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ROSEDALE SECTION, BLOOR STREET VIADUCT

PORTION No. 2 OF THE PROPOSED $2,500,000 STRUCTURE TO BRIDGE THE DON AND ROSEDALE VALLEYS IN NORTHEAST TORONTO.

IN *The Canadian Engineer* for October 29th, 1914, a description was given of the larger section of the proposed viaduct to connect Danforth Avenue (east of the Don River) with Bloor Street, thereby linking it and the surrounding district with the older business thoroughfares of the city. While the article dealt chiefly with the design, executed by the Department of Works, for a 1,618-ft. section of the proposed development, it included an interesting summary of preliminary investigations of site and foundation tests. That portion, known as the Don section, was opened to tendering of both steel and concrete interests last July, and the tenders that have been under consideration have included five for steel and five for concrete. The concrete tenders were all based upon designs submitted by the contractors themselves, while the steel tenders were based upon the design of the Department of Works, described in the article referred to above. On Friday, December 11th, the city council awarded the contract for this section to Messrs. Quinlan & Robertson, Montreal, the price being $996,564.81, it being the lowest steel tender, although it was about $147,500 higher than the low tender for a concrete viaduct.

The Rosedale section of the project provides for the construction over the Rosedale Valley, to the northeast of the Parliament Street intersection with Bloor Street, and extends from the head of that street to Castle Frank Road, as shown in Fig. 2. The design calls for a steel structure 580 ft. in length with wing walls and approaches. A retaining wall 170 ft. long extending from the west abutment of the bridge toward Sherbourne Street, and on the north side, forms an interesting part of the design. The bridge itself includes a 190-ft., 3-hinged steel arch span with steel spandrels and with a 64-ft. rise. This arch is of the same type as the arches on the Don section, previously described. Similarly, there will be an 80-ft. span corresponding in design to that of the Don structure. The cross-section of the bridge is similar to that of the other section, having a total width of 86 ft. from the outer edge of the railing. The centre 22 ft. will be devoted to two street railway tracks. On either side the

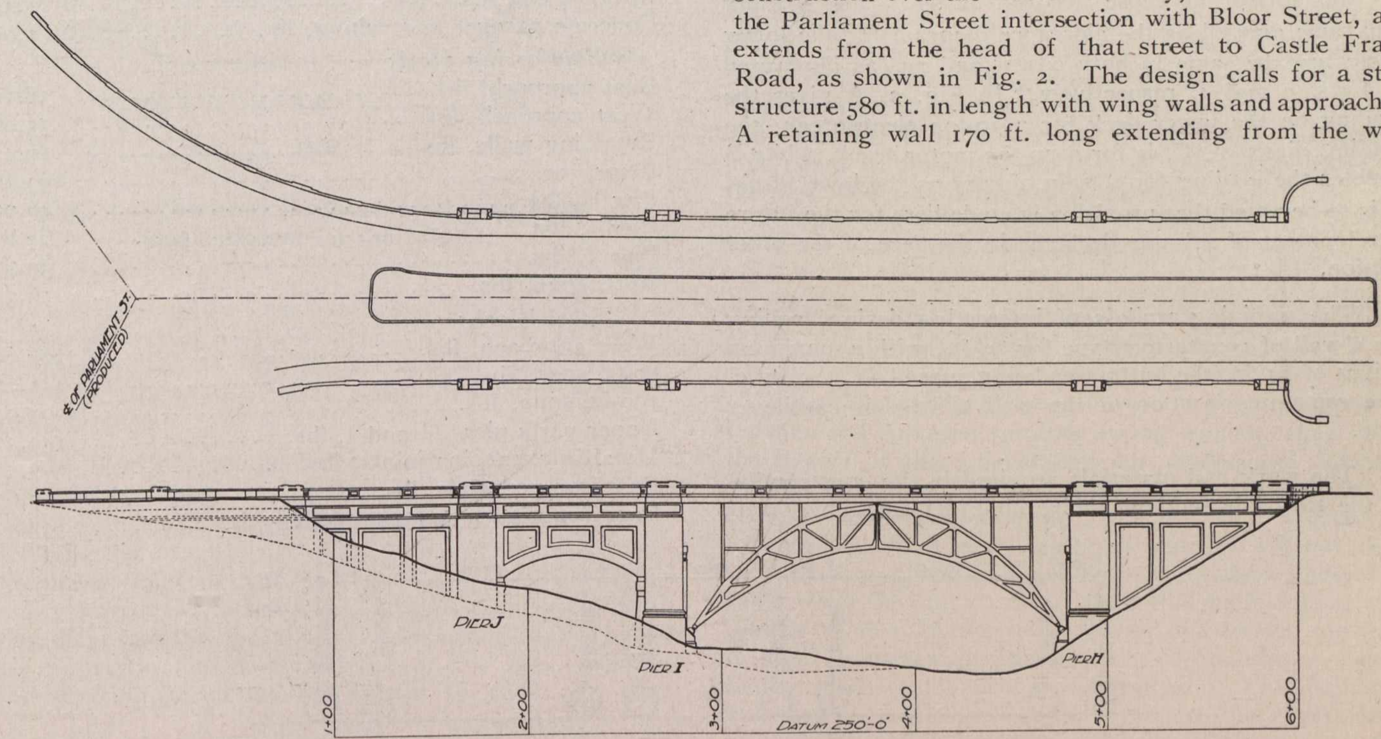


Fig. 1.—Plan and Elevation of the Proposed Rosedale Section of the Bloor Street Viaduct, Toronto.

design provides for a 20-ft. roadway, bordered on the outside by cantilevered sidewalks 10¾ ft. wide. The height of the roadway above the Rosedale Valley drive will be 94 ft. In many respects the general design of the Rosedale section corresponds to the design for the Don section. The specifications also are practically the same for the former as those for the latter. The loading diagrams as well as the clearance diagram for the lower deck, are the same in both cases, and are as illustrated in Figs. 3 and 4, respectively. In Fig. 3, A gives the loading on the upper deck for a 50-ton electric car; the loading diagram, C, is for a 20-ton motor truck, while B denotes the loading for a train of cars on the lower deck. It is to be noted that provision is made here for the future development of a lower deck, as in the case of the other section.

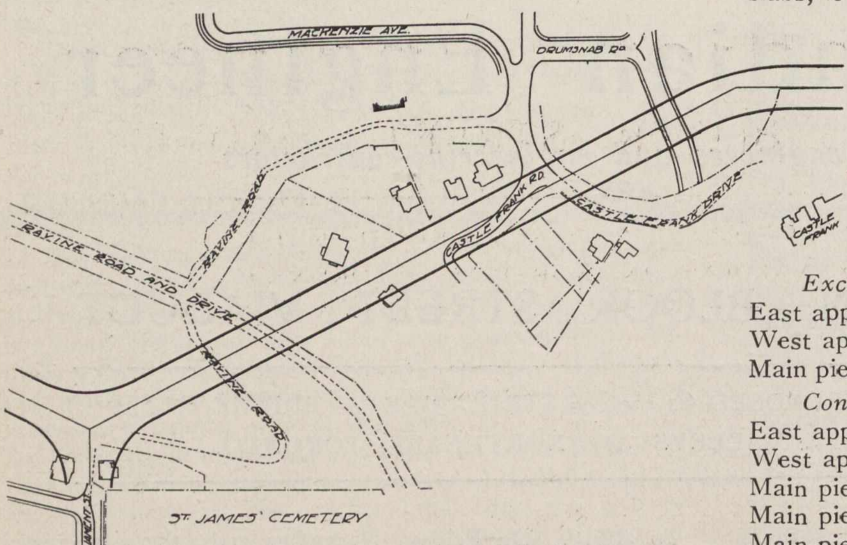


Fig. 2.—Location of Rosedale Section.

The retaining wall is of interesting design, calling for a wall of counterfort type for 69 ft., with a maximum height of 24 ft., the buttresses being spaced 15 ft. c. to c. The remaining portion of the wall will be of cantilever type.

The work and materials required in the construction of the Rosedale section involve about 31,100 cubic yards of excavation for the east and west approaches and for the piers. There will be about 16,900 cubic yards of concrete work in piers, approaches, retaining wall, floor slabs, etc. Reinforcing steel to the extent of about 486,000 pounds will be required, and the structural steel will have a weight of about 3,063,000 pounds. Provision for the lower deck of the Rosedale section (identical in cross-section to that proposed for the Don section) will require about 352,000 pounds of structural steel and 320 cubic yards of concrete. The engineer's estimate of quantities, in brief detail, is as follows:—

Excavation:	
East approach, cu. yds.	21,207
West approach, cu. yds.	1,819
Main piers, cu. yds.	8,082
Concrete:	
East approach, cu. yds.	[1]2,252
West approach, cu. yds.	[2]2,267
Main pier H, foundations, cu. yds.	1,847
Main pier H, body, cu. yds.	3,038
Main pier I, footing, cu. yds.	829
Main pier I, body, cu. yds.	2,610
Main pier I, top, cu. yds.	305
Main pier J, footing, cu. yds.	610
Main pier J, body, cu. yds.	1,540
Main pier J, body, cu. yds.	1,540
In floor, cu. yds.	[3]1,450
Concrete parapet and railing, lin. ft.	1,089
Reinforcing Steel:	
East approach, lbs.	38,100
West approach, lbs.	35,060
Retaining walls, lbs.	19,430
Floor, lbs.	193,260
Pier H, lbs.	46,090
Pier I, lbs.	64,890
Pier J, lbs.	39,970
80-ft. span, lbs.	16,310
Steel Work:	
West approach, lbs.	306,600
80-ft. span, lbs.	451,770
190-ft. span, lbs.	1,501,040
Upper parts piers H and I, lbs.	143,300
Metal in expansion joints, lbs.	7,300
Cast iron pedestals, lbs.	7,600
Cast iron gullies and catch-basins, lbs.	32,300

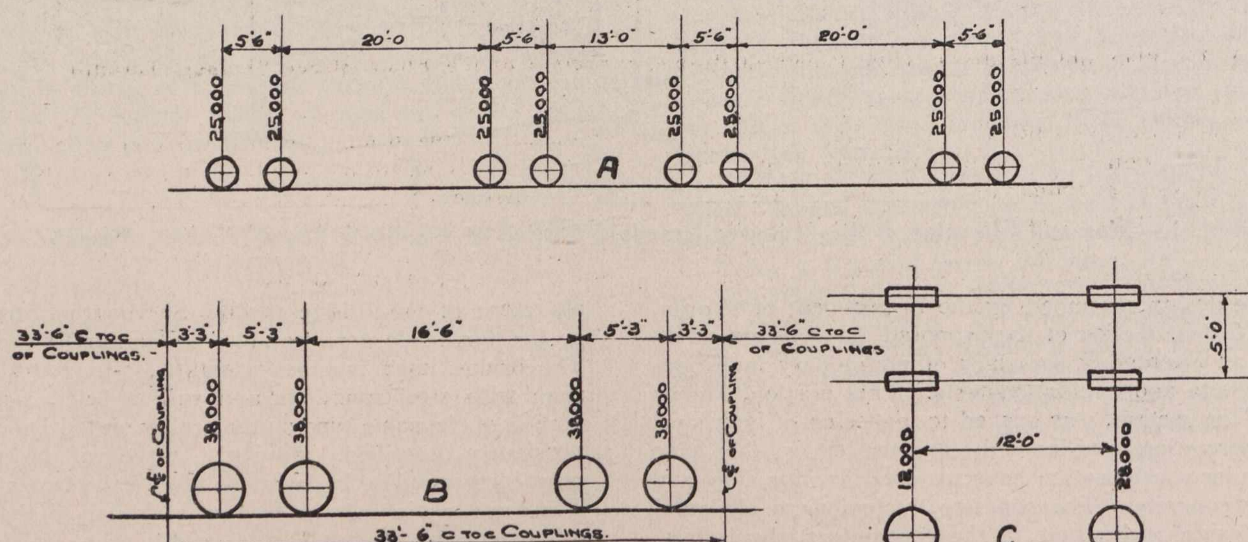


Fig. 3.—Loading Diagrams for Cars and Motor Trucks.

Waterproofing:

Track allowance, membrane and mastic, sq. yds.	1,306
Roadway, felt and waterproofing compound, sq. yds.	2,578
Back of retaining wall, sq. yds.	460
Granite bearings for 190-ft. span, cu. ft.	455

[1]Of this total 228 cu. yds. is in footings for east abutment, 970 cu. yds. is in body of abutment and wing walls, 221 cu. yds. is in north longitudinal walls and 324 cu. yds. in a cross-wall above footings. [2]This includes 620 cu. yds. in body of west abutment, 320 cu. yds. in longitudinal walls, 190 cu. yds. in soffit of 80-ft. span and 284 cu. yds. in side walls of 80-ft. span. [3]Of this 1,257 cu. yds. is floor slab.

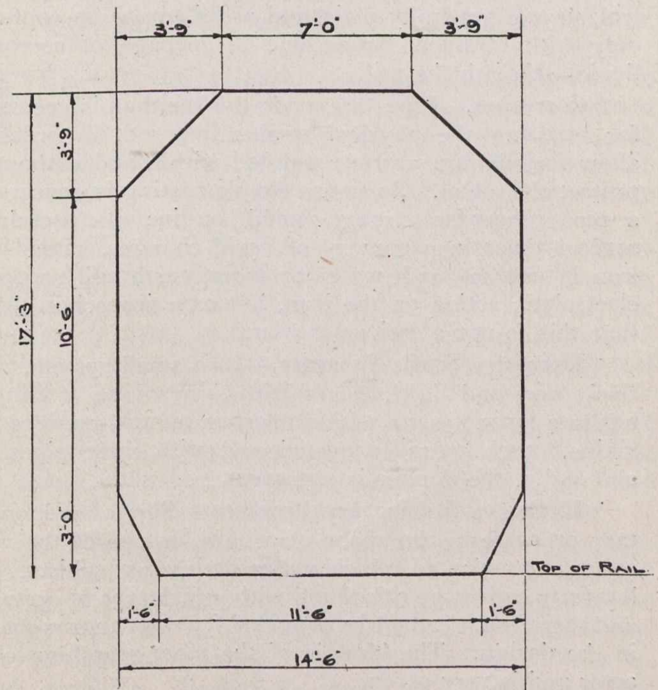


Fig. 4.—Clearance Diagram for Lower Deck (contemplated for the future).

The material required for the lower deck includes the following:—

Steel in stringers, floor-beam stiffeners and anchor bolts, lbs.	352,000
Concrete in slabs, cu. yds.	316
Steel reinforcement in slabs, lbs.	32,300
Hook bolts in slabs, lbs.	550
Cast iron gullies and shoes, lbs.	11,800
Waterproofing, membrane and mastic, sq. yds.	510

Tenders for the Rosedale section were advertised for early in November and will be received up to December 21st, 1914. As in the case of the Don section, bids for steel will be accepted on the plan of the Department of Works, as described herein, and also on a reinforced concrete structure, in which case the tenderer will submit his own plans and specifications.

Among the latest incorporations is that of the Walkerville Roofing Mfg. Co., Limited, capitalized at $60,000. Messrs. J. T. Sullivan, L. H. and C. J. Cheesement are associated with the new concern.

FLOW OF STEAM THROUGH PIPES.

There is perhaps no phase of power-plant design in which the rule-of-thumb methods are still adhered to so commonly as in the determination of the proper size of steam pipes.

Several reasons are attributed by "Power" to this: The commonly accepted formulas are complex, are not any too well substantiated by experimental data nor based on sound theory; the tables given by various writers are incomplete and inconvenient. The engineer who installs pipes which are too large will seldom be criticized, for the mistake shows but slightly in the first cost of the entire plant and the large radiation losses remain unnoticed. Many designers overestimate the importance of keeping the pressure drop in the lines low. Loss of pressure in a pipe line carrying any fluid is due to friction, and results in the transformation of energy of motion of the fluid as a whole into molecular energy or heat. In a water line this heat is usually a total loss, but with steam flowing in well covered pipes most of this heat is carried on with the steam, raising its temperature or its quality. Thus, instead of being able to figure the percentage loss of power as being equal to the percentage of pressure, as is usually true for water or electricity, the loss is materially reduced by the return of the heat to the steam. Or, the total energy of each pound of steam just after entering the pipe is, heat energy + pressure × volume energy + energy of velocity along the pipe.

Before leaving the pipe the heat energy has been drawn upon to increase the volume and also to increase the velocity of the steam, while at the same time the friction has been absorbing a part of the energy of velocity and returning it in the form of heat energy. So, if the pipe could be perfectly insulated all the energy entering the pipe would be delivered at the other end.

CANADIAN PATENTS OWNED BY GERMAN AND AUSTRIAN SUBJECTS.

The following is a list of Canadian patents issued to German and Austrian subjects during August, 1914. For the import of this information our readers are referred to *The Canadian Engineer* for October 29, 1914, page 589. In connection with the following list it is essential to note that the Commissioner of Patents will not void any of these patents, but will grant licenses under the same when the applicant can show that he is willing and intends to manufacture the invention in Canada, and that it is in the interest of Canada, part of Canada, or a particular trade that a license be granted. The applicant will also be required to pay a royalty to the government of probably about 5 per cent. of the selling price of the article.

157216, Aug. 4, 1914—Friction coupling. (Hungary.)

157219, Aug. 4, 1914—Fuse.

157221, Aug. 4, 1914—Type setting and distributing machine.

