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EDITORIAL

AT THE TIME of this writing our Editor is again a hospital patient. A week ago he had a serious accident in his home resulting in a head injury. The latest report on his condition is favourable, but still serious, and we know every member of the Institute joins in wishing for a speedy recovery. We were without the guidance of our Editor for a few months this spring when he was hospitalized. Such occasions make us realize how fortunate the *Journal* has been to have an Editor whose able leadership has helped so much to bring our publication to its present high level. And now, in this emergency, we find so many others so willing to help in extra ways.

Teamwork is essential in any activity or enterprise. In our case teamwork means the joint effort of the Editor, Publisher, members of the Toronto board, all Provincial Representatives and, what is most important, every member of the Institute. We make a special and personal appeal to every Canadian architect for *Journal* material whether articles, photographs of buildings or just ideas to be used to improve your *Journal*. There are many members of your Editorial Board who devote good portions of their time and effort to obtain articles and photographs. These men are busy with their practices in these prosperous days but they find some time for the *Journal*. There are others, not members of the Board, who give freely of their time and effort. The latest, and indeed a very busy architect, is our Institute President who is off to the Coronation but has promised us an article on his experiences and observations of that event. After his close association with Sir Hugh Casson at our Annual Assembly, his report on the London decorations should be most interesting.

There must be many events, interesting to architects, taking place in every province. If these could be recorded or the Board notified of where, or how, the information and material could be obtained, it would be a stimulus for the *Journal* and help our aim of making the *Journal* truly representative of all sections and locations of our profession. The *Journal* is the official publication of the R.A.I.C. It reaches every member every month and every member should feel proud of his *Journal*. The *Journal* can be improved only by publishing more and better articles and more photographs of better buildings. The material must come from the members who, after all, are the ones who make architecture. It is the fervent and constant hope of your Editorial Board that we have a wealth of material at hand for the best, the most interesting, provocative and representative photographs and articles for publication. It could be said it is our dream to be flooded with material.

We know that in the past some members have submitted photographs or articles and had them returned without being published. We sincerely hope this, or the thought of this, will not deter anyone. If the ultimate aim of publishing only the best representative material is to be accomplished it can only be achieved by having a wide choice. Having material rejected is never a complete loss. It is a contribution because it makes competition possible. We hope to reach the point where the standard of your *Journal* is so high it will be considered a great achievement in the profession to have work published. We need more and more material. It can be submitted to your local representative.

It is our great wish that next month our Editor will again have one of his sparkling editorials in this space for your perusal and enjoyment.

EARLE C. MORGAN
Chairman of the Editorial Board

A paper given at the 46th Annual Assembly of the Royal Architectural Institute of Canada.

New Structural Systems

Clare D. Carruthers

IT HAS BEEN SUGGESTED that I talk to you today on recent trends in structural design of buildings. Trends is a very elastic word. It indicates a slow but not necessarily positive movement in some direction. This movement is determined normally by the economic factor, that is toward a more economical structure for the class of structure whether it be ordinary wood joist, mill type using heavy timber, non-burning types, or fire resistive. But there are other factors that may help or sometimes may temporarily obstruct this trend toward a more economic structure—the desire of engineers for more accurate designs, taking into account more of the factors affecting the stresses in the structure; or as is often the case with engineers as with other people of this world just the desire to do something different or more sensational.

I do not intend to develop any new sensational ideas but rather to try and bring into proper focus some of the developments that have occurred since the end of the last war. The sensational may be more interesting but I doubt whether it is the more useful.

There are very few architects who are not familiar with wood as a structural material. They generally are brought up on wood structures since in practically all residential work, wood is still the accepted building material. It has many advantages, you can always cut a little nick in it without any trouble if for some reason or other the plumbing doesn't fit just as planned. I will only touch on some of the new developments in the use of wood as structural material.

As everybody realizes we have been using up our natural resources at a great rate of speed particularly from those areas which are easy of access. The select grades of structural woods have become scarcer and scarcer. However, there has been a new development in the last ten to fifteen years in the gluing together of woods to make laminated types of beams or columns or any other shapes that you may desire. This scheme has the advantage that the good grades can be put where they are required and the lower grades down to No. 2 common may be placed in those parts of the member that are not subjected to serious stressing. Actually, laminated beams made of several different grades of wood are better than if they had been made of one piece cut from a log. In the one piece you must accept all the defects that occur, and hence the whole stick will be graded low even though most of the piece is excellent material. The laminated product is better in many other respects; since it is made of small pieces, generally 2 x 4 or 2 x 6, it can be dried under controlled conditions with little checking and splitting, and when installed will have the proper moisture content. In most building structures in service there will be very little change in the moisture content throughout the years. Some people may be a little suspicious of the glue but in all the tests that we have seen never once have we seen a failure occur in the glue but always in the wood. Also by laminating these wood beams one can have almost any size and shape that is desired although there are certain factors that must be taken into account. It is preferable to use multiples of standard building units, that is 2 x 4's, 2 x 6's or ⅞ material 4″ or 6″ wide. The degree to which members may be curved is determined by the thickness of the members. For details of this one should consult the catalogue or more preferably the representative of one of the laminating firms.

One of the interesting things that can be done with laminated woods is that even in beams any necessary camber can be introduced in a similar manner to a steel truss. Except that with the wood, of course, each individual piece of the beam is slightly cambered.

It is noticeable that since the development of laminated type of structure there has become quite a comeback in wood construction of the mill type and long span beam or truss types. The increased stresses allowed for laminated structures do allow the use of increased spans which is one of the most noticeable tendencies today in all forms of construction. One of the problems of wood construction of course, is the connections, these generally have to be made using cast iron or steel members to connect together the various pieces with bolts or with some of the newer patented connectors such as manufactured by Timber Connectors—Teco Rings, Shear Plates, etc. Probably some day someone will invent a glue which can be just painted on in the field and the two members stuck together without pressure. At the present time all gluing requires a high degree of pressure. As a matter of fact it is my opinion that no gluing in the field should ever be allowed. Only factory production of this type of material should be accepted. This allows careful control of the methods, materials and pressures.

In the field of structure steel there is not quite as much to report. There has been the maintenance of and even improvements in the quality as manufactured in American mills. This is offset to some degree by the poorer grades of steel which we have received in certain cases from European countries. Structural steel as rolled on this continent is the most consistently uniform type of structural material we have. There has been much greater need for careful inspection of structural steels and reinforcing steels during the last few years because of the shortages and the tendency of some people to use anything that has the name steel attached to it. This will continue until the shortage is over.

There has been one development in recent years which has added a new type of section. This is the use of gauge material pressed into the form of channels or I beams in order to make very light sections. These have not always been acceptable under existing Codes although if kept to their proper place they are, in my opinion, a satisfactory type of member.

The biggest advance in steel construction has been the introduction of welding as a method of attaching members together. I am often asked why there are not more all welded structures today. The only reply I can ever give is that until fabricating shops have decided they can afford more space for welding, welding will be held back in structural fabrication. With welding an accepted method of jointing members, there are many savings that can be made in the structural steel members that go to make up the whole assembly. Once welding is introduced then we have the same concept of the structural frame as we have with concrete, that is, that it is a continuous structure both as regards columns and beams. In steel this gives a more noticeable economy even than in concrete. A steel beam is always rolled the same depth throughout its length, therefore, if the size of the beam is reduced, it is reduced for the full length. One of the effects of using continuity in the steel structure will be to increase slightly, but only slightly, the size of the columns, since with rigid connections of beams to columns the columns are called upon to take moment as well as the vertical load. Fig. 1 give examples of some welded members and connections.

In some degree this distribution of moments to beams and columns may be varied by using semi-rigid connections, that is, designing the connection of a beam to a column for the amount of moment you wish the column to take. This is a design technique that still must be handled with kid gloves.

Welding allows much greater freedom in shaping the structure. Individual members may be built up from plates, or a rolled beam strengthened by plates due to high local stresses. In trusses, particularly light trusses, welding gives real economy due to saving in detail. Hence the development of long span joist types.

Welding allows the economic use of rigid frames particularly the arched type or ridge type. The ridge type is shown in Fig. 2. These require careful proportioning of height of column and height of ridge to develop full economy. Cost will be less than laminated wood if the steel does not need to be covered or fireproofed.

Another type of structure that welding makes easier to construct is the Vierendeel truss (a truss without diagonals). These trusses will be expensive structurally but may sometimes fit the bill beautifully. Reasonable economy can be achieved by using diagonals in the end panels and leaving the centre panels only without diagonals. I know they could be an architect's delight but don't use them indiscriminately. They can be very expensive under heavy or variable load conditions. This type of truss is illustrated in Fig. 3.

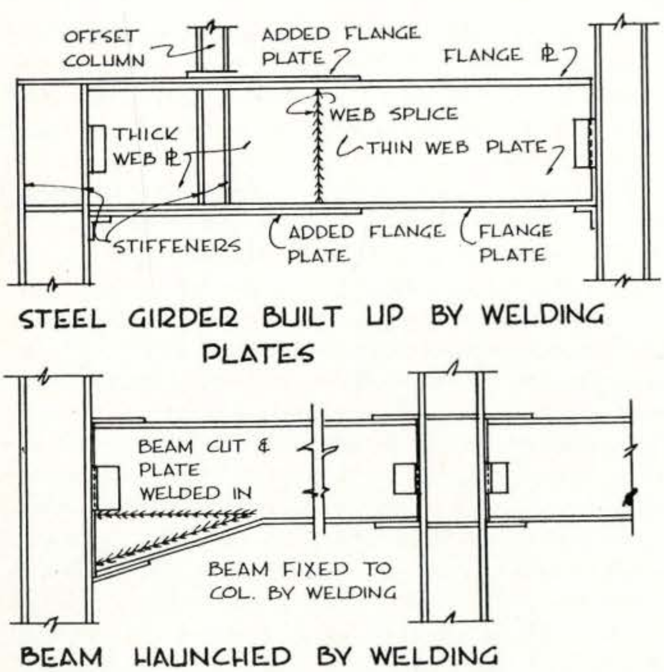


Fig. 1

Fig. 1 The upper detail shows how a girder with highly different stress conditions at the two ends may be built up to achieve maximum economy in the use of the metal. The lower detail shows methods of connecting to columns for rigid connections. For the left hand end, the beam has been deepened to take high end moment by haunching.

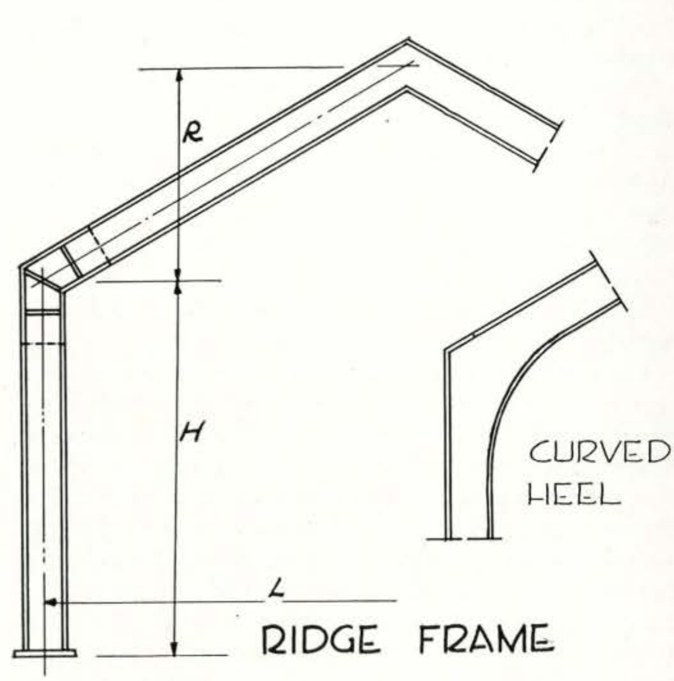


Fig. 2

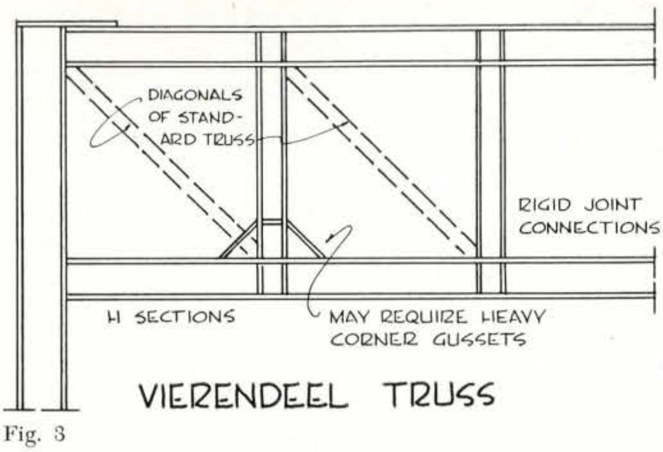


Fig. 3

Fig. 3 Trusses without diagonals or with diagonals omitted in certain panels. These trusses are sometimes made a full storey in height.

One other structural form that welding provides for economic development is the use of large square or rectangular columns and beams which can be used for ducts and piping. There are, of course, problems of getting in and out of the members with holes of any great size and also the almost impossible problem of fireproofing the steel. It is probable that the present scheme of separate mechanical ducts and pipe spaces is the more economical.

I rather look forward to the day when structural steel buildings will be all welded structures and will be designed in the beginning as welded structures, not as has been done so often to date, designed as rivetted or bolted structures and then connected together by welding. That scheme does not give nearly the full savings that can be made by welding.

Another development in structural steel is the use of space frames, that is the use of relatively light trussed members which by arching action or by the use of available horizontal resistances can be made to span over large areas. Domes are a good example of space frames. Recent developments have indicated effective use of structural steel trusses in rectangular structures in the form of space frames. Saw-tooth roof construction where both the inclined surfaces are made into trusses with the one supporting the other is a good example.

One form of connection which may develop in the near future, and for which there is promise of reducing costs of connections, is the use of high strength bolts with washers in place of rivets or turned bolts. These high strength bolts are made of special carbon steels. They have heavy washers underneath the head and the nut, which allow the tightening of the bolts so that the stress in the bolt is somewhere between 70 and 80 thousand pounds per square inch. By this scheme the pieces are clamped together and held in place through friction rather than the shear of one member on another through the bolt. These have been used to a small degree in the States by both the Bethlehem Steel Corporation and United States Steel but have not been adopted in this country. The bolts and washers can be manufactured here. The only problem is one of field control of the amount of tension that is required in the bolts. The principle appears to be satisfactory to all who have studied the question and it is largely a matter of developing field controls. Of course, field controls probably also are required for both ordinary bolting and rivetting but since they have been accepted practices for years and years, no one really questions them. There is probably as much bad workmanship in rivetting as there would be if this type of high stress bolts were used. We have already had the same problem of field and shop control in the case of welding. It has been successfully solved in Canada through the work of the Canadian Welding Bureau. We have an excellent set up, one many of our neighboring countries envy.

To date there has been little if any use of high strength steels in structural work. Generally the standard 20,000 pound stress carbon steel has been found to be the most economical and only if extra strength in columns is required have special steels ever been used. I believe there have been a couple of occasions in this city where silicon steel with an increase in stress of about 20% has been used. However, unless some real saving in size of columns is achieved it is hardly worthwhile. To use it in beams and girders would not make any noticeable saving in size and would cost a good deal more.

