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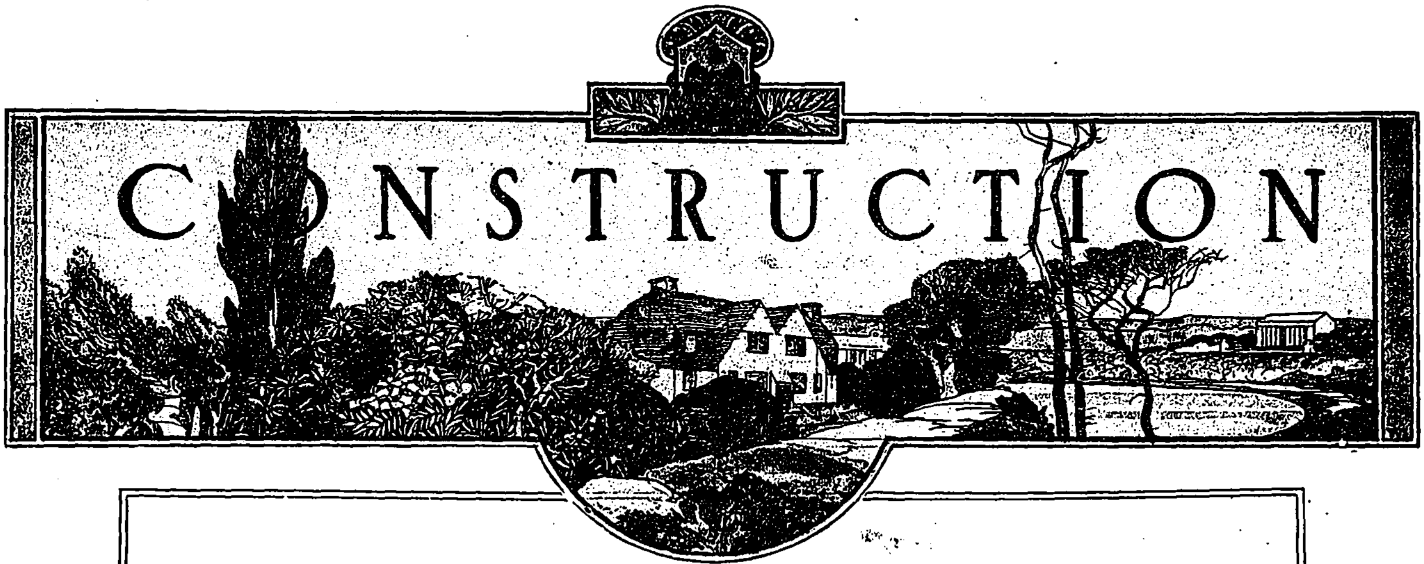

September, 1918 Volume XI, No. 9

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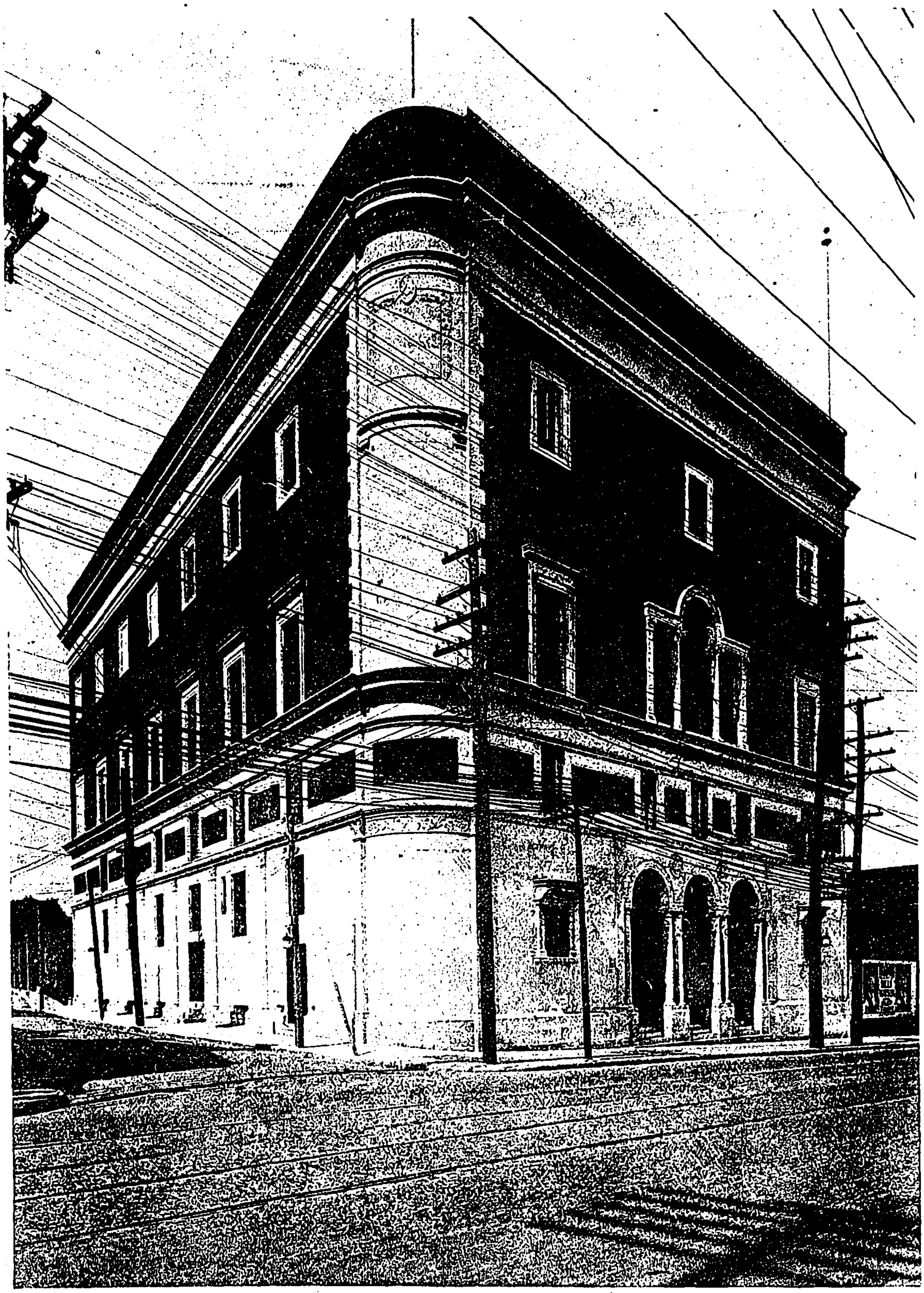


NEW MASONIC TEMPLE.

Yonge Street and Davenport Road, Toronto.

Wm. F. Sparling Company, Architects and Engineers.

New Masonic Temple, Toronto

THE new Masonic Temple is located at the northwest corner of Yonge street and Davenport road. It is a commodious structure, six storeys and basement, occupying a frontage on Davenport road of 135 feet and a frontage of 85 feet on Yonge street. On January 1st, 1819, the construction was so far advanced that the lodge rooms on the first floor level and the main auditorium on the ground floor level could be used, and the building was completed shortly afterwards.

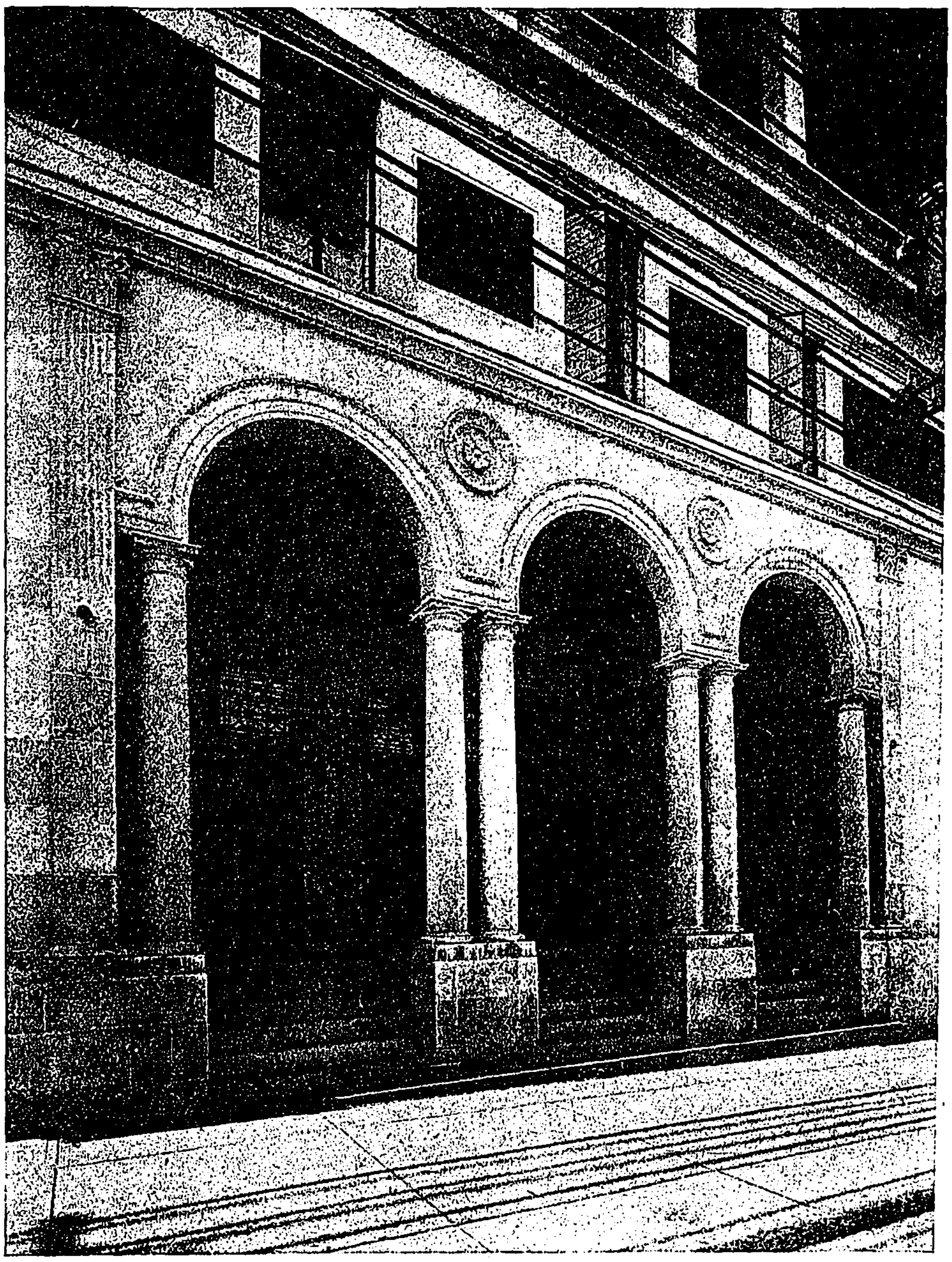
The building is designed in the Italian Renaissance style, the exterior walls being partly of Indiana limestone and partly of selected tapestry brick. Tile back-up was used throughout. A fireproof construction of reinforced concrete was adopted, and steel casements were used to the street elevations, and steel sash and wire glass to the others. All partitions, furring, etc., are built of tile.

The basement contains a large banquet room, with kitchens directly attached, also coat rooms, toilet accommodation, janitor's apartments, boiler and fan rooms, etc. A unique feature of the banquet room is that it is capable of subdivision into two separate banquet rooms by means of two series of folding doors, for the purpose of providing an air space to assist in preventing noise from one room reaching the other.

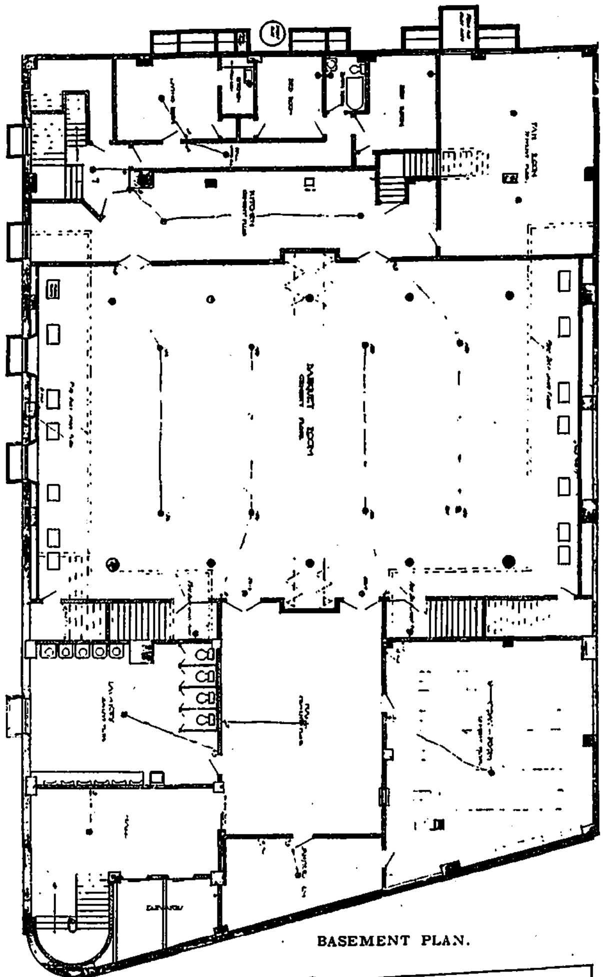
On the ground floor is a large auditorium, which, with the gallery, seats twelve hundred. Fixed seats are used in the gallery, but on the ground floor, which can be used for dance purposes as well as a concert hall, movable seats are provided. A storeroom under the stage is used to store these movable seats when not required. The remainder of the ground floor contains a large foyer, lobby, men's smoking room, check rooms, ticket offices, ladies' parlor, retiring rooms, etc. On the gallery and mezzanine floor are the main gallery to the auditorium and the offices of the Masonic Temple Corporation, comprising general office, board room, committee rooms, etc.

The first floor is devoted to lodge and chapter rooms, and contains one large blue room, 47 feet by 53 feet clear; one smaller blue room, 29 feet by 53 feet, and one chapter room, 33 feet by 53 feet, together with anterooms, reception rooms, etc. The choir galleries and organ lofts to these lodge and chapter rooms are on the first floor mezzanine, on which level is also a general storeroom.

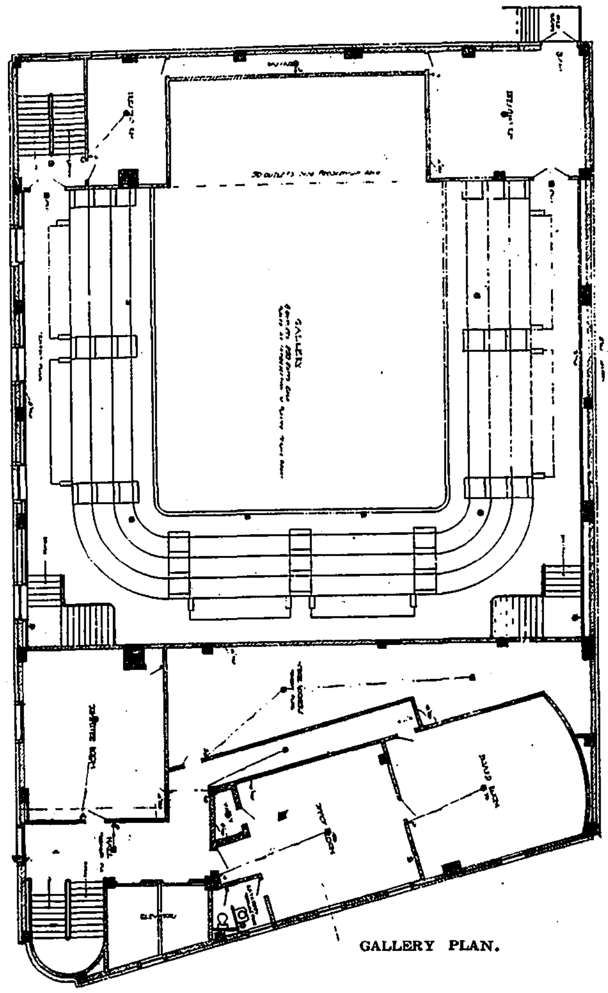
The Scottish Rite and Preceptory rooms,



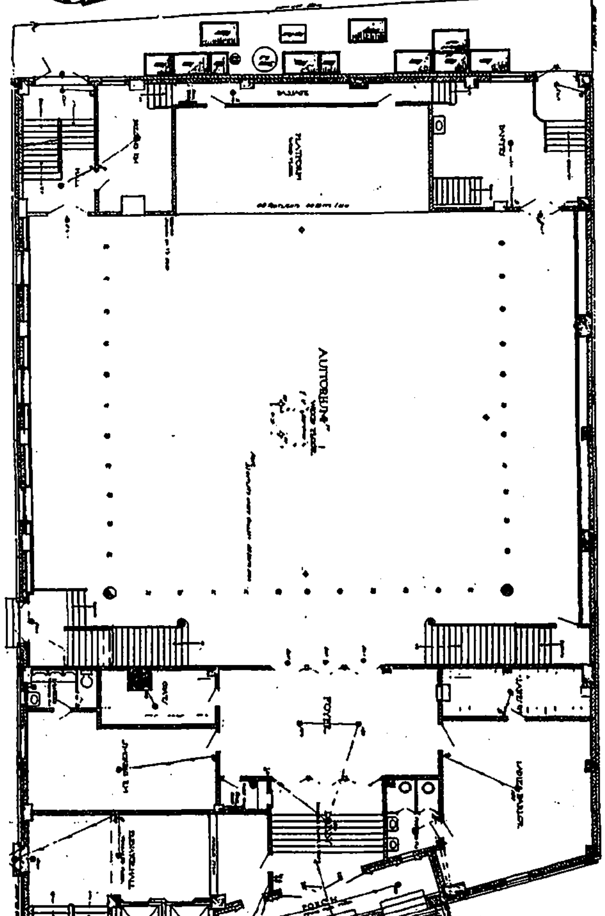
DETAIL OF ENTRANCE.



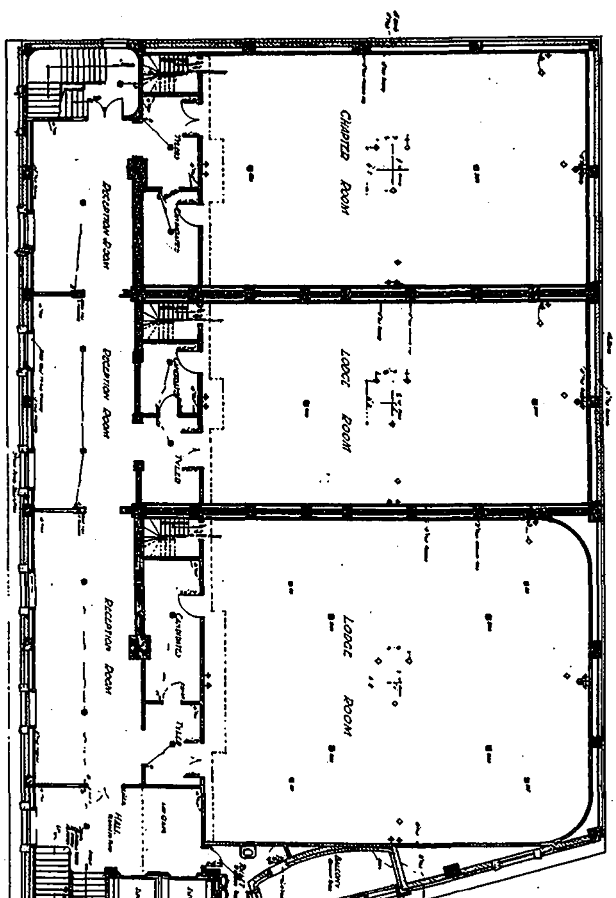
BASEMENT PLAN.



GALLERY PLAN.