157236, Aug. 4, 1914—Iron manufacture.

157246, Aug. 4, 1914—Bicycle alarm.

157396, Aug. 18, 1914—Acid converting process.

157402, Aug. 18, 1914—Method of producing chemical reactions in gases.

We are indebted to Ridout and Maybee, Toronto, for the above list.

CAUSES OF BREAKS IN WATER MAINS.

THE annual report of the City of Chicago for 1913 contains the results of an investigation made by Mr. Claude E. Fitch, assistant mechanical engineer, into the causes of breaks in the city's water mains. Many breaks have occurred during past years, but no attempt had been made, until 1912, to discover the cause. Mr. Fitch's findings are very interesting, and are abstracted below. The causes of breaks were ascribed to improper design, poor material, improper handling and installation, soil movements, jarring from traffic, frost, temperature changes, electrolysis, corrosion, excessive static pressure, excessive momentary pressure, periodic pressure waves and extraordinary causes. Explanations of these causes are given as follows:

Improper Design.—For the design of pipe there are numerous formulas giving very nearly the same results, as much the result of experience as theory, and generally considered satisfactory. For the design of valves and special fittings, theory and practice are not so far advanced, but there is not much danger of breaking and such as there may be is more likely to occur at the time the first test is made.

Poor Material.—All reputable builders and nearly all large users employ inspectors who may be reasonably depended on as conscientious in their work. Measurement, superficial inspection, pressure test, hammer test and the breaking of a test bar are the methods usually employed. Chemical tests have their value, but are not so universally used.

Improper Handling and Installation.—A pipe otherwise good may be badly damaged by mishandling in transit or in laying, and thus weakened so as to be unserviceable; or it may be improperly caulked.

Subsidence or Rise of Soil.—Assuming that the pipe has been properly laid, then the soil might be disturbed in one of several ways. Parallel trenches, heavy buildings nearby or the construction of tunnels and subways may so displace soil as to cause leaks or breaks.

Jarring from Traffic.—Where pipes pass through railroad embankments or under street railways or in streets subject to heavy traffic, there is not only displacement of soil from the weights above, but also jars are transmitted to the pipe. Where the displacement is considerable, the danger to the pipes is the same as described in the previous paragraph. The jarring may break a brittle pipe, but the more probable trouble is at the caulking, where the lead is continually deformed by the slight motion, until no longer tight. The resulting leakage causes softening of the soil, making further displacement probable.

Frost.—Under ordinary conditions, this is little to be feared in large mains, as the depth to which the ground freezes in severe winters has been determined by observations extending over many years. Further, the water is scarcely ever below 39 degrees F. in temperature, and if flowing will ordinarily not freeze solid. Troubles from frost are ordinarily confined to smaller mains and service pipes.

Temperature Changes.—The range of temperature of water in mains is not very great, probably 25 degrees, but this is enough to cause a measurable amount of expansion. Expansion or contraction of metals is exerted with great force; almost invariably enough to cause endwise motion of the pipe against the friction of the surrounding soil. This motion is undoubtedly taken up in the more loosely caulked joints, causing them to become more loose and to leak a little. This ability to move slightly at the joints is the reason for the use of the bell and spigot joints, rather than bolted joints.

A more serious phase of this condition may occur at a tightly caulked joint where the cast iron of the bell is first severely strained by the excessive caulking. Should this caulking be done in cold weather, the later expansion of the lead, being several times as great as that of cast iron, may cause sufficient additional strain to rupture the bell.

Electrolysis.—The evidences of damage by electrolysis are generally plain and are likely to be confused only with chemical action due to seepage of corrosive liquids through the soil.

Corrosion.—Pipes are made thicker than is necessary for resisting the physical strains imposed, in order to allow for rusting, and are painted within and without to protect the metal. So far as simple rusting is concerned, a pipe otherwise strong would outlive its usefulness several times in a country of rapid changes. Lead and iron in contact with water or moist earth will cause an electrolytic action on the iron, but experience has shown that this is not a serious matter.

Excessive Static Pressure.—In a small system, relatively new and tight, this might be a source of danger, but in a large system with numerous pumps, engines and mains, much cross connected and with some pipes old and leaky, the danger is not great.

Excessive Momentary Pressure.—Shock, or momentary pressure in the shape of a blow, is one of the most serious troubles to which water mains are subject. Its intensity cannot be calculated with any degree of certainty and therefore it cannot be provided for even approximately in the design. The blow is of the most searching character and is very severe.

Pulsation from pumps is one cause to be considered and may be classed under the head of water hammer. Under this name the effect has been extensively studied.

Periodic Pressure Waves.—Injury from this cause is comparatively infrequent, but may be quite serious, and its way of action is not so easily discovered. Should a pipe receive a set of pressure waves in tune with its natural period of vibration, it will vibrate with increasing force, possibly until it is ruptured, unless stopped by friction.

Extraordinary Causes.—These include explosions and blasting, earthquakes, lightning, intentional injury and possibly the breakdown of a heavy truck above.

An analysis of the list of breaks in Chicago during 1912 showed 42 joint leaks, 3 broken valves and 2 burst pipes. The valves were all three of an ancient type of poor design. No cause was discovered for the bursting of the pipes, although irregular cooling strains were indicated in one case. Of the joint leaks, one was under a railroad embankment and was probably due to the jar of trains and subsidence of the soil. Four were under street tracks where heavier cars have recently been run than previously. A large number were discovered in the spring and early summer after a very severe winter, and temperature changes may have been partly responsible.

But the majority of these leaks were within a mile or so of the Fourteenth street pumping station. This station differs from the Harrison street one only in one pump—the other pumps are exactly similar in the two stations. This pump has twice the rated capacity of the others, a relatively lighter flywheel, and only one air chamber, which is on the pipe line, while the other pumps have a large air chamber for each plunger. Moreover, the check-valve is placed between the air chamber and the water main. It was therefore concluded that the greater part of the joint leaks were caused by some derangement of the action of this pump, which transmitted pulsations to the mains, possibly assisted by temperature changes and soil movements.

PROPOSED STANDARD SPECIFICATIONS FOR ONE-COURSE CONCRETE HIGHWAY.

THE following specifications have been submitted to the members of the American Concrete Institute to be given their consideration prior to the coming Convention of the Institute to be held in Chicago in February. Many interesting and useful points are contained therein, as indicated below:

Materials.—1. The cement shall meet the requirements of the Standard Specifications for Portland Cement, adopted by the American Society for Testing Materials, August 16, 1909, with all subsequent amendments and additions thereto adopted by said Society, and adopted by this Institute (Standard No. 1).

When the cement is not inspected at the place of manufacture it shall be stored a sufficient length of time to permit of inspecting and testing. The engineer shall be notified of the receipt of each shipment of cement.

2. Fine aggregate shall consist of sand or screenings from clean, hard, durable, crushed rock or gravel consisting of quartzite grains or other equally hard material graded from fine to coarse, with the coarse particles predominating and passing, when dry, a screen having ¼-inch openings. It shall be clean, hard, free from dust, loam, vegetable, or other deleterious matter. Not more than twenty (20) per cent. shall pass a sieve having fifty (50) meshes per linear inch, and not more than five (5) per cent. shall pass a sieve having one hundred (100) meshes per linear inch.

Fine aggregate containing more than three (3) per cent. of clay or loam shall be washed before using.

Fine aggregate shall be of such quality that the mortar composed of one (1) part Portland cement and three (3) parts fine aggregate by weight, when made into briquettes, shall show a tensile strength at least equal to the strength of 1 to 3 mortar of the same consistency made with the same cement and Standard Ottawa sand.

In no case shall fine aggregate containing frost or lumps of frozen material be used.

3. Coarse aggregate shall consist of clean, hard, durable, crushed rock or gravel, graded in size, free from dust, loam, vegetable, or other deleterious matter, and shall contain no soft, flat or elongated particles. The size of the coarse aggregate shall be such as to pass a one and one-half (1½- inch round opening and be retained on a screen having one-quarter (¼) inch openings. In no case shall coarse aggregate containing frost or lumps of frozen material be used.

4. Natural mixed aggregate shall not be used as it comes from deposits, but shall be screened and used as specified.

5. Water shall be clean, free from oil, acid, alkali, or vegetable matter.

6. Reinforcement.—Concrete pavements twenty (20) feet or more in width shall be reinforced with metal fabric. All reinforcement shall be free from excessive rust, scale, paint, or coatings of any character which will tend to destroy the bond. All reinforcement shall develop an ultimate tensile strength of not less than 70,000 pounds per square inch and bend 180 deg. around one diameter and straighten without fracture.

7. Joint filler shall consist of prepared felt or similar material of approved quality having a thickness of not less than ⅛ nor more than ¼ in.

8. Joint Protection Plates.—Soft steel plates for the protection of the edges of the concrete at transverse joints shall be not less than 2½ in. in depth and not less than ⅛ in. at any point nor more than ¼ in. in average thickness. The plates shall be of such form as to provide for rigid anchorage to the concrete. The type and method of installation of joint protection plates shall be approved by the engineer.

9. Shoulders.—Materials for the construction of shoulders shall be approved by the engineer.

Grading.—10. The term "grading" shall include all cuts, fills, ditches, borrow pits, approaches and all earth moving for whatever purpose, where such work is an essential part of or necessary to the prosecution of the contract. When to bring the surface to grade, a fill of one (1) foot or less is required, the area shall be thoroughly grubbed. All soft, spongy or yielding spots and

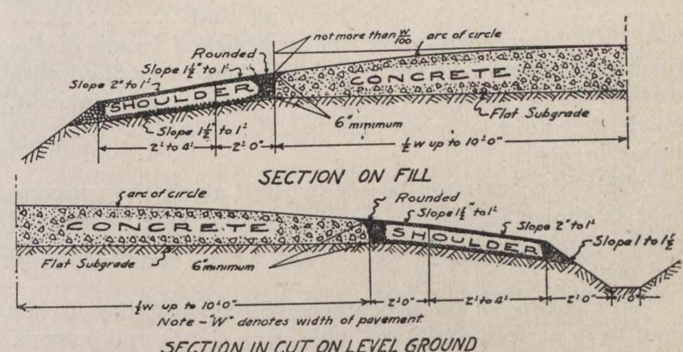


Fig. 1.—One-course Concrete Highway—Sections on Fill and in Cut.

all vegetable or other objectionable matter shall be removed and the space refilled with suitable material.

11. Stakes will be set by the engineer for centre line, side of slopes, finished grade and other necessary points properly marked for the cut or fill.

12. Excess material shall be disposed of as directed by the engineer, the free haul not to exceed........feet.

13. Over-haul.—Materials hauled a greater distance than the free haul from the place of excavation shall be paid for at the rate of................cents per cubic yard for each additional................feet.

14. Fills.—Embankments shall be formed of earth or other approved materials and shall be constructed in successive layers, the first of which shall extend entirely across from the toe of the slope on one side to the toe of the slope on the other side, and successive layers shall extend entirely across the embankments from slope to slope. Each layer, which shall not exceed one (1) foot in depth, shall be thoroughly rolled with a roller weighing not less than five (5) tons nor more than ten (10) tons before the succeeding layer is placed. The roller shall pass over the entire area of the fill at least twice.

The sides of the embankment shall be kept lower than the centre during all stages of the work, and the surface maintained in condition for adequate drainage. The use of muck, quicksand, soft clay or spongy material which will not consolidate under the roller, is prohibited.

When the material excavated from cuts is not sufficient to make the fills shown on the plans, the contractor shall furnish the necessary extra material to bring the fills to the proper width and grade. When the earth work is completed the cross-section of the road shall conform to the cross-sectional drawings and profile shown in Fig. 1.

15. All slopes shall be properly dressed to lines given by the engineer.

16. Finished Grade.—When grade line is approached, the final grade stakes will be set, for which sufficient notice must be given to the engineer. (In excavating cuts, it is considered advisable, when the line of the sub-grade is approached, to compact the remaining material by rolling. The depth of material left in the cut to be compressed to the finished grade by rolling will depend upon the character of the material.)

17. Drainage.—The contractor shall construct such drainage ditches as will insure perfect sub- and surface-drainage during construction and such work shall be completed to the satisfaction of the engineer, prior to the preparation of the roadbed as herein specified.

Tile drains shall be placed as shown in the drawings attached hereto. Tile to be laid in the trench at least ....(........) inches wide and .... (........) feet deep below the established grade of the finished pavement. Such trench shall be back filled with crushed stone or pit run gravel, with sand removed, which after light tamping shall be ....(........) inches in depth.

Open ditches must be constructed along the concrete road as shown in Fig. 1, the dimensions, side slopes and grade of said ditches being as shown on the cross-section and profile.

At the time of the acceptance of the road, the ditches must be in perfect condition, with clean slopes and bottom, containing no obstructions to the flow of water.

Sub-grade.—18. Construction.—The bottom of the excavation or top of the fill, when completed, shall be known as the sub-grade, and shall be at all places true to the elevation as shown on the plans attached hereto.

The roadway shall be graded to the proper sub-grade to permit of the specified thickness of paving materials being laid to bring the finished surface of the pavement to the lines and grades as shown on the plans.

The sub-grade shall be brought to a firm, unyielding surface by rolling the entire area with a self-propelled roller weighing not less than ten (10) tons, and all portions of the surface of the sub-grade which are inaccessible to the roller shall be thoroughly tamped with a hand tamp weighing not less than fifty (50) pounds, the face of which shall not exceed 100 square inches in area. All soft, spongy or yielding spots and all vegetable or other objectionable matter shall be entirely removed and the space refilled with suitable material.

Where considered necessary or of assistance in producing a compact, solid surface, the sub-grade before being rolled shall be well sprinkled with water.

When the concrete pavement is to be constructed over an old roadbed composed of gravel or macadam, and the concrete is to be wider than the old gravel or macadam road, the latter shall be entirely loosened and the material spread for the full width of the roadbed and rolled. All interstices shall be filled with fine material, and rolled to make a dense, tight surface of the roadbed.

19. Acceptance.—No concrete shall be deposited upon the sub-grade until it is checked and accepted by the engineer.

20. Completion.—Upon the sub-grade thus formed shall be laid the concrete pavement as shown in Fig. 1.

Forms.—21. Materials.—The forms shall be free from warp, of sufficient strength to resist springing out of shape, and shall be equal in width to the thickness of the pavement at the edges. Wooden forms shall be of not less than two (2) inch stock and shall be capped with two (2) inch angle iron.

22. Setting.—The forms shall be well staked or otherwise held to the established line and grades, and the upper edges shall conform to the established grade of the road.

23. Treatment.—All mortar and dirt shall be removed from the forms that have previously been used.

Pavement Section.—24. Width, Thickness of Concrete and Crown.—The concrete pavement shall be...... ......feet wide,............(......) inches in depth at centre, and............(........) inches in depth at the sides. The finished surface shall conform to the arc of a circle, as shown on Fig. 1.

Note.—Crown shall be not more than one-one-hundredth (1/100) of the width. The thickness of the concrete at the edges shall not be less than six (6) inches.

Joints.—25. Width and Location.—Transverse joints shall be not less than one-quarter (¼) inch nor more than three-eighths (⅜) inch in width and shall be placed across the pavement perpendicular to the centre line, not more than 35 feet apart. When a curb is specified or where pavement abuts a building a joint not less than one-quarter (¼) inch wide shall be placed between it and the pavement. All joints shall extend through the entire thickness of the pavement and shall be perpendicular to its surface.

26. Protection of Joints.—The concrete at transverse joints shall be protected with soft steel joint protection plates which shall be rigidly anchored to the concrete. The installation of the metal protection plates shall meet with the approval of the engineer. The surface edges of the metal plates shall conform to the finished surface of the concrete, as shown in Fig. 1.

All joints over one-quarter (¼) inch high or one-half (½) inch low shall be removed.

27. Joint Filler.—All joints shall be formed by inserting during construction and leaving in place the required thickness of joint filler which shall extend through the entire thickness of the pavement.

Measuring Materials and Mixing Concrete.—28. Measuring.—The method of measuring the materials for the concrete, including water, shall be one which will insure separate and uniform proportions of each of the materials at all times. A bag of Portland cement (94 lbs. net) shall be considered one (1) cubic foot.

29. Mixing.—The materials shall be mixed to the desired consistency in a batch mixer of approved type, and mixing shall continue for at least forty-five (45) seconds after all materials are in the drum. The drum shall be completely emptied before mixing successive batches. The drum of the mixer used shall revolve at a speed not less than the minimum nor more than the maximum number of revolutions shown in the following table:

Rated capacity, cu. ft. unmixed material.	Capacity, bags of cement in 1 : 2 : 3 mix.	Revolutions per minute of drum. Min.	Max.
7 to 11	1	15	21
12 to 17	2	12	20
18 to 23	3	12	20
24 to 29	4	11	17
30 to 33	5	10	15

30. Retempering of mortar or concrete which has partially hardened, that is, mixing with additional materials or water, shall not be permitted.

31. Proportions.—The concrete shall be mixed in the proportions of one (1) bag of Portland cement to not more than two (2) cubic feet of fine aggregate and not more than three (3) cubic feet of coarse aggregate, and in no case shall the volume of the fine aggregate be less than one-half (½) the volume of the coarse aggregate.

A cubic yard of concrete in place between neat lines shall contain not less than one and seven-tenths (1.7) barrels of cement.

