

# Economic Principles Of Macadam Street Work

Instructive Paper Read at N. B. Union of Municipalities Convention by Town Engineer of Campbellton.

Following is the full text of a most excellent paper on street making, read at the recent convention of New Brunswick Union of Municipalities, by D. T. Black, C. E., town engineer of Campbellton:

## ECONOMICS AND PRINCIPLES.

Good streets are necessary in the advancement and development of all progressive towns. Attention to facilitate traffic and to reduce expense of haulage are sure signs of progress in any town. Good streets encourage industries; industries make towns important and build them up; therefore build good streets; but good streets are expensive improvements; therefore economize in every possible way.

Road building dates back to the Romans, and still is a very important question of today. The day is coming rapidly when every town, and even village, in Canada will be demanding something better than the muddy earth roads with deep and dangerous ditches.

Today many varieties of paving are used. One class may be preferable to another on a special thoroughfare to reduce the noise, or to increase the load for the same motive power, or to guarantee longer wear for heavy traffic. Mr. W. A. Clement, city engineer, and a committee of the Vancouver council, after an extended visit through the States, in their report said: "a perfect pavement has not yet been found—no one paving material combining in itself all the desired qualities." The question then arises. What will be chosen? A town may desire its main street paved in wood block or some other modern material, but one street in a town will not satisfy the people of this country in the next few years. The feeders to the main street and residential streets must also receive attention. From an economical view a town on such a transformation scheme as permanently constructed thoroughfares and residential streets should consider well its natural resources of supply in such construction; imported material generally increases the cost. Macadam still makes a serviceable street and many cities still put down miles of it annually. Motor and heavy traffic in cities may call for materials with a harder wearing surface, but such traffic is not seriously met in towns at the present day. Macadam, being low in first cost, having a hard, unyielding surface over which great loads can be drawn in all kinds of weather, makes it a good material for the street improvement schemes of a young growing town. Many engineers exaggerate the cost of maintenance of Macadam, which is due to the fact that statistics were taken from the roads of Macadam construction without recognizing the changes wrought by the steam roller and crusher. The broken stone road of today is quite a different structure from the type of road built by Macadam, who used hand broken stone that was practically uniform in size, laid on an unrolled base, without the addition of a binder, and left to be compacted by passing wheels; the results were the wheels cut ruts in the loose stone until the soil worked up from below, and the wheels powdered and broke some of the stone until the voids were filled. The surface soon gave way, owing to a defective sub-base, and the continuous system of repair became necessary, employing a large staff of road men, which accounts for the heavy cost of maintenance. In the then Macadam process it took 18 inches of loose stone to make 12 inches of Macadam surface; some text books therefore, state that the steam roller will compress loose stone one-third, which is an error. Rolled as roads now are no such compression as this is possible, although in some cases where the stone is placed upon improperly rolled sub-grades some stone is driven into the earth and lost, which has led many engineers to believe that the roller has compressed the stone one-third or more. This is but one of the errors commonly accepted as truth and accounts for too high estimates of broken stone required in road construction. Macadam was the first to economize by utilizing from 6 to 12 inches of broken stone. The stone crusher has further modified the cost in road construction when the fines are used as a binder and void filler, and now 6 inches and even 4 inches of metal give excellent results.

In modern Macadam four important factors enter into its construction:

(1) Proper drainage and rolling of earth foundation.

(2) The use of machine broken and screened stone with the screenings to fill the void and as a binder.

(3) Well sprinkling but not over-flooding with water.

(4) Thorough consolidation with a steam roller.