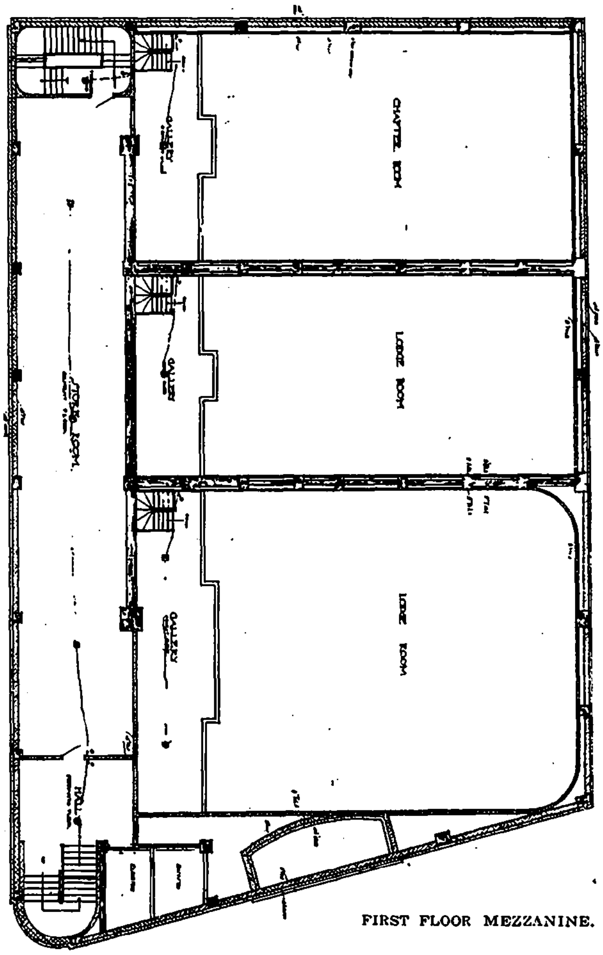


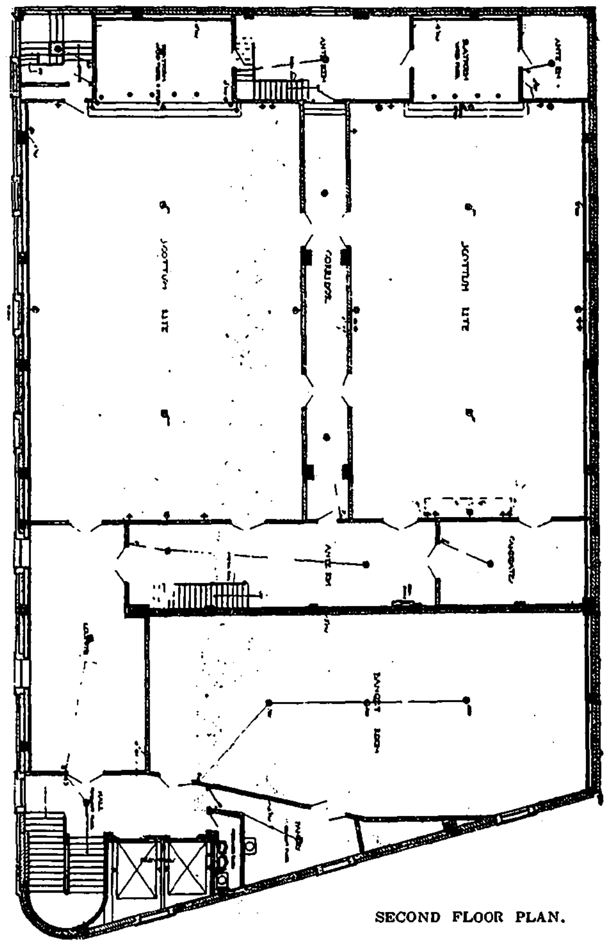
GROUND FLOOR PLAN.

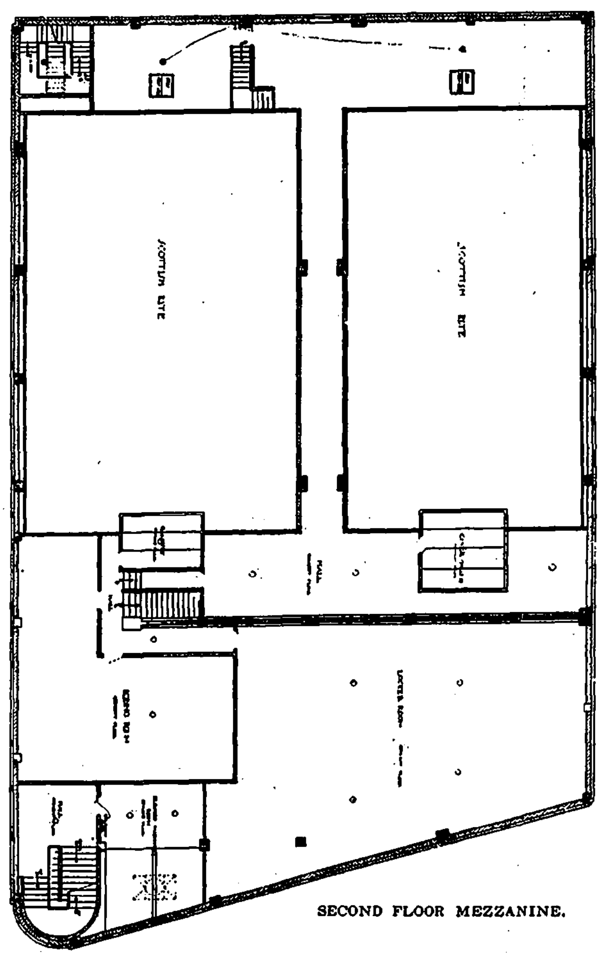


FIRST FLOOR PLAN.

NEW MASONIC TEMPLE, TORONTO, WM. F. SPARLING CO., ARCHITECTS AND ENGINEERS.


FIRST FLOOR MEZZANINE.

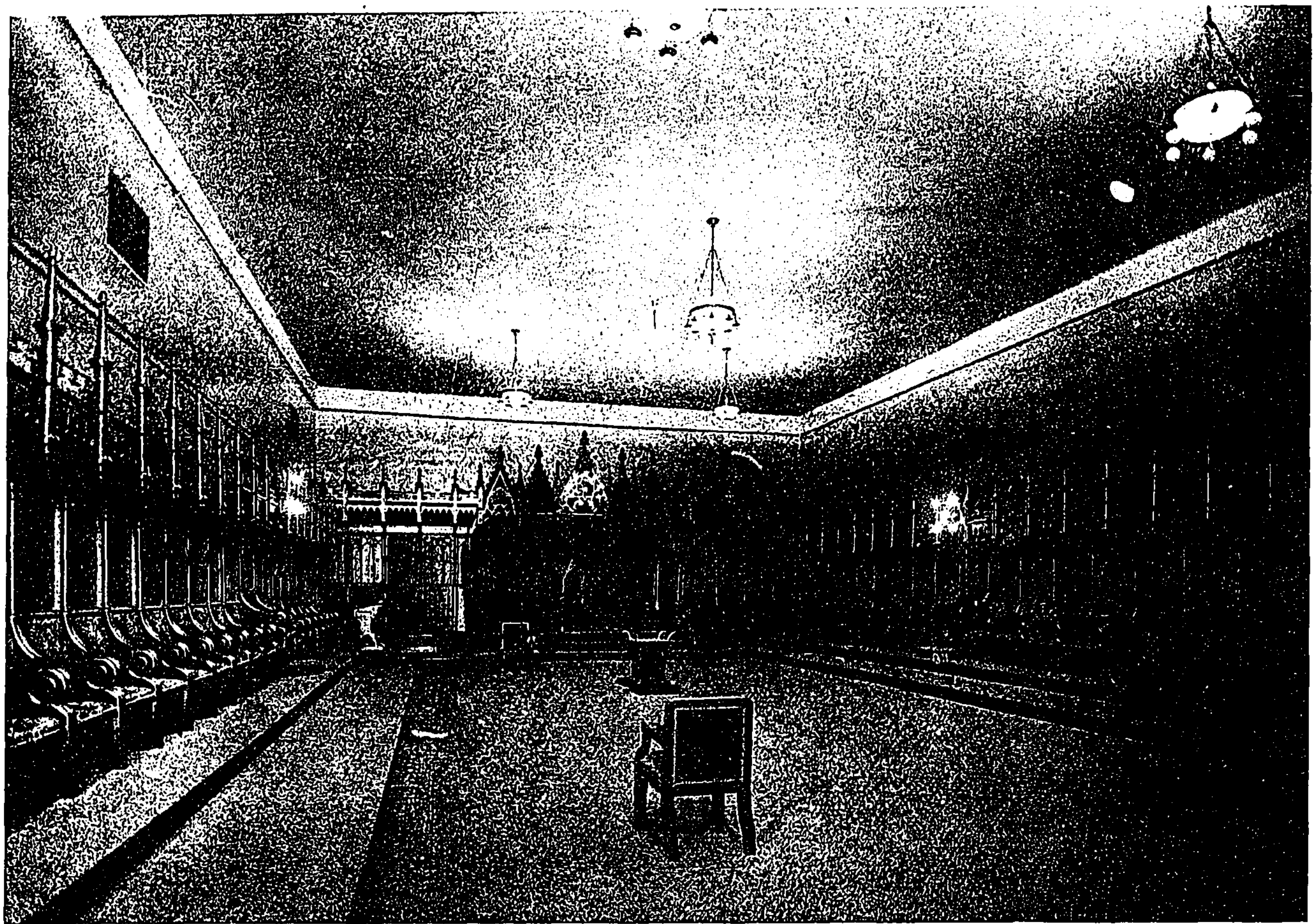

SECOND FLOOR PLAN.


SECOND FLOOR MEZZANINE.

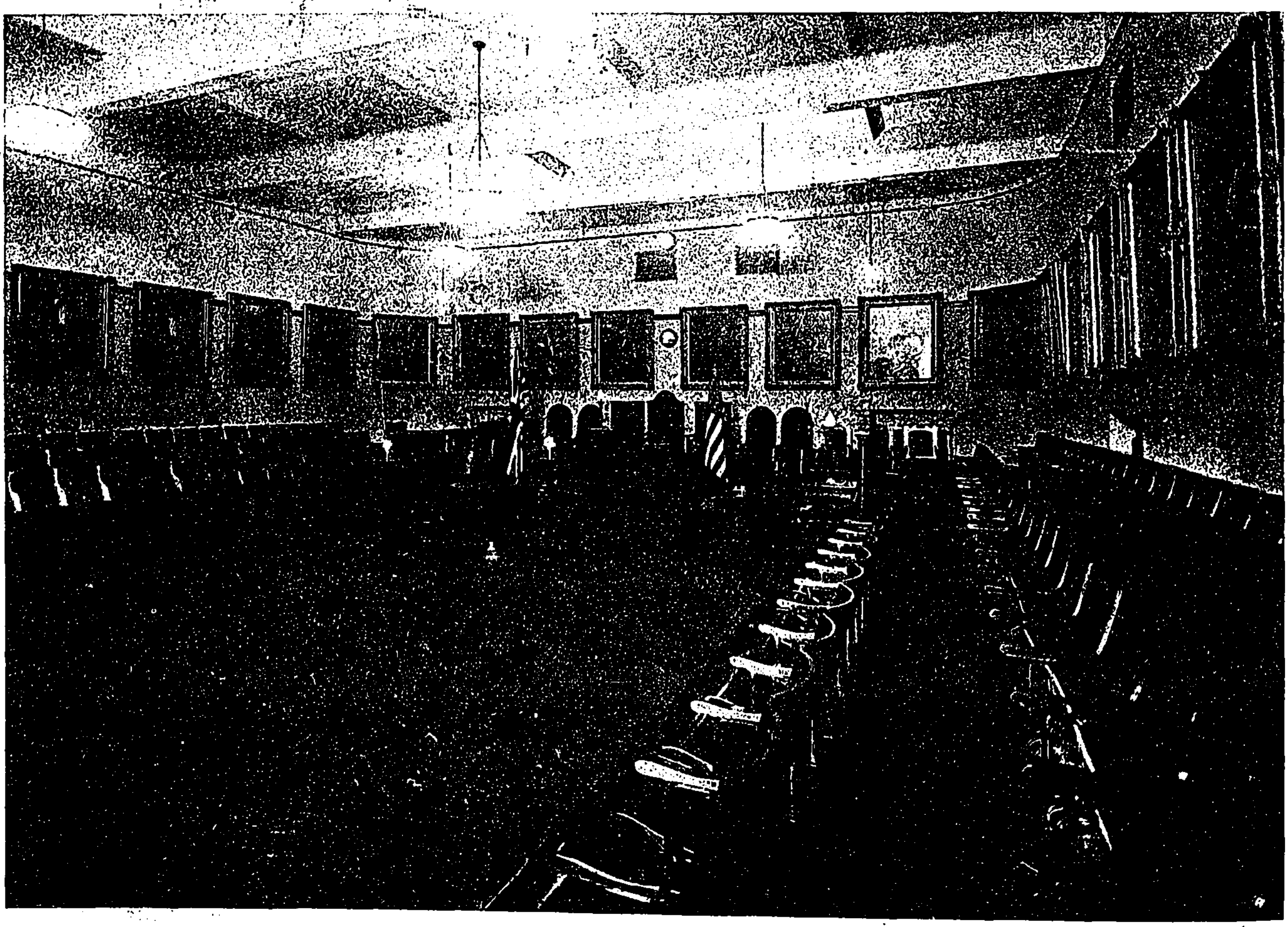
with anterooms, lounge, etc., and a moderate size banquet room, comprise the second floor. On the second floor mezzanine are located the choir galleries to these lodge rooms, together with a general lounge and smoking room. The roof is designed for marching purposes, and is covered with a flat tile laid in asphalt.

An up-to-date system of steam heating was installed, being partly direct and partly indirect. Radiators were located in suitable recesses around the walls, and additional heat is supplied by forcing washed and heated air into the various rooms and exhausting the foul air outside. This ensures in all the lodge rooms, which contain no windows, ample ventilation, together with the fresh warm air supply. For this ventilation and indirect heating the building is divided into two sections. The apparatus supplying the lodge room floor and above is located in the pent-house on the rear of the roof, and that supplying the auditorium and banquet room in the basement, is located in the basement. Suitable controls admit of any one portion being heated independent of the other.

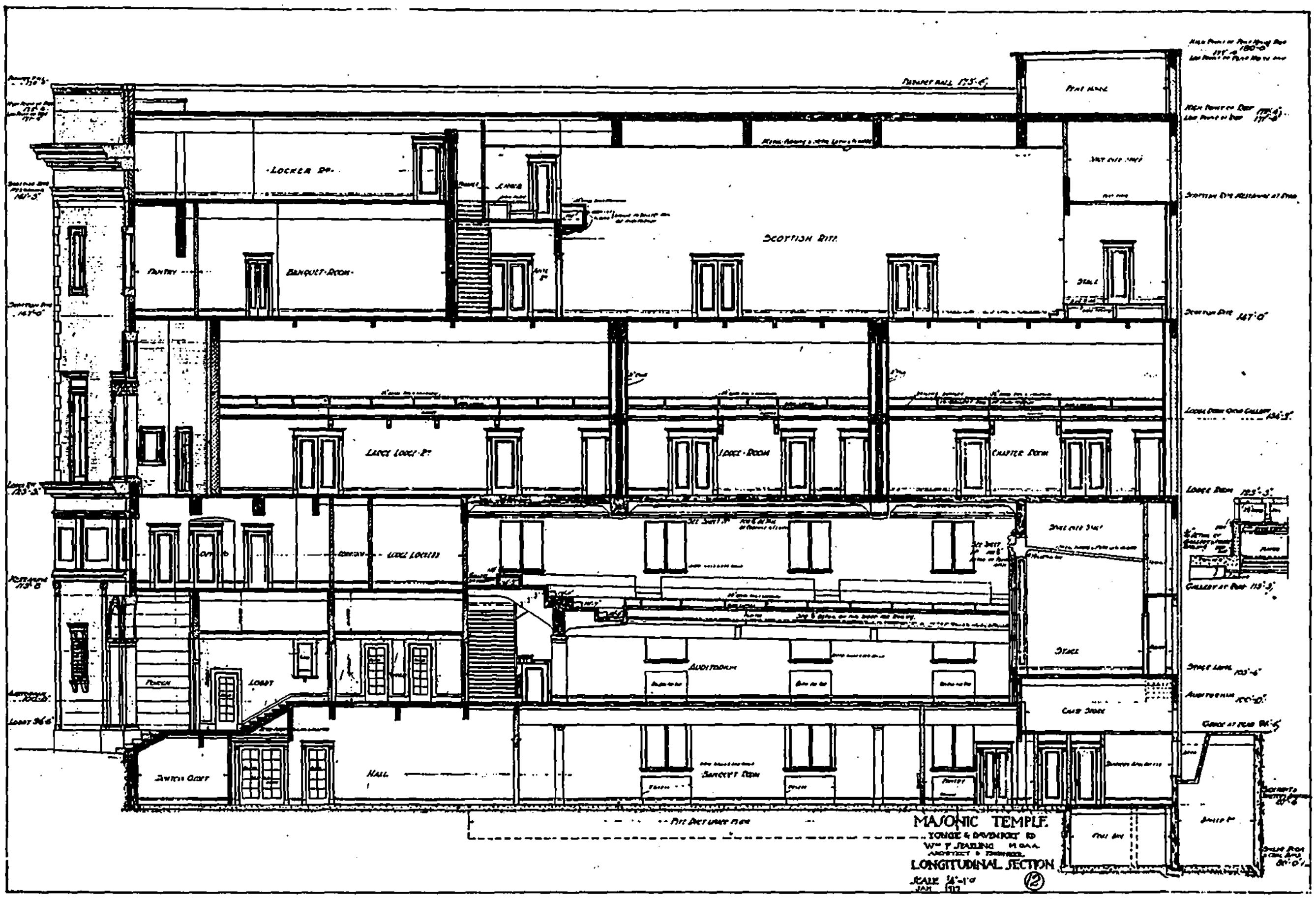
Among the features of interest from an engineering and construction standpoint are the four large reinforced concrete trusses. These are the largest trusses of their kind to be built on this continent, having spans of 66 feet and 68 feet 8 inches, and



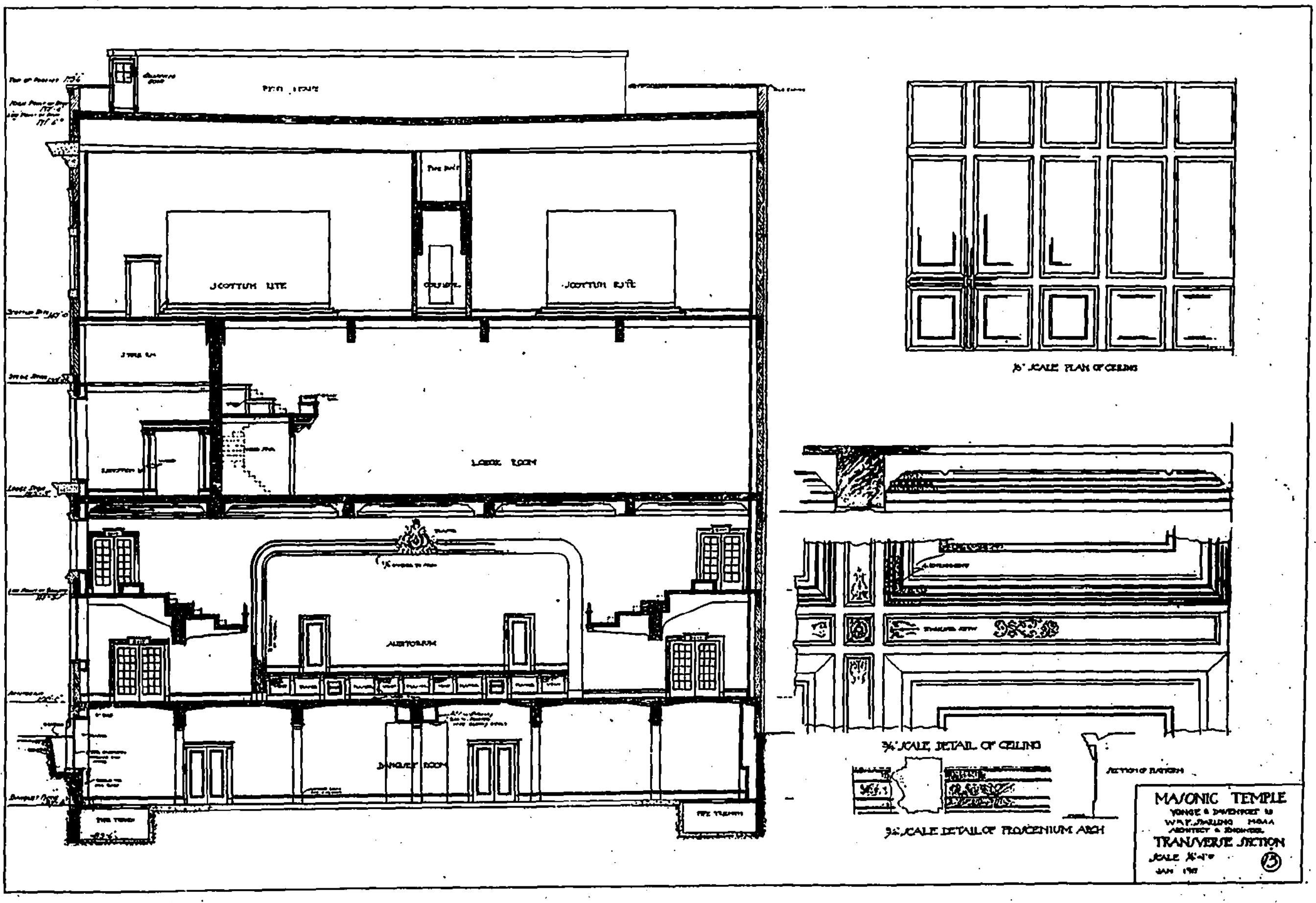
SCOTTISH RITE ROOM, NEW MASONIC TEMPLE, TORONTO. WM. F. SPARLING CO., ARCHITECTS.



