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NOTE ON THE LOCATING OF A BURST MAIN.

By

W. E. BUCHANAN, M.I. Mech. E.,

Engineer, Water and Drainage Works, Simla Municipality.

The consumption of water in Simla in May 1922 was, on the average, 50,000 gallons daily more than that in May 1921.

It was not easy to draw any conclusion from the comparison with May 1921, as many large Government buildings had been completed since then, it was also difficult to know whether residents were taking the same measures to economise as in 1921.

Still as the month went on the excess consumption did not seem justified.

Deacons' waste water meter diagrams were taken on the distribution system but nothing abnormal was found.

The excess water returns for May, however, when examined in June showed that the amount chargeable to consumers for excess water was much less than in May 1921, and this distinctly suggested that a leak had occurred.

The Deacons' meters were again put in action and still nothing unusual was found.

It thus appeared that whatever was wrong must be outside the distribution system and in the supply mains or possibly in the reservoirs or filters.

There was also the possibility of the Cherot Roturbo pump discharge having fallen off due to wear and tear.

The discharge from the Chair source and that from the Upper Gravitation line are measured at Dhali and the figures were normal.

The 3 cast iron mains from Dhali to Sanjoli are unmetered, as they are not under much pressure, and such mains have seldom given trouble, and hardly warrant the heavy cost of Deacons' meters and valves.

As a telephone cable had been laid along the road in the winter of 1921-22, damage might have been done to one of the mains and it was decided to test them, having first made a careful but fruitless inspection of the hillsides and nullahs below, on the chance of leakage being visible.

At the same time tests were made of the Sanjoli and Church reservoirs which showed there was nothing wrong with them.

The 3 mains at the Toll Bar being joined by tees and valves, the first test was made of the 3 mains altogether by shutting the valve on each main at Sanjoli reservoir, and measuring the decrease from one of the new filters.

Unfortunately the country-made valves, which were the only ones obtainable for the new 7" main during the War, all leak more or less, and the valve on the 7" main at Sanjoli had to be changed.

On testing again a decrease in the filter was measured equivalent roughly to 40,000 gallons per day, but the 7" valve still leaked somewhat.

The next step was to isolate each main and test it by closing the valves joining it to the others.

Here again a valve had to be changed as it leaked.

The result of these tests showed that the 8" main was all right, and the 7" had possibly slight leakage which might be due to the new valve at Sanjoli, which the stethoscope showed to be still leaking a little.

But the 6" main showed a substantial leakage of 30 to 40,000 gallons per day, and this was confirmed by a second test from one of the old filters.

This main was again tested by closing off valves in rotation from Sanjoli, and the leakage appeared to be in the section, Toll Bar to Dhali, a length of 2,000 feet.

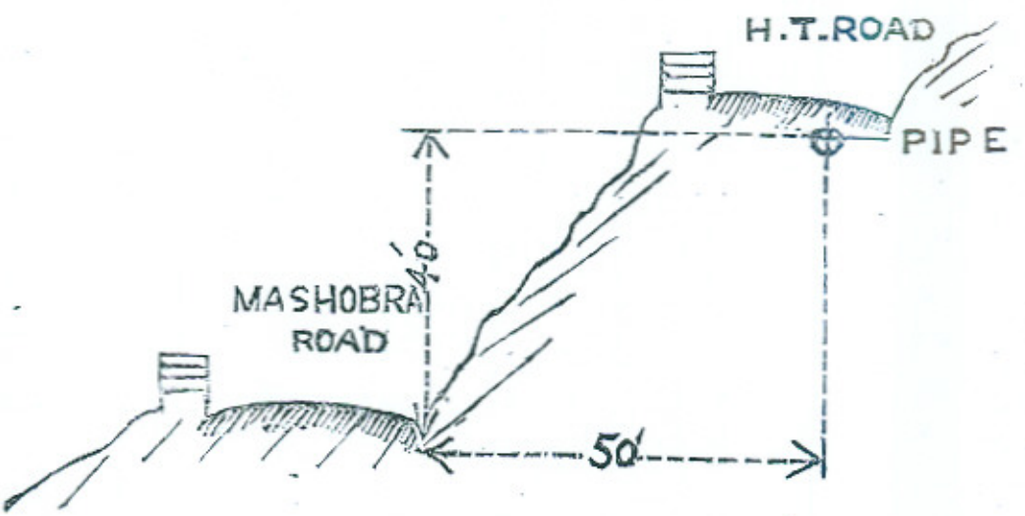
As it was impossible to dig up such a long section, a valve was placed half way, and test showed leakage in the upper portion.

