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THE CANADIAN ENGINEER

An Engineering Weekly.

SUPERELEVATION OF BRIDGES.*

Superelevation of the outer rail for curves on bridges may be obtained by one of the following general schemes, or a combination of two or more of them:

1. By building the masonry bridge seats out of level or by using bevelled shoes of different heights under the bridge bearings, as in Fig. 1.

2. By building the stringers or girders supporting the ties so that their tops will be out of level (Fig. 2).

3. By capping the trestle bents, either pile or frame, out of level or the equivalent of using a tapered cap, a tapered shim on a level cap or by tilting a framed bent on inclined footings (Fig. 3).

4. By tapering the ties, as in Fig. 4.

5. By shimming under the ties, as in Fig. 5.

6. By shimming under the high rail, as in Fig. 6.

Thirty replies were received to a large number of circulars sent out by the committee and the first five methods above received approximately equal numbers of advocates. No. 6 has no supporters.

Ballasted-floor bridges are not here specifically considered. They solve the question of superelevation at once, without special consideration; although for bridges of this class on curves some provision should be made to prevent trackmen or the action of trains from throwing the rails from their exact prescribed position, else there may be trouble from improper clearance.

1. In Fig. 1 the girders are inclined from the vertical. For moderate elevation it is advocated by twelve replies. Some doubt the advisability of this inclination, on account of the action of the live load; but one thoroughly competent engineer considers that the girders in this position support the loads more conformably to the calculations. It is likely that high speed trains will strain the transverse bracing less, and slow trains more, than if the girders were vertical.

Several object to Sketch "a," on account of the difficulty of building the masonry. If of concrete, however, such difficulty is not apparent. Many advocate securing part of the elevation in this way and the balance in the ties.

Several replies class this scheme as bad practice. It is of course out of the question for truss spans.

2. Thirteen replies favor the scheme in Fig. 2. A few object to it on account of dapping the ties across the grain. Cases are numerous where ties have split when so dapped, necesitating bolts. The scheme is applicable to deck and through girders as well as to truss bridges.

3. **The method shown in Fig. 3 applies only to timber** trestles, either pile or frame. Fifteen approve one style or other of this figure. A few object to "a" as difficult framing or as being unsightly. Plans "b" and "c" require an excess of timber, and "c" furnishes a bad joint for inducing decay.

Plan "d" is advocated by only one reply. The purpose of this style seems to be to secure square framing.

The committee is not a unit on this matter, but those having the largest number of trestle bridges prefer Style "a," and experience no difficulty in its use.

4. Seventeen expressed approval of some style of tapered tie (Fig. 4). All should have a certain minimum depth under the low rail equal to the standard for the stringer spacing in its use.

Several members object to tapered ties of any kind, holding that the regular stock size for straight-line bridges should be used in all cases to simplify labor and material carried for repairs.

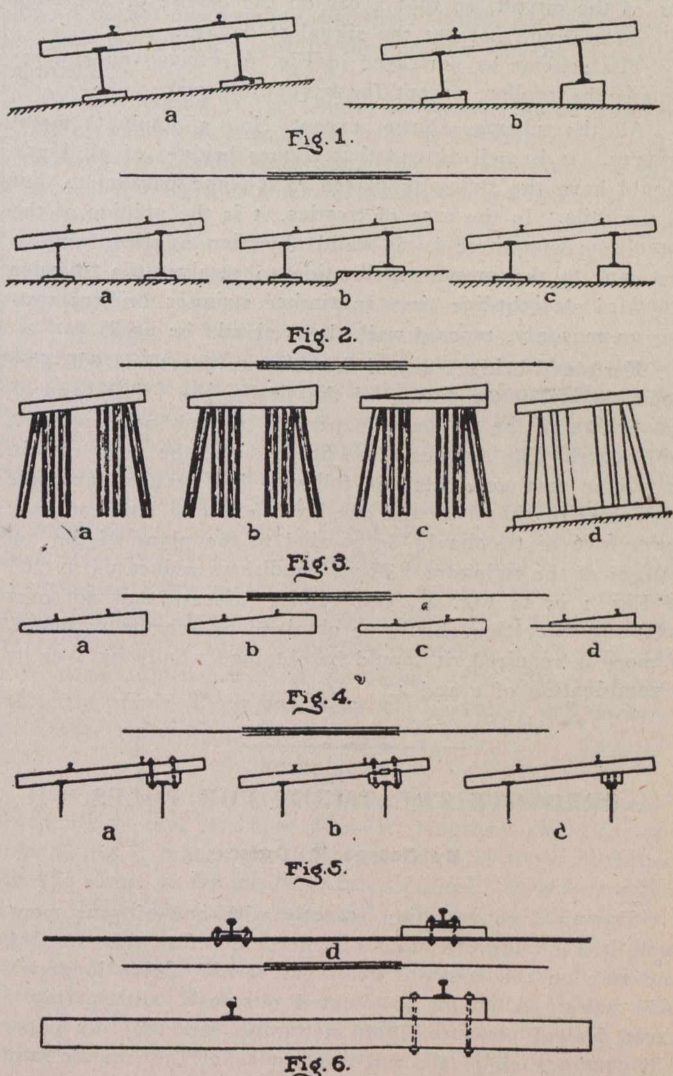

Fig. 1.

Various Methods of Securing Superelevation on Bridges.

Style "b" allows the use of a smaller stick than "a" for a high elevation and is just as efficient.

Style "c" is the standard on the Boston & Maine road for metal bridges. It is somewhat expensive, in that it has to be adzed to shape; but bridges on curves are of no great length and the labor item for a given bridge is hardly appreciable. Its advantage is that the depth at the thin end is not reduced too much for properly holding the guard timber, and the low rail is not canted away from the traffic, as it is on all other inclined ties.

*Committee Report to the annual convention of the American Railway Bridge and Building Association, October 18-20, 1910.

Style "d" is advocated by one reply as a good method on a double-track deck with long ties. The shim is 8-feet long and is well bolted to the tie.

5. Nine advocate shims under the ties (Fig. 5). Several object to these on account of their getting out of place, etc. Plan "b" was used by the Baltimore & Ohio R.R. when 16-inch timber was in style. Plan "a" does not give sufficient elevation and can hardly be subject to this objection.

Style "c" is advocated by some and objected to by others. It is a longitudinal timber as wide as the girder flange and bolted thereto.

Style "d" is used on solid plate-floor bridges without ties. It is objectionable on block signal lines, as perfect insulation is uncertain, which necessitates cutting the bridge out of the circuit, so that a car on the bridge or a broken rail on it would not put the signal at danger.

The scheme as portrayed in Fig. 6 received no support among the replies, except for temporary work.

All the schemes shown except No. 3 apply to metal bridges. It is well agreed that timber bridges of all kinds should have the stringers placed in a plane parallel to that of the rails. In the case of trestles, it is the opinion of the committee that there is no valid objection against framing the caps to the proper inclination to receive the regular standard straight-line tie. In timber stringer bridges resting on masonry, tapered wall plates should be used.

For metal bridges any of the schemes described will give good service, if the fitting of the ties to the bridge and of the bridge to the masonry is perfect, so that no movement will occur. The simpler these fittings are, the more certain it will be that good fits will follow. To secure favorable conditions of simplicity the masonry should be level, and the lower face of tie should be parallel to the plane of the top flanges of the stringers. These conditions reduce us to "b" of Fig. 1 or to Fig. 4. Our replies indicate that not over 4-in. superelevation should be obtained by scheme 1; hence, if more is required, it should be obtained wholly by 4 or by a combination of 1 and 4.

CREOSOTE TREATMENT FOR POLES.*

By George R. Ogier.

During a conversation recently with one of your members, it was suggested that I come here before this meeting and talk on the creosote treatment of our native lodgepole pine poles. Although I accepted this task, anticipating a great deal of pleasure, I am not quite sure that my paper will convince all of the full importance of this matter and subject. However, I have endeavored to set forth the most important phases of the subject, in order to have a paper of a limited number of words, and yet have the desired effect.

First, for the benefit of those not familiar with the general subject of wood preservation, I will relate something of its history. Wood preservation is an old art, and has been practised since the beginning of the 18th century. In 1705 Homberg soaked wood in an aqua solution of corrosive sublimate. In 1730 Job Baster saw the worth of this important subject when treating wood for shipbuilding purposes with an aqua of corrosive sublimate and arsenic. In 1740 Reed used wood vinegar. In 1756 the process generally used for preserving wood was by dipping it in boiling hot wood tar, and then later, about 1812, coal tar was first used by Cook for ships and ship timbers; and in 1838 dead oil of coal tar or creosote was first introduced as a preservative for timber by Mr. Bethell in England. Wood preservation began in the United States on a commercial scale in 1848, when James B. Frances established a cyaniding plant at Lowell, Mass. This plant is still in operation, although the amount of timber treated in it is comparatively small. About 1874 a creosote impregnating plant was established in West Pascagoula, Miss. This was the first plant of its kind erected in this country, and is still in active operation. Since the erection of this plant a number of others have been installed, the most rapid development being along the Gulf of Mexico. The gradual depletion of the timber supply, resulting in an increase in the price of the raw product, has more recently fostered the growth of wood preserving plants, especially throughout the central and eastern United States. In 1904 the total annual output of treated timber in the United States was approximately one-half billion ft. b.m. In 1907 the number of plants had increased to 60, with a total annual output of approximately one and a quarter billion feet b.m. New plants are being erected from time to time in various parts of the United States, and up to date, the timber treating plants number 72.

*Paper read at eighth annual convention, Colorado Electric Light, Power & Railway Association.

Up to the present time creosote has been recognized by our government, and those familiar with the good qualities necessary in wood preservatives, to be the best; it is the most costly and at the same time the most effective in preserving wood.

The preservation of wood from decay by treating it with chemicals which prevent the action of decay is of increasing importance in the United States. From the standpoint of the conservation of our rapidly diminishing forest resources, and the prevention of a possible timber famine, the preservative treatment of timber may be a most effective measure, because it lengthens the service of the wood which is used and therefore decreases the amount necessary to supply the demand. From this point of view wood preservation has a distinct advantage over measures for the growing of more timber, since these measures require years in order to show their effect, while preservative treatment is a remedy which can be applied immediately.

Wood preservation is especially important in the states of the Rocky Mountain region, because of the rapid decay of the most of the native timbers of this region when used in contact with the ground, and the necessity, which grows more pressing with every year, of using these native woods for telephone poles, railway ties, mine timbers and many other uses which expose the wood to decay.

The federal government, realizing the great importance of the subject as a protection against the possible rapid decrease of timber in the United States, actively engaged in educating the western timber users to the advisability of treating the different structural timbers, about 1906. In 1908 the government through the Office of Wood Preservation, erected a simple demonstrating plant at Norrie, Colo., for treating the timber on the national forests. The government's work there was to some extent experimental, inasmuch as it operated upon the fire-killed native lodgepole pine, standing in burned-over forest tracts. As the outcome of these experiments it has been conclusively proven and actually demonstrated that even this fire-killed timber becomes efficient and extremely durable when treated according to the specifications of the nation's scientific experts. But it was not permissible for the government to do more than prove the value of the process, and as the government does not carry on commercial enterprises, they sought private parties to carry on the enterprise, and the plant was sold to the Denver firm, of which I am a member, and now with certain additions to the equipment and enlargement in capacity it is prepared to turn out approximately 53,000 poles and six million feet b.m. of structural timbers per annum.

The Process.

The process used at our Norrie plant is what is known as the "open tank" process. The apparatus consists of three storage tanks, supported upon a platform high enough to allow the creosote to run by gravity into two treating tanks, one circular 10-ft. in diameter and 9-ft. high, and a rectangular tank 12-ft. long, 4-ft. wide and 8-ft. deep. By the use of a derrick the treating tanks are loaded, oil is allowed to enter to a height in the tank sufficient to creosote the pole to the height stated in the specifications, which is about 6-ft. of the butt on a 25-ft. pole, treating all the buried end of the pole and about 1-ft. above ground. The creosote around the pole is now heated to a temperature sufficient to open the pores in the wood, expel most of the air by expansion, thus forming a partial vacuum. This condition is now relieved by turning off the steam, and thereby stopping the hot bath. The hot oil is replaced by cool oil, which penetrates the pole while cooling is taking place. The duration of this cool bath is made sufficient to give the desired penetration for about a 20-year service.

The theory of the above process may be given in few words: The heat of the preservative expands and expels a portion of the air and water contained in the cellular and inter-cellular spaces of the wood tissue, and when the cool creosote replaces the hot there is a contraction and condensation of the air and water which remains. To destroy the partial vacuum thus formed the liquid is forced by atmospheric pressure into the cellular and inter-cellular spaces, a process aided, of course, by capillary attraction.

The ease and effectiveness with which timber can be treated by this process depend upon the kind of wood, and whether seasoned or unseasoned. Air is easier expelled than water, and in our native lodgepole pine timber there is very little moisture; it being fire-killed timber, therefore absorbs the preservatives more readily than green timber.

There is probably no reason for discussing the value of the creosoting process in this report, for it is believed that there is no longer any question at this time as to its positive value, provided it is well done.

Life of Creosoted Poles.

It is not merely the expense of the new pole which has to be taken into consideration, but also all the extra expense connected with it, such as the employment of skilled men to erect them.

The prices of the best grades of wood, such as cedar and oak, are becoming so high that the cost of an untreated pole laid down in Colorado is as much as a creosoted native lodgepole pine pole.

At many points in Colorado a creosoted native pole can be laid down for a less price than the imported pole, and the life of this treated pole is estimated at from five to ten years longer than any untreated pole which can be laid down in Colorado. The following is a table of data compiled by the United States government showing the comparative life of untreated and treated poles:

Species—	Average Number of Years Untreated Life	Average Number of Years Treated Life Est. by F.S.
Cedar	12 to 15	25
Chestnut	8 to 10	20
Lodgepole Pine	5	20
Western Yellow Pine	6	25
Cypress	12	25
Juniper	10 to 13	25
Redwood	12 to 15	30
White Oak	8	20
Douglas Fir	8	20

Some of the above data is estimated from test lines put in by the United States government in co-operation with the American Telephone & Telegraph Company in November, 1906. I do not mean to say that these figures are conclusive, but they go toward showing the benefit of the creosote treatment.

At the meeting of the Dublin Section of the British Institute of Electrical Engineers, held in December, 1902, A. T. Kinsey gave some interesting figures regarding the life of creosoted telegraph poles, of which the following is an extract:

The author has traced the erection of creosoted poles in Ireland as early as 1858, and again in 1861, but a systematic branding of the date of creosoting was not begun until 1873. It is impossible to identify with certainty the poles creosoted before that time. The result of an examination by percussion showed that the poles thus branded are apparently quite as sound as when first erected. Poles dated 1877 were being taken down, but were apparently as good as new, and would pay for re-erection.

The best available figures on the life of creosoted poles are from the German Postal and Telegraph Department, which after 52 years of observation gives a life of 21 years for creosoted Baltic pine. The use of creosote for preserving timber has been shown by the experience of the English and French lines to be beyond question a method which protects those parts injected with it absolutely. Creosote prevents that effect shown by intermittent wet and dry, and makes the timber waterproof.

Advantages.

One of the greatest advantages of creosote treatment for timber is that not only does it lengthen the life of timbers, but it makes the life of all kinds of timber practically the same, so far as decay is concerned. It will readily be seen that if our native pole which, without the preservative treatment, will last but from three to five years, can be made by treatment to last 20 or 25 years, it is much more profitable to use the native pole, which can almost always be obtained at a much cheaper price, than to use an imported pole lasting about 15 years untreated, and for that reason commanding a higher price. The use which preservative treatment makes possible of timber which without that treatment would not be usable at all, is at once a great economy to the individual and a considerable aid toward the conservation of the timber supply. The financial saving is one of the advantages, but being such an important question I have placed it under a separate heading.

The financial saving that would result each year in the United States were a uniform policy of treating timber adopted, is about $72,000,000. It should be remembered that this includes the cost of labor as well as that of the timber itself, and thus represents the amount of money that could be turned each year into other channels, if wood preservation were uniformly adopted throughout the United States.

In the following table I have endeavored to show the estimated annual financial saving by a proper preservative treatment of poles:

Material	Placed	Total	Cost Foot	Years of Life Untreated	Years of Life Treated	Annual Charge Treated	Annual Charge Untreated	Annual Saving	Quantity in Use	Total Amount Saving
$4.00	$3.00	$7.00	$1.50	13	23¼	$0 78	$0.69	$0.09	32,000,000	$2,880,000

This table was figured from averages by the following formula:

$$a = p \frac{1.0r^{n} x 0.0r}{1.0r^{n} - 1}$$

a = annual charge, p = investment, n = years in recurring period, r = int. on investment at 6 per cent.

In many cases the consumers require in their specifications poles of larger diameter than the actual service requires, in order that a certain amount of deterioration by decay shall be allowable before replacement is necessary. For example, it is computed that a circumference of not less than 28-ins. of sound wood in the pole at the ground line is required to support the strain to which the line is liable to be subjected, and the poles used have a circumference of 36-ins. at the ground line, then 8-ins. of deterioration or the equivalent of a depth of decay of approximately 1¼-ins. is allowable before replacement is required.

In some species otherwise durable the sapwood decays very quickly. Untreated white cedar poles in Georgia, inspected after being set in line four years, showed 45 to 50 per cent. of the number with sapwood completely decayed at the ground line, which amounted to an average deterioration of 4-ins. in the circumference equivalent to an average depth of decay of fully ⅝ of an inch. Cypress poles in Florida, inspected after being in the ground seven years, showed an average depth of decay of 0.8-in. at the ground line. The heartwood of these poles is sound and in nearly all cases is of sufficient dimensions to meet the requirements of the line in which they are used, although graded by the butt circumference they fall decidedly lower than their original class. If poles originally of the same grade represented by these poles after the sapwood has decayed, had been used, and the butts well treated with creosote so that their full size and strength would be maintained, not only wou'd the poles be equally as strong as the ones now in use, but their ultimate length of life would be greater. The difference in cost between the two grades of poles in some cases would largely offset the cost of the treatment. It appears that pole users are paying money to secure large diameter sizes of poles in order to secure longer life, that might more profitably be spent for preservative treatment. The possibility of using lighter poles and giving them preservative treatment so as to maintain their full size and strength is one that merits the attention of all pole users.

Wood preservation, then, accomplishes three great economic objects:

(1) It prolongs the life of the durable species in use;

(2) It prolongs the life of the inferior and cheaper wood;

(3) It enables the utilization of those inferior woods, which, without the preservative treatment, would have little or no value.

I believe, and most any one who has considered this important subject will agree with me, that the time is at hand when all companies will find that they are obliged to have all their poles creosoted, as at the present high prices of both labor and poles it is too expensive to have to be constantly renewing them.

SUPERVISION OF MUNICIPAL WORK.*

By Will P. Blair, Indianapolis, Ind.

There are many questions with which we come in close contact, or with which we actually must deal, that are mooted or about which we disagree with reason or plausible excuse, but under a wide range of experience and observation there comes to us much that is so utterly inconsistent with human reason or intelligent purpose, that, from our view point, at least, it is utterly inexcusable. Common with all, municipal matters come within these limits. Try as we will, to those of us whose business brings us into contact with, or to those who are making special study of various municipal problems, it would seem that they bear a burden of undue proportion of evils unreconciled within the bounds of reason. So many things are so inexplicably inexcusable that we sometimes want to characterize them softly because we are ashamed to speak the naked truth. But how can we hope to correct abuses unless we hold them up to view with all the daylight of truth, with severest search and utmost scrutiny? The very name of this society suggests that its purpose is to strive for progress and advancement in municipal concerns. Fault and dereliction should be replaced with corrected measures and integrity of purpose.

How shall we make competent and honest but by pointing out the awful examples—the inefficient and the unreliable? The public welfare does not suffer altogether from a single agency, or from several agencies. The public is frequently neglectful in some—perhaps many—ways of her own interests. Stupidity and carelessness on the part of the public is no less to be condemned than when found in the individual. But the sentiment that the public deserves all she gets, and possibly more, simply because we naturally expect that some one is on hand at all times in this country, stirring the public to alertness and watchfulness—oftentimes in the directions even from which comes no alarm—is the excuse of the petty grafter, and is unworthy of a trusted public official or employee. If there is to be a distinction in the honesty of dealings, let them be more honest when dealing with the public. The public is practically helpless in our hands, and for this reason alone should command our most honorable service.

Very recently, in a city of less than 75,000 inhabitants, a street was to be improved, in fact was being improved, of which the wearing surface was vitrified brick. A 10-inch concrete base, 1½-inch sand cushion and 5-inch vitrified block, cement filled, were the features of the specification.

What possible reason could be advanced for the use of a 10-inch concrete base?