The engineer shall compare the calculated amount of cement required according to these specifications and plans attached hereto with the amounts actually used in each section of concrete between successive transverse joints, as determined by actual count of the number of bags of cement used in each section. If the amount of cement used in any three adjacent sections (between transverse joints) is less by two (2) per cent., or if the amount of cement used in any one section is less by five (5) per cent., than the amount hereinbefore specified, the contractor agrees to remove all such sections and to rebuild the same according to these specifications at his expense.

32. Consistency.—The materials shall be mixed with sufficient water to produce a concrete which when deposited will settle to a flattened mass, but shall not be so wet as to cause a separation of the mortar from the coarse aggregate in handling.

Reinforcing.—33. Concrete pavements twenty (20) feet or more in width shall be reinforced. The cross-sectional area of the reinforcing metal running parallel to the centre line of the pavement shall amount to at least 0.038 square inch per foot of pavement width and the cross-sectional area of reinforcing metal, which is perpendicular to the centre line of the pavement, shall amount to at least 0.049 square inch per foot of pavement length.

Reinforcing metal shall not be placed less than two (2) inches from the finished surface of the pavement and otherwise shall be placed as shown on the drawings. The reinforcing metal shall extend to within two (2) inches of all joints, but shall not cross them. Adjacent widths of fabric shall be lapped not less than four (4) inches.

Placing Concrete.—34. Immediately prior to placing the concrete, the sub-grade shall be brought to an even surface. The surface of the sub-grade shall be thoroughly wet when the concrete is placed.

After mixing, the concrete shall be deposited rapidly in successive batches upon the sub-grade prepared as hereinbefore specified. The concrete shall be deposited to the required depth and for the entire width of the pavement, in a continuous operation, between transverse joints without the use of intermediate forms or bulkheads.

In case of a breakdown concrete shall be mixed by hand to complete the section or an intermediate transverse joint placed as hereinbefore specified at the point of stopping work. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used in the work.

35. Finishing.—The surface of the concrete shall be struck off by means of a template or strike board which shall be moved with a combined longitudinal and crosswise motion. When the strike board is within three (3) feet of a transverse joint it shall be lifted to the joint and the pavement struck by moving the strike board away from the joint; any excess concrete shall be removed. Concrete adjoining the metal protection plates at transverse joints shall be dense in character and any holes left by removing any device used in installing the metal protection plates shall be immediately filled with concrete.

After being brought to the established grade with the template or strike board, the concrete shall be finished from a suitable bridge, no part of which shall come in contact with the concrete. The concrete shall be finished with a wood float in a manner to thoroughly compact it and produce a surface free from depressions or inequalities of any kind. The finished surface of the pavement shall not vary more than one-quarter (¼) inch from the true shape.

The edges of the pavement shall be rounded as shown in Fig. 1.

Curing and Protection.—36. Excepting as hereinafter specified, the surface of the pavement shall be sprayed with water as soon as the concrete is sufficiently hardened to prevent pitting, and shall be kept wet until an earth covering is placed. As soon as it can be done without damaging the concrete, the surface of the pavement shall be covered with not less than two inches of earth or other material which will afford equally good protection, which cover shall be kept moist for at least ten (10) days. When deemed necessary or advisable by the engineer, freshly laid concrete shall be protected by a canvas covering until the earth covering can be placed.

It at the time the pavement is laid or during the period of curing the temperature during the daytime drops below 50 degrees Fahrenheit, sprinkling and covering of the pavement shall be omitted at the direction of the engineer.

Under the most favorable conditions for hardening, in hot weather, the pavement shall be closed to traffic for at least fourteen (14) days, and in cool weather for an additional time, to be determined by the engineer.

The contractor shall erect and maintain suitable barriers to protect the concrete from traffic, and any part of the pavement damaged from traffic or other causes occurring prior to its official acceptance, shall be repaired or replaced by the contractor at his expense in a manner satisfactory to the engineer.

Before the pavement is thrown open to traffic the covering shall be removed and disposed of as directed by the engineer.

37. Temperature Below 35 Degrees Fahrenheit.—Concrete shall not be mixed or deposited when the temperature is below freezing.

If at any time during the progress of the work the temperature is, or in the opinion of the engineer will within twenty-four (24) hours drop to 35 degrees Fahrenheit, the water and aggregates shall be heated and precautions taken to protect the work from freezing for at least ten (10) days. In no case shall concrete be deposited upon a frozen sub-grade.

Shoulders.—38. Construction.—Where shoulders are required they shall be built upon the properly prepared sub-grade, as shown on the cross-sectional drawing, Fig. 1. The work shall be done to the entire satisfaction of the engineer.

ADDITIONAL POWER FOR KINGSTON, ONT.

The Public Utilities Commission is considering an offer from the Gananoque Electric Light and Power Company for the supply of a large block of power, presumably from the development at Kingston Mills on the Rideau. Mr. F. A. Gaby, chief engineer of the Hydro-Electric Power Commission of Ontario has been consulted regarding the technical features of the proposition. At present the Kingston Street Railway Company consumes 51 per cent. of the city's existing output, which it obtains at a rate of 1 2-5 per k.w. hr.

USES FOR POWER FROM IRRIGATION DAMS.*

THE question may be asked, What is the best use to make of electric power which is developed by water for irrigation? Irrigation dams are usuolly situated at considerable distances from cities and other centres where electric current is wanted for lighting, tramways, and motive power. Although electric transmission of power is efficient, a long distance transmission line is expensive to construct and maintain, and even in countries where there is no trouble with ice and snow, there are the risks of stoppage due to wind and dust storms, bush fires, etc.

When estimating the supply available from a given source for domestic purposes, only the minimum flow can be reckoned upon, if risk of shortage is to be obviated. Therefore, for a domestic supply of electricity all surplus between the minimum and the maximum flow is wasted, so far as power is concerned, and expensive spill-weirs and channels have to be provided.

Clearly, it is wise to make use of the electric power as near to where it is generated as possible, also for operations which use the same power right through the 24 hours, but which can be temporarily suspended if need be.

When the Assuan dam comes to be harnessed a part of the power is to be transmitted about 30 miles and used for pumping. Assuan presents considerable difficulties, because, in the first place, it is not easy to select an industry to be pursued which could utilize power that varies between 100,000 h.p. and 10,000 h.p.; also during the greater part of the year the climate at Assuan is extremely hot, and it is, therefore, difficult to develop large manufacturing industries in such a climate.

When the Trawool dam scheme was being considered a suitable use for the power appeared to be to transmit it to the cities of Ballarat, Bendigo, and Melbourne for a domestic supply. The great advances of the last few years of electro-chemistry and metallurgy have, however, changed the situation considerably. During this period of eight years many new industries which utilize large quantities of cheap electrical power have safely passed the experimental stage, and a single factory making fertilizers could now easily utilize the entire output of the water power, and with an absolute certainty of selling the product without disturbing prices. The tendency is now to establish electro-chemical and metallurgical factories close to the power, and to dispense with transmission lines; also to work the water power and the factory together, arranging the output of the one to meet the demand of the other so that the utmost use can be made of the water available. When that is done surplus water need not be wasted, and under certain conditions the whole mean annual rainfall may be reckoned upon after allowing for evaporation.

The following are some of the new electrical industries which require large quantities of electrical power at low cost: (1) Manufacture of nitric acid from atmospheric nitrogen in electric furnace by the direct method. (2) Making nitrogenous and phosphate nitrogenous fertilizers by the direct process. (3) Manufacture of calcium carbide for acetylene lighting. (4) Manufacture of calcium cyanamide fertilizer from calcium carbide. (5) Electric reduction of iron and steel. (6) Making alkali from salt by the electrolysis. (7) Making aluminum from bauxite. (8) Making carborundum for use as an abrasive. (9) Making graphite in the electric furnace. (10) Melting concentrates. (11) Treating refractory zinc ores, etc.

Some of these industries have to be carried on continuously, as, for example, the manufacture of calcium carbide and calcium cyanamide, the reduction of iron and steel, and the making of aluminum, etc. The cost of stoppage and restarting is excessive in all smelting and allied operations. On the other hand, some of the industries, such as fixation of atmospheric nitrogen by the direct process, can be worked intermittently. The manufacture of graphite can also be carried on intermittently.

Where the water can only be used for a portion of the year, the problem is to fix upon some particular industry which can utilize power intermittently, and will permit of changes in the amount of labor employed, without undue additional expense. Also, the product must be such that it has a widespread market, so that when it is turned out in considerable quantities it does not upset prices. At the same time it should be capable of being conveniently stored at times when the output may temporarily exceed the demand. The manufacture of fertilizers from atmospheric nitrogen by the direct furnace process meets all these conditions, and is, therefore, ideal. Not only can the process be carried out intermittently, but the demand is practically unlimited, for to be continuously productive all soil requires plant foods. The most direct and simple method to make fertilizer is to blow air through an electric arc flame so as to form nitric oxide gas. In the presence of oxygen this changes to nitrogen peroxide, which, when brought into contact with water, produces nitric acid. If lime is acted on by this dilute nitric acid a nitrogenous fertilizer called calcium nitrate, containing 12¾ per cent. of nitrogen, is produced. Large quantities of this fertilizer are made in Norway, and it is finding its way to the fruit lands of California and to other parts of the Pacific in competition with sodium nitrate and sulphate of ammonia.

A valuable fertilizer can be made by grinding up phosphate rock and mixing it with water to the consistency of cream. When the gas from the furnace is passed through this it changes the phosphate into the citric soluble state, so making it valuable as phosphate fertilizer. At the same time the lime is acted upon and takes up nitrogen, so that the fertilizer contains two out of the three principal plant foods. The phosphate of basic Bessemer slag is in the soluble condition, and is very largely used as a phosphate fertilizer, but the slag from some open-hearth steel furnaces is largely insoluble, and so the phosphate is not in a form in which it is immediately available for agriculture. This waste basic slag is being produced in Middlesborough alone at the rate of 150,000 tons a year. With the aid of the electric furnace it may be possible in the future to turn it to good account. The direct method of making fertilizers has reached enormous proportions in Norway. One factory utilizes 140,000 h.p., which is generated by a water-power at Rjukan, while another factory to utilize 120,000 h.p. is being equipped. About $40,000,000 is invested in the business in Norway alone.

* Abstracted from a paper by E. Kilburn Scott before the British Association, Australian meeting, August, 1914.

Mayor H. C. Hocken, of Toronto, and several of the officials of the works department will represent the city at the fifth American Good Roads Congress in Chicago this week.

The MacArthur Concrete Pile and Foundation Company has appointed the Douglas Milligan Company as their sales agents for Eastern Canada, with main office in the New Birks Building, Montreal, and branch office at 95 King Street East, Toronto.

NEW ASPHALT PLANT AT MONTREAL.

By Daniel J. Hauer, C.E.

THE need of the proper kind of a modern asphalt plant in many Canadian cities has been made very evident to the writer in his visits to the eastern part of the Dominion during the past few years. The newest municipal asphalt plant recently put in use in Montreal is therefore of interest, and admits of the following description:

Tenders were submitted to the city upon plans and a general arrangement specifying size and capacity, together with a set of specifications showing the quality of materials, etc., gotten up by the chief engineer of Road Department of Montreal. The contractors had to design the building and plant, also provide a set of specifications for the building and machinery, all of which were to be approved by the city. The successful bidders for the job were Warren Bros. Company, of Boston, Mass.

The Building.—The plant is located in the Road Dept. yard in the north end of the city. The building, as shown in Fig. 1, is built of structural steel with corrugated sides and roof. The main part of the structure is of two stories with a tower on each end of an additional story for the hot storage bins for sand and stone. In the rear, in a 1-story addition, is the boiler and engine room. The windows in this room are ordinary in type, while in the rest of the building they are of corrugated steel, each opening as a shutter.

The lower floor has a concrete pavement in it. The second story has a reinforced concrete floor designed to carry a dead load of 400 lbs. per sq. ft. with a factor of safety of 4. This floor is intended for storage of limestone dust and asphalt. The third floor is of similar construction, but the dead load figured for it with the same factor of safety is 200 lbs. per sq. ft. The roof is designed to carry a snow load of 40 lbs. per sq. ft., with a safety factor of 4. The corrugated iron used on the sides of the building is No. 24 gauge and on the roof No. 22. The entire lower story is open, allowing easy transit for men and teams.

Arrangement of Ground Floor.—In the centre of the first story is located 5 asphalt melting tanks or kettles, provided with air agitation, each of a working capacity of 2,000 Imp. gal. Two of these tanks are of the enclosed pressure type and three are open, all being connected at the bottom with a 3-inch pipe line, by means of which the contents of any of the open tanks may be drawn by suction into either of the pressure tanks, with suitable connections in the air compressor so that it may be operated as a vacuum pump to accomplish this purpose. On the second floor a 3-inch pipe runs from the pressure tanks to the asphalt weighing buckets at both mixers, thus feeding the asphalt by air.

The melting tanks are encased in brick and each has an independent fire-box for heating purposes, the bottom of the tanks being protected from burning by fire brick. The fire-boxes are constructed for coal consumption. There is an independent smoke stack for these tanks.

Fig. 2 is a view of the lower floor and shows these melting kettles. In the foreground is the driveway under the binder mixer and at the other end of the building is a similar driveway under the topping course mixer. These two driveways can be seen better in Fig. 1. To the rear of the melting tanks are located the drying units, consisting of 2 Warren standard 40-inch sand dryers and a single binder dryer. Each sand dryer has independent settings, but are coupled together with the same driving gear. Each dryer is fed by an independent bucket elevator. The stone and sand are brought to the plant in cars or wagons and dumped near the building, where it is picked up by the elevators and fed directly into the drying units. The revolving cylinders are 19 ft. 8 in. long and the dryers are so constructed that the material passes through them by gravity instead of being forced through by spirals. These dryers are so arranged with induced draft, so that the flames and hot gases pass the full length of the dryer on the outside of the revolving cylinder and return through the inside before being taken out by the fan. In the cylinders longitudinal vanes are provided that lift the materials being dried to the top of the cylinder, dropping it as the latter revolves, through the hot gases being drawn through it by the exhaust fan.

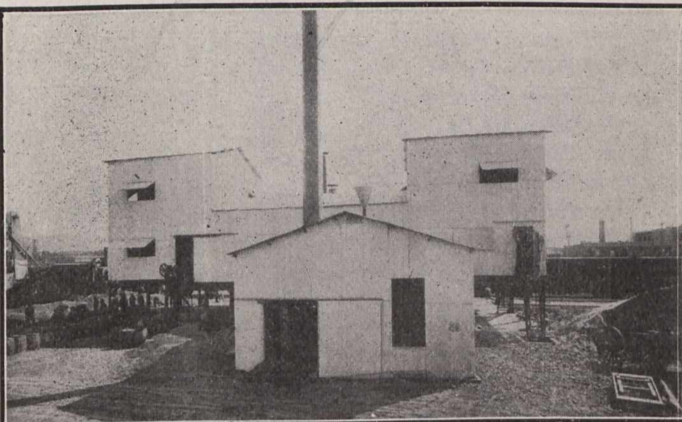


Fig. 1.—Exterior of New Municipal Asphalt Plant of Montreal.

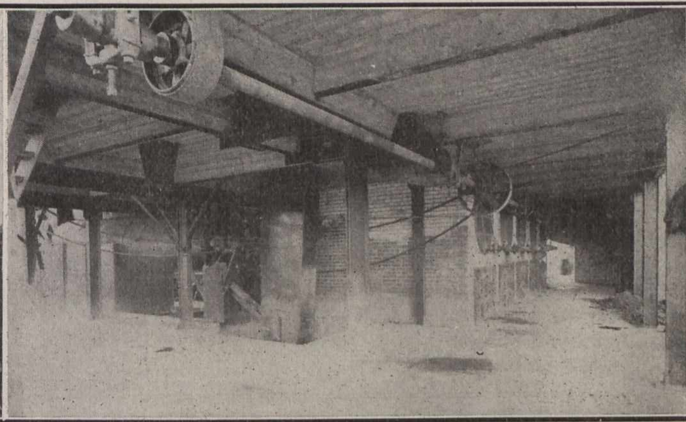


Fig. 2.—View of Ground Floor.

This induced draft is supplied by a 50-inch steel plate exhauster, provided with a Cyclone dust collector to separate from the exhaust the fine particles of sand, thus preventing the sand from being discharged into the air. Each dryer has a fire-box 3 ft. 8 in. wide and 10 ft. 6 in. long, giving an extremely large grate surface, providing a low rate of combustion of fuel and obtaining the full capacity of the dryers, without unduly forcing the fires.

The revolving cylinders are supported at either end by heavy 6-in. x 12-in. Universal bearings, the rear bearings being fitted with thrust collars to take care of the expansion and contraction of the cylinders.

The binder dryer is of similar type and size but using only a 40-inch steel plate exhaust. The exhaust gases from the dryers are carried off in stack from the dust collector.

The dryers discharge their contents by gravity into boots below the level of the floor, from which the hot material is carried by enclosed elevators to the hot bins on the third floor in the towers. The elevator shown in Fig. 2 is that for the binder, while beyond the melting tanks is located the one for the hot sand. The spout projecting through the concrete floor in the illustration is the bottom of the rejection bin, which serves as a storage reservoir for the rejection, when running topping, so that they may be hauled away without creating a nuisance around the plant.

The screens for the materials are located over the hot bins in the towers. All the shafting for operating the plant is on the ground floor.