In small cities and towns the actual width of roadway is usually much greater than is required for the traffic, therefore all streets should be carefully studied and full statistics of the amount and character of the traffic taken with a view to reducing the area to be paved by widening sidewalks and laying out grassy berms. Having determined the proper widths of roadway of the various streets then grades should be most closely studied in order to get the best results with the least change of existing grades. The use of machinery for grading should be carefully considered. Contractors of the present day are well aware of the great economy attending the use of scrapers and graders, but the cross sections designed are usually such that the use of these machines are practically impossible. Before grading any streets there should be in place a complete system of sewers, pipes for gas or water with service branches to every lot, manholes and catch basins so arranged to take the water readily and rapidly and constructed to prevent silt and street waste from entering the sewers. Select a profile with a minimum grade of  $\frac{1}{4}$  per cent. and a maximum of 3 per cent. if it can be obtained at a nominal cost, but some streets require steeper grades naturally, while others up to 5 per cent. or even 8 per cent. are necessary to avoid expensive excavations or refills, for the tractive power of a horse is not a constant quantity and is greater than most authorities state. The base or cross section of the sub-soil requires most careful consideration. The thorough drainage of such streets as have been naturally muddy in spring or in fall must be provided for before any method of surfacing is considered. Mud underneath the road is more destructive than mud on the surface, so that without a well drained sub-soil the best surface must prove a failure. If there are depressions in a clay surface below the stones, water will find its way and lie there, soften the soil, undermine the Macadam and weak spots will develop in the road. The natural earth is the real road bed, and it can only support the pavement by being kept dry. In most towns a portion of the streets have good grades and will drain naturally if rightly formed. Design a rather flat arch for the road surface, with a crown or drop of  $\frac{1}{4}$  inch in 12 inches on ordinary grades, thus it will be possible to do the grading by horse instead of man power.

For any method of road making or paving which may be adopted a steam roller is requisite in order to compact the earth road bed so that it will sustain the wheels which will pass over it. The roller should not exceed 15 tons actual weight when loaded, so proportioned as to distribute the weight on wheels which cover and compass the full width of its track.

Curbs and gutters are also essential to complete the streets of a city or town. The combined curb and gutter made of concrete cast in place in lengths preferably 5 feet long, fulfills its duty well, looks neat and is economical in construction. It is a usual custom to specify that no stone in a broken stone road shall be over 24 inches in diameter, because it is claimed that if larger it will work to the surface. If a mass of loose stone of various sizes is passed over by wheels there is no doubt the larger stones will tilt up when the weight comes upon one end of them and the smaller stones will roll down into the place made vacant; but it does not follow that in a broken stone road, rolled with a steam roller and bound together with the addition of fines, that a stone will work to the surface if it is 2 inches below the surface to begin with. In fact, the mass is so perfectly bound together that it is impossible for tilting to take place, therefore larger stones than 24 inches can be used in road construction, especially for the lower course.

The introduction of the crusher transformed the construction of Macadam roads, but called forth a better understanding of their construction. When stones are broken by

hand there are no fines or dust of any consequence, but when crushed we have 16 per cent.  $\frac{1}{4}$  inch and fine, 24 per cent.  $1\frac{1}{2}$  inch and 60 per cent.  $2\frac{1}{2}$  inch. The saving use of crushed stone is not therefore so very great unless the dust and fine can be utilized. Macadam in his later years showed that broken stone possessed the property of knitting together, or becoming cemented under the rolling action of passing wheels. In Scotland some years before the steam roller was introduced, when wheel traffic still did the binding, it was the custom to spread a very thin covering of road scrapings over the stones to assist the binding. After the roller and crushed stone were introduced, the same custom was adhered to, but the scrapings were not added until the rolling was almost completed and large piles of fines lay at the quarry sides or used for sidewalks. This has also changed and all go now to make the rolled Macadam road. It is often asked what holds Macadam roads together, and only too often receives for an answer "that the roller, by shaking and pounding the mass of loose stone placed on a road finally compresses the stones together until they are almost, if not quite, as compact as solid rock." In the first place the roller does not compress the stone to its original volume, that is, it does not reduce the voids to zero. Secondly a road is never bound when the rolling is finished unless a binder has been added. It is well known that the voids in loose machine broken stone are about 40 per cent., and in order to reduce these voids to zero 6 inches of loose Macadam would have to be rolled to 3.6 inches. Upon a firm foundation where no stone can be lost in the sub-grade, 6 inches of hard broken stone has never been rolled to 4 inches, or a reduction of the voids to much less than 20 per cent. These voids must be filled and what could be better than to utilize the screening for such a purpose. Trap rock should always, if possible, be used for surface work, while sand stone or slate may be used for bottom course. Most text books give the different stones with co-efficients of wear and from it can be determined whether the locality can supply the desired material to make good and satisfactory work. Atmospheric influence has a great effect upon the durability of a stone, for a rock that really absorbs water, as does loose grained sand stone or slate will quickly go to pieces under the action of frost. Although sandstone or slate are not so desirable for surface yet it is not to be assumed they are not suitable for the bottom course surfaced with 2 or 3 inches of trap rock, and this is usually good practice because trap will outwear limestone or any other soft rock several times over.

