PAGES

MISSING

Volume 22. Toronto, February 1, 1912 Contents of this issue on page 241

The Canadian Engineer

An Engineering Weekly

STRAIN MEASUREMENTS OF STEAM BOILERS.

Two 72-inch boilers which had been in active operation for 27 years were contributed for investigative purposes by the late Nicholas Sheldon, treasurer of the Kendall Manufacturing Company, of Providence, R.I. They were made by the Whittier Machine Company, of Boston, Mass., out of "Benzon" steel, were put into service in March, 1881, and had never required repair or renewal in any part. They were made in five courses, two sheets to a course, and had the following general dimensions:

Diameter	72 in.
Length, over dry sheet	16 ft.
Thickness of shell	⅜ in.
Thickness of heads	½ in.
Number of tubes	140
Diameter of tubes	3 in.
Length of tubes	15 ft.
Diameter of dome	2 ft. 6 in.

Longitudinal seams, double-riveted lap joints, ¾-inch rivets, 2-inch pitch, punched holes, rows 2⅛ inches apart, rivets staggered.

Girth seam, ¾-inch rivets, 2⅛-inch pitch.

Heads stayed, each, with 14 braces.

Cast-iron manhole frames and safety-valve nozzle.

Supported by lugs, three on a side.

The feed-water came from the Pawtucket river.

The utmost advantage of this opportunity was secured by placing in charge of the tests James E. Howard, qualified by long years of service as the head of the government test-

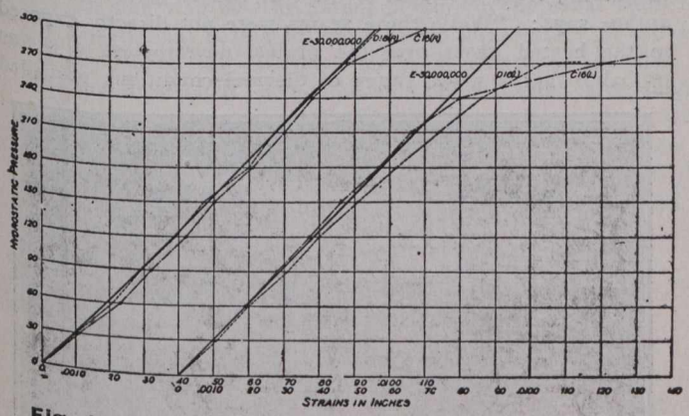


Fig. 1.—Curves of Tangential Extension, Solid Sheets, at Middle of Length of Courses.

ing plant, at the Watertown arsenal and now engineer-physicist of the Bureau of Standards, at Washington. He was advised and assisted by Francis B. Allen, vice-president of the Hartford Steam Boiler Inspection and Insurance Company. The tests were made at the W. H. Hicks Boiler Works, Providence, and form the subject of a paper to be presented at the December meeting of the American Society of Mechanical Engineers, from which the following information is derived:

The tests were made by subjecting the boilers to hydrostatic pressure and measuring the deformation at various points. For this purpose holes about 0.05 inch in diameter and 0.10 inch deep were drilled 10 inches apart in various portions of the shell, and reamed with a reamer having an angle of 65 degrees. A 10-inch strain gauge having conical points with an angle of 55 degrees, adjustable with a micrometer screw, was used to measure the distances between these holes as they varied under stress. The difference in

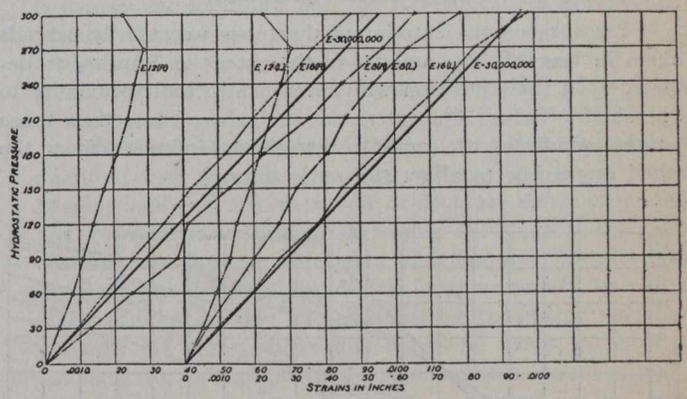


Fig. 2.—Curves of Tangential Extension, Solid Sheets, End Course Near Rear Head, Girth Seam and Middle of Length of Course.

angles made the gauge bear near the surface of the sheet $\frac{1}{10,000}$ and it is believed that the readings are reliable to $\frac{1}{10,000}$ inch. The stress which would produce an elongation of this amount in a distance of 10 inches is 300 pounds per square inch, assuming a modulus of elasticity of 30,000,000 pounds; that is, supposing that the stress per square inch divided by the stretch per inch of length would equal 30,000,000.

The boilers tested were of a very simple type, yet in very few instances were strains developed corresponding to those which would be indicated by the usual calculation for strains in a cylindrical shell subjected to internal pressure.

In Fig. 1 are laid off in a horizontal direction the amounts of stretch which would be produced by various pressures per square inch in a plain cylinder and with a modulus of elasticity of 30,000,000, each at a height corresponding to the pressure required to produce it. A pressure of 60 pounds per square inch in the interior of a cylinder of this diameter and thickness of shell would, for instance, produce a stretch of nearly 0.0020 inch in a length of 10 inches; and a pressure of 300 pounds a stretch of about 0.0095 inch. The points so determined would lie in the heavy straight line of the diagram marked E = 30,000,000. The distortions actually found were set off in the same way and connected by the lighter lines. They show the extensions of the third and fourth sheets of the boiler, counting from the front on the right and left sides of the boiler respectively, taken at the middle of the lengths of the courses. The courses are lettered A, B, C, D, E; C—16 R. on the diagram means gauged length 16 on sheet C, right-hand side. These follow

the heavy reference line for the ideal condition quite closely upon one side of the boiler, but the leaning to the right of the plotted lines of the other diagram indicates more than a normal stretch.

The strains produced at the various places measured are plotted in this way and the diagrams accompany the paper. E-8 was taken near the girth seam between this and the next sheet and E-16 in the centre of the rear sheet close to, but not spanning, the longitudinal joint. Diagrams of the boiler are given in the paper showing the location of each of the spans measured. Fig. 3 shows the extension across the longitudinal seam on the middle course, curve C-7 being taken at the front edge, C-11 at the rear edge and C-15 in the middle of the sheet. The author points out that in the case of a three-course boiler with one sheet to a course, as found in current construction, it would seem that a double riveted lap joint might occasion (by reason of the greater extension) an excessive stress in the solid sheet abreast the end of the seam, under certain pressures.

Pressure on the exterior of the tubes necessarily extends them in length. The amount of the extension appears to depend upon their position with reference to their proximity to the shell. Tubes adjacent to the shell extend less than those at the middle of the rows, a restraining influence from the shell appearing to affect the outer ones.

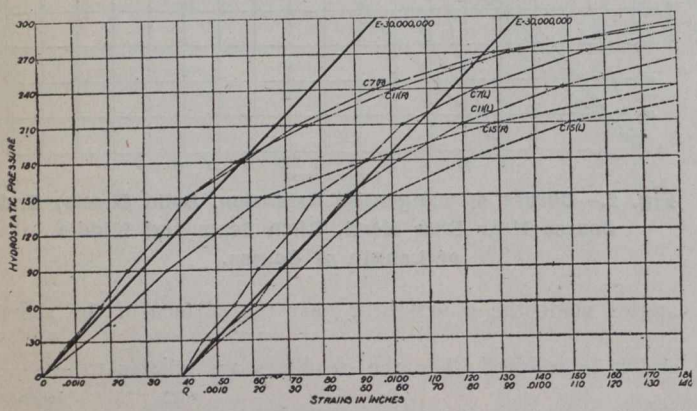


Fig. 3.—Curves of Tangential Extension, Across Longitudinal Seams, at Middle of Length of Course and at Edges.

In a plain cylindrical shell, increase in diameter would necessarily be attended by a definite amount of endwise contraction, eliminating the effect of pressure on the heads. The tests showed that there were parts of the boiler which were nearly free from longitudinal strains, while there were other places in which the strains were reversed and longitudinal extension shown instead of contraction. Along the lower quarter of the boiler the longitudinal strains were contractions, while along the upper quarter they were in part contractions and in part extensions. Figs. 4 and 5 show the amount and character of these strains at 270 pounds in the middle of the sheets and across the girth seams respectively.

It will be noticed that the lower part of the shell contracted notwithstanding the fact that the tubes were extended by the exterior pressure to which they were subjected. This behavior calls for bending at the flanges of the heads to compensate for the difference of these movements. The six through braces would relieve the shell of a portion of the longitudinal tension coming from the heads in the upper half of the boiler. Longitudinal gauged lengths on the upper part of the shell showed diminished contractions over those observed on the lower portion or displayed strains of extension. On the very top of the boiler the strains were extensions of a pronounced order.

The tests for which the figures and diagrams in the paper are given were made upon only one of the boilers. In the tests of the first boiler greater strains were displayed in the vicinity of the dome and the manhole frame than at other parts of the shell, which resulted in an early failure at these places. Actual rupture of the dome was not accomplished, but leakage along its single-riveted longitudinal seam became so great at 266 pounds that it was necessary to remove the dome and close the opening to it in the shell with a patch in order to reach higher pressures with the pump available.

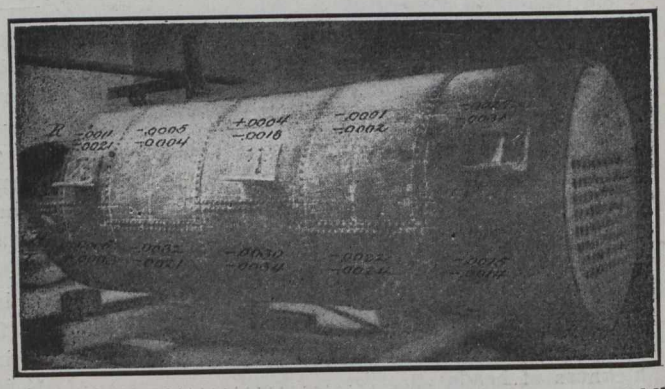


Fig. 4.—Longitudinal Strains on Solid Sheets at Middle Length of Courses. Minus Signs Indicate Longitudinal Contraction; Plus Signs, Longitudinal Extension.

At 270 pounds the cast-iron manhole frame fractured across the middle of its length. Another patch was then put on the shell covering the manhole and the test resumed, when at 295 pounds the rupture of three braces of the front head occurred. The test was then discontinued and the boiler dismantled. The strain measurements made upon the boiler were of the same order as those reported for the second and the results were similar.

A feature, however, in the test of the first boiler was absent or obscure in that of the second. Measurements of strains across the longitudinal seams increased progressively in passing from the front to the rear end of the boiler. The author says: "While these seams were not directly exposed to the heated gases over the grates, nevertheless it seems probable that a wider range of thermal conditions prevailed

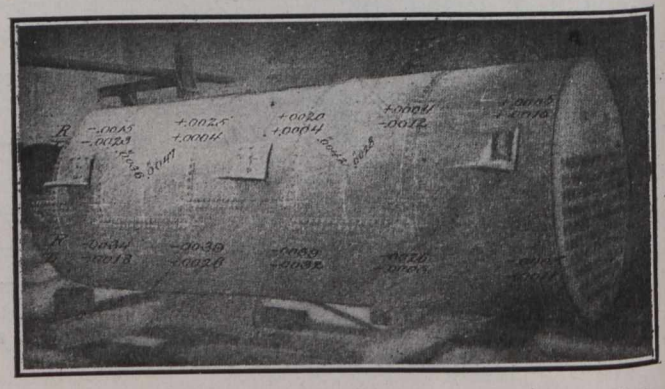


Fig. 5.—Longitudinal Strains Across Girth Seams, Also Strains on Diagonal Gauged Lengths of Courses.

in the vicinity of seams at the front end over those at the rear end of the boiler. If such was the case it would aid in explaining the greater slip of the forward seams." Leakage at the longitudinal seams began at 120 pounds and became general at 180, but at this time the slip of the joints had become pronounced and necessarily disturbed the calking.

The second boiler was stripped of its dome and manhole frame and the openings covered with patches before it was

tested. The heads were strengthened by means of six 1¼ inch through braces. The cast-iron safety-valve nozzle was allowed to remain in place, but was eventually replaced by a soft patch after 300 pounds pressure had been applied and released, as the distortion of the shell under the flange of the nozzle caused leaks impracticable to calk. During the test the boiler was supported on two wooden shoes sawed to fit the curvature of the shell.

When the pressure in the boiler was increased from 300 pounds, the highest indicated on the diagrams, to 335 pounds the manhole patch ruptured. Three of the rivets were sheared by the tangential stress of the shell followed apparently by the fracture of other rivets by tension on their stems which pulled off the heads and finally tore the sheet longitudinally along its upper element, starting this fracture at a rivet hole of the manhole as shown in Fig. 6.

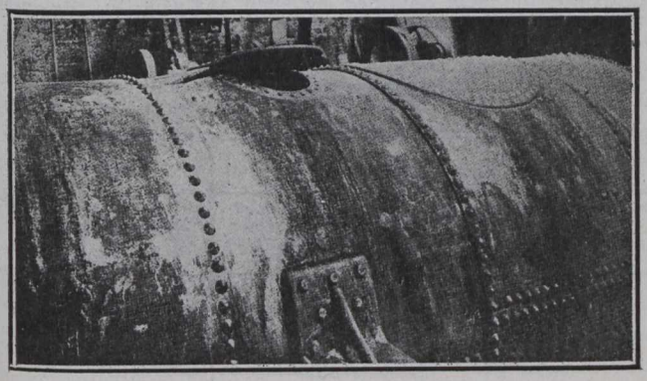


Fig. 6.—Manhole Patch After Rupture.

The shell was repaired by cutting out a portion of the middle course and putting in a section the full width of the course and about 3 feet wide measured on the arc. This was double riveted to the shell at its longitudinal seams. The hand-riveted seams extended rapidly, and copious leaks were started so that at the time of writing the paper no greater pressure than that of 335 pounds, at which the manhole patch ruptured, had been attained.

In summing up, the author points out the usual influence of longitudinal seams in intensifying the stresses in the adjacent sheets, the excessive stress developed at the side of the manhole patch and at the side of the safety-valve nozzle, and suggests that if such abnormal stresses can occur with so simple a structure as the boiler under consideration, it might be well to apply this method of examination to the strains produced in boilers of more complex construction.

GREASE IN GARBAGE.

Grease in garbage at Toronto was determined by a test made in January, 1911, at the works of Messrs. W. Harris & Company, under the direction of Messrs. Hering & Gregory, consulting engineers, of New York City. The object of the experiment was to ascertain by means of the reduction process the amount of grease contained in samples of Toronto garbage. Ten loads of garbage and rubbish, having a total weight of 11,075 lbs. were delivered at the works. This material was sorted over and the rubbish removed from it, leaving a net weight of 8,823 lbs. The garbage was then subjected to the reduction process and it was found from the results and analyses that the total amount of grease was about 4.71 per cent. of the weight of garbage. It is impracticable to recover all of the grease, but it is stated that by the use of the naphtha process the total amount of grease which could have been recovered would have been about 4 per cent. of the weight of the garbage.

COST ANALYSIS FOR CONTRACTORS.

The American Society of Engineering Contractors has for some months been working upon a uniform system of cost analysis for contractors, a committee having been appointed and discussions having been held at the monthly meetings of the society in New York and by some of the sections of the society in other cities. The subject has been freely discussed at these meetings by many contractors and a certain amount of progress is apparently being made. At a meeting in New York Edmund A. Pratt, under the title "A Simple Form of Cost Analysis," presented a form dealing with reinforcement in concrete work. This was somewhat modified by the discussion which followed, the resulting form being that shown herewith. The form presented is not intended to be kept in the field, but in the office, containing the results and total of records kept in the field. It seemed to be the general idea that the most convenient size for the form was that of the ordinary letter head, as it made it convenient for filing and for reference. As indicating the general ideas of the members concerning the subject of cost analysis we quote certain remarks from the minutes of that meeting as published in the September number of the Journal of the society:

Secretary Wemlinger—Although we have become acquainted with many and various systems and forms for cost keeping and cost analyses, few of such are sufficiently simple and convenient to become available for general use. It is our aim, therefore, to determine what features, classifications, items or subdivisions are desirable or necessary in cost analysis blanks, so that the engineering contractor who needs to study his costs can readily do so by using some of the standard forms and methods recommended and adopted by the society.

Mr. Lockwood—Concerning cost-keeping systems there is always danger of too much detail. In a certain shop a very elaborate system was put in to revolutionize the work and to show how much the owners were losing. At the end of the year they had lost $30,000; the system was so complicated with minute detail that it took half the time of the men to fill out cards.

Mr. Smith—There is a weekly time card that I saw one contractor use, something like that illustrated below:

Foreman, F. C. Burke.

Laborer, John Angelo.

Day.	7	8	9	10	11	1	2	3	4
Monday	A		C		D	C		A	
Tuesday	B								
Wednesday	D	E		A		D			C
Thursday	C								
Friday	E					D			
Saturday	B	A		B			E		C

At the top of the card is written the foreman's name and the name of the laborer. The first column is for the day, there being six spaces, one for each day of the week. Across the top, under the names, are printed the working hours. In the morning the foreman would take the card for each man and write a capital letter to indicate the class of work that the man was working on; later, say nine o'clock, if he changed him to another class of work, he would write another letter in the column 9. Every time the workmen were put to work on some other part of the job the proper classification letter was entered in the time column. . . . The foreman took the cards from the men every morning at seven o'clock and kept them in his pocket until noon, when he handed them back to the men. Then at one o'clock he took the cards back and entered the proper classification of work for each man. At five o'clock the cards were handed back to the men, and the whole thing repeated each day.

Mr. Wake—We find that the finer we try to get the records the more inaccurate they are. If you give the contractor too much to keep track of he cannot, or will not, do it.

Mr. Wemlinger—The object of cost keeping is not like that of book-keeping, to itemize everything to cents, but to get an approximate idea of the various costs. That is what we aim to do.

Mr. Wake—A contractor could not afford to keep these records if we go into too much detail.

Mr. Wemlinger—The large organization can afford to keep them, but we want to devise blank forms for the fellow that cannot afford to keep a man busy keeping track of all these details. We want something for the contractor who may have to do all this work himself.

Mr. Watson—The efficiency of any system of cost analysis depends, in the first place, on the accuracy of cost records. To serve the purpose well these must be clear and reliable and the conditions of the work concisely explained. Furthermore, the items of cost should be kept in accordance with some uniform system, so that records of different jobs may be compared intelligently and used advantageously in the analysis of costs for future estimates.

To get costs and to make the proper distribution on the records should be the duty of one man alone. If this man is shown what to do and how to do it, where and what changes to make, and is on the job all the time, keeping a journal and photographs as well, then at the end of a job these records are worth something; but ordinarily the timekeeper simply makes the easiest distribution he can and gives no details.

By watching the reports I myself know what job needs my attention most and when. Some contractors say: "The job is not large enough to pay the costs of a clerk." This is the biggest mistake possible, for every job will pay a clerk's wages. If you are losing money have him more than ever, for the records will show what the loss is and the reason why, and you can avoid making the same mistake again. My experience is that foremen and assistant superintendents who keep good cost records are not fit for anything else, as a rule, and could not get the work done for the estimated cost. For that reason, I say emphatically, have a cost clerk on every job; the better the man the more money you will make in the end.

In a discussion by the Indianapolis section of the report of the Committee on Uniform System of Cost Analysis considerable time was devoted to discussing the possibility of utilizing the facts obtained by such analysis in preventing the recognized evil of the low bids submitted by inexperienced contractors, which bids are too often accepted to the injury of both the contractor and the city or other party for whom the work is done.

The distinction between productive and non-productive labor and material was made a point of discussion also. In connection with the discussion DeWitt D. Moore, chairman of the committee, called attention to the committee's chart wherein it was endeavored to classify the several items of cost in a general way, this having formed a part of the report of the committee at the first meeting in 1911.

Mr. C. Brown said:

As a result of the speaker's experience in keeping final records of costs of additions to existing plants, such as sew-

FRONT OF FORM

REINFORCEMENT

COST—ANALYSIS.

Date.....19

JOB .....LOCATION .....

Period.....19 to.....19

Item.	Rate	No. days or quantity	Total amount	Class of u it	Unit cost	% total
Cutting and Bending—						
Foreman						
Labor						
.....						
.....						
.....						
				Lb.		
Placing—						
Foreman						
Labor						
.....						
.....						
.....						
				Lb.		
Materials—						
Steel, f.o.b.						
" Freight						
" Unload'g & cart'g						
				Lb.		
				Lb.		
Wire						
Total Materials						
Tools*				Lb.		
Repairs*				Lb.		
Grand total				Lb.		100.0

*The total cost of Tools and Repairs for the entire job is to be entered in the third column and is distributed on the total weight of the reinforcement placed, so that the cost of these items is given per pound of reinforcement in the fifth column.

BACK OF FORM

REINFORCEMENT—2

COST—ANALYSIS.

STYLE OF REINFORCEMENT				REMARKS
State whether wire mesh, expanded metal or bars, deformed or plain	No. of mesh, or sizes of bars.	Area of mesh or lengths of bars.	Weight, lbs.	Give reasons for using style of reinforcem't sel.
	Total weight.*		.....	

*This total must be the same amount as the total weight of Reinforcement given in the fourth column on the other side of this sheet..

CONDITIONS UNDER WHICH THE WORK WAS DONE.

Class of Labor; Experienced?.....Inexperienced?.....
Are the workmen members of a Labor Union?..What Union?..
Nationality of Labor? .....
Climate.....Weather: Give percentage of wet days.....
Was any work done on rainy days?.....How many days?....
Was the Reinforcement handled by labor or with derrick or other machine? .....
Describe in detail how handled.....
.....
How was the cutting or handling done? By machine or by hand?.....
Where was the Reinforcement placed? If in an excavation, what was the size and depth of this excavation?.....If in a building, how many stories?.....If in a bridge, give length of span.....
.....
If cost of Cutting and Bending or of Placing is high or low, give reasons why.....
Suggestions that will improve the conditions under which the work may be done again, and that will reduce the cost if this was high .....

ers, waterworks, and the like, in which distinctions must be between new construction and maintenance and repairs, he strongly urges the separation of items on the basis of productive and non-productive labor and material. The separation is made quite generally in the schedules offered in the committee report and in Mr. Luten's discussion of the same, but incidentally rather than upon a fixed principle. It may, therefore, help to point out this principle in order that it may serve as a guide to determine the method of handling the details.

The distinctions between the above two classes of labor and material are as follows:—

1. What might be termed productive material and labor, to borrow the term without modifying it to fit the facts exactly, is material that remains in the work and forms a permanent part of it, and labor which puts that material in its place and keeps it there.

2. Non-productive material and labor figuratively speaking, consists of tools, equipment, etc., used in handling the material put into the work and in holding it in place temporarily; such non-productive material being then removed permanently from the work, thenceforth to have no further conection with it. Non-productive labor is the labor which is put upon this non-productive material, in preparing it for use, in disposing of it, transporting it, etc.