Why the 5-inch block in such a city?

Why the 10-inch concrete base?

We are not, however, calling in question such a specification because there is any lack of merit. In these two particulars the specification was simply overdone; but we do question the extraordinary expenditure enforced by this specification in view of what followed in the application of the cement filler.

A member of the Board of Public Works was found upon the street supervising the construction. He permitted the expansion cushion to be poured in prior to the application of the cement filler. This hot liquid ran back into the joints more than three bricks' length, subsiding, in many cases, one-half of the height of the brick. In the application of the cement filler it was allowed to be mixed in a box that of

*A paper before the American Society of Municipal Improvement.

necessity was up-ended slowly in floating out the mixture upon the pavement. As it reached the upright position in this operation, a man, detailed for the purpose, threw a bucket of water into the box each time, so that a portion of the sand, going out of the box last, went out entirely cleaned of cement. The sand was put into a wheelbarrow and wheeled to these boxes; the proportion of sand was greater than one-half (at least an uncertain quantity), because it was not measured. A sack of cement was then put into the box and the same only stirred three times over with the hoe. In no instance was it brought to an even shade by the mixing process. The water thrown into the box while in its upright position only assisted in washing the cement to the gutter, so that in the gutter and into the place for the expansion cushion went the mixture of almost pure cement, while the crown of the street was filled with a mixture not richer than four parts of sand to one of cement; in certain parts not even so rich as this, and owing to the large quantity of the mixture deposited on the street at one time, and the water flowing promptly to the gutter before it could be swept in, it left the mixture thick enough to bridge the interstices, so that many of them were not filled at all. The use of the squeegee at angles of 45 degrees seems not to have been suggested at all to prevent hollowing out the interstices.

Even a member of the Board of Public Works contended that the application of the expansion cushion as mentioned was required by the specifications under which the street was being built, but an examination of the specifications showed them to be correct and the board member wrong. From the ignorant manner of putting in the filler the disastrous results could readily be observed, even while the work was going on. But the incongruity of the affair: such lavish expenditure of the taxpayer's money on the one hand and such woeful ignorance on the other—yet all this in a vigorous American city of unusual thrift and intelligence. The condition of that street even one year hence is perfectly apparent through this operation, the cement bond having already broken on a portion of the finished street. In less than one year the whole street will be in a far worse condition than it should be at the end of twenty years' use.

Contrast, if you please, the condition of this work with that of the five-year-old finished street, Jennings Avenue, Cleveland, O. Though utilized by two street car tracks, its beauty, utility and satisfaction as a city street and the extraordinary care and skill with which it was constructed are scarcely possible of description. Its very sight is inspiring. You can cross and re-cross the street without any knowledge of the car tracks, if you but close your eyes. Not a single wave, depression, jolt or jar discernible, either to the eye or by use of the street. The foundation is but 6 inches and the brick are but 4 inches in depth, and, although the traffic is four or five times that of the street just mentioned, its five years in use have in no wise reduced its worth. It bears every evidence and every promise of 100 cents on the dollar in value at the end of ten or fifteen years in use. If it were possible to afford a critical examination of that street on your part at this time, I do not think you would call me extravagant if I would say twenty-five years in use would not depreciate its value sufficient to call for repairs. In the one case may be found a sacrifice of $65,000 upon the altar of ill-considered plans and unskilful and ignorant execution. In the other, the investment of a like amount is maintained at full worth and answering its purpose completely.

In one of our larger cities another brick street was in construction. In this case the specifications were right. The concrete foundation was put in in fairly good condition, but should have been much smoother. The sand cushion was not compressed, and was much intermixed with sticks, wood and broken stone. The brick were dropped into the street regardless of best edge up. The provision for expansion was a board 5 feet in length, 3½ inches in width and ⅜ of an inch in thickness. The board was taken out and the expansion cushion even poured before the rolling of the brick, preceded, however, by the filling of gravel in the crevices at least one-half way up the brick, to prevent the roller from closing the opening entirely. The rolling began at the crown instead of the gutter. A husky, muscular fellow was delivering the portion of sand in a wheelbarrow, while a physically weak and decrepit one was delivering the cement. The proportions corresponded to the individuals doing the work. This mixture of sand and cement was made upon the sidewalk, shovelled dry upon the street, shot at with the hose. Most of the cement went into the sewer. This was overseen by an inspector in constant service for the city, supervised by an engineer, but all characterized and dominated by an ignorant contractor, in constant complaint with the citizens and officials to the effect "that it was impossible for him to make a good street, being compelled to use brick that were for the most part culls;" yet in truth and in fact I have never seen a better delivery of brick anywhere.

The engineer was not the commander, but the menial, so servile that his suggestions were met with virulent abuse from the contractor—yet this job involved an expenditure of not less than $100,000.

Suppose you, under circumstances of this sort, that satisfaction could be guaranteed, and that the money was not thrown away? But the tension and irritation of this experience was greatly relieved by another experience, but not in the same city, yet where a like contract was being executed. At its very inception the engineer, deputies and inspectors were upon the ground. Intelligence and sound judgment were exercised in every detail, and, though the contractor stormed and fumed, he soon realized that he was bound, hand and foot, to the specification as it read. Neither argument, abuse nor irony affected in the least bit the attitude of the engineer. The contractor, in less than one hour, reversed his disposition and skilful results followed, yet no more and no less was expected or required of this contractor than that which was written in the specification. The cost of the improvement was about the same in the aggregate as the one mentioned preceding, but the taxpayer got value received, dollar for dollar.

A picture of future results is fully and fairly illustrated by what was observed by the committee on brick paving from this society in a little trip taken by them in July, in the condition of Linn Street, Cincinnati, and that of Holmden Avenue, Cleveland. Each about the same length of time in use, of similar brick and similar use, but what a difference by contrast in the present condition! Measured by money value, a difference of about 90 per cent., but that difference as found to-day was simply the difference that might have been observed at the time the two streets, respectively, were built.

These observations, gathered fresh from the field within the past few weeks, seem extreme, but they fairly represent the ebb and flow of the tide in character and practice of municipal work, and, while these illustrations involve only brick street construction, such conditions are not confined to brick street construction alone, but permeate all branches of municipal work, and to an extent that is absolutely alarming, and afford a black spot upon municipal government in this country.

Is it not, therefore, the duty of every patriotic citizen to change this state of affairs? Is it not the duty likewise of every engineer to eliminate from his profession everything that attaches to, confronts, hinders or delays the exercise of professional duties in the most advantageous way for the benefit of the public welfare? How may this be done? We may be sure it never will be done by efforts outside the profession. It may be inaugurated, insisted on, even demanded, on the part of and by the profession itself, for professional practice does not end with plans; it terminates only with execution. Co-operation and sympathy on the part of the public must be obtained in order that our own efforts shall be effective to the end sought. A remedy for these conditions must be sought for personally, individually, by the engineering profession and by the combined influence of just such organized force as that of the American Society of Municipal Improvements. In fact, it is right and proper that this society shall go down in history as the one society taking the lead in this matter, for here we have the combined influences of professional engineers, of municipal officials, and those whose business it is to serve the public through them.

I wonder if the lights of the General Electric Company would at this time have been developed to that world-wide extent if the manager had sat in his chair, and taken on, as assistants to his leading engineers, help based on recommendations of personal quality alone. Rather, have they not succeeded by seeking out almost entirely a class of thoroughly trained collegiate engineers, who could readily grasp every detail of their work, and thus be able to soon acquire efficiency in their service? The engineer in such an institution may be heard attentively by the hour, in the urgency of his suggestions toward perfection and the adoption of detail, which has contributed so greatly to the success of our commercial enterprises. In municipal matters, more in the past than in the present, "Mike" or "John" or "Jim" was chosen to assist the engineer because of his acquaintance and political influence in his ward, and this, and this alone, is his recommendation.

"You must get along as best you can with the men we furnish," comes the order from higher up to the municipal engineer. "The ordinance of the council prevents my writing the specification as it should be written; my hands are tied; McDougal & Flannagan must have this contract."

These are the hindrances to the reforms suggested, and these are the hindrances that must be removed, and these are the hindrances that will only be removed upon demand by the engineering profession of America. When shall this be done? I say now! The sear is being rubbed off the public conscience, and it is now in better condition to receive the medicinal dose than at any time heretofore. You who are simply city officials join hands with the engineers in a resolution from this body that shall reach to the core of the evil.

THE PUBLIC SIDE OF STREET RAILROADING.*

By Patrick Calhoun.

Theoretically, the public side of the question should be confined to three propositions:

(1) That the complicated machinery and organization of a street railroad system shall result in cheap, first-class and efficient service.

(2) That the best methods of granting the use of streets for transportation purposes shall be adopted, and full payment be made for such use.

*Abstract of paper read at convention of American Street & Interurban Railway Association, held at Atlantic City, N.J., October 10 to 14, 1910.

(3) Whether a higher return for the use of the streets and a better and more efficient street car service thereon can be more cheaply obtained through pubic than through private operation.

In every city of the country the problems of street railway transportation are receiving the attention of the most skilled and competent men, yet no questions affecting our city life have created more virulent, demagogic attacks, have been discussed with less intelligence or more bitterness. The politician, the yellow journal, and the muckraker have combined to misrepresent the position of the railroads. Managers and owners are falsely charged with being the chief source of corruption in city government, and the effort is being made to separate them from the balance of the community. They are denounced as the enemies of society. The result of these attacks has been in a notable instance, in the city of Cleveland, to throw a perfectly solvent, splendidly managed property into the hands of receivers; to make many conservative investors fearful of the future of the securities of street railroads, and to place such securities in the speculative, instead of in the investment class, where they belong properly.

The reason for this is twofold: The railroad management is brought in contact with every phase of city life; every character of request for assistance is made upon it, from a contribution to a church bazaar to a contribution to an international exposition; from furnishing a special car for an infant's baptism to a funeral car for a man's last ride; from the just demand for increased service during the busy hours of the day to the unjust demand of the real estate speculators that unprofitable roads should be built into unpeopled suburbs.

The railroad has no control over the street traffic. Oftentimes its tracks are the only well-paved part of the street; wagons and teams crowd upon them, and an inefficient or inimical city administration, neglectful of the people's comfort, allows the ordinary street traffic to delay the cars. The hurried and impatient patron, who does not see the cause, blames the railroad for the delay.

And this brings us to the second cause for the attacks upon street railroads. There is a growing class of men in all of our cities, socialistic in their views, some sincere, others insincere, who desire to create that condition of unrest and distrust which will prevent further street railroad extension and bring about municipal ownership. With this class the end justifies the means. No attack is too wicked, no misrepresentation too false, provided it aids in the creation of public sentiment in favor of municipal ownership.

Allied with these men are local agitators and ward politicians who hope through municipal ownership to acquire jobs for themselves, or increased power through the increased patronage which would come from public operation.

Allied with both of these are the unscrupulous demagogues who seek support, frequently as reformers, sometimes as progressive reformers, through fostering unrest and discontent, and who believe that so great is the unrest and discontent of the country that popularity and power are to be gained through attacks upon corporations.

There is not an intelligent street railway manager in the country who does not desire to keep his corporation per se out of politics. No class of men is more opposed to corrupt alliance between corporations and politicians; no men more earnestly favor the overthrow of the boss system in party management; no men more sincerely desire non-partisan discussion and non-partisan action in regard to the serious business problems involved in city transportation; no men are better equipped to help the people arrive at correct conclusions on this subject; no men have greater selfish interests or broader patriotic motives in seeking the proper solutions of the problems; no men will unite more cordially with their fellow citizens in an effort to better conditions, materially and morally. They believe earnestly that the railroad companies and the problems involved in their operation should not be made the targets of political attacks, but should be left unmolested, subject to public, non-partisan control, to carry on their business.

They know that co-operation between the railroad, the general public and city officers—cordial, sympathetic, willing co-operation—is an essential to efficient service.

There are two methods by which corporate interests can be protected. One is by their officers and officials apparently abstaining from politics, apparently devoting themselves entirely to business, claiming to be business men and not politicians, and making secret deals with those politicians who will give them protection.

The other method is for the corporate manager to defy boldly the politician, high or low, who undertakes to drive him from a participation in public affairs; to refuse to be blackmailed, to refuse to buy political protection through campaign contributions, to put his trust in the plain people of the country, and, willingly, boldly and fearlessly lay his case or his needs before them.

I advocate, absolutely, clean political methods—bold, fearless, courageous methods—and the establishment in every community, by the men who manage corporations, of a reputation for fearless political courage, until they secure a leadership in civic affairs recognized to be disinterested and for the public good.

I advocate a campaign of education, the widest publicity of the affairs of public service corporations, freedom from entangling political alliances, the sternest integrity in the administration of both the private and the public side of corporate management, and the passage of such laws as are necessary to establish non-partisan tribunals of a judicial rather than a political character, with power to grant franchises and regulate public service corporations.

One of the causes of political distrust of the corporation to-day is that corporate managers have sometimes professed to be out of politics, while they have had secret deals with the demagogue who has been proclaiming his desire to keep the railroad out of politics.

There is no doubt that a campaign of lies has been inaugurated and is being carried on by our opponents. Why should not the railroad interests of the country inaugurate a campaign of truth and go before the people confident that the campaign of truth will win out over the campaign of lies? They may meet with temporary defeat here and there. What of it? Defeat should only be an inspiration for more vigorous action if a man is armed with conscious integrity. The time is ripe for a movement of this character.

A bold, frank, open, courageous course will give any man a standing, whether he is a corporate manager or whether he is not, in any American community.

Railroad managers should take an active leadership in providing the best method by which franchises may be granted with the least temptation to corruption and the best results to our cities. This is a subject upon which all good citizens should unite. Corporate managers do not desire to overreach the people in acquiring new franchises.

No greater misconception exists in the public mind than that the franchises generally of street railways have been founded in corruption. As a matter of fact these franchises were originally granted to the foremost men in their respective communities, often influenced by a noble public spirit and the desire to give to their communities the transportation absolutely essential to a city's growth.

We may admit, however, that the present method, by which the state grants a charter to a public service corporation, and then leaves it to the local legislative bodies in our towns and cities to grant franchises for the use of the streets and to regulate the rates of public service corporations, has been the source of corruption. The system is wrong. So long as greed is strong in the human breast, so long will you find some politicians ready to hold up the corporations until they have exacted their pound of flesh. Nor will the fact that the public laws controlling the city charter provide for the freest advertisement of franchises for sale to the highest bidder meet the difficulty. A striking illustration of this fact has been found in San Francisco. By the charter of that city to-day any franchise for a street railroad must be advertised for 90 days and the bidder must pay a minimum amount of the gross receipts to the city government. At the end of 25 years all the property of the railroad passes to the city without consideration other than the grant of the original franchise.

Some of the foremost gentlemen of San Francisco applied to the Board of Supervisors for a franchise to build a railroad through the sand dunes of what is known as the Sunset District. There were no houses in this district and the streets had not been opened. These gentlemen, who were large real estate owners, determined to open an important boulevard at their own expense, and to build a street railroad into this desert of sand, for the purpose of developing their property and putting it upon the market. The street railroad franchise was of no value. They knew that it could not be made profitable, and that they would be compelled to charge the money which they expended in the construction of the boulevard and the building of streets to the cost of their real estate. It was manifest that it was to the interest of the city that the franchise should be granted, and yet it was held up for months by the Board of Supervisors. Finally, some of the men connected with the enterprise employed a prominent lawyer, who then also occupied the position of a political boss. They paid him a fee. Still the franchise was not passed during his period of political control. Subsequently certain members of the Board of Supervisors were bribed, on a skating rink ordinance, by a set of buccaneer financiers and politicians who had banded together to gain control of the city for personal exploitation. These men offered and gave complete immunity to the supervisors whom they had bribed, provided the supervisors would incriminate, among others, these land owners in the Sunset District. The supervisors promptly accepted the price of their immunity, and declared that they had been promised money by the so-called political boss if they would pass the ordinance for the railroad. The land owners who had projected the road and who were ready to build, and did subsequently build, a splendid boulevard at their own expense, were promptly indicted. The political boss was also given a written contract of immunity, in the hope that he could be forced to incriminate the land owners among others, but it developed that the supervisors never received a cent of money either from the political boss or from the gentlemen connected with the enterprise. The political boss declared that he had received a fee in connection with the road, but that he had never been authorized, directly or indirectly, to pay or promise any money to the Board of Supervisors, and had never done so, and that he would not perjure himself to convict innocent men. The franchise was held up for nearly three years, when the so-called reform administration granted it under the public pressure which had been aroused and the fear of political retribution if they held it up longer. The result was that a most unprofitable street railroad was built, while the assessor states that real estate values tributary thereto advanced 800 per cent.

I suggest that the remedy is for the State to refuse to delegate the power of granting franchises and regulating their rates to varied local bodies, too frequently corrupt and irresponsible, but to reserve this great right to itself; to provide franchise courts or public service commissions composed of a few men of the highest ability, character and integrity, who should have the power to grant franchises only after the fullest public hearing. The court or public service commission should hold public meetings in the different cities and towns. The grant of franchises should be withdrawn entirely from politics and left to such court or commission.

The period when public pressure and the consideration of the public phase of railroading is brought close home to a street railroad manager is during a strike. Then it is necessary more than at any other time for a railroad manager to have a definite conception of his public duties and of his private rights. Tremendous pressure will be brought to bear upon him by civic and religious bodies, well-meaning to the core, but who, without knowledge of the great fundamental rights which lie at the basis of society, are willing to temporize and adopt any expedient which will produce a speedy resumption of traffic.

No man has so great an interest in the stability of property rights as the honest workman, of whatever calling, who has no property except the property to be acquired through his own labor. No prosperity can exist except where there is the utmost protection and safeguard to the rights of the individual in his property, whether it be in his labor today, or whether it be in the results of yesterday's labor which he has husbanded and saved. You cannot separate the rights of man from the rights of property acquired by his labor without depriving him of his liberty and reducing him to a condition of serfdom. Railroad franchises rest upon the law to the same degree that the title to the real estate fronting upon the streets rests upon the law. Both rights were acquired by grants from government, but the rights entrusted to our care are clothed with a public use, while the rights derived from a grant to a piece of real estate may be all private. It behooves us, therefore, more than any other class of men in the country, to study and to understand what are our private rights and what are our public duties.

It is the patriotic duty of the railroad manager, fighting demagogism and socialism on the outposts of society, to stand firmly for the protection of those limitations which form the basis of the liberty of the individual.

NEW INCORPORATIONS.

Hamilton.—Acme Motor, Carriage and Machinery Co., $800,000; H. H. Kittson, P. D. Crerar, W. Southam.

Montreal.—Wayagamack Pulp and Paper Co., $5,000,000; E. Languedoc, C. G. Greenshields, A. C. Calder. Jas. W. Pyke & Co., $300,000; E. Languedoc, C. G. Greenshields, A. C. Calder.

METHODS OF HANDLING TOOL AND MATERIAL SUPPLY TRAINS FOR RAILWAY MAINTENANCE WORK.*

By Mr. A. S. Kellogg.†

This paper is a review of the supply car system as in operation on the Tucson division of the Southern Pacific Co. It is our purpose to deliver on a regular day every month of the year to section foremen and others what material they require for the ensuing thirty days, to pick up all tools in need of repairs, and all scrap on the entire division. We operate as follows:

Two regular supply cars are fitted up, one being the oil car, the other a living car for the supply car storekeeper and his helper, in which is also stored supplies for station men, pumpers, etc. To this equipment are added three common standard freight cars, in which are stored all spikes, track bolts, track tools, etc., for section men, and supplies for signal maintainers on the block signal system, and on leaving El Paso three empty flat cars with side boards and one empty box car, the latter being used to load all second-hand track tools for repairs, such as picks, tamping bars, shovels to be rehandled, etc., as well as all other material of that nature. On the three flat cars is loaded all scrap, the different classes of scrap being separated as much as possible. In one car all the car scrap and second-hand material, such as brake beams and couplers, found along the right of way, is placed. It is always understood that this scrap is assembled at section tool houses and piled conveniently near the tool house close to the track, where it can be loaded in the least possible time. For this purpose an air derrick with a capacity of three tons is used, which with the superintendent's business car and a caboose for the crew makes up the supply train.

