Engineering Department

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Roadmaking Old and New.

Among the earliest roads of which we have definite information were those built by the Romans, chiefly as military highways, leading east and west to the remote Provinces, from which arose the proverb, "all roads lead to Rome." So substantially were these roads built, of layer upon layer of stone and concrete, three and four feet in thickness, that many of them still remain, and are commonly supposed by the peasantry of Spain and other of the countries of Southern Europe, to be of supernatural origin. These roads were built at an enormous waste of money and labor, and while of the greatest durability they lack the first essential of modern construction-a properly balanced union of economy and efficiency.

For several centuries after the downfall of Rome, road making became a forgotten art. In France during the eighteenth century, under the engineer Tresaguet, road construction was revived, but on very different principles from those followed by the Romans. The type of road built by the French engineer, was that introduced into England by Telford, and consisted of a foundation of large stones, laid on edge and carefully shaped, upon which was placed a coating of finer broken stone.

Early in the nineteenth century, Mc-Adam advocated and constructed in England a still more economical design, in which the foundation of large stone was omitted, but greater care was given to draining the roadbed. McAdam's sys-tem is that most commonly followed to-day with a number of important alterations consequent upon the introduction of roadmaking machinery. In the time of McAdam, the best method attainable, was to break stone by hand, which was then placed loose on the roadway and left for traffic to consolidate. The process of consolidation was slow, during which a considerable amount of the stone was forced into and mixed with the earth subsoil, lessening the strength and durability of the road.

Under present methods by means of a crusher, stone is broken much more cheaply than it could be done by hand. Stone dust and chips, (screenings), are created in the process of crushing, which are used to fill the voids, instead of waiting for this to be produced by traffic, or allowing the clay or loam from beneath to be forced up among the stones. With a roller the road metal is made thoroughly compact, forming a strong, waterproof covering over a firm subsoil. The result is that more perfect work is done in a few days and at less cost than the methods of McAdam or Telford would accomplish in several months. The main features of present day roadmaking, which are of recent introduction are :

(a) The use of grading machines for forming the earth foundation and open drains.

(b) The thorough drainage of the earth subsoil.

(c) The use of a crusher to prepare the road metal.

(d) The screening of broken stone so as to grade it for application to the roads in layers according to size.

(e) The use of stone dust and fine chips (screenings) as a binder.

(f) The use of a roller to consolidate both the earth foundation and the surface covering of broken stone.

A road surface of gravel or broken stone performs various services. The ordinary dirt road of clay or loam alone ruts readily, softens quickly after a rain, and has little supporting power. A wellcompacted layer of gravel or broken stone over it distributes the concentrated wheel load over a greater area of sub-soil; it does not rut readily, and affords good surface drainage; it gives a smooth, hard wearing surface; water does not easily penetrate it so as to soften and reduce the supporting power of the sub-scil.

The depth of gravel or stone to be used must vary with the quality of the material, the amount and nature of traffic on the road and the nature of the sub-soil. A dry, compact and stony sub-soil needs less metal than does a plastic clay, difficult of drainage. A definite rule cannot be laid down to accurately meet all conditions, but from six to twelve inches of well consolidated material will afford a sufficient range to accomodate most circumstances. Ordinarily ten inches of metal should accomodate the heaviest traffic to which a gravel or broken stone roadway can be economically subjected.

A very notable defect of most country roads is the flat or even concave surface. Others present the opposite extreme and are so rounded up as to be dangerously high in the α ntre, making it difficult for vehicles to turn out in passing. Roads must be crowned sufficiently to shed water from the centre to the open drains at the side, otherwise water will stand in the roadway, soak into it, soften and cause rapid wear, resulting in ruts and holes, but a crown higher than is necessary to properly drain the surface is also objectionable. The smoother and harder the surface of the road the less crown is needed.

The amount of crown should not be more than sufficient to provide for surface drainage. A sharp crown tends to confine traffic to the centre of the road, and also in turning out the weight of the load is thrown on one pair of wheels in such a way as to rut the side of the road. The shape of the crown is a matter on which expert road-makers differ, but with the class of material available for roads in Ontario, and the methods and plans of construction, a form as nearly circular as possible will be found serviceable, and most easily obtained.

From the edge of the open drain the graded portion of the roadway should be crowned with a circular rise of one inch to the foot from side to centre. That is, a drive-way twenty-four feet wide should be one foot higher at the centre than at the side. This amount of crown may at first appear excessive, but with gravel roads, and roads metalled with the quality of stones commonly used, is not more than enough to provide for wear and settlement consistent with good surface drainage.

The elevation of the read above the level of the adjacent land, need not be greater than is sufficient to provide against the overflow cf storm water, which should always be guarded against. The depth of the open drain must vary according to the amount of fall and the quantity of water to be provided for ; also according to the sub-drainage needed and provided. When tile sub-drains are used, the open drain can often be very shallow, in which case the wid h of the graded roadway can be narrowed, there being no danger of accidents such as are caused by a deep trench at the roadside. The tile drains should be placed below severe frost, and usually a depth of three feet will answer.

Specification for Macadam Roadway.

LOCATION AND EXTENT OF WORK.

1. The location and approximate extent of macadam or broken stone roadway to be laid under these specifications are as follows :

EXCAVATION AND GRADING OF ROADWAY.

2. The space over which the roadway and curb are to be laid shall be excavated to the required depth below the elevation of the finished roadway in accordance with the plans and profiles, and schedule, on file at the office of the clerk of the -, and forming part of town of these specifications. Perishable or objectionable material shall be removed to a further depth, to secure a firm foundation if so required by the engineer. Such excess excavation shall be filled with gravel or other material approved by the engineer, and the bottom of the subgrade thus obtained shall be then made thoroughly firm and solid by pounding and rolling. For all extra excavation or filling ordered by the engineer, the contractor shall be entitled to the sum of 20 cents per cubic yard.

REMOVAL OF EXCAVATED EARTH AND RUBBISH.

3. The earth taken from the excavation for the roadway and curb is to be used in