3. There is also the usual class of non-productive labor, i.e., labor which has no direct effect in putting the materials into their positions in the structure.

- Cost
  - 1. *Material* .....
    - 1. Actually entering into work ÷ by items of diff. character.
      - 1. Actual quantities.
      - 2. F. o. b. price.
      - 3. Waste.
    - 2. Accessory or incidental.
      - 1. Quantity.
      - 2. Price.
      - 3. Salvage & loss.
    - 3. Labor..... 1. Delivery to job.
  - 2. *Labor* .....
    - 1. Direct or productive....
      - 1. Itemized by sections of varying character.
      - 2. Itemized by kind of work done (Gen. Div.)
      - 3. Spec. divisions, pay work.
    - 2. Indirect or non-productive.*
      - 1. On job
        - 1. Supervision
        - 2. Repairs.
        - 3. Incidentals.
      - 2. Material delivery (A material charge)
      - 3. General supervision.
    - 3. Yards or shop, direct labor.
  - 3. *General Charges.*
    - 1. Direct to job..
      - 1. Bond and insurance.
      - 2. Expense.
      - 3. Fittings and repairs.
      - 4. Fuel and oil.
      - 5. Specials.
      - 6. Commissary (where required).
    - 2. Indirect to job
      - 1. Petty tools.
      - 2. Tools and machinery.
      - 3. Yard and shops, payroll and expense of general character.
      - 4. General office payroll and expense.

NOTE.—Under General Charges.—To be proportioned over cost of material or labor, or their sum.

*To be proportioned over the various items of productive labor.

CEMENT STRONG ROOMS.

In a recent English test of the burglar-proof qualities of vaults of reinforced concrete, a slab of the material six inches thick was perforated with a hole 3½ inches in diameter by means of the oxyacetylene blowpipe. When a steel bar was reached, it was instantly fused away by directing a jet of pure oxygen on the white-hot metal, but this metal-cutting jet had little effect on the concrete.

The time required for making the hole was 24 minutes. As a similar hole in any kind of steel could be made through an equal thickness within four minutes with the jet, it was evident that the concrete offered an important advantage for strong-room building.

SHALLOW FLOORS FOR RAILWAY BRIDGES.*

By O. F. Dalstrom.

In railway bridges of the through type, designed for crossings where local conditions do not govern the depth of the floor system, that depth is determined by sections that give the greatest economy of material consistent with simplicity of construction and facility of erection.

The Shallow Trough Floor Bridge.—The floor beam usually determines the depth of floor in designs of open floor through bridges, whether truss or plate girder type. The term "depth of floor" will be used throughout this discussion to indicate the distance from base of rail to lowest steel of span. If considerations governing the design of the trusses produce panels of considerable length, the stringers, instead of the floor beams, may determine the depth of floor. A single track truss span of 350 to 400 ft., with trusses 18 ft. 6 in. or 19 ft. centres, may have panels over 30 ft. in length. In such a design the economical depth of the stringer would be about the same as that of the floor beam. In common practice the floor beam would still be made deeper than the stringer to obtain simple details of connection between these members.

But conditions of grade and requirements of clearance below the bridge may make it necessary, in a measure, to disregard economy of material and simplicity of construction and erection to obtain designs that will meet all the requirements in special cases. Difficult conditions of grade under clearance, necessitating extreme shallowness of floor, are frequently encountered in crossings over streets and over other railways; and the type best adapted to any particular crossing must be determined by a careful study of the local conditions.

A crossing over another railway usually requires that the grades be carried above the normal grade of the line, with a through bridge over the railway at the apex of the grades. If the approach grades are long and heavy, the slightest reduction in the depth of the floor of the bridge means an appreciable reduction in the cost of the approaches. And—what may be of greater significance than the reduction of the cost of bridges and approaches—it means the reduction of grades that would be costly and otherwise objectionable, or practically impossible, from the standpoint of operation, where local conditions determine the limit of running out of the grade.

The files of the bridge department of the C. & N. W. contain the plans of a large number of bridges that have been designed to meet extreme conditions of clearance grade and curvature. A few of these designs have been selected, with special reference to shallowness of floor, as typical. Fig. 1 shows the floor details in the design of a double track through truss bridge of 170 ft. span, in which the depth of floor is 1 ft. 11 in. This bridge is designed for Cooper's Class E-50 locomotive; or a concentration of 60,000 lb. on each of two axles spaced 6 ft. 0 in. centre to centre.

The floor is of trough construction, the troughs being placed perpendicular to the axis of the bridge. Each trough carries a tie under each track, as shown in transverse section through troughs and floor beams in Fig. 1; the tie is supported at four points on horizontal angles riveted to the tops of diaphragms extending between the webs of the troughs. In every alternate trough, except those adjacent to the floor beam, special diaphragms are provided near the ends of the ties. To these diaphragms the ties are anchored by bolts

*A paper before the Western Society of Engineers, December 13th, 1911.

through the horizontal angles at the tops of the diaphragms, which are so located in the troughs that the bolts will be about 4 in.—a convenient working distance—inside the guard rail. The horizontal legs of the angles at the tops are turned toward the ends of the ties to make the bolts accessible after the ties are put in place. The tie bolt diaphragms are omitted in the troughs adjacent to the floor beams, as they would interfere with the driving of the field rivets at the ends of these troughs.

The troughs (half-section, B-B), are carried by longitudinal girders which are parallel to the trusses, and placed at a sufficient distance from the lower chord to permit ready inspection of the chord and girder. The longitudinal girders are carried by the floor beams (half-section A-A), which are designed to receive the entire panel load and transmit it to the truss.

The troughs are designed to carry a concentration of 60,000 lb. on each track, each concentration distributed over two ties. This gives a load of 30,000 lb. on each of the two ties carried by the trough, or 60,000 lb. carried by the trough. The floor beam is designed to carry the load from the intermediate troughs, concentrated at the bearings of the longitudinal girders, 2 ft. 1 in. from the centre lines of the trusses; and, in addition, to carry its part of the load on the ties in the adjacent troughs.

The heavy load carried by the floor beam, together with its greater length, requires in this member a section considerably heavier than that of the troughs. The depth back to back of angles is made the same in the floor beam and troughs, but the addition of flange material required to give the necessary section modulus in the floor beam, makes the extreme depth of this member somewhat greater than that of the trough sections. This extreme depth of floor beam determines the depth of floor for this type of bridge. By flattening the rivets under the rail and allowing a clearance of 1 in. from the base of rail to the tops of the flattened rivet heads, a satisfactory section is worked out with a depth of floor of 1 ft. 11 in.

It will be noticed that the material in the floor beam and trough sections is not disposed symmetrically with reference to a horizontal line at the middle of the section. In order to obtain the most effective distribution of material, the neutral axis is maintained at the middle of the section. The metal is increased on the tension or lower side to make up for the reduction of section by rivet holes, no allowance for reduction of section by rivet holes being necessary on the compression or upper side of the section.

The depth of the longitudinal girders is made considerably greater than economic considerations require for the section. This is done to obtain a good detail at the end bearing and at the connection to the floor beam.

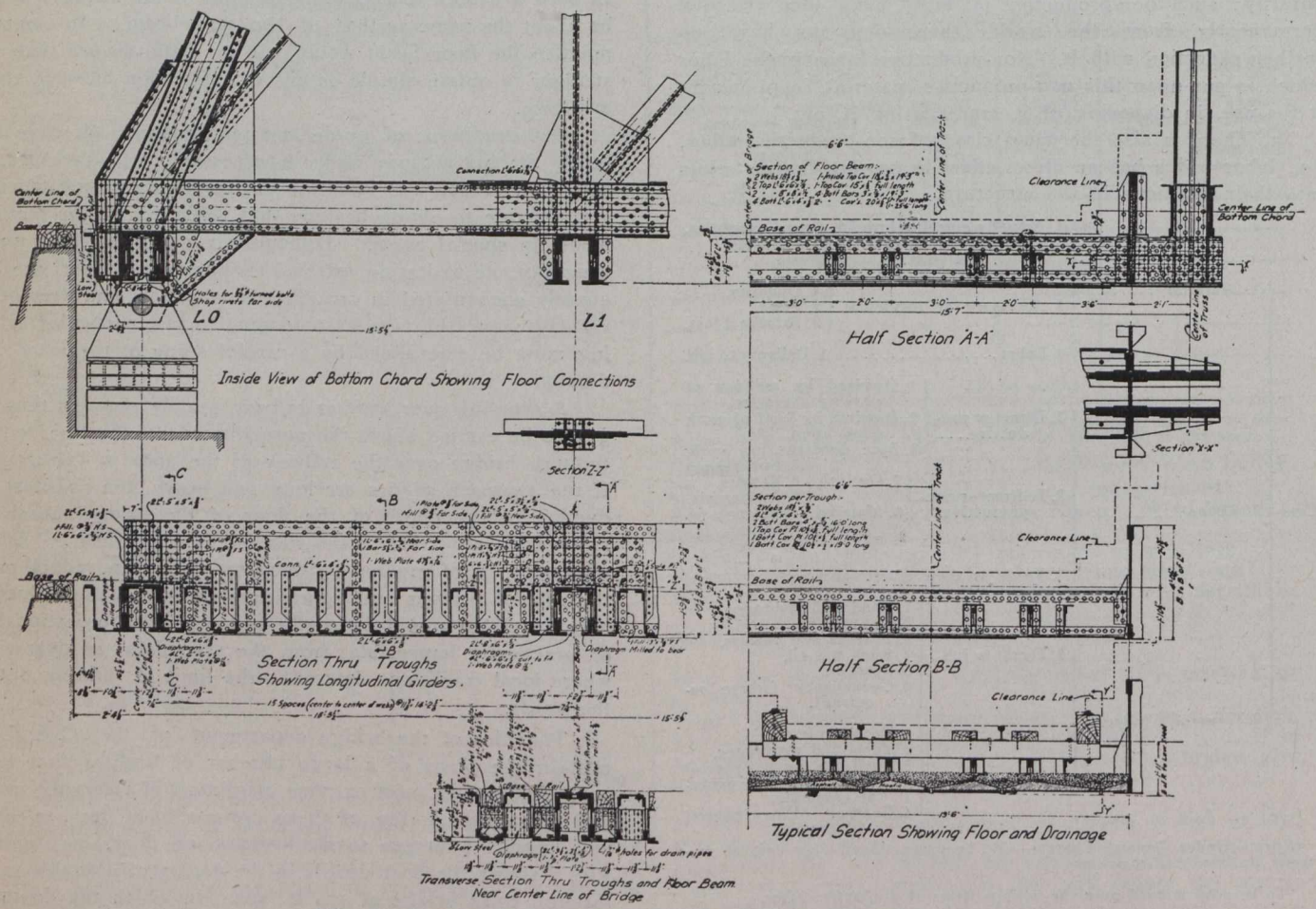


Fig. 1.—General Details of Shallow Trough Bridge Floor.

The top flange of this girder is unsymmetrical, being composed of a plate and an angle, the angle placed with its face against the web, the horizontal leg projecting over the top of the web and outward from the track. This detail of the top flange is to gain an additional horizontal clearance, as at this point the structure approaches nearer to the clearance diagram than at any other place except at the end post, where the edge of the cover plate is coincident with the extreme vertical line of the clearance diagram. An advantage in erection is also obtained by this detail of top flange section, as it permits setting the trough sections in place on the bottom flanges of the girders, with only a very slight displacement of the girders from their permanent position.

To further facilitate erection of the troughs, the stiffeners are omitted from the inner side of the longitudinal girder. The end connection angles of the troughs, which are field riveted to the web of the girders, are placed high enough so that the tie bolt diaphragms near the ends of the troughs will not interfere with the driving of the field rivets at the ends of the troughs in which the tie bolt diaphragms occur.

The troughs are drained through 1 in. gas pipes fitted into holes in their bottoms and projecting slightly below the trough to form a drip. This projection of the drain pipes must not extend below the line of low steel determined by the rivet heads on the under side of the extreme cover plate of the bottom of the floor beam. The upper ends of the drain pipes are threaded into washers to hold them in place. The lower part of the troughs is filled with asphalt mastic, the surface sloping toward the drain pipes and flashed over the washers at the upper ends of the pipes. A layer of broken stone covered with gravel is spread over the mastic for a protection.

sections. There is no interference from the girder in driving the rivets on the outside of the truss, but these rivets, up to the level of the tops of the girders, should be driven at the same time that the riveting on the opposite side of the truss is done.

In the development of this type of shallow floor for double track bridges, the first efforts were directed toward obtaining an open floor design, with stringers beneath the track, transmitting the load directly to the floor beam. The excessive bending moment in the floor beam, resulting from this arrangement, made it impracticable to design a floor beam that would come within the required limits of depth f floor.

Following this, a trough floor type was designed, differing from the one shown on Fig. 1 in that it had no longitudinal girders to carry the troughs. Instead, the troughs were extended to the trusses and connected to the bottom chord in the same manner that the floor beam in Fig. 1 is connected to the chord at the panel point. The bottom chord was designed to act as a girder, to carry the panel loads to

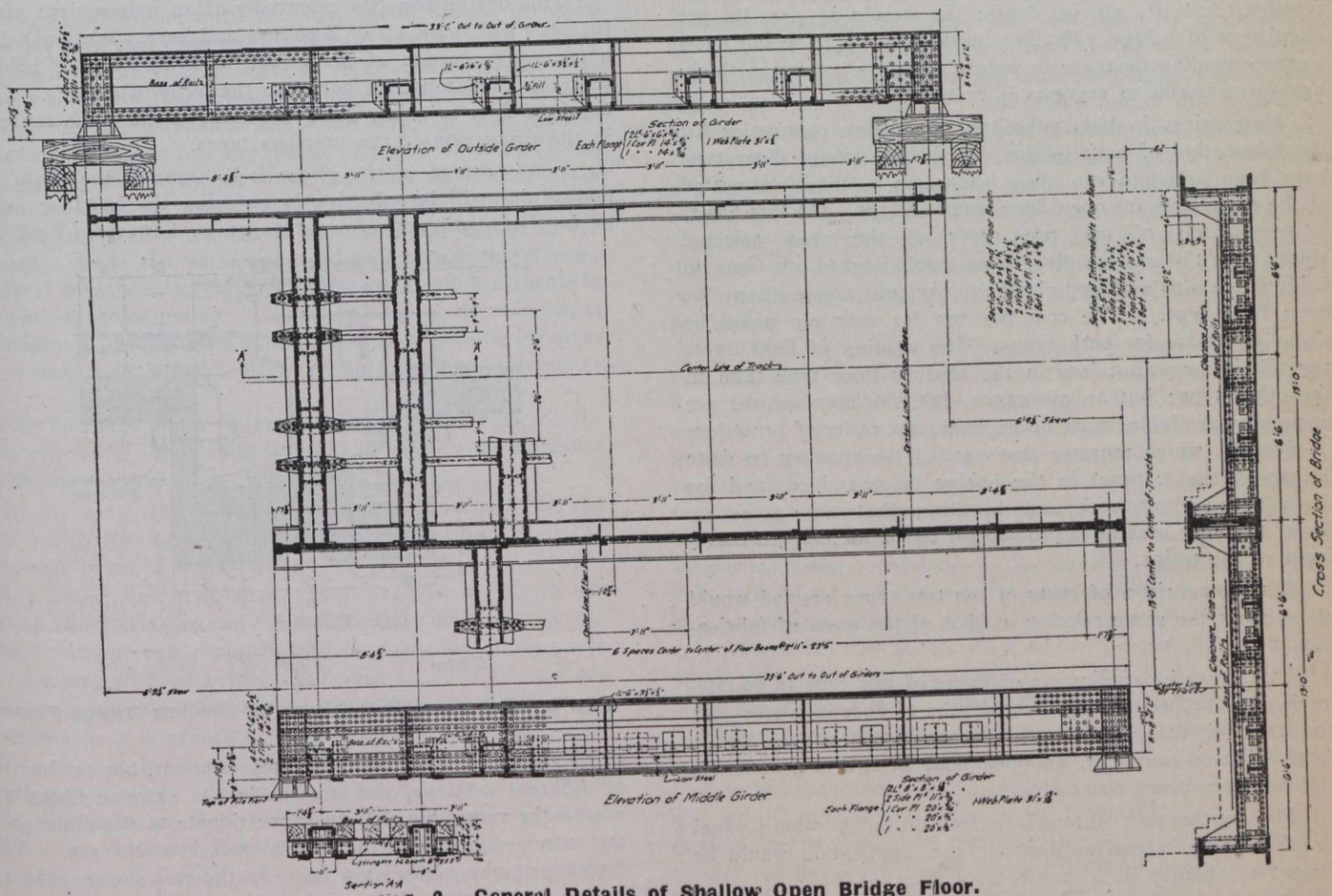


Fig. 2.—General Details of Shallow Open Bridge Floor.

The deflection of this floor under a maximum load is considerably greater than that of floors designed for depths determined by economical sections. Under maximum load the theoretical deflection at the centre of the floor beam is 0.65 in. The erection of truss bridges of the open trough floor type requires a special order of work in riveting, owing to the longitudinal girders being located so close to the trusses. After the girders have been placed in position, no riveting can be done on the inside of the lower chord opposite the girder. On this account all riveting in the trusses below the level of the tops of the girders must be done before the girders go into place, which means that all lower chord splices, floor beam connections to trusses, and web member connections to gusset plates, up to the level of the tops of the girders, must be riveted before placing girders and trough

the panel points. This design brought the depth of floo within the required limits, but made the troughs excessively heavy. The bottom chord was necessarily made deep and heavy, since it had to act as a beam for the floor troughs at the same time that it was doing duty as a tension member in the truss.

The next step was the introduction of the longitudinal girder. This was placed as close to the track as the clearance diagram would permit, to reduce as far as possible the bending moment, and thereby the sections, of the floor troughs. The introduction of the longitudinal girder changed the bottom chord from a combined beam and tension member to a simple tension member, and eliminated from it the objectionable secondary stresses produced by the vertical loads applied at the trough connections.

Below are given a few figures for the comparison of a 170 ft. double-track span of the above type, and a double-track span of the same length, with the usual open floor construction, in which the floor beam and stringer sections are determined by the economical depth.

	Shallow trough floor type.	Deep floor type.
Depth of floor	1 ft. 11 in.	4 ft. 9 in.
Weight of floor system per lineal foot of bridge	5,000 lb.	1,700 lb.
Weight of trusses and bracing, per lineal foot of bridge	3,400 lb.	3,250 lb.
Weight of 170-ft. span, complete..	1,496,000 lb.	900,000 lb.
Total cost of span, f.o.b. cars at bridge company's plant, at $0.025 per lb.	$37,400.00	$22,500.00

Difference, $14,900.00 = 66.2 per cent. of deep floor type.

As the depth of floor is increased, the weight diminishes rapidly. At 2 ft. 4¼ in. depth, the weight is 4,100-lb. per lineal foot of bridge. Further increase of depth would show a corresponding decrease in weight until the minimum thickness of material in sections is reached.

Unit prices in bids submitted by bridge companies for the fabrication of material for the shallow trough floor type have been found to run about the same as those submitted at the same time for open floor truss bridges. On this basis, a comparison of the two types of the span selected shows that the shallow floor type would cost, f.o.b. cars at bridge company's plant, about 66 per cent. more than the deep floor type. The cost per ton for erecting would be about the same for both types. The number of field rivets per ton is somewhat less in the shallow floor type than in the other type; but an allowance, for which no figures are at present available, must be made for the order of procedure in riveting, which requires that part of the riveting be done before all the material in the bridge is assembled, and for the additional falsework and blocking that are necessary under the floor system to provide for the uninterrupted movement of the trains.

The comparison of costs of the two types erected would show about the same relation as that of the costs of fabrication.

The range of application of floors of this type in double-track truss bridges would cover depths of floor of about 3 ft. and under, if the panel lengths do not exceed 15 ft. With a depth of floor over 3 ft. an open floor bridge is practicable and would be more economical.

For double-track through girder bridges, where panel lengths can be varied as desired, the application would be limited to about 2 ft. 6 in. depth of floor.

The Shallow Open Floor Bridge.—A design of open floor, double-track bridge, with 1 ft. 6 in. depth of floor is shown in Fig. 2. This is the plan of a bridge erected near Mapleton, Wis., on the new line of the M. S. & N. W. The design shown is for a double-track bridge, but the type is applicable to crossings with any number of tracks at the standard distance of 13 ft. centres. The limitation of this type of bridge is in the direction of span lengths, being suitable only for spans of less than 40 ft.

The relation of the clearance diagram to the girders shows that in the longer spans the girders and not the floor beams or stringers determine the depth of floor. The section of the middle girder, which carries load from both tracks, is exceptionally heavy, while that of the floor beams have no shapes over ⅝ in. thick. In shorter spans, 20 to 25 ft., it would be possible to make a shallower girder and reduce the depth of the floor beam so that the depth of the floor would be about 1 ft. 3 in. At that depth the stringer would be so shallow that any further attempt to reduce the depth of floor would result in stringers so shallow and short, and floor beams so close together, that the floor would consist of floor beams connected by diaphragms acting as stringers. It would be approximating the type described above under the name of shallow trough floor bridges.

In spans of 15 ft. or less, the girders can be brought under the third offset of the clearance diagram, making the floor beams shorter and lighter. At this point the depth of floor would probably be determined by the stringer, and the floor beam would be designed in accordance with that depth.

The Rail Girder.—Fig. 3 is the plan of a girder designed to carry a track over a 4 ft. 6 in. clear span in places where there is not sufficient space for stringers and ties below the rail. Conditions requiring such designs are not uncommon in railway yards and in city streets, where pipes and conduits are laid close to the grade of the track.

This design consists essentially of an independent girder for each rail, built up of Z shapes and bars. Section E-E is a transverse section of the girder, showing the rail held in place by cast iron clips bolted to the webs of the Z's. The depth of floor is 3 in., using the term in the same sense as in the discussion of the previous tvpes.

In the design of the girder it is assumed that both rail and girder will be effective in resisting the bending under load. They will act as separate units, however. Both rail

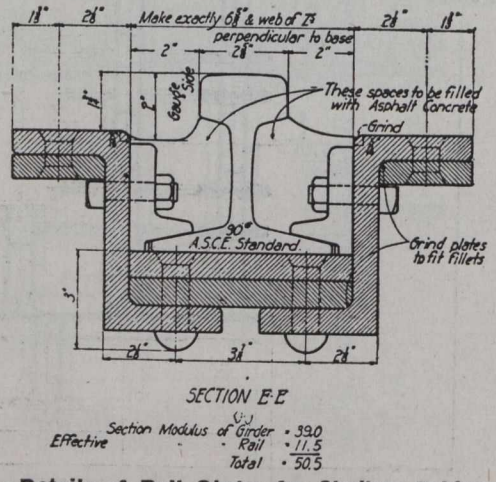


Fig. 3.—Details of Rail Girder for Shallow Bridge Floors.

and girder will be deflected the some amount, but as they are of different sections, the stresses in the extreme fibres will not be the same, but will be proportionate to the distance of the extreme fibre from the neutral axis in each case. This distance in the girder is 3 in. In the rail shown it is 2⅞ in., or 0.96 of that of the girder.