This train is run as a special on the 18th of each month and is also used as a pay train, pay checks being delivered to the section foremen, extra gangs, etc., by a regular authorized division paymaster. On this trip are the superintendent, storekeeper and the several roadmasters, who go over their respective districts. At times the division engineer accompanies the train. It takes four days to make the main line trip from El Paso to Yuma, a distance of 560 miles. Every tool house is entered, personally gone over by the superintendent, storekeeper and roadmaster; pump houses, pumpers' quarters and station quarters are inspected. Wherever the section foreman has a surplus of tools they are turned over to the supply cars and due credit allowed. Where he may have an insufficient supply, he is fitted out with what is necessary to do good work. Every tool delivered is inspected. The superintendent knows when he leaves each section that its section foreman is equipped with tools and material to do good work for the following thirty days. Requisitions are always made out by the section foreman, approved by the superintendent, and are in the hands of the supply car storekeeper four or five days previous to the date the supply cars are scheduled to leave Tucson. On the ground oftentimes these requisitions are reduced or increased in quantity, as the case may be, as conditions may have changed between the time the section foreman placed his

*Paper read at the annual convention of the Railway Store Keepers' Association.

†Division storekeeper, Southern Pacific Co., Tucson, Ariz.

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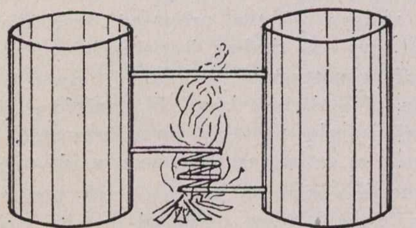
CONCRETE SECTION

ARRANGEMENTS FOR HEATING MATERIAL FOR CONCRETE.

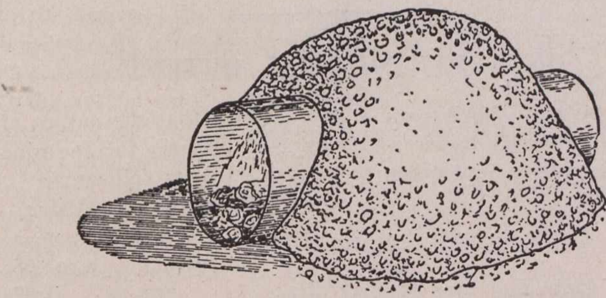
Concrete has become such a universal and necessary material for construction work that the close of the building season in Canada usually sees large quantities of concrete work uncompleted, and the devices which are adopted to maintain heat in the material until it has properly set are numerous.

Recently we saw specifications which stipulated that



concrete was not to be placed where the temperature was lower than 30 deg. F. before there is any danger from frost able, as under certain conditions temperature can be much lower than 30 deg. F. before there is any danger from frost when placing concrete. If it is a large body of concrete, and the sand, gravel and water are well heated, there is no danger from frost at 20 deg. F., provided it is possible to protect the material when in place.

For heating the sand, if it is stored in bins and run directly into the mixer, steam coils may be used, but if it is shovelled by laborers direct into the mixer, one of the most suitable devices for heating the gravel is of cast-iron pipe. The material is heated over a pipe, the fire started inside.



Defective cast iron water pipes are quite suitable for this work. Frequently we have seen sheets of steel or wrought iron used, but when they become heated, they warp and cave in, and thus are not so suitable as the cast-iron pipe.

The accompanying sketch illustrates a simple arrangement for heating the water to be used in concrete work in cold weather. Two barrels six feet apart are used, one placed a couple of feet higher than the other. A piece of two or three inch water pipe is bent into coils and connected up and fire placed under the coil, and as the water flows from one barrel to the other it is heated.

CEMENT CONCRETE VATS AND TANKS.

By Albert Moyer, Assoc. Am. Soc. C.E.

Impervious, odorless, tasteless and sanitary vats and tanks for butter-milk, wine, oil, pickles, sauer kraut, etc., can be constructed of reinforced concrete, the reinforcing to be designed by a competent engineer, provided the interior surfaces are treated as follows:

After the forms are removed, grind off with a carborundum stone, any projections due to the concrete seeping through the joints between the boards. Keep the surface damp for two weeks from the placing of the concrete. Wash the surface thoroughly and allow to dry. Mix up a solution of 1 part water glass (sodium silicate) 40 deg. Baume with 4 to 6 parts water, total 5 to 7 parts, according to the density of the concrete surface treated. The denser the surface the weaker should be the solution.

Apply the water glass solution with a brush. After four hours and within 24 hours, wash off the surface with clear water. Again allow the surface to dry. When dry apply another coat of the water glass solution. After four hours and within 24 hours, again wash off the surface with clear water and allow to dry. Repeat this process for 3 or 4 coats, which should be sufficient to close up all the pores.

The water glass (sodium silicate) which has penetrated the pores has come in contact with the alkalis in the cement and concrete and formed into an insoluble hard material, causing the surface to become very hard to a depth of ⅛ to ½-inch, according to the density of the concrete. The excess sodium silicate which has remained on the surface, not having come in contact with the alkalis, is soluble; therefore easily washed off with water. The reason for washing off the surface between each coat and allowing the surface to dry, is to obtain a more thorough penetration of the sodium silicate.

It is obvious that concrete surfaces so treated, if hard, impervious and insoluble, have been made impervious, tasteless, odorless and sanitary.

TABLE OF PROPERTIES OF CONCRETE.

Proportions.	1†.	2.	3.	4.	5.	6.
1 : ½ : 1	6.8	3.97	$.37	$.34	5,340	...
1 : 1 : 2	9.7	2.79	.314	.274	4,000	...
1 : 1½ : 3	12.6	2.14	.283(a)	.237	3,200	835
1 : 2 : 4	15.6	1.73	.264	.214	2,700	...
1 : 2½ : 5	19.0	1.42	.246	.195	2,300	...
1 : 3 : 6	22.8	1.18	.23	.179	2,000	...
1 : 3½ : 7	26.6	1.02	.219(b)	.169	1,785	486
1 : 4 : 8	30.4	.89	.210	.160	1,625	...
1 : 4½ : 9	34.2	.79	.205	.154	1,500	...
1 : 5 : 10	38.0	.71	.200	.149	1,400	...
1 : 5½ : 11	41.8	.65	.195(c)	.145	1,320	347
1 : 6 : 12	45.6	.59	.192	.141	1,250	...

(a) First-class brickwork in cement mortar, 44 cents per cubic foot.

(b) Good brickwork in cement, 35 cents.

(c) Ordinary brickwork, 26 cents.

*Derived and used by the Aberthaw Construction Company, Boston, Mass.

1†. Vol. in place cu. ft.

2. Bbl. of cement per cu. yd.

3. Cost per cu. ft. broken stone concrete.

4. Cost per cu. ft. gravel concrete.

5. Ult. compr. strength broken stone concrete, 1 month old, per sq. inch.

6. V. ult. compr. strength per sq. inch of brickwork.

RELATIONS OF TEMPERATURE TO TIME OF SET AND STRENGTH OF CONCRETE.

The text books have plenty to say regarding the time required by concrete to set under normal temperatures, but very little indeed as to the conditions when the temperatures vary. In a word, little has been published which bears directly upon the boiler's problem of determining how long to leave centres under concrete.

To assist in providing some definite information regarding this subject the Aberthaw Construction Company of Boston, Mass., through the courtesy of the Quincy Market Cold Storage Warehouse Company and with the assistance of Mr. H. L. Sherman, cement chemist, both also of the same city, have undertaken a series of tests under controllable temperature conditions. Publicity has already been given to some of the results covering a relatively short period. In the following table are given the results at the end of three months.

Temperature of air and materials.	Mixture.	Average tensile strength in lbs. per sq. in. at end of 3 months.
72°	Neat	759
	1:3	305
41°	Neat	660
	1:3	303
34°	Neat	567
	1:3	249
41° (room—7°)	Neat	29
	1:3	9

It will be noted that at a temperature of 72°, the cement showed a decrease in strength from 7 days to 28 days on the neat tests, while on the mortar tests the strength was the same. On the tests at 41°, there was a good increase between these periods on both sand and neat tests, and at 34°, a better percentage increase on both. In the opinion of the chemist this is an illustration of the importance of water on the early strength of cement. At 72°, the excess water contained in the briquettes was evaporated rather quickly, while at the lower temperatures, the rate of evaporation was very slow. Between 28 days and 3 months, the briquettes at 72° showed a very good increase, those at 41° a less decided increase, and those at 34° still less. Apparently cement at low temperatures (above freezing, however) attains less strength than at a normal temperature, but its increase in strength in short times is greater.

It is interesting to note that the cement kept at the very low temperatures finally set and attained a very little strength. It would be interesting to discover whether there would be an increase in strength at later times.

CONCRETE IN THE WOODS.

A striking example of the possibilities of concrete construction in out of the way or inaccessible places is given in a recent report of Lockwood, Green & Company, architects and engineers, of Boston, on a proposed cotton mill in the South Appalachian districts. They advised locating the mill on a plateau or tableland, some 100 feet above the river, from which the power is to be obtained. Although 14 miles from the nearest railroad, the location for the mill is advantageous, being high and sightly with a desirable exposure, well drained on all sides, and of sufficient size to allow ample extension as need may develop. Sufficient room is also available for the erection of cottages for the help, in a high and healthful location close by the mill.

A quotation from the report itself is indicative of the extent Lockwood, Green & Company were influenced in locating the mill at this point, because there was such a material as reinforced concrete of which the mill could be built.

The type of construction to be used in the mill has received considerable thought. The bricks, which are made locally, are of rather poor quality, and we do not recommend their use, and as all materials, except sand and stone, to be used in the construction, will have to be hauled a distance of 14 miles, the use of timber interior construction is not recommended at this time though more detailed study of this feature may lead to a change of view. There is in the immediate vicinity of the proposed development, a large amount of heavy oak timber, but this is not a desirable material for mill construction, although it could be used in the construction of a timber dam. It, therefore, appears to us that the mill might properly be constructed of reinforced concrete and the estimates have been made upon that basis.

In connection with the hydro-electric power development comparative figures were prepared on the costs of a concrete or a timber dam. The following table gives these costs based on a 25,000 spindle mill, which is the size recommended by the engineers.

	Concrete.	Timber.
Total cost of power plant...........	$102,500	$ 83,700
Cost of power plant per spindle	4.10	3.35
Total cost of entire plant per spindle	27.05	26.10
Total cost of plant	676,300	652,500

Comparing these figures it will be noted that the concrete dam only adds about 3½ per cent. to the total cost of the plant. As there is appreciable depreciation on the timber dam, the reliability and permanence of the concrete dam would more than justify this added expense.

ONTARIO'S MINERAL OUTPUT.

Returns to the Bureau of Mines show that the output of the metalliferous mines and works of Ontario for the nine months ending September 30th, 1910, was as follows:

		Quantity	Value
Gold	oz.	1,390	$ 28,729
Silver	"	19,791,033	9,792,669
Cobalt (paid for)	tons of 2,000 lbs..	275	44,884
Copper	oz.	7,168	1,022,436
Nickel	"	13,905	2,989,651
Iron Ore	"	120,358	273,906
Iron Pyrites	"	16,454	44,690
Pig Iron	"	319,698	5,039,626
Zinc Ore	"	700	5,760

Shipments from silver mines aggregated 23,824 tons, of which 19,191 tons were of ore and 4,633 tons of concentrates. The former averaged 768 ounces of silver to the ton and the latter 990 ounces. Gowganda, with six shippers, contributed 402 tons of ore, containing 334,210 ounces of silver. Elk Lake contributes 17 tons of ore; South Lorrain 9, and the Lake Superior district a small production, the remainder being from Cobalt proper. The output of metallic silver from the mines of the Cobalt camp is increasing, being 468,887 ounces for the nine months. During the period 7,069 tons of ore (containing nearly 50 per cent. of the total silver yield). were treated by the silver reduction works at Thorold, Trout Mills, Copper Cliff and Deloro.

The production for the corresponding period of 1909 was 18,751,549 ounces of silver, valued at $9,385,600.

METHODS OF HANDLING TOOL AND MATERIAL SUPPLY TRAINS FOR RAILWAY MAINTENANCE WORK.*

(Continued from Page 706.)

order and the arrival of the supply cars, so that this trip is not only to deliver material but is one of a monthly inspection by the officer in charge of the division with his assistants. The turning in of old tools and material for the new is carried out and followed rigidly, even in the case of material which is not further usable. Every third month the branch line, about eighty miles in extent, is gone over. Every pound of scrap is picked up and when the supply cars arrive at Yuma, the western terminus, the superintendent is satisfied that the division has been thoroughly cleaned of scrap and is in absolutely first-class working order as to tools and material necessary to do first-class work, and also that every man has been correctly paid.

When these supply cars were first instituted so many track tools were collected that scarcely a new track was ordered for nearly two years. Hand cars are also picked up on this trip and left at Tucson, the division headquarters on the trip west, unloaded and repaired. The car with the second-hand tools is also set out, all tools being immediately repaired and all shovels rehandled in the shops, so that with but very little addition of new tools the same tools picked up one month are repaired and given out the following month. Thus the only charge made against operating accounts for this class of material is that of labor and what material is required to repair such tools. With the derrick car all frogs in need of repair, as well as hand cars, are loaded, and almost every trip during the past four or five months there have been picked up wrecked cars, etc., which in each case means the saving of sending the 100-ton derrick and crew to the scene of the wrecked car. The trucks are previously separated by a couple of car men sent out for this purpose on passenger trains in advance. The saving in the operation of the supply cars cannot be correctly estimated, they being so diversified and so many. Following are some of the things they eliminate:

They have reduced O. S. and D. reports on damaged and company freight 95 per cent. They save local freight crews handling this class of supplies, which almost invariably means overtime to them. They save revenue trains handling this class of freight. They save local freight trains from being burdened with a lot of material sent in haphazard from sections and stations from month to month for repairs. They save the loss and leakage of oils on shipments made by local freight and consequent damage to commercial freight, which is often loaded along with company supplies. They pick up all the scrap and get it to the mills, instead of leaving it for the roadmaster to drift a car, which is handled by local trains, set out at station after station, and then the scrap is only half picked up. They reduce complaints from section men and others as to non-receipt of material, as their receipts for material delivered on their requirements are secured.

Before the advent of the supply cars the Southern Pacific Co. ran a scrap train with an extra crew over this division. Upon arrival at Yuma, the western terminus, there had been picked up forty-four carloads of scrap. This was the result of not running a supply and scrap train, but leaving it to drift cars. One may think this a rather bad condition of affairs, but it is safe to say that a great many railroad companies not operating supply cars can do this very thing right now. The Tucson division now averages about ten to twelve car loads of scrap per month, representing all kinds of scrap and second-hand material, and it is surprising where it all comes from, as it often looks as though section men were digging up scrap buried years ago by their predecessors. The Los Angeles division, several years ago, ran a strictly scrap train once only. It took about three months to complete the division, including all branches, and the value of this train figured over $40,000, the operating accounts being credited with that amount.

The tanks in the oil car in this supply car equipment are piped with air pressure drawn from the train line, so it is not necessary to have oil pumps. Oil for the next station deliveries is drawn into oil cans and receptacles between stations.

The division superintendent feels that only by accompanying the monthly supply cars and noting conditions, can an approving officer be qualified to correctly sign these monthly requisitions for material. There was considerable antagonism against the supply cars when they were first inaugurated, but section foremen and roadmasters would now be a unit in opposition against their discontinuance, and they were the ones who looked upon it with suspicion and distrust when first inaugurated. The inspection given by the superintendent and his assistants has had a wonderful effect on the general appearance and tidiness of tool houses, as there was a time when each section man had so much miscellaneous material in these tool houses that they had hardly room enough to get their hand cars inside, and they were still ordering material, which they had buried under sacks of spike hole plugs, etc. The inspection of section men's tool houses and their equipment, as one feature only, is a commendation to the supply cars.

In the interim between the monthly trips, a semi-monthly trip is made to the roundhouses and car shops, where the sub-stores are located. The supply car storekeeper takes their supplies with him on this trip. He goes over their stock where necessary, by checking up their stock books, helping them where necessary to get their stock in order, tag and properly mark it, take away surplus material and give them what they need. The supply car storekeeper is responsible for the general appearance of these outside stores. He sees that all bad order wheels are promptly shipped in to the division store, where they can be worked over; takes a check of baggage trucks and warehouse trucks at each station, and he also makes a trip over the branch every thirty days, though not at the time when the regular monthly main line trip is made.

All scrap is loaded at district terminals before the arrival of the supply cars by section yardmen, and it is only necessary at such points to switch the cars into the supply train. At Tucson all these cars of scrap are gone over carefully, good second-hand material picked out, the scrap being shipped on to the mills. This sorting over and shipping are also done at Yuma.

By Mr. C. H. Rost.‡

On the road with which I am connected there are operated four cars, consisting of: 1. A car with necessary shelves for miscellaneous material and supplies for all departments. The car is arranged with ample space to provide sleeping accommodation for attendants. 2. A car with necessary racks and shelves in one end for roadway tools, in the other end floor space for spikes and track bolts. 3. A car with

‡District storekeeper, Chicago, Rock Island & Pacific Railway, Shawnee, Okla.

(Continued on Page 718.)

ROAD CONSTRUCTION AND MAINTENANCE WITHIN LARGE CITIES.*

By Hector F. Cullan, Superintendent of the Works Department of the City and County Borough of Belfast.

In dealing with the construction and maintenance of roads in large cities the factors which must be present in the mind of an engineer in the choice of the method and materials which shall be adopted for providing the surface of a roadway are as follows: (1) The conditions of traffic; (2) the cost per annum of present maintenance and cleansing; (3) the cost per annum of maintenance and cleansing of any proposed method of surfacing, together with first cost of road construction, where such a change is required; (4) the future development of the district, and consequent future requirements of the road, in respect to traffic; (5) the local requirements in respect to noiselessness, and non-slipperiness under varying conditions of weather; (6) the hygienic qualities of respective methods. Each road, and in some cases sections of the same road, should receive special consideration.

Conditions of traffic.—The nature and volume of the traffic, both mechanical and horse traction, should be carefully ascertained, alike as regards speed, weight (load per axle), width of tyres, together with any special local conditions that may be present.

Present cost per annum.—It is most important that records should be kept, with the utmost care, of the actual cost per annum of existing surfacing, both as regards (a) maintenance (b) cleansing and in determining the cost of any particular road surface; owing to the varying conditions of the seasons it is necessary to take the average of at least three years' records as a basis for calculation.

Cost per annum of proposed method.—Where the question of altering the form of a road surface is under consideration, the cost per annum for maintenance and cleansing, together with the first cost of any reconstruction that may be required, must be determined, and a comparison drawn between the existing cost and the future cost of the proposed work.

Future development of roads.—In all cases most careful consideration should be given to the probable, or possible, developments that may arise in the future, not only of the road under consideration, but also of the district through which it passes.

Local requirements.—The question of non-slipperiness and noiselessnes must be carefully studied, both in respect to gradients and curves, and also in regard to the localities through which a road passes, (a) residential districts, (b) business quarters, (c) shops, (d) works, warehouses, and quays.

Hygienic qualities.—The hygienic qualities principally required in road surfacing are non-absorption and dustlessness. The principal road surfaces now in use are: (1) Macadam (water-bound); (2) tar macadam, including "tarmac," "Tarvia," and other kindred tar-bound roads; (3) sett paving; (4) wood paving; (5) bituminous asphalt paving, including Val de Travers and Limmer asphalt.

Foundations.—In dealing with the question of road surfacing it is absolutely essential that the foundation should in all cases be sufficient to support such loads as it may be called upon to bear over its entire area, as any failure or partial failure of the foundation is bound to destroy the surface, no matter how carefully the materials have been selected or how skilfully the work has been done.

Macadam (water-bound).—The essentials in the formation of a good macadam road surface are—the selection of a thoroughly tough stone which has been carefully broken to pass through a 2-in. ring, and after having been rolled into position the proper amount of small stone chippings added and brushed in, which shall be exactly sufficient to close the interstices between the stones without unduly choking the road with fine material. During the rolling operations which are necessary to thoroughly consolidate the road a certain amount of water is required, which varies according to the state of the weather; but from the result of careful experiments the author is of opinion that the quantity of water used for this purpose in many cases is considerably overdone, and that in wet weather, on flat roads, little or no water is required. In Ireland in the driest of summer weather not more than four gallons of water per square yard of road surface is required. A final coating of gravel, about an eighth of an inch in depth, greatly assists in finishing the road surface, and protects a new road from the effects of traffic. The cost of surfacing a macadam road to a depth of 2½ in. is from 6d. to 1s. 6d. per square yard, according to local conditions.