Power Plant.—The power plant (see Fig. 1) consists of a horizontal tubular boiler 66 ins. by 14 ft. in a brick setting, and has a stack 40 ft. high. The boiler is equipped with an injector and a boiler feed pipe, also a 100-h.p. open feed water heater for heating the boiler feed water. The engine is built by the Goldie & McCulloch, Company,

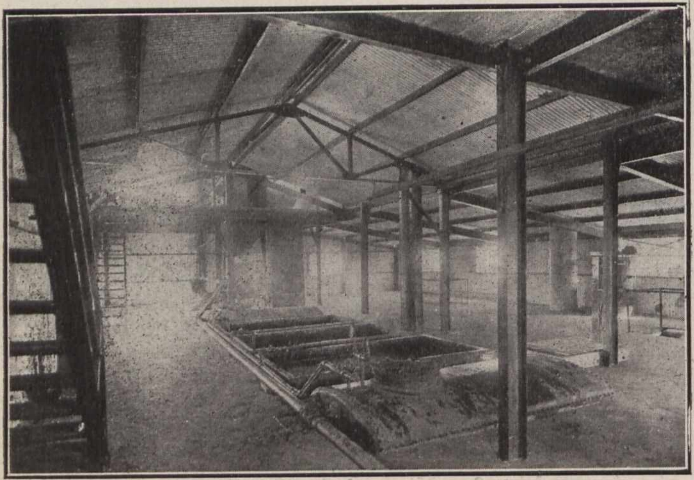


Fig. 3.—View of Second Floor.

Limited, of Galt, Ont. It is an enclosed engine of the automatic cut-off type, 13 x 12 in. stroke and equipped with the splash oiling system.

A 6 x 10 x 8 in. Clayton fly-wheel compressor, capable of compressing 80 cu. ft. per min., makes up the equipment in the engine room. The piping of the air system is so arranged as to be able to run the pump as a compressor or as a vacuum pump, as the requirements dictate.

Hot Bins and Towers.—The hot bins, as already stated, are located in the towers. These bins are of steel and have a capacity, level full, of 10 cu. yds. These bins serve the mixers. Each bin is provided with a rotary sand screen 30 in. in diameter, having an effective screening surface of at least 3 lin. ft. of 8-mesh iron wire cloth made of No. 20 gauge wire. Each screen is so arranged that when it is desired to run binder from either of the mixers the stone may be discharged directly into the bin without passing through the screen. The top of each bin is covered with light steel casing to retain the heat in the material and to confine the dust to the bins.

Arrangement of Second Floor.—The interior of this floor is shown in Fig. 3, as standing alongside of the topping mixer and looking towards the binder mixer. Ample room is provided for storing the bags of limestone dust and barrels of asphalt. The plant is equipped with two elevators for carrying these materials to this floor. These can be seen in Fig. 1, the continuous bag elevator on the right and the continuous barrel elevator on the left.

In the centre of Fig. 3 can be seen the tops of the 5 melting tanks and the asphalt feed pipe running towards the two mixers.

The two mixers are of Warren 9 cu. ft. type, capable of mixing economically batches of 1,000 lbs. of topping mixture and 1,100 lbs. of binder mixture. The drive of this type of mixer is furnished with a jaw clutch, so as to throw it out quickly in case of an accident. The bottom of the mixer is fitted with sectional reinforcing lines made ⅜ in. thick to take the wear and tear off the mixers. One mixer is equipped with topping teeth and the other with regular binder teeth. The mixers discharge by means of a sliding gate through the floor into wagons beneath.

A limestone dust bin of 2 cu. yd. capacity is provided with each hot material bin so that topping may be run from either mixer as desired. The dust is fed into the hot sand weigh-box by means of a screw conveyer operated by a friction clutch controlled by the weigh-box attendant. A separate elevator is used for placing the dust in the bins.

Each mixer has an asphalt weighing-bucket mounted on a carriage running on an overhead track with scales that automatically weigh the bucket full and empty.

The weigh-box at each mixer has a capacity of 12 cu. ft. This box is filled from the hot bins by an orifice with a swinging cut-off gate. The weigh-box rests on platform scales and discharges its contents through a gate in the front, by gravity, into the mixer. A by-pass in the tray allows of rejected material being dumped into a reservoir, as previously stated. The scales used for weighing are of such a type that each batch of material is weighed without the necessity of calculation, and so that the proper charge of limestone can be weighed with the sand.

A flux-weighing tank having a capacity of 300 gal. is also provided, resting upon a 3,000-lb. platform scales, constructed to balance the tare and give the weight of the oil by direct reading.

The main drive from the engine is an oak-tanned triple extra leather belt. The drives from the main shaft to the elevator countershaft are of double extra leather. The drives from the main shaft to the mixer driving shafts are silent chains. Those to the dryers are of steel bush roller chains, while the rest of the drives are detachable link belting. The entire plant is interchangeable and can be used for binder and topping, or can be used for topping alone. When the two classes of materials are run the capacity of the plant is 2,000 sq. yd. of finished pavement per day, while if the plant is run on topping alone it will produce 3,000 sq. yd. 2 inches thick.

This plant is, in consequence of this output, the largest asphalt plant in the Dominion, and is one of the largest municipal asphalt plants in use anywhere.

This is the third plant built by these contractors for the city of Montreal. The first plant built was in the east end, the second in the west end of the city. Both of these plants are still in operation, the first one being built in 1903 and the second one in 1907.

The north end plant is a modern and economical one. Similar plants with smaller capacity can be built by decreasing the units and their size. It is economy to have a well-designed plant rather than a makeshift, and the money so expended will earn a handsome dividend over using a poorly designed and constructed plant in the cost of operation alone, not considering the quality of the pavement laid.

COPPER AND THE WAR.

THE world's production and consumption of copper have been seriously interfered with by the war, and prices are very unreliable, as no one can foresee, at the moment, the probable demand during the immediate future, nor the length of the war. The world's production of copper during recent years has been as follows:—

	Tons.		Tons.
1913	1,005,900	1911	893,800
1912	1,018,600	1910	891,000

More than 50 per cent. of the total is produced in the United States. It is noteworthy that although the United States output largely exceeds the United States consumption, copper is, nevertheless, imported. Thus, during October 475 tons of slabs were imported from Japan and 690 tons of pig copper from Peru.

Copper was produced last year in the following countries: Mexico, 90,000 tons; Japan, 77,200 tons; and Australia, 41,800 tons. As regards Europe, German and Austrian output was the largest, the quantity being 52,100 tons, out of a total European output of 186,500 tons. Great Britain is second, with 41,100 tons; then Russia, 34,300 tons; and Spain with 23,600 tons. European consumption during 1913 reached 643,100 tons; after allowing for the European output, 456,600 tons had to be imported, obviously mainly from America. The European consumption was as follows: Germany, 259,300 tons; Great Britain, 140,300 tons; France, 103,600 tons; Russia, 40,200 tons; Austria, 37,200 tons; Italy, 31,200 tons. The United States consumption reached the enormous quantity of 351,000 tons.

Reduced consumption has necessarily resulted in reduced production; the world's copper output, now that curtailment has become effective, has dropped, according to very competent expert opinion, to a basis of about 500,000 tons per annum.

The world's consumption of copper over a term of years has been as follows, in tons:

	1913.	1912.	1911.	1910.
England	140,300	148,877	159,736	148,187
France	103,600	106,753	106,408	92,838
Russia	40,200	38,818	31,830	28,237
Germany	259,300	253,429	234,985	208,826
Austria	37,200	51,574	41,101	37,150
Italy	31,200	34,378	40,949	32,487
United States	351,000	365,922	316,791	334,565

The copper exported from America, practically all to Europe, during the nine months of the year and the corresponding months in the preceding four years has been as follows:

	1914.	1913.	1912.	1911.	1910.
January	35,566	24,659	30,967	29,357	26,699
February	34,384	26,767	35,418	18,992	25,238
March	46,504	42,428	27,074	23,200	19,963
April	34,787	33,024	23,341	27,466	31,062
May	31,948	38,251	32,984	26,655	20,832
June	35,182	27,808	26,547	30,074	23,430
July	34,145	29,096	25,445	34,955	22,875
August	19,676	34,722	29,526	27,893	27,876
September ..	16,838	34,314	25,572	25,745	31,733

These figures distinctly indicate the effect of the war during August and September on the world's copper markets.

Towards the end of September, a noteworthy feature of the copper market was the action of the British Government in acquiring all the stocks of copper carried in Dutch warehouses, as this metal almost always is destined for Germany. Three cargoes of copper afloat for Holland were also taken by the British Government. It is reported that the German Government has followed the lead of the British Government in the compulsory acquirement, and paying at prices fixed by the British Government, of all stocks of copper stored in Rotterdam warehouses, and captured afloat in neutral vessels, belonging to American companies. Considerable stocks of copper are stored in Germany belonging to American owners; the German Government has confiscated them, and is paying for them in precisely the same terms as those fixed by the British Government.

We are indebted to Engineering (London) for the information.

GOVERNMENT GRAIN ELEVATOR AT VANCOUVER, B.C.

The contract for the new Government grain elevator at Vancouver has been awarded to Barnett & McQueen, whose headquarters are in Minneapolis, Minn., with a branch office at Fort William, Ont. The construction of this elevator, the contract price for which is $690,000, will practically complete the government's chain of interior and terminal elevators extending across Canada between Port Arthur and the Pacific Coast. The elevators included in this system are: One at Port Arthur for eastbound grain, the proposed elevator at Vancouver for Pacific trade, and three interior elevators at Moose Jaw, Saskatoon and Calgary. In this connection might also be mentioned the elevators of the Montreal Harbor Commission, which are now under the control of the Western Grain Commission in many respects. It is also likely that an elevator, for terminal purposes, will eventually be constructed at Port Nelson for the Hudson Bay route.

The Vancouver elevator is to be of reinforced concrete. It is to have a storage capacity of 1,250,000 bushels, 300,000 of which will constitute the capacity of the working house, and 950,000 of the storage building proper. The design shows 52 circular storage bins in the latter, and 32 in the former. The storage building is further equipped with 32 interspace bins. It is to be 232 x 71 ft. The working house will be 126 x 62 ft. and, in addition to the 32 circular bins, there will be 21 interspace and 15 outerspace bins. The elevator buildings will also include a sacking plant and transformer house. These will be housed in one building 62 x 25 ft. The adjoining track shed is to be 150 ft. 8 in. long x 52 ft. wide. The wharf on Burrard Inlet will accommodate seven lines of tracks, and there will be also five tracks between the wharf and the Canadian Pacific Railway line. Three car ways will lead to receiving hoppers, each hopper with a capacity of 2,000 bushels. In all, there will be nine of these hoppers. Outgoing grain will be loaded on vessels by two-belt galleries, one on either side of the wharf. The sacking plant will include two sets of automatic sacking scales, each scale with a hopper capacity of from 2 to 6 bushels, and capable of weighing 1,500 bushels an hour. The power equipment will consist of forty 60-cycle, 3-phase, alternating current motors, aggregating 1,520 horse-power.

It will be noticed that the above elevator will resemble in many particulars those now in operation at Port Arthur, Saskatoon, Calgary and Moose Jaw. It is expected that the structure will be completed in November of next year.

HYDRAULIC PLANT, JOLIETTE, QUE.

A VERY interesting pumping plant is now in the process of construction in the town of Joliette, on the Assumption River. Fig. 1 shows the general layout. This includes a solid concrete overflow dam about 230 ft. in length, and varying in depth from 5 to 7½ ft., tapering from a width of 2 ft.

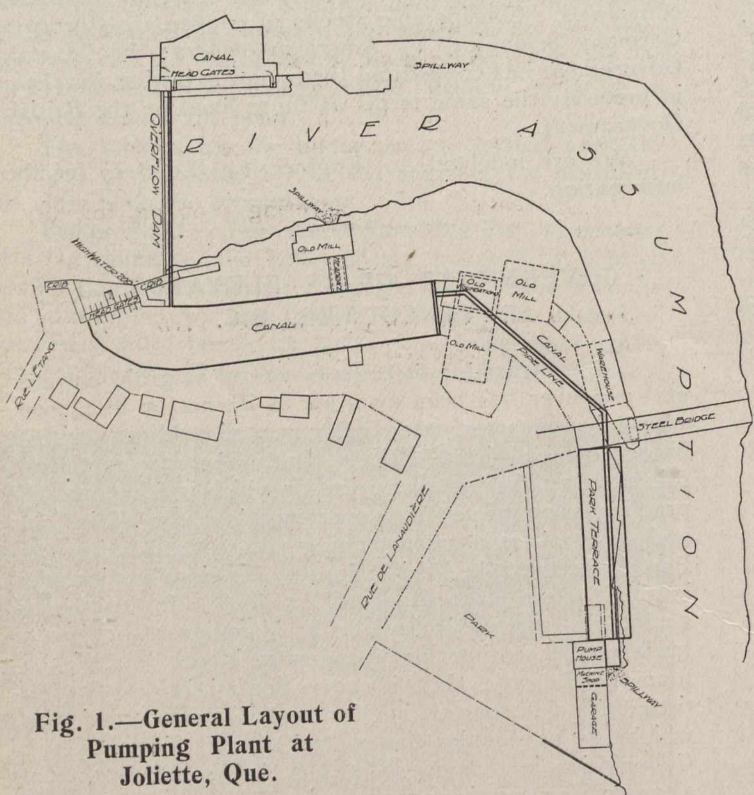


Fig. 1.—General Layout of Pumping Plant at Joliette, Que.

at the top to 11 ft. at the base. West of this structure the head gates admit water into a canal, the sides of which are of concrete retaining construction, and are terminated by a solid concrete head wall with an entrance to a stave flume 6 ft. in diameter and about 400 ft. long. The power house, also of reinforced concrete construction, contains a double Francis turbine of 200 h.p., carrying a horizontal shaft to which are belt-connected two centrifugal pumps, each with a capacity of 1,500 Imperial gallons per minute when working in parallel, and providing water at 65 pounds per square inch pressure. The drawing also shows a reinforced concrete platform 210 ft. long and 40 ft. in width, running parallel to the river, and to be used for pleasure purposes. Buildings indicated by dotted lines on Fig. 1 show the position of buildings, the demolishment of which is being necessitated by the new development.

Fig. 2 shows a section of the dam. It shows anchor bars 1¼ in. in diameter, which are staggered the entire length of the dam in planes 4 ft. 9 in. apart, the rods having a longitudinal spacing of 12 ft.

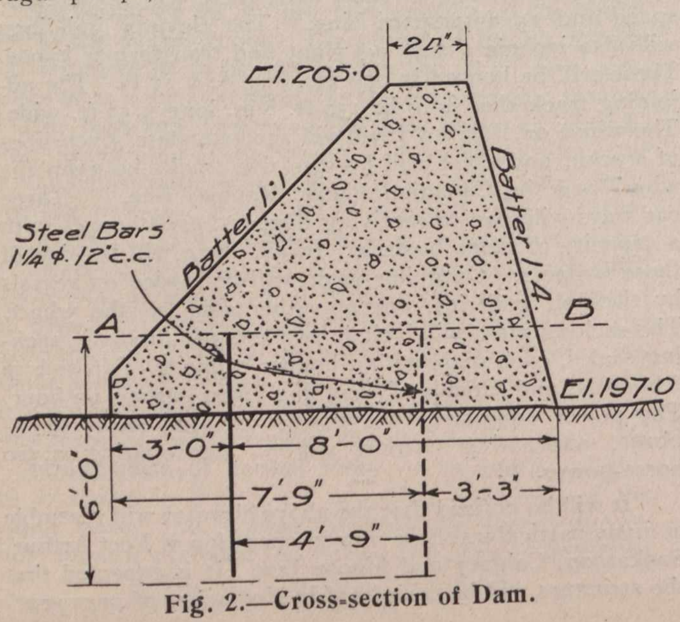


Fig. 2.—Cross-section of Dam.

The wood stave pipe 6 ft. in diameter, is joined with steel sections. Two pronounced angles are encountered in the alignment of the conduit. The pipe is supported on concrete pedestals placed 8 ft. c. to c. and resting on rock foundations. These supports are to be 12 in. in thickness, and 6½ ft. in length at the top with a gentle taper. The lower end connection of the pipe is shown in plan and elevation in Fig. 3.