The section modulus of the girder given below, Section E-E, is the actual section modulus of the net section of the girder. The "effective" section modulus given for the rail is 0.96 of the actual section modulus of the rail. The sum is the effective section modulus of girder and rail acting as separate units, and deflected the same amount.

Section E-E shows a 90-lb. A. S. C. E. rail section, on the girder. Any type of rail can be used with the girder by varying the details of the cast iron clips to conform to the section of the rail to be used. The space in the girder on each side of the rail is filled with asphalt mastic, to protect the steel and provide a run off for drainage.

The weight of a pair of girders of the section shown in section E-E is about 1,500 lb. The weight of a pair of the special section is practically the same as that of the standard section.

CONCRETE CONSTRUCTION.*

By E. Brown, Professor of Applied Mechanics and Hydraulics at McGill University.

Concrete construction has many followers, ranging from the rabid enthusiast who will assert that it is the thing for almost every kind of building, to the more modest and perhaps more effective advocate who realizes at one and the same time its advantages and its limitations. There was a day when it had its opponents, but its record of actual achievement in the past few years has established its claim to being one of the principal forms of construction at the present day. The opponents have become friendly critics or even converts, and I imagine there are now very few who are so blind as to ignore the facts of the situation. There are, however, some who seem to think that a designer in reinforced concrete is drawing on his imagination (shall I say) to a much greater extent than a designer of steel work. Some steel designers, at all events until recently, would almost give you the impression that their work was calculated to such a nicety as compared with that possible in reinforced concrete work, that the latter by comparison had very little claim to exactitude. I am not here advocating one form of construction as against another, nor any particular type of either form, but I do say that if we set down the exact conditions of the problem confronting a designer in these rival forms of construction, there is not much to choose in the matter of exactitude. I am not here concerned with any considerations of actual construction. We can have good and bad work in any kind of construction. I am speaking of the conditions of design. The problem is always this, no matter whether it is a design for a huge bridge or for an office building or store.

(1) To make some estimate, more or less exact, of the forces which will probably be brought to bear on the structure considered. Floor loads, wind loads, etc.

(2) By some theory, more or less exact, to determine the forces which the above estimated loads will produce in the component parts of the structure.

(3) From our knowledge, more or less exact, of the physical characteristics of the materials employed in the various parts of the structure, to so proportion those parts that they may withstand successfully for an indefinite period, the forces which are estimated to come upon them.

After that it is necessary to have the work carried out in strict conformity to the designers by efficient labor, under the best supervision. In the matter of the first two processes above, designers of steel work and of reinforced concrete work are on the same footing.

As regards the third point, our knowledge of the properties of concrete, and of the effects of changes in its composition is now of considerable extent, and I do not think that a conservative designer need have any anxiety in regard to the behavior of his structure if reasonable, sound specifications are lived up to. Steel designers, in recent years, have come to consider much more carefully than heretofore, the probable effects of eccentricity in some of their details, and in this, reinforced concrete designers can learn from them. In the particular case of columns consisting of angle and other sections latticed and tied together, we are only in the early stage of finding out how they really act. I could show you experimentally the actual conditions of stress in such a member as a tie bar made up of two angles, back to back, connected by a plate at their ends, and separated at intervals by distance pieces—one of the commonest forms of construction imaginable. Experiments of a very interesting character are being made by one of our staff at McGill on this matter, and all I need say to emphasize the point I am now making, is that any steel designer who thinks that even such a simple built up member acts as one piece has another "think" coming to him. No, gentlemen, we are all engaged in "estimating" something. Formulae expressing the complex action which is going on in either a steel structure, or in one of reinforced concrete may be forthcoming, but of this I have grave doubt, and even if they are, we shall, for practical purposes, make such modifications of them as will eliminate from them any complexities which are due to effects which are either of small magnitude, or which can be allowed for in a simpler manner.

A survey of the development of our professional work generally will show that whenever and in so far as it has been possible to exalt any branch of that work to the rank of a science, the progress has been due to the gradual but certain development of a few fundamental ideas. Our great electrical industries of to-day have developed by applications of the great principle discovered by Faraday when he found that a closed coil of wire moved across a magnetic field generated an electric current. And while few of our branches of engineering science are as scientifically exact as the one I have just mentioned, in all or most of them there is such a mass of practical experience and of results of tests to couple with some simple fundamental ideas expressing actual conditions but inadequately, that we can go ahead with our designs with complete confidence in the results. The science of hydraulics is an instance of this phase of the work of our profession.

So that while I for one would not be prepared to admit that the steel designer can figure the actualities to a much finer degree of accuracy than the reinforced concrete designer, I do think that the latter depends to a tremendous extent on the honesty and sincerity with which his plans are carried out. Structural mild steel is manufactured in our steel mills under reasonably uniform conditions, and speaking broadly of course, an engineer buys it in the open market with considerable confidence in its physical properties. He knows that he can figure safely on 16,000 pounds per square inch in tension, and that if he is cutting his sections as finely as possible, he may reduce them by say 10 per cent. and increase his unit stress accordingly. The properties of his material are not altered. He is **not** taking an **unknown** risk.

But in concrete construction the material by which the compressive forces in the structure are carried is made and laid on the spot and is liable to such variations in mixing as may occur in practice quite apart from any variations in quality due to change of composition. If we reduce cement by say, 10 per cent., use an inferior sand, or change the nature of the aggregate without definite knowledge of the effects of this change—if we do all or any of these things we are altering to an uncertain extent the physical properties of our concrete. We **are** taking an **unknown** risk, and one which to my mind is entirely different in character from that involved in a cut of a definite per cent. on steel sections. We know from experience that certain expectations in the properties of mild steel will almost certainly be lived up to, and it is in the power of those engaged in reinforced concrete work to produce a concrete equally uniform and reliable. A successful designer has always in mind certain possible differences between assumed and actual conditions, and it is in a proper realization of such differences, and in the capacity of the designer to apreciate the extent of their influence, that reliance must be placed. If for any reason he may fear that the concrete will only stand a compression stress of 400 pounds per square inch, instead of perhaps 600, his oppor-

*Abstract of paper read before Montreal Builders' Exchange.

tunities to make both a successful and economical design are at once limited. Poor concrete is much the same weight per cubic foot as good concrete, and if the concrete is poor, and only capable of safely carrying a small compressive stress, more is required to sustain a given compression load, and hence, more steel is required to carry the extra dead load necessitated. But we **can** get uniformly high grade concrete if proper care is exercised. At the same time the calculation of a designer can be rendered of little avail if the actual work is not carried out in a thoroughly conscientious manner.

Any theory of reinforced beams starts from the assumption that the several layers of the beam are lengthened or shortened by an amount proportional to their distance from the plane separating tension and compression areas. Careful experiment shows while this is not rigidly true in all cases, it is conformed to with reasonable accuracy in most cases. Accepting it as true we shall get different results for the bending moment which the beam can carry according as we assume.

(a) Variable modulus following assigned law.

(b) Modulus uniform during loading.

(c) Different values for uniform modulus.

Assume a rectangular beam 10 inches deep with, say, one per cent. reinforcement. Then, taking average concrete, one should find that under working loads the distance from the steel line to the point in the section where the resulting compression acts is about 8 feet 6 inches if we assume a variable modulus with the definite law of variation; 8 feet 8 inches if we assume a uniform modulus of 3×10^6 pounds per square inch.

The safe bending moment on the beam is the product of the allowable force in the steel and one or other of the above numbers. It is evident that the difference shown in the safe bending moments is only some 2½ per cent., and any attempt to figure to such a degree of supposed accuracy is foolish. Rods, in practice, may easily be displaced by an amount affecting strength of calculations far more than do these different theories.

These figures neglect concrete tension and their differences indicate the extent to which different methods of calculations affect the broad features of design. Under the specifications adopted by the American Society for testing materials, the American Society of Civil Engneers, and the Maintenance of Ways Association, all concrete is now taken to have the same modulus, a great change since the days when cinders, rock concrete, gravel concrete, etc., were all supposed to have a different modulus, and following a different law of variation as the load increased. It has been amply demonstrated that all these were unnecessary refinements and the standard specifications recently drawn up have swept them away. Similar simple specifications were drawn up earlier by the Royal Institutes of British Architects, and I would urge the adoption of some such standards here. I do not believe you have any such standards at present. When in Toronto a couple of years ago attending the Cement Association Congress I learned that their buliding by-laws prohibited a designer from figuring any continuity in reinforced concrete floor systems, and I believe that foolish and unjustifiable prohibition still stands. It seems to me to eliminate competition to a great extent and to leave a clear field for the steel construction. Here, in Montreal, I do not think you are hampered by any by-laws on such matters—it is more of a go-as-you-please. You are more familiar than I can be with the results of this, but unless something miraculous happens, the usual result of such conditions is to find one design called for according to one set of specifications, another design according to another set, and so on. Now, even if all these varied specifications are beyond reasonable criticism—which is questionable—would it not be better to have a working standard? Our railroad bridges and highway bridges are built under standard specifications, and it seems to me desirable that there should be some standards in this matter also. I am sure it would be advantageous to have something of the kind, whether the architect prepares the plans in his own office or has them prepared independently by an outside firm.

PATENTS AND THE ENGINEER.

The following is the outline of an address delivered to the Engineers' Club, of Toronto, on Thursday, January 11th, by Mr. J. E. Maybee, patents solicitor of Toronto.

The main purpose of the address was to point out to prospective inventors the proper course to follow if they wished to avoid the more common pitfalls which beset the inventor's path. The great inventions, outside a few lucky hits, are not made by men who sit down with the idea of inventing something but in response to the stimulus of a known want.

An inventor who succeeds with the least waste effort will follow fairly closely the following order of procedure, which is given substantially in the lecturer's own words:

1. Find a want, i.e., be sure you have a market. It pays to devote the utmost care to gauging the needs of your public.

2. Be sure you have, or can acquire, a sufficient quantum of knowledge to enable you to direct your efforts wisely.

3. Obtain as wide a knowledge as possible of the inventions of others along similar lines. (Some in practice do this just before taking step No. 6.)

4. With sweat of brain evolve a new idea and embody it in concrete form.

5. Devote every effort to **work out your details** as thoroughly as possible, so that your device will not only work well, but what is just as important, **can be easily and cheaply made.**

One of the most fruitful fields for inventors lies in devising means for more cheaply making various articles of manufacture or in devising simplified forms of commonly used articles or machines.

6. See that you get as good a patent as can be obtained.

In both patents and inventions "pretty near is not good enough." In a recent address before the Engineers' Club, of this city, Mr. Justice Riddell pointed out that failure to keep the above maxim in mind led to such disasters as the Austin dam failure, and unless the inventor would court failure he must make "as good as possible" his motto, and he should select professional advisers who will live up to the same rule.

It was pointed out that engineers, as a rule, did not figure largely as patentees, the exceptions being those specially employed by large concerns to perfect their goods or machinery.

The main reason given for the lack of inventiveness of the engineer was the necessary conservatism of his procedure in his work, whereas the disposition of the typical inventor was to exhibit a contempt for authority and tradition.

A strong plea was made to the engineering student to acquire as broad a general culture as possible and to cultivate the imaginative faculty which in essence is the same in the artist as in the engineer, and which is one of the most useful and prominent characteristics of a successful inventor.

THE DESIGN OF TALL CHIMNEYS.*

By Henry Adams.

Architects, in the course of their practice, have frequently to furnish designs for special constructions, and although they sometimes adopt the sensible course of calling to their aid the services of an expert, they more frequently draw out what they think ought to do, and place the responsibility upon the contractor. The present condition of general knowledge upon the subject of the stability of tall chimneys is strikingly shown in connection with the Mechernich shaft.† This was designed to withstand a wind pressure of 160 lb. per square foot; Prof. Rankine calculated that it would stand only 70 lb. per square foot, while Mr. R. J. Hutton, a later writer, estimated that a wind pressure of only 32 lb. per square foot over the whole height would be sufficient to damage it. Tall chimneys ought to be designed upon scientific principles, so that there is an absolute guarantee for their stability, and in the following paper the author desires to elucidate these principles.

Height.—In designing a tall chimney‡ it is desirable first to know what height to make it. Forty-five feet is an ordinary height to serve two steam boilers, but in some

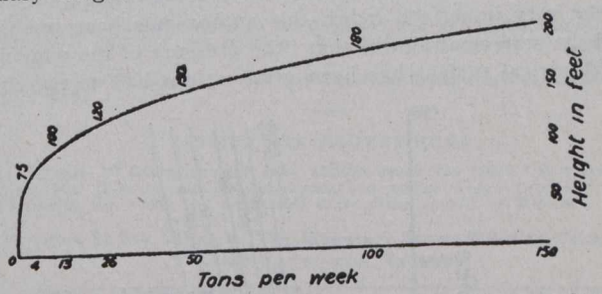


Fig. 1—Height of Chimney According to Consumption of Coal.

towns, as Manchester and Leeds, 90 ft. is the minimum allowed. They are sometimes proportioned for height according to the coal burnt per week of fifty-six hours, thus:—

4	tons per	week	= 75	ft. high.
13	"	"	= 100	"
26	"	"	= 120	"
50	"	"	= 150	"
100	"	"	= 180	"
150	"	"	= 200	"

This table is checked by the graphic curve shown in Fig. 1. Another rule is to make the height of the chimney three times length of boiler + twice distance of furthest boiler to chimney. This allows 1 ft. of height for every foot the gases travel round the boiler and 2 ft. of height for every foot of external flue. And again, a round chimney should not exceed twenty-five times its internal diameter in height. In many modern power stations Babcock & Wilcox boilers and Green's economizers are used; what is saved in obstruction in the boilers is lost in the economizers, so that no material difference arises, but the chimney shafts are, as a rule, only from 75 ft. to 100 ft. high, and of very large sectional area. For chemical works, or where poisonous fumes are emitted, they should be higher than for ordinary steam boilers, in order to disperse the fumes at such a height that they may be diluted to a harmless condition by the time they reach the ground. The Townsend chemical works chimney at Glasgow is 454 ft. high, and was, when built, the highest in the world.

Sectional Area.—The sectional area or internal diameter is the next point to decide, and there are many different rules, some depending only upon the coal consumption, others upon the firegrate area, and others upon the water evaporated in a given time. Simple approximate rules are:

(a) 1 sq. ft. area for each cwt. of coal burned per hour.

(b) Area = one-tenth of the total firegrate area, each flue being one-fifth of its firegrate area, and main flue one-eighth of total.

(c) 2½ sq. in. per indicated horse-power of the engine.

(d) If the height of the chimney is taken into account, as of course it should be, then on the average—

$$\text{area} = \frac{\text{lb. of coal burnt per hour}}{12\sqrt{\text{height in feet}}}, \text{ or } \frac{\text{fire-grate area sq. ft.}}{1.5\sqrt{\text{height in feet.}}}$$

Shape.—The necessary sectional area being obtained, it should next be decided whether the chimney is to be round, octagonal, or square. It is generally acknowledged that circular chimneys have the best appearance, at least above the pedestal, which is usually square, and from which the circular part springs by broached angles. Octagonal chimneys have the next best effect, some even consider that they are more sightly than round chimneys, while square chimneys always look more or less heavy, and are only suitable for short stacks of large area, such as are generally used in modern central station work. The circular chimney is most efficient for its area, as it takes the least material and there are no angles in which soot may cling; but with any chimney it is desirable to add 2 in. all round to the calculated minimum area to allow for friction. Octagonal chimneys require special bricks for the angles in alternate courses, to produce the best work.

Wind Pressure.—The comparative efficiency according to the shape of cross-section may also be considered from the point of view of obstruction to the wind, that which offers the greatest obstruction requiring the greatest stability or quantity of material apart from other considerations. It is not yet definitely settled what is the pressure of the wind upon a plane surface due to a given velocity, and still less

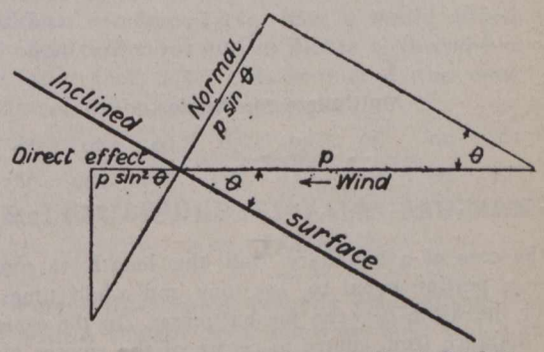


Fig. 2.—Effect of Wind on Inclined Surface.

is known of the effect upon a surface inclined to its direction. We shall generally be quite safe, however, if we allow for ordinary purposes a pressure of 56 lb. (or ½ cwt.) per square foot on a plane surface normal to the direction of the wind, and even half of this may be sufficient in many cases. When we come to fix the value of these figures against an inclined or curved surface we find much difference of opinion and no sufficient experimental evidence.

---

*Paper read at a meeting of the Society of Engineers, England.

†Trans. Soc. Eng., 1887. Paper by R. J. Hutton on "The Stability of Chimney Shafts."

‡In different districts this would be known as a high chimney, mill chimney, chimney shaft, chimney stack, chimney stalk, smoke stack, furnace shaft, boiler shaft, etc.

A formula agreeing closely with Hutton's experiments* is:—

$$P = ap(\sin\theta)\ 1.84 \cos\theta$$

where P = total pressure in lb.
a = area of surface in square feet.
p = normal pressure lb per square foot.
θ = angle of incidence.

and this is the basis of the majority of tables of effective pressures; but Hutton experimented on a surface only 22 sq. in. area, which was too small to be of much practical value.

Some years ago† the author suggested a variable allowance according to the width and height of the structure, would cover all cases and be more in accordance with modern experiments. His empirical formula for this purpose is now:

$$\log p = 1.125 + 0.32 \log h - 0.12 \log w$$

where p = ultimate wind pressure in lb. per square foot necessary to be allowed for against a plane surface normal to the wind,
h = height in feet of centre of gravity of surface considered, above ground level,
w = width in feet of part to be taken as one surface,

and when the surface is inclined at θ degrees to the direction of the wind, the ultimate pressure normal to the surface may be taken as $= p \sin\theta$, or its effect in the same direction as the wind $= p \sin^2\theta$ (see Fig. 2).

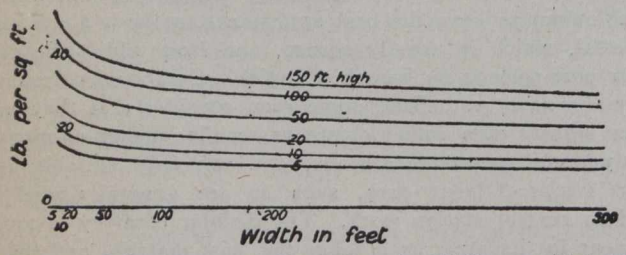


Fig. 3.—Wind Pressure According to Width and Height.

This would give allowances as in the following table, for which the curves are plotted in Figs. 3 and 4.

Wind Pressure Lb. Per Square Foot on Plane Surface.

(For very exposed positions 25 per cent. may be added.)

Height	Width in feet.						
in feet.	5	10	20	50	100	200	500
150	54.6	50.3	46.3	41.4	38.1	35.1	31.4
100	48.0	44.2	40.7	36.4	33.5	30.8	27.6
50	38.4	35.4	32.5	29.1	26.8	24.7	22.1
20	28.7	26.4	24.3	21.7	20.0	18.4	16.5
10	23.0	21.1	19.5	17.4	16.0	14.8	13.2
5	18.4	17.0	15.6	13.9	12.8	11.8	10.6

Multipliers for Angle.

θ	10	20	30	40	50	60	70	80	90
Sin	.174	.342	.500	.643	.766	.866	.940	.985	1
$\sin^2$	.0303	.117	.250	.431	.587	.750	.884	.970	1

In the case of a boundary wall the length to consider would be a portion equal to, say, one and a-half times the height, or the width between the buttresses. In the case of a roof the distance from centre to centre of the trusses should be taken, unless the stability of the whole structure be under consideration, when the full length should be taken. In the case of a lattice girder bridge 50 per cent. should be added to the actual area offered to the wind and both girders taken.

* See paper by the author on "Wind Pressure on Roofs," read before the Society of Architects, March 14, 1893.

† See discussion on a paper by R. J. Hutton on "The Stability of Chimney Shafts," Trans. Soc. Eng., 1887.

The lower part of the above table, shown graphically in Fig. 5, gives the multipliers for angle when the surface is not at right angles to the direction of the wind, the sins being used for obtaining the normal pressure on an inclined surface such as a roof, and the $\sin^2$ for the effective pressure in the same direction as the wind on such a surface as a square chimney placed diagonally.

Theoretically, account should be taken of the effect of the batter in determining the wind pressure on a chimney, but this is so slight that it may usually be omitted.

Pressure on Square Chimney.—A square chimney will give the same resistance whether facing the wind or standing diagonally to its direction, the greater area of the inclined surface and the reduced pressure upon it making the same total as the flat side under the full pressure.

Pressure on Circular Chimney.—With circular chimneys a very serious difference of opinion exists as to the effective pressure of the wind, as shown by the following list of multipliers recommended:—

Rankine	=.5	Prof. Hutton	=.66
Wilson	=.56	Gaudard	=.66
Borda	=.57	Bressé	=.78
Sir B. Baker	=.57	Adams	=.7854

"Molesworth's Pocket-Book" says somewhere (but owing to the very imperfect index the author has been unable to find the statement again) that "the pressure of the wind upon a cylindrical surface has been given at one-half to two-thirds

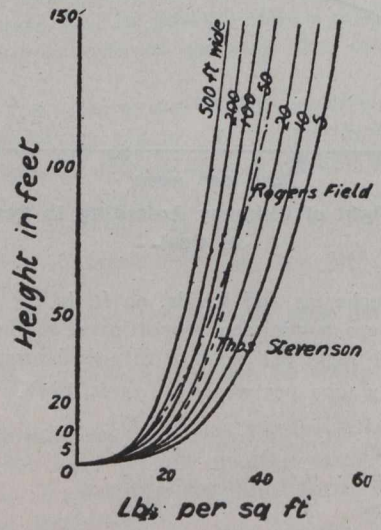


Fig. 4.—Wind Pressure According to Width and Height.

of that against a normal plane, while experiments show it to be nearer three-quarters." C. B. Bender, in a paper on "Wind Pressure," read before the Institution of Civil Engineers in 1882, says "cylinders have the special coefficient of 0.54, but larger surfaces probably increase this value."

The author's investigations lead him to adopt $\frac{\pi}{4}$ as the multiplier, which, if incorrect, is at any rate on the safe side. The area taken for wind pressure in the case of a circular chimney is the diametral vertical plane, and no further allowance need be made for suction on the lee side.

Pressure on Octagonal Chimney.—An octagonal chimney has two extreme positions with regard to the wind—viz., when it is acting directly against one face, and when acting directly against one edge. For the former case the author's multiplier would be 0.83, and for the latter 0.82; there is not much difference, but the latter coefficient gives rather the highest result as it is taken against the width over angles.

(To be Continued.)

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

Managing Director: JAMES J. SALMOND.
Managing Editor: T. H. HOGG, B.A.Sc.
Advertising Manager: A. E. JENNINGS.