Tar Macadam.—The results of tar macadam surfacing are largely dependent on the manner in which the tar solution is prepared. Care should be taken that all water or volatile oils are removed, and that the tar be applied to the stone at a boiling temperature. The stone should also be hard, free from all dust, thoroughly dry, and warmed to a temperature of 100 degrees before being coated with tar. Care should at the same time be taken not to scorch the stone in the drying process. Various systems are in operation in preparing and laying down tar macadam, with the object of obtaining a road surface absolutely impervious to moisture, and having all the stones bound together into one homogenous mass. The full thickness of a surfacing of tar macadam, after having been thoroughly consolidated, should be about 4 in., a 2½-in. layer of 2-in. tar macadam being first laid and gently rolled, this being covered with a second layer 1 in. in depth of 1-in. material, which is again firmly rolled down and finally covered with a top layer half an inch in depth of ½-in. material, the whole road being then thoroughly rolled and consolidated. In practice it will be found necessary to somewhat exceed the thickness of each layer, to allow for consolidation. Where the road foundation is found to be moist it is desirable to spread a fine coating of ½-in. tar macadam before laying the 2-in. material. After the road has been laid for about six months and the surface has become hardened, a coating of hot tar thoroughly brushed in greatly improves the surface and adds to its durability. The cost of laying a tar macadam surface of existing foundations varies from 4s. to 5s. per square yard, according to local circumstances.

Sett paving.—Sett paving for heavy traffic should always be laid upon a bed of concrete from 6 in. to 9 in. in depth, varying according to the nature of the subsoil. A thoroughly tough, hard stone should be selected for sett paving, which at the same time will not become unduly slippery under horse traffic. To determine the toughness of stone the Belfast Corporation have instituted an impact-attrition test to which all stone proposed to be used for paving purposes is submitted, and no stone is accepted where the loss in

*A paper presented at the second International Road Congress.

dust exceeds a certain percentage. Stone being supplied under contract is also tested from time to time, to ascertain if the quality is being maintained. The results of this test have been found of the greatest value in determining the wearing qualities of paving stone and also for macadam. After careful observations over a period of upwards of five years it is found that the comparison between the test results and those of conditions of actual wear is most remarkable.

The standard size of setts used in Belfast is 4 in. square on head and 6 in. in depth, truly dressed on all surfaces so that the setts can be paved on either end; the setts must be squared and dressed to the exact measurements (4 in. by 4 in.), and the variations in depth must not exceed one quarter of an inch. The 4-in. square sett on the surface affords greater foothold for horses, whilst, as compared with cubes, the extra 2-in. depth in the sett secures greater power of resistance to the rolling action of the traffic, and breaking of the bond. The setts are paved upon an inch bed of compo formed of four parts of gravel and one part of cement, and again grouted with compo of the same strength. Seven days are allowed for the jointing to set before the traffic is permitted to pass over the new paving. The camber of a sett-paved roadway should not be greater than 1 in 50. In some cases the sett paving is grouted with a mixture of pitch and tar. This has the advantage of allowing the traffic to pass over the roadway as soon as the jointing has become thoroughly hardened, but owing to the varying quality of pitch there is considerable risk of the joints not wearing satisfactorily over long periods. The cost of laying sett paving on concrete foundations is 15s. per square yard, without the foundations 10s. per square yard.

Wood paving.—Wood paving, like sett paving, should be laid upon a bed of concrete, and in the case of wood paving the surface of the concrete must be truly floated in cement to correspond with the finished contour of the roadway, and the wood blocks directly laid on to the cement surface. The sizes of wood blocks, as laid in Belfast, are 9 in. x 4½ in. x 3 in. All blocks must be of thoroughly well seasoned wood, free from shakes or other defects, and cut square to exact sizes by machinery. The blocks before being laid should be dipped to a depth of half an inch in a mixture of pitch and tar or creosote oil, and an expansion joint left on either side alongside the curb to allow for the expansion of the wood when the roadway becomes moist. The width of expansion joint allowed is approximately one- ninetieth the width of the paving. To prevent the space being filled with dirt or moisture the joint is loosely closed in with puddled clay.

The author has used both cement and pitch for grouting wood paving, with satisfactory results in both cases; but in some instances, owing to the pitch mixture not being sufficiently hard, with the vibration of the traffic in hot weather, the grouting has worked downwards and forced its way under the lower surface of the blocks, thereby raising individual blocks above the normal level of the roadway. The advantage of pitch as against cement is that the pitch will more rapidly adjust itself to the expansion and contraction of the wood paving, whilst a cement joint has no means of doing this after the bond is broken, and the moisture, therefore, more readily finds its way into the surface of the roadway. Again, the traffic can be at once allowed to pass over the roadway as soon as the pitch grouting has cooled, whilst it is necessary for seven days to elapse to allow the cement grouting to become thoroughly set. The author's experience in the case of hardwood paving (karri and jarrah) has been that the expansion and contraction are greater and more difficult to deal with than in the case of softwood (Baltic redwood). The cost of hardwood paving is 17s. per square yard, whilst softwood costs 15s. per square yard, including foundations in both cases.

Bituminous asphalt paving.—This should be laid on a sound bed of concrete truly finished to correspond with the surface of the roadway. For heavy traffic a coating of two inches of asphalt should be laid, and care should be taken in spreading, where joining up to asphalt already hardened, to thoroughly make good the jointing in order to prevent fractures appearing in the road surface after the work has been finished. The cost of a 2-in. surface of bituminous asphalt paving is 15s. 6d. per square yard, including foundations.

Life of various methods of road surfacing.—Waterbound and tar macadam should in no case be laid on roadways, in large cities, called upon to withstand the heaviest forms of traffic. For suburban roads and in side streets with light traffic both methods of surfacing will be found suitable. The life of a properly formed macadam road surface on good foundations will vary from one to five years, or under favorable conditions even longer, according to the nature and volume of traffic passing over it, and also to a certain extent to the conditions of weather. The increased durability of tar macadam over waterbound macadam on good foundations may be taken in the ratio of three to one.

The life of paved roadways on concrete foundations of best materials and workmanship may be set out as follows: Sett pavement, fifty years (setts supplied to Belfast Standard specification once repaved lower end upwards during this period); hardwood pavement, twelve years; softwood, nine years; bituminous asphalt, fourteen years.

Cost of various methods of road surfacing.—Owing to the varying durability of the different methods of road surfacing—in considering the question of cost—it is necessary to determine a period which will afford a fair and proper comparison between one class of road surface and another. For this purpose the author proposes to adopt a period of fifty years. In dealing with leading macadam roads it is estimated the increased cost of maintenance and cleansing will, in the course of fifty years, vary from 50 to 100 per cent. more than at the present time, due to the increase of wear and tear in consequence of the growing volume and weight of the traffic year by year, and also to the probable increase in the cost of labor and materials in time to come.

CORRELATING SIDEWALK GRADE TO CURB GRADE.*

By Clark C. Anderson, City Engineer, Moline, Ill.

There was, once upon a time, a negro—quietly and expeditiously satisfying his voracious thirst for nature's own nectar, in a melon patch not his own, when the farmer's dog arrived. He had no more than placed a convenient fence as a barrier between himself and the dog when he discovered sand fleas creeping up his legs. With a yell he mounted the highest rail of the fence, and carefully drawing up his legs, sat there ruminating about as follows: "What's I gwine do now? I done los' my melon, dat dawg an' his boss will suah git me if I stays heah, an' I caint git home 'thout goin' froo dem fleas?"

So with the engineer and the sidewalk grade problem in localities where the topography of the city is markedly irregular. He may find escape from the greater isolated problems which may face him, for he has but one proposition at a time to deal with, and his wit may save him. The

*Paper presented at meeting of American Society of Municipal Improvements, Erie, Pa.

sidewalk grade problem is insignificant individually, but it is numerous, persistent and aggravating like the fleas; so that the engineer, as was the case of the negro, "caint git home 'thout goin' froo' em."

Upon unimproved streets the sidewalk grade problem would appear as a very simple proposition of grades and their intersections. As soon as the roadway curb makes its appearance, or, upon streets where the curbs are in place, the question of sidewalk grade comes forth with an astonishing variety of combinations, and especially so at street intersections.

As an illustration I might ask "what should be the elevation of grade for the intersection of two walks at a corner from which one curb ascends at the rate of 4 per cent. with the walk 10-ft. distant, and the other curb descends at the rate of 8 per cent. with the walk 4-ft. distant from the curb?" In this particular case we will have one of two possible conditions: either the walk on one of the streets must be depressed below the curb on that street, thus draining the parking on to the walk, or, if the walk be raised so as to drain the parking to the curb, it will necessitate either steps or a very sharp incline to meet the conditions at the cross street. In such cases we cannot "eat the pie and keep it too" and in the compromise we must determine what conditions of the problem outweigh all others in the solution thereof.

The elements to consider in the establishing of sidewalk grades should be:

1. Service to the public.
2. Hazard to the municipality from the standpoint of personal injury damage suits.
3. Benefit and damage to the abutting property.
4. Beauty of the street.

In considering service to the public it is not sufficient to take account only of what the ordinary able-bodied person is capable of doing, or what the public is willing to tolerate, but honest effort should be given toward bringing the walks provided for pedestrians to such condition that the blind, lame, aged, and women with children may travel along the same with reasonable assurance of safety and with the least effort.

Volume of traffic may enter into the question of service to the public as excessive slopes, steps, and other necessary devices that may be permitted on residential streets of limited extent and traffic might prove hazardous, objectionable and intolerable on business streets.

Uniformity in general plan is also worthy of consideration as man is more or less of an automaton in his actions. Provide one or two of the eight gutters at a street intersection with crossing plates and you will find many people stumbling there, especially if the street light happens to be out of commission, or let a crosswalk drop on an excessive grade at such a place and people will be continually slipping there, on the same principle that your foot will always discover the faulty riser in a flight of stairs

The public at large is disposed to ignore the principle of law as applied to reasonable care to "stop, look and listen," and expect their servants to provide means of travel of such character that this principle need not be invoked by them. We say it is impossible, but many a costly judgment in personal injury suits could have been spared municipalities if a little more attention had been given these insignificant details.

In cities of rugged character topographically, the question of damage or injury to the abutting property due to determining sidewalk grades, and location of the walk as well, often becomes very troublesome. This is especially true on streets where retaining walls have been carelessly built to support terraces, or where buildings may exist close to the street line. Having found a happy reconciliation of utility, safety, damage, and beauty of the street, under such conditions, the engineer may well grin defiance at the most intricate problem in the higher mathematics.

No one may say, in these days of aesthetic endeavor, that the beauty of the street should be neglected for the sake of utility. But the engineer having determined upon a reasonable compromise in the establishing of a difficult sidewalk grade is rather disposed to say, with the fellow in prison for smiling at his neighbor's wife, "To perdition with Beauty! See where it lands me!"

When other modifying conditions may be ignored there are three combinations of circumstances under which hard and fast rules may be laid down for the relationship between sidewalk grade and curb grade, namely: where intersecting curbs approach a block corner on a level; where intersecting curbs approach a block corner on equal, or substantially equal descending gradients; and where intersecting curbs approach a block corner on substantially equal ascending gradients. It is readily seen that there are three other combinations, namely: where a level curb intersects a curb on descending gradient; where a level curb intersects a curb on ascending gradient; and where a curb on ascending gradient intersects a curb on descending gradient; any or all of which conditions upset any fixed rule for this relationship. The three last named combinations are more frequently met with than are the three first named, and the writer will therefore briefly discuss the treatment of conditions most frequently encountered.

The first determinations to be made are, satisfactory transverse slope for the walk, and desirable incline of the parking or that portion of the walk space between the walk and the curb. There is some difference of opinion among engineers as to what these slopes should be. As the writer is using ¼ inch per ft., or the equivalent of 2.08 per cent. for transverse slope in the walk, and a minimum of ½ inch to the ft., or the equivalent of 4.17 per cent. for the slope of the parking on the streets used for residential purposes, these figures will serve as well as any others for the purpose of illustration.

The only useful function of the transverse slope is to drain surface water to the street gutter. This will not be accomplished in the case of walks on level or low grades, using the figure given for minimum in the parking, unless the earth surface is left somewhat lower than the top of the walk, in case the parking is seeded, as the sod will form a mat higher than the edge of the walk that effectually dams the water and prevents its flow to the gutter.

In dealing with transverse slopes we find that the maximum incline in a walk on level grade is the transverse slope perpendicular to the direction of the walk, and that as the grade increases the maximum incline shifts with the width and slope of the walk, so that on excessive grades we find the surface water flowing nearly parallel with the center of the walk. The direction of this maximum incline may be defined as the hypotenuse of a triangle of which the width of the walk is the altitude and $\frac{\text{\% of walk gradient}}{\text{\% of transverse Slope}} \times$ Width of walk is the base. For example, given a walk six feet wide on a 10 per cent. grade with a transverse slope of ¼ inch per foot, we find that $\frac{\%G}{\%S} \times W = 28.8$ ft., and that the surface water will flow diagonally from one corner to the other of a stretch of wall 28.8 feet long. Pursuing this a little further we find that this diagonal is on an incline of 10.21 per cent., as against the prescribed 10 per cent. longitudinal gradient. The combined effect of transverse slope and longitudinal gradient is to increase the prescribed incline of the walk, and to lead the surface water on and along the walk instead of across it, both of which results add to the hazard and discomfort of the public using the walk.

It would therefore seem reasonable to require that surface drainage should be confined to the shortest path across the walk, wherever possible, and that a limiting angle should be fixed beyond which it should not be permitted to go. Assuming that the path of drainage be confined between the limits of ninety degrees and forty-five degrees with the direction of the walk, substituting the value of any required transverse slope, making the base equal to the altitude, and solving for % grade in the formula given, we find that in each case the limiting grade is equal to the transverse slope. This relationship may be best shown by the following table

Transverse Slope Inches per Foot.	% of Transverse Slope Also limiting grade.	Inclination of 45 degree diagonal.
1/8	1.042%	1.47%
1/6	1.389%	1.96%
1/5	1.667%	2.36%
1/4	2.083%	2.94%
1/3	2.778%	3.93%

It will be observed that the inclination of the forty-five degrees diagonal is in all cases approximately 40 per cent. greater than the corresponding transverse slope.

This table gives us working limits for any assumed slope. Thus, assuming that ¼ inch per foot is the minimum permissible slope for satisfactory drainage, and ½ inch per foot is the maximum permissible slope, we find that ¼ inch per foot may be used on grades from 0.0 per cent. up to 2.08 per cent.; that 1/5 inch per foot may be used on grades from 1.48 per cent. (interpolated) to 1.67 per cent.; that 1/3 inch per foot may be used on all grades less than 2.78 per cent.; that ½ inch per foot may be used on level grade only, and so on for any of the other slopes, if the cross drainage is to be confined to the shortest reasonable paths across the walk.

If the surface drainage could be confined to the amount of water falling on the area of the walk alone, if it was uniformly distributed, or if the walk is of short length, the issue here raised would be without point, but this is rarely the case. Property owners will spend considerable sums of money in levelling their premises so as to drain away from the dwellings and toward the street. Private walks and driveways are often water collectors discharging upon the public walks with no regularity of interval and in such manner as to often make the walks unduly hazardous during the cold and wet season. This drainage also has a tendency to wear fixed water courses along and in the walk. For these reasons all effort should be made to rid the walks of water as quickly as possible, and the method here offered will apply to grades up to four per cent.

Again, the principles enunciated are sufficiently obvious to most of us to be axiomatic, but it is not unusual in formal sidewalk specifications to find requirements for transverse slope without regard to grade. The average contractor engaged in this class of work will blindly follow a "rule of thumb" with acquiescence on the part of the average inspector allotted to the engineer, unless explicit instructions to the contrary are issued.

How should walks laid on grades in excess of 4 per cent. be treated?

At first glance it might appear desirable to give the walk a crown similar to that prescribed for pavements, in order that the middle of the walk, which is also the path of the greatest number of pedestrians, may rapidly shed snow, ice and water. It might also appear less objectionable to have a gradually increasing and curved incline on either side of the center than to have all of the incline in one direction across the walk. As the principles already stated for transverse slope apply with the same force to a crowned surface, and for the further reason that this form of construction would have to be built with greater care than is usually accorded this class of work, and at a greater expense, this idea may be dismissed without further comment.

The answer to this question appears to lie in restricting the amount of surface drainage to the area of the walk by either providing suitable depression in the earth surface on either side of the walk, or laying artificial drains to serve the same purpose; the walk should then be laid without transverse slope as the longitudinal incline is sufficient for purposes of drainage.

In connection with the subject of slope in the parking brief mention may be made of the admissibility of steps in sidewalk construction. As a general proposition the writer is of the opinion that they should be avoided wherever it is possible to do so. They are from 400 to 500 per cent. more costly than walk of the same area, exclusive of proper guard rails; they add to the expense of maintaining the parking by creating excessive slopes; they subject the public to needless hazard in sleeting weather; they are dangerous to persons afflicted with bodily infirmities; they add to the lighting bill of the city. These objections apply only to all ordinary conditions. Situations undoubtedly exist where steps afford the only possible convenient means of ingress or egress for the public from one street to another, or from one section of a city to another. On residential streets of short extent, where the lot lines may lie parallel with terraces, and where the street walk may be placed at a considerable distance from the curb, steps may be used with good effect. Cement walks with a float finish, brick walks laid of unglazed brick, and cinder walks, on grades as high as 12 per cent., and possibly higher, may be used by the public with no apparent discomfort at all times except when the walks are covered with ice, and the insertion of steps for the purpose of reducing the grades would appear to be of doubtful economy. Limestone flags and walks constructed of glazed tile in vogue in some sections of this country are slippery in wet weather on relatively low grades.

There is one feature of the prescribed slope for parking that deserves consideration in communities of rapid growth where certain streets in the residential districts are so located as to invite invasion by business houses. In such localities the slope in the parking should be held down to the minimum commensurate with satisfactory drainage in order that the walk may be extended out to the curb without creating an excessive inclination or needlessly requiring building up over the top of the curb.

Given two walks A and B located parallel with corresponding curbs a and b.

Let Aa = Distance between curb and walk A.
Bb = Distance between curb and walk B.
Wa = Width of walk A.

(Continued on Page 724.)

NATURAL GAS IN ONTARIO.

Increase in Production—Legislation to Prevent Waste —List of Gas-producing Concerns.

The production of natural gas in Ontario has much increased of late years. In value it amounted in 1909 to $1,188,179, an increase over the yield of 1908 of $199,563, and being the largest output yet recorded. For the last four years the quantity produced has been as follows: In 1906, 2,534,200 thousand cubic feet; in 1907, 4,155,900 thousand; in 1908, 4,483,000 thousand; and in 1909 about 5,388,000 thousand cubic feet.

The output comes from three fields, namely; Welland county, Haldimand and Norfolk counties, and the counties of Essex and Kent. The Haldimand-Norfolk field is the largest producer. The people of these districts, and of the cities, towns and villages outside of the actual gas area to which it is piped, enjoy a great boon in the use of natural gas for fuel purposes. It is an ideal fuel. It is cleanly, leaving no ashes and producing no smoke; it can be turned on when wanted and turned off when its work is done, thus eliminating waste entirely to the careful user; and it is much cheaper than either coal or wood.

The possession of natural gas is an important advantage for the householder as well as to the manufacturer, though it seems a pity that a fuel so suitable for domestic use could not be preserved for that purpose only; and as the quantity, no matter how large it may be, is in any field limited, it is naturally an object of prime importance to the people in that field to conserve the supply to the utmost.

Act Passed to Prevent Waste.

To assist in doing so, the Legislature in 1908 passed an Act to prevent the wasting of natural gas and to provide for the plugging of all abandoned wells, by which power was conferred upon inspectors appointed under the Act to enforce the stoppage of waste. The Supplementary Revenue Act, 1907, also contained provisions which were even more effective than those of the above-mentioned Act, and the enforcement of these laws has reduced the waste of gas to a minimum. Probably not less than 200,000 people in Ontario are now using natural gas, and extensions of pipe systems, etc., are now in progress, which will result in a large increase in this number.

From the Haldimand-Norfolk field gas is piped to Hamilton, Dundas, Galt, Brantford and other places; the Welland field supplies St. Catharines, Niagara Falls, Bridgeburg and other towns and villages; and from the Kent-Essex field people in Chatham, Leamington, Blenheim and elsewhere are supplied. Franchises have been obtained by the Volcanic Gas and Oil Company from the city of Windsor and the towns of Walkerville and Sandwich, and gas is to be delivered in these places from the Kent field by 1st December, 1910.

List of Gas-Producing Concerns.

The principal gas-producing concerns are the following: In Welland, Provincial Natural Gas and Fuel Company, Buffalo, N.Y.; United Gas Companies, St. Catharines; Port Colborne-Welland Natural Gas and Oil Company, Port Colborne; Welland County Lime Works, Port Colborne; Bertie Natural Gas Company, Ridgeway; Ontario Iron and Steel Company, Welland; Sterling Natural Gas Company, Port Colborne; Empire Limestone Company, Buffalo, N.Y.; Industrial Natural Gas Company, Welland; in the Haldimand-Norfolk field: Dominion Natural Gas Company, Pittsburg, Penn.; Producers' Natural Gas Company, Hamilton; Norfolk Gas Company, Port Dover; Selkirk Gas and Oil Company, Selkirk; Dunnville Gas Development Company, Dunnville; and in the Essex-Kent field: Volcanic Oil and Gas Company, Niagara Falls; Beaver Gas and Oil Company, Leamington; Maple City Oil and Gas Company, Chatham; and Leamington Oil Company, Detroit, Mich.

