making improvements to the building. — The building No. 31 King street west, is to be remodelled. It is rumored that it is the intention of the owners to turn it into an hotel.—The City Engineer has been requested by the Property Committee to prepare plans and specifications for the improvements to the Yonge street wharf.—A meeting of the Sheppard Company will be held in the company's offices on the 21st inst., when the purchase of a site and the erection of a suitable building thereon will be discussed.— A water main is to be laid on Blair avenue, cost $475.—The fittings are to be placed in the new Isolation Hospital at once. The cost will be in the neighborhood of $6,000.—At the regular meeting of the Board of Works on Monday last, the recommendation of the City Engineer for the extension of the Yonge street sewers was adopted, and the work ordered to be done at once. —At a meeting held last week of the diectors of the National Club, which has purchased the leasehold of the old United Empire Club's building on King street, it was decided to submit a suggestion to the members to expend the sum of $33,000 in making improvements and alterations to the building. Should the suggestion meet with approval, Messrs. Strickland & Symons, will in all probability be entrusted with the supervision of the work.—Building permits have been granted as follows J. M. Dickson, pr. b. f. dwellings, 42 McGee st., cost $2,200; W. H. Cormack, 15 Russell st., det. 2 story and attic bk. and stone dwelling, e side Madison ave., n of Lowther ave., cost $7,000 J. H. Farr & Co., 1 story bk. factory w. side Moose st., cost $1,200.

FIRES.

The Mission City hotel Mission City, B. C., was completely destroyed by fire on the 10th inst. —Mr. F. G. McMullen's large steam saw mill at Ryan's Creek, N. S., four miles from Shubenacdia, was burned to the ground on Friday of last week. Loss, $3,000.—G. W. Ayer & Co.'s shingle mill and a grist mill occupied by Manson & Boright at Magog, Que., were burned on the 28th inst. Loss, $6,000.—The Roman Catholic Glebe House at Church Point, N. B., was burned last week. Loss, partially covered by insurance.—J. L. Lyon's store and dwelling at Tusket, N. S., was totally consumed by fire on the 8th inst. Insurance, $3,800.—The Thomas McDonald Manufacturing Company's works on Inspector st, Montreal, were damaged by fire recently to the extent of $40,000. Loss, $27,000.—J. G. Findlay's mill at Wallaceburg, Ont., was burned on the 6th inst. Loss, $2,000.—Buildings owned by Levi Bros., C. Bouthilette, and A. P. Ferguson, at Mattawa, Ont., were destroyed by fire on Thursday of last week.—The residence of Mr. Evans Ingram at Otonabee, Ont., has been destroyed by fire.—Mr. Donald Brown's dwelling at St. Lambert, Que., was burned to the ground on the 13th inst. Loss, $2,500; insurance, $1,400.—J. S. Henderson's factory at Parrsboro', N. S., was burned on Sunday last.—Edmond Teclerc's door and window sash factory at L'Islet, Que., was burned recently. Loss, $5,000.—A disastrous fire occurred at Regina, N. W. T., on the 14th inst. The following are the names of owners of the buildings destroyed: Mowat Bros., John Dawson, Mr. McCarthy, Mr. Curtis, Hugh Armour, George Webb, Mr. Lunan and Charles Howson.

CONTRACTS AWARDED.

TORONTO, ONT.—The Metallic Roofing Co. are manufacturing 200,000 square feet of galvanized corrugated iron for covering the train sheds of the new Union Station in this city.

MONTREAL, QUE.—The municipality of St. Cunegonde have awarded the contract to Messrs. Bastien & Valiquette for constructing pavements next year on St. Antoine, Notre Dame, Duerney, William and Levi streets.

The Ronald Fire Appliance Works, have sold to the town of Regina, N. W. T., the World's Fair engine and a house heater for the same. The same firm have also contracted for a complete outfit for Edmonton, N. W. T., and have been given an order for a 50 gallon chemical engine for Springfield, N. S.

Mr. Emile Dubé, of River du Loup, Que., has purchased the lumber business carried on by the Estate of the late Mr. F. C. Dubé. He will continue alone in business as lumber merchant and contractor.

TEST LOADS ON PILES.