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.

ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404** and **7405**, branch exchange connecting all departments.

Montreal Office: B33, Board of Trade Building. T. C Allum, Editoria Representative, Phone M. 1001.

Winnipeg Office: Room 404, Builders' Exchange Building. Phone M. 7550. G. W.. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

Address all communications to the Compan and not to individuals. Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Change of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed..

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 22. TORONTO, CANADA, FEB. 1, 1912. No. 5

CONTENTS OF THIS ISSUE.

Editorial:

The Annual Meeting of the Canadian Society of Civil Engineers 241
Lethbridge Sewage Sedimentation Plant..... 241
The Canadian Highways Improvement Act... 243

Leading Articles:

Strain Measurements of Steam Boilers..... 229
Cost Analysis for Contractors 231
Shallow Floors for Railway Bridges 233
Concrete Construction 237
Patents and the Engineer 238
The Design of Tall Chimneys 239
Report of Annual Meeting of the Canadian Society of Civil Engineers 244
Bituminous Roads 250
Lethbridge Sewage Disposal Works 252
Contracts for the Supply of Electric Power from the User's Point of View..... 254

Personal 255
Coming Meetings 256
Engineering Societies 256
Market Conditions 24-26
Construction News 59
Railway Orders 66

THE ANNUAL MEETING OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Canadian Society of Civil Engineers is again a matter of history. This year the meeting, which was held in Montreal, was very well attended, and it can be seen from the report, which appeared in the daily issues of The Canadian Engineer and continued in this issue, that a good deal of interest was taken in the discussions.

It looks as if some change were necessary in the present method of carrying on the business of the annual meeting. The time of the meeting is all too short to allow of the discussion of reports of committees, etc. With the present mode of procedure, the first day and the morning of the third day are devoted to business and discussion of reports. The second day is the excursion day to the different plants to be inspected; and the afternoon of the third and last day is reserved for the meeting of the new council.

From the analysis of the discussion it appears that the general consensus of opinion is that the excursion day, or second day, should be devoted to business, and that the discussion of reports of committees be carried on at the meetings of the different branches of the society.

With the elimination of these two matters the business of the annual meeting would undoubtedly be much facilitated, and a great deal more time allowed to the actual affairs of the society.

The excursion is certainly a valuable function, for it aids greatly in the members getting acquainted with each other. However, by postponing it until the fourth day of the meeting it would serve this purpose nearly as well, and would give an additional day to the work of the society. The discussion of the reports of committees, in the opinion of many of the members, could be better carried on at the branch meetings. While there would undoubtedly be difficulties to this method of procedure, still these could be overcome if it were considered advisable to change.

The retiring president, Mr. C. H. Rust, suggested that an annual summer session would be an excellent thing, and the idea met with a great deal of approval. By this means many interesting places and works could be visited by the society as a body, which under present conditions are impossible, and it would afford an excellent opportunity for the members to become acquainted. The latter fact, after all, is one of the most valuable results of the society meetings.

THE LETHBRIDGE SEWAGE SEDIMENTATION TANK.

Patent rights have recently been granted in connection with a sewage sedimentation tank which introduces several novel features of construction. The working principle of the tank appears to be somewhat similar to the type known as the "Emscher," inasmuch as the object aimed at is the automatic immediate separation of sedimented solids into a separate section of the tank. The patented claim, however, only appears to cover the principle of separation or isolation of sludge in connection with rectangular tanks, and the constructive features may not be applicable to circular tanks as with the Emscher design.

Both forms of tank have been fully described and discussed in The Canadian Engineer and elsewhere, and it would appear that the principle involved in these modern types of sedimentation tanks, which is creating much interest in sanitary engineering circles, is likely to supersede the older types of efficiency.

Up to within a recent period we have been accustomed to hear so much about the efficiency of the septic tank that the name has almost become synonymous with the term "sewage disposal." In fact, in many quarters, when a municipality is contemplating the introduction of sewage disposal works, it is common to state that "septic tanks" are proposed without any definite knowledge of the particular form and method of sewage disposal under consideration.

More recently, however, we have been told that septic tanks are a mistake, that they have been founded on error and resulted in failure.

It now appears, however, that there are some good features connected with the much-maligned septic tank, and that it cannot be thrown altogether aside and scrapped. In fact, the newer forms of sedimentation tanks, which appear to meet the demand of modern conclusions and knowledge gained by experiment and practice, are simply a compromise between the old continuous-flow sedimentation tank and the septic tank. With the continuous-flow sedimentation tank the working principle depends upon reduced velocity of flow for the precipitation of the suspended solid matter and the immediate removal of the settled solids to sludge beds adjoining the tank, where they are generally allowed to rot and form the chief nuisance connected with any sewage disposal works. On the other hand, the principle of the septic tank is to allow the settled solids to remain in the sedimentation tank and undergo the rotting process, after which they can, at extended intervals, say, once or twice a year, be removed to sludge beds adjoining the tank without the same risk of nuisance, as the putrefactive process has taken place in the tanks, and the removed solids are practically of a mineral and non-offensive character.

The latter method gained much favor, and, under the term septic treatment, was very generally adopted as more economical and efficient than the daily removal of fresh sludge from tanks.

The method, however, very soon proved itself a partial failure as it was found very detrimental to the final treatment of the tank effluent to allow this sludge or settled solids to remain in the tanks in contact with the continuous flowing sewage.

The newer form of tank meets the above objectionable feature by providing a separate compartment, into which the solids are precipitated, where they undergo septic action or the putrefactive changes necessary to render them inoffensive on removal. At the same time the tank effluent is unaffected by the presence of accumulated putrefying solids.

Thus the efficiency which is peculiar to septic treatment of sewage is attained, together with the efficiency peculiar to the ordinary continuous-flow sedimentation tank. The Lethbridge tank also introduces several novel features, such as the use of wire reinforced glass for the tank slopes so as to accelerate the discharge of the settled solids into the separate decomposing chamber.

The Emscher tank is a German design, while the Lethbridge is Canadian, its name being taken from the city where it is being installed. We understand that this form of tank has been adopted at several other places in Canada.

EDITORIAL COMMENT.

The forestry question in Canada has become an exceedingly important one, and it is one which is of great interest to engineers, closely associated as they are with the building and constructional fields. Our forests have been depleted by fires and by the necessities of life until little remains of our original magnificent heritage. We must look to the future, and in doing so our only salvation is in scientific forestry. The Canadian Forestry Association are doing a great deal towards promoting a sane forestry programme, and the association deserves the support of all engineers. This association are holding their annual convention in Ottawa on February 7th and 8th, and the discussions at this meeting should be productive of much which will be of interest.

* * * *

We have drawn attention in The Canadian Engineer before to the fact that the executive of the Ontario Good Roads Association is completing arrangements for a provincial deputation to attend at Ottawa on Thursday, the 8th day of February. This deputation will wait upon Premier Borden and the members of his Cabinet to present their views in reference to federal aid for good roads and how it can best be distributed and applied throughout Canada, and Ontario in particular. An effort was made to bring this deputation together in December, but owing to the early adjournment of the House and other matters, a satisfactory date could not be secured. In response to the notices sent out in November, more than one-half of the county councils of the province expressed their approval of the idea by appointing delegates. A similar notice will go before the city, town and county councils this month, and it is hoped that all will arrange to be represented. A meeting for the organization of the deputation will be held in the council chamber of the city hall, Ottawa, on the morning of the day appointed, commencing at 9 o'clock.

LETTER TO THE EDITOR.

The Editor:

Sir,—I have read with interest the article by Mr. S. B. Code, O.L.S., concerning concrete sidewalks. This is a subject upon which very little is written; perhaps the idea is so simple, and there is not much to give to the engineering profession.

The suggestions put forward by the writer are well founded, but there are a few points which he touched upon in so general a way as to make the article of less value than it otherwise would have been. It would be interesting to know Mr. Code's opinion as to the proper thickness of the surface mixture, concrete body, and the foundation. I understand that some cities are laying cement walks at the present time, and do not provide any gravel or cinder foundation at all, and their walks have been reportd to be satisfactory. This, of course, is a matter which is governed by locality and condition of the foundation with respect to porousity or impermeability.

Another point is the distance between expansion joints, which are places in the neighborhood of 50 feet. It would seem to me that joints braced thus far apart is too much for ordinary severe climatic conditions, unless all the intermediate joints between each slab are perfect.

I would further remark, that as a general rule pitch between the expansion joints squeezes out during the

summer, and is very objectionable when the cold weather comes.

These points are matters which might well and profitably be discussed by members of the profession, and it would be interesting to get the ideas of various municipal engineers on the subject. Yours truly,

A. C. D. BLANCHARD, City Engineer.
Lethbridge, Alta.

THE CANADIAN HIGHWAYS IMPROVEMENT ACT.

The following is the text of the Act to encourage and assist the improvement of highways, which is now before the House of Commons at Ottawa. This is Bill No. 77 of the first session of the twelfth Parliament.

1. This Act may be cited as The Canada Highways Improvement Act.

2. In this Act the word "Minister" means the Minister of Railways and Canals.

3. The Governor-in-Council may, in any year, and upon such terms and subject to such conditions as are prescribed by order-in-council, grant to any province in aid of the improvement of existing highways or the construction of new highways in such province, or for both such purposes, a subsidy not exceeding such sum as may in such year be voted by Parliament for that purpose.

4. Any highway for which aid is granted to a province shall be improved or constructed, as the case may be, according to descriptions, conditions and specifications approved by the Governor-in-Council on the report of the Minister, and specified in each case in an agreement between the Minister and the Government of the province, which agreement the Minister, with the approval of the Governor-in-Council, is hereby empowered to make.

5. Each highway to be constructed or improved shall be defined and described in such agreement, and provision may be made therein for the future maintenance of such highway in good condition according to a specified standard and to the satisfaction of the Governor-in-Council.

6. The Minister, with the approval of the Governor-in-Council, and upon such terms and conditions as are prescribed by order-in-council, may undertake the construction of any new highway or the improvement of any existing highway in any province, and may expend in such improvement or construction the whole or any part of the sums voted by Parliament for such subsidy to that province. Provided, however, that the Minister shall first obtain the necessary authority from the legislature of such province and the consent of the Lieutenant-Governor-in-Council.

LECTURES FOR INSPECTORS.

The department of health of the city of Toronto have entered upon a series of lectures with a view to broadening and extending the usefulness of inspctors and others. The lectures are held once a week at 4.30 p.m., and all health inspectors are required to attend.

Among the subjects discussed are:—Bacteria, Their Nature and Functions; General Sanitary Inspection; Special Sanitary Investigations; Foods, Their Nature, Uses, Value, Adulteration, Preservation and Possible Dangers; General Food Inspection; The Milk Problem; House and Lodging House Inspection; Hygiene and Sanitation in the Home; Disease Carriers and the Value of Medical Inspection in Schools; Isolation Regulations and the Enforcing of Them; The Municipal Control of Tuberculosis; The Work of the Tuberculosis Nurse; Plumbing Inspection; Meat and Slaughter House Inspection; The Social Aspect of the Tuberculosis Problem; The Work of Charitable Societies in Their Relation to the Work of the Health Department.

An examination is held at the close of the series, when the results will materially effect the standing of inspectors and other employees.

REINFORCED CONCRETE—THE COLD WEATHER BUILDING MATERIAL.

In the winter many factory managers and mill agents are confronted with the fact that they must have an increased space to handle a larger factory production. Often this extension is deferred until the spring, as from bitter experience they are aware of the uncertainty of completion of mill constructed buildings due to the slow deliveries of materials and do not consider reinforced concrete either on account of its higher first cost or doubt as to the safety of construction under cold weather conditions. Buildings with steel frames are not considered, as very few factories are built of this design nowadays.

Very often factory managers will incline to mill construction on account of the lower first cost, while in ultimate cost, considering depreciation, insurance, interest, and vibration with its resultant wear on machines, reinforced concrete is cheaper in most every instance. In winter time concrete work will average from 6 to 10 per cent. more than the cost of work done in warm weather, and mill construction will cost from 4 to 8 per cent. more, but the early occupancy of the concrete building more than offsets the extra cost of concreting in winter, while with mill construction there is absolutely no surety of the completion of the building, four to six months being often taken to finish a building that should be put up in three months.

Reinforced concrete work that has been executed in the coldest weather is just as sound as summer work, provided proper precautions are taken. In New England, with its severe winters, for the last eighteen years a contracting firm in Boston, the Aberthaw Construction Company, have successfully carried through three or four jobs each year, under the most adverse weather conditions.

The principal points of winter concrete work consist in heating the sand, stone, and water before putting the same in the mixer. The cement is not heated, as its setting is hastened to too great a degree. Salt is sometimes mixed with the concrete in the proportion of two pounds of salt to each bag of cement. Of course all snow is removed from the forms by a steam jet, and the whole building as it goes up is enclosed floor by floor with canvas until the concrete is set and salamanders burning coke are placed underneath all freshly poured concrete floors and kept there until the concrete is thoroughly set. In this way the interior of the building is kept about 30 degrees above that of the air outside. The tops of the concrete floors which cannot be enclosed with canvas are covered with about 12 inches of hay or straw, the latter being sometimes sprinkled with salt.

On account of the speed and certainty of erection, together with its numberless known advantages, it seems that reinforced concrete construction in winter will become more and more adopted by factory owners, when it is realizd that with experienced contractors the soundness of the structure is just as good as if it had been erected in the summer time.

REPORT OF ANNUAL MEETING OF CANADIAN SOCIETY OF CIVIL ENGINEERS.

(Continued from daily issue of Jan. 26th.)

Friday Morning's Session—January 26th, 1912. PRESIDENT C. H. RUST in the chair.

THE PRESIDENT: If you will come to order, gentlemen, we will proceed with the business. The examiners of student papers have recommended to award the prize in the general section to Mr. Percy E. McDonald, for his paper on "A General Description of the Structural Detail of Buildings." We will now take up the reports of branches.

THE SECRETARY: The only outstanding branch is Vancouver, and I have not received a report from it.

THE PRESIDENT: We will proceed, then, with the discussion on the reports of committees.

THE SECRETARY: Before proceeding, I would like to call attention to the excursion that is provided for this afternoon for those interested to the Oxygen Plant at Maisonneuve, which is said to be exceedingly interesting, and Mr. R. J. Levy, the manager, has kindly undertaken to be here at 2.30 to conduct the party there.

Mr. Muckleston, of Calgary, sends a discussion on the report of the Committee on Roadbeds and Ballasting. I don't know whether it is in order to take it up until there is some member of the committee present.

THE PRESIDENT: Probably we had better leave it over for the moment. Is there any gentlemen here on the Committee for Roadbed and Ballasting?

MR. MACKENZIE: Mr. President, may I ask what you propose to do regarding this report?

THE PRESIDENT: Well, we want the report to be received, and if there is any discussion on it we will be glad to have it.

MR. MACKENZIE: Of course, I am not the chairman of that committee. I am simply a member of the committee and I am not authorized to present the report, but I have something to say regarding it, if it is in order.

THE PRESIDENT: Very well, it is now open for discussion.

MR. MACKENZIE: I think this is one of the most important reports that we have. I came here purposely to take a small part in the discussion of this report, and I may say that I am very much disapointed to find that the chairman of the committee is not present. I don't know whether or not there is any communication from him.

THE PRESIDENT: This matter came up the other day, and we postponed it until to-day. We have had no communication from the chairman of that committee.

THE SECRETARY: The practice has been to have any member of the committee who is present represent the committee.

MR. MACKENZIE: Since this is the case, is it in order that I should make a few remarks on this report before it it is received?

THE PRESIDENT: Certainly.

MR. MACKENZIE: I may say, then, Mr. President, that I heard nothing of this proposed specification until about a month before this meeting. I spent a couple of days going through it, and jotting down my views regarding certain points which are contained in it, which I sent to the chairman. The report, however, has been printed as it originally appeared, without any change whatever, and, as I said before, it is certainly a very important report, seeing that there is a great deal of railroad building being done in Canada at the present time, and I think it would be of very great benefit and convenience to all engineers engaged in railroad work that a standard specification should be adopted by this association. There are a great many different specifications in use at the present time on roadways, and this draft presented by the committee has been largely modeled on the standard accepted by the American Engineering Association, with improvements or supposed improvements sandwiched in here and there through it, producing what we have before us in this report.

Now, in comparing it with the standards as found in the 1911 Manual of the American Engineering Association, the first difference we find is in the marginal references. Here we have no marginal references at all. These are very convenient in actual work, and particularly if there is an index at the beginning of these marginal references. I think that these marginal references should be put on.

In paragraph 8, if you will kindly turn to it, it is stated:—

"Stumps shall be cut off even with the ground, where cleaning is to be done, except between the slope stakes of embankments, where they may be cut so that the depth of filling over them will not be less than 2½ beet."

Well, if that is carried out literally, you might have stumps there 17½ feet high. It seems to me that that requires revision.

Paragraph 11 says, "All trees that may be reserved shall be stripped of their tops and branches, made into ties, or cut to such lengths as may be directed and neatly piled up at such places on the right of way as may be designated, for which service payment may be made by the tie or by the cord of 128 cu. ft."

I think, Mr. President, with reference to that particular paragraph, that we should make it quite clear that the wood cut on the right of way belongs to the railroad company, and not to the contractor. These are little things, but they always come up in carrying out the work.

Now, if we are to make a specification as a standard, let us make it so clear that there will be no difference with the contractor when the work is being carried out.

In paragraph 12 it mentions that close cutting is to be included in the price paid for clearing. It seems to me that is not right. Close cutting should be paid for separately.

Paragraph 16 says: "Grubbing shall also be required between slope stakes of all embankments of less than 2½ feet in height."

In this paragraph the 2½ feet mentioned conflicts with the 4 feet mentioned in paragraph 18. That requires revision.

Paragraph 18 says that the payment for the grubbing shall be paid for separately. It seems to me it should be measured in square acres. The contractors understand square acres better than any other measure for that kind of thing.

The grubbing should be paid for as grubbing on excavation or anywhere else. It does not matter where the contractor does the grubbing, he ought to be paid for it. It is sometimes said that if a contractor takes out stumps with a steam shovel that he has no right to be paid for grubbing. That is not correct. It costs the contractors just as much to handle stumps with a steam shovel, as it does to grub them out anywhere else, because he has to handle them two or three times.

Am I going into too much detail, Mr. President?

THE PRESIDENT: We have a great deal of business to go through this morning, and I was going to suggest to you, that if the report is not satisfactory to you, Mr. Mackenzie, it should be referred back to the committee, because the committees themselves, before they present the reports, I understand, got together and agreed upon them.

MR. MACKENZIE: Well, it has not been agreed upon.

THE PRESIDENT: Well, had you not better move that it be not adopted but referred back to the committee again?

MR. MACKENZIE: Well, that would result in putting it a year back.

THE PRESIDENT: Well, as you are the only member of that committee present, it seems to me if we are going into it in detail, I do not know that we could do very much, because the other members of the committee may not look upon your ideas in the same way as you do, and it would be better if you are not satisfied with the report of the committee to have it sent back to the committee.

MR. MACKENZIE: These notes that I have been reading were sent to the chairman of the committee about three weeks before the meeting.

THE SECRETARY: Perhaps Mr. Mackenzie would give a general criticism with a motion that the report be referred back to the committee.

THE PRESIDENT: How would it do for you to make your suggestions in writing, which, of course, would make it necessary to have the report referred back for another year?

MR. MACKENZIE: I see nothing else than that. The report will have to be postponed for another year.

MR. MOUNTAIN: I quite sympathize with Mr. Mackenzie. I think we should have a finality to these things. (Hear, hear.) We are going on with these reports, and we all know that these reports are particularly useful to railway engineers, and we are now using—most of us who are railway men in this room—are using the American Railway Engineering Association standards. We prefer to use our own. This society has made standards and they are approved.

There is another one coming up shortly—the bridge specification. That committee was formed, I think, two years ago, and I understand to-day that it is to be brought up and carried over. Now, we are dealing to-day with half a dozen different specifications, and I for one would particularly like to see this matter closed up and some finality reached about these specifications.

THE PRESIDENT: How would it do, Mr. Mackenzie, to authorize this meeting to have these specifications adopted when they are revised, but not wait for another year.

MR. CLEMENT: The adoption of a standard specification by this society may debar certain members who are working under specifications of their own. I do not think the society should adopt the standard until all the members have had a chance to be present and discuss it. We have had brought before us a specification, and the only member of the committee present states that he took no part in that specification, and did not know it was being adopted by the committee. I would move, sir, that this report be referred back to the committee, and that it be brought before the various meetings of the sections and various branches for discussion, and that the result of these discussions be sent in in the form of suggestions to the committee for their consideration.

MR. DUGGAN: I entirely agree with the remarks of the last speaker. I think we ought to go further and revise our whole method of dealing with these reports. The matter was up in Winnipeg last winter and it was then agreed that the reports should be issued one month before the annual meeting, so that it might be discussed. As a matter of fact, we have at the annual meeting perhaps not over five per cent. of the whole membership of the society. There is a lot of other business to be attended to, and a report comes up. It is too long to be read over clause by clause, as it is in the other associations, and the thing is either adopted or rejected or sent back to the committee for continuance. I think that Mr. Clement's suggestion is an excellent one, that the report should be read by the various sections and got into shape and discussed by them, and I think we should go even further, and when a committee considers that a report has been discussed as far as possible, both before the various branches and by written communications, that they should issue a final report for letter ballot by the society. This society, stretched out as it is all over the country, can hardly deal with important matters in any other way than by letter ballot, and I do not think the time of this meeting can be taken up better than by passing a resolution to that effect. We should deal with these important reports coming up before us every year in a proper manner, and I have much pleasure in seconding Mr. Clement's motion.

THE SECRETARY: Might I say, for the information of those present, that as far as possible the resolution of the annual meeting at Winnipeg was carried out. The only reports which are presented here are those which were turned in a month before this meeting, and they were in the hands of the members—perhaps not a whole month—but about three weeks before the meeting. There are other committees who have not reported at all.

MR. MACKENZIE: There are just two suggestions that I wish to make before the discussion ends, with regard to the standard specifications. I intended to suggest that when this special specification is completed by the committee and before final adoption by the society as a standard, a copy should be sent to every member of the Canadian Society of Civil Engineers, giving him a month to reply, and to send in any suggestions or criticisms which he may wish to make by letter, to the secretary of the society. No one can then say he did not have a chance to say what he wanted to say about any standard specification, and further, I think it would be a helpful thing if a copy were sent to every one of our principal railway contractors in Canada, as some of these contractors have decided views with regard to these specifications, and I do not think it is quite fair that an engineer on one side and a contractor on the other side, who are associated in carrying out the work based on these specifications—I do not think it fair that the man who does the greater part of the work should have no say whatever in the specifications under which he is working. (Hear, hear.)

Some of these contractors are engineers as well as being contractors. Most of them are very intelligent men, and can give engineers pointers regarding the specifications, as well as the actual carrying out of the work every day in the week.

Now, I think we should have the secretary to ask the assistance of some of those contractors in preparing a standard specification which would be, I hope, a standard as long as we live.