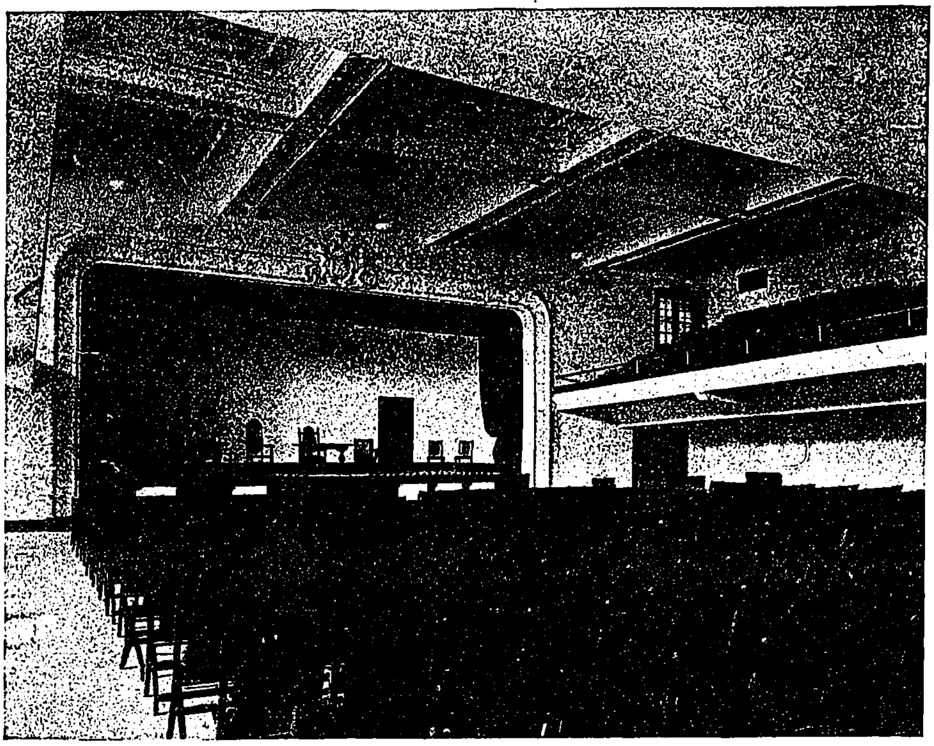
BLUE ROOM, NEW MASONIC TEMPLE TORONTO, WM. F. SPARLING CO., ARCHITECTS.



LONGITUDINAL SECTION.



NEW MASONIC TEMPLE, TORONTO, TRANSVERSE SECTION. WM. F. SPARLING CO., ARCHITECTS.



AUDITORIUM, VIEW TOWARD STAGE, NEW MASONIC TEMPLE, TORONTO.

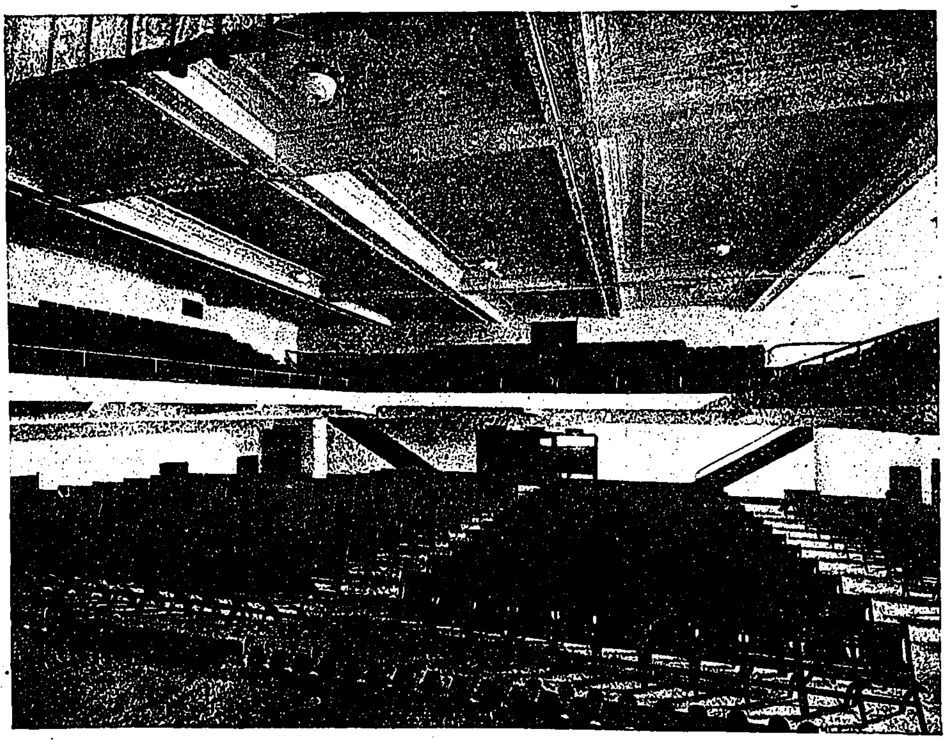
in the erection of the formwork for these trusses, so that when striking the false work each truss would receive its load in a uniform and symmetrical manner.

The heaviest truss carries a designed load of one thousand tons, and contains fifty-four main rods in the bottom chord. In rolling the rods for these trusses —some of which rods were 99 feet 6 inches long—an opening was made in the end of the rolling mill so that they could be rolled. In the case of the roof truss supporting the upper floors over the large lodge room, the truss does not show on the ceiling of this room, because this floor above is hung from the bottom chord of this truss. As will be seen from an inspection of the accompanying plans, the mezzanine floors frame into the middle of the webs of some trusses, and an opening for a doorway is provided in the centre of the largest truss.

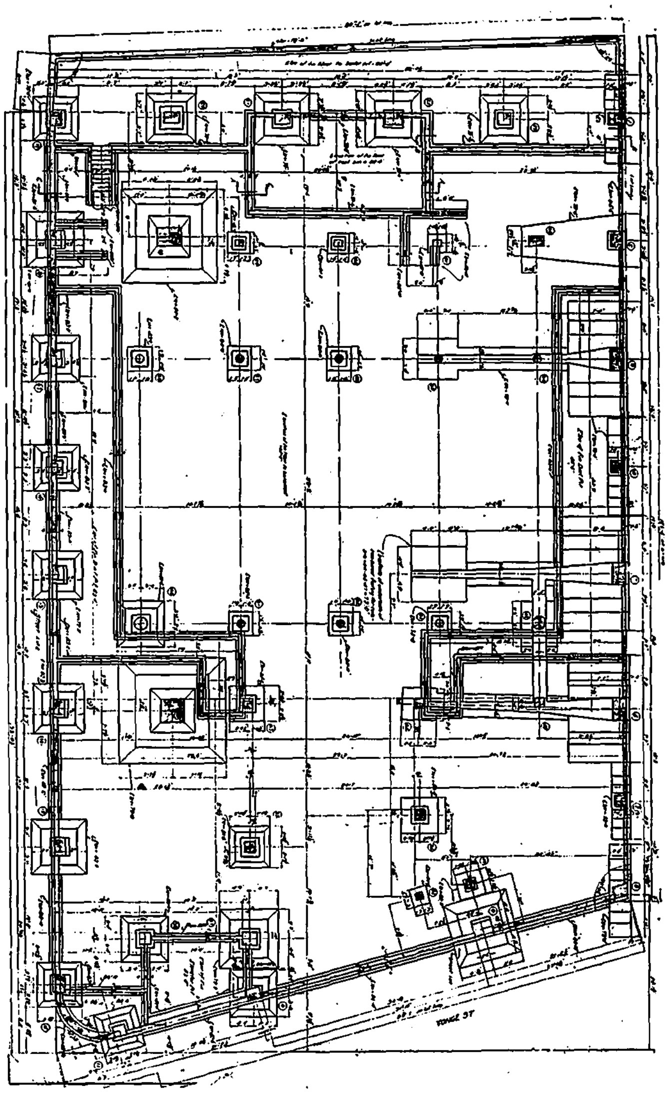
carrying the upper portion of the building over the auditorium 67 feet by 78 feet clear. Two of the above trusses frame into a third at about its third points, and these three, 24 feet deep, were poured in one continuous operation, necessitating the placing of 240 cubic yards of concrete and the handling of heavy pressures. Heavy timber false work was erected as temporary supports to the trusses, the truss located under the roof requiring false work 60 feet high, and the others 40 feet. Special care was taken

There are numerous large beams in the various floor, but the framing to the gallery of the main auditorium may be mentioned. The gallery is carried on cantilever beams, mainly supported on large through beams spanning 56 feet, with an overall depth of 4 feet 9 inches, and carrying a designed load of 127 tons. As architectural considerations controlled the sizes very closely, these beams contain more than a usual amount of compressive steel.

All the footings excepting the combined and cantilever footings, were designed without the use of shear steel. In the combined footing for columns 5, 6, 44, 45, 47, girders 10 feet deep were used to handle the heavy shears. and owing to the unusual arrangement, this footing is worthy of note.



AUDITORIUM, VIEW TOWARD REAR, NEW MASONIC TEMPLE, TORONTO.



FOOTING PLAN,
NEW MASONIC TEMPLE, TORONTO.

Corrosion of Ironwork

In a paper read before the Iron and Steel Institute, J. N. Friend summarized as follows the results of his researches on the usefulness of paint for protecting ironwork from atmospheric corrosion:

(1) The practical value of acceleration tests is very small in the present state of our knowledge. Reliable results can only be obtained from tests carried out under conditions closely resembling those prevailing in practice.

(2) Addition of pigment paint to oil increases the efficiency of the latter as a protective paint until a maximum is reached. After this, further addition of pigment causes deterioration. The best results are obtainable from paints possessing as high a percentage of good oil as is compatible with good body and any other working property that has to be considered.

(3) Linseed oil on setting expands by some 3.3 per cent. This is the primary cause of crinkling. Further oxidation causes a decrease in volume, which in time leads to cracking.

(4) Linoxyn is permeable to moisture. The permeability is reduced by heating in absence of air, the oil increasing in density, viscosity and molecular weight.

(5) Polymerized linseed oil affords a better protection than raw oil when used as a paint vehicle.

(6) The functions of a pigment are to toughen the film and render it less permeable to water-vapor and oxygen. It also reduces the expansion of the oil on setting, and thus minimizes the tendency to crinkle.

(7) A thick coat of paint protects the underlying metal more efficiently than a thin coat, provided the coat is not so thick that running or crinkling takes place.

(8) The very best results are obtained by multiple coats. Two thin coats are better than one thick one of equal weight.

(9 Thinners enable thin coats of paint to be applied. Turpentine leaves a very slight residue behind upon evaporation, but its effect on the efficiency of the paint is small.

(10) Other things being equal, the most permanent paints are those containing black or red pigments, since these absorb the shorter rays of light, and prevent them from hastening the destructive oxidation of the linoxyn by the air.

(11) Finer pigments afford more efficient protection than coarse pigments, since they are more thoroughly in contact with the oil.

(12) Iron structures should be painted whilst their scale is still on, after loosely adherent flakes and rust have been scraped off. The paint will last rather longer than if applied to the pickled or sand-blasted surface, and the labor of removing the scale is saved.

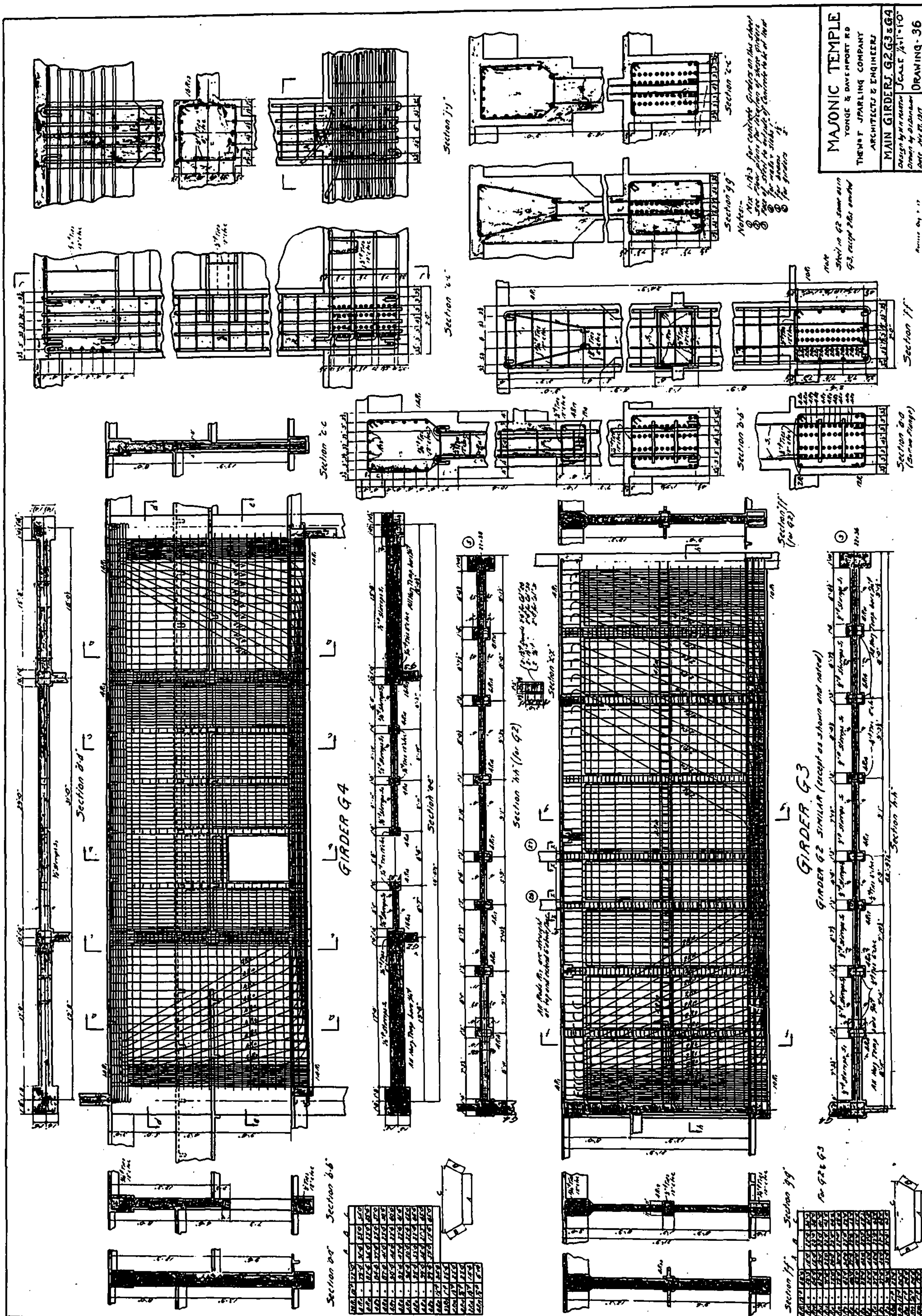
(13) Experiments with rusty plates are not conclusive, but suggest that the rust need not be so carefully removed prior to painting, as is usually thought to be necessary.

Increase in Permits at Galt, Ont.

A substantial improvement is noted in the value of building permits at Galt, Ont. The total up to September 1st amounts to $140,285, which is $60,000 ahead of the corresponding period of last year. During the month of August the aggregate for permits issued reached $30,350, including one item of $17,000 for the erection of a storage warehouse.

Vancouver Shows Big Improvement

Building permits issued at Vancouver, B.C., for the first eight months of this year amount to $1,011,316. This is substantially ahead of the corresponding period of 1917, when the sum of $405,920 was recorded. August operations reached a total of $216,313, as against $54,420 in the same month last year.



New Masonic Temple, Yonge Street and Davenport Road, Toronto. DETAILS OF MAIN GIRDERS. WM. F. SPARLING CO., ARCHITECTS AND ENGINEERS.

Underground Concrete Work in Winnipeg*

By Bertram Stuart McKenzie, B.A., B.Sc., Consulting Engineer, Winnipeg, Man.

IN presenting this subject for discussion, under the general title given above, it is proposed to eliminate theory as much as possible, and to cite (literally) concrete examples of deterioration under various conditions. Examples which will be given are taken from experience in the Province of Manitoba, and mainly in the city of Winnipeg. These have all come under the observation of the writer, or have been reported to him from reliable sources.

As this subject deals with underground conditions, the examples naturally divide themselves into two main classes:—

(a) Foundations for buildings or bridges.

(b) Pipes for sewers, drains or water supply.

These will be discussed in the above order and a few typical examples given.

FOUNDATIONS.

(1) The first case which came under the writer's observation occurred in the footings for the columns of a seven-story building in Winnipeg. The footings consisted of the usual square-stepped design. Owing to proposed increase in the loading, it was considered necessary to put caissons to rock under the existing footings, and in the course of excavation for this work some rather extraordinary conditions were revealed. The first discovery was made by one of the workmen who was engaged in placing a strut between two adjacent footings. To his astonishment, the concrete of one of the footings appeared to be practically a slime. The mass was so soft, indeed, that he could without difficulty plunge his hand into the same and squeeze the material through his fingers. The matter was reported to the writer, who was associated on the work, and an examination of the material was made. The concrete had the appearance of lime mortar, being quite white and of a slimy consistency. There was quite a strong smell of sewage, and the inference, at first, was that there had been a chemical action by sewage from a broken drain in the vicinity, but this was not confirmed by further investigation.

Other examples were soon discovered in other footings as the work proceeded, and conditions were of such a nature that the architect in charge of the work decided to remove the old footings altogether and to build the caissons up to the base plates of the columns. In one extreme case a mass of concrete fell away from the corner of a footing, and was so soft that it was possible to swing the head of a sledge hammer sideways through the mass. The disintegrated concrete, on being allowed to dry, becomes fairly hard, with a white, powdery surface. In the course of removing the old footings it was found that patches of this soft concrete occurred in what appeared to be otherwise quite sound masonry, thus indicating that a gradual rotting process was going on, which now appears to be most probably due to some chemical action by the ground water which had gained access to the footings. Wherever the condition was found it was observed that the concrete was very damp and porous, and the latter condition may explain the action to a certain extent.

IN CLAY FOR FOURTEEN YEARS.