The terrace has been designed in reinforced concrete supported by pillars 17 ft. c. to c., resting on rock foundation. An artistic arch construction will be accompanied by reinforced concrete railings and ornamental lighting standards. The park side of the terrace provides three approaches by concrete

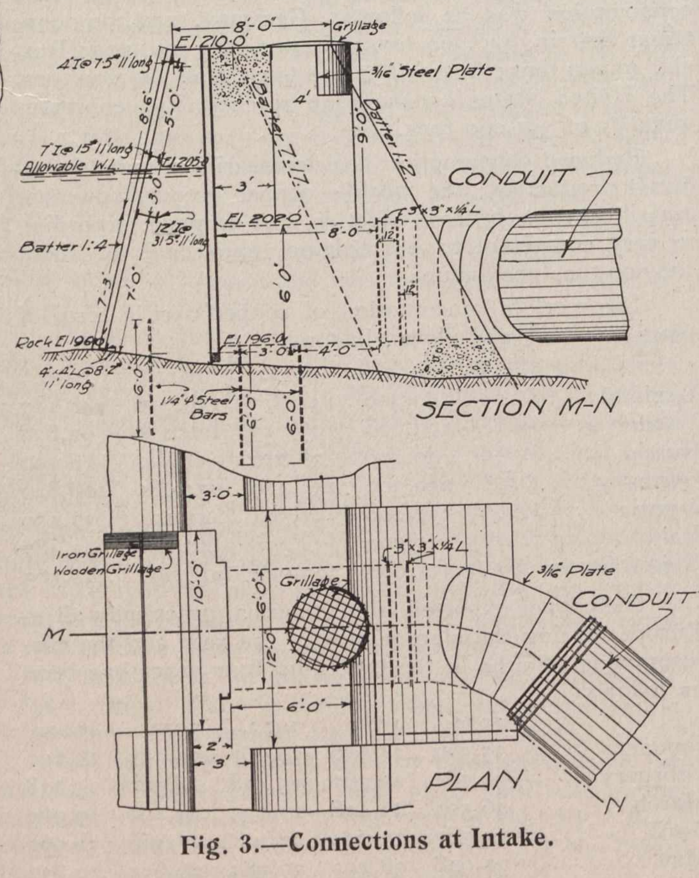


Fig. 3.—Connections at Intake.

steps. A section of the supporting piers, showing also the location of the conduit, is given in Fig. 4. The terrace provides 39 columns 14 in. x 14 in. in section reinforced by ¾-in. steel rods placed longitudinally and varying in length from 8 to 11 ft. The floor slab is 6 inches thick and the beams and girders are 20 and 28 inches deep, reinforced longitudinally with Kahn bars.

At the south end of the terrace will be situated the pumping plant, of reinforced concrete construction on rock foundation. The turbine chamber into which the water enters from the conduit is 12 ft. x 9½ ft. The water leaves the turbine through an 8-ft. vertical draft tube tapering from 4 ft. 5 in. in diameter at the turbine end to 5 ft. The tail race projects beneath the floor of the building directly to the river bank. This flume is also of reinforced concrete construction.

To the turbine shaft is direct connected a fly wheel 8 ft. in diameter with belt drive to the floor above, where the two 1,500-gal. centrifugal pumps are installed. The general arrangement of this is shown in elevation in Fig. 5.

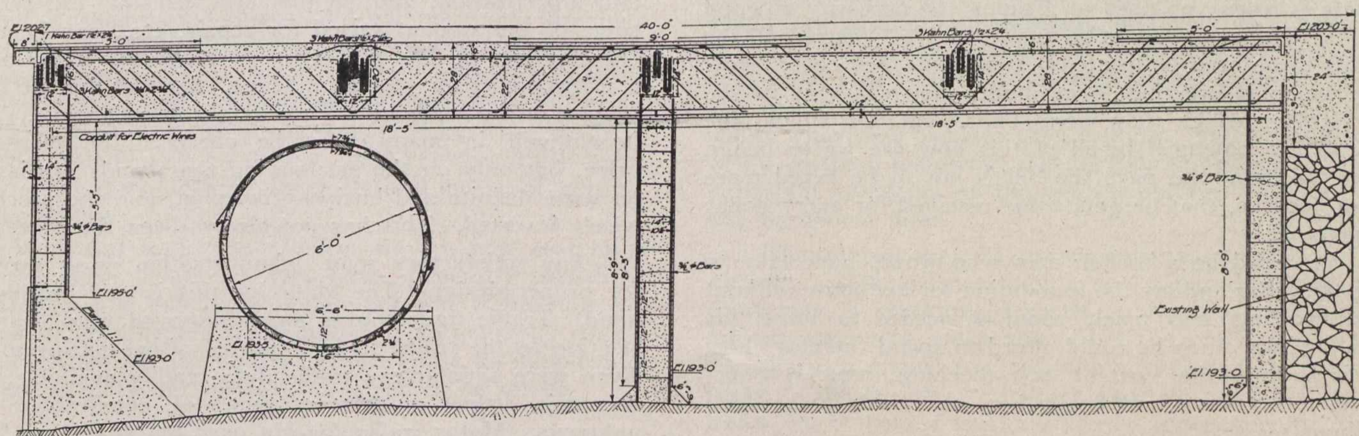


Fig. 4.—Cross-section of Park Terrace and Pipe Line.

The general contract for the development was let to Messrs. Arsenault and Planondon, engineers and contractors, Montreal, for $32,516. Escher Wyss & Company are supplying the machinery, the price being $5,155. Surveyer and Frigon, civil engineers, Montreal, have charge of the development.

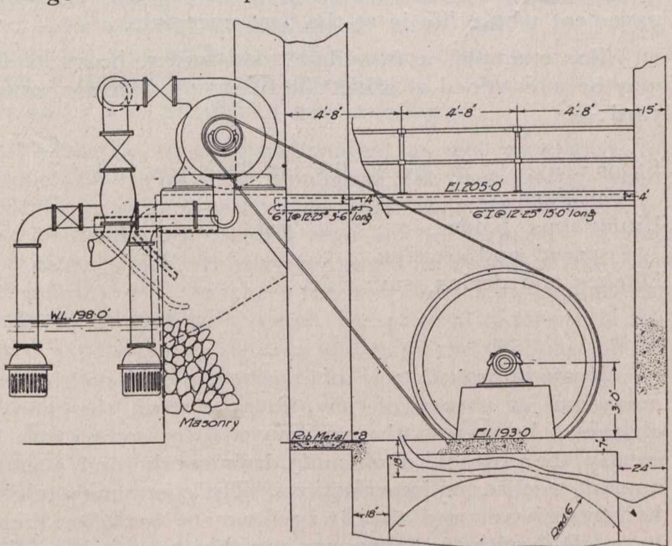


Fig. 5.—Pumping Arrangement.

Wood paving block is specified as one of five kinds of paving that may be laid in Honolulu streets. Approximately 100,000 Douglas fir blocks have been laid in the city. The size of block that is thought best adapted is 3 by 4 by 4-in. A bid submitted by a contractor during the middle of October, 1914, named $1.962 per square yard for Douglas fir blocks, furnished and placed, including foundation. The price bid was lower than in some previous tenders. Ohia also has been used for paving block and, being a native wood, has probably been favored. No large amount of wood-block paving remains to be done in Honolulu, but much will be done in the future in the next largest city, Hilo.

NOTES ON MINING ACTIVITIES.

In commenting upon the effects of the war upon mining, a contemporary states that they are not all harmful. The lack of employment in the copper fields has induced copper miners to invade gold and silver-producing districts to lease and to begin operating. Prospecting, too, has received quite a boost.

"This," states the writer, "must result in much good to the mining industry. The work of prospectors will result in new mines and the opening up of new opportunities for investors. The working of leases means greater development and more extensive mining operations. The man who takes a lease and succeeds—that is, makes good money for himself—is pretty sure to continue in independent mining. The more independent successful miners there are in a camp the livelier and more prosperous the camp." There has been a serious lack of prospecting during recent years and if the war will have the effect outlined above it will be a benefit, no doubt, to mining. When general business and industrial conditions recover from the effects of the disturbance caused by the breaking out of the war mining should find itself in a better position than it would have been had the war not occurred. There should be an increased demand for the products of the mines, not only to supply the needs of Europe, but to meet increased demands of domestic industries, and mining should prosper.

According to the Labor Gazette, the mining industry, however, is fairly active in this country. In November the collieries at Sydney Mines were running full time. The Dominion collieries were reported as not quite so busy, though they had a fair amount of work. Other collieries in coal mining districts in Nova Scotia were fairly active. In some of the western mines the delay in the advent of cold weather rendered conditions somewhat inactive. At Nanaimo the mines were working to full capacity, though some of the mines in the adjacent districts were not working full time.

In metal mining, operations in the Cobalt district came back to normal, and at the month's close very few men in the camp were out of work. At Porcupine the Hollinger mines increased their force and had about 1,000 men employed. Some reductions were reported in the staff in the iron mines at Michipicoten.

Heavy shipments of ore were reported from the Rossland mines to the Trail smelter, and the larger output of the mines in the district and the increased numbers at work were having the effect of renewing activity in business at Rossland.

EFFICIENCY OF HIGHWAY ORGANIZATION.*

By Col. E. A. Stevens,
State Highway Commissioner of New Jersey.

THE very size and the commercial importance of the highway problem make efficiency necessary to a fully successful solution. To-day we can state the problem in general terms only. Even the total mileage of roads and what portion of them have already been improved are only approximately known facts. There is to-day no need of arguing the necessity of good roads. The questions to be answered are: Where will the roads to be built be located? What will they cost? How are we to insure that, once built, they will give us the service for which they were built, and for which the people are paying? In all of this how are we to insure that the man who pays the bill is not to be taxed more than need be, that he gets value received for every dollar expended?

It would be a foolish man who would undertake to dig the cellar and lay the foundation for his house without first deciding how much room he needed to house his family; how much he could afford to spend therefor; how he is to meet the cost of housekeeping, repairs, insurance, and taxes; and finally how all this is to be done without waste.

In such a case, it is easy to see the need of some forethought. In the much larger problem of providing good roads, the very immensity of the quantities and costs, and the difficulty of gathering the data necessary to state them with approximate accuracy, or the failure to realize the importance of this knowledge, seems to have prevented preliminary study. We have in general tackled the problem with a view limited to a solution over a very narrow field. Since we took up the subject, the problem of administration, design, and construction, have been changed by motor traffic. This traffic has made the road a matter of general and not of local interest; has shown us that hitherto approved methods of construction are no longer generally available, and that systematically organized methods of caring for our roads and of raising our road funds are at least worthy of our most careful thought.

Let us, therefore, look at our problem for a moment without worrying about what others have done. The best way of doing the job is still an unsettled question. On whom shall we place the burden of arriving at the best method? Taking John Fritz's quip that "an engineer is the man who can do with one dollar what any fool can do with two," it is clear that that sort of an engineer is the man we want. Without a force properly drilled in the work, and properly organized to do it, efficiency, the getting for one dollar what with waste will cost us two, is impossible. With such a force, money and time spent in careful preliminary study, in being sure we are right before we go ahead, will not be wasted.

We need, first, a force that can lay out a well-thought-out plan with a fair chance to do so without political meddling. The cost can then be forecast. Changes in traffic may lead to changes in general design and detail without making efficiency impossible. The same happens so often with even so simple a task as building a house, that the wise man always allows some margin on the first detailed estimate of cost. With the cost known, plans for raising money can be made for meeting it, and a program of construction arranged with a view of giving the earliest and greatest return for the money spent.

Bond issues and the "pay-as-you-go" plan must be considered. It is evident that over any period for which bonds are issued, the tax levy must include interest and amortization charges on the bonds, as well as the cost of caring for the roads built, and to meet depreciation. If the same amount be raised each year by taxation and used to meet road-building, repair and depreciation charges, it is clear that the amount raised for interest and amortization, and, in the first part of the period, some of the amount raised for repair, etc., can be used for new work. The net result over the whole period is a reduced cost for a given mileage. Against this we have the use of the roads built for a longer average time. This benefit will, in many cases, be cheap at the increased price, but only on the assumption that bonds are issued on some definite and business-like plan, and the proceeds wisely invested. This has not always been the case.

Any satisfactory road administration must provide for proper design. The data for this is not readily at hand. Traffic figures over an unimproved road bear no relation to the traffic to be expected after improvement. Even were satisfactory traffic data readily available, the economic values of different types of construction are unknown. Motor traffic for not over ten years has been a serious destroyer of road surfaces. It is increasing yearly in intensity. The surfaces specially designed to carry this troublesome and valuable load have not been in use long enough to determine their probable lives and cost of upkeep under the conditions of to-day. The cost of the road is a yearly one, and must include depreciation, if the waste of road material is not made good every year. Therefore, it may well be cheaper to spend money in the repair of a cheap type, such as macadam or gravel, rather than to resurface with an expensive pavement pavement whose life is at the best uncertain.

For example, a macadam road under heavy traffic may be maintained at about the following cost per square yard:—

	Cents.
Stone, say, ½ in. or 42 lbs. at $3 a ton rolled in place	6.3
Bituminous binder, say, ⅜ gal. at 15 cents, spread and covered	5.6
Ditches and drains, say	1.0
	12.9

If an improved type of surface is laid on the old macadam at a cost of, say, $1.25 a yard, the annual charge to be seen in the tax levy will for some years be merely the cost of ditch and drain work and a small amount to care for imperfections. The community might, however, have used the $1.25 for new work, or might have left it with the taxpayer; in either case, it is costing the interest which, at 4 per cent., is 5 cents. We have, then, a saving of 6.9 cents, but it seems fair to assume that over a life of from 10 to 20 years we should allow at least 0.9 cent for repairs. Our saving is then 6 cents. We would have to realize this saving for about 21 years to get back our $1.25, and if the new surface lasts less than that period it may well prove wasteful.

But any such figures are of academic interest only, unless we have the organized repair force needed to keep our roads in repair and a system of accounting that will give accurate data and that is based on an outlook over a period somewhat longer than that covered by next year's tax bill. On the basis of such a system and with

* Read at Fourth American Road Congress, Atlanta, Georgia, November 9th to 14th, 1914.

such a force are our railroads operated. Their problem is of the same kind as ours—a matter of cheap and efficient transportation. It is, perhaps, curious that while the tendency of the day is to regulate these and other public service corporations as to the safety and adequacy of their service, and as to their methods of financing, the people of this country have in no case insisted on such safeguards as to the work of those entrusted with their roads.

The engineering problems of railroading have been solved in their broad lines. We will probably be able, as in the past, to keep on increasing axle loads and reducing ton-mile costs, but along lines indicated by carefully collected and thoroughly digested data of many years' work. This, as in the past, will be done by thoroughly trained and competent men knowing their business and eagerly looking for ways and means of getting better results.

With our highways problem we are now searching for the best solution. We have, generally speaking, inadequate and untrained or only partially trained forces. We have no accepted traffic unit and no generally recognized system of accounting. These must be supplied if we are to solve our problem as it should be solved.

HYDRATED LIME IN CEMENT AND CONCRETE.

Bulletin No. 10 of the National Lime Manufacturers' Association contains a report by Henry S. Spackman, of Philadelphia, on the effect of hydrated lime on strength and change in volume of cement mortars and concrete. The report is the result of tests on mortars and concretes with varying percentages of magnesium and calcium hydrate. The pieces were exposed under water and in air, outdoors, and alternately in water and in air. Examination was made to note the expansion of the pieces with variation in moisture content. The conclusions drawn by Mr. Spackman are as follows:

Variation in moisture content as well as change in temperature affect the volume of the test piece; when kept from contact with water other than the moisture in the air there is a marked tendency to shrinkage of the test piece, which tendency continues up to and beyond the six months' period; where the test piece is in constant or frequent contact with water, the general tendency is toward expansion in volume, and with the draining off of the excess gauging water there is a marked shrinkage in the 24-hour period followed in some cases by expansion at 48 hours and further shrinkage if test-piece specimens are out of contact with water and expansion if in contact with water; the addition of hydrated lime, while increasing somewhat the maximum expansion and contraction when the test pieces are constantly exposed either to water or dry air, markedly reduces the shrinkage due to the draining off of the surplus gauging water and also the extent of the movement when the test piece is alternately wet and dry.

Further tests for strength indicate that Portland-cement mortars and concrete, either with or without the addition of hydrated lime, develop the greatest strength when in continuous contact with water, and where allowed to harden in air out of contact with water there is a marked diminution of strength. Considered broadly, the addition or substitution of 10% of hydrated lime has no marked effect on the strength of the mortars, the test showing increase in strength at some periods and decreases in strength at others.

THE LAW OF STEAM POWER-HOUSE ECONOMY.*

By R. H. Parsons, M.Can.Soc.C.E., Assoc.M.Inst.C.E.

THERE are figures in abundance as to the performances of the component parts of a power-station, such as boilers, turbines, generators, etc., under test conditions, but nothing appears to have been published with respect to the efficiency with which the whole aggregation of machinery performs its functions. It is the purpose of this article to examine the performance of a power-plant, considered as an organic whole and to suggest a basis of comparison between different plants which has hitherto been lacking. The development of the method, moreover, will furnish an answer to many important problems of the central station engineer, as will be shown later.

The subject may be conveniently approached by an analogy. The efficiency of a steam-engine, under any conditions of working, depends upon a vast number of factors, mutually independent for the most part, such as cylinder condensation, radiation, friction of the various parts, leakage, etc. However carefully each of these items might have been investigated independently, their aggregate effect upon the economy of an engine would be an extremely difficult thing to forecast, and still more difficult would it be to deduce a law for the efficiency of the engine throughout its range of load, from the various rates of change of its multifarious sources of loss. By analogy we could hardly hope to determine the efficiency of a power-station at various loads from a consideration of the efficiencies of the different machines and apparatus which constitute its component parts.

The problem of the efficiency of the steam-engine was solved empirically by the late Mr. Peter Willans, who discovered that the total steam consumption per hour could be plotted as a straight line against the load on the engine. Thus, if the steam consumption at two different loads only were known, the consumption at any other load could be at once determined. This discovery placed in the hands of engineers an extraordinarily useful method of analyzing and tabulating the results of steam-engine trials. Experience proved the Willans law to have a remarkably wide range of application to prime movers, and for many years it has been utilized by manufacturers so far as it concerns their products.

By considering the analogy between the numerous sources of loss in a power-station and the almost equally great number of losses inherent in a steam-engine, it appears reasonable to suppose that there may be some rule corresponding to the Willans law which will correlate the efficiency of a power-station with the load upon it. Experiment proves this to be so, at any rate in the case of the particular power-station for the management of which the author is responsible, and no doubt a similar rule would apply generally.