One feature of structural steel construction which is relatively new, is the developmtent of long span open web steel joist. The long span steel joist is the same type of joist but capable of being used up to spans of 60 feet or more. The use of these joists has developed real economies from the point of vew of roof construction. Provided deflections are watched they can also be used for floor construction. The use of these joists on roof construction allows the economical framing of relatively large bays, 40′ to 50′ square bays are quite commonplace and can be done with trusses and long span joist with a poundage of steel not much greater than would be used for a 30′ square bay using rolled sections. The use of long span joists and trusses has a further advantage in the roof construction, particularly in factories, in that the pipes and ducts can be run through the truss area with the result that all of the space beneath the trusses is usable space. Fig. 4 illustrates this type of construction.

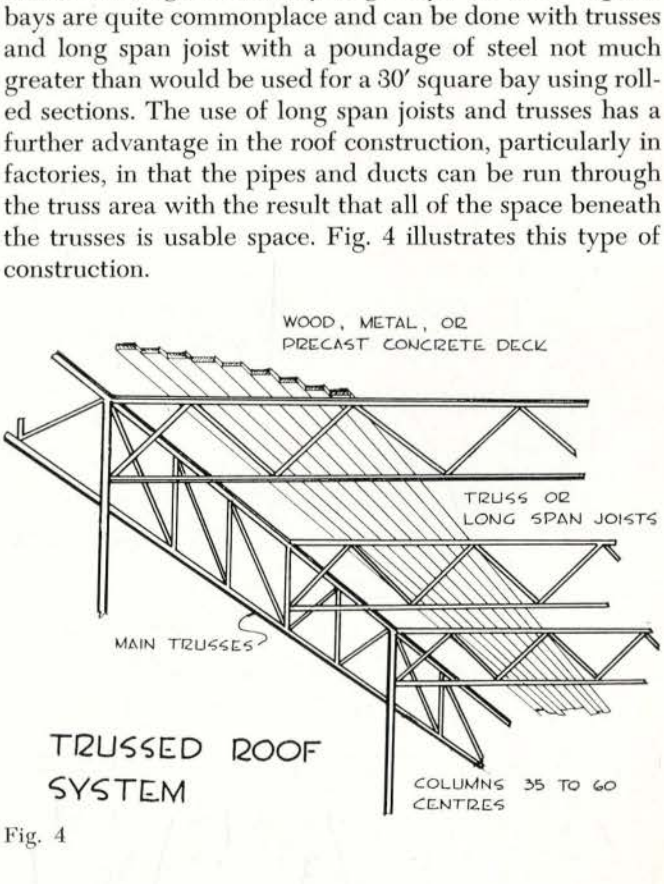


Fig. 4

Of all the materials mentioned, concrete is one of the newest in its development as a major structural material in building. True, concrete or cements which allow you to make concrete have been known for thousands of years, but the use of a mixture of cement and aggregate with water to form a plastic material which can be poured into forms and reinforced with steel rods is relatively new, dating from about 1875. The fact that it is a plastic and can be poured into forms made into whatever shape or size one may desire gives it some advantages for use over other materials that may be employed. It is very easy to fit its shape to the shape of the facing material that is to be used, for example, precast terrazzo placed in the forms, or it may be shaped so as to be the facing itself. With the introduction of concrete, designers naturally thought of making the beams of the same type as was used in wood or in steel construction, that is relatively narrow beams but fairly deep. This does tend toward economy and I think you will see in practically every text book on concrete there is a formula for determining the economic depth of concrete T beams. Many of the concrete structures, at least up to the last few years, were of this beam and slab type which is illustrated in Fig. 5. a) and b).

The other type of structure generally associated with reinforced concrete floor systems, is the flat slab. In this type of structure there are no beams at all. There is a dropped area around the column and there is a flared column capital in most cases. See Fig. 6, a) and b). It is only in concrete that it can be used. It has many advantages. It does not take up very much height. It allows a free flow of pipes and ducts underneath it without the necessity crossing under large beams. It has been found under test load to have very high strengths even when loaded well in excess of the desired strength. It is capable of considerable variation in column settlement. That is, it is a relatively flexible type of structure. It was generally used for buildings with

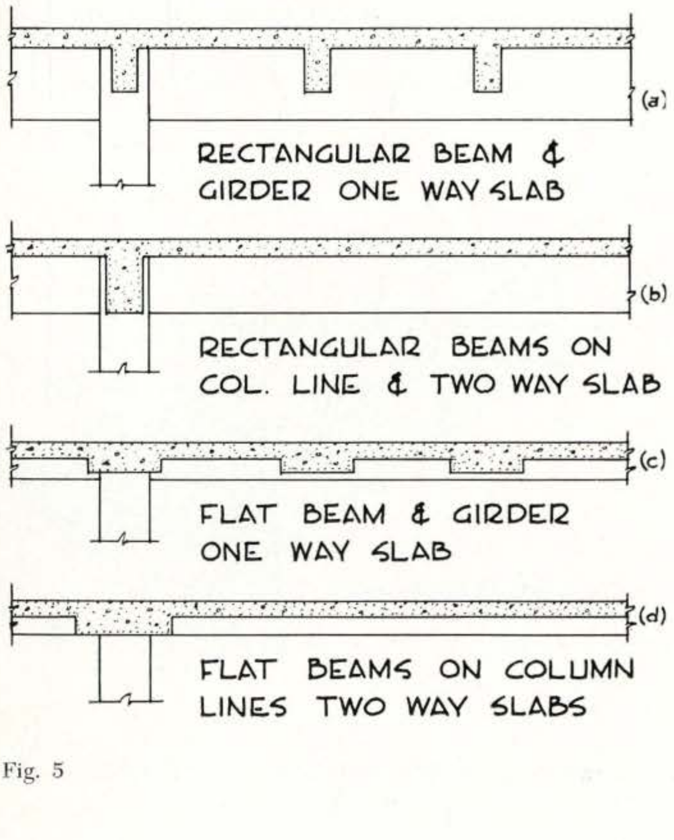


Fig. 5

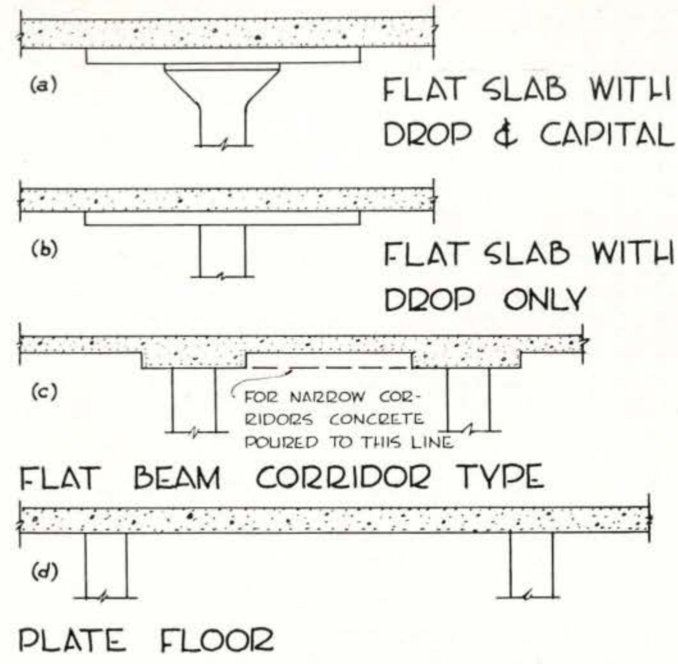


Fig. 6

relatively heavy live load, say 125 pounds per square foot and up. It has of course certain disadvantages. It is difficult to cut large holes through the floor particularly adjacent to the columns. It is difficult to make major changes in its structure. Even large pipes often cannot be put through immediately adjacent to the column. It is not satisfactory for framing which has an irregular pattern, although what framing really is satisfactory on irregular patterns of columns. The flared column heads is a disadvantage in types of buildings where flat finished ceiling is desired.

In recent years there has been a greater tendency to use this flat slab construction for lightly loaded buildings where it is possible to have a uniform spacing of columns at spans that are in the range of 18′ to 25′. In lightly loaded structures it is nearly always possible to omit the column capital and have just the slab and the drop panel that occurs around the column. See Fig. 6 b). This has resulted in some very low cost structures of the fire resistive type and has had the additional advantage of reducing the depth of the structural system by 1′ or more. In one recent building we designed, it was possible through the use of this type of floor system to get 12 storeys instead of 11 storeys in the 130′ height allowed for buildings without setbacks.

Another development in concrete work which has developed from this flat slab idea is the use of broad flat beams instead of the narrow deep beams. This type is illustrated in Fig. 5 c) and d). It is true that these wide flat beams add to the amount of concrete and to the amount of reinforcing steel required but reduce very considerably the form work due to the large flat areas. In this way the costs of forms are reduced sufficiently to balance the extra concrete and reinforcing steel, and there is in addition the saving in storey height. It is normal practice to have these beams not much more than 6″ to 8″ deeper than the slabs they are supporting. They have other advantages too in that it is possible to bring pipes up through these broad flat beams even directly in contact with the columns. For the use of broad flat beams again you must have an even regular spacing of columns, although not quite as necessary as for the flat slab construction.

From this development came the use of corridor beam construction as illustrated in Fig. 6 c). When we have two rows of columns, one on either side of the corridor probably 8′ centre to centre, you could use two of these broad flat beams, one on each row of columns but that would leave a relatively small space between them. Instead of paying for the extra cost of forms it is now general practice to pour this corridor slab the same depth right across. Hence the name corridor beam. It is really the two beams joined together. It has one advantage that columns may be offset from one another across the corridor provided they are not at such a distance that reinforcing between them becomes a problem. As with all structures uniformity of layout adds to the economy. If the side wings of such a structure exceed say 20′ then it is often more economical to run the beams across the building rather than parallel with the corridor. Again we would use the broad flat beams or alternatively tin-pan, or tile joist the same depth as the corridor beam to take care of the larger spans. They have one additional advantage over the narrow beam, they very often reduce the slab thickness significantly due to the reduction in span between the beams. Where they have their limitations is when there are any heavy loads such as masonry walls or offset columns to be carried. As a matter of fact, offset columns in concrete construction are always a problem since the concrete is relatively poor material in shear. Offset columns usually set up very high shearing stresses. In such cases it is often necessary to introduce structural steel beams even into a concrete frame.

Once a designer has been able to reduce the difference in thickness of his beams and slabs, say, something in the order of 6″, he begins to think in terms of not having any projections below the slab at all, that is, he achieves a plate floor which is the same thickness throughout, as illustrated in Fig. 6 d). This has some very marked advantages if it can be achieved, particularly if ceilings are not required. Obviously the form work would be more economical since it is just a flat sheet.

Then one day certain individuals began to wonder if it wouldn't be possible to omit the form work completely. It was obvious that if the slab could be poured on top of another slab on the ground and then raised up to its position, it would be considerably more economical with form work at 40 to 60 cents a square foot. This led to the development of what is known as the lift slab construction and was developed by Youtz & Slick in Texas. Why it was saddled with a name like that at birth I don't know. It is a marvel it hasn't died, however, it hasn't and gives promise of becoming a very lusty development in concrete construction. Most of you probably have read or heard of this type of construction since it was well explained to you about a year ago by Mr. Ford, an architect from Texas. However, a short review of the type of construction meant by the word lift slab might be in order. First the footings are poured, the steel columns are set, the slab on earth is then poured to act as a form for the slabs above. It may be necessary to construct some wood formwork around the outside of the slab on earth since very often you wish to have an overhang for the floors and roof slabs above. Then the reinforcing steel for the slab is set and the concrete poured. The same scheme is followed through for the other floors and roof. After the concrete has developed sufficient strength to handle the stresses due to dead load, the slab can be raised into position. The whole trick in this type of construction is the jacks that are used to lift the slabs. I will have to refer you to the various items of literature on the subject for the picture of this jack and the way it works. The maximum load the jack will pick up is 100,000 pounds although it is always advisable to keep your lift load well below this figure, say approximately 60 or 70 thousand pounds, (note that continuity increases load on some columns and decreases it on others). There are certain other limitations which we should point out. The minimum distance from the edge of a slab to the centre line of the columns is 2′-6″. It is much better if the distance from the edge of the slab to the centre line of the column is made ⅓ to ¼ of the span. The layout of the columns should be uniform and the most economical spacing is from 18′ to 25′, depending on the amount of live load can be carried. Greater spans are possible provided means are used to lighten up the slab. The limitation on storey height is due to wind bracing requirements. It is in the range of a maximum of 9 storeys, with 3 to 4 storeys the optimum height, although 6 storeys are quite possible without any serious trouble. Naturally on higher buildings your procedure becomes a bit more complicated. The class of concrete used in these slabs is never less than 3000 and is generally in the order of 3500 to 5000 pounds per square inch at 28 day strength. Provided adequate measures are taken to get good aggregates, set up proper mixes and watch the water content, there is no reason why these concretes cannot be manufactured and they are much easier to place. I see no reason why concrete of 8000 pounds per square inch could not be developed although extreme care would have to be used in the choice of aggregates, the grading and the mixing. Also, in the use of high strength concrete, it is necessary to pay far more attention to setting of the reinforcing steel than is too often the custom. Setting of reinforcing steel is one of the weakest features of Canadian construction.

While the use of lift slabs does require more concrete and better concrete and more reinforcing and better placing of the reinforcing, the savings by using this type of construction as far as the structure is concerned are in the order of 60¢ to $1.00 a square foot. We use an average figure of 75¢ a square foot saving for a lift slab over the same type of flat slab poured in place using forms. Relative to other types of construction we consider it just under the cost of the structural steel frame using precast slabs.

This type of construction can lead to a revolution in concrete construction if its use comes into general practice. I do not think we have by any means appreciated as yet the possibilities of pouring slabs on the ground level and hoisting them into the air. I do not see that it needs to be limited to slabs which are poured on top of one another, but I feel that many other types of construction even when forms are used could be employed. Even relatively complicated types of structure could be poured on forms on the ground, then the slab lifted, the forms removed when it is up about 6′ and the slab taken up to its final location. By the use of forms it is possible to greatly lighten your structure. Actually there is one manufacturer in the States who is making a plastic type dome form particularly for use on life slab types of construction, reducing the weight of the construction by as much as 50%. As a matter of fact I do not see why structural steel might not be fabricated together at grade level and the whole floor section hoisted up to its proper place by the use of these jacks. We have designed several buildings using lift slab. One of these is for the Hamilton area and I believe that units of this slab are being raised at the present time.

There is one thing it does require, that is that instead of somehow fitting a structure into an architectural layout, you must start with some very positive idea of your structure and particularly your column layout and fit your architecture into that. The minute the spans become many different lengths and the columns are offset from regular grid lines, etc., your lift slab just doesn't work out satisfactorily.