(2) The second example was discovered when exposing the surface of cassions which had been lying in the clay for over 14 years. These were under one of the 10-story office buildings in Winnipeg. It was found necessary, on account of settlement of the building, to excavate under those old cassions and continue same to rock. They were generally lying at a depth of about 35 feet below ground level and in practically every case (21 in number) water in considerable volume was found lying around the cassion and concentrated at the bottom. This water had come from under the basement floor and seeped down along the surface of the cassion. The first cassion exposed had an unusually rough surface, having the appearance of a pile of broken stone. There was a certain bond between the stones but the concrete was full of large voids.

If any martar had ever existed in these spaces, it had entirely disappeared. It was noted that in the spaces mentioned above, a deposit of a brown jelly was often found. It was thought at first that this might be gelatinous silica, left as a residue from some chemical action, but this was not confirmed by analysis. Wherever this rough surface appeared there was discovered a curious sheath of hard clay about 1½ ins. in thickness, which showed quite a marked cleavage from the mass of surrounding clay. When the surface of the cassion was smooth the sheath disappeared. The cassion was dressed up a little to show the condition more clearly. There seemed to be some direct relation between the appearance of this sheath and the condition of the concrete surface. It was thought that there might be some chemical action going on which had caused a combination of certain elements of the cement with the clay, but an analysis of a sample of hard clay did not confirm this. The clay analyzed as follows:—

Loss on ignition	13.33%
Silica	50.94%
Alumina and iron	30.84%
Calcium oxide	3.87%
Magnesium oxide	Trace
Sulphur	Trace

The condition may have been caused by pres-

*Paper read at the Saskatoon meeting of the Engineering Institute of Canada, August 8th to 10th, 1918.

sure due to settlement of the cassion, but so far no satisfactory reason has been assigned. In some cases. at the bottom of the cassion where it had been belled out to get greater bearing surface, the concrete was practically loose stone without any bond whatever. If this condition can be produced by the action of ground water on concrete, then it is indeed full time that the question should be carefully investigated.

HISTORY OF THE CONCRETE NOT OBTAINABLE.

(3) The third case occurred in the foundation of the vault in the same building. This instance consisted of a mattress in which steel I-beams had been placed for reinforcement. In excavating under the mattress, preparatory to the construction of additional cassions, it was found that the concrete resembled close-packed, sandy gravel. It was quite soft, could easily be scraped away, and was water-soaked clear through. When the underlying clay was removed, water dripped from the under surface of the concrete, and white stalactites were formed, sometimes as much as ¼ in. in diameter. The concrete seemed to have lost its character entirely, and a sieve analysis of a dried sample gave some extraordinary results. There was found no product finer than that retained on a 50-mesh sieve, and a microscopic examination of this product showed no trace of cement. It seems incredible that the cement should have disappeared in this way but it has not been established that it did not do so. In this particular case the actual history of the placing of the concrete would be of great interest, but this was found impossible to obtain. (This matter will be referred to in general remarks later on.) The stalactites above referred to were analyzed and found to be calcium sulphate.

(4) The fourth case also in the same building as the third instance, occurred in the concrete beams which had been constructed across the cassions to support the outside walls. These were reinforced with steel I-beams, or as a matter of fact the concrete served as a protective coating for the steel. In the course of an examination of one of these beams the concrete was found to be rather soft, and at one point quite a large hole was discovered. The concrete on the side of the beam was easily laid off with a pick and the steel beam exposed. The beam was found to be very wet, as water had penetrated into the heart of the beam and the resultant corrosion of the steel was quite marked. It was then decided to examine all the beams and as a result of the conditions found they were all stripped and a new concrete covering constructed. Arrangements for under-drainage were also provided so that water could be kept away from the beams as much as posible.

STEEL BEAM WAS CORRODED.

In one of the cases, the concrete covering, if it had ever existed, had completely disappeared from the lower half. The space was spanned by a regular forest of small stalactites which had been formed by water dripping from the upper surfaces of the space. These were brown in color and on analysis were found to be composed of a combination of calcium and iron carbonate, the iron coming from the corrosive action of the water on the steel beam. On the bottom of the beam and lying also on the lower flange of the outside beam a slimy mass, similar in character to boiler sludge was found in considerable quantity. This may have been a by-product from some chemical action by the ground water on the concrete of the beam. The case was somewhat complicated by the presence of manure which had been carelessly left on top of the cassion, where it had been placed as a protection from frost, as the chemicals in the manure might have had something to do with the condition found. The example is given, however, as a matter of interest, and a possible help in the investigation.

PIPES AND SEWERS.

(1) This is a matter which has been under observation for several years, both in Winnipeg and the neighboring city of St. Boniface, and was the reason for the starting of the series of experiments by the city analyst of Winnipeg. It has been the custom in Winnipeg, as in other cities, to construct sewers, either in place of or by the use of pre-molded pipe, and construction conditions are therefore subject to some variety. Conditions have developed which in several cases have resulted in a complete collapse of the pipe and a consequent cave-in of the ground surface. This first indication of disintegration is found in the appearance of soft patches in the interior of the pipe. These gradually extend until a hole develops or the pipe collapses. The appearance of the action on the interior was at first explained by the theory that it was due to the action of certain chemicals in the sewage, but as cases were observed in pipes which did not carry sewage, this explanation did not hold. Experiments to date appear to indicate that a much more probable cause is the action of chemicals carried in ground water on the outside. This seems to be borne out by the fact, in stretches of pipe made of the same materials and at the same time, disintegration will be found only in certain portions, thus pointing to local conditions acting from the outside. In the city of St. Boniface this local deterioration has also been observed. In one case a sewer disintegrated to such an extent that it collapsed and caused a cave-in under a railroad crossing, whereas in other parts of the same job the pipe appeared to be quite sound. Cases have been observed where disintegration occurred within six years from the time of construction, but on

the other hand pipe has been in the ground for over thirty-five years without a sign of decay. Perhaps the most serious case in Winnipeg was the collapse of the sewer on Yale Avenue about a year ago. This was built in place and had been in service about ten years. It collapsed without any warning, and caused a cave-in of the street above.

(2) Deterioration has also been found in manholes. These are usually constructed with premolded rings. They exhibit the same tendency to deteriorate, but as in the case of the pipes above mentioned this deterioration has been local and not general. All this data seems to confirm the conclusion that outside agents are at work in certain localities.

GENERAL CONDITIONS.

The above are given as typical examples of the trouble under discussion. Unfortunately it is practically impossible to get the true history of the concrete which has deteriorated. This is due in many cases to lack of proper records, but more usually to a somewhat unpardonable reticence on the part of those concerned in the original construction of the concrete. It is, therefore, somewhat difficult to draw definite conclusions, and it will be impossible to get at the truth of the matter unless the concrete can be intelligently observed from its construction to its possible decay.

So many elements enter into the construction of concrete, such as material used, the proportioning of same, time of year placed, condition of the ground and amount of ground water present, that only a series of carefully thought-out experiments can give a true line on the situation. If it is a fact that concrete constructed of carefully selected and tested materials, graded and mixed under intelligent and conscientious direction and placed under proper conditions as regards temperature, under drainage, etc., will deteriorate after remaining a few years underground, then it is full time that the Engineering Institute of Canada should take the matter in hand.

INVESTIGATING COMMITTEE SUGGESTED.

It would seem that an effective method of handling the situation would be the appointment of a working committee consisting of a practical engineer, a chemist and a laboratory man, which committee would be so financed by the Dominion Government, or by the Provincial Governments of the three western provinces, that they could devote their entire time to an investigation of the subject. Field work could be carried on during the summer months and data gathered on which to work during the winter. Laboratory work could, of course, be going on all the time. Field experiments could also be carried on, similar to those already in progress in the Western States, but adapted to our local conditions. A certain amount of investigation has already been done in Manitoba, and an attempt made to collect data on the subject, but up to date there has not been sufficient to arrive at any definite conclusions.

CHEMICAL INVESTIGATIONS.

This matter as above mentioned has been carried on under the direction of the city analyst of Winnipeg. Speaking generally, the work has consisted of the analysis of the clays of the Winnipeg District, samples of ground waters, and samples of deteriorated concrete as compared with samples of sound concrete. As a result of these analyses, chemical experiments have been undertaken with the object of determining the action of solutions of the various salts found in the ground waters, on neat cement and on mortar. Solutions have been concentrated and briquettes have been steam-cured in order to arrive at results in the shortest possible time. Under construction conditions the process of deterioration is, of course, a very gradual one, taking several years before conditions become serious. In connection with these experiments some interesting results have been obtained by Mr. Thompson, who has been making experiments on the density of mortars.

Two main theories have been advanced to explain the deterioration of concrete by the action of chemicals in ground waters.

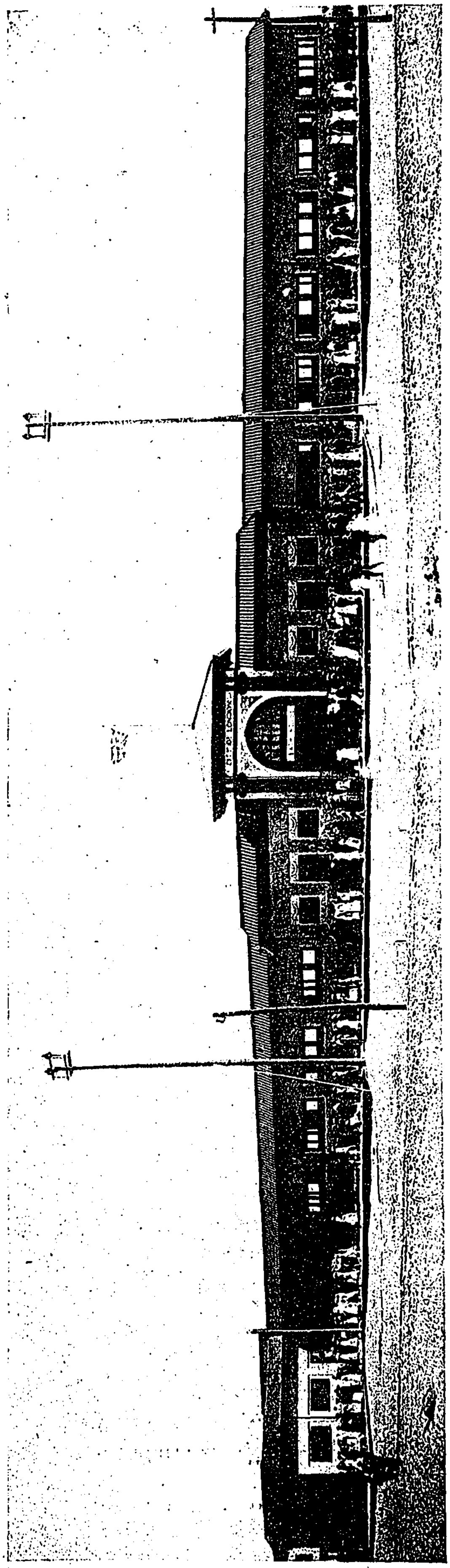
1. The formation of soluble compounds in the concrete which are leached out by the water.

2. The disintegration of the concrete due to expansion in the process of crystallization of the newly formed chemical compounds.

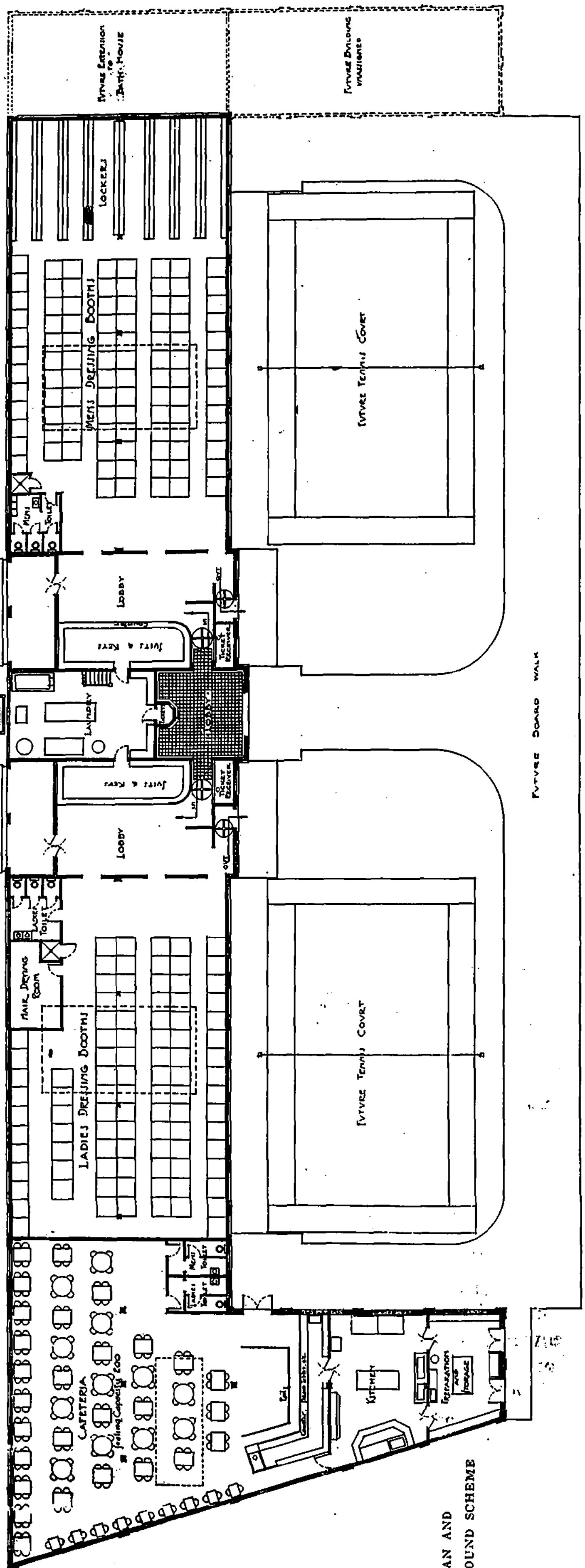
It has not been considered advisable to publish the results so far obtained from experiments until they are more conclusive. It is hoped that some way may be found to make the above record of facts perfectly complete, and that a full and satisfactory explanation may be reached to account for the above-described conditions of some concrete work in Winnipeg

Correction

The new Park School, illustrated in the July issue, was designed by the architectural department of the Toronto Board of Education, under the supervision of Mr. Bishop, the Superintendent of Buildings, and not by J. C. Pennington, as stated under the large frontispiece cut. Mr. Pennington was the architect for the Windsor Collegiate appearing in the same number. This mistake was due to an oversight in making up the pages, and we take this occasion to promptly make correction and to place credit where it is properly due.

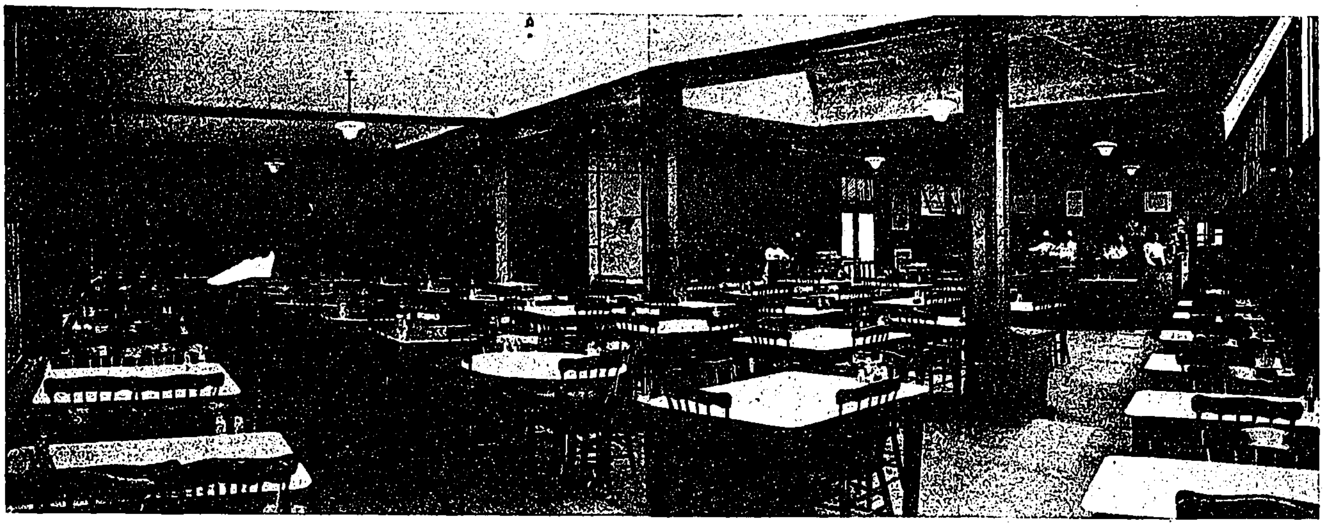


GENERAL EXTERIOR VIEW



PLAN AND GROUND SCHEME

BATHING PAVILION AND CAFETERIA ERECTED AT PORT STANLEY, ONTARIO, FOR THE LONDON AND PORT STANLEY ELECTRIC RAILWAY, WATT & BLACKWELL, ARCHITECTS.



INTERIOR OF CAFETERIA, PORT STANLEY BATHING PAVILLION, WATT & BLACKWELL, ARCHITECTS.

Port Stanley Bath House and Cafeteria

The bath house and cafeteria illustrated on the preceding page were erected in the spring of 1917 at Port Stanley, thirty miles south of London, Ont. This is the southerly outlet or terminus of the London & Port Stanley Electric Railway, and is a summer resort serving the cities of London, St. Thomas and district connected with these places, besides having a large number of visitors from Ohio cities coming across the lake by steamer throughout the entire season.

The frame work of both the bath house and cafeteria consists of a steel and frame skeleton supported by a concrete foundation, the skeleton being lathed with hyrib metal lath. The exterior is finished with stucco, and the interior is plastered between the wood studs, forming panels which gives a rather remarkable interior effect. In the cafeteria, the walls are lined with wall-board panelled with lattice work. The bath house has all modern equipment necessary for a building of this kind, including a complete laundry and sterilizing plant, even to electric hair dryers; and has accommodated during the hot weather as many as twenty-four hundred bathers in a single day. The cafeteria is laid out on the improved self-serving plan, and has all the necessary kitchen equipment, steam tables, etc., required to quickly and satisfactorily take care of its capacity of two hundred at one sitting. All cooking in this building is done by electricity.

Education and Training

"It is not easy to lay down the lines on which future generations of architects are to be educated. The advantages of a definite and systematic training in a school are obvious, but I venture to hope that the equally great advantage of being guided and inspired by a great master will be considered in any scheme that will be decided upon. I admit that our system of education so far has been rather haphazard. We must not, however, be content with imparting knowledge, with training the hand, the eye, and the mind only, but must create the desire to exercise the knowledge and skill acquired by school training, and nothing is so certain to do this as close personal contact with a great architect and with his work."

The above is quoted from the address of Mr. Ernest Newton, A.R.A., past president of the Royal Institute of British Architects, and this year's Royal Gold Medalist, in accepting the latter coveted honor. The remarks were made in alluding to his own experience in the office of Norman Shaw, who, according to Mr. Newton, "had an immense influence on all who came in contact with him, and an amazing power to bring out all that was best in those who worked in him." Mr. Newton recalled the time when as a timid schoolboy or seventeen, knowing practically nothing of architecture, he took his appointed seat in the modest room in London, which served as the draughtsmen's office, and started his career by copying to the best of his ability one of the working drawings for which Mr. Shaw was so famous.

Elected Board of Trade President

Mr. W. H. Carter, of the firm of Carter-Halls-Aldinger, prominent Western contractors, has been elected president of the Greater Winnipeg Board of Trade, comprising a membership of over two thousand of the leading business men of that city. Mr. Carter has been identified with some of the largest constructional work west of the Great Lakes, and was formerly president of the Winnipeg Builders' Exchange.

BRIDGE NO. 0.9, ONE OF TWO NEW VIADUCTS BUILT BY THE C.P.R. ON THE NEW SUBDIVISION BETWEEN LEASIDE AND TORONTO.