THE PRESIDENT: Would it not be the proper thing for the members of the committee to send the information out to the contractors, and get their ideas before submitting a report?

MR. MACKENZIE: I think the society as a whole should, perhaps, request the committee to do that. It would carry more weight, and they might have very different opinions about the advisability of doing it. Some engineers know it all; the contractor takes what comes to him.

THE PRESIDENT: Of course the members of the committee would know better who the contractors are than probably the society at large.

MR. MACKENZIE: If the suggestion was made to them, I think it would be a great help to suggest that the committee do it.

THE PRESIDENT: Do you want to put your motion, Mr. Clement?

MR. CLEMENT: I do not know that my motion has been seconded.

MR. LEOFRED: It seems to me, Mr. President, that the Canadian Society of Civil Engineers should not overlook the remarks of the chief engineer of the Intercolonial Railway, who says to us very frankly that he has not been consulted, and that the committee, of which he is a member, never wrote to him stating what report they were going to propose for adoption. I believe, under the circumstances, we ought not to adopt this report without taking into consideration the very valuable remarks of the chief engineer of the Intercolonial Railway, whether in the form of a motion or otherwise. We should take his remarks into consideration.

THE PRESIDENT: Well, gentlemen, is it your pleasure that we dispose of this matter or leave it over for another year, by referring it back to the committee?

MR. DUGGAN: No, do not leave it over. It is too important.

MR. JAMIESON: This question of committees and the question of dealing with specifications is one that requires a great deal of consideration by this society. Now, if the society is going to issue specifications they should certainly be most carefully prepared and every point corrected before they are adopted by the society. That involves a very large amount of work by any committee, and that committee should have every consideration from the society, and should not be subjected to undue criticism, because there are many points that cannot be dealt with to the satisfaction of all; but one thing the committee should do, is to take care, I think, to have everything in as good condition as possible, and every clause carefully considered as widely as possible by the members of the committee as a whole after getting the advice of others wherever necessary. Then they should bring the report before the society and make their recommendations. After that the annual meeting may be able to deal with it to better advantage than we can in this way.

I understand it is quite impossible to discuss these reports clause by clause during our annual meeting, with the time we have at our disposal to do so, and unless we are going to devote the whole of the time to a discussion of the business affairs of the society, and cut out our trips around the city, and if these reports are not in such shape as to be above fair criticism, I think it might be well for it to be referred back to the committee for another year, with a view to getting them in that shape, and making final recommendations.

MR. MONSARRAT: Mr. President, I know in connection with the bridge specification, it has been very difficult indeed to get a discussion of the various clauses contained in it, on account of the committee being so widely separated all over the country, and, as Mr. Jamieson has said, there is a great field to be discussed and it takes a great deal of time. I think, therefore, it would help considerably if the committee would be furnished with a secretary who could look after the correspondence and the collating of information, and the resident members of the committee could discuss the matter and make suggestions. The secretary could see that these suggestions were forwarded to the outside members of the committee for their revision or suggestions and, after they had come to an agreement in the matter, then these reports could be submitted to the society as a whole, and written discussion sent in on them, or opportunities given to discuss them or bring up any point for the committee to discuss. Then the reports could be put in proper shape and submitted to the society at the annual meeting, which would thus eliminate a great deal of discussion at the annual meeting when there is very little time to do it properly.

MR. JAMIESON: I quite agree with the last speaker that when there are a number of committees dealing with these reports that there should be a secretary, who would act for all the committees, because it involves a great deal of research in connection with matters of specifications that the secretary could look up, and it is very difficult for the general members of the committee to get at it. The preparation of a specification is essentially a one-man job along with a secretary, and then it could be sent out to the other members of the committee for their revision or suggestions and concurrence after preparation, and then go through that final revision before being referred to the annual meeting.

THE PRESIDENT: At our annual meeting in Winnipeg we made provision for that, and we were given authority to spend money for that purpose.

MR. HARKOM: Instead of dealing with this special report, it seems to me that the discussion is taking a general form. As has been said here, I think it will be desirable to send out and get the expression of all the members before hand.

It seems to me that the act of putting out a specification by the society as authoritative and the society being responsible for a specification, should be very carefully considered. There is also the question as to whether the meeting, such as this annual meeting, is really properly qualified to dispose of such a subject. Would it not be better, Mr. President, that all committee reports, when they come in, should be dealt with by the Executive Council, and that they should not be issued as authoritative, but as recommended practice. Then again, it might be possible if that provision is made in that way, for a committee's report to be issued between annual meetings, and, if a secretary were appointed for that purpose, it could be sent out to all the members of the society who are interested and qualified to speak on the subject, and then the council might deal with it in a far more satisfactory manner than at a meeting like this.

MR. JAMIESON: Mr. President, pardon me if I again speak on the subject, but Mr. Harkom has raised a new point, and one that is very important; that is the question of sending in the report or specification for revision by the council. When we appoint committees at our annual meeting we are assumed to select for members of that committee those members of our society who are assumed to be best qualified to deal with the subject under discussion. If that is so, then that committee should be in a better shape to prepare their full report or make the specifications than the council is; and furthermore, they are appointed for that special purpose while the council has lots of other duties to perform. I think, therefore, it is essentially the work of the committee and not the work of the council.

It also raises the question as to whether those committees appointed at the annual meeting are committees of the whole society or committees of the annual meeting, or whether they are subservient to the council of the society—whether they should deal directly and report to the annual meeting or not. Of course all committees necessarily must work in concurrence with the council, because the council is the governing board of the society, but they should not be subservient to the society, nor have to depend on sending

in their report for revision to the council. Otherwise it would take away all sense of responsibility and pride that the members of that committee may have. I think we ought to know now exactly what is the standing of our committees.

THE SECRETARY: Mr. President, answering Mr. Jamieson, the procedure in regard to committees is quite definite, whether it is a proper one or not. It is this: The committees draw up their reports, when, in the opinion of the committees, the reports are ready they are sent in to the council, and the council is instructed by the annual meeting to send those reports out to the members for their information, and for any discussion they may wish to make. The reports are then supposed to be ready for consideration by the annual meeting.

MR. JAMIESON: Yes, but that does not involve the revision of any report by the council.

THE SECRETARY: No, certainly not.

MR. JAMIESON: I have raised this question because there are certain cases in which the council has, I think, stepped in where they have had no right to do so, and have interfered with the personnel of these committees. I do not wish to go into it any further, but it certainly is not right that it should be that way.

MR. HARKOM: It is not my intention to suggest that the Executive Council should be empowered with, or in any way to deal with, the report of the committees, confirmed by a ballot or referred to the society as a whole, but with the result that the committee's report should govern the council.

THE PRESIDENT: We are now discussing this report and nothing else, and I would like somebody to make a motion in regard to it, as to what we are going to do with this report on Roadbeds and Ballasting.

MR. JAMIESON: I move that the report of the Roadbed and Ballasting Committee be referred back to the committee for the incoming year, and I do this with a great deal of deference, because it is going to result in putting it over.

MR. SNYDER: I would move an amendment to the motion that the reports of committees, or every report, should be submitted to one special meeting of the society for discussion. It is utterly impossible to discuss so many reports at one single meeting, and if the reports on Bridge Specification are submitted at one meeting and nothing else, then we would have an interesting paper. It has been stated here that there are no interesting papers for discussion brought up in the society. These reports of committees are practically papers which are submitted to the society at the annual meeting, which could be submitted to one meeting and then they could be properly discussed, but I submit it is utterly impossible to do it properly at the annual meeting. Therefore, I move that the report of the committee be submitted to the society and be discussed at any meeting, but not at the annual meeting.

MR. DUGGAN: I understand, Mr. President, that you are dealing simply with this report of the Committee on Roadbed and Ballasting.

MR. JAMIESON: At the request of a member I add to my motion that it be referred back, and in the meantime, as early as possible, copies be sent out to all members for suggestions, and that as finally revised, be printed. If there is a demand for it, it may be issued in the meantime, of course, not as adopted by the society, but sent out for sug-suggestions.

MR. MACKENZIE: What I have asked Mr. Jamieson to include in his motion is, when the committee's report is made as good as they think they can make it, that they should send a copy to each member of the society and ask that member, within four weeks, to let them have the benefit of his suggestions or criticism, and that they should do that also in the case of prominent contractors who do such work.

MR. ST. GEORGE: Why not specialize the men to whom you would send it? For instance, a bridge report should be sent to bridge builders. It seems to me that would save a good deal of time.

MR. MACKENZIE: I mean to contractors in that particular line of work.

MR. HOLGATE: Is it not included in the Bulletin?

MR .JAMIESON: Well, that is the sense of the motion that I propose. I can write it out, if you like.

MR. McGOUN: I wish to second the motion.

MR. DUGGAN: I beg to move an amendment to the motion, adopting Mr. Clement's idea, namely, that this report be referred to the various branches, and that they be asked to discuss it, and report their discussion to the committee; and also, that every member should be asked by letter to send in their opinion or suggestions before the first of March, let us say, and that the committee should then deal with the suggestions and issue the report for letter ballot to the society.

If the matter is to represent practically a standard specification, it surely is a matter of sufficient importance to a lot of men who are at a distance to be given an opportunity to discuss it; it is merely a matter of dealing with the matter within the next two months in the same way as we would have to if it were referred back to the committee to be dealt with at the next annual meeting.

MR. CLEMENT: I second the amendment.

MR. JAMIESON: It seems to me there is very little difference between the amendment and the original motion.

THE SECRETARY: While the amendment is being prepared formally, there is a discussion from one member on this report. I have a communication from Mr. Muckleson, of Calgary, who sends in a discussion on the report of the Committee on Roadbed and Ballasting.

THE PRESIDENT: Had not that better be referred to the committee? Is that your pleasure?

Carried.

MR. SKAIFE: While the amendment is being prepared, there was a motion brought up the day before yesterday by Mr. Stead and it was duly seconded, and the meeting apparently took no notice whatever of it. I wish to bring that motion to the attention of the meeting now, and I would therefore move that in future the council form a reception committee to receive the outside members and see that they meet the local members of the society at every annual meeting.

THE PRESIDENT: I understood that Mr. Stead withdrew his motion at that time, and I stated that we would bring it up to-day as new business.

MR. JOHN KENNEDY: May I say just a word while the amendment is being prepared about these reports. I think it would be well if the Committee on Specifications would include in the specifications, as a specification only, those points upon which the engineers are pretty well agreed as a whole, and that the specification which may be considered as a standard specification, if adopted, should be accompanied by remarks upon recommended practice or variations under special conditions. In many instances variations are necessary for meeting special conditions, and remarks to that effect are very valuable.

I have in mind the specification of the American Society of Civil Engineers, and another of our own, which is all mixed up. The specifications proper and the remarks about what ought to be done in recommended practice, and what is done by the association for testing material in the United

States, are given, and there is an immense amount of valuable information in this, but it is utterly impossible to use it as a specification. One cannot refer to it and state that the work and materials are to be according to the specification of the Canadian Society of Civil Engineers, because it will not work as a specification, although it contains very much valuable matter. Now, if the specification proper were to include just such things as are standard and agreed upon for all ordinary occasions, and then be accompanied by an index with remarks upon recommended practice, or what is done under special conditions, it would be really more valuable and more easily workable. (Hear, hear.)

MR. DUGGAN: Mr. President, my amendment is as follows: That a notice be sent out requesting each of the branches to discuss this report and report the discussion to the secretary not later than the first of March. Also, that those who cannot attend the meeting be requested to send in written discussion before the first of March, and that the committee be requested to take such discussion into consideration and send out the report again for adoption by letter ballot not later than the first of June, such ballot to be returned not later than the first of July.

MR. SHERWOOD: Mr. Duggan's amendment seems to be in the right direction, but I think one important point is to get a discussion of the suggestions.

MR. TYE: It seems to me that the suggestion that these specifications and reports be discussed separately at a meeting, is a very valuable one. I think that personal discussion often brings out better points even than written discussion, and if this suggestion of Mr. Duggan's could be carried out and then referred to one of our ordinary meetings called for that purpose, it would be then discussed just as an ordinary paper would be, and I think you would get good information from discussion in such a way. (Hear, hear.)

MR. MACKENZIE: I see that the amendment has ignored the suggestion that prominent contractors in the same line of work should be given an opportunity to make suggestions or criticisms. If it is the sense of the meeting that that should be, I have nothing further to add. Otherwise I think it should be included in the amendment.

MR. DUGGAN: I did not intend to ignore that suggestion by any means. I think Mr. Mackenzie's suggestion is an excellent one. I should think the committee, in dealing with the specifications, would be only too glad to get ideas from contractors, and I would therefore amend my amendment that notice be sent out to members of the society as well as to the prominent contractors. Of course, it is a difficult thing to include it in the motion.

THE PRESIDENT: The resolution and the amendment are practically the same, with the exception of the word "contractor."

MR. TYE: I wish to put that suggestion of mine in the form of an amendment to the amendment, or perhaps Mr. Duggan, who seems to favor it, might include it in his amendment and not necessitate a further amendment being made.

MR. JAMIESON. Is it not in order for the society to call a meeting and have it discussed?

THE PRESIDENT: When?

MR. JAMIESON: Right away, or at any time.

THE PRESIDENT: Yes, I should think so.

MR. JAMIESON: I mean without a motion to that effect.

THE PRESIDENT: While the amendment is being prepared with the further suggestions that have been added, there is a resolution that has been moved by Mr. Skaife to the effect that hereafter at all annual meetings of this society a reception committee be named by the Executive Council who shall see that the outside members meet the local members. This is moved by Mr. Skaife and seconded by Mr. Harkom. What is your pleasure, gentlemen?

Carried.

MR. DUGGAN: My amendment will now read as follows: That notice be sent out requesting each branch to discuss this report and report the discussion to the secretary not later than the first of March. Also, that those who cannot attend the meeting be requested to send in a written discussion before the first of March. That the committee be requested to take such discussion into consideration and ask for a letter ballot on a final draft of the report, not later than the first of June, such ballot to be returned not later than the first of July.

THE PRESIDENT: You have heard Mr. Duggan's amendment, which has been seconded by Mr. Clement. What is your pleasure?

MR. JOHN KENNEDY: Does this amendment refer to all reports or to this special report?

THE PRESIDENT: To all reports.

Carried.

THE SECRETARY: Might I ask what would happen after the first of July?

MR. DUGGAN: The council will issue it.

MR. McGOUN: I think that all the members here present should have an opportunity of discussing this now.

THE PRESIDENT: Well, I have declared the amendment carried.

MR. McGOUN: The report of the annual meeting asks for discussion of all reports, and it seems now that all this discussion is cut out. We who have come here from a distance do not get an opportunity to discuss it.

MR. DUGGAN: I might say that I had no intention of cutting off discussion in making my amendment.

THE PRESIDENT: There is another important matter for discussion, and that is the proposal to sell our property. I will ask the secretary to read the communications that he has with regard to this project.

MR. SKAIFE: I would like to ask in this connection if there is a real estate broker's commission of two and a half per cent. to come out of the amount mentioned, or do we deal directly with the purchaser?

THE PRESIDENT: We do not pay any commission.

MR. TYE: I will be glad to move the necessary resolution. As I understand it, it is the case of a railway taking the property, and they can expropriate it if they see fit. It seems to me that this offer which we have obtained is a very good one, and we are not likely to get anything better.

MR. MARCEAU: I second the motion.

MR. OGILVY: As a matter of information, Mr. President, will you state what this property stands on the books of the society at the present time?

THE SECRETARY: A little less than $16,000.

MR. KEEFER: When do we require to vacate the premises?

THE SECRETARY: Theoretically on the 1st of May, but practically not for some time.

MR. KEEFER: Has the committee any other site in view that we can obtain?

THE PRESIDENT: Yes, we have two or three sites in view.

MR. KEEFER: Have you figured out how much it comes to by the square foot?

THE SECRETARY: It comes to a little over $20 a foot.

MR. ST. GEORGE: Is there interest to be paid on the other two instalments of ten thousand dollars?

THE SECRETARY: Yes, at six per cent.

MR. MURDOCK: Will it cost more or less than $60,000 to get the new premises.

MR. TYE: I think we should take this occasion to get a better site and a better house than we have now. This is getting a little small for us, and I think we could very well afford to take the $60,000 and put $20,000 or $30,000 more to it, and get a good place.

THE PRESIDENT: What is your pleasure, gentlemen, shall we approve of this sale?

Carried unanimously.

MR. SKAIFE: I would like to move in connection with this matter of securing new premises, that a building committee be named by the society for looking after the erection and procuring of a site. I think the council of the society has enough to do without looking after that matter exclusively, and I would like to name Mr. St. George on that committee. I cannot help remembering the services he did in connection with securing this site and building.

MR. ST. GEORGE: No, no; leave it to the council.

THE PRESIDENT: I think that had better be left to council.

MR. SKAIFE: All right.

MR. ST. GEORGE: It seems to me the council should be authorized by this meeting, if it is necessary, to purchase another property without coming back to the society for authorization, but I think we should give them authority now to make the purchase of a site which is satisfactory to the council, without coming back to the annual meeting. They have to do it, and there is no use calling upon the society again. I think we have confidence in the council, and that that matter should be left entirely in their hands.

MR. SKAIFE: I wish to second the motion.

MR. ST. GEORGE: I would add to my motion that the council be given such powers to spend the necessary money to erect a suitable building—a building that will be a credit to the society, even if we have to go in debt, because we could afford to go in debt, but my suggestion is that we should have something good, and something that will be a credit to the society. (Hear, hear.)

MR. TYE: Well, would it be necessary for the society to say how much money the council might spend in connection with this proposal?

MR. ST. GEORGE: Well, let us say not to exceed $100,000.

THE PRESIDENT: What is your pleasure, gentlemen, in connection with this motion?

Carried unanimously amidst applause.

PROFESSOR HAULTAIN: With all due deference to the mover and seconder of this motion, it seems to me you are passing a very serious matter, very casually. I repeat this statement as a non-resident of Montreal. I think that we outsiders who are not represented here should have something to say as to whether $100,000 should be spent on a building in Montreal.

THE PRESIDENT: The matter is not open for further discussion. The next order of business is the report on Railway Ties.

MR. TYE: Why not apply to this report the same procedure that we applied to the last report, and then we would not require any discussion here at all.

THE PRESIDENT: What is your pleasure, gentlemen?

Carried.

MR. MOUNTAIN: What about the bridge report?

VOICES: The same thing.

THE PRESIDENT: Is it your pleasure that Mr. Duggan's amendment apply to all reports of the different committees?

MR. DUGGAN: I must say that I made my amendment simply to deal with the report that was then before the meeting. I think it is a great mistake when men have come a long distance to discuss these matters that they should not have an opportunity to do so. If we have other business of importance to get through, let us dispose of it, and then we can go on and discuss the reports as long as we have time to do so; that is to say, let us resolve ourselves into a committee of the whole society to discuss these reports, because I do not think they should be disposed of in any such offhand manner as is now suggested.

MR. JAMIESON: I agree with Mr. Duggan that if the society is going to issue specifications there is scarcely any more important business that we have to deal with in order that they should be put out in proper shape, otherwise we should not put them out at all.

THE PRESIDENT: I quite agree with you.

MR. TYE: Well, don't you think that this method of dealing with them is going to reach that result? We have only an hour or so more to discuss these things and we cannot go through all these reports in that time. They are going to be discussed at the annual meeting; the only thing is to do the same as the Maintenance Society in Chicago does. If they are going to be taken up at the annual meeting, there is nothing else to do but cut out all our visiting, and if we are going to have these strictly business meetings, we will have to discuss the reports and nothing else, and give one-half the day to general business only, but it seems to me this other way of having the reports discussed by the different branches and finally sending out a letter ballot is a very good way, in view of the fact that we do like to take these excursions to the different places of interest in the city.

THE PRESIDENT: If we get through our business in time we can have some discussion on these reports. What is your pleasure regarding the motion?

Carried.

THE PRESIDENT: We have the report of the scrutineers and the Nominating Committee and several other matters now before the meeting.

MR. CHIPMAN: What is the first on the program?

THE PRESIDENT: We have now disposed of all the reports, Roadbed and Ballasting, Railroad Ties, Good-Roads, Sewage Disposal, etc.

MR. CHIPMAN: I was not aware that the sewage report had been disposed of.

THE PRESIDENT: Well, it was not quite settled, but I understand all these reports are being sent back to the committee.

MR. CHIPMAN: Until next year?

THE PRESIDENT: No, certainly not.

MR. JOHN KENNEDY: There is one question in connection with the sewage disposal matter that I would like to bring before the attention of the meeting, and that is, that the Senate of Canada has a bill on sewage disposal—a rather drastic one—and it will come before the House shortly, and the point is whether this society should take any part in that matter in any way, either official or unofficial, or through a committee, or in any other way. If our opinion is of any use at all, it is time to put it in. I confess to being somewhat puzzled along just what lines we should act. If we can do anything towards assisting the Senate, it seems to me it should be done at the present time. There is some danger of a law being passed which will be unworkably severe.

MR. MACKENZIE: What are we going to do with the Good Roads report? That was a very important report. We don't know that there are any imperfections in that report, or anything that requires revision.

(To be continued.)

BITUMINOUS ROADS.*

By Major W. W. Crosby.

It is not the purpose of the speaker to trace the history of bituminous road work from the early efforts of the Peruvians, nor even to review the work of this country for the past 40 years, but rather to touch merely on some of the points in it at present of so much common interest and, in so doing, perhaps to suggest a thought or two that may be of value in stimulating consideration and discussion of this important subject.

For surfacing roads—usually called "Streets"—in cities, the larger practice in the use of bitumen has been to use it in the form of asphaltic cement, such as in sheets or block asphalt pavements. Such pavements, under proper conditions, give good satisfaction at reasonable expense. The first cost of them varies between $1.50 and $3.50 per sq. yd., however, and in recent years an effort has been made to secure a similar surface, of even wider applicability, at reduced cost. Incidentally, success in this line would offer a much needed surfacing for filling the gap between the best macadam, cheap but sometimes of questionable satisfaction, and the rather expensive asphalt pavements referred to.

In this effort, the use of cheaper bitumens—such as the tars for instance—has been tried, and also new methods and mineral materials for the body of the pavement, cheaper than the graded hot sand required for the sheet asphalt. Much success has been had with naturally some failures. This work, as a whole, however, in the cities has been so like the development of the country roads along the same lines, and the distinction between a highly developed country road and a minor street in a city is so lacking in clearness that we probably may proceed, with this reference to city work, to the consideration of road work proper.

Bituminous roads constitute a modern development to meet both the actual needs under modern traffic and the desires of modern civilization for greater efficiency, comfort, satisfaction and better sanitary conditions. The advent of the motor vehicle has greatly changed the conditions under which a road existed. Good roads are in greater demand owing to the greater radius of action of the automobile. Smoother roads are more desired because of its sensitiveness —at its greater speeds—to slight inequalities of road surface. More cementitious surfaces are needed, due to its ability to destroy the bond of the stone surface, to cause internal friction and wear of the pieces of stone forming the crust, and to render the road thus more susceptible to the elements. And further, the dust, which formerly laid on a good road surface and which, when not too profuse, was not only not seriously objected to, but was of some actual value in the protection which it afforded the stones composing the road, has been violently brought to our attention by the motor—so violently and powerfully in fact that we are now well aware that, under recent conditions at least, the disadvantages, discomforts and unhealthfulness of this dust far outweigh any good it may formerly have possessed.