Where underfloor ducts are required in this type of slab we suggest the use of a metal tube underfloor duct placed about 3″ below the top of the rough slab which, in the case of the lift slab, is the finished slab. This forms an economical and satisfactory type of underfloor duct system which can have any reasonable spacing. If it is desired to raise the metal underfloor duct say 1½″ below the finished rough slab then the ducts must be kept away from the ¼ panel area centred on the column. In that area the concentration of steel is such that you cannot get your ducts above a level approximately 3″ below the top of the rough slab. This same type of underfloor duct system can be used with flat slab and as a matter of fact with most types of concrete construction, although with beams supporting the slabs it is often necessary to restrict the location of the ducts. Fig. 7 illustrates this type of duct and as well Q-Floor, a metal

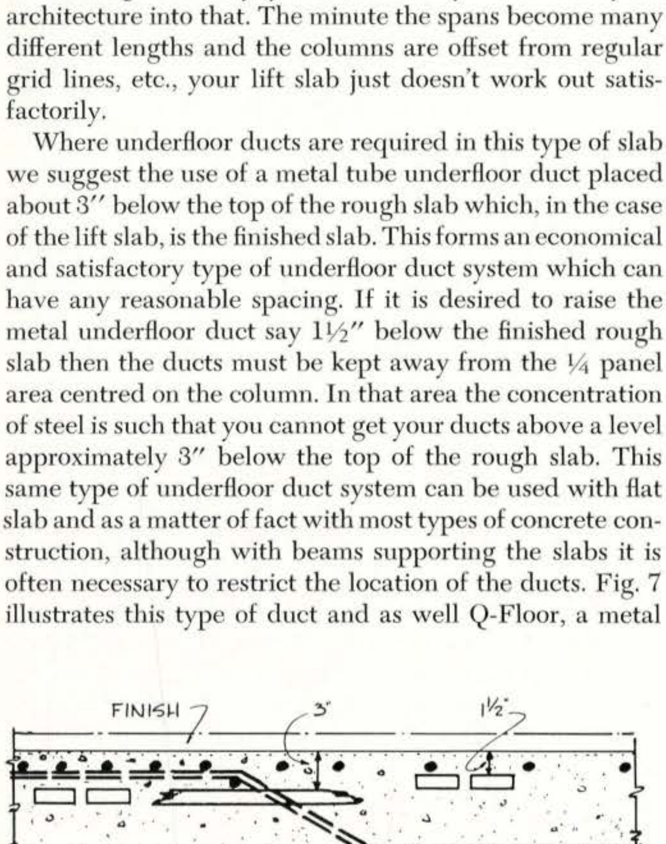


Fig. 7

duct system forming both the floor and the duct and the H-M Floor a precast concrete slab providing ducts.

Another development in concrete which is most interesting is the use of precast concrete members of various sizes and types. We might call them factory made units of concrete. We are familiar with the small slabs 8′ to 10′ long used for roof construction or in some cases for floor construction. We do not suggest their use for floors with moving or concentrated loads. These lengths are now being greatly increased. These may be either lightweight concrete or standard stone concrete. They do form an economical method for roofs or floors particularly where the height of shoring required to hold the formwork in place is excessive. They are not so satisfactory or economical when used on ordinary poured concrete beams. If precast beams are used they will work satisfactorily. Medium span panels could be built on concrete beams poured on the ground and lifted into place by lift slab methods. One of the most interesting of these precast slabs is the slab which is used to form ducts as well as forming support for floor or roof. These ducts may be used either for purposes of heating or as electrical raceways. Careful detail needs to be used in order to make these slabs act as a unit and be properly anchored to the supporting members. This is true of all types of precast concrete and requires considerable thought to make workable connections between slabs and beams, beams and columns, columns and footings. It is very easy to introduce high torsional stresses due to badly designed eccentric connections.

One must always take into account the effect of lateral forces. It is true that the only lateral forces which we are used to considering are those due to wind or the action of machinery, e.g. cranes, but there are others that are just as important. Those due to earthquakes or explosions or since we must always think in terms of defence, those due to the action of high explosive or atomic weapons. We have on the boards at the present time a building which it is proposed to use not only precast slabs but also the walls, or interior walls at least, to act as supports for the structural roof slabs which, in this particular case, we propose to make a poured slab – partially because of the type of building and partially because we are using the poured slab to get sufficient lateral rigidity. In this particular case, the finishes are not as important a factor and the concrete will be used as the finished material. It would appear to indicate some very desirable savings, but will require careful study of the electrical and mechanical installations in order that they may be properly handled. Precast joists are not unknown although they have not been used to a great degree in this country. Again it is a matter of economics which apparently Canadians are much more concerned with than our American friends, where they will experiment even at additional cost. The use of precast beams has been found acceptable in many buildings where uniformity of layout will allow repetition of the same size member so that forms may be reused. If forms cannot be reused then the only additional cost between the precast member and the one poured in place is the actual shoring of the formwork. There is no particular reason why full structural assemblies using precast concrete units cannot be made, but care must be taken that there are sufficient members of the same size to make form costs savings worthwhile, and that the connections of members to one another can be easily and simply made. The welding together of small steel members embedded in and anchored to the precast concrete is a very satisfactory method structurally.

The adherence to uniform layouts of structural work is one of the factors which will reduce costs faster than any other procedure. This is particularly true if the building is of a size that can be reused several times. The use of plywood for formwork has become quite general where there are sufficient reuses of the forms to make it worthwhile introducing it to begin with. It is possible with reasonable care in the use of plywood forms to have anywhere from 10 to 20 reuses of the same material. The new types of form oils that have been developed break almost completely the adhesion between the concrete and the form. Steel forms are equally satisfactory.

Up to the moment I have not mentioned what is popularly known as pre-stressed concrete but what is just as often post-stressed concrete, that is, the concrete is put under compression in the normal tension area after it is poured.

Its exponents are very enthusiastic about its use and seem ready to see it used anywhere whether acceptable or not. I am not as enthusiastic. I appreciate its use on long span concrete girders such as for roofs, on bridge work where real savings in depth are effective in producing savings in other ways than in structure, e.g., in grading of new roads, or in alteration of grades of existing roads. I can appreciate its use in precast members manufactured in large quantities under factory controlled conditions. Then real savings would be possible. That it will develop there is no doubt. Let us hope that its enthusiasts do not use it in the wrong place too often and, in that way, actually retard its development.

This subject of shell type structures is one all by itself and one which can be most interesting. How far its development may go in America is questionable, since, with our relatively low material costs and high labour costs, the economics of the problem may limit the construction of these types of structures for some time to come except for some very specific conditions. In a recent issue of the American Concrete Institute Journal a list of 108 structures having shell type roofs (generally it is only used for roof construction), only 16 were in the U.S. and 1 in Canada, all the rest were European or South American where the labour costs are very low and material costs relatively high. Just the same they are going to be used more in the future both in the U.S. and in Canada. Fig. 8 illustrates an unusual but interesting type of shell structure. It could be used very successfully for service stations or concession type structures.

One of the most often asked questions is —What will this cost? To determine the costs of any structure within limits the client will appreciate, is always somewhat of a task. For today about the best I can do is to group the various forms of structural frameworks into their order of cost, starting with the least expensive and working up to the more expensive. What one must also realize is that the structure is only one part of a building and that the other parts, the finishes, the ceilings, the walls, the type of electrical and mechanical equipment, the type of heating, all help to decide the type of structure which will best fit any particular building. It is not possible to treat the structure as a separate entity and say here is the most economical scheme for all the conditions that you may have in

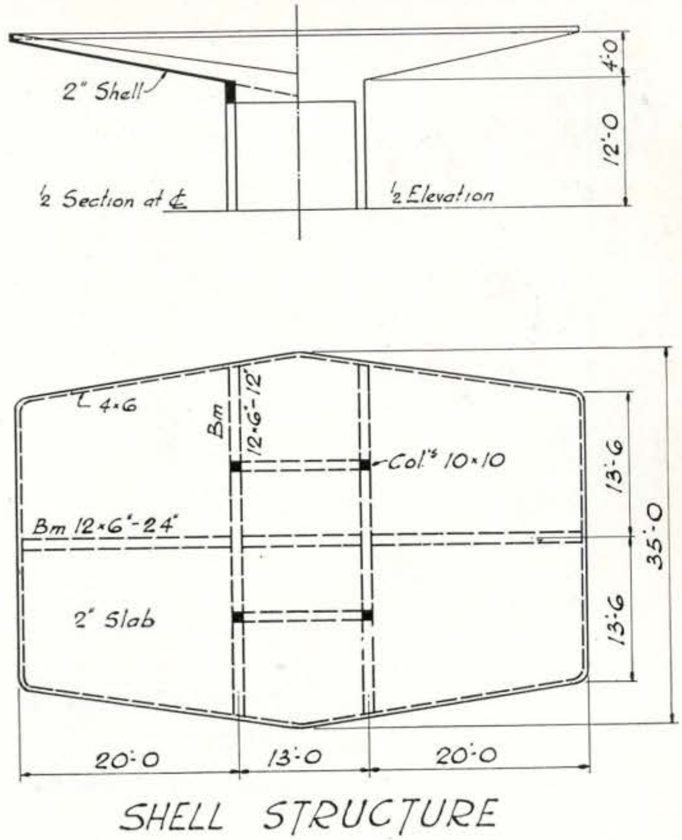


Fig. 8

this building. Subject to those limitations and considering only normal spans we can take the costs of structures in an ascending scale as follows:

1 Wood joist on wood stud walls.
2 Wood joist on masonry walls.
3 Wood joist on wood beams and masonry walls.
4 Wood plank on wood beams and masonry walls.
5 Wood joist on structural steel beams and columns and masonry walls.
6 Wood plank on steel joist and steel beams.
7 Steel deck on structural steel either rolled beams or open web joist types.
8 Lift slab construction for roofs.
9 Precast concrete slabs or asbestos roof deck in structural steel.
10 Concrete slabs on O.W.S.J. on structural steel.
11 Poured concrete on fireproofed structural steel in its various forms. Poured concrete.

It is not possible to differentiate between costs of structural forms of this last type without detailed information since sometimes all concrete, and sometimes steel and concrete, is more economical.

Fig. 9 is a curve showing the effect of span on cost. This curve was compiled for costs of factory roof construction using precast slabs on structural steel which we made about three years ago. It indicates the usually accepted fact that spans of 16 to 22 feet are the most economical and the cost increases from that range as the column spacing decreases or increases. The costs shown are comparative only and not actual.

One other item on costs that is often in question is when in use lightweight concrete aggregates. Again no complete

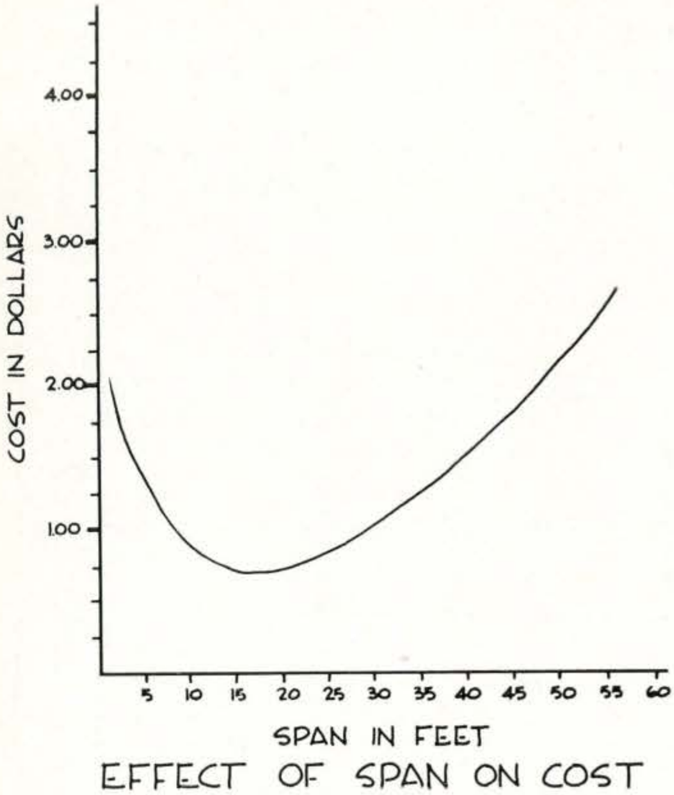


Fig. 9

answer is possible. There is economy in the use of lightweight concrete aggregates when there is enough saving in the structural frame to pay for the extra cost of the lightweight concrete. The only way to find out is to design your structure both ways and compare relative costs. We have found that for a steel framed office building when spans of beams and girders are over thirty-five feet there is a saving in using lightweight concrete. In concrete construction the span at which savings starts appears to be about the same.

There are other factors affecting costs that should always be kept in mind when choosing types of structure. There are fireproofing requirements, the question of sprinklers which are tied in with insurance costs which, when considered over a period of years, may be a determining factor. There is the factor of maintenance, the factor of salvage and let us not forget entirely today the question of appearance. They should be assessed both by the architect and the owner.

I have attempted to cover present types of construction and suggest forms that may be trends of the future. There may be some amazing developments but I consider it more likely we will keep our feet on the ground. I am sure Canadian engineers and architects can be expected to develop along with the rest of the world. We may be more conservative, we may watch the economic factor more, we may not be as interested in the spectacular just because it is spectacular; we certainly are not likely to do anything and everything with a lot of bally-hoo but I am sure we will achieve the reputation of being sound and reliable in our thinking and in our methods. If you want something to watch develop in the future – for concrete: precast work, lift slabs and shell roofs; in steel, welding and space frames.

I have enjoyed very much the privilege of giving you this talk this afternoon. I trust that during the question period that follows that no one will stump me completely, although that could be a possibility.

I will attempt to answer all questions whether on points already covered or on a brand new subject.

The above paper by Mr C. D. Carruthers was followed by a Question and Answer period.

Question: In this lift slab type of construction, could you give us some indication of what the limitations are, of putting holes in the slabs and about the spacing? **Answer:** Spacing, if I might take that first, somewhere in the range of eighteen to twenty-five feet seems to work out most economically, but it can be greater. All you need do is to lighten your structure by using lightweight concrete or putting in some sort of domes or panels to lighten the slab.

There is no trouble with holes provided they are in the centre of your panel. You could put reasonable-sized holes in fairly close to the column, let us say two foot, six inches away. That is, the same as the two foot six inches which you must stay in from the edge of the lift slabs with the column because there is a steel collar placed in the slab, and which is welded to the column after it is up in place. You have to be clear of that and have some space outside it.

Question: In regard to the last slide, that graph of costs and span, is this an average of any material and any loading or how is it to be looked up? Surely it depends on the material and loading and method and so forth. **Answer:** That is correct, although all materials within their range will be given the same shape of graph. This one was for steel roof deck on structural steel – at least, that is what it was derived from.

Question: What provision is made for brick curtain walls at the edge of the lift slab when you have the two foot six inch proection beyond the column. Is there any special reinforcing put in? **Answer:** No, the walls must be self-supporting. The wall will go outside the lower lift slab or else it is brought up to the edge of the lift slab and wedged. **Q.** In other words, you have to provide a separate structure outside the building for that? **A.** Not necessarily, you can bring your walls up inside, wedge them after they have set and they will take the load from the wall that is above.

Question: In these lift slabs, what method do you use to fasten the slabs to the column when it is in place? Is it steel? **Answer:** There is a cast steel collar that is poured into the slab and then after slab lifted is welded to the steel column with a sufficient weld to hold it. It is joined both top and bottom, you weld it on the top in order to get some stiffness into your connection.

Question: I presume steel columns are only used in lift slabs, that is to say where fireproofing is necessary. That means fireproofing on the outside of the wall again. **Answer:** That is right, although you can use concrete columns with a steel band at the point where your slab will rest. **Q.** Has that been used yet? **A.** Yes, it has. Another thing, gentlemen, in a multi-storey building of lift slab construction, the steel column is used for dead loads shifting, and after the slabs are in place you concrete around your steel column to provide additional strength for your live loads.

Question: Could you mention anything in the way of parts or characteristics of that triangle section corner beam that is used in the General Motors building and the UNESCO building erected in Paris? **Answer:** I do not see the advantage, except possibly in economy of material, but there is a lot more labour involved welding up a triangular truss of that type. We would, I think, prefer to use two long-span joists rather than the one triangular truss. I have not seen any actual detail of it myself.

