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Permanent Culverts

Brick culverts are the best and most economical to use for ordinary road purposes where vitrified culvert pipe is not sufficiently large, because it is far superior to the wooden culvert. First, it makes a permanent improvement on the public highways, the same as the iron bridge, which, in almost every instance, has taken the place of the wooden bridge over large streams. Second, they will take the place of the iron bridge where the span would be too short for an iron structure. Third, in as much as the laws of the country permit portable engines to travel the highways at pleasure, it becomes necessary that all our bridges and culverts be of a solid substantial construction. Fourth, as the life of a good wooden culvert is from eight to ten years, and that of a good brick culvert from fifty to one hundred years, it seems to me that the brick culvert is an absolute necessity on the public highways, at least as far as convenience and experience is concerned.

As to the way they should be constructed, I presume there are a variety of opinions even among our best engineers and mechanics, but my judgment is a solid foundation, either natural or artificial, but not necessarily a dry foundation, from the fact that good brick culverts have been built when it was necessary to keep the water dipped out of the pits ; but, at the same time, my choice would be a dry foundation, and the next thing necessary is number one material of all kinds to build the culverts. The brick should be number one sewer bricks, and any bricks that show any sign of being soft should be rejected and thrown out, as they will soon crumble on account of the dampness and effects of the frost. Each brick should be dipped in water or wet with the same before being put in the wall. The sand should be clean, sharp sand taken from the creek in preference to that from the bank, as that taken from the bank is liable to have more or less clay in it, and will make the mortar soft and crumbly. I think the bottom of the pit for the barrel of the culvert should be at least eighteen inches below the bed of the stream, but this would depend on the size of the culvert to be built and the height of the road grade at the place where the culvert is built, and the wing walls should be started at least twenty or twenty-four inches below the bottom of the barrel walls, in order that the water will have no chance to get under them, and undermine the whole structure. In making the mortar I would use two parts cement and three parts sand. I think that the bricks on the inside of the barrel of the culvert at their front edge should almost or quite touch each other so there will be very little mortar at that point to wear and wash out, and in time let the bricks become loose and drop out, and the water should never be allowed to wear the bottom of the stream away from the lower end of the culvert and fall over the end, as it will wear the mortar from between the bricks and then they will wash out. The wing walls should be built at least two and one-half inches higher than the top of the barrel to hold the dirt and at least eight inches thick, and I would put in sixteen inch bolts in the top of the wing walls in order to bolt a two inch plank to the top of the wall to hold the bricks from being knocked loose.

Roads and Roadmaking.

Many a city and town has been prejudiced against road improvement by the bad work of contractors, or by the results of ignorance on the part of its own officials. The town may have been enterprising enough to decide to improve some of its roads, and people may have been generous enough (sensible enough would be better) to have furnished the money, and the money may have been expended on the highways and yet the highways may be after the lapse of a few years as bad as ever. It may have been proved to the dissatisfaction of the town that to have maintained those highways in a state of excellence would have cost far more money than the town had to spend or the investment warranted, thus the town is convinced that the talk about road improvement and the benefits to be derived therefrom comes either from impractical visionaries or from swindlers. In fact, this has been the experience of many towns in Canada, and the convictions held in those towns that macadamized roads are delusions and snares has done much to retard the progress of the movement for the improvement of country highways. The real fault in this road, though (as any competent road engineer would tell them) lies in the fact that it was imperfectly drained. Road makers who have not had much experience are apt to fail to realize the paramount necessity of maintaining a perfectly dry foundation of earth for their surface of broken stone to lie on. If the soil under the road surface is left unprotected from the assaults of moisture, it is certain to ruin the road. A protracted rain will soften it and when a heavy load passes over its broken stone, injurious ruts are sure to result. Again, in those latitudes where Jack Frost digs deep in, water in the soil will freeze, and its consequent contractions, expansions and heavings can result only in ruin to the road. In order to insure a permanent road the dirt bed on which the broken stone is to be placed must be thoroughly drained, and after that, the mass of stone which forms the surface of the road must be so consolidated and packed that it is practically watertight. If these things are attended to, the road is almost certain to be easily maintained and durable. It must be remembered that drainage is by all odds the most important thing to be taken into consideration in the building of a road.

Another mistake in road construction which is often made, is that of building the bearing surface, of stone of unequal strength. It is much better to build the whole surface of soft stone than to combine hard and soft stone. If the mixture could be always perfectly even this would not be so, to so great an extent, but it is sure to be very uneven. The soft stone is certain to gather in pockets. When the road is completed the traffic commences. These pockets are the first places to wear. Holes quickly develop where the soft stone has lain and the jar of the wheels jolting into the holes and being pulled through them and out at the other side is certain to crumble the surrounding surface of hard stone.

A road may be perfectly smooth both before and after a vehicle has passed over it, but if it sinks in the least after the passing of the wheel, this yielding presents before the wheel a miniature ill up which the vehicle must be raised with loss of power. If the depression were one inch, and the wheel four feet in diameter, an inclined plane of one in seven would be formed, and one-seventh of the entire weight would need to be lifted up this inch. A road surface of India-rubber of the most perfect smoothness would be therefore the worst possible for traction, though very pleasant for passengers. The wheels would always be in depressions, and the horses would always be pulling up hill. An elastic bottom for a road such as a boggy sub-stratum, would for this reason, cause great waste of draught. A solid unyielding foundation is therefore one of the first requisites for a perfect road. A road made of broken stone laid on the earth without any foundation has the following defects: The weight of vehicles forces the lower stones into the earth, which raises up into the intertices and forms a mixture of earth and stones which will always be loose and open and never consolidates into a compact mass. In winter the water penetrates, is frozen, and breaks up the road. After a thaw and in wet weather the road is a quagmire, the wheels cut deeply into it and sometimes through the entire thickness. At the best, after a rain the semi-fluid soil will rise up to the surface and form a coat of mud, and after a drought the looseness of the stones will make them rub off their angles and soon wear out. Nor will any thickness of stone destroy the elasticity of the soil. These defects can only be removed by bottoming, that is, by placing a complete layer of quarry chips on the bottom of the road over the sub-grade and underneath the road covering, in this way the pressure of the wheels is distributed over a large space. Suppose that the wheel touches and presses on a surface of two square inches, this pressure is carried to the foundation stones which rest at