New C.P.R. Viaducts, Toronto

A RATHER remarkable piece of reinforced concrete work has just been completed in the construction of two new viaducts in connection with the double-tracking of the North Toronto subdivision of the Canadian Pacific Railway, between Leaside and North Toronto. The undertaking involved the replacing of bridges (known as 0.9 and 1.8) which had been trestles constructed of steel, and is regarded as a distinct achievement in railway construction work.

Bridge No. 0.9 is 386 feet long and 90 feet high, carrying two tracks, while No. 1.8 is of similar dimensions, but a three-track structure. The length of the individual spans and the details of their construction are unprecedented in the engineering world. Previous to this no reinforced concrete beam with a length of more than 25 feet has been attempted; the spans of these two C.P.R. structures are each from 35 to 37 feet long. These spans have been made possible by the employment of unit construction, by which each span was designed as two "T" beams, which, after being manufactured near the work, were laid side by side on the previously built reinforced concrete towers. The towers themselves are really reinforced concrete buildings, constructed in the usual manner by means of wooden forms built around a steel reinforcement, which was previously assembled and securely wired together. When all was in readiness the concrete was poured by means of long spouts, which led in several directions from the main mixing tower. The pouring of the concrete was maintained as continuously as possible until a whole tower was completed. This work was done during the winter, at a time when the temperature was below freezing point. It was performed inside of what was virtually a building erected to maintain a suitable temperature around the newly deposited concrete until it was out of danger by being damaged by frost.

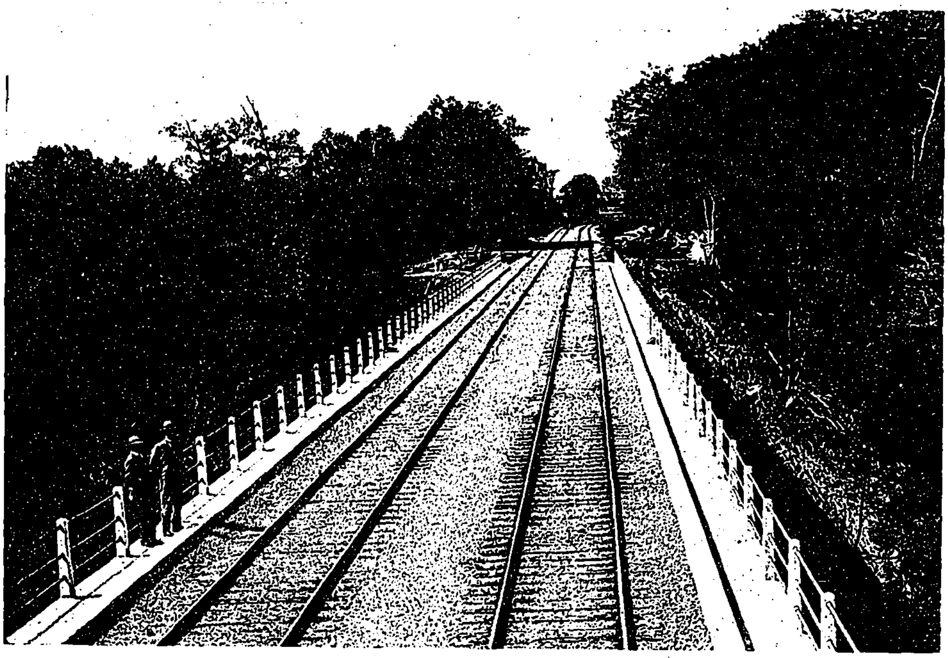
These two structures are provided with narrow sidewalks and hand rails, which enable trainmen to move conveniently alongside standing trains. The hand rails add considerably to the appearance of the structures, which are extremely artistic in appearance, and at the same time satisfactory from a general utilitarian point of view, besides being absolutely permanent. Both are designed to carry the heaviest engines in existence with a considerable margin of safety, and are epoch-making in the art of bridge engineering, inasmuch as they involve certain precedents of design as regards the use of reinforced concrete in permanent bridge structures.

These two structures are so solid that when passing over them on a train one gets the impression that he is on a solid fill instead of on a bridge.

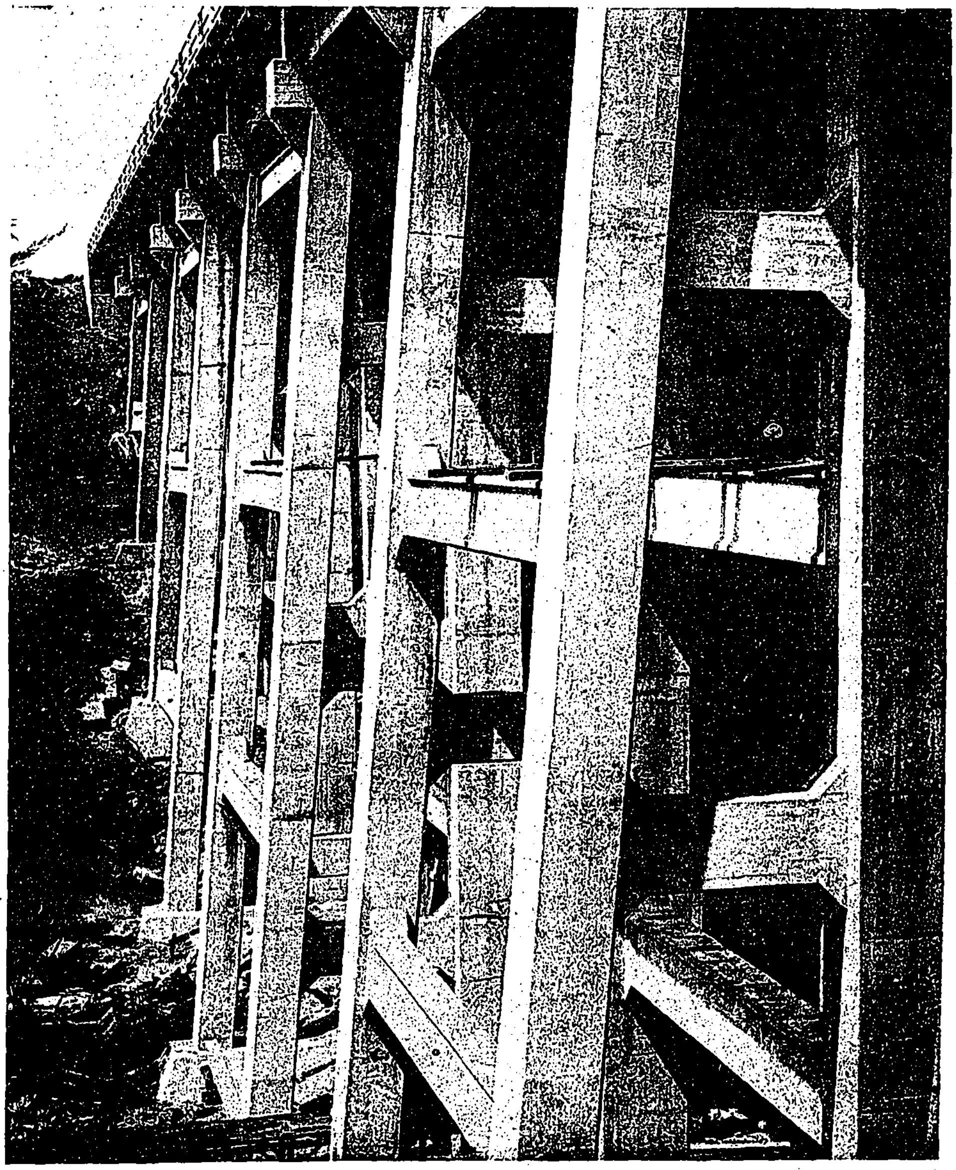
The method employed in the erection of the reinforced concrete spans is a specially interesting feature of the structures. Each slab, as a unit, weighed 55 tons, which was the limit load that could be handled by the C.P.R. 100-ton standard wrecking cranes. The crane engaged handled no less than 110 slabs, each 55 tons in weight, or in all. something like 6,000 tons, and all this was done without a single mishap to either men or material. Another remarkable feature is that both structures were built without interruption, from the beginning of June, 1917, to the beginning of July, 1918, which was a shorter period than would have been required to manufacture and erect similar structures in steel. Passenger and freight traffic on the C.P.R. main lines was continued without interruption during the progress of these interesting works.

MOVES TO NEW OFFICES.

Architects Denison & Stephenson, Toronto, who for the past several years have been located at 18-20 King Street West, have moved their offices and draughting rooms to the Confederation Life Building, Queen St. entrance.



VIEW ALONG VIADUCT AT ROADBED LEVEL.



CLOSE VIEW OF C.P.R. VIADUCT NO. 0.9, NORTH TORONTO SUBDIVISION.

Circular Housing Plan

Proposed by

G. J. LAMB, Assistant City Engineer

Port Arthur, Ont.

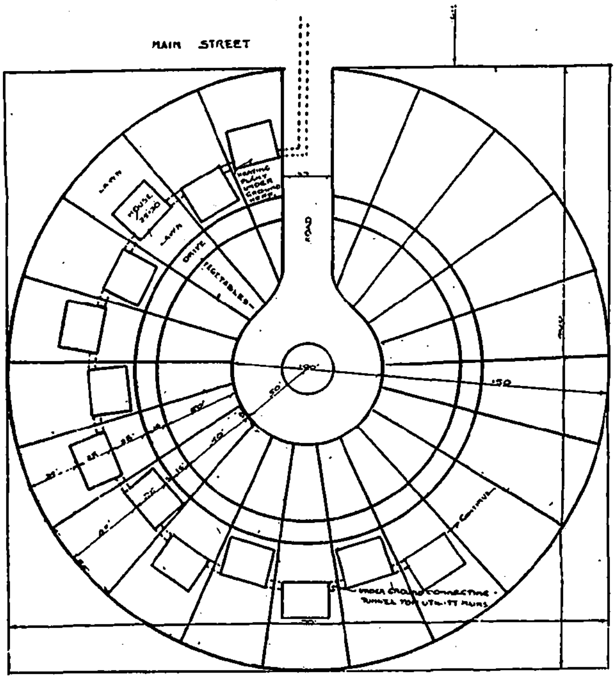


Fig. 2.—Layout of block of twenty-one houses. Note the arrangement of the buildings which admits of direct outside light on all four sides. The lots are approximately 150 feet deep, and vary in width from about 15 feet at the inner circle or drive to 35 feet at line of outside circumference, thus allowing adequate room for lawn space and vegetable gardens. The scheme provides for a service tunnel to be constructed beneath the circular line along which the houses are staggered. This tunnel would carry the sewer, water and gas mains, electric and telephone wires; also the heating pipes which would connect with a central heating plant located near a point where the street and inner road intersect.

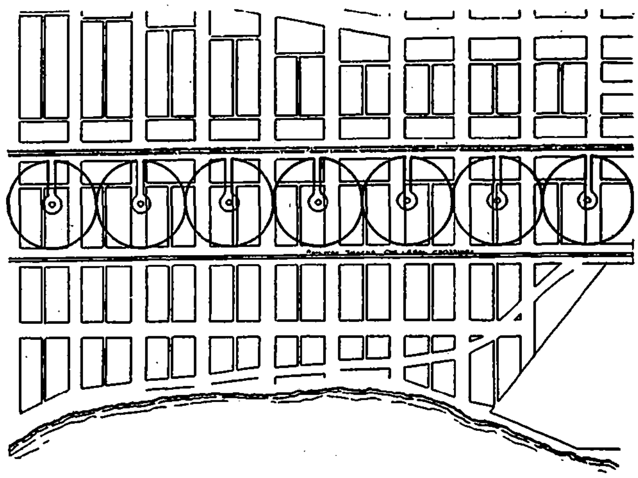
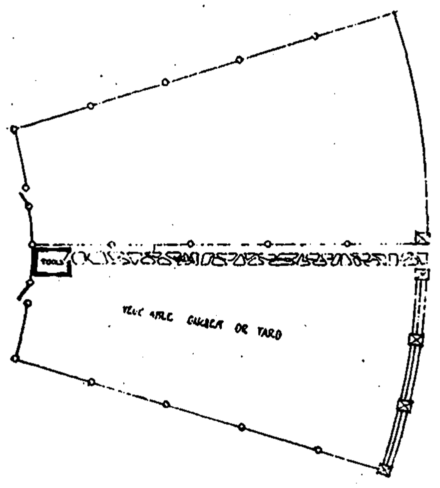
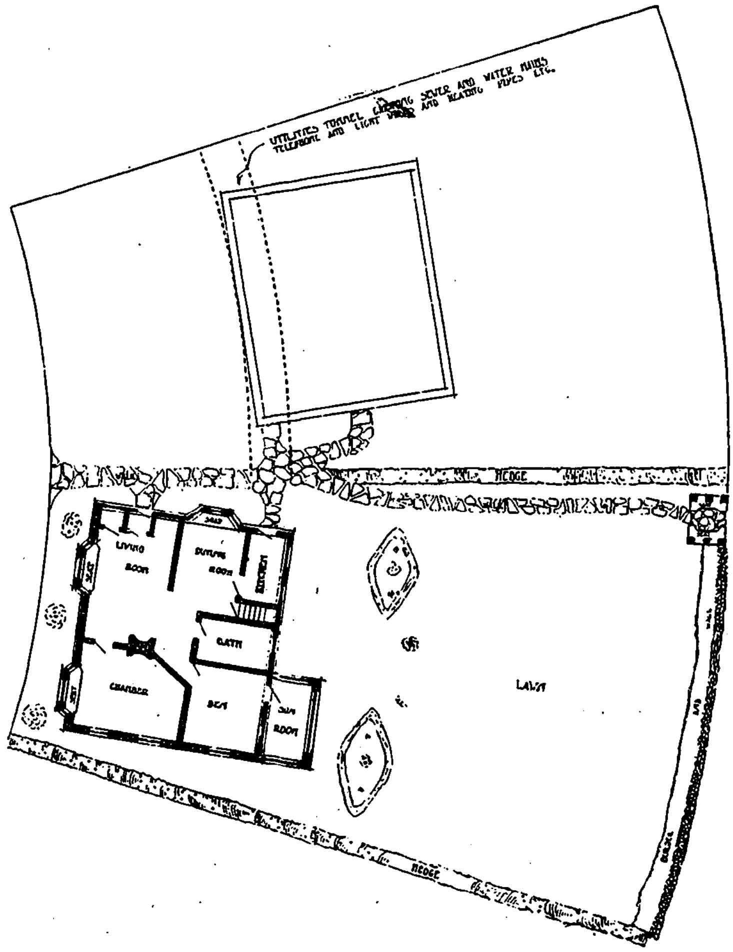


Fig. 1.—Plan showing how the circles in which the houses are grouped can be adapted to rectangular city blocks. This scheme, it is claimed, eliminates a number of common engineering difficulties and offers certain economical advantages as regards up keep and service.

Fig. 3.—Detailed scheme of a pair of individual lots, showing suggested ground treatment, plan of dwelling, utility or service tunnel, flagged walks, hedges, etc.





The plan in the lower half of the drawing is for a detached house. The other structure could be a two-family dwelling, with each tenant having his own lawn space.

Circular Housing Plan

A HOUSING scheme for which many advantages are claimed—economic, engineering and otherwise—has been worked out by G. J. Lamb, assistant city engineer of Port Arthur, Ont. If not altogether new, it is at least interesting in theory, and has the virtue of being considered in relation to various important phases which necessarily enter into the successful solution of such a problem. Mr. Lamb proposes a circular plan, whereby the lots are laid out radially from a common centre, such as is indicated in the accompanying drawings.

Fig. 1 shows how the circular blocks can be fitted into rectangular city blocks. In Fig. 2 the position of the houses in the individual circles are indicated, each circle providing for a group of twenty-one dwellings. Fig. 3 shows a suggested plan for a house occupying one of the lots into which the circle is divided. The direct advantages or benefits which will be derived from the adoption of this scheme are said to be: A direct saving in cost of over thirty per cent., sufficient ground space to allow for adequate lawns and vegetable gardens, an abundance of light on all four sides of each building, increased safety for children as regards neighborhood traffic, the advantages of a central heating plant, and the consequent saving of fuel per tenant, together with economic advantages as regards water mains, sewer and roadway maintenance.

While the drawing in Fig. 1 was made in reference to a portion of the city of Port Arthur as at present subdivided, the scheme from all appearances could be successfully carried out in almost any community. The lots, or sectors, into which the circle are divided are approximately 150 feet long. These range in individual width from approximately 13½ feet at the inner circle to about 50 feet at line of outside circumference. It will be observed that the houses are staggered about a circular line. This line is the centre line of a tunnel, which is constructed of connecting links and an additional basement partition in each house. The tunnel carries sewer, water and mains, electric light and telephone wires and heating pipes. It may also be used as a private entrance to the various basements. The various utility mains and wires enter the tunnel from the main street at the point where it intersects the road running to the centre of the block, the heating plant being situated near the same point. The lots may also be intersected by a semi-private drive, as shown, or entered from the common centre or hub. The corners, cut off from the square by the circular layout, are alloted to park purposes. While the design shown is tentative, it is said that the scheme offers itself readily to an endless variety of effects and modifications without giving up any of the general principle. The block as it stands represents a unit of ownership, but by proper legislation individuals might become owners if so desiring. While the plan illustrated in Fig. 3 provides for a detached house, the building on the other lot could be designed as a two-family dwelling, each tenant having his own lawn.

The features of the general plan as explained more in detail by Mr. Lamb himself are as follows, and are, to say the least, quite interesting.

By the adoption of this plan, some common engineering difficulties are at once eliminated. Under the present block system, the engineer is compelled to forecast the probable future traffic of each road and walk. He is compelled to design for traffic much in excess of immediate requirements and the needs of the individual block. This excess must be carried as an added burden to the adjoining property or the city at large till such time as the traffic designed for actually develops. The same thing may be said in a general way about sewer and water mains and other utilities. The proposed plan does away with guess-work. The engineer would know at the outset the exact requirements of the block, and would govern himself accordingly. Definiteness would characterize the whole scheme.

The smallest size commonly used for street water mains is 6-inch. This is much above the requirements for domestic purposes, but fire needs demand it. The large mains extend the whole way around a block served with water. Fig. 2 calls for a 6-inch main from the main road to the utilities tunnel only. A fire hydrant would rise from the tunnel at that point. The domestic supply could be carried by a much smaller pipe, reducing in size as it gets farther from the main. Pressure-reducing valves could be installed if necessary on the domestic supply line, conserving the pressure for fire-fighting purposes, reducing the proportion of leaks and saving much wear and tear on the whole domestic system. As the fire hydrants extend into the tunnel, frost jackets would not be required.

MAINTENANCE.

The greater portion of the cost of maintenance of a waterworks system is caused by excavations for leaks. This work is particularly costly in winter, when the ground is frozen. In cold climates it is also necessary to make a daily personal inspection of fire hydrants, and also to give them special attention after they have been used. This bill of expense would automatically disappear. All pipes would be open for inspection at all times, and trouble would be detected at once.

WATER WASTE.

Where sewer and water mains are laid in the same trench, leaks in water mains are very difficult to detect, because they may never show at the surface. Leakage may amount to from 15 per cent. to 20 per cent., according to condition, age and pressure. Where water is pumped this is, of course, accompanied by a corresponding loss of coal or electrical energy. Detection of waste is a live issue with most municipal engineers. Cutting off waste means deferred extensions to pumping plants and equipment at a time when such are exceedingly costly. This source of expense and trouble would not be possible under the proposed system. Leaks would be detected and repaired at once without excavation.

HOUSE CONNECTIONS.

These connections carry water, sewage, electrical energy, gas and telephone service from the house to the street mains. They represent a big portion of the capital cost of housing and require much attention. They require much energy to operate them. They would be entirely unnecessary with the proposed layout.

CONSTRUCTION.

These houses could be built to a given standard without making them identically alike, and a big saving could be effected in this manner, but it is not legitimate to hold this out as an added attraction of this plan. It may be said, however, that owing to the connection of the buildings, excavation could be done with a steam shovel, effecting a saving of a substantial amount over the hand-shovelling method.

HEATING.