Question: There is one point, Mr Carruthers, you haven't mentioned – the cost of designing such structures. That might be of interest to the meeting. **Answer:** Well, I didn't want to bring up that subject. Actually we find the cost of designing lift slabs and some of those other more complicated types of shells – although we haven't done any shells – but I am told they are more expensive to do. Lift slabs, we find about twice as expensive to design as ordinary construction, largely because of the way slab gets broken up. And in lifting you have two sets of stresses to handle, one when in place, and, when everything is welded together, another, making about four steps to go through. **Q.** And then you find it doesn't work anyway, and you go back to something else. **A.** We haven't found that in any work yet, not when that far along, anyway.

Question: In a multi-slab building of, shall we say, four storeys, when one slab is cast on top of another on the ground, no doubt there is some material put in between them to allow them to separate. What is it? **Answer:** That is a good point. The material used is no more than a wax on top of which they dust on what they call moulding powder, which is just a talcum, really, to take the stickiness off your wax so there is no sticking of concrete. That is most important, because if you do pour two layers of concrete together, they will stick so well you would never pull them apart. **Q.** Have you had trouble from sticking? **A.** They have had small areas that have stuck together, yes. And if that happens, all you can do is cut out that small area. You keep lifting on your jacks and do this until you see where it occurs, and then you have to go in there with pneumatic hammers and break out that section of slab so as to free it.

Question: You say you put a wax coating and talc on the top of the slab. What about the finishing on the top of the slabs when you lift them? **Answer:** With lift slabs, your finish is on your slab when you lift it – you finish the slab as if it were a finished floor. If you are thinking of some material you might put on, like mastic tile, you can wash this material off with kerosene or gasoline, it dissolves quite easily.

Question: Mr Carruthers, somebody mentioned a three or four storey building of lift slab construction. Do I take it they pour the ground floor, we'll say, and then they pour the first floor and the second and third and the roof on top of that, and then lift the roof up? **Answer:** That is right. **Q.** And then your columns are high enough to take the roof and there is no lateral support on the column while it is up there? **A.** That is right. **Q.** It needs a pretty large column, doesn't it? **A.** Not as much so as you might think, because the bottom end of your column is fixed and if you have four slabs for it on top of your ground floor, you are up about two feet so that you have taken off a bit of length that way. You can wedge them at that point so as to give your column more bracing at the bottom. So that up to a 40-foot column is not bad – when you get above that, it is too much.

Also with lift slab, your storey height is normally reduced. You will not have much more than nine feet or nine feet six inches.

Question: I was wondering in connection with the wax you use, whether anything else had been tried. It was considered by me for some time before development started, and I had in mind that possibly a light grade material, such as congoleum, with smooth surface would be a good thing to pour the slab on. I was wondering if they had used that. **Answer:** No, they have never used any other material than this wax preparation – largely a matter of economy. Your linoleum would work, I would think. They tried paper once and that won't work, it comes up in little ripples. **Q.** If you pour on a glassy surface similar to linoleum, would it not be comparatively inexpensive? **A.** If you get a cheap material, but the wax and powder costs from one to two cents a foot, so it has to be a pretty cheap material.

Question: Mr Carruthers, you mentioned nine storey lift slab construction. In a nine storey building you are going to get up to a pretty high column which I suspect would be too long to erect in a single stage. What sort of process would be used for extending the columns for that height? **Answer:** Well, there are several methods that might be used. One would be, particularly if your building is going to be in two sections, to put up the columns in one section, brace them with temporary steel bracing and tie the tops of the other columns to them. But likely you would do it in two lifts and possibly pour your second lift of slabs up in the air, with necessary shoring to take care of it. It is getting pretty high at nine storeys, I won't tackle one for a while.

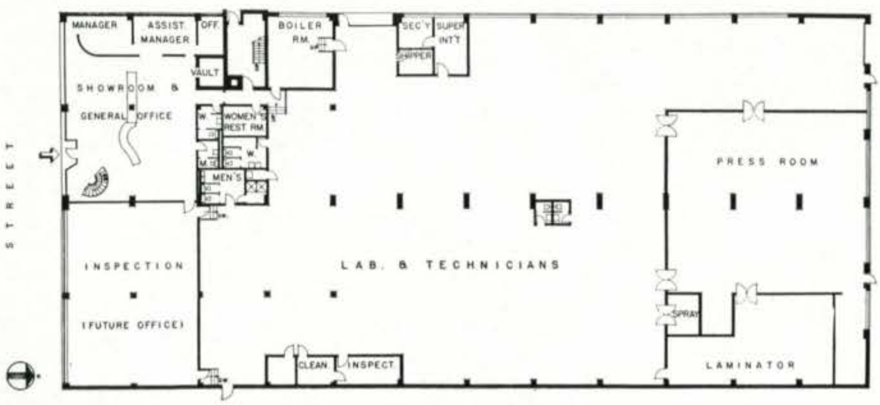
Question: Is there any patent or royalty to be paid on it? **Answer:** No patent or royalty. You pay so much a square foot for the lifting of the slabs. The patent or royalty is held for Canada by Frank Lount & Son of Winnipeg and they charge so much a square foot for lifting your slabs. It is not a high amount, 25 or 30 cents a square foot. **Q.** Are they the only ones that will lift it? **A.** They are the only ones in Canada that I know of to date that will lift it. They are trying to get an Eastern Canada representative.

Mr Alvin Prack, of Hamilton, terminated this discussion by thanking Mr Carruthers for his excellent paper and for his answers to the questions.

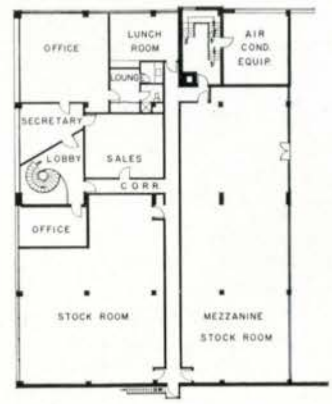
Crystal Glass & Plastics Ltd., Toronto, Ontario

Gordon S. Adamson, Architect

Murray Associates Ltd., Structural Engineers
Carter Construction Co. Limited, General Contractors

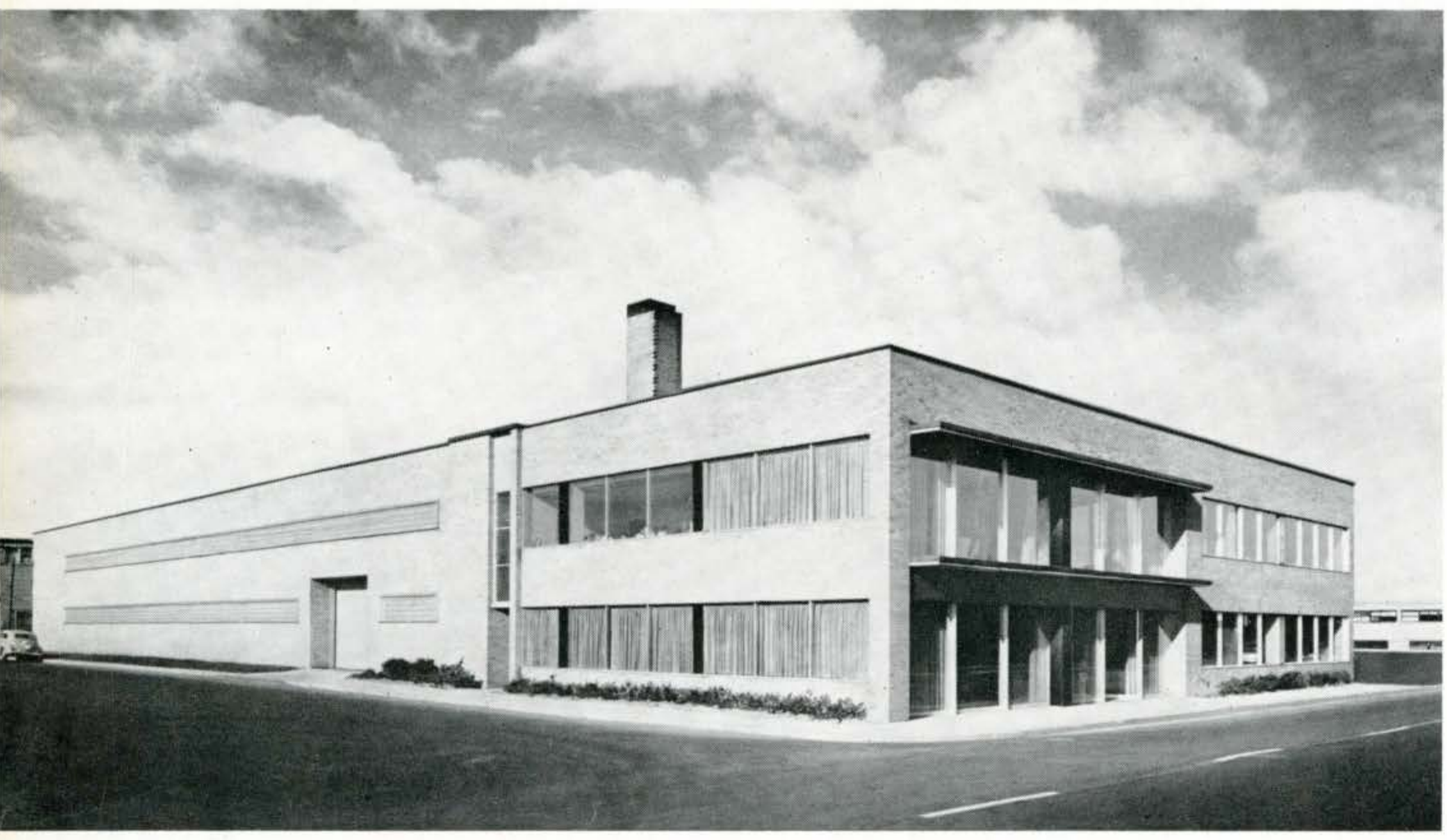


first floor



second floor

southwest corner



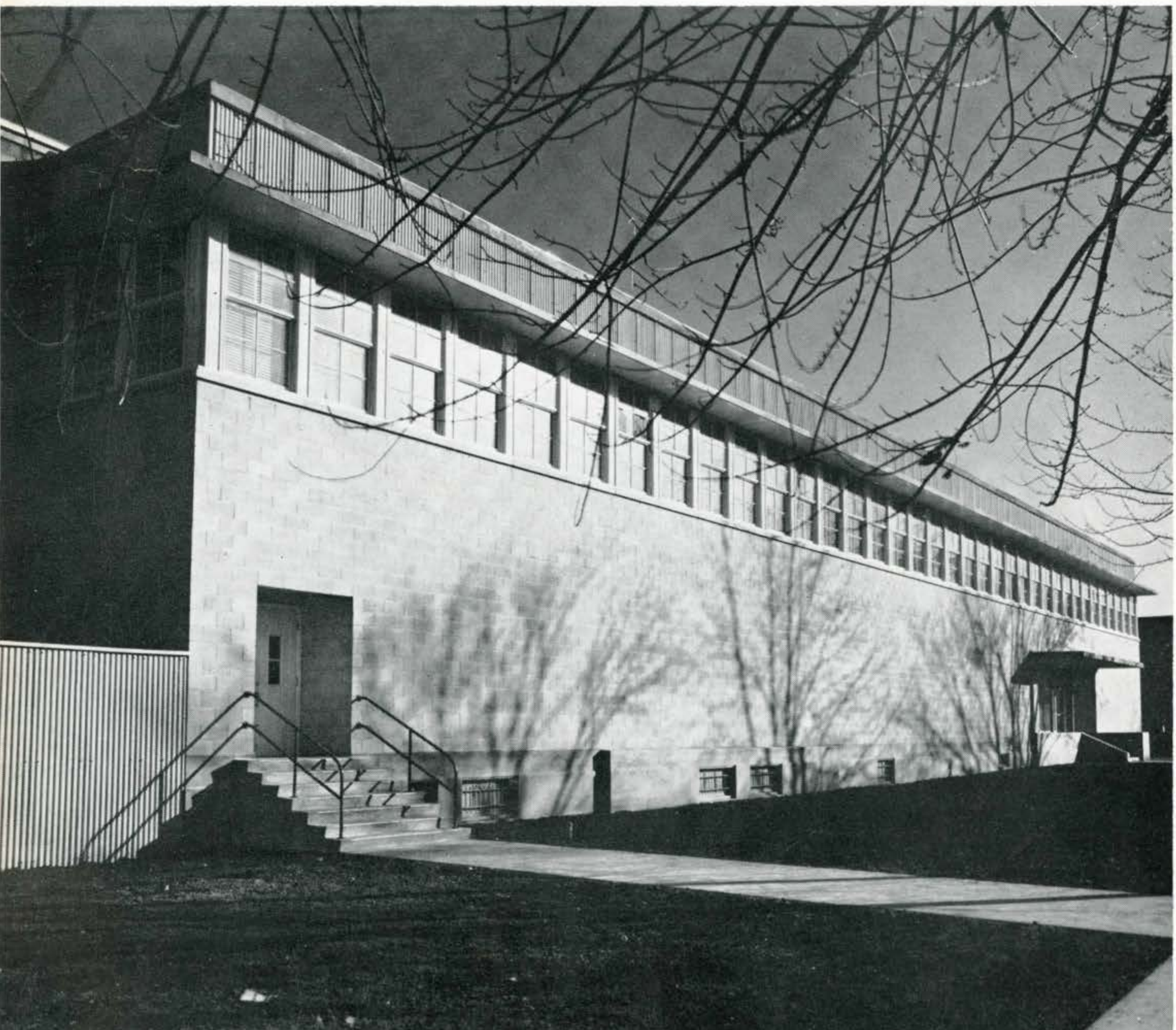
general office

general view of plant

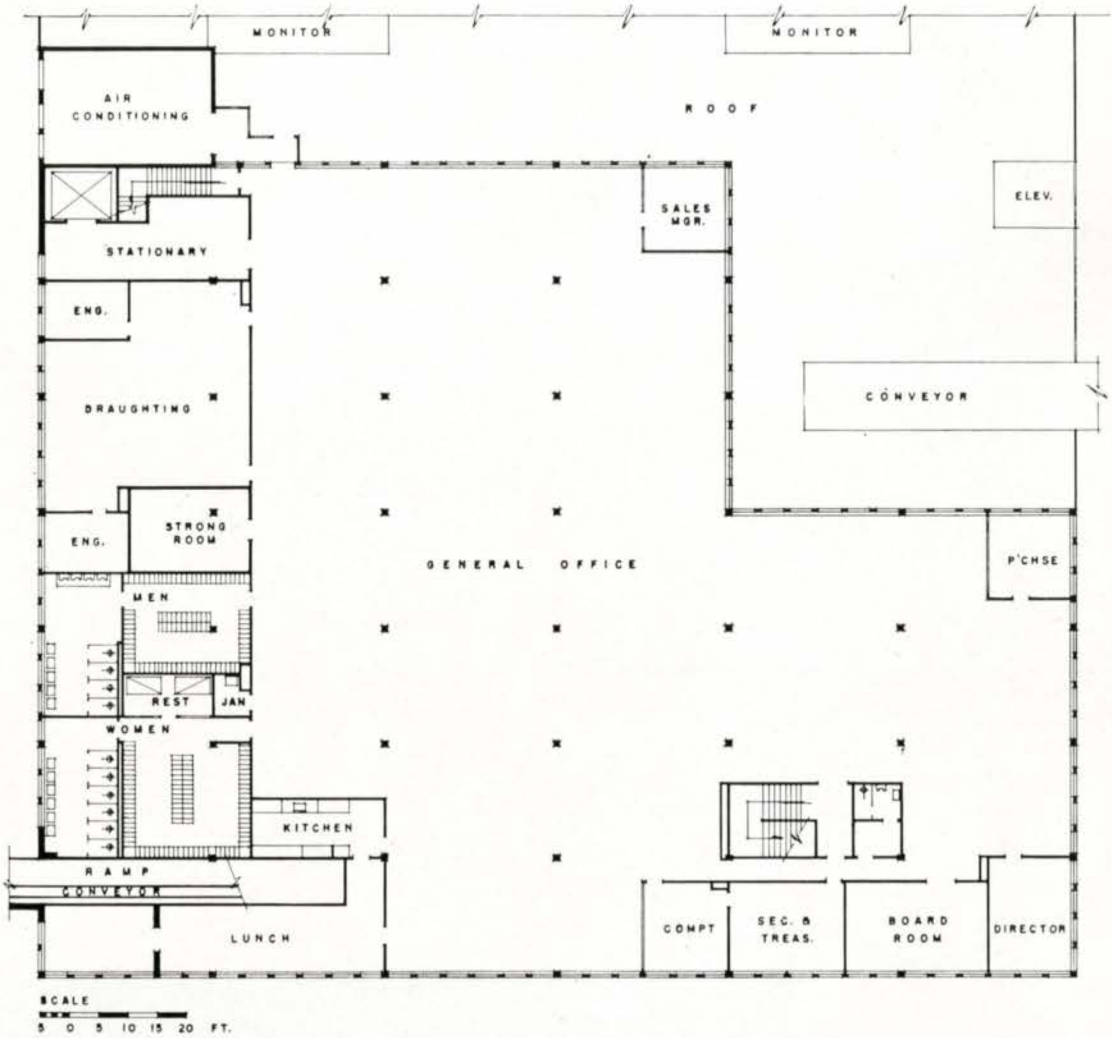
H. J. Heinz Co. of Canada Ltd., Leamington, Ontario