In Fig. 1, above, the total steam consumption of the station per eight-hour shift is plotted against the gross electrical output of the station in the same period. The figures refer to the station performance during the month of September, 1914, and ninety records are plotted, covering a range of output varying from 4,500 to 24,300 kilowatt hours per shift. It might have been better to have taken the readings hourly instead of at eight-hour intervals, as this would have eliminated the effect of varying load-factors; but, on the other hand, the error

* From Engineering (London).

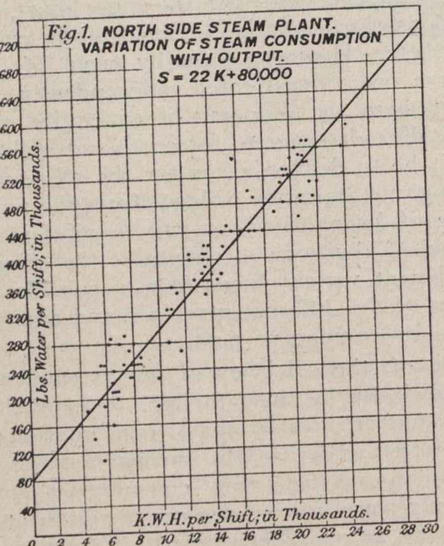
due to varying water-level in the boilers would be accentuated by the shorter intervals. The steam consumption during the shift is taken as being equal to the water pumped into the boilers, and the gross electrical output is the sum of the main-generator meter-readings.

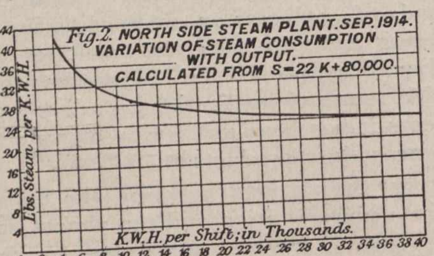
By referring to Fig. 1, it will be seen that the mean of the observations is approximately a straight line, having the equaticn:—

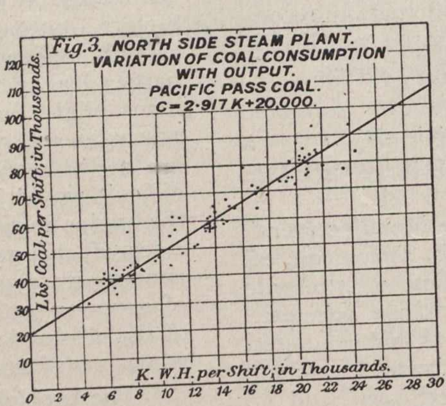
$$S = 22\ K + 80{,}000,$$

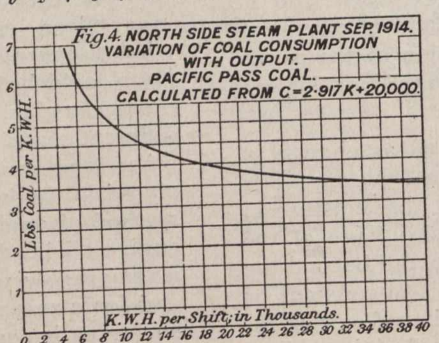
where S is the total steam consumption per shift expressed in pounds, and K is the gross output per shift expressed in kilowatt-hours. It thus appears that there is a constant loss of steam, amounting to 80,000 lbs. per shift, and that there is in addition a consumption of about 22 lbs. of steam per kilowatt-hour.

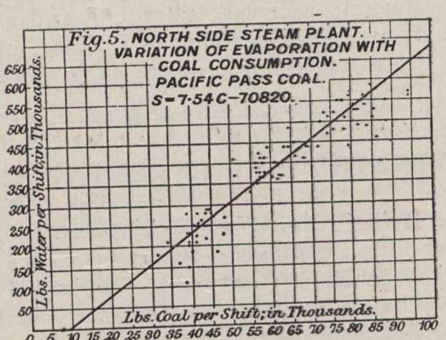
Fig. 2 represents the steam-consumption curve of the station, expressed in pounds of steam per kilowatt-hour, the curve being deduced from the line shown in Fig. 1. The assumption has been made that the load-factor per shift was unity. From the equation it can be

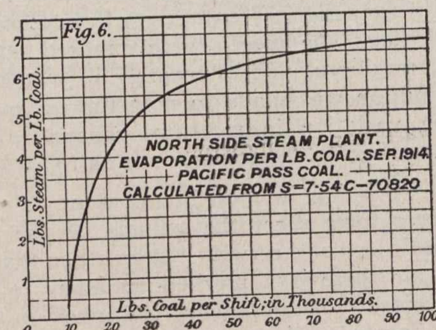












deduced that at an output of 80,000 kw.-hours per shift, which is the rated capacity of the station, the steam consumption would be 23 lbs. per kilowatt-hour. The consumption evidently tends to a limiting value of 22 lbs. per kilowatt-hour with an infinite load on the station.

The principle illustrated in Figs. 1 and 2 may be applied with equal instructiveness to the investigation of the quantity of coal consumed in the power-station. Fig. 3 shows the total coal consumption per eight-hour shift, plotted against the gross station output per corresponding shift, during the month of September, 1914; we see again that the total coal consumption follows a straight-line law, and may be expressed by the equation::—

$$C = 20{,}000 + 2.917\ K,$$

where C is the total coal consumption per shift expressed in pounds, and K is the gross electrical output per shift as registered by the generator meters. The diagram shows that 20,000 lbs. of coal are burned per shift to provide for the constant station losses, such as steam leakage, radiation, and general stand-by requirements. An additional 2.917 lbs. of coal per hour are needed for every kilowatt actually generated. With the station carrying its rated load of 80,000 kw. it may be deduced from the above equation that the coal consumption would amount to 253,360 lbs. per shift, or 3.16 lbs. per kilowatt-hour. In Fig. 4 is shown the coal consumption per kilowatt-hour corresponding to the line drawn in Fig. 3. The limiting value of the coal consumption is 2.917 per kilowatt-hour, which, of course, could only be obtained with an infinitely great load on the station.

From the two equations given above, namely—

$$S = 22\ K + 80{,}000,$$

and

$$C = 2.917\ K + 20{,}000,$$

we may deduce a third equation, representing the variation of the amount of water evaporated per pound of coal, as the load on the boilers is increased. The equation is:—

$$S = 7.54\ C - 70{,}820,$$

By equating it to zero, which represents the condition when no steam is being taken from the boilers, we get $C = 9{,}388$, showing that 9,388 lbs. of coal are required per shift to maintain the head of steam in face of radiation and other losses. This quantity may be compared with the amount of 20,000 lbs. per shift, which has already been found to be necessary to operate the station at no load. Thus about half the constant loss is attributable to the engines and half to the boilers. The equation further shows that the boiler-room losses are equal to the condensation of 70,820 lbs. of steam per shift, and that if they were absent we could evaporate 7.54 lbs. of water per pound of coal.

The last equation, correlating the total evaporation per shift with the total coal consumption per shift, could, of course, have been obtained graphically by plotting down the readings of the water-meters against those of the coal scales. In Fig. 5 this has been done, the line representing the mean of the observations being, however, drawn to agree with the calculation above. Nevertheless, it falls very fairly among the points. Fig. 6 shows the evaporation per pound of coal in accordance with this line.

In Figs. 1, 3, and 5, it may be objected that the variations among the observations do not allow a straight line to be drawn with any certainty, and hence a rather large amount of theory has been built up on a somewhat uncertain basis. This may be so, but the records are not put forward as being absolutely accurate. They are subject to corrections for water-level in boilers, coal on grates and in stokers, meter approximations, blow-off losses, etc., and they, of course, have a great dependence upon the economical operation of the plant, during the shift to which they refer. Nevertheless, they do undoubtedly appear to give evidence of certain laws of economy to which it is the object of this article to call attention.

The first question which will be asked by the practically-minded central-station engineer will be, "What use can be made of the results obtained from such an analysis of the operation of a plant?" One very important use can be made. The curves show at once the coal consumption or the steam consumption of the plant for any load which the station may have to carry. Hence the fuel cost for any additional load is readily obtained. For example, in the plant under consideration two problems were presented. One involved the question as to whether it would pay better to do the main waterworks pumping electrically or by steam-driven pumps. Steam had always to be maintained in the waterworks boilers, because the low-lift pumps were exclusively steam-driven; but the writer had the option of running either the motor-driven or the steam-driven pumps, as he thought fit. The combined labor costs of the two plants were unaffected by the decision. The waterworks load, when pumping was done electrically, was of a reasonably uniform nature, the load-factor per twenty-four hours being about 75 per cent. This load, as the equation corresponding to Fig. 3 shows us, can be carried on the steam plant at the cost for fuel of 2.917 lbs. of coal per kilowatt-hour. In an average month this would amount to 440 tons of coal, which figure can be directly compared with the extra coal burnt in the waterworks when the steam-driven pumps are operated. A definite solution of the problem can thus be obtained.

The other question related to the advisability of operating a large producer-gas engine, which normally runs in parallel with the main steam-power station. The gas-engine uses a low-grade lignite, costing about 0.16d. per kilowatt-hour. We see, as above, that the load could be transferred to the steam plant at an extra cost of coal of 2.917 lbs. per kilowatt-hour. But as the steam plant uses a more expensive fuel, the cost of 2.917 lbs. of steam coal amounts to about 0.26d. The fuel bill alone would therefore, be increased by 0.1d. per kilowatt-hour by making the change, but against this difference must be set the saving in labor, etc., which would result from shutting down the gas plant. The problem, like the former one, is, therefore, capable of an almost exact solution, which is only rendered possible by the foregoing analysis of the coal consumption of the main station.

The figures concerning the water and coal consumption of the power-station per shift, which have been taken as an illustration of the method, are actual working results obtained during the normal operation of the station. The month of September, for which they are given, was the first month for which it was possible to obtain them. They are put forward merely to illustrate a principle, and the writer is not concerned to defend them. Criticism should be directed not at the figures themselves, but at the use made of them. However, a brief explanation of certain points with regard to the station may not be out of place.

The power-station serves a non-manufacturing town of about 70,000 inhabitants, and furnishes alternating current for lighting and power, and direct current for street railway purposes. The plant comprises water-tube boilers with chain-grate stokers and superheaters, but without economizers. The generating machinery operated during the month of September consists of turbine-driven alternators for the lighting load and vertical high-speed engines and motor generators for the traction load. The condensing plant is partly steam-driven and partly motor-driven, and exciting current was furnished by a steam-driven exciter. In the diagrams above referred to the gross output of the main generators is given, this including the electrical energy used for auxiliary machinery and induced-draft fans in the station. The fuel used was a class of coal intermediate between lignite and bituminous coal, its average analysis being about as follows:

B. Th. U. per pound of dry coal	10,100
Moisture per cent.	7.3
Volatile matter per cent. (dry coal)....	26.5
Fixed carbon per cent. (dry coal)......	52.0
Ash per cent. (dry coal)..............	21.5

Although the writer trusts he has disarmed criticism of the operating results by the statements given above, it must not be assumed that the results are considered worthy of publication, except for the purpose of illustrating what appears to be the law of power-plant economy. The power-station is still rapidly approaching a higher degree of efficiency, as the following table of total generation costs will show:—

Period.		Total cost (including capital charges).
1st six months,	1912....	1.56d. per kw.-hour.
2nd "	1912....	1.37d. " "
1st "	1913....	1.12d. " "
2nd "	1913....	1.02d. " "
1st "	1914....	0.94d. " "

The costs per kilowatt-hour include the whole of the operation and maintenance charges of the plant in question, as well as the interest and sinking fund on the capitalization, which is particularly heavy.

In conclusion, it is suggested that a method of analysis has been indicated which will enable engineers to compare the working results of different power-stations by studying the respective equations of cost. It is also hoped that a means has been provided for forecasting with reasonable accuracy the cost of generating any extra load which may be offered to the station. The method might have been made more general, though less practical, by giving the results on a thermodynamic basis.

OTTAWA BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

On Friday, December 4th, a goodly attendance of the Ottawa members was present at a luncheon. Mr. W. P. Macoun, Dominion horticulturist, gave a ten-minute address on "A New Country Club." Mr. A. St. Laurent, chairman of the Branch, presided.

SEWER WORK IN NARROW ALLEYS.

The problem of putting down a large sewer in a narrow alley, say, 16 ft., is one which frequently presents itself to the contractor. Methods vary, depending upon conditions governing disposal of excavation, etc., and upon contract requirements of various kinds, but the problem is sometimes made difficult by these conditions, if by nothing else.

In a letter to "The Contractor" some little time ago Mr. Ernest McCullough, consulting engineer, Chicago, describes a method that will be found of interest, differing more or less from other methods with which our readers may be more familiar. He assumes adverse conditions as regards dumping earth on paved streets at the end of the alley, breaking fences, etc., with operations confined entirely to the alley.

To begin, explains Mr. McCullough, the sewer trench will take up considerable space in the 16-foot alley. It is 48 inches in diameter, which means an over-all width of 6 feet to be excavated. The depth is 12 feet. The space along the sides is only 5 feet on each side of the trench. It is a shallow depth to work in by tunneling, but in this case I would tunnel. First, go along the line of the alley and brace all the fences inside the yards so dirt piled against the alley side will not destroy the fences. Where the fences have a fine appearance and the owner will resent keenly any defacement, place a lining of thin boards along the fence to a height of 5 feet.

Divide the alley into 12-foot lengths. On alternate lengths pile the material to be used in the construction of the sewer. Along the edge of the trench place boards about 1 foot high to keep the earth from falling back into the sewer. These boards can be tied by scantlings to posts driven along the fence line. Then we have on either side a 5-foot space ready to contain the excavated material. On the spaces holding material will be piled the sheeting to use for the sides of the trench. Set men at every space between the piles of material and let them get to the bottom as fast as possible. All the dirt will be thrown to the side except some direct from the tunnels under the material spaces, which may be left on a staging. The workmen will go straight down on the clear spaces, sheeting as they go so the heavy burden placed on the sides will not cause caving. They will begin to burrow under the material piles when they reach the depth which will cover the top of the proposed sewer and must place timbers under the material piles and line the tunnels to avoid caving and falls. When the burrowing begins the stagings appear; they should be not more than 5 feet long at first and even this length will leave an uncomfortably short throwing space at the ends. Such work is not cheap, although on a similar job our cost for 650 feet was done at 62 cents per cubic yard of excavation, which included back fill.

No time should be lost in starting the sewer when the cut is down to depth. Pumps may be required to take care of old sewers, etc., but such items are in addition to the excavating problem and must be solved when met. Rain is the greatest danger. On one job I put a canvas roof over the alley and sent the rain into the neighboring yards. Such work, of course, must be done only by permission of owners and damages must be repaired. When the sewer is in, side boards are removed after the sheeting is drawn and the earth shovelled in until the sewer is covered. The earth over the tunnel is broken down by picks so it falls on the sewer and takes care of uniform settlement. If possible no water should be used but the earth should be tamped dry. The tamping cost depends upon the intelligence of the man in charge. It should be merely enough so horses will not mire in the fill. This leaves a lot of earth still piled against the fences and this should remain until the whole block is sewered.

The next step is to run rollers over the trench and the loose earth should be plowed in until the alley is restored to grade, or a little above it. Horses' feet are the best possible tampers and the surface is finally settled by light rollers followed by heavy rollers. A light roller for such work is 3 tons and a heavy roller is between 7 and 10 tons. The surplus material, which should not be large in amount, is to be hauled away in wagons. Personally I prefer to place all the material over the sewer and raise the level of the alley for a time, later removing the surplus earth after settlement. In the case of a paved alley no plowing in can be done from the sides and the paving over the entire trench should be removed before the sewer goes in, over tunnel spaces and all, for the top of the tunnel should be broken down on the sewer. In a paved alley, of course, all the earth should be put in by shovel filling and tamping.

Usually not more than three sections will be opened at a time, for this permits of wagons going in and out from one end of the block. However, when plenty of men are available it is best to work along the entire length.

McGILL UNIVERSITY ATHLETIC FIELD.

Work started last August on the construction of an athletic field for McGill University, Montreal. It includes the construction of a reinforced concrete stadium with athletic field and running track, an out-door skating rink, a gymnasium and other accessory buildings, amounting in all to about $2,000,000. The contract has been awarded to L. A. Ott & Company, of Montreal. The excavation includes about 12 to 14 ft. of loose rock and earth amounting to 50,000 cu. yd. of shovel work and a considerable quantity of rock. A ⅞-yd. Bucyrus revolving shovel is being used on the work. Rock is being handled by hand into 1½-yd. dump cars which convey it to a crushing plant, where it is crushed and stored for use in the construction of the reinforced concrete grandstand. This structure is to be 400 ft. long with a seating capacity of 12,000.

The contract calls for completion in September, 1915. Work has closed down recently owing to weather conditions.

NEW C.P.R. STEAMER FOR PACIFIC COAST.

The first of two new passenger steamers that are being built for the Canadian Pacific Railway Company by Messrs. Denny Bros. & Company, was launched recently. The steamers will be used in the British Columbia service between Vancouver, Victoria and Seattle. The first, "Princess Margaret," measures 395 ft. in length and 54 ft. in breadth, with a 28-ft. 3-in. depth to promenade deck. It is driven by geared turbines, steam supplied by oil-fired water-tube boilers. Manoeuvring in port is effected by a large windlass forward and a steam capstan aft. Steering is effected by steam tiller acting on a balanced rudder and controlled by telemotor from the flying bridge. The vessel is to be fitted out with wireless telegraphy on the Marconi system and a special petrol-driven generating set is installed on the boat deck which is capable of working the wireless system as well as lighting the decks, even if there be no steam in the boilers.

