"Sewerage and Drainage Works in a Small Mining District."

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(ABSTRACT).

AFTER some general opening and explanatory remarks the writer speaks as to the great necessity of local information in general planning of lines of route in mining areas.

He then describes most fully the necessary action to be taken under the Public Health Act, 1875, and the Support of Sewers Amendment Act, 1883.

The paper continues as follows :—

In mapping out a line of route for his sewers a Municipal Engineer may find that he cannot carry out his scheme without crossing land which has already been undermined, and he must then satisfy himself as to the extent of any further subsidence that may occur in future. When estimating this, attention should be given to the following points :—

(1) What proportion of the minerals has been worked, *i.e.*, were pillars left in, and, if so, size of roads around them, and is there any intention of taking out the remaining minerals ?

(2) Thickness of mineral bed worked, and depth of same below surface.

(3) How long since the working ceased.

(4) Was timber left in.

(5) Was mine flooded with water.

In ironstone mining practice roads and cross roads are usually worked, dividing the mine into a series of square pillars and open roads, the stone extracted to form the latter being the mineral won, the square pillars forming a support for the roof. The roof of the roads from pillar to pillar is timbered where necessary. After a time, often a lapse of several years, these pillars, in their turn, are taken out, which, in mining vernacular, is termed " working the brokens." It is not usual for subsidence to occur as a result of the first working, but this, of course, depends upon the amount of stone worked, the usual quantity taken out at the first working being from 40 to 50 per cent.

Should the course of the proposed sewer be through land from under which minerals have been taken, but pillars left in, no disturbance is likely to be caused to the works if sufficient time has elapsed since the workings ceased, say 10 years. Thus a sewer may safely be laid across such land, the Local Authority relying upon the remaining stone being left in, but should the mine owner decide to work the pillars, then the engineer will be called upon to decide how much of the remaining stone will need to be reserved to avoid disturbance of the work.

Equal immunity may be obtained over land from under which the whole of the minerals have been extracted, but, of course, the risk is greater. In the latter case, when estimating the risk of further movement, greater attention must be paid to the points set out above, as it can readily be seen that factors such as the length of time since the workings ceased, and condition of the mine as to water, give data from which can be calculated the possible life of the timber supporting the roof. Then, again, must be considered the total thickness of the band of stone and what depth of this was worked, *i.e.*, was any of the hard stone left in to support the roof. This often is the case in practice, and on the withdrawal of the timber this thin band slowly but surely gives, gradual subsidence ensues, and should the mine be flooded with water, this will act as a cushion, and subsidence may be extended over a period of years, but generally speaking, subsidence ceases after 15 years.

The purchase of sufficient minerals to ensure inviolability from disturbance is often a financial impossibility to small Local Authorities who thus prefer to take the risk of relaying a pipe line once or even twice, rather than incur this large initial expenditure ; but in cases such as pumping stations and disposal works the acquisition of support becomes not only necessary but a financially economical proposition.

Should it be ascertained that the boundaries of various mining royalties follow the line of a stream or watercourse, as is often the case, it may prove advisable to make the line of the new sewer follow as closely as possible that of the stream.

It is the custom of mining engineers in the writer's district to cease their workings some 25 yards from their royalty boundary, that is to say, 25 yards of solid stone is left in, and in cases where the boundary is a naturally defined one, such as the centre of a watercourse, this distance is usually extended, so as to obviate the increased pumping that would become necessary should disturbance take place in the bed of the stream. Obviously, therefore, under these conditions the bed of the stream becomes the safest place for the sewer line, and has the additional advantage of being at the lowest level of the watershed, so that every point in that watershed can be drained by gravitation.

Even where the royalty boundaries do not follow the physical features of the surface, it may be advisable to lay the sewers over the course of these boundaries, as in many cases one royalty owner will prefer to leave a wall of solid stone at his boundary, rather than incur the risk on a dipping seam of having to pump the water which may find access to his mine from his neighbour's workings either by percolation or other means unnecessary to detail.