This still left the suspicious section 1,000 feet in length, so another valve was placed midway giving two 500 feet sections.

Test from one of the old filters showed roughly 30,000 gallons per day loss in the upper section, and nothing was left to do, but dig up every joint.

After digging for a week a cracked pipe was found, the crack being nearly 3 feet long, and accounting for all the suspected loss of water.

Although a section of the road here is something like this,



yet the road was dry and there were not the slightest signs of water escaping anywhere, though one would think it would appear through the bank below somewhere.

But as has been shown on many previous occasions in Simla, a main may be burst and show no external evidence whatever, and the water simply runs direct into the fissured rock, and this case shows once more the necessity for constant vigilance and control by meters and valves in running a hill water supply.

The cause of the burst is inexplicable, as the pressure was small, and frost has never affected this main which is of English pipes and was laid about 40 years ago, and is still in excellent condition, but it shows how necessary it is to allow a margin for accidental loss when calculating the probable consumption of water.

Looking back on his records the author can now give the probable date on which this pipe burst, as some day in the last week of April, and yet owing to the many problematical causes for the increased consumption, all of which had to be investigated, it took some 10 weeks to discover.

DISCUSSION.

MR. DORMAN introduced this paper in the unavoidable absence of Mr. Buchanan. Having briefly outlined the arrangement of pipes and meters he described the steps taken by Mr. Buchanan to locate the leak, which had occurred at a time when the average consumption of water in Simla was 650,000 gallons a day. He said it was extraordinary that there should have been no visible signs of any leakage in the shape of a trickle from the steeply sloping hillside below the place where the crack was eventually located.

COLONEL BATTYE drew attention to the trouble that had occurred on the gravity main for Simla, which was laid along the Hindustan-Tibet Road at an altitude of well over 8,000 feet. It was first filled in the summer but during the following winter it burst frequently. The main was covered to a depth of 3′ and 4′ but it was found that with air temperature at 16° Fah. above zero the ground even 4′ deep was frozen solid. Bursts usually took place where there were no trees along the road, and the matter was referred to Dr. Simpaon, F. R. S., of the Meteorological Department. It was found that the great penetration of the frost into the ground was due to the fact that although the air temperature was only 17° Fah. the actual ground temperature was many degrees lower, possibly even below zero. This abnormal difference was due to the excessive radiation from the ground surface accentuated by the altitude. Such radiation was of course much less under trees, hence the freedom from bursts where the road was shaded.

R. B. DEWAN AMAR NATH NANDA stated that Mr. Buchanan's paper though brief drew attention to a matter of great importance as regards water supply both in the hills and in the plains. He knew the Simla water-works well and regarded it as one of the best managed in India and yet with ample appliances in the way of meters, stethoscopes, valves, etc., for detection and an excellent organization it took ten weeks to locate the burst under discussion. In the case of Municipal schemes in the plains which were not always so well constructed, controlled or maintained the difficulties of detection and repair were greatly enhanced and in his opinion better organization was highly desirable. Referring to his experience in leakages he took Lahore as an example. The city was built on made ground and leakages which were numerous were very difficult to detect. They occurred in one street and the waste water passing through underground cracks and passages more often than not appeared in another street some distance away. The system was badly laid, and poorly controlled and so detection was complicated and difficult. Water passing thus underground often affected the stability of buildings causing much damage to property. In one instance some shops inside the Shahalmi gate collapsed as a result of a burst pipe but this event did not prove to be an unmixed evil as it led to the opening out of a very congested section of the city. The whole of the water supply for Lahore,

however, was pumped from wells as in the case of most schemes in the plains and waste of water consequently meant heavy waste of money. He, therefore, urged the necessity of greater interest and vigilance than appeared to be given to this important question at present.

MR. LINDLEY, though not a water-works engineer, thought there must be appliances that would have saved the time and labour used over crude methods. After the leak had been traced to a section of main between valves (after putting faulty valves right), the section could be further narrowed down by putting in temporary valves. The leak of 30,000 gallons a day could then be located by digging up the main till it was found. Diwan Amar Nath Nanda's remarks gave the impression that leaks were ignored as of no account till they caused buildings to collapse : even the speaker would not accept this as sound practice, especially within the area of an Oriental city.