In quarrying it is most essential, if cost is to be considered, to open where considerable depth of face can be obtained, and where little stripping is required. Drilling ought always to be done with power drills, and it is well to remember the cost of quarrying increases rapidly as the depth of the hole decreases; therefore it is desirable to make the hole not less than six feet deep. The cost of dynamite also varies as the depth of hole, decreasing per cubic yard excavated as the depth of hole increases. The crushing is more a question of the mileage of road to be constructed, and where a very large plant can be used the cost can be reduced considerably.

A good serviceable crusher, having a 9x15 opening, should in 10 hours verage an output of 60 cubic yards. The use of a rotary screen is necessary, having three sizes of circular openings 1-3, 14, and 14, as the screenings are required to be kept separate to ensure the even distribution of the binder throughout the road. Bins should also be created to receive the broken stone and avoid re-handling.

Some specifications under the heading of spreading compel dumping on boards, as it is claimed that dumping a load in one spot results in undue consolidation at that place, but if the spreader knows his business and tip-bottom wagons are used, he will not allow the load to fall all in one place, but dump in several small heaps, since to do otherwise would make work for himself. When the output of several crushers are daily placed on the road, a Stuart grader may be used to advantage as the blade will level on an average 500 cubic yards per day, thereby saving

## FANNIE HAS BEEN VERY UNFORTUNATE

Married and Divorced Four Times in Russia—Now After Fifth Divorce—Ill-treatment Alleged.

New York, April 6.—Mrs. Fannie Rosen, No. 215 Monroe street, has not been precisely fortunate in her matrimonial ventures. Yesterday in the Supreme Court she began suit for separation from her fifth husband, Harry Rosen, who lives at No. 115 Broome Street. Mr. and Mrs. Rosen are each fifty-five years old and have been married a little over a year. The husband is represented by Aaron J. Levy and Miss Frieda Thomas, well known as the "Little Mother of the East Side," has undertaken the case for Mrs. Rosen.

"Four separate times my client was married in Russia," Miss Thomas said "and was later compelled to get a divorce because of ill treatment on the part of her husbands. They simply had gone through the ceremony expecting to get hold of her little savings. Then if she objected they were cruel to her. If they succeeded in getting it they deserted her. Finally, heart-weary and disgusted, she came to America, where some of her children had preceded her.

"She went to work here, saved up about \$200 and married again."

## MICHIGAN PARTLY DRY

Detroit, Mich., April 4.—More than 300 saloons were voted out of business by the people of nineteen Michigan counties today. Of the thirty-six counties, where local option elections were held, the one county not heard from is Oscoda, where is said to possess only one saloon, so the returns are fairly complete. Nineteen counties voted "dry" and sixteen voted for license.

Detroit, April 5.—Complete returns from 36 counties in Michigan where local option elections were held yesterday, show that 20 counties voted "dry" and 16 "wet." Of the 83 counties in Michigan 40 will now be "dry" and 43 "wet."

## PART OF THE FUN.

"I propose to open an exclusive hotel; no room less than \$20 per day."

"Don't be too exclusive. You'll find that the richer guests like to have a few poor people around to snub."

at least one cent per cubic yard over hand labor. The screenings should not be dumped directly upon the broken stone, but placed in piles at convenient places along the side and spread with shovels after the rolling has been nearly completed. It is necessary that the metal be well rolled before the screenings are added. If an excess of binder and water are put on before the course stones are consolidated there is no doubt that Macadam can be compacted in a shorter time, but it will be difficult to properly bind the stones if any filler gets between the fragments of stones while they are loose. Careful rolling is essential in completing the street or road but excessive rolling will injure the road, especially if there has been too much wetting, or if the stone is either soft or brittle.

Sprinkling is a variable item usually of little expense in a town where hydrants are conveniently placed. It takes about 4 cubic feet of water per cubic yard of Macadam to puddle the screenings, and an equal amount to keep the sub-soil in compact condition, although in very sandy soil twice as much may be required.