The Essex-Kent and Haldimand-Norfolk gas fields are proven to the edge of Lake Erie in both cases, and a natural inference was that the gas-bearing territory would be found to extend under the waters of that lake. A number of leases have been granted by the Crown authorizing the sinking of wells for gas and oil on parts of the lake bed in front of Rainham, Walpole, Charlotteville, Romney, Tilbury East and Woodhouse townships. Good wells have been found on several of these leases and a corresponding addition has been made to the gas-yielding area.

INSURANCE OF WORKMEN.

Statistics of Europe Reveal Some Interesting Facts—Norway Has a Compulsory System.

In most of the States of Europe, with the exception of Germany, Austria-Hungary, Norway and Luxemburg, such insurance is not compulsory, but is a matter of mutual understanding between employer and employed. The following table shows the comparative amount of insurance paid out by the sick funds (Krankenkassen), and also gives the number of insured:

Country.	Population.	Number of insured according to percentage of population.	Per cent.
Germany	63 millions	13.2 millions	26.9
Austria	27.8 "	3.4 "	11.2
Hungary	21 "	0.8 "	3.8
Luxemburg	2.510.000	36.079 "	14.4
Norway	2.410,000	440,000	18.3
Italy	33 millions	1 million	3.3
France	39 "	4.1 "	10.5
Belgium	7.4 "	0.42 "	5.6
Great Britain	43.5 "	6.1 "	14.0
Sweden	6.4 "	0.585 "	10.8
Finland	3 "	44.859 "	1.5
Netherlands	5.8 "	0.6 "	10.3
Denmark	2.7 "	0.626 "	23.1

	Millions per Insured.	Amounts paid in millions of marks.
Germany	35.2	26.6
Austria	55.1	18.1
Hungary	15.8	19.2
Luxemburg	1.2	33.5
Norway	—	—
Italy	—	7.5
France	—	8.5
Belgium	3.8	9
Great Britain	—	—
Sweden	—	10.77
Finland	—	9.61
Netherlands	—	6
Denmark	—	8.07

Employer Pays One-Third.

In Germany the employer pays one-third and the employee two-thirds of the fees. Norway has a compulsory system for all branches of industry up to salaries of M. 1,515 for cities, and up to M. 1,350 for the country districts. The system was introduced last year. The fees are borne for the greater part by the workmen themselves (six-tenths), two-tenths by the State, one-tenth by the local authorities, and only one-tenth by the employer. Statistics compiled by the Imperial Statistical Office on Accident Assurance are not nearly as complete as the foregoing. Accident insurance in Germany comprises all workmen and persons employed in trade and agriculture drawing a salary up to M. 3,000. Of Germany's sixty-three millions, in the year 1908, 23,700,000 persons, or 37 per cent., were enjoying the benefits of accident insurance. Contributions of the Federations of Labor (Berufsgenossenchaften) amounted to M. 181,600,000, borne, too, by the employers.

Expense of Accident Insurance.

In Austria, where the employer bears most of the expense of accident insurance, 11 per cent., or 3,800,000 persons, come under the insurance Act, averaging M. 7.70 per capita. The workman pays 10 per cent. In Italy, with a population of thirty-three millions, 1,800,000, or 6.1 per cent., are insured.

The average amount paid by the employer is M. 6.50. In France the employers contributed in 1906 M. 65,400,000. In Luxemburg, of 250,000 inhabitants, 36,701 are insured against accidents, the employers paying M. 1,070,000, or for each person insured M. 29.11.

Sickness and old age insurance is now being introduced into France, all workmen and employees earning up to M. 2,400 being beneficiaries, employer and employed paying each one-half.

In Germany 24.1 per cent. of all the population are insured against sickness and old age, the fees paid amounting to M. 184,400,000, or for each person insured the sum of M. 12.

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CONTENTS OF THIS ISSUE.

TORONTO'S SUBWAYS.

One of the most acute questions in municipal politics in the city of Toronto has been the transportation matters. Candidates for public offices have made claim for consideration because of their advanced ideas on the matter of subway transportation. Just now the company holding the franchise for operating city railways is endeavoring to simplify surface transportation. While the municipal politicians are endeavoring to unite on a possible solution, and while the City Railway Company management is making efforts to handle the increased number of travellers without increased facilities, the citizens of Toronto and Toronto's visitors are not receiving that consideration to which they are justly entitled.

There are three directions from which one may approach Toronto on well-equipped interurban lines, and, while Toronto has been fighting the Street Railway, splendid opportunities for the centering of this interurban traffic in the heart of the city have been lost. Toronto's growth and development now depends upon the facilities with which she is fed from the outlying districts, and it is gratifying to notice that one of the leaders in municipal matters has requested that plans and specifications be prepared upon which private companies may bid and state the terms upon which they will be willing to construct subways and operate subway cars from the western limits of Toronto to the centre of the city.

ENGINEERS' CLUB, TORONTO.

For almost a year the engineers of the city of Toronto have been working on a scheme by means of which they hope to bring under one roof the headquarters of the leading technical societies of the city.

The growth of Toronto in the business and financial centre has increased the desirability of Toronto as the centre for architects and engineers, and it has been felt for some time that they should have, in addition to a common meeting room and technical library, suitable club quarters where they might meet socially.

That the wish of the men who years ago organized the Engineers' Club of Toronto should be about to be realized must be not only gratifying to them, but to the men who, since its organization, have been closely identified with the club. In their new quarters, with permanent secretary and the nucleus for a splendid technical library, the organization will have facilities for reference work and club quarters such as will appeal to every man interested in the development of the country and in the work of the technically trained man.

PROSPERITY ON CANADIAN RAILWAYS.

The last returns from the United States railroads shows that the earnings for September and for the three months ending with September have not indicated that increase that they anticipated. The average gross gain on forty-eight United States railroads for September was 5.70 per cent., and the net showings indicate a decrease of almost .20 per cent., while for the three months the same roads show a gross gain of 6.59 per cent., with an average net decrease of 6.80 per cent. The showings of two of the large Canadian roads, the C.P.R. and the Canadian Northern, is vastly different, although the Grand Trunk, because of the strike, did not do much better than the American roads.

For September the C.N.R. shows a gross gain of 18.86 per cent. and the C.P.R. shows a gain of 11.92 per cent., the net returns being respectively 22.37 per cent. and 13.97 per cent., while for the three months the C.P.R. gained 19.87 per cent. in gross and 24.92 per cent. in net earnings compared with the increase of 31.18 per cent. in gross earnings on the C.N.R. and 33.11 per cent. net.

THE TORONTO STREET RAILWAY AND THEIR NEW BY-LAWS.

About ten days ago the Toronto Street Railway Company intimated that they were going to request the Ontario and Municipal Railway Board to sanction by-laws prohibiting smoking and spitting in the cars, and enforcing pay-as-you-enter. Upon formal application made to the Board two members approved and one dissented.

The dissenting member, Mr. H. N. Kittson, gives seven reasons why he cannot agree with his colleagues, the rolling stock is modern and designed for the purpose, and, while we approve of pay-as-you-enter system when we think that Mr. Kittson's objections are so well taken that we give them in full:—

In the matter of the application of the Toronto Railway Company, under Edward VII., chapter 30, section 153, for approval of By-law 36, my opinion is that the by-law as drawn should not be sanctioned by the Board on the following grounds:—

(1) The by-law as drawn, while it provides for unobstructed entrance to the cars, provides for no unobstructed exit.

(2) In any case exit by the rear door should be permitted when more convenient to passengers, especially as giving conductors the right to pack people in the front of the cars will obstruct exit by the front door.

(3) Conductors should not be compelled to remain on the back platform without protection from the weather.

(4) The power given to conductors to eject passengers is liable to lead to unnecessary breaches of the peace.

(5) The by-law as drawn, being intended to meet altered conditions caused by the introduction of pay-as-you-enter system, should not come into force until the company has provided proper pay-as-you-enter cars.

(6) The increased penalties sought to be imposed are, in my opinion, oppressive.

(7) The locking of front doors of trailers is, in my opinion, dangerous, and in case of accident people could not quickly escape from the cars.

TORONTO'S BUILDING BY-LAWS.

Some weeks ago a committee of the Engineers' Club, Toronto, organized a committee of forty to consider the suitability of the city of Toronto building by-laws for present conditions.

We understand the deliberations of the committee have been harmonious, and that their report will receive the support of almost the whole committee, and that the City Architect's Department has afforded the committee all the assistance that should be reasonably expected of them in connection with a matter of this kind.

At a later date we expect to devote some considerable space to discussions of the recommendations, but just now we wish to draw the attention of the different engineering societies throughout Canada to the opportunities that are afforded them in most cities of improving the conditions under which structures, both small and large, are erected.

ELECTRIC LIGHT SITUATION IN LONDON.

The rejection by the London Electric Company of the offer of the city of London, who wish to buy for $100,000 the poles, wires and good-will of the London Electric Company, brings to our attention a situation that is likely to be duplicated in a number of Ontario municipalities.

It is the people's money that is in the London Electric Company, and it is the people's money that has constructed the Hydro-Electric distributing system, and there is sure to be disaster following the waste that the competition between private enterprise and Government organization are bound to bring.

The city of London may have offered all that the whole lines were worth, and if the shareholders of the London Electric are content to meet competition rather than merge, we suppose it is nobody's business but their own, yet we do think that Government regulation in preference to Government interference in a number of municipalities would be much more acceptable.

EDITORIAL NOTE.

At a sitting of the Railway Board in Montreal last week Chairman Mabee spoke in no uncertain manner as to the relative responsibilities of railways and municipalities in connection with the level crossings. The chairman said it would be absolute ruin to saddle the companies with the whole cost of safety appliances, and that the municipalities would have to pay their share. Whether that share would be as much as one-third has not yet been decided.

Copies of the Canadian Engineer of October 6th, 1910, are wanted. For one copy, those sending in copies could have their subscription of the Canadian Engineer extended one month.

PRECIPITATION FOR NOVEMBER.

The amount of precipitation recorded during November was more than average over the larger part of Canada, but in Northern, and locally in the Peninsular of Ontario, the Kootenay Valley and Cariboo Districts of British Columbia, Alberta, Southwestern Saskatchewan, Eastern Quebec, and Southwestern Districts of the Maritime Provinces, the normal quantity was not reached. Snow fell in all parts of the Dominion and remained on the ground in many localities, the depth varying considerably with the district.

Depth of Snow on the Ground.

The depth of snow on the ground on the last day of the month has been reported as follows:—

Western Provinces.—Battleford, 4 inches; Swift Current, 1; Qu'Appelle, 6; Minnedosa, 10; Winnipeg, 5.

Keewatin.—The Pas, 12 inches.

Ontario.—Port Arthur, 5 inches; Emsdale, 12; Gravenhurst, 8; Barrie, 10; Meaford, 12; Southampton, 2; Clinton, 3; Lucknow, 5; Port Stanley, 2; London, 4½; Port Burwell, 1; Toronto, 1½; Uxbridge, 10; Kingston, 1.

Quebec.—Montreal, 4 inches; Quebec, 2; Father Point, 12.

New Brunswick.—Chatham, 2 inches.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for November.

Ten inches of snow is calculated as being the equivalent of one inch of rain:—

Station.	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	0.30	— 0.42
Edmonton, Alta.	0.70	— 0.14
Swift Current, Sask.	0.30	— 0.35
Winnipeg, Man.	1.20	+ 0.12
Port Stanley, Ont.	4.40	+ 1.39
Toronto, Ont.	2.55	+ 0.02
Parry Sound, Ont.	2.70	— 1.30
Ottawa, Ont.	1.90	— 0.45
Kingston, Ont.	2.60	+ 0.01
Montreal, Que.	2.40	— 1.04
Quebec, Que.	1.40	— 1.67
Chatham, N.B.	4.00	+ 0.18
Halifax, N.S.	5.20	+ 0.68
Victoria, B.C.	7.70	+ 1.63
Kamloops, B.C.	0.70	— 0.42

ENGINEERS' CLUB.

Definite plans were formulated at the last meeting of the Engineers' Club of Toronto, regarding the proposed change which for some time has been under the consideration of the members of the Club. This is the formation of a new club and the taking-on of larger and more suitable quarters for this new club. At this meeting a set of by-laws, as enacted Nov. 15, 1910, by the provisional directors: Messrs. C. M. Canniff, Willis Chapman, John Galbraith, J. G. Sing, J. B. Tyrrell, A. J. Van Nostrand, was sanctioned by the Club. Mr. Canniff gave an explanation of certain difficulties which had arisen in the past and advised the passing of the by-laws, as they had been carefully prepared and it was to the interest of the Club to get thoroughly started. Dr. Galbraith also urged the united support of the members of the old club, as it was of vital importance at this time. Upon the motion of Dr. Galbraith the by-laws were passed.

The Club and its aim is best defined by a section of the by-laws which states as follows:

The Club shall be known as the Engineers' Club of Toronto, and shall be composed of Engineers, Architects, Surveyors, Industrial Chemists, and others who may be connected with or interested in Engineering or allied professions.

The objects of the Club shall be the provision of ways and means to improve the members professionally and promote social intercourse between those having to do with applied arts and science.

The head office of the Club shall be in the city of Toronto, in the Province of Ontario, at the place therein where the business of the Club may from time to time be carried on.

The seal of the Club shall be the seal heretofore used by the Engineers' Club of Toronto, a corporation incorporated under the Benevolent Societies Act.

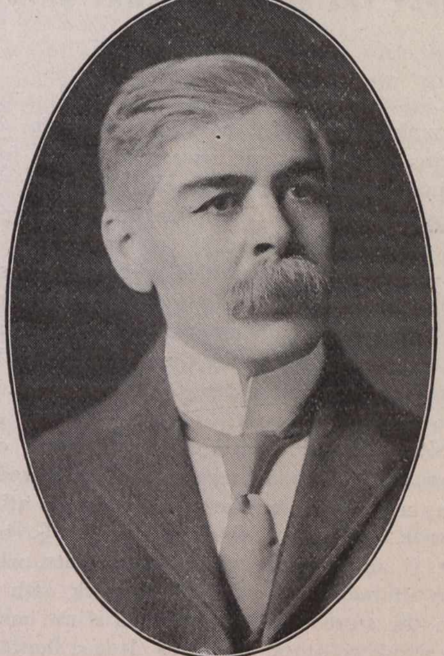
Membership.

(a) The members of the Club shall consist of the charter members, the members of the Engineers' Club of Toronto (a corporation incorporated under the Benevolent Societies Act), to whom none of the provisions as to election of members shall apply, and such others as may be elected under the provisions of the by-laws of the Club.

(b) The membership shall be limited to 800, as follows: 500 Resident, 200 Non-resident, 25 Life, and 75 Associate members.

(c) A Resident member is one who resides or whose chief place of business is in the city of Toronto, or within 25 miles thereof. He shall pay an entrance fee of $50 and an annual fee of $30.

(d) A Non-resident member is one who does not reside within 25 miles of the Club House for a longer period than three months in the year, and whose principal place of business is outside of the city of Toronto. He shall pay an entrance fee of $25 and an annual fee of $20.



C. M. CANNIFF.
President Engineers' Club, Toronto, Ont.

(e) A Life member is one whom the Directors may elect as such by unanimous vote of the whole Board on payment of a fee of $500.

(f) An Associate member, who must be a charter member, is one who, on payment of an annual fee of $5, shall be entitled to the use of the Library and Reading-room and Lecture Hall, but shall not share in the social privileges of the Club.

(g) Notwithstanding anything in these by-laws contained, the directors, in their discretion, may admit to membership in the Club all, or any, subscribers to the new Social Club for Engineers, etc., in course of organization in the early part of the year 1910, on payment of an entrance fee of $25 and the annual dues as provided for Resident members.

The annual dues for all classes of members are payable in advance on the first day of January in each year, and if paid on or before the first day of February in the same year the sum of $25 from a Resident member and $15 from a Non-resident member shall be accepted in full thereof.

The Club will afford all the privileges of a down-town social club.

After the passing of the by-laws and remarks from President Canniff, the members in a body inspected the proposed new quarters, which are directly adjoining in the same building as the present rooms. They are at present in process of renovation, but far enough advanced to give a fair idea of the final appearance of the rooms. Should the Club decide to take the proposition, which is most probable, the future Club rooms will be a vast improvement upon the Club's present accommodations. Features of the proposed new rooms are the billiard room and the dining room. The dining room, which will be well furnished, is 50 x 15 feet, but an extension of 12 feet may he had and in all probability will form a part of a convenient L shaped dining-room, suitable for banquet purposes. The members were

(Continued on page 729.)

METHODS OF HANDLING TOOL AND MATERIAL SUPPLY TRAINS FOR RAILWAY MAINTENANCE WORK.*

(Continued from Page 709.)

necessary tanks with self-measuring pumps for oil supply; also contains waste bin and necessary racks for oil cans. 4. An ordinary box car for stationery. This car is loaded by the stationery department, supplies being loaded in station order, and the car is released as soon as empty. The first three cars mentioned are provided with end doors, to enable attendants to pass from one to the other while the train is in motion. They travel on local freight trains when making deliveries, and cover the entire line of 1,000 miles in ten days, averaging 100 miles per day, two attendants being required to handle the work.

Requisitions are due from all departments on the 25th of each month. These on receipt are registered and any bulky items not carried by the cars are drawn off to be shipped otherwise. They are then stamped "To be filled by supply cars," and turned over to attendants, who draw off a summary of material needed, and check with the various sections in the storehouse, to ascertain if the material is on hand with which to stock the cars. Items short are immediately reported, and efforts made to get them before date of departure. Two days before cars are due to leave, they are stocked for the trip, and by closely checking the orders received and stocking cars accordingly, it has been found that very few complaints are registered on account of running out of any items en route.

No supplies are delivered by cars, with exception of oil or tools with extra gangs, unless the attendants hold approved requisition for same. When deliveries are made, items are circled on the original requisitions, which are sent in at the close of each day's business. In addition to this, receipts are prepared in duplicate, bearing the requisition numbers and the date of delivery; one copy receipted is retained by the attendant, and turned in with requisitions, while the other copy is given the party receiving the material, who signs it and sends it to his approving officers. On receipt of the requisitions, items circled as delivered are invoiced against the department ordering same, and invoices are checked in the division offices against the receipts sent in covering the delivery. In case any items are not delivered they are back ordered and taken care of the following month, unless items are duplicated, in which case the back order is cancelled, with permission of the maker.

One of the greatest advantages gained by operating the car is the picking up of old material, a large percentage of which can be repaired at a small cost and reissued. We insist on old material being turned in when new is drawn. On the return of the cars this is closely inspected, and any that is worth repairs is immediately put in shape to be reissued, the worthless being scrapped, credit as to its worth being allowed the department to which it properly belongs. If this material were not picked up and taken care of by the cars, it would reach the scrap dock in scrap cars, and would nearly all be worthless and unfit for repairs when received in this manner. The value of the material picked up for repairs by the supply cars will more than pay the expense of operating them. During the season when track work is extensive, sufficient tools are carried to take care of extra gangs.

Once each year, usually in October or November, in connection with the supply cars, there is run what is known as an "Economy Special." Accompanying the special are all division officers, a representative of the stationery department, and last, but not least, the storekeeper. Every building on the right of way—stations, towers, shops, roundhouses, car repairers' shanties and hand car houses—in fact everything resembling a building, is inspected, and all surplus serviceable material and tools, including those needing repairs, is picked up by the special and returned to the general store. The first trip of this kind was inaugurated three years ago, and the result was amazing to all, the material picked up representing a greater value than was anticipated. The result of this trip cannot be based alone on the value of the material reclaimed, its influence being worth much more to the company, as the trip one year later demonstrated. Less than 10 per cent. of the material picked up on the initial trip was gathered in on the second. Some of the older men on the line are talking about it yet, as we gave them all a thorough house cleaning.

Branch lines of from ten to forty miles are not covered by the cars, as the small amount of material to be taken care of would not justify the time consumed. Oil cans and tools needing repairs are sent to junction points, and orders are taken care of by the cars at these points and are shipped from there. Branch lines, however, are covered by supply cars once each year when run in connection with the "Economy Special." The cars run about the same time each month, varying only a day or two, and this allows agents, section men and lamp men to order closely, as they know what is required to last them between trips, when they are regular. A schedule is prepared sufficiently in advance, showing divisions, date and trains on which cars will travel, and this is mailed direct to each party interested. The transportation department follows this schedule closely and moves the cars promptly according to same.