A report has appeared giving details of tests which were applied a few months ago to piles by Mr. Weydert, the superintendent of buildings, Chicago. The public library was to be built on piles driven into the clay, and it was assumed that they would be able to carry a load of 30 tons on each. Mr. Weydert ordered that a platform 7 feet by 7 feet, consisting of 12 inches by 12 inches yellow pine timbers resting on steel I-beam 16 inches deep should be placed on four piles, and on this platform pig-iron was piled to a height of 38 feet. This test was commenced in the morning, January 6th, a week after the piles to be tested had been driven. The surveyors marked points on top of the piles and took levels on them after the pig-iron had been piled to a height of 4 feet, and the load was about 45,200 lbs. The piling up of the pig-iron continued irregularly, owing to the severe weather, until January 10, when it had attained a height of 21 feet, and a weight of 224,500 lb. Levels were taken, but no settlement was discoverable. On January 16 at 2 P.M. all the pig iron had been piled on; it had then reached the height of 38 feet and the load on the four piles was about 504,800 lb. or about 50·7 tons per pile. On January 18 levels were taken and no settlement was discovered. The levels were repeated on January 20th, after the above load had remained for three days; also on January 28, after the load had remained for eleven days, in both cases no settlement being observable. Further tests, not being deemed necessary, and the tests hindering the progress of the work, orders were given on January 29 to proceed with the removal of the pig-iron. The four piles, therefore, sustained a load of a little over 50 net tons each for practically a fortnight, without giving any indication of settlement.

The piles were driven by a steam-hammer of the Nasmyth type; weight 4,500 lb.; fall 42 inches, making 54 blows per minute. The last 20 feet were driven with a follower of oak. It was found that it required 48 to 64 blows to drive the last foot with the follower, and as the ratio of blows without follower to blows with follower is as one to two, it may be estimated that it would have required from twenty-four to thirty-two blows of the hammer to drive the last foot directly without follower. In the same soil it required about sixteen blows of a drop-hammer weighing 3,000 lb. and falling 30 feet to drive the last foot with a follower as above, and thirty-two to thirty-six blows of the same drop-hammer falling 15 feet with a follower.

The piles were driven 2½ feet between centres, nearly, three in a row along the trench. This is deemed to be as close as they can be driven with ease. They were about 54 feet long, and were driven about 52½ feet. They had an average diameter of 13 inches, circumference of 41 inches, and an area at tip of 80 square inches. If a pile similar to the test piles is left for 24 hours, it is found that it requires 300 to 600 blows of the above described hammer to drive it the last foot, or a repetition of 300 to 600 blows of 189,000 inch pounds each. The heads of the piles, after being sawed off, were 27 feet below the street, and the tips about 80 feet below the same. They were driven about 27 feet in soft plastic clay, 23 feet in tough, compact clay, and two feet in hard pan. The bearing power of this hard pan may be estimated by Rankine's formulas at 170 lb. per square inch, and by empirical results at 250 lb. per square inch; in this case it may be a fair assumption that it would carry 200 lb. per square inch. The extreme average frictional resistance per square inch of sides of piles like those described, as deduced from experiments made under analogous conditions, may be placed at 15 lb. per square inch.

The average area of the tip of the above piles is 80 square inches. Therefore their extreme point of resistance will be 16,000 lb. The surface of their sides is about 25,000 square inches, so that their total extreme frictional resistance will amount to 376,000 lb. As the point resistance in comparison to the latter is but small, it may be neglected, and the ultimate bearing capacity of a pile similar to the test piles may be estimated at 375,000 lb., or about 180 tons. But inasmuch as the ultimate crushing strength of wet Norway pine may not be over 1,600 lb. per square inch, or using a factor of safety of 3,533 lb. per square inch, and whereas the minimum area of piles specified to be not less than 8 inches at the top and 16 inches at the butt is about 113 square inches, each pile should not carry more than 60,000 lb., or 30 tons. This provides a factor of safety of 2 for the crushing resistance of the timber, and a factor of safety of 6 for the frictional resistance of the soil. If the timber be loaded to one-half of its ultimate strength, a load of 90,000 lb., or 45 net tons may be assigned to one pile. But in the library building the conservative load of 30 tons per pile was adopted, which gives assurance that this building will not be likely to suffer from any want of strength in its foundations.

PILE DRIVING

A falling body cannot do more work when its progress is arrested than has been done on it in lifting it up to the height from which it has fallen. This is a fundamental and unalterable principle. Thus, for example, let us suppose that the ram of a pile driver weighs one ton, and that it falls four feet on to the head of a pile; then the work in the ram cannot be either more or less than that which is equivalent to four foot tons. Thus, the work in the ram at the moment it touched the head of the pile would be sufficient to raise the ram up again to the point from which it fell; or to raise a weight of four tons to a height of one foot; or to raise one pound through a height of 8,960 feet; or to raise 48 tons through a height of one inch. Now, it is clear that if the ram were employed to raise one ton through a height of four feet, it must exert a force of one ton through the distance of four feet. If it did not, it would not move one ton at all, for it would be overbalanced. If it were called upon to raise four tons through a height of one foot, then it must exert a push of four tons through a distance of one foot; if to lift a weight of 48 tons, then it must exert a push of 48 tons through a distance of one inch, and so on. Bearing this in mind, there will be no difficulty in understanding the following simple rule: The force of a blow is measured by dividing the whole distance passed through by the ram before impact by the distance passed through after impact, and multiplying the weight by the quotient. Thus, let the ram weigh one ton, let the fall be 48 inches, let the pile descend one inch at each blow, then the push or effort exerted by the ram on top of the pile will be