Marani & Morris, Architects

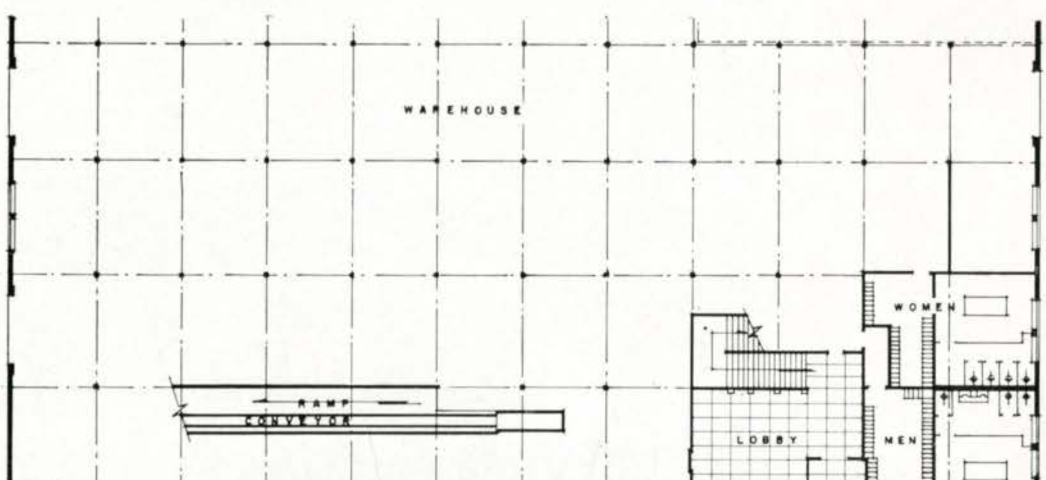
Wallace, Carruthers & Associates Ltd., Structural Engineers
H. H. Angus & Associates Limited, Mechanical Engineers
Dinsmore-McIntire Ltd., General Contractors



LOMAC STUDIOS



second floor

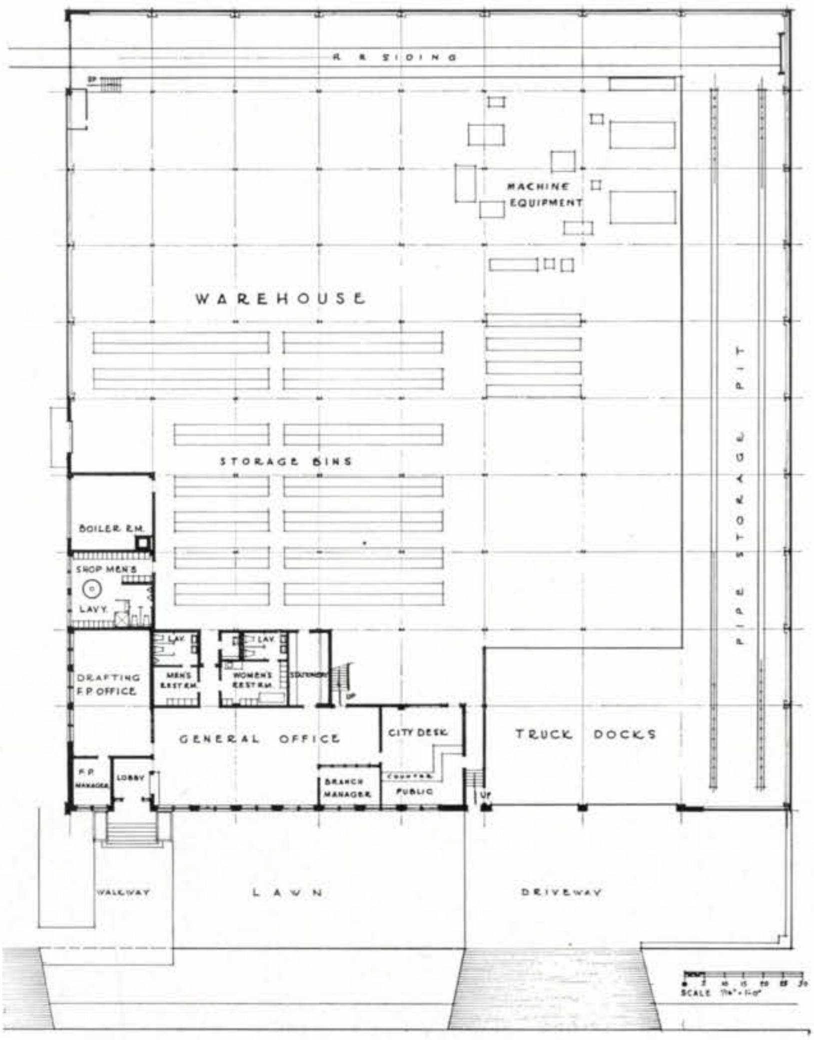


first floor

Grinnell Company of Canada Ltd., Vancouver, British Columbia

Townley and Matheson, Architects

John Read, Structural Engineer
Dominion Construction Company Ltd., General Contractors



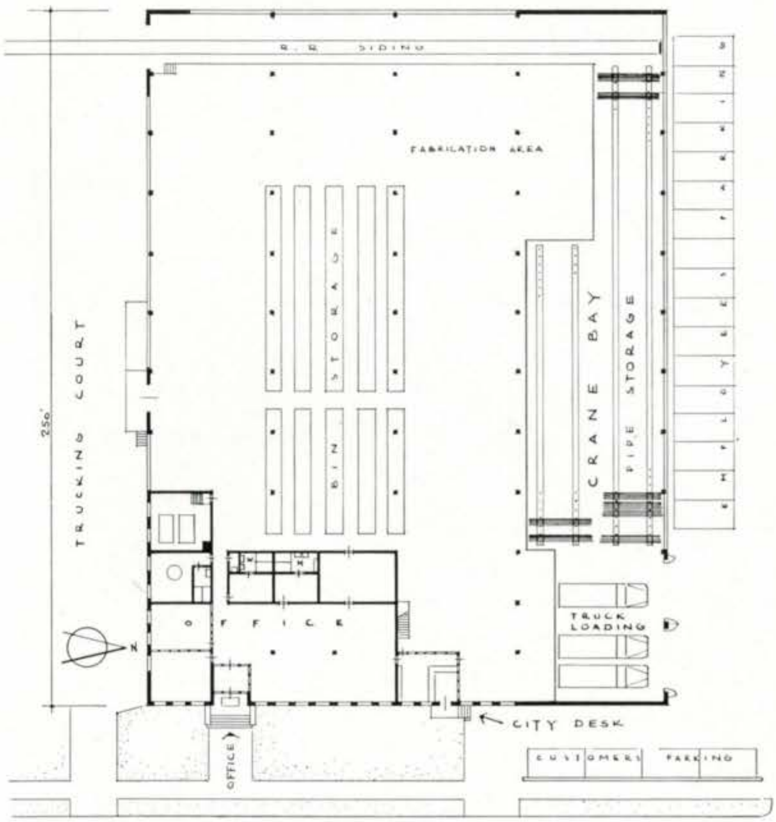
floor plan

INDUSTRIAL PHOTOGRAPHICS

Grinnell Company of Canada Ltd., Edmonton, Alberta

Main, Rensaa & Minsos, Engineers and Architects

Christensen & Macdonald, General Contractors



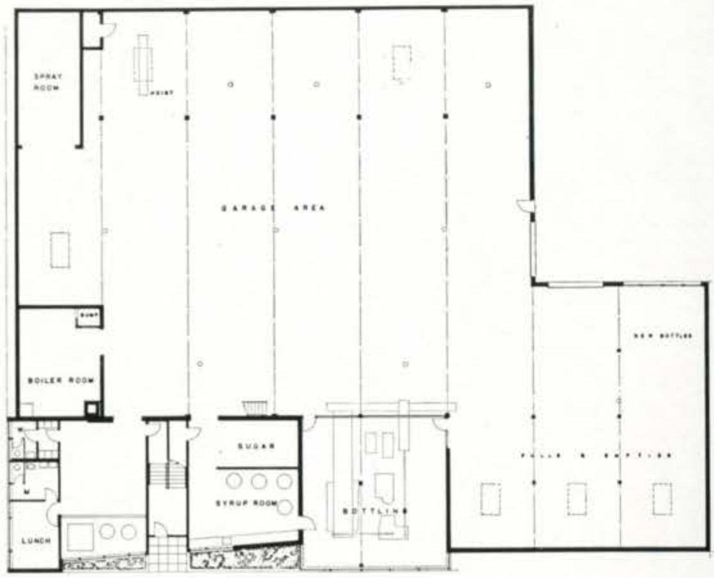
floor plan

RANSON

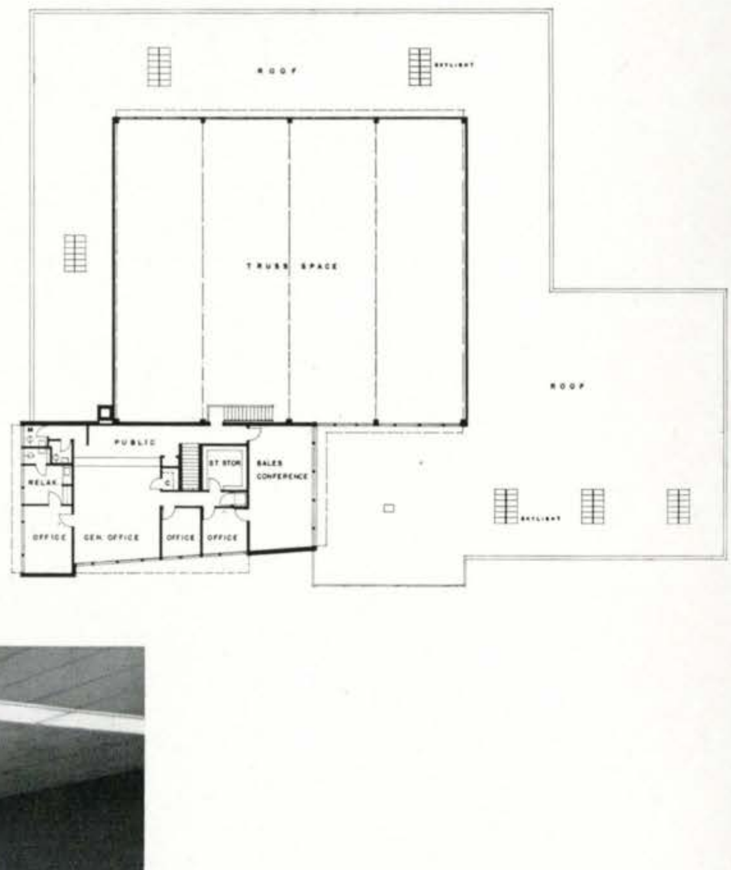
Seven-Up Vancouver Ltd., British Columbia

Semmens & Simpson, Architects

Victor Thorson, Structural Engineer
D. W. Thomson, Mechanical Engineer
Narod Construction Ltd., General Contractors