The supply car is not alone a benefit to the store department, but all departments gain through its operation. Its field should not be limited, but broadened, and every item of material that can be handled by this means of delivery should be added to its work. Small items ordered, which usually are handled by baggage or on local freight trains, as far as consistent should reach the consignee through the supply car, thereby saving handling and expense to the transportation department and preventing loss or damage. Since we have used the car for such deliveries, our claims have been materially decreased, thus saving correspondence and labor in all departments. By giving the cars close attention and following up the details in connection with them very satisfactory results are being obtained.

TORONTO: ITS WATER SUPPLY AND WASTE.

It is with satisfaction that we note that the city of Toronto is taking action to remedy the great waste of water which attends the system of distribution.

In our issue of November 26th last year we called attention to investigations made by Mr. Rust in 1899, which clearly showed as follows:—

"In 1899 the per capita consumption was 99.7 gallons per day.

In 1909 the per capita consumption was over 120 gallons per day.

In 1899 about 12,000,000 gallons per day of water were being pumped to waste.

In 1909 about 21,500,000 gallons per day of water were being pumped to waste."

We then took the occasion of formulating propositions as follows:—

"(a) The annual cost of pumping 21,500,000 gallons per day without benefit of any kind being derived from it.

(b) The probable cost of treating 21,500,000 gallons per day of waste water, represented as sewage.

(c) The probable annual cost of filtering at the Island 21,500,000 gallons per day of water which will never be used, but only filtered in order to pass it direct from the leaking water service to the sewers.

(d) When the annual cost of (a), (b) and (c) have been arrived at, then we would like these sums added together and capitalized at, say, 3½ per cent., so that the available capital amount can be arrived at which might be spent in putting the Toronto water supply on a reasonable and efficient basis."

Since calling attention to the above important points the city Waterworks Department has spent about $10,000 in chasing leaks in a district bounded by Yonge Street, College Street, Bathurst Street and Queen Street. This district represents an area of about a half square mile, and is mostly residential.

House services to the number of 4,862 have been examined, disclosing 635 leaks, of which 358 were in connection with water closet services, 123 at taps, 25 at garden hydrants, 26 at services under houses, 61 not located, and 42 in metered houses.

The number of leaks outside in connection with the mains and city portions of the services amounts to 41.

Thirteen per cent. of the houses tested proved to have leaking fittings and services, while only about 6 per cent. of the total leaks found were allocated to the city mains.

In 1899, when an area of the city bounded by Dundas Street on the west, Manning Avenue on the east, and College Street on the south to the city limits on the north, was put under a similar examination and test, the results were: 14 per cent. of the houses tested proved to have leaking fittings and services, while 19 per cent. of the leaks found were allocated to the city mains.

This year's test has shown a total number of leaks in the central portion of the city of 676, with a total daily waste of 1,576,800 gallons of water, or 2,300 gallons per day per each leak. The 1899 test showed a total number of leaks in a suburban portion of the city of 366, with a total daily waste of 85,426 gallons of water, or 234 gallons per day for each leak. Mr. Rust concluded in 1899 in connection with the results of the test then made: "The time is not far distant, unless proper means are taken to prevent waste, when the ratepayers will be called upon to provide large sums for improvements to the system."

Just what Mr. Rust's conclusion is with reference to this 1910 test we do not as yet know. But we do know that about a square mile of the central part of the city is capable of producing a total daily waste of water amounting to about one and a half million gallons per day, or 575 million gallons per annum.

As all this extra waste water has to be pumped, sand-filtered and afterwards treated at the sewage works, it is evident that we have a civic utility which is remarkable for its high inefficiency, and which is capable of repair, supervision and general adjustment which must result in an enormous annual saving of money.

The annual value of water wasted in the half-mile area just tested is estimated at $28,787, or $959,600 if capitalized at 3 per cent.

The city of Toronto is face to face with the question of either metering domestic service, or creating an efficient method of administrative supervision.

In connection with the test of 1899, before repairs were made the consumption of water for the area under examination amounted to 234,163 gallons per day After the repairs were made the consumption was reduced to 140,565 gallons per day, or a reduction consumption efficiency of 40 per cent.

If a 40 per cent. reduction was effected all over Toronto it would immediately result in a daily water consumption of 40,000,000 gallons being reduced to 24,000,000, and a daily per capita consumption of 120 gallons reduced to 72.

There is no reason why this 40 per cent. reduction may not be effected, as such a reduction would yet leave 20 per cent. margin for unavoidable waste as shown by recent sewer gaugings between 3 a.m. and 4 a.m., when the water consumption is at its lowest.

We would certainly regret to see Toronto's domestic water service under meter, and we think that efficiency can be obtained just as economically by greater and more continuous supervision of plumbing. Certainly in Great Britain, where domestic water supply is not generally metered, the average per capita supply is only 45 gallons per day, and we know this low consumption figure is not obtained by restricting the use, but only by efficient administration and drastic action in connection with users who neglect the necessary precautions as against leaks and imperfect water fittings.

SOME WATER PURIFICATION NOTES.

In taking a sample of water, rinse out the bottle first with the water to be examined.

Some analysts express results in grains per gallon, others in parts per 100,000, others in parts per 1,000,000.

$$\text{Parts per } 100{,}000 = \frac{\text{grains per gallon} \times 10}{7}$$

Grains per gallon = parts per 100,000 × 0.7.

Parts per 100,000 = grammes per 100,000 c.c.

Color is due to matter in solution; it has nothing to do with turbidity.

Turbidity is due to solids in suspension; it has nothing to do with color.

Hardness.—The permissible amounts of hardness in a water should be (in parts of 100,000) 21 parts of total hardness and 7 parts of permanent hardness.

The hardness scale for water is approximately:—

Not exceeding (parts in 100,000)	6 = very soft.
" " "	13 = soft.
" " "	20 = hard.
" " "	34 = very hard.

Chlorine.—All waters contain chlorides. The knowledge of the amount is of no value unless we know the normal content of the particular water under observation. An excess over the normal content points to sewage pollution.

A high chlorine content combined with an excess of nitrates points to suspicion of pollution.

Lead.—No trace of lead is permissible in potable water.

Nitrites.—The presence of nitrites in water points to suspicion of organic pollution.

Nitrates.—These are the products of the oxidation of organic matter, chiefly derived from manure and sewage. As much as 1.5 parts per 100,000 should cause grave suspicion.

Free Ammonia.—Most waters contain a trace. Permissible amount is only .005 parts per 100,000. If over the permissible amount in conjunction with excess of chlorine, fœcal pollution is probable.

Albuminoid Ammonia.—The permissible amount is .01 parts in 100,000; however, if the water be of a peaty or vegetable nature, the amount may be higher; if accompanied by an excess of chlorine, then the excess is suspicious.

Oxygen Absorbed.—0.1 part in 100,000 is the highest permissible amount.

Bacteriological Examination.—All surface waters and shallow well waters should be subjected to a bacteriological examination as well as a chemical.

The presence of B. coli in water points to sewage pollution, as such bacteria are peculiar to the intestines of animals.

OUTLINE OF SANITARY WATERWORKS IN THE PROVINCE OF QUEBEC.

By James O. Meadows, Sanitary Engineer of the Board of Health of the Province of Quebec.

(For editorial comment on this article see page 687 of last week's issue.)

There are two broad classes from which our domestic water supplies are derived, namely, surface and underground supplies. The origin of all fresh water is in the rain and snow. Of the total precipitation 50 per cent. is returned to the atmosphere, 33 per cent. is run-off or surface water, and the remaining 17 per cent. is cut-off or ground water.

Dr. Jos. A. Beaudry, in the two previous meetings of this Convention, has told you of the different classes of water and how they are purified. From his papers you have noted that ground water supplies are to be preferred because they are purer and are less liable to pollution. It very often happens that a ground water supply can not be secured or that the supply of this nature is not large enough to supply the needs of the municipality. When a good and abundant ground water supply can not be secured it is necessary to secure a surface water supply to meet the needs of the municipality.

This surface water, whether it be in river, pond or lake, drains all the land adjacent to it. The surface water in passing over the soil takes into solution the soluble organic and inorganic constituents of the soil, and it also carries in suspension insoluble matter and bacteria. The chemical constituents normally present in water vary a great deal, according to the geology of the country in which the watershed is situated. A water low in mineral matter is called a soft water and such a water is very desirable, both for domestic and manufacturing purposes, because in the household less soap is necessary, and in the manufacturing plant the soft water forms very little scale in the boilers. A water containing a large amount of mineral constituents in solution is a hard water. The water supply of some municipalities is so unsatisfactory because of this fact that means have been resorted to to remove a large portion of these chemical constituents.

The top layers of the soil are rich in bacterial life, and many of these microbes are carried in suspension in the water. The waste from man and animals is swarming with bacteria, some of which find their way to our domestic water supplies. The dejecta from patients suffering with typhoid fever finds its way into our water supplies and, in numerous cases, cause severe epidemics in municipalities located on the same supply further down stream.

Thus, it is seen that we can not guard the municipal supplies, which are derived from surface waters, too carefully. Several large typhoid epidemics have occurred in this Province, due to polluted water supplies, the recent large epidemic at Montreal being very severe and one known to all of us present.

During the past eight or nine months the Quebec Provincial Board of Health has been studying some of the surface waters in this Province. Particular attention has been given to the water purification plants already installed as it was desirable to know what purification they were accomplishing.

A sanitary survey of the Ottawa river from Pembroke to Montreal has also been started and will be carried out so that reliable data can be secured in regard to this river. It is the intention of the Board to carry on this work on the other rivers of the Province which serve as municipal water supplies. Valuable data will be secured in this way which will be of value to all the municipalities located on the streams.

It is the purpose of this paper to outline briefly some of the work which has been done on the surface waters in the Province.

Ottawa River.

The Ottawa river has its source in lakes near the height of land. The river has a length of 700 miles and has a total watershed area of 56,000 square miles. The upper part of the Ottawa flows through a granite plateau and the country is low and marshy; below the granite plateau the river falls rapidly. The upper Ottawa basin contains many lakes having a total area of several hundred square miles.

The sanitary work in the Ottawa river was started above Pembroke and continued until the river joined the St. Lawrence in Lake St. Louis. Samples, both chemical and bacteriological, were taken, usually above and below a municipality.

The Ottawa river from Pembroke to Ottawa is a series of lakes separated by rapids. Pembroke Lake has an area of 60 square miles, Coulonge Lake 25 square miles, Lac des Chats 40 square miles, and Lake Deschênes 45 square miles. The current through these lakes is slow, and matter in suspension including bacteria has a chance to settle out. The amount of sewage entering the river from Pembroke to Ottawa is comparatively slight. Only three of the municipalities through this stretch of the river have municipal sewers and their combined population is not over 15,000. The three towns disposing of raw sewage into the river are Pembroke and Arnprior on the Ontario side, and Alymer on the Quebec side. Samples taken a short distance below their sewer outlets showed signs of pollution, but this gradually disappeared, due to the natural purification of the stream.

At Pembroke, Ont., the sewage is carried up stream by eddys and the wind, so that the municipal water is polluted. This pollution was responsible for an epidemic of 400 cases of typhoid fever at Pembroke last year. At present, the Pembroke supply is being temporarily purified by the use of calcium hypochlorite, but it is the intention of the municipality to install a filter plant.

Above Ottawa, the Ottawa river has a fairly low germ content, the color is high and the total hardness and alkalinity is low.

The Ottawa river has a maximum discharge of 250,000 cubic feet per second and a minimum discharge of 17,500 cubic feet per second. With this large volume of water and the comparatively small amount of sewage which enters the river above Ottawa one would expect to find the river in an unpolluted state. The population from Pembroke to Ottawa is sparce and the small municipalities do not dispose of their sewage directly into the river. Naturally, some pollution enters the river from these small municipalities, due to runoff and seepage, but it is very small in volume.

Aylmer and Hull on the Quebec side and Ottawa on the Ontario side, are situated within a radius of seven or eight miles and have a total population of nearly 100,000. All of these cities have sewers emptying into the Ottawa river and it is to be expected that the quality of the river water would be affected.

As the total population of the Ottawa river watershed is about 475,000, the population of Aylmer, Hull and Ottawa is more than one-fifth of the total population. As only about 15,000 of the remaining population of the entire watershed have sewer outlet into the Ottawa river it is evident that the bulk of the pollution occurs at Ottawa and vicinity. Samples were taken from Ottawa to Montreal, and they show a considerable increase in germ content over those taken from the Ottawa river from Pembroke to Ottawa. Bacillus Coli, the microbe normally present in the intestines of man and animals, was more prevalent in these latter samples. The chlorine content of the Ottawa river increases below Ottawa, this increase being most probably due to the raw sewage which enters the river. Sewage is high in chlorine, and when introduced into a stream of water it raises the chlorine content of that stream.

The conclusions drawn from this preliminary survey is that the Ottawa river above Ottawa is very slightly polluted because of the sparce population and the relative small amount of raw sewage directly entering the river. The Ottawa river below Ottawa shows signs of pollution because of the volume of sewage entering the river at that point. A natural purification is noted from Ottawa to Montreal, that is, the bacterial content of the river gradually diminishes as the distance from Ottawa becomes greater.

The discharge of the Ottawa river during the month of June is higher than the average discharge of the river, the maximum discharge being in May, the average discharge being in July and the minimum discharge being in September.

It is intended to continue the work on the Ottawa river during the low water stage, because at that time the pollution should be the greatest, due to the lower dilution of the sewage entering the river. By working on this river at different seasons of the year, data will be secured which will complete the work and make the whole intelligent. This work will be of value to all the municipalities situated on the Ottawa river for from it they can secure a very intelligent knowledge of the river near their respective municipalities.

The population of the Ottawa river watershed is increasing and will be much greater in ten or twenty years than it is now. With the increased population the pollution will correspondingly increase, unless measures are taken to lessen it. The work done on the river at this time will serve as valuable comparative data for any work which is done on the river in the future.

Filtration Plants.

The work on the water purification plants in this Province has mainly been confined to Verdun and Longueuil, but it is intended to extend the work to all the purification plants in the Province.

Verdun secures its supply from the St. Lawrence river and secures mixed Ottawa and St. Lawrence river water. The intake extends into the river 1,000 feet and secures a water which is practically free from shore wash.

Verdun has a population of 10,000 and has a daily consumption of about 350,000 gallons of water. Two one-half million gallons mechanical pressure filters are installed to filter the water for the municipality. The coagulant is introduced into the pump suction, and the treated water is pumped to the filters. The filters have sand beds three and one-half feet thick through which the water passes before entering the service mains of the municipality. At the beginning of the work on this plant a good bacterial removal was being secured but the color present in the raw water was not being removed. It was found that the color could be removed by using three grains of alum or two grains per gallon of sulphate of alumina. As sulphate of alumina is the cheaper, it was used in place of the alum and, when properly used, it effects a very good bacterial and color removal. During the typhoid epidemic in Montreal, Verdun did not have a single case of typhoid, although the water supply of both municipalities is practically the same, the Montreal supply being unfiltered and the Verdun supply being filtered. A single instance of the value of this inspection and analytical work in connection with the purification plant was shown at Verdun. The sulphate of alumina purchased by Verdun was about 25 per cent. below strength. This weak chemical cost as much as the stronger article and requires more to do the work. From now on Verdun will buy its sulphate of alumina under specifications furnished by the Board and in this way they will be assured of high-grade article.

Longueuil has a population of about 4,000 and a water consumption of about 325,000 gallons daily.

The supply is taken from the St. Lawrence river and after being treated with alum is filtered through two pressure filters, having a combined capacity of 400,000 gallons per day. The St. Lawrence water is clear and low in color during the major portion of the year, and because of this fact it has been the practice at Longueuil to only use alum the short period during the year when the water is turbid. During the remainder of the year, the water is filtered without the use of a coagulant. As a mechanical filter is not designed to be used without a coagulant the results secured at Longueuil when alum is not used are very poor. The town of St. Lambert is situated directly above Longueuil on the St. Lawrence river and disposes of its sewage into the river. The raw water at Longueuil is polluted and the pollution is not removed by passing the water through the filters without the use of coagulant. Alum should be used all the time to secure a good water, for without its use the water is not much better than in its raw state. The cost of converting the polluted raw water at Longueuil into a safe filtered water would not be more than a dollar to a dollar and a half per day, a very small amount when one takes into account the improvement made in a municipal supply.

The matter has been brought to the notice of the municipal officers of Longueuil and an improvement over the system now in vogue is expected.

Here at St. Hyacinthe, the consumption is greater than the capacity of the filters, and to get sufficient water through the filters the coagulant has been temporarily discontinued. This municipality soon intends enlarging their filter capacity and will then treat the river water with a coagulant.

Sterilizing Plants.

During the recent typhoid fever epidemic in Montreal, the Provincial Board of Health suggested to the city of Montreal and the Montreal Water & Power Company, that they temporarily purify their respective water supplies by using calcium hypochlorite or bleaching powder. The plants were installed under the direction of the Board and have been operated continuously ever since.

The treatment consists in dissolving the bleaching powder in storage tanks and from the storage tanks a measured amount of the sterilizing agent is added to the water supply. The chemical breaks up, due to the free carbonic acid present in the water, and oxygen is liberated which oxidizes the organic matter. This oxygen has a strong action on the bacteria present in the water and kills a very large per cent. of them. On the two supplies treated at Montreal a good reduction in bacteria is secured and a much safer water is supplied to the municipality.

The sterilizing agent only affects the bacteria in the water, it does not remove turbidity or color and for this reason is not applicable to many waters as a permanent method for purification.

The typhoid epidemics at Montreal have occurred during the fall and early winter months, when the river is low, and it is hoped that these epidemics will be arrested by the application of the sterilizing agent. The city of Montreal is now having its water question investigated by a firm of expert consulting sanitary engineers and a report as to the methods to be adopted by the city is expected soon.

The investigations of the water supplies in this Province has just begun but it is planned to carry the whole out in a systematic way, so that information as to the character of the water will be secured for every section of the Province.

SEWER AIR.*

The popular fear of sewer gas is based not so much upon its direct poisonous action as upon its possible relation to communicable disease. For generations the belief has prevailed that typhoid fever, scarlet fever, diphtheria, etc., were induced by inhalations of sewer air from leaky plumbing fixtures. Since the day of bacteriology, doubt was cast upon this theory of disease communication. Now it is known that these diseases are due to specific terms. Every case of a transmissible disease is due to some prior case. It is difficult, in many cases, to trace the infection to its origin through certain contact or media. A very important question is, does sewer gas, as it escapes from defective plumbing systems or from the city sewer, act as a medium to transmit infectious germs to be taken into the human system by inhalation?

This question has been the subject of much research work on the part of scientists. A valuable contribution to the knowledge of this subject is due to the investigations of the sanitary committee of the National Association of Master Plumbers. Under its direction, Prof. C. E. A. Winslow of the Boston Institute of Technology conducted a series of laboratory investigations. Investigations were begun in 1907 and a final report was made two years later.

Only a few conclusions can be given. The professor says: "In the whole series of 200 liters of air collected from the most diverse locations on nineteen different plumbing systems, not a single sewage organism was found except where the air was exposed to immediate local infection by fine particles of spray." * * *

"Actual examinations of the air in sewers, however, by Miquel in France, Petri in Germany, and Carnelley and Haldane, Robertson and Laws and Andrews in England, showed that sewer air, as a matter of fact, contains very small numbers of bacteria and those of types common in street air rather than in sewage." * * *

"In general my results confirm the results of Horrocks in so far as they show that specific bacteria may be ejected from liquids into the air above. My tests of house-drain air, like those of Carnelley and Haldane and Laws and Andrews on sewer air, indicate that mechanical splashing may produce a local infection of the air in immediate contact with the spray. Such an infection does not, however, extend for any distance or persist for more than a minute or so. I found the general air of house-drainage systems singularly free from bacterial life. Out of 200 liters examined, only 48 contained any organisms capable of development at 37 degrees. Sewage bacteria were found in the air of the house drains only four times out of 200 liters, and then in the presence of mechanical spraying of sewage at the point of collection. The general air of the house-drainage system, aside from this local infection, was, as far as examined, free from sewage organisms." * * *

All investigators testify that under certain conditions, as splashing of liquids and bursting of bubbles, sewage bacteria in small number are allowed to escape into sewer air. It is also admitted that the liberation of bacteria from dried sewage adherent to the surface of pipes, by means of air currents, is to be considered. In the light of scientific research, under ordinary conditions, there is little or no danger from sewer gas as a vehicle to transmit typhoid or other pathogenic germs. Sewer air, like other foul and impure gases, for physiological reasons, is to be avoided as detrimental to health.

*From the September bulletin of the Columbus (O.) Board of Health.

COMING MEETINGS.