A heating authority has given it as his opinion that, with fuel at present prices, these houses could be heated at a cost of about five dollars per month for fuel. A central heating plant of the general design he proposes, could use soft coal or wood. With individual heating plants it is extremely doubtful if the same result could be obtained for less than twelve dollars per month for the winter months. The price of five dollars per month is estimated for the most severe weather.

The same authority advises the use of high-pressure steam. This is impracticable for ordinary installations, but where it can be used it is economical of fuel, pipes and radiators. The layout lends itself admirably to this method. A saving of one-third could be made on the capital cost of house-heating fixtures alone.

In the ordinary house, the house plumbing is connected to the street plumbing at the line of the front wall. The lines ascend into the house at the rear. This means carrying the sewer and water pipes the full length of the house before they come into service. Under the proposed plan this expense is eliminated.

PUBLIC SAFETY.

It can be seen at once that the houses, lawns and yards are more or less isolated from main arteries of traffic. This would give children freedom to play in private lots and in public parks without undue exposure to danger from passing vehicles.

TRAFFIC REGULATION.

It would be no hardship to restrict traffic within individual blocks to a speed limit of five miles an hour. The relatively short time spent on internal roads and drives would justify this. This restriction would further increase the safety of children at play. It would also make possible a very cheap kind of construction for these internal roads and drives.

As no house would front directly on a main road, they would be at a distinct advantage in the matter of dust and street noises.

ABUNDANCE OF LIGHT.

The plan shows the position of the houses staggered. This means light in abundance on all four sides. By taking the houses one after the other and studying the problem from the viewpoint of hours of actual sunlight, it can be seen what this arrangement means in comparison to the block system. When the radial system was first proposed, this was the greatest advantage claimed for it. Compare one of these houses with its maximum of actual sunlight and daylight on all four sides with the ordinary house in a block, shut off by its neighbors on two sides from daylight and sunlight alike, one of the other sides possibly shut off from the sun the year round and the other taken up by the woodshed. Or compare it with an apartment block, with some of its tenants never getting any sun or partly dependent on a narrow light shaft.

MAIN ROADS.

Main roads in a district built up of such blocks would traverse a series of parks.

Having adopted the idea of an intersecting drive, the vegetable garden, chicken run or more ordinary part of the property would be separated from the houses and lawns by that drive. No window would look out on a neighbor's back yard.

Set apart from main roads, each block would be more or less self-contained and would have an air of privacy quite impossible to realize under any block system surrounded on all sides by the main routes of public travel.

COMMUNITY INTERESTS.

The layout of the block in itself is a direct encouragement to the growth or various community interests. The central space or hub has great possibilities in the way of library, reading room, athletic, social or public welfare interests which people hold in common. With many parks close at hand, they could be laid out with a wide range of purpose and to meet a variety of health-giving and pleasant sporting aims.

An example of the advantage to be gained in actual dollars and cents appears below. It has a purely local coloring. It should be borne in mind that this saving would not be made on a block of shacks. It would at once appear where the ordinary conveniences and improvements were introduced. The actual saving would increase very slowly as the costs of the buildings increase. In other words, the saving would be as much on a house costing two thousand dollars as on one costing ten thousand. Once admit that people must be warm and comfortable and have proper sanitary protection, and that these are required at a minimum of expense, and we are forced to a realization of this plan. The saving accomplished is not on frills and follies which may be avoided, but on the stern necessities. The less elaborate the house, the greater the percentage of gain. It is a saving which strikes directly at the root of the matter of the "high cost of living." That this saving in capital cost and in fuel cost can be affected at a time when money is so much in demand and fuel so scarce, should have a special significance.

REAL ESTATE SPECULATION.

Before this plan can have any widespread application in incorporated towns, the matter of re-subdivision of land will have to be taken up by the various legislative bodies. They can see to it that those for whose benefit the redistribution is to be made, have an honest intention to build and can see to it that they do build. It will have a tendency towards compactness which in itself is a tendency away from wild-cat speculation in outside subdivisions.

COMPARISON OF COST OF TWO SYSTEMS

ITEM	BLOCK SYSTEM		CIRCULAR SYSTEM	
	Quantity	Cost	Quantity	Cost
Lots	333	$ 83,250	333	$ 83,250
Houses	333	566,100	333	466,200
Excavation	60,000	60,000	60,000	15,000
Heating plants	333	66,600	7	28,000
Heating Installations	333	166,500	333	99,900
Plumbing	333	99,900	333	66,600
Other fixtures	333	33,300	333	33,300
Roads	4,620	23,100	1,600	2,400
Lanes	5,280	5,280	0	0
5-ft. walk	8,778	13,778	588	888
Water mains	4,260	27,720	588	3,528
Water mains	0	0	6,244	1,874
Sewer mains	0	0	6,244	1,874
Drives	0	0	4,752	4,752
Concrete walk (priv.)	10,961	8,791	2,664	3,330
Concrete wall	0	0	1,200	3,122
Elec. light mains	4,620	4,620	588	588
Telephone mains	4,620	4,620	588	588
Sewer & water con'ts	333	33,300	0	0
Electric light and tele.	333	3,300	0	0
		$1,200,159		$815,190
Total cost per house		$ 3,604		$ 2,447
Annual charges—				
Capital		$360.00		$240.00
Taxes		25.00		20.00
Fuel		96.00		40.00
*Light and water		24.00		12.00
		$505.00		$312.00
Per month		42.08		26.00

*Operated at a loss.

Halifax Reconstruction Work

Reconstruction work at Halifax is being carried out at a satisfactory rate of progress. Within the past two weeks work has been started on the superstructures of over three hundred houses, mostly four and five-room dwellings, of attractive design, for which the foundations were recently completed. These houses are being built of hydro stone—a concrete block with a stucco facing—which is susceptible to various schemes of coloring. As it is understood other structures will immediately follow, it will not be long before the destroyed portion of the city will take on a much rehabilitated appearance.

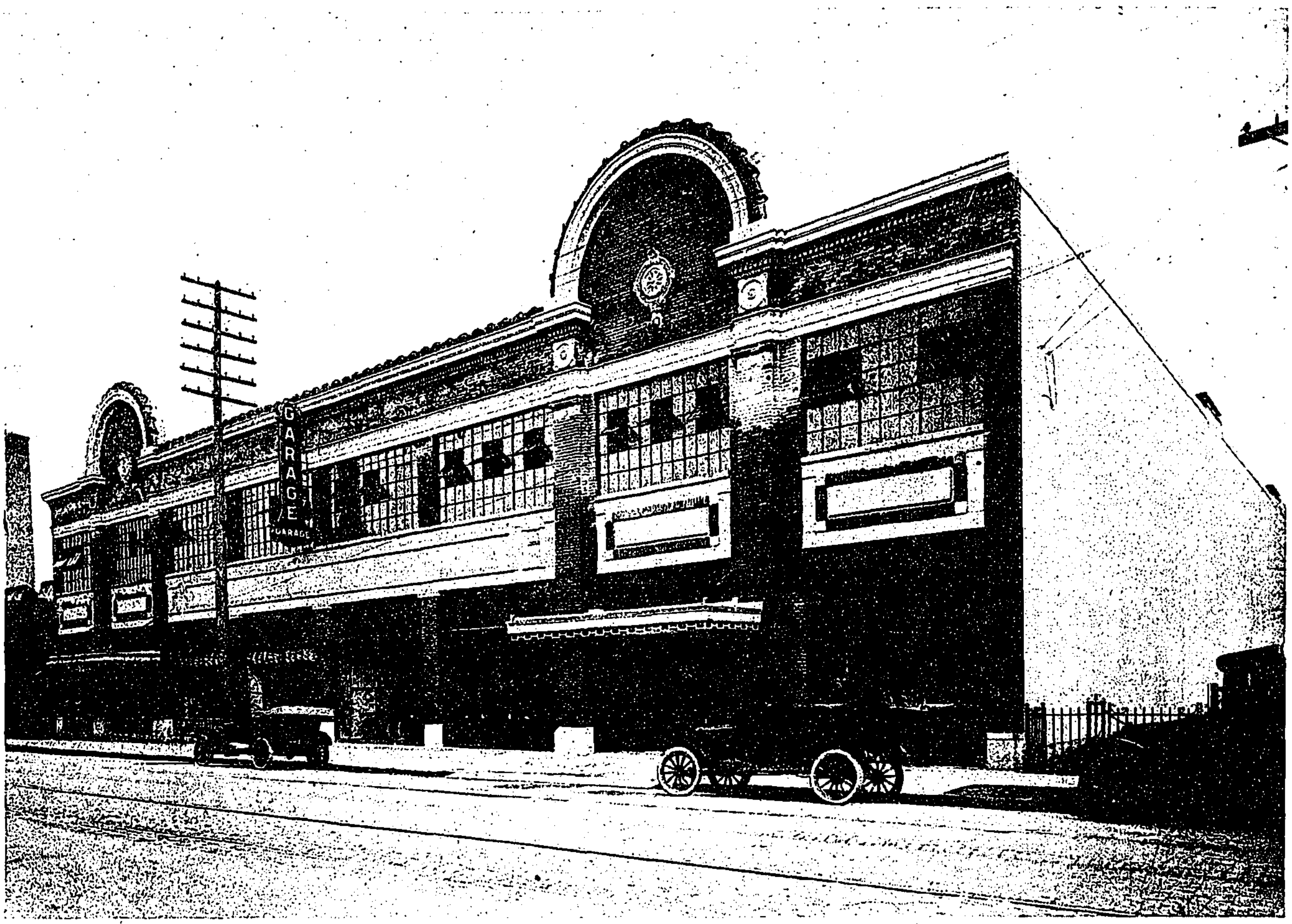
Steel Company Changes Name

It is announced that the business operated the past nine years as MacKinnon, Holmes & Company, Sherbrooke, Que., will hereafter be conducted under the name of the MacKinnon Steel Company, Limited. This concern, as is well known, fabricates all classes of steel and steel plate work, and specializes in bridges, tanks, etc. The new name more distinctly identifies the company with the steel industry, and hence makes its purpose more easily recognized by those not already acquainted with its various lines.

Concrete Ships Make Successful Trips

The reinforced concrete cargo steamship "Faith," which left a California port some weeks ago for a west coast South American port was, a few days ago, reported as having arrived safely in first-class condition. The "Faith" is discharging her cargo of lumber and is expected to reload for an American port, which she will reach by the Panama Canal.

A new five-dollar note of rather unique design has been issued by the Canadian Bank of Commerce to commemorate the jubilee of its president, Sir Edmund Walker. On the face of the note is a central group consisting of Mercury holding the caduceus, supported on the left by a figure representing Architecture, and on the right by another figure symbolizing Invention, and holding in her hand a model of a flying machine. The note is surrounded by a decorative border of immortelles, fruits and vines.

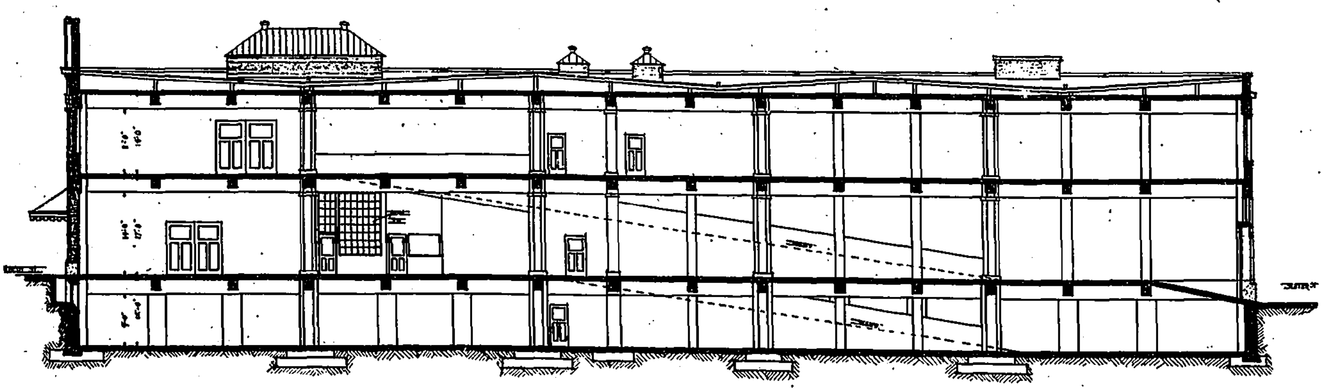


OTTAWA CAR COMPANY'S GARAGE, OTTAWA, ONT. W. E. NOFFKE, ARCHITECT.

Ottawa Car Company's Garage

It requires no special gift of mental perception to visualize the many ways in which the automobile has contributed to the field of architecture. Besides bringing into existence large manufacturing and assembling plants necessary to its production, it is responsible for the erection of countless buildings for the private housing of cars, the development to a large extent of country and suburban estates, and the construction and rehabilitation of many rural hostelries and wayside inns, catering to the motorist's patronage. Moreover, to its credit also belongs the large public garage and service station which is gradually being developed into a distinctive type of structure taking an important place among commercial buildings.

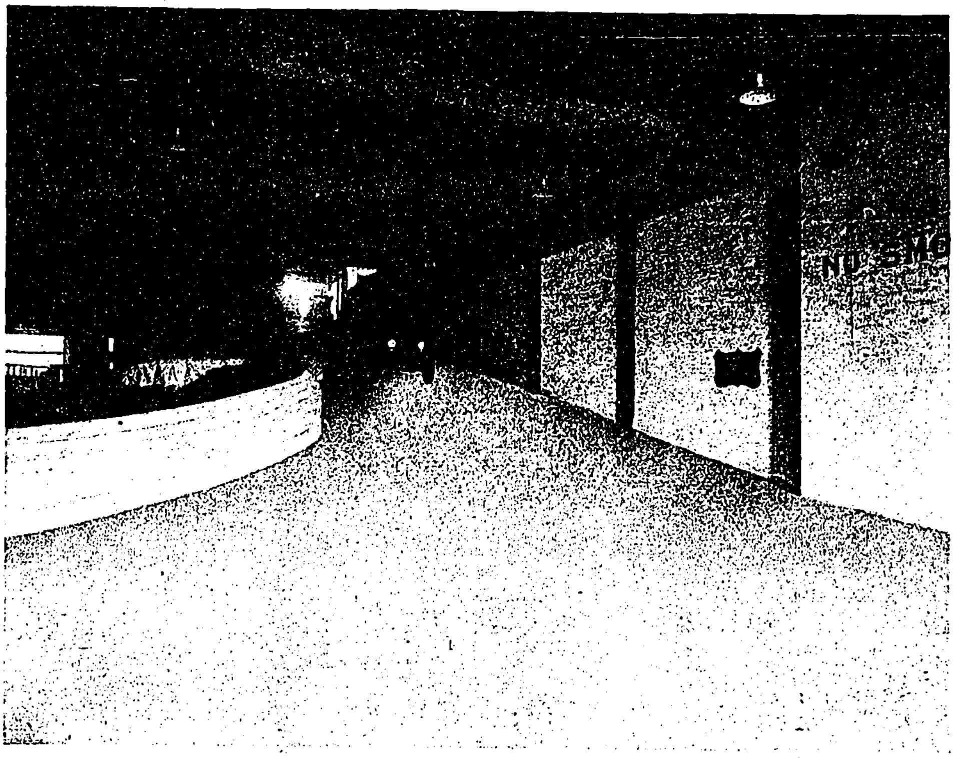
Of the latter class, a recent example is the Ottawa Car Company's garage, which has only lately been completed and open to the public. This building is situated on Albert Street in the City of Ottawa, next to the large plant of the Ottawa Car Manufacturing Company, and is one of the largest and best equipped garages in Canada. It has frontages on Albert and Slater Streets of 136 feet and 68 feet, respectively, and a total depth of two hundred feet from street to



LONGITUDINAL SECTION.

street. The present structure is two stories and basement in height, but the plan provides for two future stories to be built as additional space is required.

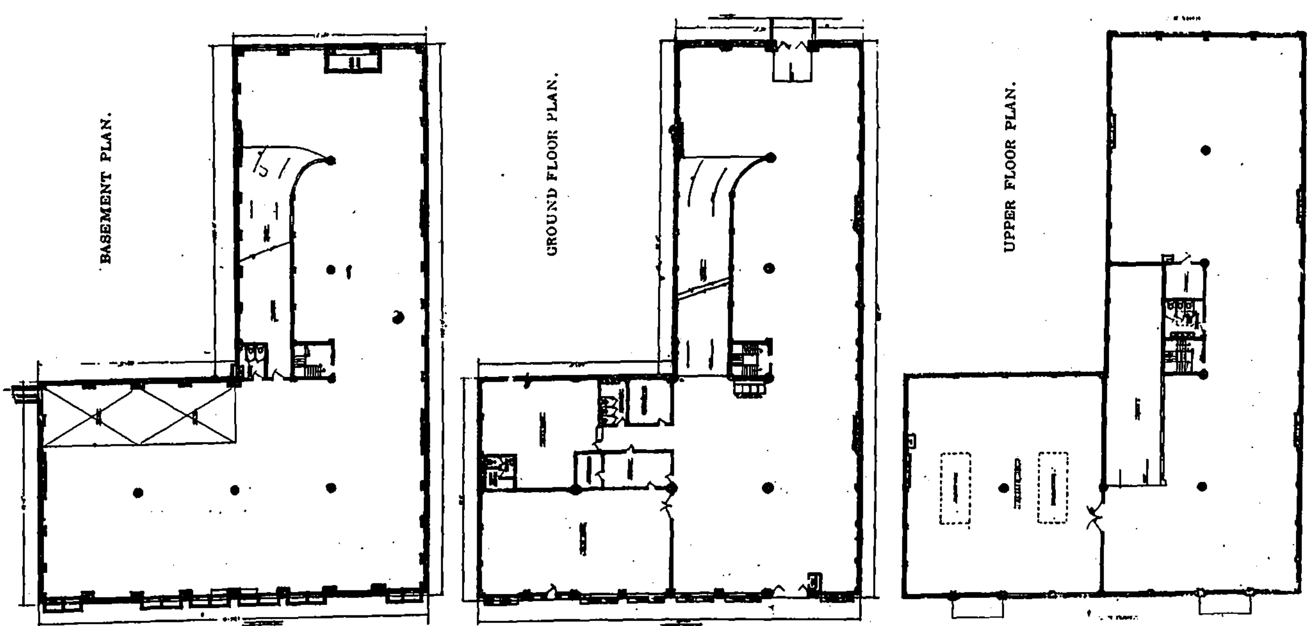
Fireproof methods have been followed as far as possible in the construction of the building. The floors and columns are of reinforced concrete, the walls are of brick with Indiana limestone trimmings, and the windows throughout are of metal sash and wired glass, with the exception of the large plate glass show windows which extend down to the level of the ground floor, and practically occupy the entire lower portion of the walls on both fronts. There are two entrances for cars on Albert street and one on Slater Street, the main car entrances being thirteen feet wide.


VIEW OF RAMP, OTTAWA CAR COMPANY'S GARAGE, OTTAWA, ONT.

A feature of the plan is the elimination of elevators. Large ramps, 18 feet wide, being used instead, on which the cars run from floor to floor under their own power, thus doing away with inconvenience and delays in moving cars in and out of the building. This is modelled to a large extent on some of the largest garages in the principal American cities.