MR. D. A. HOWELL did not agree with Mr. Lindley, as waste was a question which had the constant attention of water-works engineers, and, with a properly laid out and controlled system means were to hand not only for the prompt detection of waste but also for its location. Conditions, however, varied with every water-works and the Engineer responsible had therefore to consider his own case on its merits and work out his own method. There were no stereotyped rules to follow. One or two points in the paper needed attention. In the last paragraph but one on page 37 mention was made of the laying of a Telephone Cable in the winter of 1921-22 and that damage might thereby have been done to the mains. This suggested that the exact position of the main in the road was not accurately recorded. This was a common defect, and rendered the work of preventing and detecting waste, complicated and difficult. By accurate records were not meant completion plans similar to those maintained by the Public Works Department in India, but something much more exact, so kept in fact, that every pipe joint, special, and valve could be marked out on the ground at any time. The best means of meeting these requirements were by the maintenance of accurate survey note-book records of each main, the centre column representing the main, with offsets off its centre line to prominent points at every angle and at every fifty feet along the straight. The exact laying length of each pipe, special and valve should be shewn together with any distinguishing marks on the sockets and the depths of cover. Such records were very useful, not only in waste detection but also for the supply of information to other people who have to lay gas mains, electric cables, and the like in the same roadway.

It was suggested that sufficient use had not been made of the stethoscope. If the exact position of the main was known, there was no necessity to excavate at all, as by driving a blunt steel rod on to the back of the pipe at intervals of about 4 yards and applying the listener to the head of the bar, the noise of the leaking water could be detected at once. Instance was given of where the speaker had occasion to test 30 miles of trunk main which was losing 40,000 gallons per day out of two millions.

There were sluice valves every mile and by charging up the main and testing by pressure gauges it was an easy matter to locate the sections in which leakage was occurring. It was found to be due to a large number of minute leaks in a certain type of joint. Inspectors became very expert with the listening instruments and could detect a minute leak from which only a trickle of water appeared. It took two months to test the whole 30-mile length.

The speaker also remarked that the cause of the burst was inexplicable. The cracked pipe owing to rust would of course explain nothing. Pipes transported in such difficult places as exist at Simla needed careful handling to prevent damage. A pipe might remain in the ground for years before exhibiting a defect that existed before laying, and might then owing to water hammer or increase of stress from some other cause, suddenly burst. Experience shewed that there were no means of ensuring that a pipe was sound when laid. It might "ring" when slung, and still be cracked—the crack generally being in the centre and not extending to the ends. Another common defect was for the jointer to exert too much force in caulking. This might at first cause a hair crack say half an inch long at the socket and it might take months or even years for this to extend back to the body of the pipe and so cause leakage. In concluding, the speaker referred to the difficulty of waste detection and prevention in the Punjab where intermittent supplies were the usual practice. For continuous supplies the proper use of meters was no doubt an advantage, but for intermittent supplies, he recommended rigid house to house inspection of the consumers pipes and fittings, especially where domestic supplies were not metered, although in India this would probably be somewhat difficult owing to the purdah system. The temptation to use water for illicit purposes due to scarcity, high temperatures and deficient rainfall was no doubt very great, but this was made worse by the use of very inferior fittings. Actual deficiency was therefore intensified by waste and until the Municipal authorities were prepared to enforce rigid inspection and control by house to house inspections no improvement could be expected.

MR. BUCHANAN wrote in reply that there was no comparison between the main to which Colonel Battye referred and that described in the note. The former was at a very much higher elevation and in winter frost was so severe that it had to be drained of all water and kept empty from 1st December to 15th March. The latter had water running continuously in it and damage by frost was exceedingly unlikely.

He could not quite follow Mr. Lindley's remarks, as the action suggested was very much that which had been taken.

Mr. Buchanan agreed with Mr. Howell that records of the positions of water mains would be useful, but the main which had burst had been laid very many years ago, and apparently no very accurate plans had been kept.

The Telephone Authorities had laid their cable when he was on leave and as they had no hesitation in laying it on the very top of a water main, he feared they might have caused damage with a crow-bar in excavating.

The reason why the stethoscope was not used for the final location of the burst, was that neither the position nor the depth of the main was known. It was therefore considered it better to start from the ends exposing every joint rather than to have men digging holes all over the road in hopes of finding the pipe. The road had also to be kept open for traffic.

In regard to the time taken to locate this burst main it must be remembered that it did not take 10 weeks to find once it was known it had burst. The time was taken up in looking for all possible causes for the increased consumption and in making many tests to allocate it. Had the 3 supply mains referred to been fitted with Deacon meters and valves the leakage would have been located in a shorter time, but as pointed out in the note these mains had given so little trouble that the expense of such meters and valves had not been considered justifiable.