Telford pavement consists of a bottoming of large stones usually no less than 6 inches or not more than 12 inches deep set on edge and supporting a layer of Macadam. Telford is more adapted to wet soils not easily drained and is preferable in a town where the sub-soil drainage has not been properly constructed, or where the traffic is heavy. It is often stated that Telford or Macadam are not economical pavements for a town or city because the maintenance is so costly. If such were the case very many cities must err in judgment by constructing such roads and yet cities after having years of experience in this class of pavement, are still annually constructing miles of it. It is true many Macadam pavements have gone to pieces under heavy traffic, but the same can be said of wood block, asphalt and other pavements where improper construction or where poor materials have been used.

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## Mr. Foxhall Keene Breaks Collar Bone.



Mr. Foxhall Keene.

strong London, April 8.—Mr. Foxhall Keene had a nasty fall while competing for the Ladies' Purse, the chief event of the annual Melton steeplechases. His horse, Precursor II which he brought over from America in the hope of winning the Liverpool Grand National, came down while taking one of the jumps and threw his rider so heavily that Mr. Keene's collar bone was broken. The unfor-

tunate accident naturally marred the day's sport, as Mr. Keene is very popular in the Melton country. Most of the fashionable people who have hunting boxes there were present at the races, including Lord and Lady Lonsdale, Lord Herbert VaneTempest, Lord and Lady Robert Manners, Lord and Lady Gerard and Marquis Cholmondeley.

## REAR ADMIRAL BACON ON FUTURE OF WARSHIPS

### HOW THEY KISS.

(N. Y. World.)

"I have been keeping tabs on the different kinds of kissers who come in here," said Gustave Melhauser, the big porter at the piers of the Hamburg-American line, at the foot of First street, Hoboken, yesterday, "and have found that there are six general types and many varieties. To begin with, there is the whisker kiss, or the Russian kiss, which is given by one man to another. The kissers enfold each other in a giant embrace and, putting whiskers to whiskers, kiss each other on the cheeks. M. Witte, the Russian who came over to settle up the Japanese row, gave us the best example of this when he was in Hoboken. I notice that even the lowest Russians and the Asiatic people bordering on the Russian states when they meet their brothers and friends here have this same masculine kiss, but sometimes bestow it on the lips.

"The sweetheart kiss is distinct from the husband and wife kiss. I can tell German sweethearts from German wives as far as I can see or hear their kisses. I can see the energy of the kiss generating in Heinrich's face as he stands on the dock waiting and watching to catch sight of Gretchen on the ship. When she comes down the plank and—yes, throws herself, that's the word—throws herself into his arms, you can hear the smack of that kiss half way down the pier, a sound to give strength and courage to every male thing that hears it explode.

"There is the 'sent for' kiss! The scared, doubtful kiss of the girl who has come to America to marry a man she has never seen. Perhaps she has been introduced to him by some mutual friend in a letter. Some Swedish man in Minnesota has written home to his old school teacher to find him some girl in 'Sma'land' that will make him a good wife—and here she is. When they finally find each other, and, after due inspection, exchange salutes, it makes one think, generally, of the touching of two icicles.

"Then there is the wifely kiss; you all know that, with its varieties of jealousy and trust; and the kiss of elopers, who have stolen across and salute each other as they set foot on free American soil—a sort of congratulation that they are at last safe—not knowing that the police of Hoboken and the customs inspectors and immigration authorities have a description of them and are only waiting for this signal to grab them.

"And last, there is the holy kiss of the good boy who has come here, made money enough to send for his old mother, and greets her as she comes feebly down the gangplank with the light of wonder and hope in her old eyes, he having come a thousand miles, or two thousand miles, across country, to guide her to the new home he has made for her."

Eighty cent gas in this city seems to have been profitable last year to the gas companies.

The lecturer raised his voice with emphatic confidence.

"I venture to assent," he said, "that there isn't a man in this audience who has ever done anything to prevent the destruction of our forests."

A modest-looking man in the back of the hall stood up.

"I—er—I've shot woodpeckers," he said.—Everybody's Magazine.