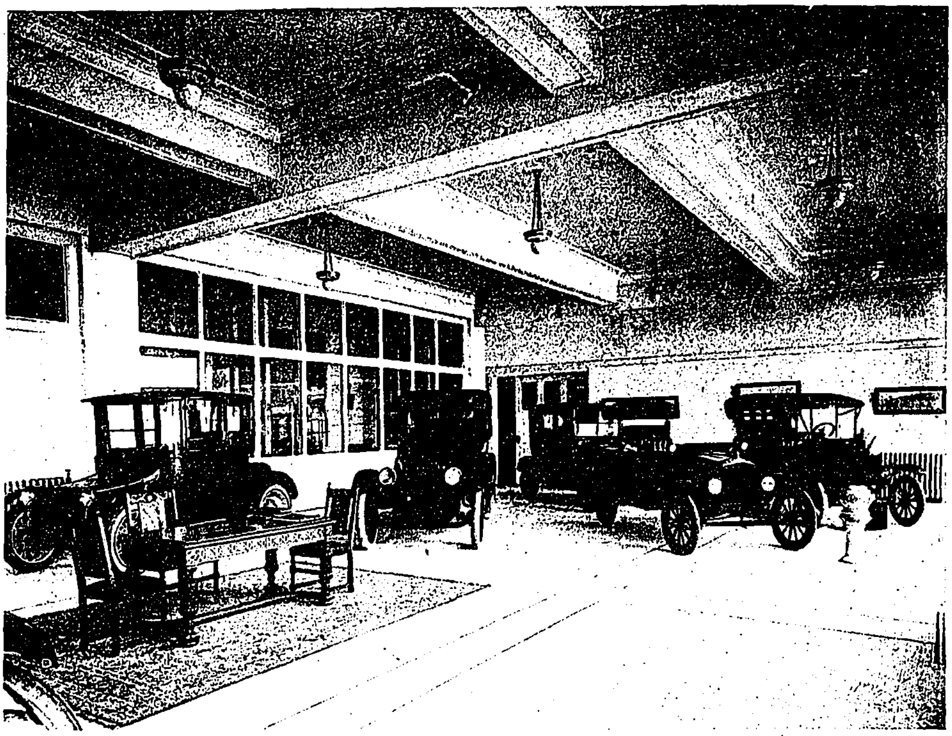
The total floor area of the building is about 60,000 square feet. Storage space is provided for about three hundred automobiles, and each patron is provided with a metal locker for spare tires and accessories. Each floor has water and air stations, the gasoline and oil service being situated on the ground floor, where a special system for this purpose is installed, with the necessary tanks placed in the basement.

The building has only six columns on each floor, the spans being 34 feet. The ceiling height clear of beams, are: Basement, 9 feet; ground floor, 14 feet; first floor, 11 feet. The stairs throughout are of reinforced concrete with iron hand rails. Four large vents are provided on each floor and are connected to a fan in the roof, thus providing means for drawing off fumes and assuring continuous changes of air.



OTTAWA CAR COMPANY'S GARAGE, OTTAWA, ONT.

The show room on the ground floor facing Albert Street, is 66 by 37 feet, the wall and ceiling being plastered and the floor of mosaic tile. At the rear of the show room are the ladies' rest room and toilet, finished in tile, together with an office, 12 by 24 feet, also with plastered walls and ceiling and a tile floor. The ground floor also contains men's lavatory, stock room and a chauffeur's club room.



SHOW ROOM, OTTAWA CAR COMPANY'S GARAGE, OTTAWA, ONT.

The first floor contains large paint and repair rooms, and additional storage space. The basement has both storage space and rooms for the washing of cars, the latter being equipped with patented overhead washers. All floors throughout the building are finished with a chemical concrete hardener, and are graded to traps so as to secure perfect drainage. The electrical equipment has been carefully considered to obtain the best possible results, and the woodwork, office partitions, doors and show window frames are all of the metal covered type. The building is heated from the new heating plant installed in connection with the Ottawa Car Company's works, and the plumbing is modern in character, lavatories being provideed on all floors.

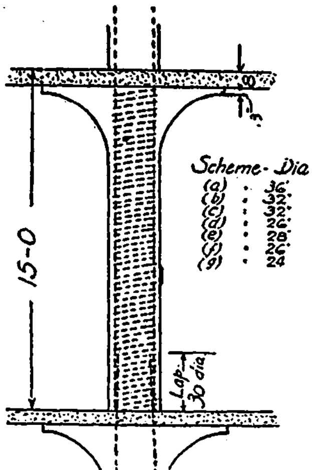
Community Houses Instead of Monuments

The erection of community houses as fitting memorials to the brave men, living and dead, who are saving the world for democracy, is suggested editorially by the "American City," in its September issue. "Liberty Buildings" is the name proposed in the United States for these structures, which, erected immediately after the war, would perpetuate the democracy of the camp and serve as neighborhood gathering places for civic activities and fellowship of all people.

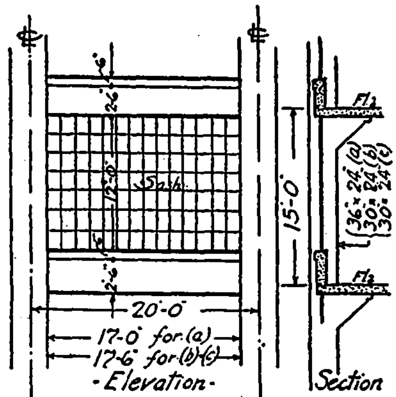
It is pointed out that of the countless numbers now engaged in the war, many will return unscathed, some will come back crippled for life, and some will never see their homes again. To those who shall live, and to those who shall die, the people will owe a debt they can never repay. But as a visible recognition of that debt they will wish to erect in every community some fitting memorial. No mere shaft of marble or granite, our contemporary says, can ever symbolize the democracy for which this world war is being fought.

The war, the editorial adds, has speeded human progress in many ways, and why not let it establish yet another precedent. This could take the form of memorials in the shape of structures which would help the living, while commemorating the dead. It recommends that when the day of peace comes that the people in every municipality be ready with their money pledged—or perhaps the necessary sum already subscribed in war bonds, with building plan completed, with an option on the site—if not already donated by the public-spirited owner, and with an organization already formed to administer the new community home when built.

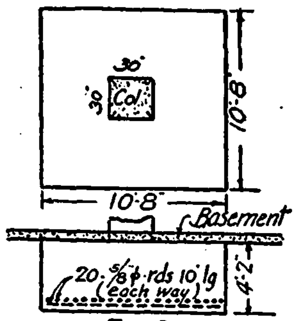
The idea is by no means without merit, and is something which perhaps could be adopted to a certain extent here in Canada. According to our contemporary, the erection of these buildings could be begun at such time as may best help to tide over, in some measure, the period of readjustment, when the returning soldiers and the industrial workers shall be in need of employment. And finally, it points out, in planning, financing and administration, an advantage would accrue by making every possible use of existing commercial and civic bodies, and of the many war service organizations which have been the medium of patriotic effort. Thus in turning to constructive works of peace with a new spirit and energy of public service, liberty and democracy would indeed be achieved.



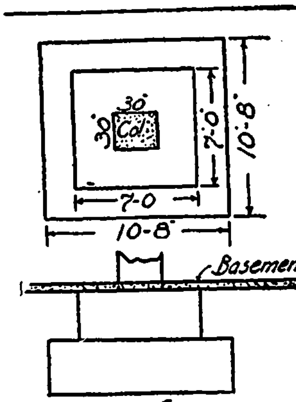
- Fig 1 -



- Fig 2 -



- Fig. 3 -
(Scheme - a)



- Fig. 4 -
(Scheme b)

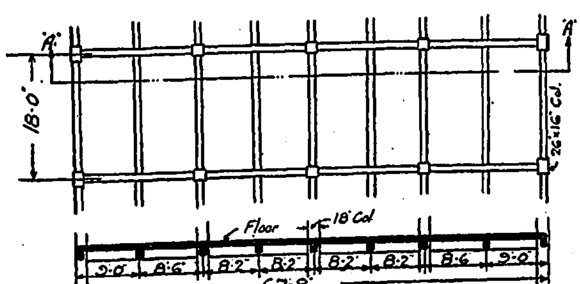
Economy in Concrete Column Design

Paper Presented by C. W. Mayers, before American Concrete Institute.

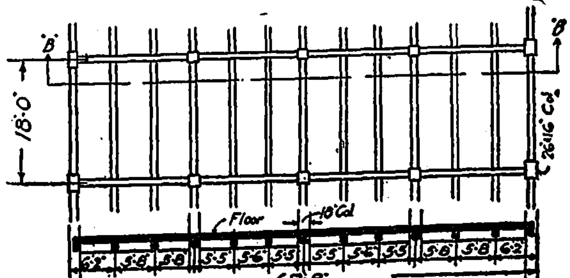
PROBABLY no part of a concrete building is simpler to design than the columns, and because of this simplicity the designer is very likely to give this part of his computations very little special study. It is also true that no part of a concrete building can conceal so effectively the lack of economical design as can the columns.

The economical design of the columns for a concrete building of only one, or even two storeys in height, is not a matter requiring much special study, but in buildings several storeys in height the subject is one of vast importance. It is not possible to design columns showing maximum economy without careful consideration of several important facts. Engineers designing concrete buildings realize that a richer mix of concrete costs more than a leaner mix. They realize that to offset this extra cost of a richer mix of concrete in column design, there is a corresponding decrease in reinforcement which results in a change in the total costs of the concrete columns. The manipulation of these mixes of concrete in order to determine the most economical column construction is a subject for real study, and to accomplish this end the engineer will find it necessary to make several trial designs and calculate the cost of each design. For example, a column 26 in. in diameter, composed of concrete mixed in the proportion of 1 : 1½ : 3, reinforced with eleven 1-in. round rods and 1 per cent. spiral hooping, will carry about the same load as a column of the same diameter composed of 1 : 1 : 2 concrete, reinforced with seven ⅞-in. round rods and 1 per cent. spiral hooping. As both of these are good designs, the question arises as to which one would be the most economical. Assuming the unit price of 1 : 1½ : 3 and 1 : 1 : 2 concrete at 36 cents and 43 cents per cu. ft. respectively, vertical reinforcement at 5 cents per lb., and spiral hooping at 5½ cents per lb. in place, it can be clearly shown that the column composed of 1 : 1 : 2 concrete will prove to be the more economical one to use. The point at which the column mixes change, and where spirally reinforced columns should be used is determined only by making these comparative estimates.

It is not uncommon to see detailed plans calling for a lap in all the rods in a lower storey column without regard to the fact that the column above may call for a lesser number of rods for its reinforcement, and it is only necessary to lap part of them. This is real waste, and shows careless design which will run into money faster than the designer suspects. For illustration, the first storey wall columns of a concrete building are 36 x 34 in., reinforced with twenty 1⅛-in. round rods. The second storey wall columns are 36 x 30 in., reinforced with fourteen 1⅛-in. rods. A lap of thirty diameters



Cross Section A-A
- FIG 5



Cross Section B-B
FIG. 6

is called for in all column rods. If the entire twenty rods in a first storey column are lapped into the second storey column it means that six of these twenty 1⅛-in. rods have been unnecessarily lapped, and consequently this extra reinforcement wasted. Had only fourteen of these first storey column rods been lapped into the second storey column instead of twenty, a saving of about 17 lin. ft. of 1⅛-in. round steel rod would have been made. This reinforcement, figured at 5 cents per lb., would have shown a saving of about $3 at this one point. Multiply this saving by the number of columns in the building where such laps occur and it becomes no small item. The expense of a cost of this kind becomes considerably greater when the column in question is a wall column on which is superimposed a so-called turned up wall beam designed to be poured with the floor slab. In this case the specified lap begins at the top of the wall beam instead of the top of the floor slab and extends upward. For example, suppose a wall beam, extending 14 in. above the second floor, designed to be poured with the slab, had been superimposed on the 36 x 34-in. wall column just discussed. In this case the lap must be measured from the point where pouring is stopped. If the twenty 1⅛-in. round rods are all carried up into the second storey column for a lap of 30 diameters it means that all the rods must extend to a point 4 ft. above the second floor, when in reality it is necessary to carry only fourteen of these rods to this point, starting the fourteen 1⅛-in. round rods in the second storey column at a point 14 in. above the second floor and extending upward. The loss incurred by carrying the entire twenty 1⅛-in. round rods into the second storey column is about 24 ft. of 1⅛-in. round rod, which at 5 cents per lb. is about $4, as against the loss of $3 when no wall beam is designed to be poured with the floor slab. Wastes of this nature at the present high price of reinforcement are serious.

In the design of wall columns it will be necessary, usually, to consider the amount of sash and curtain wall required to fill the space between columns, as the smaller the width of the exterior columns the more sash and curtain wall will be required to fill in the space between these columns. This may seem trivial, but it will oftentimes give false impressions of economy if all these seemingly trivial details are not

TABLE I.

	Design.	Comparative Estimates.		
Scheme (a)	36-in. dia. col. 11 1⅛-in. rd. vert. rods ⅜-in. rd. bands 12 in. o/c Mix 1 : 2 : 4	Conc.	99 cu. ft. at 34c.	$33.66
		Forms	Round steel	15.00
		Reinfct.	716 lbs. at 5c.	35.80
		Lost fl. space	5 sq. ft. at $2.75	13.75
		Total		$98.21
Scheme (b)	32-in. dia. col. 23 1⅛-in. rd. vert. rods ⅜-in. rd. bands 12 in. o/c Mix 1 : 2 : 4	Conc.	79 cu. ft. at 34c.	$26.86
		Forms	Round steel	15.00
		Reinfct.	1,437 lbs. at 5c.	71.83
		Lost fl. space	3 1-10 sq. ft. at $2.75	8.54
		Total		$122.25
Scheme (c)	32-in. dia. col. 12 1⅛-in. rd. vert. rods ⅜-in. rd. bands 12 in. o/c Mix 1 : 1 : 1 2-3	Conc.	79 cu. ft. at 36½c.	$28.84
		Forms	Round steel	15.00
		Reinfct.	770 lbs. at 5c.	38.50
		Lost fl. space	3 1-10 sq. ft. at $2.75	8.53
		Total		$90.87
Scheme (d)	26-in. dia. col. 11 1-in. rd. vert. rods 1 per cent. spirals (18½ lb.) per lin. ft. Mix 1 : 1½ : 3	Conc.	52 cu. ft. at 36½c.	$18.98
		Forms	Round steel	15.00
		Reinfct (vert.)	514 lbs. at 5c.	25.70
		Spirals	264 lbs. at 5½c.	14.52
		Lost fl. space	7-10 sq. ft. at $2.75	1.92
		Total		$76.12
Scheme (e)	28-in. dia. col. 20 1⅛-in. rd. vert. rods ⅜-in. rd. bands 12 in. o/c. Mix 1 : 1 : 2	Conc.	60½ cu. ft. at 43c.	$26.02
		Forms	Round steel	15.00
		Reinfct.	1,255 lbs. at 5c.	62.75
		Lost fl. space	1.45 sq. ft. at $2.75	3.99
		Total		$107.76
Scheme (f)	26-in. dia. col. 7 ⅞-in. rd. vert. rods 1 per cent. spirals (18½ lb.) per lin. ft. Mix 1 : 1 : 2	Conc.	52 cu. ft. at 43c.	$22.36
		Forms	Round steel	15.00
		Reinfct.	245 lbs. at 5c.	12.25
		Spirals	264 lbs. at 5½c.	14.52
		Lost fl. space	7-10 sq. ft. at $2.75	1.92
		Total		$66.05
Scheme (g)	24-in. dia. col. 10 1⅛-in. rd. vert. rods 1 per cent. spirals (16 lb.) per lin. ft. Mix 1 : 1 : 2	Conc.	44½ cu. ft. at 43c.	$19.14
		Forms	Round steel	15.00
		Reinfct (vert.)	306 lbs. at 5c.	30.30
		Spirals	229 lbs. at 5½c.	12.60
		Total		$77.04

given a place in the estimated comparative costs of the various designs.

Illustration of the methods of determining the economical interior column are given below. It may be well to add that no attempt is made to consider any of the various methods of concrete design from an engineering standpoint. This paper is not intended to be a text on design in any form, but rather it is intended to present to the designing engineer a method by which he can solve for himself the question of economy in his work. Hence, the reader should study the examples given here with a view to applying the methods of cost calculation to his work, and not draw engineering conclusions from any of these illustrative costs.

Several comparative designs for any interior column (Fig. 1) are shown here. The comparative costs of the various schemes are worked out in detail, using unit prices principally from tabulations in Part 1 of this paper. (Published in August issue of CONSTRUCTION, page 264).

In the estimated comparative costs (Table I) perhaps the most noticeable fact is that the columns using the 1 : 2 : 4 mix of concrete are among the most expensive. Using this lean mix necessarily produces a column larger in diameter, which means, also, a loss of valuable floor space. It will also be noticed that the smallest column designed is not the most economical. The column which shows the most economy in this case is one having a 1 : 1 : 2 mix and about 1 per cent. of vertical reinforcement, together with 1 per cent. of spiral reinforcement. Hence a rich mix of concrete and comparatively small percentages of steel reinforcement seem to show the most economical results for a column carrying a fairly heavy load.

For comparative purposes, the difference in the amount of concrete in the column heads may be neglected, as the top diameter of the head usually remains the same throughout the building. The cost of forming the column and its head has been estimated here at $15 each. This is done for convenience in arriving at a total cost of the column shaft. Ordinarily this is neglected in making comparative estimates of interior round columns, as it costs about the same to form a round column of small diameter as it does a column of larger diameter. Many other schemes may be designed for this particular column and the comparative costs estimated. However, these several examples, some of which are obviously too expensive to consider, will suffice to give the reader a working knowledge of the methods of calculation employed to determine the costs of the various types of interior columns. It is readily appreciated that even though a larger column were somewhat cheaper to build, the additional floor space occupied by this larger column might be worth more to the owner of the building than he would save in the construction of the column. Hence it becomes necessary to consider the value of this additional floor space as a part of the cost of this larger column. It is difficult to say what this floor space is really worth. However, a satisfactory way to deal with the situation is to consider the smallest column designed as a basis to which the other columns are to be compared. In the illustration this column is 24 in. in diameter. Consider the area of floor space occupied by a column equal to the square of the diameter of the column. The additional area occupied by any one of these larger columns is equal to the difference of the square of the diameter of the column in question and the square of the diameter of the smallest column designed. This additional or lost floor area is priced at a unit cost equal to the approximate unit cost per square foot of floor space of the completed building, including heating, lighting, sprinkles, etc. The unit cost per square foot of building is calculated by dividing the approximate total cost of the building by the number of square feet of floor space in the building, measurements to be taken "out to out" of the floor plan. For example, a building 200 x 60 ft. and five storeys high may cost $165,000 complete. This works out at $2.75 per sq. ft., and for general purposes this will give fairly accurate results for the purpose described above.

In the comparative estimates of the interior column (Fig. 1) given, if we strike out of each estimate the cost of lost floor space, the relative cost of each column will remain unchanged. This is not always the case, and even in our examples it will be noticed that the columns having the leaner mixes show up much more favorably when this item of cost is excluded from the total cost of the column. Frequently, the omission of this item will result in a transposition of the economic order of the various designs. In many buildings the loss of a few feet of floor space is immaterial, but in other cases it is of great importance, as in storehouses or in buildings where the machinery layout would be interfered with by a larger column. Where loft buildings or offices are rented by the square foot of net area the cost of this floor space should be figured at a considerably higher figure than the one given in our tables.

In determining the economical wall column, the method is very similar to that used for interior columns, except that the item of the cost of wood forms enters into the estimate. It will be necessary also in designing exterior columns to consider the width carefully, as every inch added to or deducted from the width of the column will change the corresponding dimension of wall sash a like amount.

Consideration is given in Table 2 to the economical design of a typical wall column (Fig. 2) for a concrete building having these columns spaced 20 ft. on centres. While only three designs are compared here, the principles are clearly illustrated and further designs should be treated in a like manner.

The cost of each wall column design includes the cost of sash and glass, together with the curtain wall necessary to fill in one bay. For convenience in making these estimates, it is assumed the glass is factory ribbed glass costing 20 cents per sq. ft., including glazing. Steel sash is estimated here at 25 cents per sq. ft., erected and pointed, making a total of 45 cents per sq. ft. for the sash and glass in place. The curtain wall below the sash is figured here at 75 cents per sq. ft. In making the sketches of the exterior wall bay for estimate purposes, no care has been exercised to select stock sizes of steel wall sash. In actual practice, however, this is usually of prime importance. The cost of the extra floor space occupied by the larger wall column has not been considered here, as its influence on these particular columns would be negligible.