If the new sewer can be kept just above or at ground level in land liable to subsidence, the pipes can be kept under constant observation, and any slight settlement repaired with ease. These were the conclusions to which the writer arrived when, during the first year of holding his present office, some considerable length of the main outfall sewer collapsed, due to mining subsidence, and as it is now six years since this sewer was re-constructed, and no sign of further disturbance of the work has shown itself, a short description of this work and of the conditions prevailing may prove of interest.

This sewer was laid through a valley some two hundred feet deep, through which runs a stream, the centre of which is the boundary of two royalties, and was constructed of 18″ stoneware pipes in cutting, averaging 10′ 0″ deep, and some 60 feet to the west of the centre of the stream. Mining operations had been carried out under both sides of the stream, the stone having been worked some 45 years previously, but pillars were left in on the boundaries of the royalty, the depth of the seam below water level being 150 feet, and the thickness of the seam worked, 8 feet. The eastern side of the stream is precipitous, composed of boulder clay overlying loose freestone, under which are shale and ironstone bands. Similar conditions prevail on the western side, but the banks are less precipitous. The royalty owners on the western side, having commenced to re-work this district, by taking out the pillars, some considerable length of the main sewer collapsed. From enquiries made, it was found that the royalty owner on the eastern side had decided not to further work the stone, so that lateral support might be given to the town, and to avoid pumping should the bed of the stream be disturbed. It was, therefore, decided to reconstruct the sewer on this side of the stream, and to lay the pipes above the water line at the edge of the stream, so that the same could be kept under observation. 15″ C.I. pipes in 12′ 0″ lengths were used, tested to 300 feet head, and were supported at each joint by a concrete pier (6 of slag and gravel aggregate to 1 of cement) carried down to the solid rock or shale, the pipes being jointed with a single collar lead wool joint, and the whole of each joint surrounded and embedded in the concrete. At the request of the Local Government Board a simple expansion joint was installed at the outlet and inlet side of each manhole. By re-laying from a point some distance above the disturbed portion of the sewer, it was found possible to obtain a continuous gradient of 1 in 125, and for the invert of the pipes to be 3 feet above normal water level.

The use of Mannesmann steel tubes was first contemplated for this work with the object of reducing the number of concrete piers, but owing to the fact that after every heavy rainfall the sewer is under water, and that mine water, containing a high percentage of sulphuric acid is discharged into the stream just above this point, steel tubes were abandoned in favour of C.I. pipes.

Mention might be made of a cloud burst that occurred one day during the progress of the work some miles inland. At 3 p.m. this day the writer crossed the stream on the boulders, and two hours later the stream ran 13 feet deep, uprooting large trees in its rush to the sea, these, with other debris, collecting on the pipe line where it crosses the stream. It was to the considerable relief of the writer that he found the enormous stresses exerted upon the newly-laid pipe line had had no ill-effcet on the work. The contractor, however, was not so fortunate, as he failed to recover much of his plant, the whole of which had been swept out to sea.

When the wayleaves for the original sewer were arranged, no support could be reserved unless the Local Authority were prepared to buy the necessary minerals, a financially impossible arrangement, and on the same conditions only could support be reserved for the re-constructed sewer. The Local Authority, therefore, decided to run the risk of further subsidence in the work, which, now that six years has elapsed since the stone on the western royalty was removed, is hardly likely to occur. Should, however, any slight disturbance show itself, it is claimed repairs could easily and cheaply be effected by the system adopted.

The writer then gives information respecting the method of dealing with fæcal matter from privy middens and pan closets in the older mining towns and villages, and strongly advises the abolition of the conservancy system.

Another defect often found in old sewers in hilly mining districts is excessive gradients, causing undue scour, and where branch sewers join the main, considerable effluvia is given off by the breaking up of the flow due to the drop into manholes. These excessive falls should be remedied by the construction of ramp manholes and the sewers kept to reasonable gradients. The upper level sewer should be carried through the wall of the manhole to form a sighting and rodding arm, and a ramp formed by a special inverted Y junction before reaching the manhole, the pipe sewer being taken down to the main invert level entering with a bend, and the whole encased in 9 inches of concrete.