LOSS OF HEAD IN CORPORATION COCKS AND SERVICE PIPES*

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SEVERAL years ago a series of tests were made by the Bureau of Investigation and Design of the Department of Water Supply, Gas and Electricity, New York City, to determine the losses of head in corporation or service cocks and service pipes. The results of these tests may prove of interest and value to the waterworks profession, particularly as to the tests made of the corporation cocks, there being very little data available on that subject. All sizes in use by the department at that time were tested. Of the two largest sizes, four of each type were tested, and of the smaller sizes, two of each type. Of the lead and galvanized service pipes, four lengths of each size about fifteen feet long were tested.

Observations Carefully Made

The observations were very carefully made, the losses being measured by mercury deflections, and the discharges by a two-inch meter of the current type. That type was selected rather than a meter of the disc type, as the flow through the latter caused considerably more vibration and fluctuations of the mercury deflections than a meter of the current type. The same meter was used during the entire series. It was rated on a testing machine at the beginning and end of tests, the exact discharge at various rates being determined by weighing. The corporation cocks were inserted in a length of 12-inch cast iron pipe capped and plugged at the ends, by a tapping machine, in the usual manner. The main was connected to a fire hydrant through the plugged end by means of a short piece of 4-inch galvanized iron pipe. The cocks were set about a foot apart, the 2-inch cocks being set nearest the capped end of the pipe in order to eliminate any uncertainties due to swirls at the high rates where the water entered the main. New lead pipe of a size corresponding to the size of the corporation cock and of double A weight was connected to the tail piece with the usual form of wiped joint. The meter with a control valve at the outlet end was connected up in a similar manner. Both the lead and the galvanized iron pipe were of the usual commercial sizes, the galvanized being of standard weight. The lengths were selected at random from a large stock.

Measuring the Losses

In measuring the losses through the corporation cocks, a U-tube partly filled with mercury was used. One leg was connected by means of rubber tubing to a ¼-inch opening in the top of the main, and the other to a 1/16-inch opening in the wall of the lead pipe, one foot from the end of the tail piece. The rubber tubing and the upper half of the U-tube were completely filled with water. The loss measured included the velocity head, entrance head, and the frictional losses through the cock and the one foot of lead pipe. This total loss was high, and at the high rates of flow it was necessary to connect three tubes in series, the loss being the sum of the deflections in each tube. The losses in the pipe were measured in a similar manner, the two legs of the U-tube being connected to 1/16-in. openings, two and four feet apart. "Tee" connections were provided at the different openings and it was thus possible to measure the losses in the corporation cocks and the various sections of each length simultaneously. The sum of the losses in the various sections was used in computing the unit loss for each length.

How a Burr Was Overcome

Some difficulty was experienced at first in preventing the formation of a burr on the inside surface of the lead pipe in drilling the holes through which the pressures were transmitted. This was finally overcome by punching the holes through the walls from the inside in the following manner: Two ⅛-in. holes were drilled partly through the walls of the pipe on points diametrically opposite, and one of them continued as a 1/16-in. through the wall. By inserting a piece of solid drill rod through this opening, the opposite wall was punched through, leaving the inside surface quite smooth. The burr around the inside of the drilled hole was removed as much as possible with a special tool, and the hole plugged up and soldered. After the tests were completed, the pipe was cut open at each of the holes and the inside surface examined. In only two cases was a burr found, and in both it was very slight. A single 1/16-in. hole was drilled through the wall of the galvanized iron pipe at each pressure point, using a high-speed drill. A small burr formed but no attempt was made to remove it, it being felt that this burr would not affect the results materially, as the inside surface was already quite rough.

Three Observers Used

In taking the readings three observers were used, one to read the meter, the others to note the U-tube deflections. At each rate of flow a sufficient quantity of water was allowed to pass so that the dial hand on the meter made a complete revolution. In this way any errors due to eccentricities of the dial hand or inaccuracies in the gradations were eliminated. The time was taken with an ordinary watch, readings being taken to the nearest half-second. As the total time for any individual test was never less than two minutes, the resulting error was probably less than 1 per cent. The deflections were read at fifteen-second intervals, the readings being taken to the nearest 1/16 of an inch. As no deflection was less than 1 inch and at least eight readings for each rate were taken, the error is probably also well within one per cent. After a sufficient number of tests had been made on each length, the unit losses at the observed rates of flow were computed, one inch of mercury deflection being equivalent to 1.047 feet of water. These values were substituted in the Williams and Hazen formula,

$$v = c\ r^{0.63}\ s^{0.54}\ 0.001^{-0.04}$$

and the average value of c for each length obtained. From these the average value of c for each size was computed. The values of c for the same section of pipe at different rates of flow showed very little variation, the extremes varying not more than three per cent. from the average. For different sections of the same length of pipe, however, the variation was considerable, even in the case of the lead pipe. The ½-in. pipe shows the greatest difference. If the same difference had prevailed in the pipe upon which the loss of head tests were made and the actual diameters had been used in the computations, the effect would have been to reduce the values of c somewhat. In the case of the ½-in. this would have meant a reduction of 4 inches. However, as it is usually quite difficult to measure the diameters accurately, values of c computed on the basis of the standard diameters would be of the greater value.

With one exception, the losses through the cocks with 90-degree tail pieces are larger than those with 45-degree

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