ground floor



upper floor

general office

GRAHAM WARRINGTON

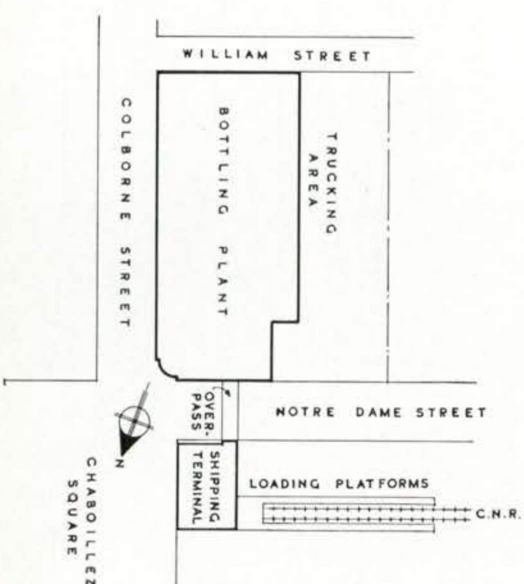
bottling area

National Breweries Ltd. Dow Bottling House, Montreal, Quebec

Fetherstonhaugh, Durnford, Bolton & Chadwick, Architects

J. Shultz & Son, Engineering Consultants
Angus Robertson Limited, General Contractors

RAPID GRIP & BATTEN

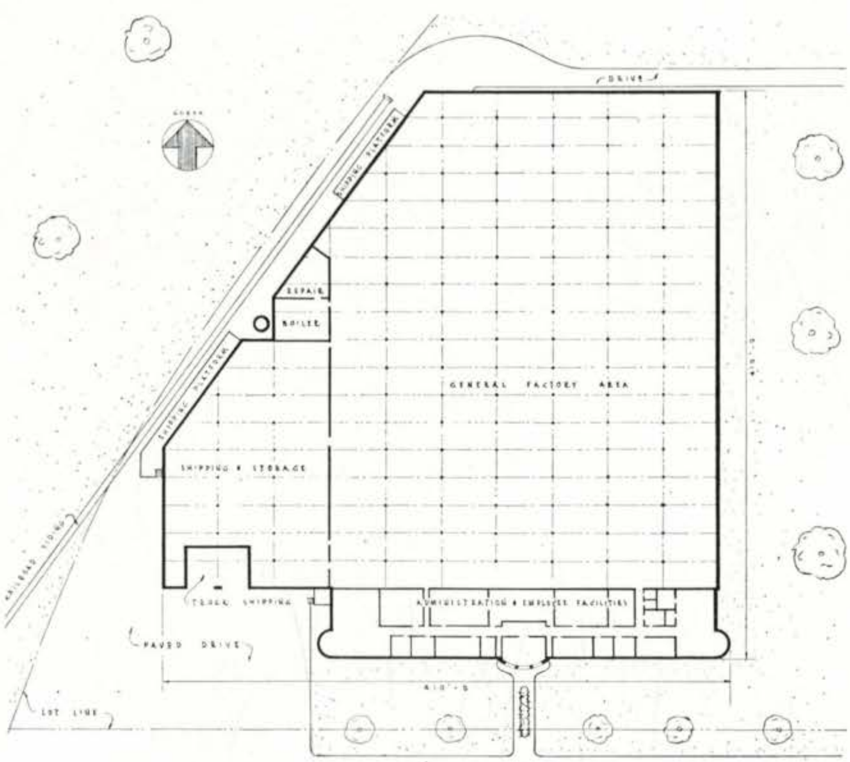


GRAETZ BROS. LIMITED

Canadian Pad & Paper Co. Ltd., Toronto, Ontario

N. A. Armstrong, Architect

W. B. Sullivan Construction Limited, General Contractors

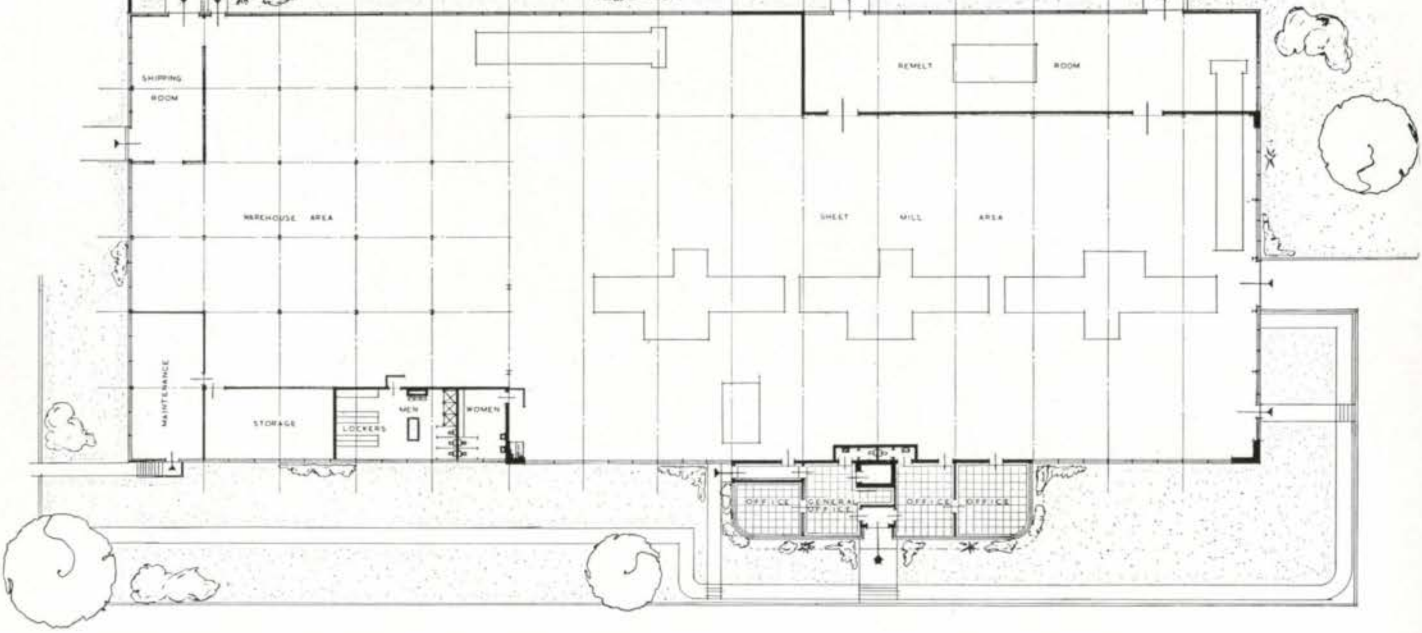


floor plan

Rolling Mill, Supreme Aluminum Industries Ltd., Scarborough, Ontario

Parrott, Tambling & Witmer, Architects

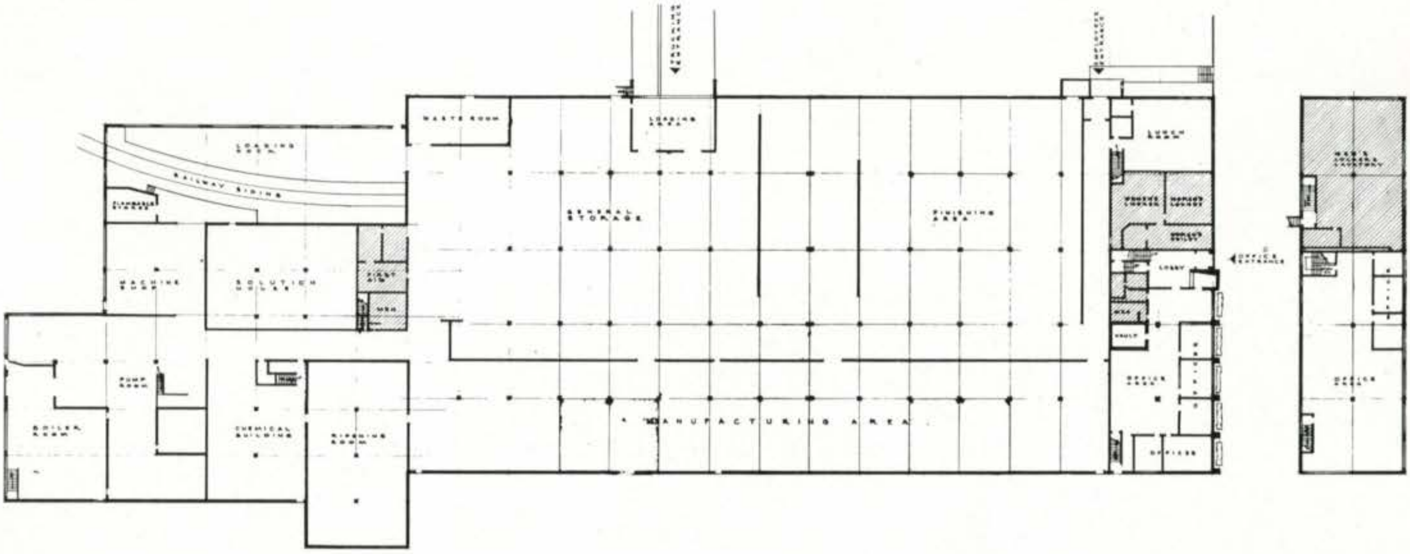
Wallace, Carruthers & Associates Ltd., Structural Engineers
W. T. Brickenden & Associates, Mechanical Engineers
Bennett-Pratt Ltd., General Contractors



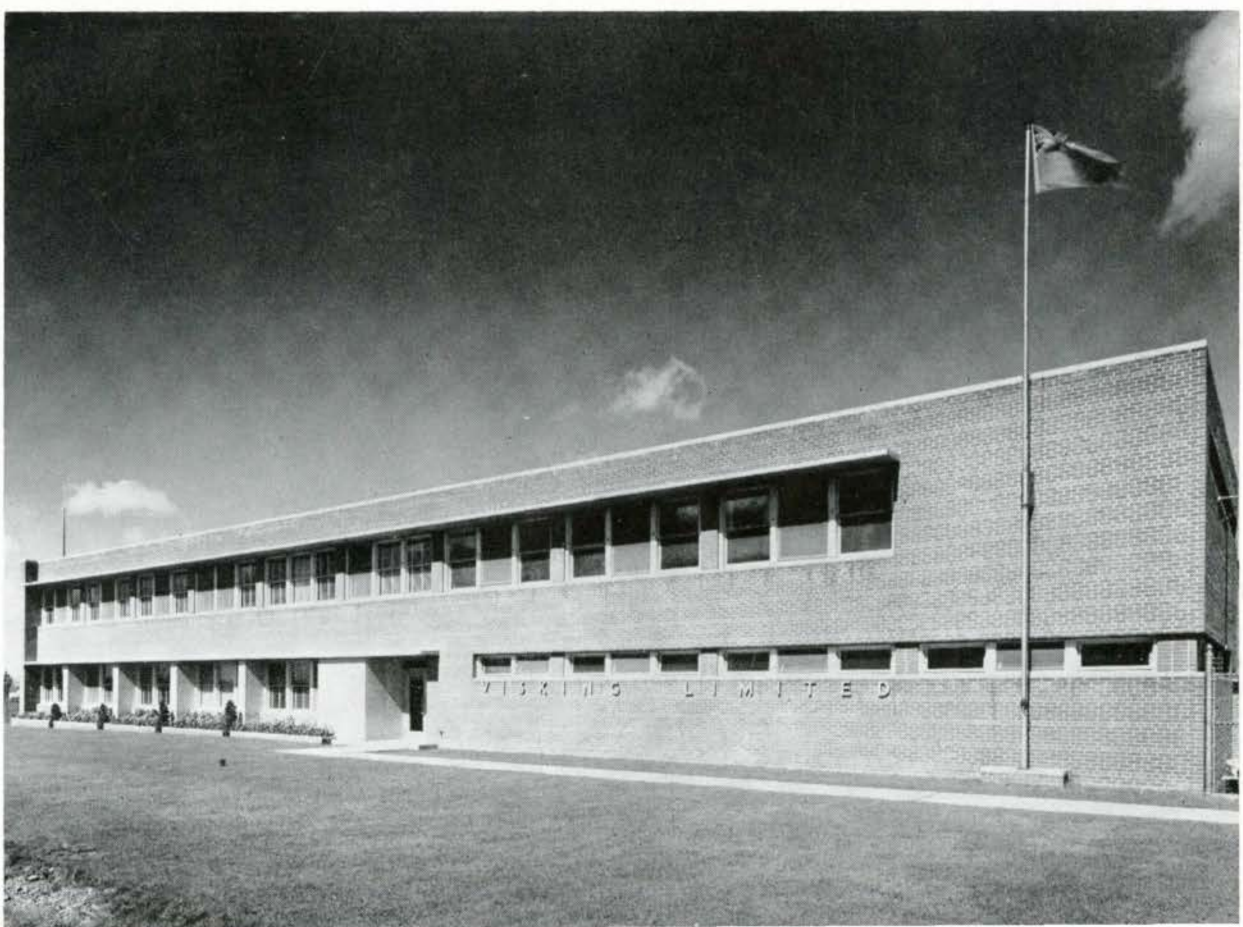
Visking Limited, Lindsay, Ontario

A. G. Facey, Architect

Edgar A. Cross, Structural Engineer
Angus Robertson Ltd., General Contractors



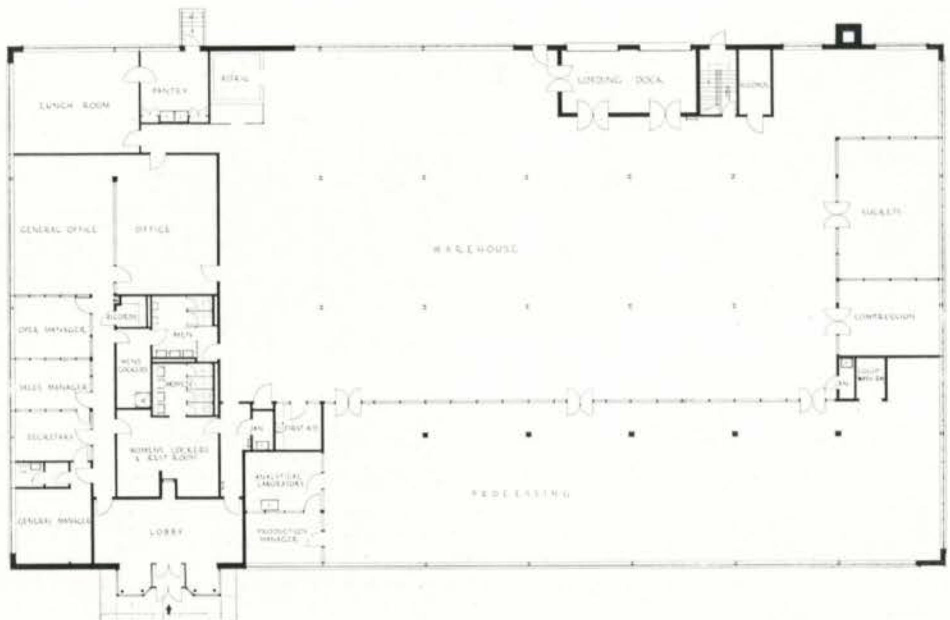
PANDA



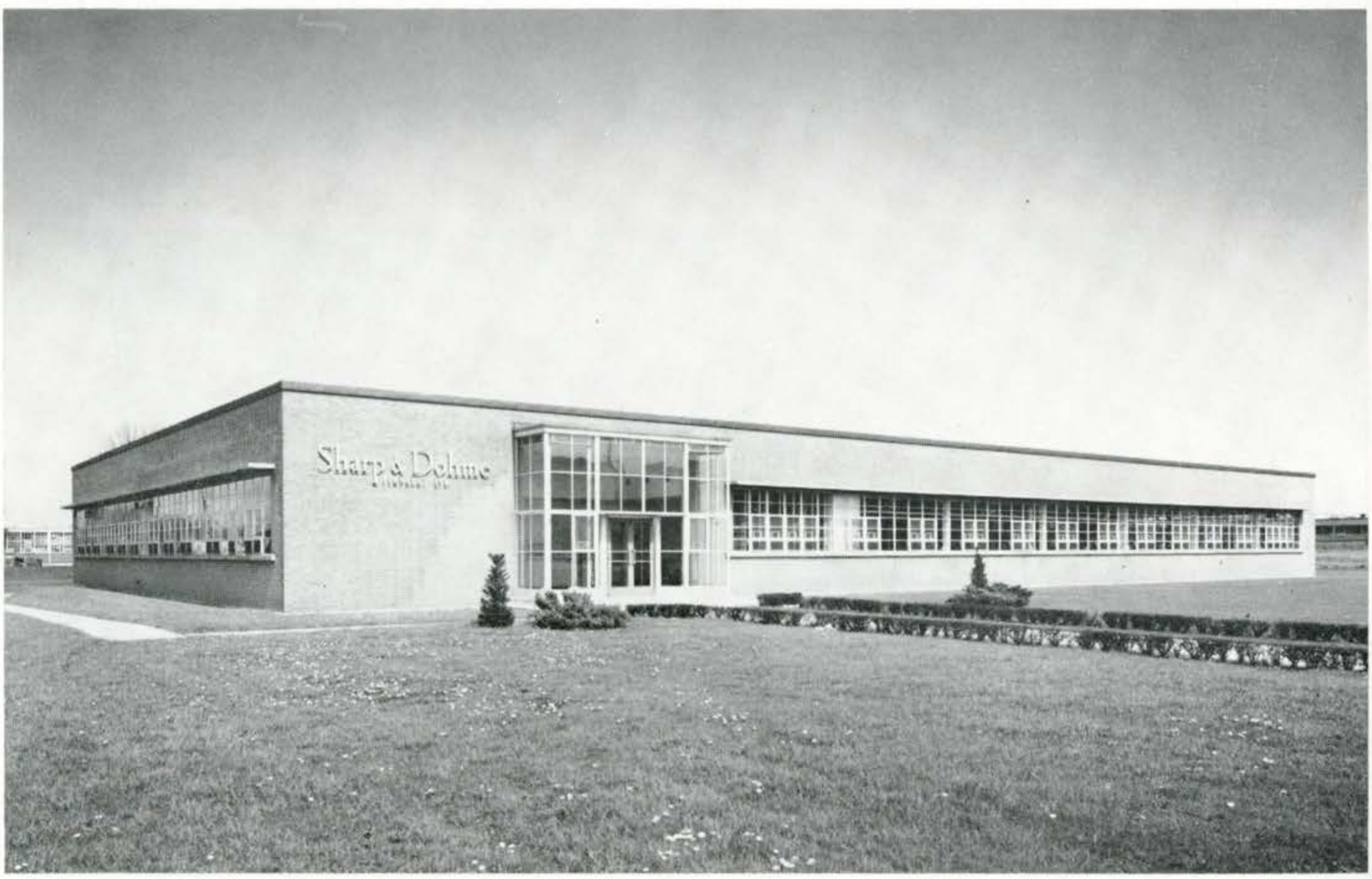
Sharp & Dohme (Canada) Ltd., Toronto, Ontario