None of us believe that the remedy for this state of affairs is the abolition of the motor-vehicle. Most of us who do not possess one are looking forward to the day when we may, and most of those who already are fortunate enough to own one are anticipating the possession of two or of more.

So the remedy seems to be to cure the defects of the road. And the speaker wishes to here again repeat what he has frequently said before, i.e., there is no one "best way" nor one "best material." The decision as to method or material to be used must depend in each case upon conditions of traffic, availability of different materials, desires of locality, and probable changes of conditions during the life of the work decided on to be done. A clear recognition of this fact is important for good work and economy. It is somewhat surprising how often it appears to be overlooked even among those who would be expected to appreciate it most.

Let us suppose now that we have the improvement of a certain road contemplated and that the details have all been worked out except as regards the road surface itself: that there is no question but that as soon as the road improvement is completed, a considerable number of motor-vehicles will use the road daily, say, not less than 20 every 24 hours. Then there is no question but that the road should be treated with bitumen either during or immediately after the construction of the surface with gravel, shells or broken stone, if economical and satisfactory maintenance is to be had. The treatment may also be justified for other reasons.

There may be said to be three ways in which a road surface may be treated with bitumens. These are, The mixing method; the penetration method; the method of surface applications, after construction in the ordinary manner.

A choice of these methods depends, as before stated, upon conditions. Such choice may be largely affected by traffic conditions but it is not yet clearly established just what amount of traffic demand justifies a selection of one method from the others. We are acquiring information on this point and it is hoped it may soon be clearer.

Generally, however, the choice is largely affected by other considerations, such as of comfort, health and satisfaction to the users or abutters, and the speaker believes that in making the choice it is well to be on the safe side from all these viewpoints. It is almost inevitable that, once a road is well improved, the previous traffic records will become almost worthless except for historical purposes. Consequently he believes that apparent extravagance in the choice at first may often prove later to have been true economy.

Although the speaker referred to construction alone in the foregoing, the remarks apply equally well to reconstruction or to repairs to a road that has deteriorated beyond the point where a surface treatment can be safely expected to relieve the needs.

At this point the speaker must inject the remark that it is his opinion that reconstruction is often attempted when a thorough surface treatment is all that is needed—not true economy. He is convinced that in the near future the use of proper surface treatments will be far wider and of greater satisfaction than it has been up to the present.

Now, the Mixing Method, as the term is generally understood, consists of mixing with the mineral material composing the wearing course of the road a sufficient amount of bituminous cement. This mixing is usually done at a plant off the roadway itself and even perhaps some distance from the site of the work. The materials may be mixed either heated or at the normal temperatures of either or both according to the method and materials employed, and by hand or by machinery for the purpose as desired. The mixed material is then taken to its place, spread and rolled and then frequently given a flush coat of bitumen and grit and again rolled. Satisfactory results from this method cost from 30 cts. to $1.50 per sq. yd. over and above what would have been the cost of an ordinary modern water bound road under the same conditions. The advantages claimed for the mixing method include great uniformity of surface and of composition of same, maximum value of surface for materials used, economy in use of materials, maximum life of surface and economy of results. There seems to be no question but that the mixing method has proved capable of producing high class results. There is grave doubt if it has always

* Paper read before the American Association for Highway Improvement, Richmond, Va., November 21, 1911.

been the economical method to have followed, and there are many instances of its utter failure. The mixing method frequently involves a considerable investment for machinery and with its first cost has led to the development of the Penetration Method.

In brief, the Penetration Method consists of simply applying a coat of pitch to the wearing course of the road just before the binding of this course by dusting, watering and rolling as usually practised in modern water-bound work. The pitch may be applied cold if properly prepared, though it is usually used hot. After its application, the pitch is coated with grit and the road thoroughly rolled. The cost of the Penetration Method varies between 10 cts. and 50 cts. per sq. yd. above the cost of water-bound work under the same conditions, according to methods, materials and quantities of the latter used. The advantages claimed by its advocates include sufficient uniformity of surface, economy in first cost, economy in long run, simplicity of operation and avoidance of complicated and expensive machinery, not to mention freedom from interference by patent infringement claims.

There is no doubt but that high class results can be secured by the penetration method. There are plenty of records of failure, however.

The method of Surface Treatments is only applicable to road surfaces already finished under other methods, usually to old or new water-bound work. In brief, the method consists of cleaning the old surface to be treated so that it shall be free from all fine material and refuse, even to washing it with water if this be necessary. After such cleaning, and when dry and as warm as practicable, the pitch is applied, allowed to soak into the surface for a longer or shorter time, as the material used may demand, then covered with grit and rolled. The process of applying pitch and chips may be repeated immediately, or after an interval as may be necessary. Sometimes two or more applications of pitch and chips are necessary for satisfactory results, and the interval between applications may vary from a day or so to a year or more, depending on local conditions. The pitch may be spread by hand or machinery as convenient, and either cold or hot, as its character may permit.

The cost of Surface Treatments varies from 5 cts. to 20 cts. per sq. yd. The advantages claimed for this method include simplicity of work, economy of first cost and, in many cases, economy in long run, lack of serious interruption to use of the coal, ease of repairs and renewal. Unquestionably satisfactory results have been secured under the method of surface treatments, and the speaker believes this method offers an easy and economical way for the revivifying of a road about to otherwise need resurfacing at a far greater cost under old water-bound methods or under either of the other two methods of employing bitumen.

The earlier success of the Mixing Method and the consequent attracting of attention to this method led many road workers to rush into it, believing it to be a panacea for all the road ills they were familiar with. A little later its extravagance in many cases became apparent and the Penetration Method received some followers. Still later the unnecessary expense of even this method became apparent for many cases and the method of Surface Treatments developed. Unquestionably, each method has its uses and the proper selection of one for a particular case is the end to be aimed at. The sphere of action of each is merged with or overlapped by those of the others and it will be some time yet before they can be clearly separated. The method of Surface Treatments is particularly applicable to use on old roads, and as water-bound construction will predominate for the near future at least, so will Surface Treatments grow in use.

The speaker is unable to wholly agree with a statement that had been made elsewhere to the effect that "the water-bound road is a thing of the past." He is yearly building a hundred or more miles of water-bound road and looks for such work to be continued indefinitely, as there are many localities where dustiness is less objectionable than increased first cost. But as these water-bound roads develop traffic over them, and as their extent and age increases, there comes a time when treatment is demanded and then Surface Treatment with pitch is often most advantageous and satisfactory.

In each of the methods referred to, a variety of materials may be used. At the present time, except possibly in the case of certain asphalt used for pavement work, the critical characteristics of a bituminous material to insure its being satisfactory in use under any definite method or conditions are not settled. Gradually, experience with them is clearing up the problem, but it is likely to be some time yet, owing to the variety already available and new forms yearly coming out, before definite knowledge will be had. Such knowledge will, of course, be hastened by co-operative effort, such as this meeting, and careful co-ordinated records of work done, which records are already being collected by the Committee of the American Society of Civil Engineers. About all that can be said now is that certain materials will generally give good results; many materials will be satisfactory when properly used; some are extremely limited in their application; and some are practically worthless.

In the foregoing we have perhaps dealt mainly with the use of bitumens or pitches in connection with ordinary road materials. And it may seem that it all was toward the end of improving what would, in many cases, have been a fair road, or under earlier conditions have been an excellent road. There is, however, another large consideration for the wider use of bituminous materials in road work. By such use many materials otherwise unfit for road surfaces—such, for instance, as the harder sandstones, granites, flints, etc., without binding powers—can be most satisfactorily availed of a great bridge over the Shimonoseki Straits for railway bituminous materials, soft stone, oyster shells, marl and even sand, can be made to cheaply form a road surface that is both highly satisfactory and most economical in a great many instances. And again, by the use of a relatively light and cheap "carpeting" of pitch and stone chips on its surface, the speaker believes many, if not all, of the defects of concrete for a road surface will be overcome. If so, a large avenue is opened for progress toward satisfaction and economy.

The selection of proper methods and materials to fit the conditions is the particular province of the unbiased and competent expert, and should not be attempted by the inexperienced nor entrusted to an ignorant or prejudiced party unless failure in some feature of the work is to be expected.

The speaker wishes to briefly suggest two thoughts more:

The first cost of bituminous roads is not a correct basis for the proper comparison of either materials or methods. Desirable, even satisfactory as such roads may be, they, like all other roads, require also maintenance.

This maintenance means expense even though reduced from the earlier figures for such work. And such maintenance should be, with bituminous roads as well as with any others, prompt, sufficient and efficient.

A LARGE BRIDGE.

A Japanese bridge project contemplates the construction of a great bridge over the Shimonoseki Straits for railway and highway purposes, to replace ferry connection. The bridge would be at an elevation of about 165 feet above water, and its total length would be over 3,700 feet.

LETHBRIDGE SEWAGE DISPOSAL WORKS.

The following description of some of the main features of the Lethbridge sewage disposal works, now under construction, should be not only of Canadian but also of general interest. The design of the sedimentation tank is understood to be original, and possesses certain features which are intended to obviate the recognized objections to the ordinary septic tank form of construction.

Generally speaking, the works are designed in order to obtain a reduced character of sewage effluent amenable to disinfection at the lowest form of construction.

The city of Lethbridge is situated in southern Alberta, on the banks of the Belly River, a stream of considerable volume, which joins the South Saskatchewan River. The city obtains its water supply from the river, which also serves as a water supply for several large coal mining centres located below Lethbridge. The population is over 12,000, and the normal water consumption converted into sewage about 700,000 gallons per day. The city is sewered on the separate system, but a proportion of the rain fall enters the sewers from roofs and a small amount of subsoil water also enters the sewers.

There is one main outfall sewer for the whole system, which up to the present has discharged raw sewage into the Belly River about a quarter of a mile below the city intake.

The demand for sewage purification is caused by the large number of typhoid cases in the mining centres depending upon the river as a source of water supply below the point of sewage discharge.

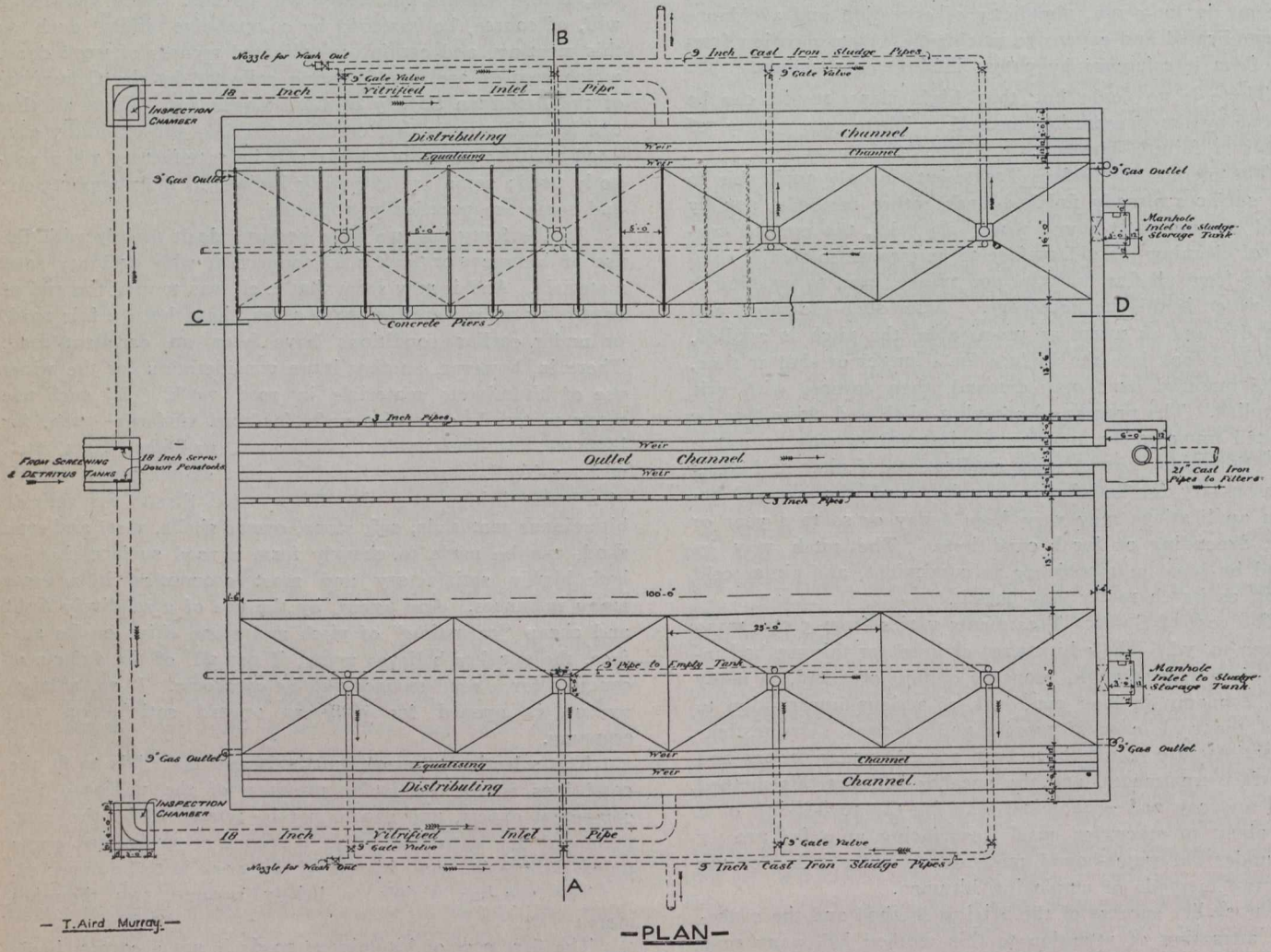
The discharge of sewage varies considerably at different periods of the day, and is only slightly affected by rainfall. Weir readings at the outfall sewer led to the conclusion that the proposed works be constructed to deal with and show a maximum rate of discharge of 2,000,000 gallons per day, a normal rate discharge of 1,000,000 gallons between 6 a.m. and 9 a.m., with a minimum rate discharge of 400,000 gallons per day between 9 p.m. and 6 a.m. Several of the water mains are composed of wood stave pipes, and much of the night flow is considered to be due to direct leakage from the mains to the sewers.

A series of analyses of samples of the sewage show it to be comparatively fresh at the point of discharge, the gradients being excellent and the distance of flow short. The average strength of the sewage is comparable with the class as described as weak in the fifth report of the Royal Commission on Sewage Disposal (Great Britain.)

Fortunately there is sufficient natural fall to allow of the sewage being treated before it enters the river without pumping.

Fig. 4 shows the general layout of the scheme, consisting of, 1st, detritus and screening tanks; 2nd, continuous flow sedimentation tanks; 3rd, percolating filters; 4th, humus tanks; 5th, chlorine mixing chamber.

The 1st, 2nd, 3rd and 4th stages of treatment may be said to be entirely subsidiary to the 5th stage, viz., that of disinfection. The preliminary methods are employed in order to ensure an effluent which can be disinfected at a high efficiency with a low annual cost. Experiments with refer-



—PLAN—

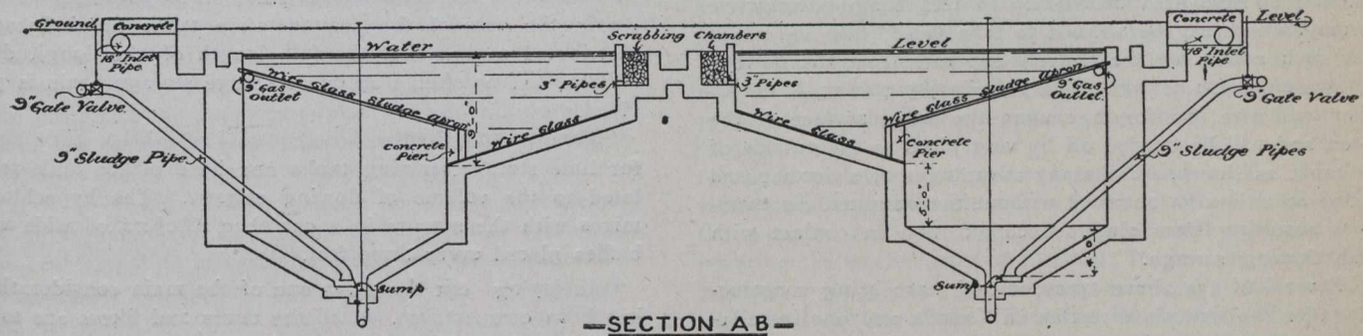
Fig. 1.

ence to the disinfection of the sewage tended to show: 1st, the difficulty of obtaining satisfactory disinfection without the removal of a large proportion of the solids; 2nd. That, in order to disinfect the settled sewage liquor after 70 per cent. of the suspended solids were removed there was required approximately 10 parts of chlorine per 1,000,000 parts of the sewage liquor; 3rd. That in order to disinfect the sewage liquor after it had been well oxidised and rendered chemically stable, it required approximately 3 parts of chlorine per 1,000,000; 4th. That, after oxidized liquor had stood for 1 hour for further sedimentation, that from 1½ to 2 parts of chlorine were required in order to obtain satisfactory disinfection. The above experiments were carried out with only small quantities of sewage and under circumstances which only allowed of very general conclusions. The general conclusions were so far in agreement with other experimental work of E. B. Phelps and others that they reasonably appeared to justify as follows:—

Supposing 2,500,000 gallons of sewage per day. To disinfect the liquor, after 75 per cent. of the solids have been removed, at ten parts of chlorine per 1,000,000 of sewage liquor, with chloride of lime at 1.5 cents per pound, the cost would be $4,000 per annum for lime only. To disinfect this sewage after thorough oxidation in filters and the removal of the filtrate humus, at 2 parts of chlorine to 1,000,000 of effluent, the cost would be $800 per annum. The difference in annual cost capitalized at 5 per cent. represents $64,000. Filters for oxidizing sewage at 2,500,000 gallons per acre at 6 feet 4 inches in depth can be constructed in Canada at a cost of $30,000 or $3 per cubic yard of filter material. There is thus a capital saving of $34,000 by adopting oxidizing filters rather than attempting to disinfect a putrescible effluent, on a unit of 2,500,000 gallon, sewage discharge.

The point where the capitalized cost would be warranted of disinfecting a putrescible sewage liquor rather than providing a non putrescible liquor by filtration followed by disinfection appears to be when only about 4 parts of chlorine are required for disinfection. The writer is strongly convinced that owing to the difficulty of penetrating even the finer solids and treating unstable sewage liquors with chlorine; that it will generally be found expedient to adopt what may be termed the standard methods of sewage disposal in order to obtain non putrescibility before disinfection is attempted.

Stress is laid upon the above point, for the reason that the proportion of dilution of volume of minimum flow in the Belly River to the sewage discharge, is away beyond that which is considered necessary to ensure oxidation by dilution.



—SECTION A B—

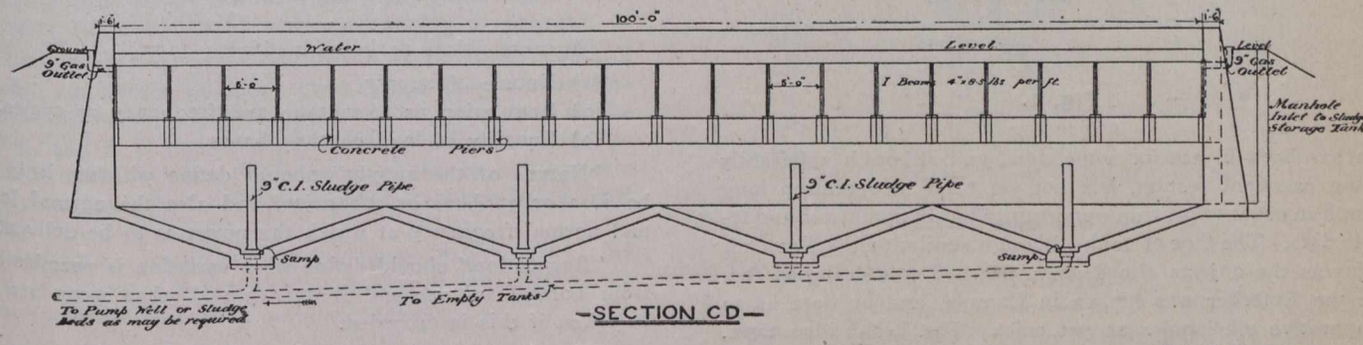
Fig. 2.

—T. Aird Murray.—

Detritus Tanks.—These are built in duplicate, each 15'.0" x 8'.0" with a depth of 6'.6", with a total capacity of 10,000 gallons, providing a normal velocity flow of 1.7 feet per minute. Wrought iron upright screens are fitted across the tanks with ½ inch openings between the bars.

Sedimentation Tanks.—Are in duplicate as per figures, 1, 2, and 3. It will be noted that the sewage is delivered over a weir the full length of the longitudinal side of the tank. This is in order to obtain a low velocity of flow with as short a period of contact as is practicable, and is a departure from the ordinary custom in septic tanks of discharging the sewage over a weir the width of the cross section only and providing a considerable length of passage for the supernatent liquid over the settled matters. The settled sewage leaves the tanks by means of 3 inch pipes fixed below the sewage level and set at equal distances apart along the whole longitudinal length of the outlet and wall, thus ensuring that no floating matters pass off with the settled liquor. The settled liquor passes up and through scrubbing chambers of clinker before it enters the main outlet channel to the filters.

Each tank is practically divided into two compartments, as in the case with the Emscher Tank. A reinforced wired glass apron is made to project into the tank the whole



—SECTION C D—

—T. Aird Murray—

Fig. 3.

longitudinal width. This apron covers what is called a sludge storage basin or area, and has a slope of about 1 in 5. The fore basin of the tank is also lined with glass with a similar steep slope. The apron overlaps the fore base and rests upon piers which are set intermittently allowing of openings between the sludge storage basin and the main body of the tank.

The working principle aimed at is, that, by means of the low velocity of flow owing to the wide cross sectional area of tank, precipitation of the solids will take place upon the apron and the fore base and that owing to the steep slopes and the minimum of friction presented by the glass surface, the precipitated solids will continually be delivered into the storage area or basin. In this basin putrefactive decomposition may be allowed to take place, with the result that such action will be entirely separate from the flowing supernatent fresh sewage The gases arising from decomposition will rise and impinge upon the lower surface of the apron and will be carried off by vent pipes to the outside of the tank, as shown. The many advantages of a decomposed sludge will thus be obtained without the admitted disadvantages resulting from sludge decomposition in contact with fresh flowing sewage.

Several of the above types of tanks are being constructed under the writer's direction in Canada and one installation has been in use for some time, and although apparently giving excellent results, has not yet been in operation long enough in order to provide opportunity to obtain official and reliable data. The type of tank although similar to the Emscher as far as the objects aimed are concerned was designed before the Emscher was known in Canada, and no data as to comparative efficiencies as yet exist. The Lethbridge tank, however, is not costly as far as construction is concerned, and the principle of the glass apron appears eminently suited to a retangular form of tank for covering a sludge storage basin separated from the main body of the tank.