In the design of concrete footings it often happens that it is difficult to decide off-hand whether a plain or reinforced concrete footing should be used. A design of each type of footing should be made and the comparative costs calculated. The engineer knowing the kind of soil these footings will rest upon should price the excavation required at a proper figure. This is a very important part of the footing cost, in fact, many times the most vital part of the estimate for foundation work. In the absence of any more reliable information the unit costs of excavation per cubic yard (not over 5 ft. deep) may be assumed as follows:

Loam or other easy excavation		$0.75 cu. yd.
Gravelly earth containing small stones	$1.00-	$1.50 cu. yd.
Frozen earth	2.25-	2.50 cu. ft.
Rock or ledge excavation	3.50-	4.00 cu. yd.
Back fill		.10 sq. ft.

For excavation work over 5 ft. deep and down to 10 ft. deep, the unit cost on the yardage below the 5 ft. depth should be increased approximately 50 per cent. An example is given below with comparative costs for the two types of footings, reinforced and plain, shown in Fig. 3 and Fig. 4, respectively. The excavation is assumed as costing $1 per cu. yd. to remove, and the excavated holes are sheeted close in order to do away with form work around the large footing block.

As shown in Table 3, the reinforced footing is the most economical to use in this case. However, provided stones or "plums" were obtainable at a small expense, the cost of the plain

TABLE II.

Scheme (a)	36 x 24 in.	Conc.	86 cu. ft. at 34c.	$29.24
	12 ⅛-in. rd. rods 17 ft. 6 in.	Forms	143 sq. ft. at 15c.	21.45
	⅜-in. rd. bands 12 in. o/c	Reinfct.	777 lbs. at 5c.	38.85
		Curtain wall	31 sq. ft. at 75c.	23.25
		Window sill	17 lin. ft. at 60c.	10.20
		Sash and glass	204 sq. ft. at 45c.	91.80
		Total		$214.79
Scheme (b)	30 x 24 in.	Conc.	71 2-3 cu. ft. at 36½c.	$26.16
	10 1⅛ in. rd. rods 17 ft. 10 in.	Forms	129 sq. ft. at 15c.	19.35
	⅜-in. rd. bands 12 in. o/c	Reinfct.	651 lbs. at 5c.	32.55
	Mix 1 : 1½ : 3	Curtain wall	32 sq. ft. at 75c.	24.00
		Window sill	17½ lin. ft. at 60c.	10.50
		Sash and glass	210 sq. ft. at 45c.	94.50
		Total		$207.06
Scheme (c)	30 x 22 in.	Conc.	46 cu. ft. at 43c.	$19.78
	12 ⅞-in. rd. rods 17 ft. 2 in.	Forms	124 sq. ft. at 15c.	18.60
	⅜-in. rd. bands 12 in. o/c	Reinfct.	460 lbs. at 5c.	23.00
	Mix 1 : 1 : 2	Curtain wall	32 sq. ft. at 75c.	24.00
		Window sill	17½ lin. ft. at 60c.	10.50
		Sash and glass	210 sq. ft. at 45c.	94.50
		Total		$190.38

TABLE III.

Scheme (a) Reinforced type. (Mix 1 : 2 : 4)	Conc.	460 cu. ft. at 34c.	$156.40
	Forms (none)		
	Reinforcement	420 lbs. at 5c.	21.00
	Excavation	19¼ cu. yd. at $1.00	19.25
	Back fill and level	19¼ cu. yd. at 30c.	5.78
	3-in. sheeting (close)	182 sq. ft. at 10c.	18.20
	Total		$220.63
Scheme (b) Plain type	Concrete 1 : 2½ : 5	507 cu. ft. at 32c.	$162.24
	Forms (top block)	84 sq. ft. at 15c.	12.60
	Excavation	24 cu. yd. at $1.00	24.00
	Excavation below 5 ft. mark	5½ cu. yd. at $1.50	8.25
	Back fill and level	29½ cu. yd. at 30c.	8.85
	3-in. sheeting (close)	270 sq. ft. at 10c.	27.00
	Total		$242.94

footing could be considerably reduced. It will be noted in the estimates for these two footings that the excavation for the plain footing is the determining factor in its cost. The materials used in the plain footing cost somewhat less than those used in the reinforced type, but the extra depth of the excavation makes the plain type the more expensive one to use. This extra cost becomes still greater when the unit cost of digging increases. In case the reinforced type of footing is built with a sloping top, and a wood form is used for this top, the cost would be about the same as though the concrete were poured up to a level with the top of the footing, and the form work omitted, as above estimated. In some operations the top part of a footing is sloped and the concrete poured "dry." This necessitates a change in the batch, slows up operations and many times does not work out economically. For estimating comparative costs of footings it is not a safe procedure to assume that the top part of the footing will be poured "dry" in order to do away with forms on the slope. Either estimate a form for this sloping surface or figure on the concrete as being poured up to a level with the top of the footing.

It has been previously stated that in the design of the beam and girder type floor, the omission or addition of one intermediate beam per bay may influence the cost materially. Although this problem is usually handled economically by engineers designing concrete buildings which have usual floor loadings and column spacings, it sometimes happens that when unusual floor loadings and column spacings are required, it is necessary for the engineer to determine a layout which will show the most economy. In a proposition of this kind it is first necessary to make the design which looks most likely to be the economical one. Then, two more designs should be made, one having one more intermediate beam and the other having one less intermediate beam. Sometimes the girders should be run in other ways and designs made on layouts entirely dissimilar. Cost comparisons made of these designs will show conclusively which system should be adopted.

For the purpose of illustrating the methods of estimating beam and girder floors with a view to economy, the two schemes shown in Fig. 5 and Fig. 6, designed for the same column spacings and live loads, are estimated here in a comparative way. Only these two layouts are compared here, but other layouts should be estimated in a similar manner, bearing in mind that the more beams and girders in the floor the more expensive the form work becomes.

In scaling the quantities for the comparative estimates of these two designs, it will be necessary to include all the concrete forms and steel reinforcement in one 18-foot bay for the full width of the building, which is about 67 ft. 6 in. In Fig. 5 the quantities will include the slab over one complete bay, seven intermediate beams, two wall beams and four girders. In Fig. 6, the corresponding quantities will include the slab over one complete bay, eleven intermediate beams, two wall beams and four girders. Under the head of "Estimate, Fig. 5" and "Estimate, Fig. 6," will be found these respective quantities to which unit prices have been fixed (a list of which will be found in Part 1), and the total comparative cost of one bay for each scheme estimated.

Estimate, Fig. 5.

Concrete, 825 cu. ft. at 34c.	$280.50
Forms, 1,860 sq. ft. at 13c.	241.80
Reinfct., 7,300 lbs. at 5c.	367.00
Total	$887.30

(Unit cost, 73 cents sq. ft. of floor.)

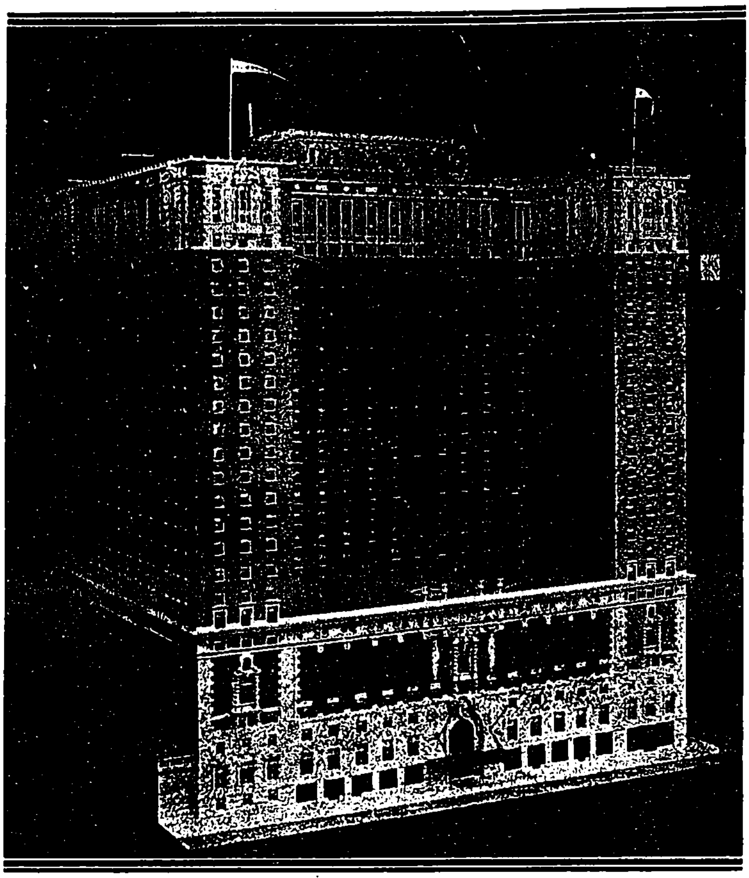
Estimate, Fig. 6.

Concrete, 700 cu. ft. at 34c.	$238.00
Forms, 2,000 sq. ft. at 14c.	280.00
Reinfct., 6,300 lbs. at 5c.	315.00
Total	$833.00

(Unit cost 68½ cents sq. ft. of floor.)

In "scaling off" the quantities for comparative estimates of beam and girder type floor, care must be taken to carefully consider the laps in the reinforcement. All steel reinforcement actually occurring in the slab and beams should be estimated. In taking off the quantities, also, it will be found most convenient to first get the quantity of concrete, then the square feet of forms, and lastly, the pounds of reinforcement. The order of scaling for the form work and reinforcement should be the same as that followed in getting the quantity of concrete; that is, if beams follow slabs in the concrete scaling, beam steel should follow slab steel in the reinforcement scaling. This method will eliminate to a large extent the liability of error, and also lessen the work of scaling dimensions, since the form areas may be taken directly from the scaled dimensions of the concrete work.

The slight changes in column and footing design which might actually occur in two buildings designed with floors like those above estimated, have not been considered here, as the details of column and footing costs are treated elsewhere. However, in buildings several storeys in height this phase of the design should be carefully considered in conjunction with the cost of floor designs when the cost comparisons are made. Even though the spacing of columns remains the same for all schemes considered, the different dead loads may influence the cost of the columns and footings considerably, and the different girder depths may make it possible to vary the over-all height of the columns in order to get the same clear head room.



MODEL OF THE COMMODORE HOTEL, AT PRESENT IN COURSE OF ERECTION IN NEW YORK CITY.

The World's Largest Hotel

A model of the world's largest hotel, the Commodore, now in course of erection in New York City, proved an interesting feature of attraction at this year's Canadian National Exhibition. This carefully executed miniature reproduction which minutely follows the architect's plan, was exhibited in connection with the Pure Food Exhibit, and gives a clear and definite idea of what this mammoth hostelry will be like in external appearances when it is finally opened to the public. It shows a brick exterior, practically solid in mass and relieved at the lower and upper stories by artistically detailed stone work, the general design being worked out in very excellent proportions. The building will be twenty-eight stories high and contains two thousand rooms, all outside ones, with baths. At night the two thousand windows of the model were lighted by electricity, producing a brilliant and vividly realistic effect. A feature of the design is the roof garden which occupies the space in the recess forming the court above the ninth floor level.

It is perhaps interesting to note that the hotel will be under the direction of Mr. John McE. Bowman, a former resident of Toronto and now president of a syndicate which control a chain of large New York hotels, representing an investment of $200,000,000. Mr. Roy S. Hubbell, assistant manager of the Commodore, and Mr. Robert J. Kennedy, publicity director of the Bowman group, came to Toronto to arrange the exhibit. According to Mr. Kennedy, when the hotel is opened in 1919, a million guests will register the first year, and over five million meals will be prepared by the culinary department. The model is made of wood pulp and cost $3,000. Six months were required to complete it.

Future Housing

In future the cost of factories will not be limited merely to the buildings wherein machines are operated and workers perform their tasks, but must include the buildings wherein the workers meet in social intercourse, and for purposes of recreation, and to some extent the buildings wherein they live. The housing of the human machine can no longer be left to speculation or to chance, and those employers who to-day are providing their work people with welfare amenities, and considering their well-being, are doing wisely, although this may only be a step towards what will be demanded in days to come. Labor has measured its strength in this crisis and will never consent to go back to the conditions which prevailed prior to the war. No man can work properly unless he be adequately housed, and it is therefore only right that employers of labor should be made answerable for the provision of a sufficiency of suitable houses and for the general well-being of those whom they employ. The whole matter is one of great and vital importance, and in a future issue we shall hope to return to the subject more fully.—"Builder," London.

Project for Irish Tunnel

Advices from London state that the scheme for a tunnel between Great Britain and Ireland has been revived, and that Premier Lloyd-George is to consider the project at a time not far distant.

It is thought that the construction of such a tunnel would be a most powerful influence in putting an end to the disputes and misunderstandings between the two countries.

The scheme is not a new one, plans having been in existence and laid before the Government some twenty years ago. Five plans for this tunnel are on paper, and it has even been proposed to build a solid railway across the Irish Channel. A bridge and a tube sunk beneath the surface have also been proposed.

CONSTRUCTION

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Proposed National Builders' Association

Local co-operative effort can always accomplish something, but national organization is what really counts in the attainment of fully effective results. Hence a great deal in the way of influence, general usefulness and accruing benefits can be predicted for the proposed Canadian Association of Building Industries now in process of formation. Permanent organization of this body will be effected at a general conference to be held in Ottawa on October 22, 23 and 24, and which gives promise of being fully attended by representative contractors from all sections of the country. The object will be to unite the various contracting and building interests, including supply and material firms, into a Dominion-wide organization, aiming to bring about a better understanding among those directly concerned, and to solidfy action in all matter relating to their interests and general welfare.

Two circumstances attending the inaugural of this movement at the meeting held at the Toronto Builders' Exchange on September 4, and which included representative contractors and builders from Montreal, Toronto, Ottawa, London, Galt and other cities, seem to indicate the assured success of the association. One is the prominent men behind the project, and the other is the draft programme to be considered at the Ottawa conference, which indicates that the proposed association is to adopt no half measure policy. Besides this personal representation and the enthusiasm displayed at the preliminary meeting, there was also a sufficient assurance by proxy of the endorsation of a large number of firms in the eastern and western sections in support of the movement.

To a certain extent the association will be analogous to the National Federation of Building Industries, recently formed in the United States. It will consider, among other things, various contracting problems, ethical and business questions, the interdependence and relations of its allied branches, business relation with the architect, engineer, owner and public works departments; cost plus percentage basis, labor trade parliaments, the matter of resources, economy, readjustment and standardization of materials, and various other important subjects having a direct or indirect bearing on the building trades.

Not the least of the association's responsible duties will be to take up with the Dominion Government the matter of securing protective legislation in regard to the present unfair condition to which the Canadian contractors are subjected through the competition of alien firms, and which has been the means of taking large sums of money directly out of the country. In fact, in many cases competition is not the proper word, as very often alien firms are awarded contracts without Canadian firms even being given a chance to figure on the work. However, a hopeful sign, and one which indicates the usefulness of the proposed association, is the announcement made at the preliminary meeting by Mr. J. Penrose Anglin, president of the Montreal Builders' Exchange, to the effect that the Minister of Public Works has signified his willingness to meet the contractors, or a delegation of their association, to talk over various matters that relate to Dominion Government work or to Federal legislation.

In view of this and the many other worthy objects it seeks to attain, it is certainly to the interest of all contractors, builders and supply dealers, to rally to the support of the new association, and to make its organization effective and complete. What will benefit the association will likewise help the individuals who comprise it. That it can become a live, active and influential factor cannot be denied. That it has already been too long delayed in coming into existence is likewise apparent. Organized along national lines it will be in a position to correct many of the existing evils which have crept into the contracting business, and with which local exchanges at the best can only feebly cope.

The draft programme to be considered at the Ottawa conference is as follows:

Proposed Ottawa Programme.

1. Provincial Roll Call. (number from each)
2. City Roll Call. (number from each)
3. Section Roll Call.
   I. General.
   II. Sub or Trade.
   III. Supply.
4. Organization for Conference.
   (a) Order of Programme Committee to arrange and post details of programme.
   (b) Builders' Exchange(future usefulness of).
   (c) Publicity Committee (Press, notices, etc.).
   (d) Three Entertainment Committees (one each day).
   (e) TeTndering.
      Quality Surveying.
      Method of calling and opening Bids.
      Contract and Bid Bonds vs. Cheques.
      Contracts—Standard Agreements, unit prices, etc.
      Cost-plus-fixed-Sum Contract.
   (g) Labor
      Labor Trade Parliaments.
      Employers' Apprenticeship and Technical Education.
   (g) Materials Committee.
      Resources, economy, readjustment, standardizatoon.
   (h) Future Business.
      Industrial housing, concrete roads, etc., contract farming.
   (i) Business Relations.
      Public Works, Architects, Engineers and Owners, Sub Contractors and Supply Houses.
      Powers of Superintendent or Inspector and Arbitration.
   Foreign competition anl Plan making.
   (j Building By-laws and Lien Laws Committees.
   (k) Other organizations. Relation to Board of Trade and Manufacturing Association, etc.
   (l) Code of Ethics as Between General Contractor. (1) Receiving bids and Awarding Work. (2) Payments. (3) Bonds (4) Bonus and penalties.
   (m) Zones of operation, plant, yards, etc.
   (n) Trade papers. Building Statictics.

The following constitutes the temporary executive committee appointed at the preliminary meeting, with power to add to its number, especially as regards Western members: J. Penrose Anglin, of Anglins Limited, Montreal, chairman; D. K. Trotter, secretary-treasurer of the Montreal Builders' Exchange, secretary; W. Davidson, member of the Winnipeg Builders' Exchange; W. E. Dillon, of W. E. Dillon Co., Limited, Toronto; Herbert Elgie, Toronto; Harry Hayman, London, Ont.; H. Hazleton, president of the Winnipeg Builders' Exchange; J. D. Johnson, Ontario manager of the Canada Cement Co., Limited; W. A. Mattice, of the Dominion Bridge Co., Limited, Ottawa; W. E. Ramsey, of Pedlar People, Limited, Montreal, and E. A. Sanders, secretary of the Mechanical Trades Association, Halifax.

Among those present at the Toronto meeting in addition to most of the above mentioned, were: John Quinlan, Montreal; C. F. Smallpiece, Eastern manager of the Taylor-Forbes Co.; H. N. Dancy, Toronto; T. Gander, Toronto; R. Jackson, of the Jackson-Lewis Co., Limited, Toronto; Walter Davidson, Toronto; Geo. R. Hyatt, London, Ont.; Edward and George Hayman, of Hayman & Sons, London, Ont.; A. G. Robb, of Galt; T. R. Wright, of London, Ont.; and F. B. McFarren, general manager of the Interprovincial Brick Co.; Geo. E. Stocker, president of Wickett Bros., Toronto.

CONTRACTORS and SUB-CONTRACTORS

As Supplied by the Architects of Buildings Featured in This Issue.

NEW MASONIC TEMPLE, TORONTO

Boilers, Kewaunee Boiler Company.
Brick, Don Valley Brick Works.
Casement, Trussed Concrete Steel Company.
Conduits, Conduits, Limited.
Electric wiring, Benett & Wright.
Elevators, Otis-Fensom Company.
Electric fixtures, McDonald & Willson.
Fire escapes, Canadian Allis-Chalmers Company.
Grilles, Reid & Brown.
Hardware, Canada Hardware Company.
Heating and ventilating engineers, Benett & Wright.
Marble and terrazzo, J. G. Gibson Marble Company.
Ornamental iron, Canadian Allis-Chalmers Company.
Painting, Hughes & Company.
Plumbing fixtures, Jas. Robertson Company.
Plaster work, Hoidge & Sons.
Reinforcing steel, Trussed Concrete Steel Company.
Radiators, Dominion Radiator Company.
Stone, Scott Bros.
Vault doors, J. & J. Taylor.

OTTAWA CAR COMPANY'S GARAGE, OTTAWA, ONT.

Concrete work, John Sutherland & Son.
Cut stone, Hooper Bros.
Electrical work, Mac Electric Company.
Heating, J. R. McLennan.
Marble work, A. K. Mills & Son.
Metal sash, Trussed Concrete Steel Company.
Painting and glazing, W. J. Carson.
Plumbing, J. R. McLennan.
Roofing, J. D. Sanderson & Company.