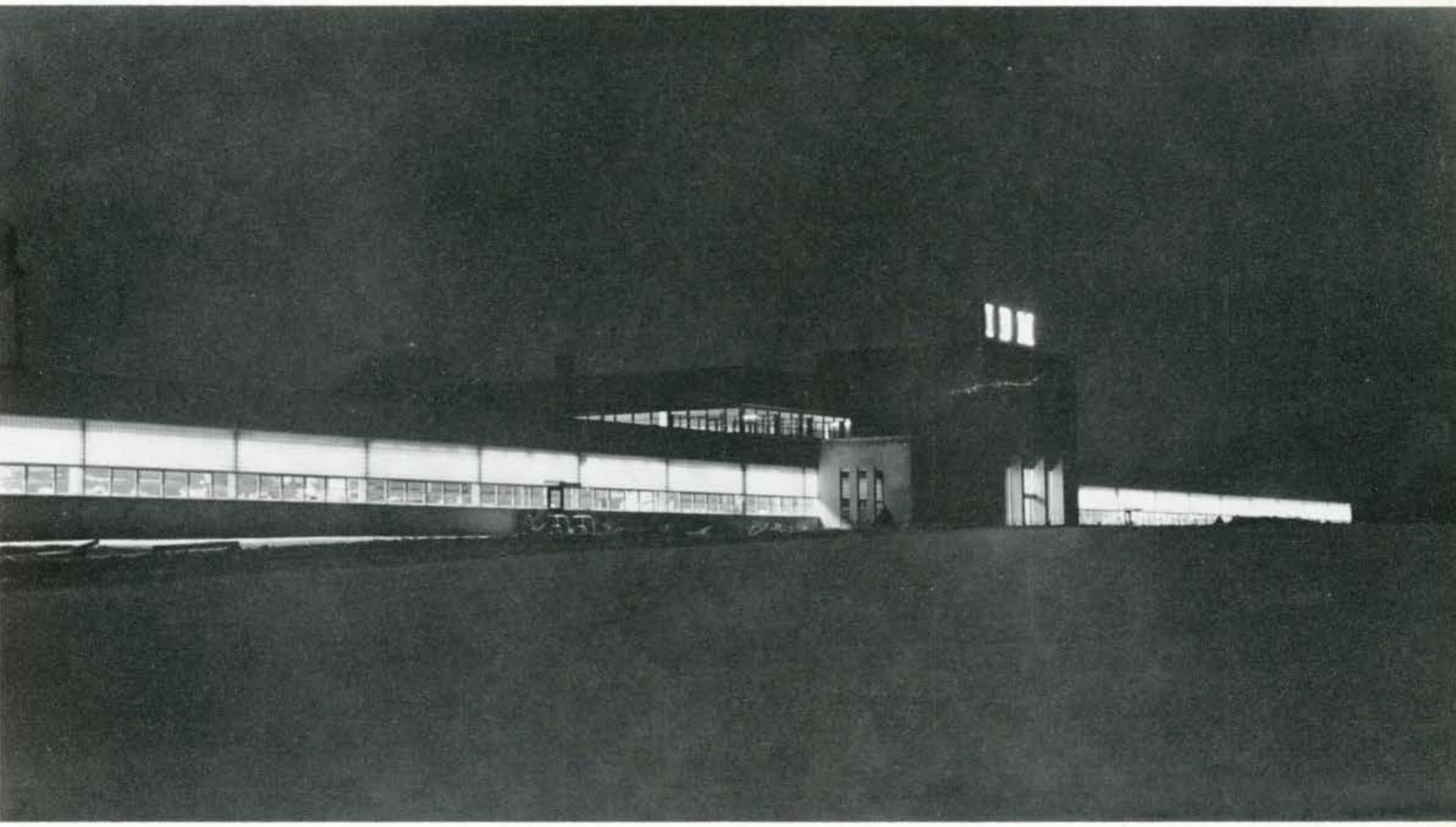
Mathers & Haldenby, Architects

Wallace, Carruthers & Associates Ltd., Structural Engineers
Dickie Construction Company Ltd., General Contractors



PANDA





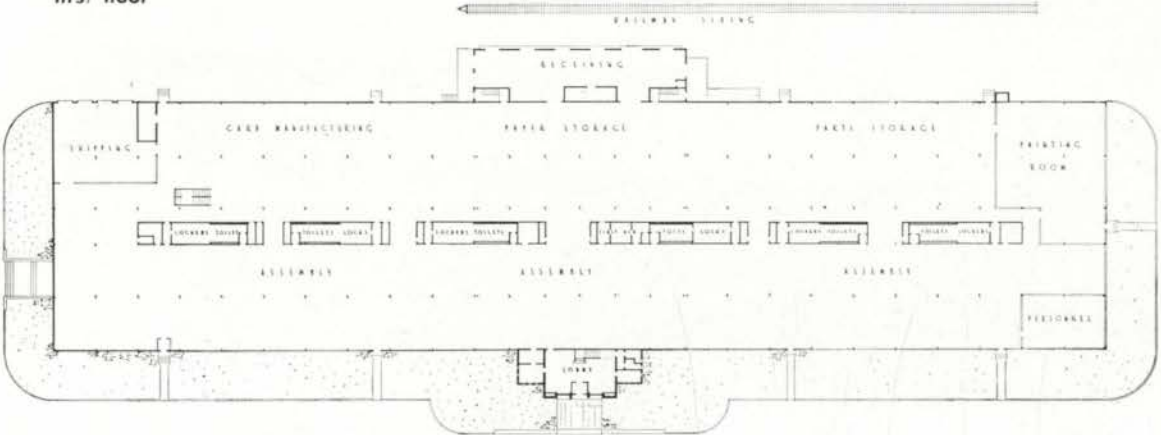
International Business Machines Co. Ltd., Plant No. 1, York Township, Ontario

Clare G. Maclean, Architect

Alex Tobias, Structural Engineer
Shepherd and Powell, Mechanical Engineers
Milne & Nicholls Ltd., General Contractors

second floor

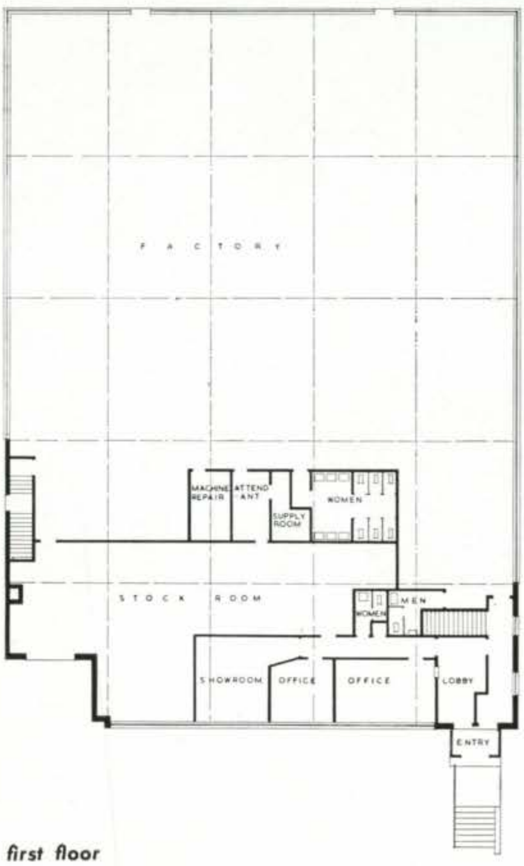
first floor



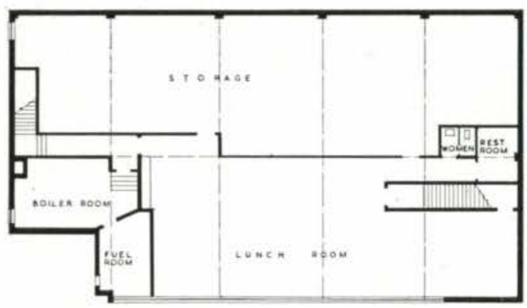
Brill Shirt & Neckwear Ltd., Hamilton, Ontario

Jack Brenzel, Architect

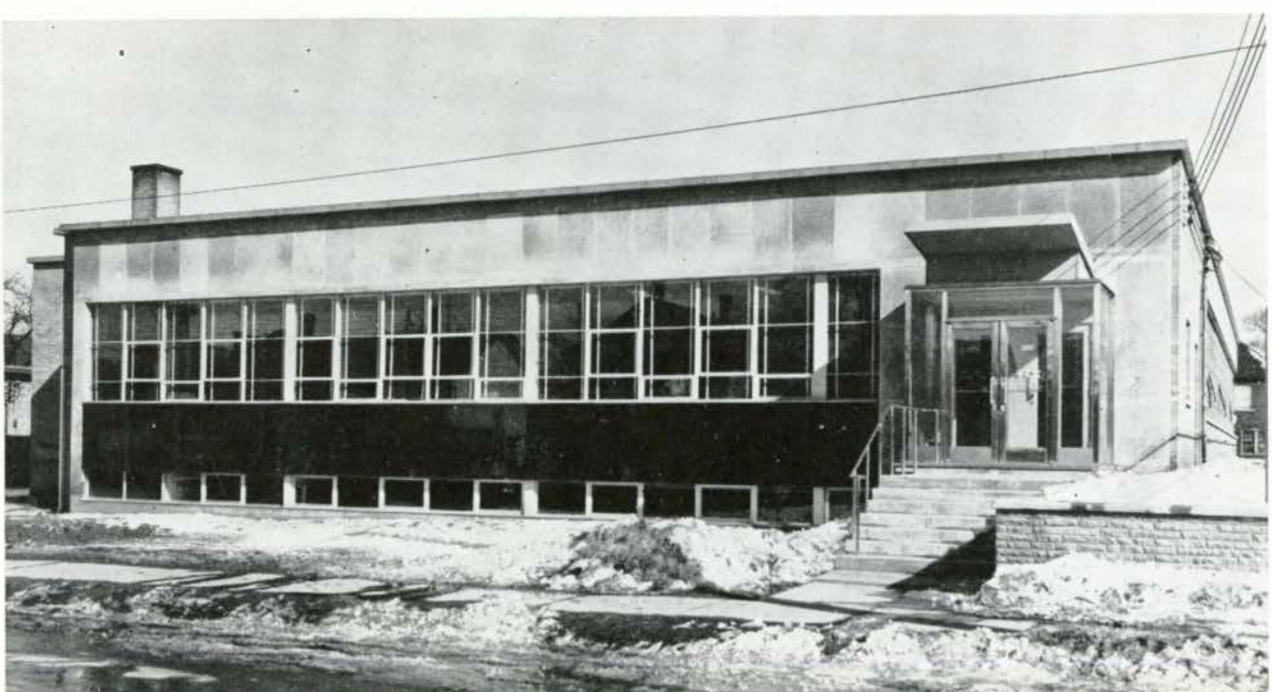
James Kemp Construction, General Contractors



first floor

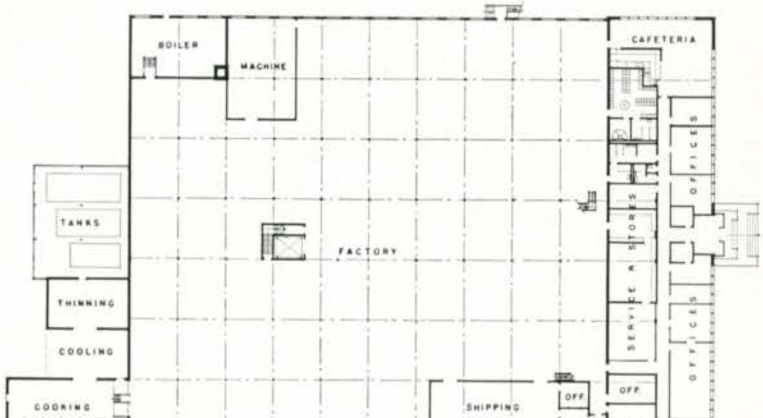


ground floor



POWELL

WARNER BROS.



The Tremco Manufacturing Co. (Canada) Ltd., Toronto, Ontario

Marani & Morris, Architects

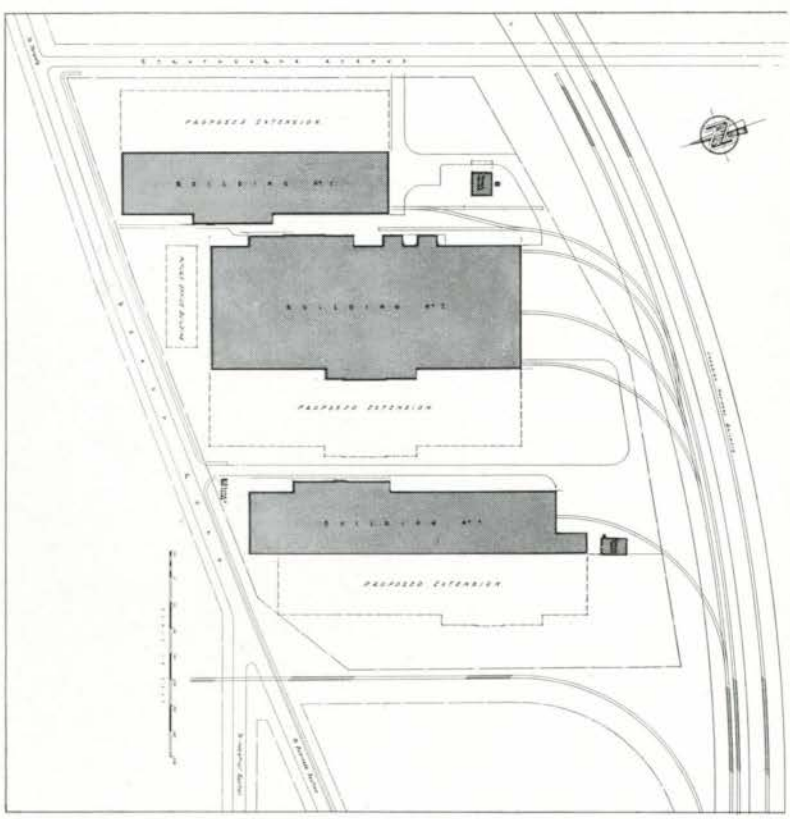
John H. Ross, Mechanical Engineer
George Hardy Ltd., General Contractors

Canadian Westinghouse Company Limited, Plant No. 3, Building No. 2, Hamilton, Ontario

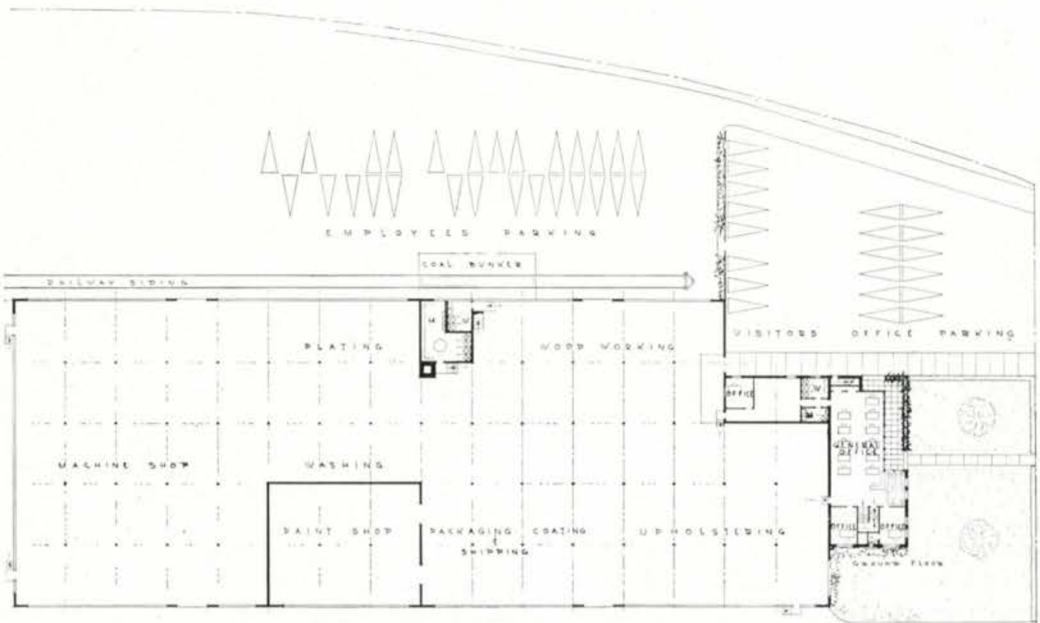
FRANK ADAMS

Prack & Prack, Architects

Frid Construction Co. Ltd., General Contractors



Royal Metal Manufacturing Company Ltd., Galt, Ontario



Barnett & Rieder, Architects

Wallace, Carruthers & Associates Ltd., Structural Engineers
John H. Ross, Mechanical Engineer
Thomas Construction Company Ltd., General Contractors

Industrial Concrete Floors

Lane Knight

IT HAS BEEN SAID that, weather permitting, a plant could operate without walls or roof, but never without a floor. Present-day production and flow lines, often inflexible, are closely integrated with rigidly defined trucking aisles. This results in the floor becoming part of the machine with wear concentrated on smaller, but nevertheless far more important areas than formerly. Premature breakdown or wear of these vital trucking areas can cause serious interruptions of production schedules. For these reasons it is important that an industrial floor be of the highest quality.