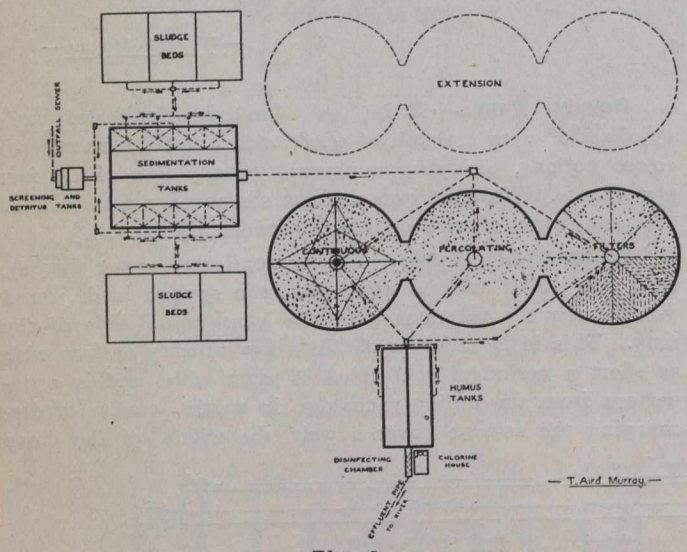


Fig. 4.

The sludge storage capacity in each tank up to the level of the lip of the forebase is equal to 60,000 gallons, while the sedimentation capacity is equal to 100,000 gallons. The velocity of flow through the tank is at the rate of .002 feet per second at the normal rate of flow of 1,000,000 gallons per day, and twice that velociy at the maximum rate of flow.

Filters.—The settled liquors from the above tanks is distributed over circular percolating filter beds, there being three in number each 108 feet diameter, with a depth of 7 feet of clinker graded from 2 to 3 inch cubes. The rate of filtration at the normal flow is 140 gallons of sewage per cubic yard of filter material.

The distributing apparatus consists of revolving distributors actuated by 2'.0" head difference between the level of the sewage in the tank and the level of the filter material in the beds. The distributing apparatus and other special mechanical appliances are designed and supplied by Messrs. Adams & Co., hydraulic engineers of England. The sub drainage of the filters is conveyed to the centre of each bed and from thence to humus sedimentation tanks.

Humus Tanks.—These are in duplicate each 80'.0" x 15'.0" average depth of 4'.0" with a total capacity of 60,000 gallons and a normal velocity of flow of .005 feet per second. As in the case of the sedimentation tanks the influent is distributed over a weir the full length of the longitudinal section, but no sludge apron or sludge storage basin is provided.

Disinfecting Plant.—This consists of a brick built house for lime storage, mixing tanks and head orifice tank regulated to the volume of flowing sewage. The hypochlorite mixes with the sewage in a chamber 26'.0" x 4'.0" wide with baffles placed every three feet.

In laying out the plant one of the main considerations has been compactness, as all the tanks and filters are to be covered and rendered frost proof.

Most of the work has been let by contract, the city supplying the clinker. The total cost is estimated at about $80,000.

The direct supervision of the work is under the control of Mr. A. C. D. Blanchard, the City Engineer, while Mr. T. Aird Murray of Toronto, as consulting engineer, is responsible for the design and layout of the scheme.

CONTRACTS FOR THE SUPPLY OF ELECTRIC POWER FROM THE USER'S POINT OF VIEW.

V.

BY H. E. M. KENSIT, M.I.E.E.

The next points to be defined are:

(1) Nature of supply.
(2) Regulation as to voltage and frequency or cycles.
(3) Equality of load on the phases.

"Nature of the supply" should define whether it is to be 1, 2 or 3 phase or otherwise, and also the normal load and normal frequency at which the power is to be delivered.

"Regulation" should define what variation is permissible from normal voltage and frequency and what steps are to be taken if this is exceeded.

"Equality of load on the phases" refers to the arrangement of the load in the customer's works. Two phase supply requires 4 wires and gives 2 circuits. Three phase supply requires 3 wires and gives 3 circuits, and there are other combinations which need not be fully discussed here. The customer's load should be so divided amongst these circuits in his works as to be approximately equal and similar on each circuit; otherwise the regulation and efficiency of distribution will be interfered with. A want of such balance in any individual works affects not only that works but the whole of the Power Company's system.

Sample clauses on these points are as follows:—

(1) "The power supplied shall be 3 phase electric energy at 600 volts and a frequency of 60 cycles, and the wave form of the alternating current shall closely approxi-

mate a sine curve. If either voltage or frequency vary by more than 5 per cent. from that above specified for more than 10 per cent. of each consecutive 24 hours the Power Company will instal more effective regulations.

"The customer agrees, that so far as the nature of its work will permit, it will so regulate its use of electric energy that the load will not vary suddenly more than 20 per cent., and that they will maintain equality of load on the phases within 10 per cent. of the load on the least loaded phase.

"The Power Company shall not be responsible in any way for the distribution of the electric energy or power beyond the point of delivery to the customer."

The insertion of the sentence relating to "wave form" is of very doubtful utility. The point is a highly technical one requiring a mathematical explanation that would be outside the scope of this article. The "wave form" depends on the design of the generating plant and on the nature of the load and cannot be said to be under the practical control of either the Power Company or the customer.

(2) "The Power Company agrees to deliver 3 phase alternating commercially continuous 24 hour power every day of the year except as hereafter provided and in the quantities above provided, at approximately 12,000 volts and approximately 25 cycles per second frequency, and the maintenance by the Power Company of approximately the agreed voltage at approximately the agreed frequency shall constitute the supply of all power involved herein and the fulfilment of all operating obligations hereunder. When voltage and frequency are so maintained, the amount of power, its fluctuations, load factor, power factor, distribution as to phases, and all other electric characteristics shall be considered to be under the sole control of the customer."

It may be pointed out that the use of the word "approximately" is undesirable, and it is better to state a fixed percentage even if this is very liberal. In case of a dispute or legal action it is as difficult to decide what is "approximate" as what is "reasonable."

(3) "The electric energy to be delivered under this agreement shall be 3 phase, 60 cycle, 2,200 volt, alternating current, and the Power Company agrees to maintain normal frequency and voltage within 2 per cent. either way. The customer will endeavor to maintain equality of phases."

Here it may be remarked that it is extremely doubtful whether any Power Company ever has or ever will be able to maintain voltage and frequency within 2 per cent. of the normal, and it is questionable whether such a requirement could be enforced. It is better to place this at a reasonable figure, say 5 per cent., and then insist upon this being lived up to.

Variations of voltage and frequency directly affect the speed of motors, and variation of frequency also affects the power factor of the motors quite appreciably.

Such variations are more frequently downwards than upwards, due to overload of the generators or transmission line or insufficiency of power.

Lowering the voltage and thereby the speed of the motors directly affects the amount of output of the factory, and in some cases its quality, and lowering the frequency lowers the power factor, and thereby in some cases increases the amount charged for power.

The power-user should therefore keep careful watch that both voltage and frequency are kept continuously within the defined limits.

All three of the points defined at the commencement of this article can be contained in one clause, and the following is suggested as the basis of a fair clause, subject to modification to meet the particular conditions:—

"The Power Company shall supply 3 phase electric energy at a normal pressure of 600 volts, and a normal frequency of 60 cycles per second. If either voltage or frequency vary by more than 5 per cent. either way from the above stated normal pressure and frequency for more than 5 per cent. of the time in any consecutive 24 hours, the Power Company shall immediately install more efficient regulating apparatus or take such other steps as may be necessary to keep the pressure and frequency within the above defined limits. The customer agrees that he will maintain equality of load on the phases of his circuits within 10 per cent."

This clause contains a guarantee by the Power Company and a guarantee by the customer. To be effective a penalty for non-performance should be provided in each case. This might be done by providing that the amount of the account for power should be deducted from or added to in proportion to the extent to which the above limits are exceeded.

Such variations represent a cash loss; in the case of voltage and frequency the loss is to the customer in affecting the quantity and sometimes the quality of his output and lowering the power factor of his load; in the case of unequal loading of the phases the efficiency of distribution is diminished and the operating difficulties increased to the disadvantage of the Power Company; it therefore appears fair that an adjustment of the account proportionate to such variations or inequalities should be made and should work both ways.

REGISTRATION OF MEMBERS OF CANADIAN SOCIETY OF CIVIL ENGINEERS.

The following members registered too late for inclusion in the daily issue of January 26th:—

240. F. E. Bremner, Montreal.
241. A. Bertram, Dundas, Ont.
242. J. Zverina, Montreal.
243. D. MacPherson, Ottawa.
244. E. B. McLean, Moncton, N.B.
245. G. W. Shearer, Montreal.
246. W. Murdoch, St. John, N.B.
247. F. Thomson, Montreal.
248. W. H. Greene, Montreal.
249. J. Mayer, Montreal.
250. H. C. Lumsden, Toronto.
251. C. Thomson, Montreal.
252. R. W. Leonard, St. Catharines, Ont.

PERSONAL.

Mr. J. J. Antonisen, of Port Arthur, has been appointed city engineer of Moose Jaw, Sask.

Mr. J. Stoddart has severed his connection with the city of Toronto. He has been appointed assistant engineer in the waterworks department of Hamilton, Ont.

OBITUARY.

Mr. Matthew Neilson, a well-known civil engineer in Canada, died on January 21st at his residence, 52 Arlington Avenue, Westmount, Montreal, after an illness of three months. Mr. Neilson was born at Almonte, Ont., 59 years ago. He is survived by a widow and one son. His death was due to pleuro-pneumonia.

FORESTRY CONVENTION.

The program for the big Forestry Convention, at Ottawa, February 7th and 8th, is now complete. The subject of how to handle our forests so as to get the most out of them, both now and in the future, will be dealt with by leaders from Canada and from the United States. Among those who will speak are Messrs. Gifford Pinchot, formerly Chief Forester of the United States; E. A. Sterling, Forester of the Pennsylvania Railroad, which is now growing its own ties; Dr. Fernow, head of Forestry School, of Toronto University; Dr. J. W. Robertson, of the Conservation Commission, and H. R. MacMillan of the Forestry Branch of the Department of the Interior. The banquet on Wednesday evening will be attended by parliamentary leaders, educationists, foresters, lumbermen and the heads of financial and commercial institutions. The day sessions are open to the public, and the importance which the government attaches to this subject is shown by the fact that these are held in the Railway Committee room of the Parliament Buildings; while the railways have granted special rates to delegates. The Seed Growers' Association convene on February 8th and 9th, so that delegates to the Forestry Convention will be able to attend some of the sessions of that body.

COMING MEETINGS.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Jan. 24. 25, 26, 1912, General meeting. 413 Dorchester St. West, Montreal. Prof, C. H, McLeod, Secretary.

CANADIAN FORESTRY ASSOCIATION.—February 7th and 8th, 1912. Forestry Convention Meetings held in the Railway Committee Room, Parliament Buildings, Ottawa. Secretary, Mr. James Lawler, Canadian Bldg., Ottawa.

CANADIAN LUMBERMEN'S ASSOCIATION.—February 6, 7 and 8, 1912. Annual Meeting to be held at the same time and place as the Canadian Forestry Association.

CANADIAN NATIONAL ASSOCIATION OF BUILDERS. — The Sixth Annual Convention will be held in Toronto, February 20, 1912.

ONTARIO GOOD ROADS ASSOCIATION.—Annual Convention to be held at Toronto, February 26, 27, 28. Secretary, J. E. Farewell, Whitby.

THE CLEVELAND ENGINEERING SOCIETY.—Regular Meeting, Tuesday Evening, February 13, 1912, Chamber of Commerce Bldg., Cleveland, O. Address by Mortimer E. Cooley, Dean, Department of Engineering, University of Michigan; Subject: "Public Utilities and Their Relation to the Public." Secretary, F. W. Ballard.

ENGINEERING SOCIETIES.

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

QUEBEC BRANCH—
Chairman, P. E. Parent; Secretary, S. S. Oliver. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, T. C. Irving; Acting Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

MANITOBA BRANCH—
Secretary E. Brydone Jack. Meets every 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, 319 Pender Street West, Vancouver. Meets in Engineering Department, University.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; 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, Councillor Siddall, Port Elgin; 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 Bee, Lemberg; Secretary, Mr. Heal, Moose Jaw

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

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.

BUILDERS, CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary Treasurer, J. H. Lauer, Montreal, Que.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

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, Canadian Building, Ottawa.

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

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, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London. Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, T. A Starkey, M.B., D.P.H., Montreal. Secretary, F. C. Douglas, M.D., D,P.H. 51 Park Avenue, Montreal.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; 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, 70 Bond Street, Toronto.

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

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, G. Baldwin; 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, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, W. B. McPherson; Corresponding Secretary, A. McQueen.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Killaly Gamble; 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.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary, R. C. Harris, City Hall, Toronto.

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, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, 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, J. Whitson; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

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. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Dr. A. McGill, Ottawa, President; Alfred Burton, Toronto, Secretary.

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

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

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

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
Arcola, Sask., schoolhouse	Feb. 1.	Jan. 18.	75
Calgary, Alta., bridge	Feb. 10.	Jan. 18.	86
Chesley, Ont., public wharf	Jan. 31.	Jan. 18.	75
Grandview, Man., scrapers	Feb. 1.	Jan. 18.	75
Hamilton, Ont., works supplies	Feb. 6.	Jan. 25.	59
Lajord, Sask., schoolhouse	Feb. 10.	Jan. 25.	59
Little Lameque, N.B., wharf	Feb. 14.	Jan. 25.	59
Lake Quinze, Que., dams and sluiceways	Feb. 15.	Jan. 25.	59
Lloydminster, Sask., public building	Feb. 7.	Jan. 25.	59
Lion's Head, Ont., lighthouse tower	Feb. 5.	Jan. 18.	75
Ottawa, Ont., iron posts	Jan. 31.	Dec. 21.	68
Ottawa, Ont., contracting machinery	Feb. 26.	Jan. 11.	59
Petewawa, Ont., improvements to wharf	Jan. 31.	Jan. 18.	75
Saskatoon, Sask., subway	Feb. 23.	Jan. 25.	68
Saskatoon, Sask., pavements	Feb. 16.	Jan. 18.	86
Saskatoon, Sask., concrete sidewalks	Feb. 16.	Jan. 18.	86
Swift Current, Sask., theatre	Feb. 16.	Jan. 25.	59
Toronto, Ont., bridges	Jan. 31.	Jan. 18.	75
Toronto, Ont., Central Y.M.C.A. building	Feb. 5.	Jan. 25.	60
Toronto, Ont., track intersections, etc.	Feb. 20.	Jan. 25.	72
Upper Salmon River, N.B., pier	Feb. 14.	Jan. 25.	59
Victoria. B.C., schoolhouse	Jan. 31.	Jan. 18.	75
Walkerton, Ont., bridge, Saugeen River	Jan. 23.	Jan. 4.	59
Winnipeg, Man., electric vehicle	Feb. 1.	Jan. 18.	75
Winnipeg, Man., drawings for Parliament Buildings	Mar. 31.	Jan. 25.	70
Winnipeg, Man., pumping machinery	Mar. 1.	Jan. 25.	72

TENDERS.

Calgary, Alta.—Tenders for sluice gates will be received by A. S. Dawson, chief engineer, C.P.R. Irrigation Department, Calgary, until February 29th, 1912. (See advertisement elsewhere in Canadian Engineer.)

Galt, Ont.—Tenders will be received until February 24th, 1912, for the construction of a building for the Young Men's Christian Association, on Queen's Square, Galt. Plans and specifications may be seen at the office of the General Secretary, William R. Cook, of the Young Men's Christian Association, Water Street, Galt, Ont.

Halifax, N.S.—L. Fred Monaghan, City Clerk, will receive tenders until February 1st, 1912, for 4,000 ft. 2½-in. fire hose, and 300 ft. 1-in. chemical hose, all with couplings complete and suitable for Halifax Fire Department.

Kerrisdale, B.C.—Tenders will be received until February 19th, 1912, for the supply of valves, hydrants and special castings, for the Corporation of Point Grey water supply. Specifications, etc., at the office of the engineers, Messrs. Cleveland & Cameron, 506 Winch Bldg., Vancouver. H. Floyd, C.M.C., Municipal Hall, Kerrisdale.

Lethbridge, Alta.—Tenders will be received until February 15th, 1912, for the construction of an extension to power house, plans and specifications of which may be obtained from A. Reid, General Supt., City Hall, Lethbridge. G. W. Robinson, Secr.-Treas., Lethbridge.

London, Ont.—Tenders will be received until February 14th, 1912, for one 50 h.p. gas engine, one gasoline engine, two half-million gallon triplex pumps, three deep well pumps, etc. F. W. Farncomb, Consulting Engineer, London. (See advertisement elsewhere in Can. Eng.)

Ottawa, Ont.—The Dept. of Public Works will receive tenders for the construction of a wharf at Cap St. Ignace, Que., until Feb. 5th, 1912. Plans, etc., at the offices of A. R. Decary, P.O. Bldg., Quebec; J. L. Michaud, Merchants Bank Bldg., St. James St., Montreal.

Ottawa, Ont.—Tenders will be received until February 24th, 1912, for the construction of five twin-screw gasoline launches for the Fishery Patrol Service of the Maritime Provinces of the Dominion of Canada, of the following dimensions:—

Length over all	45 feet.
Breadth moulded	11 feet.
Mean load draft	3 ft. 2 in.

Each boat to be equipped with two 16-h.p. gasoline engines. Plans, etc., can be obtained on application from the Purchasing and Contracting Agent, Marine Department, Ottawa. Agents, Marine Department, St. John, Halifax and Charlottetown. A. Johnston, Deputy-Minister of Marine and Fisheries, Department of Marine and Fisheries, Ottawa.

Ottawa, Ont.—Tenders for the construction of an extension to East Breakwater, and removal of L on West Breakwater, and dredging of Meaford, Grey County, Ontario, will be received until February 26th, 1912. Plans, etc., can be obtained at the offices of H. J. Lamb, District Engineer, Windsor, Ont.; J. G. Sing, District Engineer, Confederation Life Building, Toronto; Postmaster at Meaford, Ont., and at the Department of Public Works, Ottawa.

Winnipeg, Man.—Tenders will be received until February 14th, 1912, for extending the piers and abutments of the Red River Bridge, Winnipeg. Plans, specifications and forms of proposal can be seen at the office of Frank Lee, Division Engineer, Winnipeg.

Sudbury, Ont.—Tenders will be received until 1.00 p.m. February 5th, 1912, for the furnishing and installation of 2 return tubular boilers 72 in. x 18 ft. with accessories; also for 2 horizontal compound duplex steam pumps, 900 Imperial gallons capacity each; also one twelve-inch Venturi Water Meter. J. G. Heney, Esq., Mayor.

Toronto, Ont.—Tenders will be received until March 2nd, 1912, for the construction of 12 concrete bridges in East Whitby Township, Ont. Engineers, Bowman & Connor, 36 Toronto Street.

Winnipeg, Man.—Tenders will be received until February 8th, 1912, for the supply and installation of 3-50 K.W. transformers and accessories at Well No. 3, specifications, etc., of which may be obtained at the office of the City Engineer, 223 James Ave. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Victoria, B.C.—Tenders for the erection and completion of a five-room two-cell lock-up and constable's quarters at Quathiaski Cove, Valdes Island, in the Comox Electoral District, B.C., will be received till February 7th, 1912. Plans at offices of Government Agents, Cumberland and Nanaimo; the Constable-in-Charge, Quathiaski Cove, and the Dept. of Public Works, Parliament Bldgs., Victoria.

CONTRACTS AWARDED.

Calgary, Alta.—Messrs. McDougall & Foster have closed a contract for the erection of an apartment building to cost $250,000, to be erected at the corner of Jasper Avenue and Twenty-third Street, Edmonton, Alta.

Point Grey, B.C.—Contractors MacAdam & Co., of Vancouver, have the contract of the construction of a vitrified brick sewer on West Boulevard. Cost, $27,412.

Quebec, P.Q.—Mr. M. Connelly, of Montreal, has been awarded the contract to lay the Quebec water mains. Messrs. R. Maclaren Company of Glasgow will supply the fittings. This is the largest cast-iron pipe contract ever awarded in Canada ($532,000.)

Victoria, B.C.—The contract for the construction of the new six-story fireproof rooming house on Johnston Street for Messrs. Chas. Hayward and F. S. Barnard, has been awarded to the Westholme Lumber Co. The plans provide for stores with commodious basements on the ground floor, the upper portion to contain 100 good-sized rooms, each provided with hot and cold water, bath room, etc., and each furnished with telephone. The entire building is to be heated with steam, and electric lighted throughout, while an elevator in the main entrance will provide easy access to every flat. The entire cost of the building is $112,000.

Victoria, B.C.—The owner, P. R. Brown, has let a contract for about $14,000 to the Westholme Lumber Company for alterations to the premises on Douglas Street, between Fort and Broughton Streets.

Walkerton, Ont.—The Hunter Bridge Co., of Kincardine, have the contract for the erection of a steel bridge over the Saugeen River, Brant Township. James Warren, Engineer-in-charge.

RAILWAYS—STEAM AND ELECTRIC.

Brantford, Ont.—The Dominion Railway Board has approved the general location of the Lake Erie and Northern electric line to Port Dover, Ont.

Province of British Columbia.—The Dominion Railway Commission have approved the plans submitted by the Esquimalt and Nanaimo Railway Company for its extension up the east coast of Vancouver Island from Union Bay to Duncan Bay, the latter a point north of the Campbell River. It is understood that a very early commencement of construction is contemplated by the compnay, the clearance of right-of-way and a beginning of the grading of the line being already in hand. Large terminals are contemplated for Duncan Bay.

Edmonton, Alta.—Two petitions were brought before the house for the incorporating of street railway companies, one in Medicine Hat and another to serve several of the Crow's Nest towns. The Crow's Nest Pass Street Railway Company wants to operate lines from Cowley, west through Lundbreck, Burmis, Passburg, Bellevue, Frank, Blairmore, Coleman, to a point near Crow's Nest Lake. Those promoting the scheme are given as W. A. Beebe, Robert Coulthard, and Thomas B. George, all of Blairmore. The company is capitalized at half a million. Bonds may be issued to the extent of $12,000 a mile, and work is to start within two years and be completed in five. The Medicine Hat Railway Company's petition was brought in on behalf of Albert F. Krappel, David W. Brown and Warren Overplank, all of Medicine Hat. They are asking for the right to operate lines within Medicine Hat and suburban lines, including Dunmore and south-east to Elkwater Lake.

Montreal, P.Q.—It is stated that by early spring another railway, the Central of Canada, from Montreal to Ottawa, will be under construction, the contracting firm, Messrs. C. J. Wills & Sons, of London, being represented in this city by Mr. David Lyell. Orders are now being given for all the ties needed, as well as for the steel rails which are to be eighty pounds to the yard. It is said that a double track will be laid from Montreal as far as St. Eustache. The construction of three heavy bridges at the Back River, St. Eustache and at St. Andrews will be commenced when the spring opens, and by fall most of the masonry will have been placed in position. The entrance into the City of Montreal has not yet been disclosed by the company.

