

Each line consisted of eight full lengths, with the four centre lengths arranged so that their supports could be removed.

All were laid approximately level, and were plugged and subjected to 85 lbs. internal water pressure continuously after completing and setting the joints.

The two end lengths of each line were braced securely, and were supported and weighted down with fifteen lengths of 8-in. cast-iron pipe laid across the three lines on each end.

Batter boards were set up over each of the five joints, and a centre-punch mark was put on the pipe under the centre line mark for each line on the batter boards. A flat space was filed on each length before being centre-punched, and all measurements were taken later between the pipe and the batter boards at these points.

Several observations were taken from time to time, but Tables 3 and 4 show the results of the tests as completed. Line No. 1 was loaded with 200 lbs., placed at the centre of each length after the supports were removed.

Line No. 2 developed leaks at once, but not until one or two of the joints had pulled out considerably were they in such a condition that recaulking would not have been sufficient to stop the leaking entirely.

Line No. 3 developed leaks at several joints, varying from a fine stream to a slow drip. All these leaks had practically stopped at the time of the last observation.

Table 3.

Pipe.	LINE NO. 1.		LINE NO. 2.		LINE NO. 3.		Remarks.
	No.	Weight, in pounds.	No.	Weight, in pounds.	No.	Weight, in pounds.	
a.....	2505	553	1826	550	1251	580	Suspended lengths.
b.....	2101	598	1227	571	1270	560	
c.....	2135	563	1322	566	1217	570	
d.....	533	565	1300	570	1323	569	
e.....	2459	574	1267	562	1775	582	
f.....	2328	566	455	560	903	577	
g.....	1751	570	2390	567	884	579	
h.....	2862	566	2220	570	1753	581	
Averages.....		567.5		564.25		573.625	

Table 4.—Joint Tests. Measurements on Observation Points.

The First and Last Measurement in Each Observation is on the Fixed Pipe at Each End of Each Line.

Distances, in feet, from Batter Board to Top of Pipe.

	Date: 4/24/16	Date: 5/10/16	Difference.	Distance, in feet, from point to point along center line of pipe.	Moved.	Location of punch mark.
b-1	0.855	0.942	0.097		0.006 West	0.82 East of bell.
b-2	0.818	0.907	0.089		0.075 "	0.77 " " "
b-3	0.781	0.825	0.034		0.010 "	0.75 " " "
d-1	0.873	1.259	0.386 b to d	13.71	0.009 West	0.82 West of bell.
d-2	0.844	2.350	1.506 b to d	13.71	0.06 "	0.95 " " "
d-3	0.790	1.480	0.690 b to d	13.73	0.015 "	0.92 " " "
e-1	0.870	1.360	0.490 d to e	11.97	0.01 N. E.	0.81 West of bell.
e-2	0.880	2.988	2.108 d to e	11.975	0.015 West	0.85 " " "
e-3	0.812	1.760	0.948 d to e	11.98	0.010 East	0.75 " " "
f-1	0.809	1.160	0.358 e to f	12.285		0.97 West of bell.
f-2	0.782	2.217	1.435 e to f	12.36		1.155 " " "
f-3	0.770	1.401	0.631 e to f	12.45	0.015 East	1.175 " " "
g-1	0.847	0.890	0.043 f to g	12.72	0.001 West	1.62 West of bell.
g-2	0.812	0.843	0.031 f to g	12.63		1.725 " " "
g-3	0.758	0.792	0.034 f to g	12.52		1.62 " " "

Line No. 1 has developed absolutely no leaks, even under the additional load of 200 lbs. per length. Lack of time has prevented loading and observing the effect of such loading to destruction of the pipe or joint. This will be done later.

Fig. 1 shows how the three mains were laid. The letters refer to the length of pipe under which they appear. The punch marks were lettered according to the length of pipe on which they occur, and the joints were lettered according to the length of pipe containing the punch mark. The longitudinal distance was measured from punch mark to punch mark.

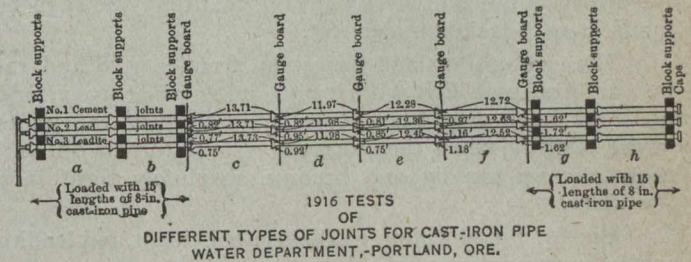


Fig. 1.

The cost per pound of the joint material was: Hemp, \$0.03; lead, \$0.09; leadite, \$0.12; cement, \$0.0055.

The cost per joint for material was about as follows:

Line No. 1—

Hemp, 0.20 lbs. at \$0.003 \$0.006

Cement, 3.5 lbs. at \$0.0055 0.01925

\$0.02525

Line No. 2—

Hemp, 0.45 lbs. at \$0.03 \$0.0135

Leadite, 4.00 lbs. at \$0.12 0.48

0.4935

Line No. 3—

Hemp, 0.45 lbs. at \$0.03 \$0.0135

Lead, 13.00 lbs. at \$0.09 1.1799

1.1934

The average weight per foot of the 12-ft. lengths of pipe, including the bells, was:

Line No. 1—567.5 lbs. per length = 47.25 lbs. per ft.

Line No. 2—564.25 lbs. per length = 47.0 lbs. per ft.

Line No. 3—573.625 lbs. per length = 47.75 lbs. per ft.

The actual weight of pipe suspended was:

Line No. 1—2,288 + 800 (sand) = 3,088 lbs.

Line No. 2 2,326 lbs.

Line No. 3 2,311 lbs.

In the case of Line No. 1, this would indicate, with the superimposed load of 200 lbs. per length, an extreme fiber stress of about 9,000 lbs. per square inch. This may be within the elastic limit of cast iron, which varies from 6,000 to 20,000 lbs. per square inch.

Conclusions.

The conclusions from these experiments are that for all ordinary mains, cement joints are superior to either lead or leadite; that leadite may often be used to advantage when time for setting of cement is not allowable; and that there are conditions where a lead joint might pull or blow out without breaking the pipe, and could be re-caulked and the main put in service more quickly than if cement were used.

The cost of making up joints is apparently in favor of leadite, with the cement joint next, and the lead joint the highest.

Mr. Shaw's statements in regard to the mixture of water and cement are substantiated by the work of Portland, except that the addition of from 15 to 20% of fine sand facilitates the ramming of the joint, and apparently does not materially weaken it. In dry weather it is neces-