$$\frac{48}{1} = 48, \text{ and } 48 \times 1 = 48 \text{ tons.}$$

It must be understood that this is the mean or average force of the blow. Its initial effort may be much less, because at the instant of impact the ram is moving at its full velocity, while at the instant the pile ceases to descend it will have no motion at all, and consequently, will exert no push, except that due to its weight. Three factors are in all cases necessary, namely, the weight, the height of fall, and the distance through which the body receiving the blow moves. In practice it is by no means easy to ascertain the latter with precision; and the energy in the falling body can be expended in more ways than one. For example, when the head of the pile is struck, two effects take place simultaneously, the ram is shortened and so is the pile. The elastic rebound of each immediately takes place, and the ram jumps up from the top of the pile. Again, the top of the pile becomes highly heated. The elasticity of the pile plays an important part in influencing the rate of its descent. A ram weighing 100 pounds, falling a height of 50 feet, will have stored in it on impact 5,000 pounds, and if the progress of the pile were one inch, its driving force would be 60,000 pounds. A ram weighing 1,000 pounds and falling 5 feet, would also have 5,000 foot-pounds of work in it, and would exert a driving force of 60,000 pounds over a space of one inch; but it does not follow that the former would be equally effective in driving the pile. On the contrary, the lighter ram striking the pile with a higher velocity might be much the less efficient of the two because the force of the blow would not be transmitted through the pile, but would be expended in compressing the top of it.

When a pile is struck on the top, what is known as a wave of compression passes through it; and this wave requires time for its passage. Such a wave is set up in all columns when stress is suddenly brought on one end. The effect of a heavy ram falling a short distance on a pile head resembles a push, in a sense, and gives time for the transmission of the effort throughout the whole pile, but when a light ram falls the effect may be confined to the top of the pile, which is shattered.

The velocity with which a ram strikes a pile head is calculated by extracting the square root of the height of the fall in feet and multiplying it by eight. Thus, let the ram fall four feet; the velocity will be 16 feet per second. If the ram falls 50 feet it would strike the pile with a velocity of 56 feet per second. If the speed was greater than that at which the wave of transmission could pass through the pile, then little or no effect would be produced in the way of causing its descent; as nearly the whole of the work would be done in compressing the top of the pile, or in shattering it, and the driving effect would be nothing. The effect of the element of time is not sufficiently well understood. About the only thing fully understood or accepted is that a heavy ram falling from a moderate height is, other things being equal, much more efficient than a light ram falling from a great height.

MUNICIPAL DEPARTMENT.

LEGAL DECISIONS AFFECTING MUNICIPALITIES.

In the case of J. A. Cherrier vs. the Township of Ascott, the plaintiff sued for $15,000 damages, on behalf of the minor child of Joseph A. Perreau and his wife, caused by drowning of the child's father and mother, while attempting to drive over that part of the travelled road leading from Capleton to Lennoxville on the 26th day of June 1892. The Coaticook river had overflowed the road. The municipality pleaded negligence on the part of Perreau, which Judge Brooks admitted in so far as to give only $500 to plaintiff.

A decision of much interest to municipalities was renderd recently by Mr. Justice Rose at Osgoode Hall in an action brought by the city of Toronto against Mr. Daniel Larsch for obstructing the highway. The obstruction complained of consists in the encroachment upon the sidewalk by the old MacDonald estate on Queen street west, near Gladstone avenue. It was contended on behalf of the defendant that no action could be brought except by the authority of the Attorney-General of Ontario, because all highways were vested in the crown. The court decided that the municipal corporation could protect itself without the leave of any other party.

Sewers and water conduits are being built at Grand Rapids, Mich., under the direction of City Engineer, N. A. Collar in rather an interesting manner, says the *Engineering Record*. The work lies along the bank of the Grand River, and its object is to intercept a quantity of sewage now discharged above the intake of the waterworks and convey it to a point farther down the stream where it will be away from the point of water supply. In the rocky bed of the river a conduit of about 25 square feet area is being excavated from the intake crib in the middle