good results on the New York Central, and it appears in general to be an imitation of the Post tie, with an endeavor to simplify manufacture, see (d) Plate XXV. Other forms of less tried qualities are the Standard, an inverted channel beam, and the International, having a section like an elongated bracket ——'——, which would appear to be deficient in vertical stiffness. It is probable that persistent attempts at improvement will have a tendency to cheapen manufacture, and hasten the introduction of metal ties on many progressive railways having heavy traffic.

(*To be continued.*)

For The Canadian Engineer.

SEWERAGE SYSTEMS OF ONTARIO.

BY WILLIS CHIPMAN, C.E.

The following tabular statement gives the extent and cost of the sewerage systems of the Province, excluding those of the cities of Toronto, Ottawa, Hamilton, London and Kingston.

	Population	Miles Sewers	System	Approximate Cost	Engineers
Barrie	6,000	3½	Separate	$ 27,000	Chipman, Ardagh
Belleville	10,000	5	S. & C.	65,000	Neilson, McDougall
Berlin	9,500	10	Separate	69,000	Bowman, Chipman*
Brantford	17,000	14	Separate	134,000	Chipman Jones, T.H.
Brockville....	9,000	11	Separate	121,000	Chipman
Chatham	10,000	18	Combined	95,000	McDonell, McGeorge Topp
Cornwall	7,000	7	C. & S.	55,000	Chipman, Wiggins, Brown
Goderich . ..	4,000	4½	Separate	19,000	McDougall,† Brough
Niagara Falls.	5,000	11½	Separate	105,000	Mitchell, Chipman,†
Owen Sound..	8,000	7¼	Combined	48,000	Kennedy, McDowell
Peterborough .	11,000	7½	Separate	70,000	McDougall, Belcher
Petrolea	6,000	6	Combined	45,000	Jones, J. H.
Renfrew ..	3,000	4	Separate	20,000	Chipman
St. Catharines	10,000	6	Combined	70,000	Gardiner, Reynolds, Roberts
St. Thomas ..	11,000	46	Combined	150,000	Bell, Campbell
Sarnia	8,000	7	Combined	26,000	Jones, J. H.
Sudbury	1,400	1¼	Separate	10,000	Gordon, Rorke
Stratford	10,500	8½	S. & C.	70,000	McDougall, Van-Buskirk
Tor. Junction.	5,000	11	Separate	120,000	Chipman
Walkerville ..	2,500	4½	Combined	50,000	DeGurse
Waterloo	3,000	3½	Separate	20,000	Bowman, Chipman*
Welland	2,500	1½	Combined	7,200	Ross
Windsor	12,000	21	Combined	280,000	DeGurse
Woodstock...	9,000	11½	Separate	50,000	Davis

In those places where the separate system has been adopted, the sewers are modern in design, and have been constructed during the last ten years under the supervision of competent engineers.

In some places the sewers have been built street by street and year by year without reference to any general plan or system, and occasionally without the advice or assistance of an experienced engineer. In some few places a large amount has been expended, but to the present time they have few, if any, proper sanitary sewers.

Class A.—Barrie, Berlin, Brantford, Brockville, Niagara Falls, Renfrew, Toronto Junction, Waterloo.

Class B.—Cornwall, Goderich, Peterborough, Owen Sound, Sarnia, Sudbury, Walkerville, Windsor.

Class C.—Belleville, Chatham, Petrolea, St. Catharines, St. Thomas, Stratford, Welland, Woodstock.

In Class A have been included those places in which the majority of the citizens are now served with well built, properly designed sanitary sewers; and where all plumbing work and the laying of house sewers are done according to stringent rules and regulations under the city or town engineer's inspection, and full records kept of all such work. These are undoubtedly the best sewer systems in Ontario, not excepting the five largest cities of the province. Drains of wood and stone are excluded from these systems.

In Class B some of the places have almost complete sanitary systems, but they have no regulations or rules whatever governing plumbing, and no complete records are kept of work done. The other places in this class have partial systems now built, covering the majority of the streets, but the plumbing by-laws are very imperfect. Drains of stone and wood are also excluded from class B.

In class C have been placed: (a) Those places that have constructed a very few sewers or a main sewer, but in which the great majority of the streets have at present no proper sanitary sewers. The work done has been of a modern character, but only a commencement has been made towards a first-class sewer system. (b) Those places in which a large part of the expenditure represents the cost of box drains and sewers that cannot or should not be used for sewage purposes. It must not be inferred, however, that all of the places in class C are not, on the whole, as well sewered as those in class B.

* Consulting Engineer only.
† Designing Engineer only.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

(*Concluded from last issue.*)

EXPLANATION OF THE TABULATED RESULTS.

The ropes are arranged in the table so that those of the same order are grouped together, and the results are the more readily comparable. Under the column, "Position of fracture":

U	is an abbreviation for		Upper.
L	"	"	Lower.
T	"	"	Thimble.
S	"	"	Strands.
P	"	"	Pin.

Where no mention is made of the number of strands broken, one strand is to be always understood. The extensions in most cases were taken over a distance of eighteen inches. In testing some of the wet specimens, however, the stretch was so great and the travel of the machine so limited that twelve inches was all that could be allowed over which to take the extensions. In the results no distinction is made between the percentages obtained from these two different lengths. In tabulating the position of fracture as centre, it is not to be taken that this fracture occurred exactly in the centre of the specimen; but was far enough from the fixtures at either end so that no damage could possibly result to the fiber. Therefore we can at once assume that wherever in the tests, a "centre" fracture is recorded, we in that case at least develop the absolute maximum strength of the specimen. The time of the test is given from the moment the load was applied to the specimen to the time when rupture occurred. The time of immersion in water before the wet test was made varied from forty-eight hours to one week, depending on the size and quality of the rope; the idea being to have the rope at least thoroughly wetted.

In the soaked tests, the ropes were in water on an average of about six weeks. The column showing the number of twists per foot is given instead of the "percentage of hard," which is referred to in the short description of the manufacture of rope.

Sufficient comparisons are here given to show that no regularity exists between the strength of one strand of a rope and the strength of three or more strands when they are formed into one rope. The result follows that if we have a rope of two strands and also one of four, we have no good reason for assuming that the one of four strands will be twice as strong as the other. The greater strength proportionately of one strand above two and two above

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in The Canadian Engineer.