Editorial

HIGHWAY LEGISLATION IN ONTARIO.

Ontario municipal corporations will welcome with avidity the recently issued publication of the provincial Department of Public Works, it being a compilation of Ontario highway laws, prepared by Mr. W. A. McLean, Commissioner of Highways. While members of municipal councils are largely taking advantage of the opportunity to equip themselves with this source of information in such convenient form, road and municipal engineers should not fail to add a copy to their own libraries for ready and reliable reference.

In the Province of Ontario the control of public roads was originally vested in the Crown, or Provincial Government, but responsibility has since been conveyed to city, town, village, township and county corporations, principally by the general Municipal Act of the Province. This Act defines the procedure whereby municipalities are created, and fixes their powers. Under it, townships are given control of all roads within their borders, except those that lie within towns, villages, or cities situated therein. In the latter case each urban municipality is responsible for the roads within its boundaries.

The more important provincial statistics relating to highways are given by Mr. McLean as follows:

Highway Section of the Municipal Act; Local Improvement Act; Statute Labor Act; Highway Improvement Act; Colonization Roads Act; Highway Travel Act; Motor Vehicles Act; Snow Roads Act; Tolls Exemption Act; Toll Roads Act; Snow Fences Act; Traction Engines Act, and Tree Planting Act. These are enumerated in the publication, with the exception of the Toll Roads and Tolls Exemption Acts, the reason for their omission being that there are now only 100 miles of toll roads in the province.

Mr. McLean draws special attention to the Local Improvement Act under which townships are now empowered to conduct road improvement in the same way as towns and cities, assessing the cost on the property benefited. Under this method the township council is authorized to pay a portion of the cost of the work, and payment of the balance levied on the property may be distributed over a term of years.

NEW WHARF ON RED RIVER.

The Department of Public Works will shortly commence the construction of one of three wharves recommended some time ago by the Winnipeg Harbor Commission. It will be known as the Rover Street wharf, and will be 400 ft. in length, 30 ft. in width and will cost in the neighborhood of $25,000. It is to be constructed of piles. A considerable amount of dredging is necessary, much of which has been done during the past season and which, when completed, will have reached an expenditure of about $90,000.

Further improvement on the river is being executed by the Department in the way of hydrographic surveys. Measurements have been made in the vicinity of St. Andrew's Locks, and others are under way at the present time between Selkirk and Lake Winnipeg. Still others are being carried out on the Winnipeg River.

During the year the Department of Public Works has performed improvements to the value of $400,000, of which about $75,000 has been done by contract.

WATERPROOFING OF MASONRY.

The following conclusions, prepared by the committee on masonry, of the American Railway Engineering Association, were adopted at the 1914 convention in Chicago:

(1) Watertight concrete may be obtained by proper design. Reinforcing the concrete against cracks due to expansion and contraction, using the proper proportion of cement and graded aggregates to secure the filling of voids and employing proper workmanship and close supervision.

(2) Membrane waterproofing, of either asphalt or pure coal-tar pitch in connection with felts and burlaps, with proper number of layers, good materials and workmanship and good working conditions, is recommended as good practice for waterproofing masonry, concrete and bridge floors.

(3) Permanent and direct drainage of bridge floors is essential to secure good results in waterproofing.

(4) Integral methods of waterproofing concrete have given some good results. Special care is required to properly proportion the concrete, mix thoroughly and deposit properly so as to have the void-filling compounds do the required duty; if this is neglected, the value of the compounds is lost and their waterproofing effect destroyed. Careful tests should be made to ascertain the proper proportions and effectiveness of such compounds.

Integral compounds should be used with caution, ascertaining their chemical action on the concrete as well as their effect on its strength. As a general rule, integral compounds are not recommended, since the same results as to watertightness can be obtained by adding a small percentage of cement and properly grading the aggregate.

(5) Surface coating, such as cement mortar, asphalt or bituminous mastic, if properly applied to masonry reinforced against cracks produced by settlement, expansion and contraction, may be successfully used for waterproofing arches, abutments, retaining walls, reservoirs, and similar structures; for important work under high pressure of water these cannot be recommended for all conditions.

(6) Surface brush coatings, such as oil paints, and varnishes, are not considered reliable or lasting for waterproofing of masonry.

SURGE TANK PROBLEMS.

Of the series of articles entitled "Surge Tank Problems" by Prof. Franz Prasil, of the Eidgenössische Teknische Hochschule, Zurich, Switzerland, published some few months ago in *The Canadian Engineer*, and being an authorized translation by Messrs. E. R. Weinmann and D. R. Cooper, hydraulic engineers, New York City, the "Engineering Record" has this to say:

"The treatise here offered is the best and clearest on surge-tank phenomena so far published in the English language."

BOW RIVER HYDRO-ELECTRIC PLANTS.

An article in *The Canadian Engineer* for December 3rd, 1914, dealt with stream flow investigations, relating specially to those of Mr. M. C. Hendry, of the Water Power Branch, Department of the Interior, based upon his studies of the Bow River above Calgary. His recent report describes, in brief, the existing developments on the river, and outlines the possible developments which other stretches of it and its tributaries possess.

The following is a brief résumé of the characteristics of the existing plants, and is presented in a complementary way to the information which has already appeared in these columns relative to the two largest developments, *viz.*, at Horseshoe Falls and Kananaskis Falls.

Eau Claire Plant.—The first hydro-electric development on the Bow River, in the section from Calgary west, is that of the Eau Claire Lumber Co., situated within the city limits. The development makes use of the natural fall in the river, by means of a diverting dam (pile and timber construction) and a canal, and the head developed is in the neighborhood of 12 feet. The diverting dam is situated just above the bridge crossing the Bow River at 9th St. W., and the intake and canal are on the south side, the canal following the south bank for about ½ mile. Advantage is taken of small islands or gravel bars, and these, together with timber pile structure, form the stream side of the canal. At the lower end, an island forms the north side of the canal or forebay, the original channel between it and the mainland forming the tail-race. Leffel wheels, set in an open timber wheel case, spanning the channel, are geared to two jack shafts, bolted to two generators. The installation is for 600 h.p.

The head developed is about 12 feet, the total flow of the river at low water being utilized. The company has the right to the total low flow of the river at that point, and an amount equal to the low flow at high and normal stages of the river. This plant supplies power for lighting throughout the city of Calgary, having a franchise for the distribution of power. The water-power is assisted by steam-generated power, and in consequence the service is liable to very few interruptions, but it is understood that during the winter season the operation of the water-power plant is interrupted for considerable periods, owing to ice troubles.

Lake Louise Power Plant.—An interesting power development in the Bow basin is that operated by the Canadian Pacific Railway in connection with the hotel at Lake Louise, near Laggan. This plant supplies light to the hotel at the lake, the station and surrounding houses and buildings. During the summer of 1912, the plant was enlarged and changed, and the output of the station increased.

The original plant was operated under a head of 45 feet, obtained by means of a concrete dam 75 feet long built across the bed of Louise Creek, about a quarter of a mile below the outlet of the lake; from the intake a 16-inch wooden stave pressure pipe led to the power house situated further down the creek, the head obtained being secured by the natural fall in the creek. A 35-kw. machine belted to the turbine, together with a switchboard, formed the station equipment.

The new installation, rendered necessary by the increased hotel accommodation, involves a concrete dam placed at the outlet of the lake, and forming part of the intake. The structure is in the nature of a bridge having the spill sections situated between the piers, and is so built that the former high, low and normal levels of the lake will still obtain. The pipe line which conveys the water to the plant is a wood stave pipe 20 inches in diameter and approximately 2,800 feet long. It is laid on the east side of the creek for the greater part of the distance, and the gross head developed is approximately 140 feet. The pipe line leads to a 24-inch S. Morgan Smith wheel which runs at 600 r.p.m. The wheel is rated at 100 h.p., and is belted to a 75-kw., 3-phase generator which operates at 1,200 r.p.m. and has an exciter mounted on the shaft. The current is transmitted at 2,500 volts and stepped down to 125 volts for lighting and other uses.

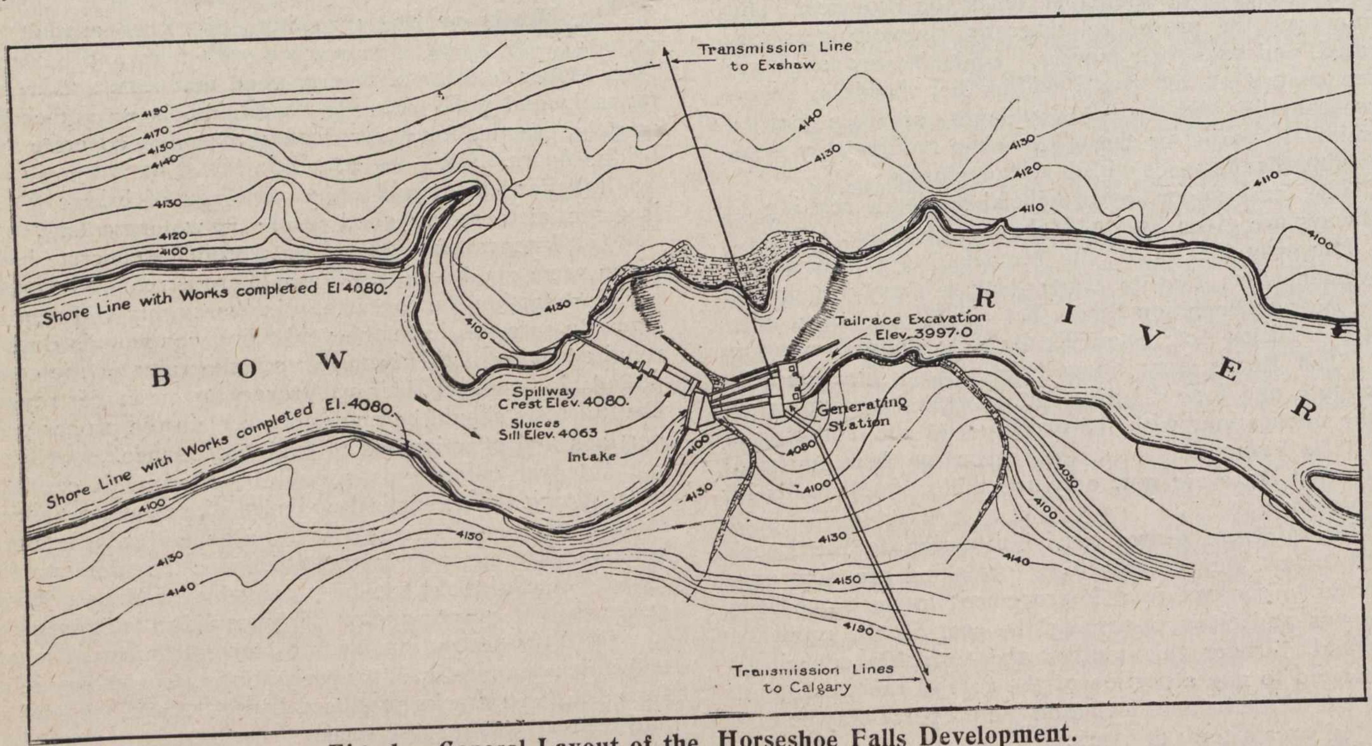


Fig. 1.—General Layout of the Horseshoe Falls Development.

The development is interesting from the standpoint of utilization of the flow, which is very limited at all seasons, during the high-water period, and illustrates the value of small hydro-electric plants to the tourist centres.

Horseshoe Falls Plant.—The largest power development on the Bow River, at present completed, is that of the Calgary Power Company. This plant is located at Horseshoe Falls, about 50 miles west of Calgary, and here one of the very few concentrated falls to be found upon the Bow, is utilized.

At this point the Bow River in its natural state flows through a deep gorge, the walls and bed of which are formed of a shale banded with sandstone. At the point of development a rock outcropping, which is in the nature of an anticlinal dip, occurs. This has been considerably eroded, and forms a drop in the bed of the river of approximately 25 feet. A solid concrete dam has been built across the gorge upon the lip of this outcrop, and this, with the natural fall, produces a head of 70 feet.

The dam is of solid spillway type, with an inspection and drainage tunnel. In addition to the spillway there are 8 sluiceways, provided to take care of flood discharges; four being simply stoplog openings and four being supplied with sluice-gates. The former are 7 ft. by 22 ft., the stoplogs being handled by means of hand winches. The other four are controlled by sluice-gates 19 ft. by 14 ft. of a modified "Stoney" type, operated hydraulically. The spillway section is 140 feet long and, together with the sluices, is sufficient to discharge a flood of 40,000 c.f.s. The inspection tunnel, access to which is gained by means of a well situated midway between the stoplog openings, extends under the spillway section into the rock at the west abutment of the dam. The intake structure is distinct from the dam and occupies a position adjacent to it, approximately parallel to the stream flow. The water, which is admitted through racks and concrete chambers to the 4 penstocks, is controlled by means of stoplogs and butterfly valves placed in the inlet chambers.

The penstock arrangement was described in *The Canadian Engineer* for August 6th, 1914, page 266, to which description the reader is referred. The power house, the main part of which measures 118 ft. by 56 ft., is situated in the gorge below the dam. It is of steel, concrete and brick construction, and houses the turbines, generators, exciters, etc. At the back of the power house, and partly over the penstocks, the switch and transformer rooms are built. The tail-race is protected from back water in time of flood by means of a wing wall, which separates the tail-race from the river for some distance below the power house.

The complete turbine installation consists of four turbines of the horizontal double-runner type in steel wheel cases, and two exciter turbines of the single-runner type, the latter being of 330 h.p. capacity each. Two of the main units are of 3,750 h.p. capacity and, with the governors, were supplied by the Jens Orten-Boving Co. They are of Swedish manufacture, as are also those of the exciter sets. The other two main units are of 6,000 h.p. each, built by Wellman Seaver Morgan Co., of Cleveland, Ohio, and are controlled by Lombard governors. The smaller units are directly connected to two generators, of 2,500 k.v.a. capacity, being 3-phase, 60 cycles, 300 r.p.m. machines and operating at 12,000 volts. The other two units are direct-connected to generators of 4,000 k.v.a. capacity, operated at 12,000 volts, 3-phase and 60 cycles. The generators of the exciter sets are 175 kw., 125-volt, and 700 r.p.m. machines. The generators were built and supplied by the Canadian General Electric Company.

The transformer room contains two 3,000 k.v.a., 12,000 to 55,000-volt, oil-insulated, water-cooled, 3-phase transformers, and two more of the same capacity will be installed very shortly.

The company has three transmission lines in operation, one extending to Exshaw, a distance of 8 miles, and the others forming a duplicate line to Calgary. The Exshaw line supplies power to the Canada Cement Co.'s plant at that place. It is a double-circuit, 3-phase, 12,000-volt line, strung on wooden poles, the conductors being of six 00 aluminum stranded cable. In connection with the line there is a telephone line strung upon the same poles, and also a ground wire. The transformer station at Exshaw contains four 700 k.v.a., 12,000-600-volt, oil-insulated, water-cooled transformers, with lightning arrestors and switching apparatus complete. The switch apparatus in this station was installed by the Canadian General Electric Co., and the transformers by the General Electric Co. of Sweden.

The transmission line to Calgary is in duplicate; each is a single-circuit, 3-phase, 55,000-volt line, the conductors being No. 0 aluminum, with telephone line and ground wire carried on 40-ft. wooden poles. The lines are

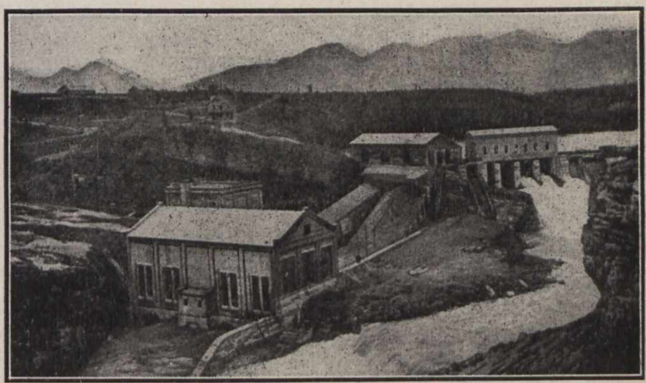


Fig. 2.—Horseshoe Falls Plant of the Calgary Power Co.

parallel to one another for the first 10½ miles from the power house, and follow the Canadian Pacific Railway. These lines handle the power output of both the plant at Horseshoe Falls and that at Kananaskis Falls, now being built.

The design and construction of the plant was carried out by the engineering firm of Smith, Kerry & Chace. The dam presented some interesting problems which required considerable thought and care in solving.

In order that the site of the foundation might be unwatered, and the discharge provided for during construction, two unwatering tunnels were driven on the intake side of the river, from the under side of the lip of the falls up to the upper level, and at such an elevation that only a low cofferdam was necessary to keep the water out of the foundation of the dam. The rock outcrop which forms the fall, and upon which the dam was constructed, dips across the river at a considerable angle, and upon unwatering and exploration of the lower part (the section near the north bank) it was found that the material which is illustrated in the section shown on the plan of the development was not of a satisfactory nature for foundation purposes. An examination proved that no better material underlay it, and this material necessitated special treatment. While the section containing the sluiceways was being built, Mr. John R. Freeman was called in by the company to advise in the matter. His report of October 10, 1910, accompanied by plans showing layout and proposed changes, was acted upon, and the plans of the plant as built, included here, embody the recommendations made.