CHICAGO CEMENT SHOW.—February 15-23, 1911. Fourth annual exhibition, at the Coliseum, Chicago, Ill. Under the management of the Cement Products Exhibition Company, 115 Adams St., Chicago.

REPORT OF DUTY TRIAL ON THE SIX MILLION IMPERIAL GALLON PUMPING ENGINE AT THE HIGH-LEVEL PUMPING STATION, TORONTO WATERWORKS.

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The city of Toronto has two pumping stations for the supply of water to the city proper, exclusive of that supplied to the residents of Toronto Island. Of these two the main pumping station is situated at the foot of John Street, close to the bay, and all the water supplied to the city passes through pumps in this station, the pressure being maintained at slightly over 90 pounds per square inch.

As the ground rises very rapidly as one proceeds northward from the bay, the pressure in the northern part of the city produced by the pumps at the main pumping station, would be rather low and in the district near the Canadian Pacific Railway does not much exceed 21 pounds per square inch.

In order to maintain the proper pressure in the northern part of the city the High Level Pumping Station was built on Poplar Plains Road a short distance above the Canadian Pacific Railway tracks.

The growth of the northern part of the city has been very rapid of late years and the consequent consumption of water has so increased that the pumps originally installed in the station were unable to maintain a sufficiently high pressure, so that an additional pump, having a capacity of six million Imperial gallons per day against a pressure of 75 pounds per square inch, has been installed and it is this latter pump with which this report deals.

Description of the Engine.

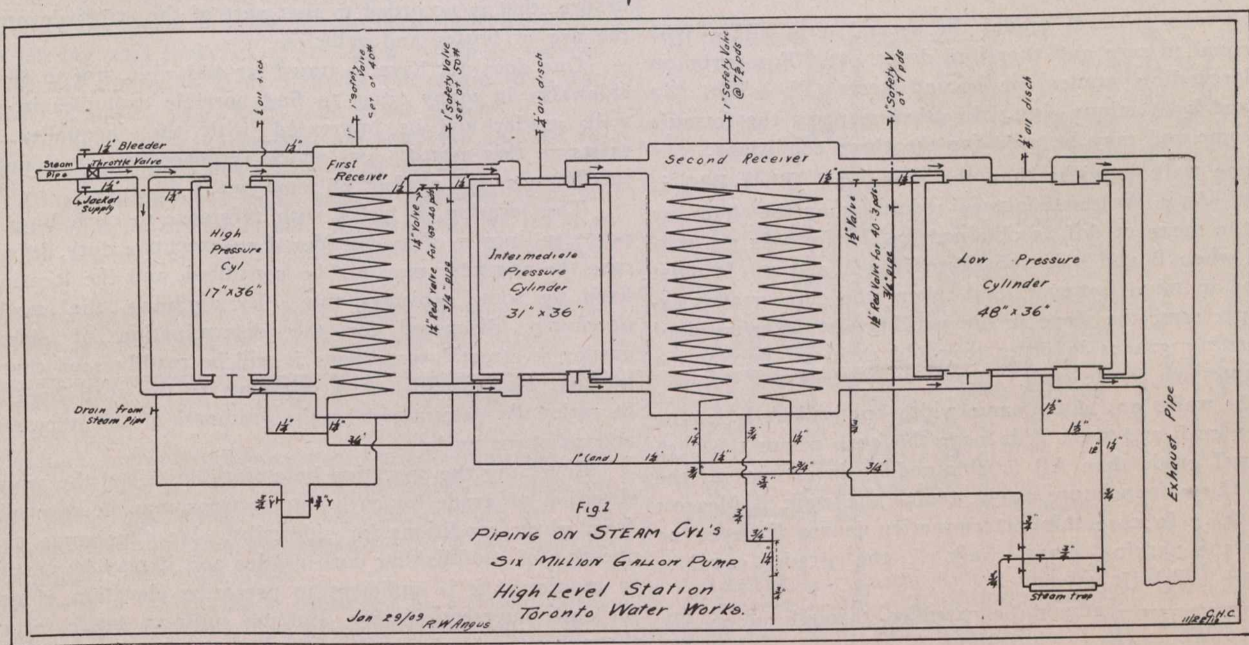
The engine tested is a three-cylinder vertical, triple-expansion crank and fly-wheel pump having three single acting plungers direct-connected to the pistons of the three steam cylinders. It is designed to give a discharge of six million Imperial gallons per twenty-four hours against a discharge pressure of 75 pounds per square inch for domestic purposes but is also capable of giving the same discharge against a pressure of 100 pounds per square inch for fire purposes.

The nominal diameters of the steam cylinders as given on the working drawings are 17-in., 31¼-in., and 48-in., respectively, and the nominal diameter of all water plungers is 21¾-in., the stroke for all plungers and pistons being 36-in. For the duty trial the diameters and strokes of the water plungers were determined with great care, as is explained later, but the dimensions of the steam cylinders were not verified.

To the crosshead of the low pressure plunger are attached the feed pump, the air pump, and an air compressor for providing compressed air in the discharge air chambers and also for the operation of the steam cylinder poppet valves if desired.

The engine has three cranks placed 120 degrees apart, the sequence being high pressure, low pressure and intermediate pressure. The crank shaft is made in two parts, which are joined together at the central crank by a sliding block which gives the shaft some flexibility without affecting its working.

Steam Cylinders and Piping.—A diagram of the steam piping for the engine is given at Fig. 1, which shows the main steam piping as well as that for the jackets and reheaters. Each of the cylinders is provided with a steam jacket, and receivers are placed between each pair of cylinders, a reheating coil being placed in each of the receivers. The sizes and arrangement of pipes are shown on the drawing and are as follows:—



(a) **Cylinder-Steam Piping.**—After passing the throttle valve the steam main has two five-inch branches, one of which carries steam to the top of the high pressure cylinder, the other to the bottom of the same cylinder. The exhaust from the high pressure cylinder is conveyed by two pipes, each 5-in. diameter, to the first receiver where it is reheated before being delivered to the intermediate cylinder through two pipes each 8½-in. diameter.

From the intermediate cylinder the steam passes through two pipes into the second receiver where it is again reheated before being sent to the low pressure cylinder. After passing through the latter cylinder the steam is conveyed by the 16-in. exhaust pipe to the heater and finally to the condenser.

(Continued on page 725.)

*In November Applied Science.

CORRELATING SIDEWALK GRADE TO CURB GRADE.

(Continued from Page 713.)

Wb = Width of walk B.
Sa = % slope in parking for A.
Sb = % slope in parking for B.
IA = Transverse incline in A in %.
IB = Transverse incline in B in %.
%a = % grade of curb a.
%b = % grade of curb b.
ab = Elevation of grade at intersection of curbs.
AB = Elevation of grade at intersection of walks.

Then for walks of equal width and equidistant from the curbs when the curbs leave the intersection on equal ascending grades, and with uniform slope in the walks and uniform slope in the parking for both cases.

$$AB = ab + (Bb + Wb)\ \%\ a + (Aa)\ Sa + (Wa)\ IA$$

the symbols here used being applicable to requirements of walk A.

While this formula, and others that will be referred to, may seem long and involved, a mere glance will show that they require but the simplest of arithmetical operations in their solution and that the symbols are used simply for brevity.

For walks on level grades the second term (Bb + Wb) %a is equal to zero and therefore drops out. For curbs on equal descending grades the second term (Bb + Wb) %a is prefixed by a minus sign. In other respects the formula is the same and may be used for the three conditions.

If one walk is wider than the other and (Bb + Wb) is equal to (Aa + Wa) satisfactory results may be had by taking the mean of AB as obtained by the formula as written and when B and b is substituted for A and a. It must be borne in mind however, that where the curb grades exceed 4 per cent. the slope in the parking should be reduced on ascending grades in order to avoid excessive inclination at the approach to the curb.

If the walks are of the same width but walk A is remote from the curb and walk B is near the curb where the curb is on level grade then AB is obtained by inserting in the formula the nomenclature applicable to the walk B (nearest to a curb). In case this determination leaves little or no slope in the parking along walk A the grades equal to

$$\frac{(Bb)\ Sb + (Wb)\ IB}{Bb + Wb}$$

should be extended through point AB, to an intersection with the regular gradient of walk A. Solving the formula for AB for both walks and subtracting the result obtained for the near walk from that obtained for the remote walk we find a certain difference in elevation which divided by

$$\frac{(Bb)\ Sb + (Wb)\ IB}{Bb + Wb}$$

gives the distance from the point AB to the grade intersection. We thus find that walk B has one controlling grade point located at the walk intersection, while walk A has two, one of which is located at the intersection of A and B and the other at some distance therefrom at the intersection of the two gradients. If the curbs in this case depart from the intersection on substantially equal ascending grades the formula should be applied for walk B the same as for level curbs, and the AB so found should be used for controlling grade for both walks A and B. If the curbs in this case depart from the intersection on substantially equal descending grades the formula may be applied in the same manner as for ascending grades, except where this result causes a reverse slope in the parking along the remote walk when two controlling grade points in the remote walk A should be determined as described in a previous case.

It is not the intention of the writer to go into wearisome detail of this whole subject. The variations in the relationship between sidewalk and curb are almost infinite, but the general principles to be borne in mind in the solution of any given problem are not many and can be applied to almost all combinations. His purpose is to lay stress upon matters often disregarded because of their seeming insignificance, and to aid in securing proper recognition and rational treatment of the sidewalk question.

The sidewalk is in reality the most important surface structure on a street, for the vast majority of the public travel on foot. Many a family has lived through generations without owning a vehicle of any kind. The householder may carry his drink, food, raiment and even his furniture, fuel and building materials without the use of a road, but he cannot be deprived of a foot path leading to his home or to his means of livelihood.

Serving so many of us it does not seem unreasonable to ask that the sidewalk be given a place of equality with, and that it receive the same application of professional skill in design, that is accorded to that part of the street devoted to the use of brutes and vehicles.

One does not have to travel far and wide, nor to observe sidewalks in many cities to find horrible examples in sidewalk grades and be impressed with the inequality that exists in this matter, and which is generally occasioned by indifference and neglect of some one.

The location of walks with reference to curb lines and property lines is often considered an executive duty, in which case the engineer may not be consulted, and the location is fixed by some arbitrary rule. By applying the methods previously discussed for the determination of sidewalk grades at street intersections it will be readily seen that the location of the walks with reference to the curb lines may be rationally determined by the gradients of the intersecting and adjacent curbs.

Reversing the operation heretofore described the required elevation of grade for curb intersections may be determined from given conditions for sidewalks. We thus come to the question of establishing curb grades and it may be pertinent to inquire if it is sufficient to prescribe elevation of grade for curb intersection only, and use uniform grade for curb throughout a block in all cases, or, if it would not be well under certain aggravated conditions to break grade at intersection of walks with curbs in order to modify steep walk approaches.

It is quite customary in small towns and in certain rapidly growing sections of the larger cities, where there is no immediate call for paved or curbed streets to establish walk grades without regard to how a future curb grade may fit. Again, such places may have established grades for curbs with no regard as to the possibility of placing a future walk at a desirable grade. Either of these conditions, upon the ultimate completion of the street improvements, give rise to situations that have all the ear marks of unsightly, inconvenient and objectionable patch work, against which the public may with justice protest.

COMING MEETINGS.

NEW YORK CEMENT SHOW.—December 14-20, 1910. First annual convention in Madison Square Garden, New York. Under the management of the Cement Products Exhibition Company, 115 Adams St., Chicago.

REPORT OF DUTY TRIAL ON THE SIX MILLION IMPERIAL GALLON PUMPING ENGINE AT THE HIGH LEVEL PUMPING STATION, TORONTO WATER WORKS.

(Continued from page 723.)

(b) **Jacket and Reheater Piping.**—The jacket supply is drawn from the main steam pipe on the boiler side of the throttle valve and connects directly with the high pressure jacket.

On leaving the high pressure jacket the steam passes, by means of a 1¼-in. pipe, to the reheating coil in the first receiver, from which it is conveyed through a 1¼-in. pipe containing a 1¼-in. globe valve and a 1¼-in. reducing valve, (set for reducing the pressure from 150 pounds to 40 pounds), to the intermediate jacket. This 1¼-in. pipe also contains a 1-in. safety valve set at 50 pounds.

After passing through the intermediate jacket the steam passes through a 1-in. pipe which is enlarged to 1¼-in. into the two reheating coils in the second receiver, which coils are arranged in parallel. The steam leaves these coils through a single 1½-in. pipe, on which is a globe valve, a 1½-in. reducing valve set for reducing the pressure from 40 pounds to 3 pounds, and a safety valve set at 7 pounds. This 1½-in. pipe delivers the steam into the low pressure jacket.

On leaving this jacket a 1½-in. pipe, which is reduced to 1¼-in. and finally to ¾-in. delivers the steam to a trap from which it passes by a ¾-in. pipe to the sewer.

For drainage from the jackets and receivers and the reheating coil ¾-in. pipes are arranged as shown.

(c) **Other Piping.**—A 1¼. in. pipe is connected from the main steam pipe on the boiler side of the throttle to the first receiver for starting up. This pipe contains a 1¼-in. globe valve.

Air discharge pipes each ¼-in. diameter and supplied with a valve are placed at the top of each cylinder jacket.

A 1-in. safety valve set at 40 pounds is placed on the first receiver and a similar valve set at 7½ pounds on the second receiver.

The high pressure cylinder has Corliss admission and exhaust valves, and on the intermediate cylinder Corliss admission valves are used, while for the exhaust for this cylinder and the admission and exhaust for the low pressure cylinder poppet valves are used.

The speed of the engine is controlled by a flyball governor which operates on the high pressure valves only and in case the speed becomes excessive this governor also opens a valve in the condenser so as to admit air to the latter and "break" the vacuum.

Feed Water and Condenser Piping.

The feed water and condenser piping scheme is shown on Figs. 2 and 3.

The cooling water for the condenser is taken from and again returned to the suction pipe of the engine. A butterfly valve is placed in the main 24-in. suction pipe and the cooling water is drawn from this pipe, on the side of the butterfly valve remote from the pump, through an 8-in. valve and pipe passing into the condenser. After passing through the condenser the water is returned to the suction main through an 8-in. pipe and valve, but on the side of the butterfly closest to the engine. By the proper adjustment of the butterfly valve any desired proportion of the water may be sent through the condenser.

The area of the butterfly valve is about 80 per cent. of the area of the 24-in. pipe, but it is never set at less than 22½° to the normal to the pipe axis and when fully open is turned parallel to the pipe axis in which case it offers practically no resistance to flow and very little water would pass through the condenser.

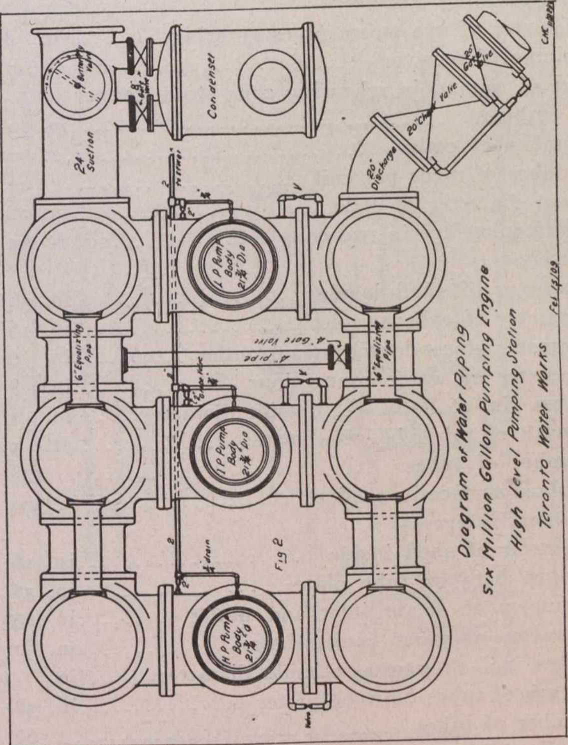
The exhaust steam first passes through a feed water heater and then on to the condenser. After being condensed the steam passes through a 6-in. pipe to the air pump from which it is discharged to the sewer.

The feed water is drawn from the main suction pipe through a 2-in. pipe, containing a valve, into the well. From the well a 2-in. pipe delivers the water to the feed pump from which it is discharged through a 2-in. pipe. As shown on the drawings the water may be sent through the heater or not as desired. A by-pass of 1½-in. pipe and containing valves is connected from the suction to the discharge pipe of the feed pump.

Pumps.

The pumps are single acting, and corresponding to each plunger there is one suction and one discharge chamber. The valves are arranged in cages, there being for each plunger seven valve cages, each cage containing 25 valves. There are thus 525 suction valves and 525 discharge valves.

The area through each of the valves is given on the drawings as 5.95 sq. in., but this was not verified.



NOMINAL DIMENSIONS OF ENGINE AND PUMPS.

Note:—The dimensions given in the following table are all taken from the working drawings but were not verified, as they are not essential to the duty trial. The exact diameter and stroke of each plunger is given elsewhere, but the sizes given on the drawings are set down here for convenience.

1.—Nominal Dimensions of the Engine.

High Pressure Cylinder:—		
Diameter of piston	in.	17
Diameter of counterbore of cylinder	in.	17⅛
Diameter of piston rod	in.	4
Stroke of piston	in.	36
Clearance (least distance from piston to cylinder head)	in.	¼

Intermediate Pressure Cylinder:—

Diameter of piston	in.	31¼
Diameter of counterbore of cylinder	in.	31 5-16
Diameter of piston rod	in.	4
Stroke of piston	in.	36
Clearance (least distance from piston to cylinder head)	in.	¼

Low Pressure Cylinder:—

Diameter of piston	in.	48
Diameter of counterbore of cylinder	in.	48⅛
Diameter of piston rod	in.	4
Stroke of piston	in.	36
Clearance (least distance from piston to cylinder head)	in.	¼

First Reheating Receiver:—

Diameter of two steam pipes entering	in.	5
Diameter of two steam pipes leaving	in.	8½
Volume of receiver	cu. ft.	33.5
Size of pipe in reheating coil (o.d. copper tubing)	in.	1¼
Number of coils		1
Number of turns per coil		18
Mean diameter of coil	in.	24
Heating surface in coil	sq. ft.	37

Second Reheating Receiver:—

Diameter of two steam pipes entering	in.	8½
Volume of receiver	cu. ft.	47
Size of piping in reheating coils (o.d. copper tubing)	in.	1¼
Number of coils		2
Number of turns per coil		22
Mean diameter of coils	in.	28
Heating surface in two coils	sq. ft.	64

Condenser:—

Diameter of shell inside	in.	36¼
Diameter of exhaust inlet	in.	16
Diameter of condensed steam outlet	in.	6
Diameter of water connections	in.	8
Tubes No. 16 B. W. G., outside diameter	in.	1
Length of tubes between plates	ft.	5
Number of tubes		228
Cooling surface in condenser	sq. ft.	300

Feed Water Heater:—

Diameter of shell inside	in.	16
Length between tube plates	in.	58
Diameter of steam inlet and outlet	in.	16
Diameter of water connections	in.	2
Tubes No. 18 gauge, outside diameter	in.	⅝
Length of tubes between plates	in.	58
Number of tubes		68

Air and Feed Pumps:—

Air Pump—Single Acting.

Diameter	in.	12
Stroke	in.	36
Diameter of inlet pipe	in.	6
Diameter of discharge pipe	in.	8

Feed Pump—Single Acting.

Diameter	in.	1¾
Stroke	in.	36
Diameter of inlet pipe	in.	2
Diameter of outlet pipe	in.	2

Air Compressor:—

Diameter	in.	3
Stroke	in.	36
Water jacket pipes, inlet and outlet	in.	¾

General Dimensions:—

Length of connecting rod, centre to centre	ft.	7½
Diameter of crank shafts in fly wheel	in.	12½
Diameter of main bearings	in.	10½
Length of main bearings	in.	18
Diameter of hole through shaft	in.	3
Crank pins—diameter	in.	6½
Crank pins—length	in.	6
Crosshead pins—diameter	in.	6½
Crosshead pins—length	in.	6
Diameter of steam pipe	in.	
Diameter of exhaust pipe	in.	16
Number of flywheels		2
Diameter of wheels	ft.	12 1-3
Rim 11-in. and 12-in. wide, 12-in. thick.		
Length of hub	in.	17½
Weight of each wheel	lbs.	20,000

2.—Nominal Dimensions of the Pumps.

Diameter of plungers	in.	21¾
Stroke of plungers	in.	36

Valves:—

Rubber, arranged on sides and top of cages, secured to deck plates.

Number of valve deck plates		6
Number of holes for cages in each plate		7
Total number of valve cages		42
Number of valves per cage		25
Total valves in entire pump		1,050
Water opening in each valve	sq. in.	5.95

(Note—one-half (525) of the above valves are suction, the rest discharge).