New Waterford, N.B.—The Dominion Coal Company have under construction at Carney's Lake, near New Waterford, a new electric power station to supplement their central electric power plant at Dominion No. 2. The work is being done by the company's construction staff, under the direction of Superintendent J. S. White.

Ottawa, Ont.—A report states that Hon. C. J. Dougherty, minister of justice, announced that the government has decided not to disallow the legislation of the Alberta Government in regard to the Alberta and Great Waterways Railway. The Provincial Government passed a bill taking over the $7,000,000 raised by the company on its bonds, and disallowance was asked for the reason, that it would be against established precedent to disallow such legislation, the rule having been established that it is inadvisable to interfere with the provinces in the administration of purely provincial affairs. Steps will be taken, it is understood, to see that the interests of those who have claims against the province are protected.

Province of Saskatchewan. — A network of railways to connect all four of the cities of the province with the Hudson Bay Railway is the evndent intention of the Canadian Northern Railway, according to a petition to be presented to the legislature.

Saskatoon, Sask.—During an attempt to wreck the C.P.R. train from Winnipeg to Edmonton, a bridge 93 miles west of Saskatoon was burnt by some persons unknown.

Saskatoon, Sask.—The city council approved the plans submitted by A. G. Sangster, electrical superintendent, to install three hundred and fifty-five light Tungsdon standards on the principal business streets of the city.

Western Canada.—W. B. Lanigan, general freight agent of the C.P.R. has been in St. Paul to borrow motive power to move from Fort William and Port Arthur 3,000,000 bushels of wheat still unmoved, which was ordered out for January delivery. He was negotiating with Great Northern and Northern Pacific Railways.

LIGHT, HEAT AND POWER.

Berlin, Ont.—The Light Commissioners have the following for sale:—One Westinghouse Gas Engine, size 19 x 22, 250 h.p., direct connected to 150 k.w. 3 phase 60 cycle 2,200 volt generator; also direct connected exciter. One 3 cylinder vertical Westinghouse Gas Engine, rated 90 h.p., size 10 x 11. Three 3 cylinder vertical Westinghouse Gas Engines, 125 h.p., size 13 x 14. One Tandem Compound Wheelock Engine 10 x 18 x 28, rated 125 h.p. Also a number of motors and generators.

Fredericton N.B.—The city council are to make an effort to secure a capable official to take charge of the electric light plant.

Carmangay, Alta.—The council have received word that the engine and boiler for the waterworks and electric light plants had been shipped. In two or three weeks the electric light plant should be in operation.

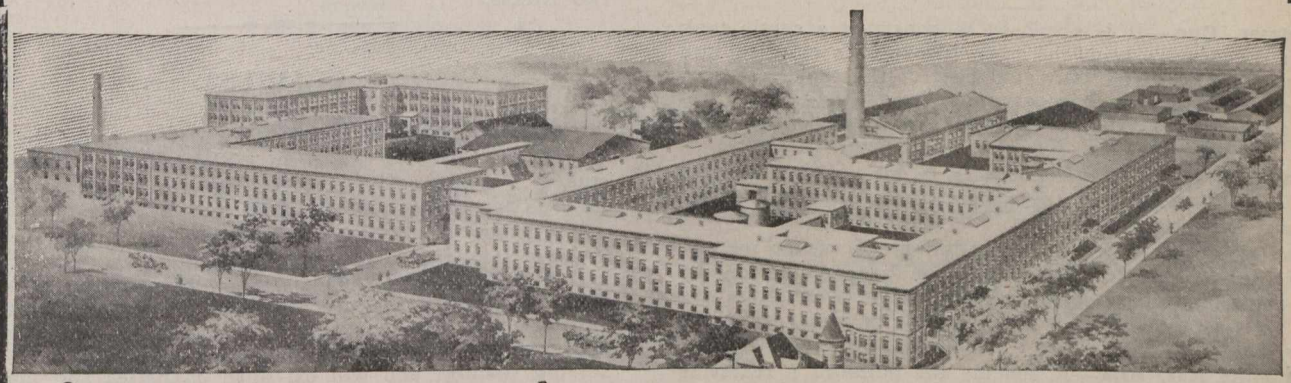
Port Arthur, Ont.—The work on the new street lighting system has been held back owing to the extreme cold weather.

Stave Falls, B.C.—The first large unit installed by the Western Canada Power Company, Stave Falls, B.C., was started on the 16th of December last. The putting into operation of this largest unit installed in Canada (excepting to Niagara Falls), went on to the greatest satisfaction and no irregularity whatever was experienced. No adjustment whatever was necessary, and the turbine was not again shut down. The present installation comprises two units of 13,000 horse-power, each working under a head of about 110 feet. The hydraulic equipment is supplied by Messrs. Escher Wyss & Company of Zurich, Switzerland. Canadian office, 408 Lumsden Building, and the electrical end by the Canadian General Electric Company of Canada.

Tweed, Ont.—The Tweed Electric Light and Power Company, controlled by the Messrs. Kisack Bros., have sold out to the Tweed Electric Light and Power Company, Ltd. The Electric Power Company of Toronto have the controlling interest, and new developments will take place in the system during the spring. Tweed is in Hastings County, Ont.

Quebec, P.Q.—A contract has been made between the municipality and the Dorchester Electric Company by which the Dorchester Electric Company engaged to do the city

Barrett Specification Roofs



Warner Bros. Co., Corset Manufacturers, Bridgeport, Conn. Day & Zimmerman, Engineers, Philadelphia, Pa.

The Most Economical Roof

FOR half a century architects have known that slag and gravel roofs would *often* show marvelous durability.

The Barrett Specification defines the method by which these roofs may be built so that they will *always* show such durability.

It provides for the best materials manufactured, and prescribes the most approved methods of application.

A Barrett Specification Roof will cost less than any other permanent roof, will last upwards of twenty years and will need no painting or coating or care. Such roofs are fire-retardant and take the base rate of insurance.

That is why they are invariably used on large manufacturing plants where the roof areas are great and where, therefore, the unit costs are carefully studied.

Booklet giving the Barrett Specification in full mailed free on request. Address nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If an abbreviated form is desired however the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15th, 1911, using the materials specified, and subject to the inspection requirement.

The Paterson Manufacturing Co., Limited

Montreal Toronto Winnipeg Vancouver St. John, N.B. Halifax, N.S.

lighting at seven cents per kilowatt hour. The contract with the Quebec Railway Light and Power Company expired on August 1 last, so that the new company will at once begin to put in their plant. Tenders will be called for in the near future.

Vancouver, B.C.—Gigantic power development is to be undertaken by the British Columbia Electric Railway Company during the present year. The plans are for the development during the present year of the generating station on the North Arm of Burrard Inlet, so as to make an available output from the plant of 85,500 horse-power. This practically means the doubling of the present output of this station. The plans at the Lake Buntzen plant and the North Arm station indicate that by the end of 1912 the company will probably have an available output of 105,000 horse-power. Plans are in hand for future developments of power sites controlled by the company which will bring its available output up to 200,000 horse-power.

SEWAGE AND WATER.

Aylmer, Que.—It is proposed to construct a septic tank to treat the sewage from the town before it is emptied into the Ottawa river. The estimated cost of the tank is $5,000 and the city of Ottawa has expressed its willingness to provide $2,500 towards the work. The town of Aylmer will supply the balance. Mr. Ker, City Engineer, Ottawa.

Brandon, Man.—Mayor Fleming in his opening address to the council stated that the waterworks system will be reorganized during the year 1912.

Halifax, N.S.—Since the installation of water meters, according to reports from the lakes, the large meters on the mains show that whereas a year ago the city consumption was about 2,250,000 gallons per day, now it is about 1,600,000 gallons per day. A very large saving.

Medicine Hat, Alta.—A scheme for building a reservoir in this city, with a capacity of 40,000,000 gallons, will be brought up before the city council in the near future. W. P. Morrison, Engineer.

Moose Jaw, Sask.—The water supply is holding out as well as may be expected for this time of the year. The Snowdy Springs and Ross Crescent supplies are still producing fairly well.

St. Catharines, Ont.—Recent examination of the drinking water showed infection to be absent.

Vancouver, B.C.—City Engineer Fellowes recommended that the four-foot brick and concrete sewer on Dufferin Street be extended from Yukon to Bridge, also the construction of a three-foot sewer on Bridge from Dufferin to Seventh Ave. The estimated cost of this work by day labor is $17,300

BUILDING.

Calgary, Alta.—Work will commence in the spring of 1912, on the grounds and buildings of the Calgary University. Rev. Dr. Braithwaite, of Toronto, has been appointed Dean.

Calgary, Alta.—The Rumley Machine Company of Laporte, Indiana, manufacturers of gas traction engines and other machinery, have purchased a site consisting of 25 acres of trackage property in this city. It is the intention of the company to establish a manufacturing plant on the property.

Listowel, Ont.—The Listowel agricultural society will spend $2,000 on erecting a new building on the fair grounds.

Montreal, P.Q.—The congregation of Westmount Methodist Church are contemplating the erection of a $120,000 structure. Rev. W. E. Baker, Pastor.

Port Arthur, Ont.—The city engineer's office have prepared preliminary plans for a fire station to cost about $25,000, also a telephone exchange building to cost about $24,000.

Port Stanley, Ont.—Speakers at the meeting of the London, Ont., board of trade suggested the necessity of the construction of a grain elevator at Port Stanley.

Saskatoon, Sask.—A company which will engage in the manufacture of Trojan flooring and fireproof partitions will erect a factory in this city. Mr. C. H. Forrester, of the International Construction Company, Winnipeg, Man., is interested in this project.

Toronto, Ont.—Work on the new St. Alban's Cathedral will commence in the spring. Messrs. Symons & Rae, local architects.

Vancouver, B.C.—Mr. J. D. Barton, New York, U.S.A., is contemplating the erection of an apartment house in this city to cost $250,000.

Winnipeg, Man. — The Canadian Consolidated Rubber Company and the Canadian Fairbanks Morse are about to erect large factories in the west end of the city.

ROADS AND PAVEMENTS.

Vancouver, B.C.—The city engineer, Mr. Fellowes, recommended to the council that tenders be called for the construction of a wood block pavement on Seymour Street from Robson to Pacific, and on Richards between the same two streets.

BUSINESS.

Bancroft, Ont.—$18,000 damage was caused by fire to several industries in this town. The buildings damaged included S. Plew's grist mill, D. Fuller's woollen mill, J. D. Payne's machine shop, and the electric light plant.

Province of British Columbia.—The British Columbia Fishery Company, of London, England, was recently organized with a capital of one million dollars for the exploitation of the deep sea fisheries of the Pacific coast off Queen Charlotte Islands. The company will engage in the salmon-fishing industry, and canning as well as in halibut, cod and herring fishing, and will establish canneries and plants for manufacturing by-products.

Montreal, P.Q.—A fire which broke out at the premises of Shearer, Brown & Wills Company, Ltd., lumber merchants, did damage to the extent of $80,000.

Trenton, Ont.—Fire damaged the opera house and a grain elevator owned by Mr. J. G. Squier. The machinery of the City Steam Laundry was also damaged. The estimated losses, $12,000.

Minitonas, Man.—J. D. Ramsay's general store was gutted by fire. More than $10,000 in stock was carried, and two-thirds of it was a total loss.

Victoria, B.C.—The estimates for the year for the fire department amount to $105,409, of which $68,716 is for salaries. The recommendation was made and adopted that twelve new alarm boxes and 4,000 feet of hose be purchased.

Yorkton, Sask.—The power plant and electric light system were seriously damaged by fire. A. C. Crasly, town engineer.

CURRENT NEWS.

Province of British Columbia.—The Forest Act brought down in the provincial legislature is an exceedingly comprehensive measure, comprising 144 sections. Among other measures it proposes to create what is to be known as the forest branch of the department of lands, to be presided over by a chief forester, with such assistance as he may require.

Calgary, Alta.—The present value of the equipment of the fire department is $291,670, made up of the following items: Equipment, $60,450, horses, harness, etc., $19,250; alarm system, $18,765; furniture, $2,600; buildings and land, $19,605.

Guelph, Ont.—A conference has been held between the municipal officials and the Canadian Pacific Railway, with a view of beautifying the railroad properties around the city.

Kingston, Ont.—That the city council purchase the Cataraqui bridge, and that the necessary by-law be prepared was the recommendation made by the civic finance committee.

Ottawa, Ont.—Representations have been made to the government for the appointment of a special commission to enquire into the lead-zinc industry. The lead bounty expires

in June and it is desired that in place of waiting for the tariff commission special enquiry be made meanwhile.

Province of Quebec.—Premier Gouin has opened negotiations with the government at Ottawa, looking to the acquisition of the territory known as Ungava, and its annexation to the Province of Quebec. The district is supposedly rich in minerals, fairly fertile, and adapted to colonization.

Toronto, Ont.—An estimate for the extension of Teraulay street has been prepared. The extension as proposed would be about three-fifths of a mile and would cross nine streets in the residential section. The cost is placed at $200,000.

Victoria, B.C.—$750,000 is the amount asked for by the council to carry on the civic business until the taxes are due.

Winnipeg, Calgary and Edmonton.—Notice comes from Ottawa that examinations will be held at Winnipeg, Calgary and Edmonton on February 12, 1912, of candidates for positions as Dominion land surveyors.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria street, London, S.W., during the week ending January 8th, 1912:—

A London firm desire to appoint agents at Montreal, Toronto, Winnipeg and other large centres in Canada, for the sale of a hygienic system of air purification suitable for theatres, picture halls, hospitals, schools, homes, etc.

A Yorkshire firm manufacturing druggists' sundries and surgical appliances, desire to get into touch with Canadian importers.

A London firm having a demand for best three-ply pine or similar three-ply wood, ask for names of Canadian manufacturers.

A West of England firm of dairy and agricultural engineers desire to get into communication with agents in Canada handling cheese-making appliances.

A firm in the West of England are in the market for supplies of tool handles of various kinds.

A London firm having a well-established connection amongst wholesale provision merchants, wish to get into correspondence with Canadian butter and cheese shippers requiring representation in Great Britain.

A correspondent in the province of Quebec is desirous of getting into touch with United Kingdom importers of Canadian hay.

A correspondent who is shortly returning to Canada is desirous of getting into touch with United Kingdom manufacturers requiring a resident agent in the Dominion; wishing to open a branch factory; open to see Canadian patent rights. Engineering, chemical or textile industries preferred.

The Canadian agent of an English manufacturer of condiments and essences is open to take up another line which he could work in conjunction.

A Montreal importer desires to obtain agencies for fancy goods.

A Winnipeg manufacturers' agent wishes to secure agencies for felt-shoe findings, house furnishings and builders' materials.

Inquiry is made by a Canadian correspondent now in Wales for the names of manufacturers of fancy leather goods requiring Canadian representation.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:

A German firm manufacturing pyrenees lambs-wool flannels (fleeces, ripples, naps, etc.), are seeking Canadian agents.

A Liverpool firm ask to be placed in touch with Canadian shippers of dried fish.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending January 15th, 1912:—

A London firm of small pipe organ manufacturers desire to open up business in Canada.

A London firm, stated to have a large market for Canadian rolled oats, wish to get into touch with some millers in the Dominion able to deal with large orders.

A London firm seek an agent in Canada for the sale of a street fire alarm system, and time-saving devices for fire stations.

A Scottish firm make inquiry for the names of Canadian buyers of Toe Calk steel.

A Yorkshire firm make inquiry for the names of Canadian miners of iron ore, who may be open to appoint an agent in Great Britain.

A Montreal chemist controlling a wholesale and several retail businesses in the city, is open to act as agent or manager of the Canadian branch of a first-class United Kingdom manufacturer. A London representative would call on interested parties.

A Montreal dealer in typewriter and duplicator supplies is open to correspond with United Kingdom manufacturers of these goods.

A Calgary correspondent, now in London, is open to take up agencies for heavy hardware, mine, mill and builders' supplies, iron and steel.

A Toronto correspondent would like to hear from United Kingdom importers of maple and birch logs in the round; also buyers of wood flour and excelsior; and buyers of maple and birch timber in the square.

A London correspondent who is shortly leaving for British Columbia, is desirous of securing agencies for the sale of paints, varnish, brushes, enamel baths, basins, sinks, galvanized cisterns, galvanized wire, nails, sheets, general ironmongery and house furnishings, stoves and boilers, wallpapers, glass, enamel tiles and other building materials.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:—

A London paper agent, who is about to visit Canada, and who claims an established connection among buyers of paper of various kinds, would be glad to get into touch with actual Canadian manufacturers of paper who are in a position to fill orders for export.

A London firm are open to purchase large quantities of cardboard milk bottle caps and invite quotations from Canadian manufacturers.

A Canadian company who are in the market for quantities of commercial sodium phosphate and ammonium chloride, invite quotations from manufacturers of these chemicals.

A manufacturers' agent in Montreal desires the addresses of manufacturers of orange-red mineral and of blanc fix for coating purposes on paper.

PATENTS.

The following is a list of patents granted to inventors in Canada. This list is furnished by Messrs. Fetherstonhaugh & Company, 10 King Street East, Toronto:—

F. J. Alderson and W. H. Dunsmore, shocking machines; C. M. Conklin, students' chair; W. Nepean-Hutchison, lock washers; A. Lemieux, price tags; G. W. Mallory, animal bits; H. L. Mason, trousers; W. C. Weeks, gravel washers.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, Manning Chambers, Toronto:—

Sir C. C. Wakefield, force feed lubricator; C. H. Sivel, safety apparatus for mining cages, lifts and the like; Wilhelm Gunther, process of treating ores; W. U. Jackson, H. Lloyd and S. F. Murrell, tube making machinery; Friedrich Stamuschulte, recuperator; E. H. Nutter and H. Lavers, ore concentration (fractional flotation); C. V. Thierry, metallurgy of zinc; Emil Fleischer, process and apparatus for making steel; L. Sunderland, and G. C. Pillinger, electrical control of engines, dynamos and batteries; A. E. Tilburn, fountain brush; G. H. Robinson, packing for piston rods or the like; Samuel Aikins (re-issue), door knobs; J. H. Garbutt and W. J. Kemmis, seed covering attachment for drils; H. Brune and H. Horst, process of drying raw peat; W. H. Baxter, stone washing machinery; R. C. Quin, fenders for rolling stock; C. B. Redrup, fluid pressure engines or pumps.

MEETINGS.

At an address given before the Engineers' Society of the University of Manitoba, Hon. R. P. Roblin, honorary president, remarked that engineering is as old as history. We have records of magnificent engineering feats from the hanging walls of Babylon and the reclamation of the desert by the Pharaohs down to the present day. While the Province of Manitoba is at present handicapped from providing adequate facilities for education and instruction in your profession still you can now get the principles here as well as at any other university on the continent. A man may be graduated with honors but still be an absolute failure. The foundations necessary to a man are character and reputation. Have character as the keystone of your life's work. The opportunities in the west are many. Electricity is one of the greatest adjuncts of civilization, and its possibilities are illimitable, in which connection might be mentioned the great asset of water power which we have. There is a rich and fertile field before you.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

15788—January 12—Authorizing C.N.R. to open for carriage of traffic its line from Groose Isle, Man., to end of track, 31 miles, fencing, etc., to be completed by August 1, 1912.

15789—January 12—Authorizing G.T.R. to reconstruct bridge No. 39 at mileage 216.51, 18th District, over Pike's Creek, Ont.

15790—January 4—Authorizing C.N.O. Ry. to take property of Joanna Britnell, in City of Belleville, Ont., for diverting Bay Street.

15791—January 10—Authorizing C.P.R. to reconstruct bridge No. 43.8 on Farnham Subdivision, Montreal Terminals.

15792—January 13—Authorizing Government of British Columbia to construct highway crossing over track of Columbia & Western Ry. at Eholt, B.C.

15793—January 13—Authorizing C.P.R. to operate and construct spur for Standard Fish & Fertilizer Co., Calgary, Alta.

15794—January 11—Authorizing C.P.R. to construct its Kerrobert Northeasterly Branch across highways from mileage 1.52 to 19.16, Saskatchewan.

15795—January 12—Authorizing C.N.R. to use for construction purposes only until July 1, 1912, crossing with its Deslisle Extension of track of C.P.R. Moose Jaw-Lacombe Branch.

15796—January 11—Authorizing C.N.R. to construct spur into plant of Saskatoon Milling & Elevating Co., Saskatoon, Sask.

15797-98-99—January 15—Authorizing C.N.O. Ry. (Sudbury-Port Arthur Line and Montreal-Port Arthur Line) and approving locations through unsurveyed territory, District of Algoma, mileage 327 to 343.15 from Sudbury Jct., through Twps. of Nepean, March and Torbolton, County of Carleton, Ont., mileage 14.3 to 27 from Ottawa, and through Twps. of Ross, Westmeath and Pembroke, County Renfrew, Ont., mileage 67 to 83.45 from Ottawa.

15800—January 12—Authorizing City of Toronto to maintain wires across C.P.R. and G.T.R. and C.P.R. Tel. Co., also G.N.W. Tel. Co., at Queen Street, Toronto, Ont. Rescinding Order 13817, May 31, 1911.

15801—January 11—On Mond Nickel Co., Ltd., application authorizing C.P.R. to construct a public crossing at mileage 70.06 of its Cartier Subdivision, Ontario.

15802—January 11—Authorizing Canadian Copper Co. to construct spur across Algoma Eastern Ry. at grade and C.P.R. by overhead crossing, interlocking semaphores to be installed.

15803—January 15—Relieving C.P.R. from erecting and maintaining fences, cattle guards on Atlantic Division, between Woodstock and Andover, N.B.

15804—January 15—15805—January 16—Issuing certificate of correction to G.T.P.B.L. Co. correcting errors in locations of Biggar-Calgary Branch and Regina-Moosejaw Branch.

15806—December 21—Directing that G.T.R. install improved type of electric bell at Edward Street, Prescott, Ont., 20 per cent. from Railway Grade Crossing Fund.

15807—November 27—Authorizing C.N.O. Ry. to join with its line the tracks of Montreal Terminal Railway and C.N.Q. Ry. near Montreal, Que.

15808—November 17—Striking out words "at Vickers Street" in Order 15655 of December 20, 1911, City of Fort William and C.N.R. crossing.

15809—January 17—Authorizing C.N.R. Ry. to construct spur in town of Neepawa, Man.

15810—January 4—Dismissing application of Sanitaris, Ltd., of Arnprior, Ont., re express classification on returned empties.

15811—January 9—Authorizing C.P.R. to take certain lands in City of Toronto, and construct branch line to cross G.T.R. and join tracks used in common with G.T.R., also to cross Toronto Railway at Junction of Spadina Avenue and Front Street.

15812—January 18—Authorizing C.P.R. (Credit Valley Ry.) to construct spur into premises of Stone Fertilizer Co., Twp. of North Oxford, County of Oxford, Ont.

15813—January 16—15814—January 18—Approving plans of drain known as "A. Gilbert Drain" along right of way of M.C. Ry. to be constructed by Twp. of Southwold, Ont.; also plans and character of Chauvin Drain, under G.T.R. in Twp. of Tilbury North, Ont.