laid upon a sand foundation	0.18	0.18	0.18	0.19	0.20	0.22	0.24	0.25	0.27	0.30	0.35
Granite blocks, concrete foundation, joints filled with pea gravel and asphaltum	0.93	0.96	1.01	1.05	1.09	1.18	1.32	1.37	1.50	1.64	1.91

The cost of a square yard of **broken stone** 8 ins. thick, put properly in place in a street, would be about $0.40.

The figures in this table were based upon a **trench** 3 ft. wider at the surface of the ground than the diameter of the pipe, in order to allow for caving, etc.

The cobble stone paving was considered at $0.30 per square yard, the granite blocks laid upon sand foundation at $0.45 per square yard, and the granite blocks laid upon a concrete foundation, etc., at $2.46 per square yard. The granite blocks were estimated to lay from 24 to 27 per square yard.

TABLE NO. 8.

AVERAGE COST OF LAYING LEAD SERVICE PIPE, INCLUDING EXCAVATING AND BACK-FILLING FOR THE SAME.

Tap and stop.		Pipe per lineal foot.			
				Laying, etc., etc., including pipe.	
Diameter.	Tap, stop, etc., including tapping.	Diameter.	Weight.	Lead pipe.	Tin-lined lead pipe.
⅜ inch.	$6.00	½ inch.	3.00 pounds.	$0.34	$0.52
½ "	6.23	⅝ "	4.00 "	0.40	0.64
⅝ "	6.81	¾ "	4.75 "	0.45	0.73
¾ "	8.67	1 "	6.00 "	0.52	0.88
1 "	10.71	1¼ "	9.00 "	0.70	1.24
		1½ "	10.00 "	0.76	1.36

The labor of excavating, back-filling and laying, etc., was considered in all cases for lead pipe at $0.16 per foot. The price used for lead pipe was $0.06 per pound, and the price for tin-lined lead pipe $0.12 per pound.

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