Air Chambers:—

Number of suction air chambers		3
Number of discharge air chambers		3

Piping:—

Suction pipe, diameter	in.	24
Discharge pipe, diameter	in.	20
Equalizer pipes, diameter	in.	10
Number of distance rods to plungers		12
Diameter of each rod	in.	3

The Duty Trial.

According to the specifications and contract, "The engine shall perform a duty of not less than one hundred and sixty million (160,000,000) foot pounds for each one thousand (1,000) pounds of commercially dry steam used by the engine and any auxiliary pumps supplied by the contractor and operated during the duty trial. Steam containing less than 1½ per cent. of entrained water, as determined by calorimeter measurements, shall be considered as commercially dry steam. In computing the duty, the work performed by the engine shall be based upon plunger displacement. The head for computing the duty shall be that shown by an accurate pressure gauge attached to the discharge main at a point inside of the engine room and beyond the last pump, less the reading shown by a gauge attached to the supply main at or near the entrance to pump. No allowance shall be made for friction of water in pumps or pipes between the pump well and the gauge attached to the discharge main. In computing the duty, the total steam used, including that used by jackets, reheaters, and auxiliary pumps, shall be charged to the engine. The duty trial shall be of twenty-four hours' duration. The engine shall be operated continuously at the rated capacity against a head equal to 75 pounds pressure per square inch on the discharge main, and shall be supplied with steam of not more than 150 pounds pressure per square inch, by gauge, at the boiler.

"The engine shall have a capacity of six million Imperial gallons in twenty-four (24) hours when operated at a plunger speed of not over 180 feet per minute, against a head equal to 75 pounds pressure per square inch, on the pumps."

It is further stated in the general data given the contractor that the pressure in the suction main is 15 pounds per square inch.

The trial was made as closely as possible under the contract conditions; as, however, the pressure in the suction main, on account of some alterations in the city water piping system, had been raised to about 25 pounds per square inch, the pressure on the discharge main during the test was about 85 pounds per square inch, in order to obtain the pressure difference of 60 pounds per square inch between suction and discharge mains contemplated in the contract.

Weight of Steam Used.

The steam chargeable to the engine was determined by the condensation from the condenser, the jackets, the reheater, etc., and tanks were arranged, placed on scales, so that the weight of the condensed steam could be directly determined. The condensation from the condenser was measured by itself in one set of tanks, and that from the jackets and other drain pipes in a second and smaller set. The weights of condensed steam were measured every half hour, two observers checking all weights independently, setting down their results and comparing them before making the entry on the observation sheet.

Pressure.

The pressure on the discharge main was taken by an accurately calibrated Bourdon gauge, the piping leading to which was attached outside the last connecting branch from the pump. The pressure on the suction main was measured similarly by an accurately calibrated Bourdon gauge, the attachment being made close to where the suction main enters the pumping station, just outside of the condenser. The gauges themselves were placed side by side in a position where they could be conveniently read from the engine platform, about fourteen feet above the suction and discharge mains, correction being made for water column. The pressure difference was maintained as closely as possible at 60 pounds by manipulating a gate valve on the discharge main placed outside the point of attachment of the discharge gauge. During the night the pressure on the discharge main became excessive, and in order to maintain the pressure difference at the required figure it was found necessary to open a hydrant adjacent to the station.

The steam pressure at the engine was determined by an accurately calibrated Bourdon gauge, and the pressure in the calorimeter by a mercury manometer.

The pressures in the first and second receivers were taken from gauges on the gauge board. These gauges were not calibrated, but correction was made for water column. The vacuum in the exhaust pipe was taken from the vacuum gauges at the gauge board which was not calibrated.

The pressure in the steam jackets was determined from the regular gauges attached to the jacket, which were not calibrated or corrected in any way.

The barometer reading was obtained from the Observatory at intervals during the test. The result given is the average throughout the 24 hours, corrected to the height of the High Level Pumping Station, and the temperature of the engine room.

Speed.

The speed of the engine was determined by the revolution counter attached to the gauge board, the reading on this counter being checked by a second counter specially set up for the test; the counters agreed perfectly.

The Quality of the Steam.

The quality of the steam was determined by a throttling calorimeter connected to the steam main on the engine side of the throttle valve. The calorimeter worked satisfactorily throughout the test. The percentage of moisture in the steam was low, and showed very little variation throughout. The steam used by the calorimeter was not weighed.

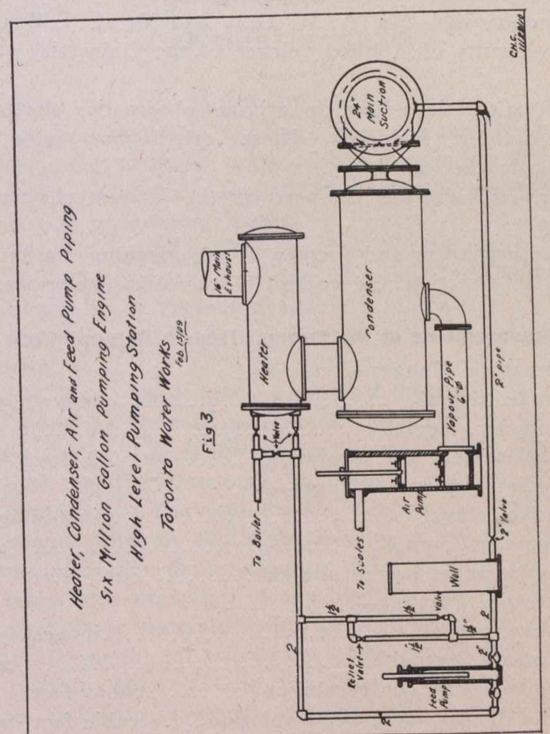
Temperatures.

The temperatures of the engine room and of the boiler room were observed throughout the test.

The temperature of the exhaust was obtained from a thermometer placed in the exhaust pipe about eight feet below where the latter left the engine.

Indicator Diagrams.

Indicator diagrams of the steam and pump cylinders were taken at intervals during the test.



Measurements of the Plunger.

The diameters of the plungers were measured Wednesday, April 7th, the engine being shut down at 4 p.m. for this purpose.

Observations.

With the exception of the measurement of the condensed steams, which readings, as mentioned above, were taken every half hour, and the barometer and thermometer readings, the observations were made every ten minutes.

Starting the Trial.

The trial began at 2.30 p.m. Thursday, April 8th, and ended at 2.30 p.m. Friday, April 9th, 1909. The watch used in the trial was compared with a chronometer at the beginning and end of the test, and was found to have lost approximately two seconds in the twenty-four hours.

The engine, after having been stopped for the plunger measurement on the previous evening, had been in operation for at least eight hours previous to the commencement of the trial, and was thoroughly warmed up. It ran satisfactorily throughout, with the exception of a slight vibration, caused by some of the cams operating and the valves on the low pressure cylinder not working quite smoothly.

The poppet valves on the intermediate and low pressure cylinders are arranged to be closed by springs or by air pressure; during the test the spring closure was used, the air compressor being used simply to keep air in the air chambers of the pumps.

Towards the end of the test a small leakage of steam from the high pressure cylinder jacket developed owing to a slight failure of the packing; the drip was caught, and from it the total loss due to this leak estimated. The weight was added to the total weight of water measured on the scales.

Observers.

The observers worked in eight-hour shifts, but each shift was present for about ten hours. These men were all skilled in such work, being students in the fourth year of the Faculty of Applied Science and Engineering of Toronto University.

The trial was under the direction of Professor Robert W. Angus, and was carried out by Mr. M. R. Riddell, in conjunction with Mr. W. W. Gray and Mr. J. J. Traill, all of the Faculty of Applied Science of the University of Toronto.

All calculations from the original observation sheets were made by Mr. Riddell. These calculations have been thoroughly checked.

Mr. Hill watched the test in the interest of the contractors.

The engineers and firemen at the pumping station were under the direction and control of the station engineer.

Measurements of the Pumps Used in Computations.

High-pressure Plunger—	
Stroke, actual ..... inches,	35.947
Diameter, actual	21.751
Displacement per revolution ..... cubic feet	7.730
Intermediate-pressure Plunger—	
Stroke, actual ..... inches	36.007
Diameter, actual	21.757
Displacement per revolution ..... cubic feet	7.747
Low-pressure Plunger—	
Stroke, actual ..... inches	35.972
Diameter, actual	21.760
Displacement per revolution ..... cubic feet	7.742
Total displacement per revolution ..... cubic feet	23.219
Total displacement per revolution ..... imp. gals.	144.699
Volume of imperial gallon ..... cubic inches	277.274

Observations and Results.

Date of Trial—

2.30 p.m. Thursday, April 8th, to 2.30 p.m. Friday, April 9th.

Duration of Trial—24 hours.

Corrected Average Pressures—	
Boiler pressure by gauge, pounds per sq. in.	150.21
At engine pressure by gauge, pounds per sq. in.	148.85
In first receiver by gauge, pounds per sq. inch	24.04
In second receiver by gauge, pounds per sq. inch (below atmosphere)	4.09
In intermediate jacket by gauge, pounds per sq. inch	39.08
In low pressure jacket by gauge, pounds per sq. inch	1.17
Vacuum by gauge, ins. mercury	27.39
Pressure on discharge main, pounds per sq. inch.	85.14
Pressure on suction main, pounds per sq. inch	25.16
Height of centre line of discharge main above centre line of suction main at point of gauge attachment ..... feet	0.7
Corresponding pressure, pounds per sq. inch	0.30
Total pressure, difference on pumps, pounds per sq. inch	60.28
Barometer, average, at pump floor level and temperature, ins. mercury	29.54
Average Temperatures—	
Of engine room, degrees Fahr. (lower platform)	76
Of boiler room, degrees Fahr.	66
Of exhaust steam, degrees Fahr.	105.5
Calorimeter—	
Pressure of supply steam at calorimeter, pounds per sq. inch	148.85
Pressure of steam in calorimeter (1 in. mercury =.4908 pounds per sq. inch)	1.21
Temperature in calorimeter, degrees Fahr.	298
Moisture in steam, per cent.	0.72
Speeds—	
Total number of revolutions by counter	43,185
Average revolutions per minute	29.99
Average plunger speed, feet per minute	179.814
Water Pumped—	
Total number of revolutions	43,185
Plunger displacement per revolution, cubic feet.	23.219
Plunger displacement per revolution, imp. gals.	144.699
Displacement in twenty-four hours, imp. gals.	6,248,813
Work Done—	
Total number of revolutions	43,185
Displacement per revolution, cubic feet	23.219
Total pressure difference on pumps, pounds per sq. inch.	60.28
Work done per revolution, ft. pounds	201,542
Work done in twenty-four hours, ft. pounds.	8,703,603,033
Steam Used by Engine—	
Total condensation from condenser, pounds	45,091
Total condensation from jackets, receivers, etc., lbs.	8,072
Total steam used by engine, pounds	53,163
Duty—	
Work done by pump in twenty-four hours, ft. pounds	8,703,603,033
Steam used by engine in twenty-four hours, lbs.	53,163
Duty per thousand pounds of steam used, ft. lbs.	163,715,423
Duty required by specifications, ft. lbs.	160,000,000

NEW INCORPORATIONS.

Oshawa, Ont.—Matthew Guy Carriage & Automobile Co., $250,000; R. W. Eyre, W. D. Earngey, J. J. Hubbard.

Toronto, Ont.—Electric Installation Co., $40,000; J. B. Ferris, J. P. Archer, A. B. Colville, Bremner Porcupine Mines, $1,000,000; R. W. Hart, M. Gordon, C. H. C. Leggott. Canadian Electric Fixture & Contracting Co., $40,000; S. Wood, H. M. Van Gorder, W. Burton. Metal-Workers' Specialties, $40,000; H. B. Nicol, W. Cowan, J. C. Cole. Canadian Commandite Co., $500,000; J. S. Lovell, W. Bain, R. Gowans. Dominion Graphite Co., $500,000; J. S. Lovell, W. Bain, R. Gowans.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Col. H. N. Ruttan; Secretary, Professor C. H. McLeod.

Chairman, A. E. Doucet; Secretary, P. E. Parent. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, A. W. Campbell; Secretary, P. Gillespie, Engineering Building, Toronto University, Toronto. Meets last Thursday of the month.

MANITOBA BRANCH—
Chairman, J. E. Schwitzer; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University

OTTAWA BRANCH—
Chairman, A. A. Dion, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Mayor Reilly, Moncton; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King s Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, E. C. Hopkins, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, R. E. W. Hagarty, 662 Euclid Ave., Toronto.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN GAS EXHIBITORS' ASSOCIATION.—Secretary-Treasurer, A. W. Smith, 52 Adelaide Street East, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, J. Duguid; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, A. D. Campbell; Corresponding Secretary, A. H. Munroe.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, C. M. Canniff; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C.B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, H. W. Selby; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Alfred T. de Lury, Toronto; Secretary, J. R. Collins, Toronto.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, H. P. Ray; Secretary, J. P. McRae.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm. Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

ENGINEERS' CLUB.

(Continued from page 718.)

well pleased with the lighting effect of this room. The billiard room is ample large enough to contain two American and one English table. There are also parlor sleeping rooms and attendants' rooms.

The plans outlined for the new library which the Club will have embrace a collection of books that will surpass anything else at present available in Canada.

The Club will have the additional advantage of a main entrance.

Mr. L. J. Street gave a detailed estimate of expenses that would be incurred and funds obtainable on the part of a new Club. The report was very satisfactory and seemed to show that the Club could more than meet expenses even the first year. The rent for the Club rooms will be $335 per month with an additional $25 per month if the 12-foot extension to the dining-room is taken. This will include all taxes with exception of the business tax. A lease may be taken, it is understood, for six months or one year, with right of renewal for two years. The rooms will be ready by January, 1911. There are 5,305 square feet of floor space, excluding lavatory room, and the rental will amount to about 73 cents per square foot. Should additional space be needed it is understood that an adjoining room 70 x 80 feet could be obtained.

The sentiment of the meeting was very favorable to the proposition as a whole. A board of directors of representative men from the different professions which will be represented in the new Club, was elected at this meeting. The directors elected are: Messrs. Robt. A. Baldwin, S. Percy Biggs, W. A. Bucke, C. M. Canniff, Willis Chipman, John Galbraith, W. A. Hare, Chas. H. Heys, E. A. James, J. G. Sing, C. B. Smith, L. J. Street, J. B. Tyrrell, A. J. Van Nostrand, Clarence R. Young.

A meeting of the directors has since been held, at which time they elected their officers. Until February, when the annual meeting will be held, the following will serve as officers: President, C. M. Canniff; first vice-president, Willis Chipman; second vice-president, A. J. Van Nostrand; treasurer, L. J. Street; secretary, R. B. Wolsey.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In addition to those in this issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Calgary, Alta., motor generator	Dec. 22.	Dec. 1.	64
Chapel Cove, N.S., breakwater	Dec. 5.	Nov. 10.	622
Maccan, N.S., timber supply	Dec. 5.	Nov. 10.	622
Monks' Head, N.S., breakwater	Dec. 19.	Dec. 1.	698
Ottawa, Ont., buoy steamer	Jan. 4.	Dec. 1.	698
Ottawa, Ont., rock-crushing plant (portable) and jaw crusher	Dec. 8.	Dec. 1.	698
Ottawa, Ont., coal	Dec. 12.	Nov. 17.	644
Ottawa, Ont., railway	Jan.	Nov. 24.	42
Port Arthur, Ont., church	Dec. 12	Nov 17.	644
Prince Rupert, B.C., buoy depot	Jan. 3.	Dec. 1.	698
Rigaud, Que., public building	Dec. 5.	Nov. 17.	644
Regina, Sask., fire hall building	Dec. 10.	Dec. 1.	698
Sherbrooke, Que., concrete dam and power house	Dec. 28.	Dec. 1.	64
Souris, Man., water works supplies	Feb. 1.	Nov. 24.	54
St. Henri, P.Q., post-office altera-			
St. John, N.B., main intercepting sewer	Dec. 30.	Dec. 1.	698
tion	Dec. 6.	Nov. 24.	42
St. Joseph de Lettelier, Que., wharf	Dec. 6.	Nov. 17.	644
Stratford, P.Q., landing pier	Dec. 5.	Nov. 10.	622
Toronto, Ont., 60-in. steel pipe	Dec. 13.	Dec. 1.	64
Toronto, Ont., post-office fittings	Dec. 12.	Nov. 24.	56
Winnipeg, Man., motor generators	Dec. 15.	Nov. 17.	54
Winnipeg, Man., electric crane	Dec. 15.	Nov. 24.	42

TENDERS.

Halifax, N.S.—Tenders will be received until December 27th for purchasing two steam fire engines. L. Fred Monaghan, City Clerk, Halifax.

Ottawa, Ont.—Tenders will be received until December 9th for the construction of two wooden scows. Public Works Department, Ottawa.

Ottawa, Ont.—Tenders will be received until December 21st, 1910, for alterations on public building, Peterborough, Ont. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Sault Ste. Marie, Ont.—Tenders will be received until the 2nd of January, 1911, by the Manitoulin and North Shore Railway, Sault Ste. Marie, Ont., for the construction of roadbed and structures of the Manitoulin and North Shore Railway; Crean Hill, mile 22.7, west of Sudbury, to connection with line at Espanola; Espanola South, near mile 61. R. S. McCormick, Chief Engineer, Manitoulin and North Shore Railway, Sault Ste. Marie.

Regina, B.C.—Tenders will be received until December 10th for the erection of a fire hall building on Scarth St., Regina.

North Vancouver, B.C.—Tenders will be received until December 12th, 1910, for the construction of a storm sewer. Geo. Hanes, City Engineer.

Mud Lark, B.C.—Tenders will be received until December 9th, 1910, for the construction of two 180 cubic yard wooden dump dredges, Mud Lark. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Point Grey, B.C.—Tenders will be received until December 14th for the purpose of clearing streets. H. Floyd, C.M.C., Kerrisdale, B.C.

North Vancouver, B.C.—Tenders will be received until December 12th, 1910, for the purpose of supplying a steel-frame jaw rock-crusher. George S. Hanes, City Engineer.

Prince Rupert, B.C.—Tenders will be received until December 19th for the Hospital Quarantine Station. Department Dominion Public Works Office, Victoria, B.C. Wm. Henderson, Resident Architect.

Vancouver, B.C.—Tenders will be received until December 12th, 1910, for the erection of an office building at Vancouver, B.C. W. H. Hazlitt, Purchasing Agent, British Columbia Electric Railway Co., Limited, Vancouver, B.C.

Vancouver, B.C.—Tenders will be received until December 12th for the erection of an office building, corner Hastings and Carrall Streets, Vancouver. W. H. Hazlitt, Purchasing Agent, British Columbia Electric Railway Co., Limited, Vancouver.

Grand Forks, B.C.—Tenders will be received until December 28 for the construction of a public building at Grand Forks. R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

Vernon, B.C.—Tenders will be received until December 19th for electric light fixtures, wiring, etc., for public building, Vernon. R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

CURRENT NEWS.

Victoria, B.C.—On account of the great demand for office accommodation, Mr. J. H. Sayward will have a 6, if not 8-storey reinforced concrete office building erected at the corner of View and Douglas Streets, instead of the three-storey one under previous consideration. The addition decided upon will cost about $75,000 and will be constructed of reinforced concrete throughout with brick partitions.

Vancouver, B.C.—City Engineer Clement has prepared an itemized statement of the work accomplished by his department during the current year. It shows that no less than 23 miles of concrete walks and 2½ miles of curbing have been laid. There have been four miles of plank roadways, 30½ miles of new streets opened up and graded, 10 miles rocked and 3.45 miles graded permanently. There have been 3.1 miles of paving completed and there is still 9.1 miles under way. Besides showing the great amount of work accomplished the report also takes under consideration concrete walks still to be put down, and all of the three-plank walks asked for up to October 24th have been laid. Work on the uncompleted contracts is still proceeding to the satisfaction of the engineer.

Vernon, B.C.—Another section of the Grey canal, the great irrigation system of the White Valley Irrigation and Power Co., has been completed and water is now flowing freely through the great syphon across the head of Swan Lake at the rate of six hundred cubic feet per minute. This syphon is eleven thousand feet long and twenty-two inches in diameter. For several thousand feet of its length it sustains a pressure of 200 pounds to the square inch. These three features taken together constitute a record for wooden pipe. The pipe was manufactured by the Municipal Construction Company, of Vancouver, and was laid under the charge of J. G. Knight. Only a small section of the Grey canal now remains to be constructed. This irrigation scheme irrigates upwards of twenty thousand acres of fruit land in White valley, Goldstream and Vernon districts. The big ditch is over thirty miles in length, and with the exception of the C.P.R. irrigation works in Alberta, is the biggest thing of the kind in Canada.