The following precautions were taken, based upon the report:—

1. The hard sandstone ledge, upon which the dam was to have been built, dipped at such a considerable angle that the cost of carrying the foundations down to this rock throughout the length of the dam, would have been excessive. The northern part of the dam was therefore built upon the shaly rock, overlying the hard sandstone, which it was considered would afford a safe foundation.

In order to obviate any leakage that might develop through the underlying seams, 3-inch holes were drilled through the rock, about 2 ft. in front of the face of the dam, 10 ft. apart, and to a depth of about 40 ft., a casing was then placed in the upper part of the hole, and a thin cement grout forced into the holes under a pressure varying between 60 and 80 lb. per sq. in. until they refused to hold any more. By this means the grout was forced into seams in the rock, cross-cut by the holes, and for a considerable distance from the holes. By first filling alternate holes and later filling the remainder, it was expected that all the seams would be completely filled for some distance from the line of holes.

2. The possibility of leakage around the north end of the dam was met by excavating a considerable distance into the cliff, for the total height of the dam. The cliff consists of a soft shale, liable to disintegration on exposure to air, but as the excavations were completely filled with concrete, any water leaking through the seams in the shale would be forced to travel a considerable distance, and the quantity would be greatly reduced by friction, and as the seams are liable to silting, the leakage would be very nearly eliminated.

3. The inspection tunnel also serves the purpose of a drainage tunnel. Drainage holes, about 16 in. square, and placed 16 ft. 8 in. apart, extend from the springing line of the arch of the tunnel upward through the body of the dam, so that any leaks that may develop through cracks will be intercepted and directed into the drainage tunnel. Other holes, 3 in. in diam., and about 12 ft. 6 in. apart, have been drilled down through the base of the dam into the underlying rock for depths of from 10 ft. to 18 ft. These are cased at their upper end, in order that the quantity of any water leaking through them and also the upward pressure may be measured.

4. The tunnel has been extended into the rock forming the north abutment of the dam for a distance of some 30 ft., so that most of the leakage around the end, if there is any, will be intercepted by the tunnel. This expectation has been realized by the stopping of leakage going on before the tunnel was extended. The tunnel itself is drained through an opening in the downstream side of the dam.

5. The protection of the foundation of the dam at the downstream side has required careful consideration. In order that erosion due to the water coming over the spillway section might be eliminated, Mr. Freeman recommended that the apron of the dam be extended downstream about 40 ft., heavily reinforced and anchored to the rock, and that baffle piers be built on the apron to reduce the velocity of the water and thereby prevent any possible erosion. Other recommendations were made, one being the building of a baffle wall on the crest of the old falls at the south end of the dam, and the facing of the cliff below to prevent undermining.

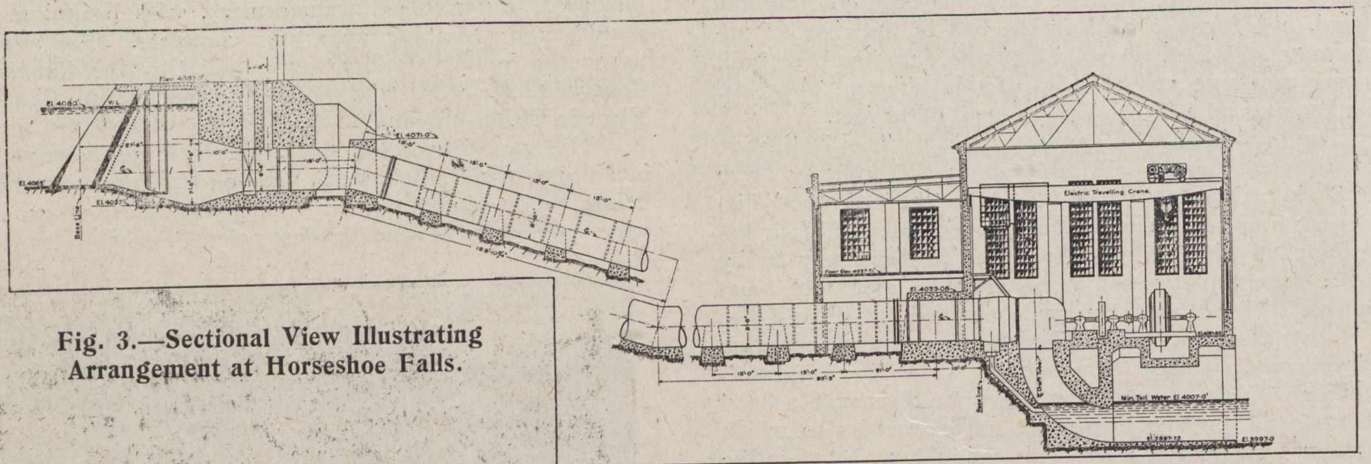


Fig. 3.—Sectional View Illustrating Arrangement at Horseshoe Falls.

The Kananaskis Falls Plant.—This development, the most recent on the Bow River, was described in considerable detail in our issue of August 6th, 1914.

SOUTH AFRICAN RAILWAYS.

The open mileage of Government-owned lines in South Africa at the end of 1913, was 8,281 miles, of these 7,807 miles being 3 ft. 6 in. gauge and 474 miles of 2 ft. gauge, the total increase during the 12 months being 433 miles. The mileage of new lines opened for traffic totalled 385 miles divided between the four provinces as follows:—Cape, 102 miles; Orange Free State, 56 miles; Transvaal, 165 miles; and Natal, 64 miles.

The position of the provinces on December 31, 1913, as compared with the end of the previous two years, was as follows:—

	1913.	1912.	1911.
Cape	3,638	3,492	3,397
Free State	1,162	1,106	1,070
Transvaal	2,362	2,197	2,020
Natal	1,116	1,052	1,052

The figures given above represent Government-owned lines only, with the exception of 50 miles leased from the Natal-Zululand Railway Company. The administration works the section from Vryburg to Bulawayo (597 miles) owned by the Rhodesian Railways, and also 56 miles privately owned within the Union.

Parliament authorized the construction of 14 new lines, but at the end of 1913 their construction had not been entered upon. The total mileage of these authorized lines was 794½ miles, the provincial allocation being: Cape, 306¼ miles; Transvaal, 191 miles; Orange Free State, 166½ miles; and Natal, 130¾ miles.

Coast to Coast

Chatham, Ont.—The city expects to have Hydro-Electric lighting before the middle of January.

Victoria, B.C.—A municipal paving plant, for which contracts were let last spring, will be constructed and made ready for operation during the winter.

St. John, N.B.—The new docks at Carleton were formally opened last week, and the completed structure turned over to the Department of Public Works by the Maritime Dredging and Construction Co.

Victoria, B.C.—The new Canadian Northern Pacific wharf to be constructed at Patricia Bay will, according to an announcement by Mr. D. O. Lewis, divisional engineer of the C.N.P., be commenced immediately, the contract having been awarded to Mr. J. Doe.

Kamloops, B.C.—The Hydro-Electric power plant on the Barriere River (described in *The Canadian Engineer* for November 5th, 1914), has been put into operation. The installation provides for a maximum development of 20,000 h.p. At the present time about 6,000 h.p. is being developed.

Brockville, Ont.—The Hydro-Electric Power Commission of Ontario will shortly construct a transformer station, 20 x 39 ft., at an approximate cost of $4,000, to be used in connection with the new power line now under construction from Prescott. This line will be completed in the spring. It will carry current at 26,400 volts, which will be stepped down to 2,200 volts for use in Brockville.

Welland, Ont.—The new factory of the Tuttle-Bailey Co. of Canada, Limited, has been completed. It is of reinforced concrete and steel, 100 x 200 feet in dimensions, and has been erected at an expenditure of about $60,000. The company will manufacture steel registers. It will employ about 50 men. Peter S. Gordon is local manager. The company has a branch at Winnipeg, Man.

Sydney, N.S.—By the end of the year the Intercolonial will have completed 105 new steel bridges, to take the place of the light bridges so numerous along its line. The railway is making wholesale preparations for the handling of heavier traffic, and the steel structures now being erected are designed to meet the requirements for many years to come. With their construction going on, the purchase of more powerful locomotives and for larger and better transportation equipment are being looked after.

Toronto, Ont.—The Commissioner of Works has recommended to the city council the construction of a highway running north and south through Mount Pleasant Cemetery, to afford a thoroughfare between North Toronto and East Rosedale. The estimated expenditure upon this much-needed improvement is $275,000. Another similar recommendation has to do with a road to run east and west across Prospect Cemetery to create a thoroughfare between Dufferin St., to cost between $25,000 and $30,000.

Vancouver, B.C.—The bulkhead belonging to the C.N.P. terminal scheme in False Creek is nearing completion, and reclamation work will be resumed at an early date. Over 3¼ million cubic yards will be required to build up the area under improvement. Of this amount over 1,000,000 cubic yards have already been deposited by the Pacific Dredging Co. This company is also dredging out the deep-water channel in connection with the harbor improvement scheme of the Department of Public Works.

Toronto, Ont.—As announced elsewhere in this issue, thhe city council has accepted the tender of Messrs. Quinlan and Robinson, of Montreal, for the construction of the Don Section of the Bloor Street Viaduct, according to plans and specifications prepared by the Department of Works of this city, under the direction of Mr. R. C. Harris, Commissioner of Works. These specifications cover a steel structure with concrete abutments and piers. The plans were described in *The Canadian Engineer* for October 29th, 1914.

Winnipeg, Man.—It has been announced that the construction of the aqueduct for the Greater Winnipeg Water District will be commenced in March. The close of the construction season finds the right-of-way located and cleared; a 90-mile railway constructed through country, much of which consisted of muskeg and timber; partial completion of the dyke across Indian Bay, 1½ miles in length; completion of preliminary channel connecting Indian Bay with Snowshoe Bay; a telephone line, permanently constructed for the full length of the system; ballast-pits located and open, and a large amount of fencing done.

Cobalt, Ont.—The Cobalt Reduction Co. has commenced the construction of an addition to their present mill. This addition will be a cyanide plant, to have a daily capacity of between 125 and 150 tons. It is to be completed and ready for operation next March. This plant will treat by the cyanide process the slimes produced by crushing operations in the mill. The building will be 193 ft. x 70 ft., with an additional wing, 80 ft. x 70 ft. The foundations are to be of concrete, and the superstructure of steel and fireproof material. The machinery to be installed will include the usual classifiers, settlers, agitators, and vacuum filters necessary in the process.

PERSONAL.

P. B. MIGNAULT, K.C., has been chosen to succeed Hon. T. C. Casgrain as member of the Canadian section of the International Joint Commission.

CHARLES L. WISNER has been appointed to succeed Mr. J. H. Housser, deceased, on the board of directors of the Massey-Harris Company.

A. E. STEVENS, of Vancouver, has been appointed general superintendent in Alberta of the Canadian Pacific Railway, succeeding Mr. D. C. Coleman, with headquarters at Calgary.

A. PRICE, assistant general manager, Canadian Pacific Railway, read a paper at a meeting of the Canadian Railway Club last week in Montreal. His subject was "Some Maximums and Minimums in Train Operation."

SAMUEL HALE, manager of the Algoma Steel Corporation, is about to retire, according to a press report. Mr. J. F. Taylor, president of the company, will take charge of the works and of the operation of the plant.

J. J. FERRIS, superintendent of oil service, Canadian Pacific Railway, delivered an illustrated address on "Fuel Oil and its Application" before the regular meeting of the Vancouver Branch of the Canadian Society of Civil Engineers on December 3rd.

OBITUARY.

The death occurred in Montreal last week of Mr. James A. Baylis, chief engineer of the Bell Telephone Co. of Canada. Mr. Baylis was a graduate of Worcester Polytechnic Institute, and has been in the employ of the Bell Telephone Co. since 1890. Mr. Baylis was a member of the American Institute of Electrical Engineers.

The death occurred in Chicago last week of Mr. R. M. Greene, a structural engineer, of Winnipeg, and a former instructor at the University of Manitoba.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY.

On December 9th the members of the University of Toronto Engineering Society assembled to pay tribute at a memorial meeting to the late Dr. John Galbraith, dean of the Faculty of Applied Science and Engineering. The meeting was addressed by several of the older graduates, including Mr. G. H. Duggan, vice-president and chief engineer of the Dominion Bridge Co., and a graduate of 1883, and Dr. T. Kennard Thomson, consulting engineer, New York, and a graduate of '86. Mr. E. D. Gray, president of the Society, was in the chair.

The speakers referred to their early associations with Dean Galbraith and to the remarkable development of the Institution, as viewed by them from a distance, since graduation. In his remarks, Dr. Thomson reviewed briefly the engineering career of the departed man, touching upon his exceptional character, marvellous foresight and preponderant spirit. The late educationist's policy was reviewed and eulogized as one which developed in the old graduates as time went on the feeling that the course of instruction which they had received from him was of far greater value than could be obtained from any course in the best modern University.

On the following day another meeting of the Society was addressed by Dr. Thomson on the foundations for bridges and buildings, especially as regards pneumatic caisson work.

Compressed-air caissons were first used on this continent in North Carolina, in 1852 for bridges, and in 1893 in New York City for buildings. Now many bridges and buildings are supported by foundations obtained by this method.

Photos were shown of the beautiful stone arch bridge over the Connecticut River, at Hartford, and accidents were described which happened in the Susquehanna, Missouri and other rivers. Many New York skyscrapers were described, especially those whose cellars are 16 to 32 feet below the level of the surrounding ground-water. No difficulty is experienced in keeping them dry, as described.

The difficulties of pile-driving were also shown by photos of many very badly driven piles. The underpinning or placing of new foundations under old buildings as high as 18 stories, without allowing the building to settle, was also explained in detail.

A description was given of the removal of a 17-story building on penumatic foundations, which was removed after 14 years' service from the corner of Wall and Nassau Streets to make place for the 39-story Bankers Trust Building. In this connection it was noted that where the steel columns were in contact with concrete no rusting had commenced, but where there was an air space between the steel and concrete, then rusting had made considerable progress.

AMERICAN CONCRETE INSTITUTE.

The eleventh annual convention of the Institute is to be held in Chicago, February 9th to 12th, 1915. The following is a summary of the programme:—

Concrete Roads, Sidewalks and Bridges.—Papers and discussions relating to the status of concrete road construction will be presented, and special attention given to costs, repairs and maintenance.

Concrete and Reinforced Concrete Tests and Design.—Discussion of the column tests made by the Institute at Pittsburgh, tests of buildings, and other matters of current special interest.

Concrete in Art and Architecture.—Discussion of architectural design in concrete, dimension and art concrete stone, treatment of surfaces, etc.

Plant Management and Costs.—Devoted to concreting plants, covering plant management and costs, the design and cost of wood and metal forms, and the methods of placing, proportioning and selection of concrete materials.

EDMONTON BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The next regular meeting of the Edmonton Branch will be held on January 6th, and will be addressed by Mr. A. J. Latornell, city engineer, Edmonton. His subject will be a description of the trunk sewer system of Edmonton.

An interesting syllabus of papers for the season has been prepared. On November 4th Mr. R. H. Parsons read a paper entitled "The Prevention of Electrolysis Due to Street Railway Tracks." On December 2nd Mr. J. Chalmers read a paper, "Depreciation as Applied to Public Utilities." Future meetings include a paper on military engineering, to be given in February by Mr. D. Donaldson. Messrs. J. Brodie and J. A. Allan will take up the subject, "Natural Gas in Alberta, with Geology Incident Thereto," at the March meeting. The April paper will be "Electric Railway Operation and Management," by Mr. J. H. Larmouth. The May meeting will be devoted to general business of the Branch. The members meet fortnightly, each alternate meeting being of a more or less informal nature, with a dinner as part of the programme. Commissioner J. Chalmers is chairman of the papers committee.

CLAY WORKERS' CONVENTION.

The annual convention of the Canadian National Clay Products Association will be held in Toronto, January 26th-29th, 1915.

COMING MEETINGS.

AMERICAN FORESTRY ASSOCIATION. — Annual meeting to be held in the Woolworth Building, New York City, January 11th, 1915. Secretary, P. S. Ridsdale, Washington, D.C.

CANADIAN NATIONAL CLAY PRODUCTS ASSOCIATION.—Annual Convention to be held at the King Edward Hotel in Toronto, January 26, 27, and 28, 1915. Secretary, G. C. Keith, 32 Colborne Street, Toronto.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Twenty-ninth annual meeting, to be held in Montreal, January 26th, 27th and 28th, 1915. Secretary, Prof. C. H. McLeod, 176 Mansfield Street, Montreal, Que.

EIGHTH CHICAGO CEMENT SHOW.—To be held in the Coliseum, Chicago, Ill., from February 10th to 17th, 1915. Cement Products Exhibition Co., J. P. Beck, General Manager, 208 La Salle Street, Chicago.

AMERICAN WATERWORKS ASSOCIATION. — The 35th annual convention, to be held in Cincinnati, Ohio, May 10th to 14th, 1915. Secretary, J. M. Diven, 47 State Street, Troy, N.Y.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—Annual meeting to be held at the Iowa State College, Ames, Iowa, June 22nd to 25th, 1915. Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.