The requirements of an industrial floor are that it shall have sufficient strength to carry the expected loads, shall resist wear and shall be reasonably economical. The strength of the floor must be such that it will carry not only distributed dead loads, but also point loads that may be imposed upon it. Further, possible changes in the clients' methods of handling and storing both finished and raw materials should be considered. The increased use of pallets and lift trucks have not only increased over-all storage heights and loads, but further may increase point loads to a dangerous degree particularly with metal-shod pallets. Fig. 1 shows the use of conventional wooden pallets which distribute loads in a generally satisfactory manner. Fig. 2 shows a metal-shod pallet in use in a plaster-board factory. Obviously the point loads are far greater in this latter operation.

Concrete when used for floors does not differ essentially from concrete for any other purpose, but certain special qualities are required. The mix should be carefully proportioned so that it finishes or "closes" well yet without noticeable bleeding or laitance formations at the all-important wearing-surface. Compressive and flexural strengths should be high – here is one place where "over-design" is justified because it is difficult, if not impossible, to foretell changes in the clients' operation. The vital part of the floor is its surface; resistance of the surface particularly determines the useful life of the floor, although a hard surface on a weak slab of poor quality may obviously fail.

Resistance to abrasion is of first importance. This property is the sum of not one but many properties, notably compressive strength, smoothness and malleability. The wear on a concrete floor may be broken down into two factors, simple abrasion and impact, which is usually termed abrasion but is not primarily abrasion.

Frictional abrasion is in fact a function of the smoothness and is part of the inherent qualities of the materials making up the surface to finish and knit together properly. Certain combinations of aggregates often present finishing problems making it virtually impossible for the finisher to produce a smooth dense surface. Assuming adequate workability, however, the resistance of the floor is deter-

Fig. 1

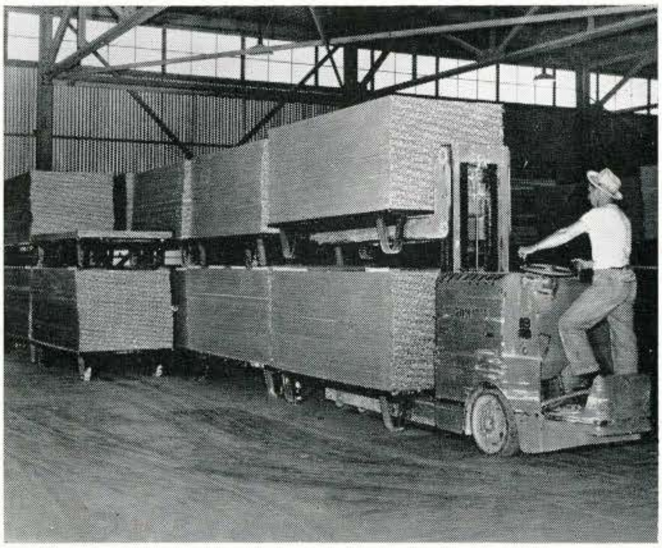


Fig. 2

mined by the strength of the surface.

Much of the breakdown of floors is due to impact. No floor is an absolutely plane surface nor are the wheels which pass over it. Fig. 3 shows a typical railroad car shop that is subject to damage from impact due to heavy falling objects and the movement of large metal sections. Where truck wheels are involved there is a drop when the wheel passes over an inequality or irregularity of the surface. This continual hammering, particularly in aisles, has a tendency to break down the mortar, chip out the aggregate and shatter the brittle aggregate. As the action continues the irregularities are aggravated so that greater impact forces are created and the deterioration accelerated.

The resistance of the wearing surface to impact has, of course, an important bearing on the life of the floor. Aggregates used in or on the wearing surface should not only be of the highest quality and strength, but further should produce the highest possible impact resistance. Many aggregates such as silica, trap-rock and certain manufactured materials are high on the Mohr scale of hardness, and so help produce a concrete surface of exceptionally high strength providing, of course, the cement paste or matrix is of proportionate quality. High strength, however, is not necessarily accompanied by high impact resistance. This is well illustrated by the behaviour of a diamond and a tenpenny nail on a railroad track upon passage of a locomotive. Although a diamond is the hardest of aggregates, it is completely shattered and virtually disappears; whereas the nail is flattened but remains adhering to the track in the same general shape it had originally.

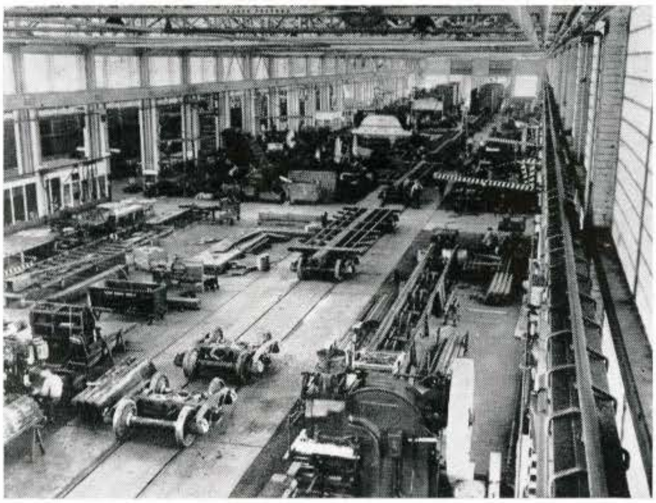


Fig. 3

The importance of malleability or ductility in concrete aggregates was discovered some forty years. Simply, it was a method of producing a metallic sand or aggregate to replace the brittle aggregates in the wearing surface. Like the tenpenny nail, the metallic aggregates had a certain malleability so that they flattened rather than shattered under impact. At the outset they were called "hardeners" a most unfortunate misnomer, inferring some chemical reaction; whereas obviously their function is purely physical.

Probably the first metallic aggregates were simply ground iron to which little attention had been paid to purity and grading[1]. Obviously the principles that apply to concrete and to mortar apply with only slight modification to metallic aggregates. A good metallic aggregate should be properly graded. Just as fine mortar sands are unsuitable for concrete, so a good metallic aggregate should be generally similar to a relatively coarse, sharp concrete sand. Suitable treatment of the metallic aggregate results in a product that is free from oil and nonferrous metal and contains only a minimum of fines and iron dust.

Power Float

Finishing Techniques

The development of metallic aggregates was accompanied by considerable research in laboratory and field on proper concrete finishing and curing techniques. Specifications were developed that were excellent in theory, but difficult to implement under job conditions. Probably the greatest single improvement in concrete finishing technique was the power float – not to be confused with the power trowel. The Bureau of Standards[2] in their study of 130 different concrete floors found that without exception wear resistance was increased by delayed finishing. As the

Power Trowel

interval between placing and finishing was increased, the wear resistance was increased proportionately. Early manipulation or finishing brings the forces of gravity into play forcing the harder and larger aggregate particles to the bottom and producing a relatively dilute layer of cement paste at the surface. The advantages of delayed finishing, however, can be offset by practical finishing problems. As previously stated a good floor is a smooth floor. If the concrete is setting rapidly – a condition often encountered with moisture-hungry winds in our Canadian West or with artificially heated concrete in Ontario and Quebec, it often "gets ahead" of the finisher resulting in an uneven, unsatisfactory finish. The power float with its vigorous consolidating action extends the safe finishing time allowing greater control of the operation and providing the important benefits of delayed finishing. Further, under normal setting conditions a specification calling for the use of a power float provides additional effective inspection. The machine, weighing several hundred pounds, cannot be placed on the slab until the concrete has firmed sufficiently to carry the weight. This precludes, to a great extent, the deleterious poulticing action of early finishing.

The power trowel with its greater diameter and somewhat reduced weight does not provide the same safeguards. As the name implies, this machine was developed primarily for trowelling and was not designed for floating operations. It is suggested that a finishing specification carry definite clauses as to the use and function of all finishing equipment. One widely used specification calls for power floating, but limits the use of a power trowel to the first trowelling only, insisting on hand-trowelling for the final operation.

Monolithic Versus Two-Course Floors

There is a certain prejudice in Canada against the use of a two-course floor, which in the light of our present knowledge and finishing techniques, is somewhat unjustified. Much of the prejudice can be traced to the use of the old 1-2 sand-cement mortar toppings that were used in the Twenties. These wet, rich mixes, usually haphazardly placed on poorly prepared base slabs and indifferently finished, admittedly had a poor performance record. Present-day knowledge and finishing standards, however, make properly designed toppings or two-course work perfectly practical, in fact preferable on many projects. The major factors to be studied before deciding whether to use a monolithic (one-course) or topping (two-course) floor are:

1. What compressive strength is required for the concentrated loads of truck wheels or pallet supports? Is this greater than the compressive strength required for dead loads or other live loads?
2. What are the practical construction problems to be considered, such as possible damage to a finished surface by other trades and from moving in heavy equipment?
3. What are the economic aspects of the above construction problems; also the comparative cost of a two-course floor having a plain brittle siliceous aggregate finish, and a monolithic or two-course floor having a metallic aggregate finish?

Although the ductile surface of a metallic floor provides great wear-resistance, long floor life also requires a base slab with sufficient strength to carry the loads. The monolithic method is usually economical only where compressive strength requirements are 4,000 pounds per square inch or less.

The two-course method (whether topping is applied before or after slab has taken its final set) makes it possible to use a lower strength base slab having adequate strength for dead and live loads, with a topping course having the higher strength required for high point loads. The two-course method also has the advantage that for suspended slabs a base may be laid as the building progresses. Construction work can continue over this slab and a topping can be placed after the building trades are finished and the building enclosed, an important consideration in winter construction. Good levels are also easier to secure.

Economics can be considered only after these factors have been satisfied. If structural and practical requirements can be met, a monolithic floor will cost less.

Corrosive Conditions

Corrosion is one of the common causes of untimely disintegration of concrete floors. Like wear, corrosion takes place at the surface. Porous-open textured floors are more quickly attacked than those with a dense non-absorbent surface. It has been observed that good plant house-keeping methods can do much to prolong the life of a good dense floor. Many dilute acids and corrosives have only a relatively slow destructive action. If the floor is dense and the corrosive spillage is removed at regular intervals the floor will often give excellent service even under adverse conditions.

Since, however, Portland Cement itself is very readily attacked by certain corrosive agents and is quite readily soluble in moderately strong acids, it cannot be expected that a concrete floor is acceptable for all conditions of corrosive service. Certain material and manufactured aggregates have been presented as "acid-proof" but as they only make up part of the surface leaving much of the readily-attacked cement exposed, it is questionable whether the floor, as a whole, can be properly described as "acid-proof". Generally speaking a floor surface containing Portland Cement is not recommended for strong acid conditions: some other type of floor such as brick or tile should be used bedded in the special acid-resistant cements available.

In view of the development of the Chemical Industry in Canada, it was suggested that a reference guide be included in this article showing under what conditions a good dense concrete floor could be expected to provide reasonable service. Scripture and Sakryd have reported that floors with a metallic aggregate surface will provide good service when exposed to the following: *

COAL-TAR DISTILLATES
anthracene, benzol, carbolineum, carbonzol, cresol, creosote, cumol, lysol, paraffin, phenol, pitch, toluol, xylol.

MISCELLANEOUS ORGANIC MATERIALS
acetic acid (dilute)
alcohol
carbonic acid (dry)
corn syrups
glucose
lactic acid (dilute)
linseed oil
milk
molasses
oxalic acid
picric acid
resin
sugar

sulfite liquor
tanning liquors (non-acid)
wood pulp

PETROLEUM OILS

light fuel oils
volatile oils – kerosene, benzene, naphtha, gasoline, heavy oils

SALTS

carbonates
chlorides of sodium, potassium, strontium, calcium
fluorides
nitrates of ammonia, calcium, potassium, sodium
silicates
sulfate of calcium, potassium, sodium, magnesium, copper, zinc
sulfide ore (wet)
sulfides except ammonium

**Report on "Corrosion Resistance Tests of Concrete Floors – With and Without Metallic Aggregate," by E. W. Scripture, Jr. and C. H. Sakryd – Journal of American Concrete Institute, December, 1948.*

In addition to the foregoing there are certain substances that strongly or actively attack concrete. It is suggested that materials other than concrete be used when the following are encountered[3]:
Acid sulphate; sulphates of calcium, potassium, sodium, magnesium, copper, zinc, aluminum, manganese, iron, nickel, cobalt; sulphuric acid, nitric acid, sulphurous acid, hydrochloric acid, hydrofluoric acid, sulphates of ammonia, nitrate of ammonia.

Vitrified brick and tile with special bedding and jointing compounds, rubber in tile or sheet form and certain plastic and latex compounds have provided a satisfactory solution for some, if not all, of the problems created by these active substances. Consultation with the engineering department of the prime producers of these substances usually provides the best solution and specification for these special conditions.

Spark Hazards

Ordinarily it is not considered that a concrete floor presents a fire hazard. In certain cases, however, such as explosive plants, hangars, paint or spray departments, volatile liquid storage, etc., the hazard from mechanical or static sparks assumes considerable importance.

Where static charges are built up on equipment on the floor, the danger of sparks from this source may be avoided if the floor is reasonably conductive so that the charge can be disseminated through the floor. Hobnailed shoes and other metal articles tend to strike sparks on a plain concrete floor. Such mechanical sparks may constitute a fire hazard although there is no agreement among fire prevention experts whether they do or not.

A plain concrete floor is a fair conductor when wet, but poor when dry. The conductivity, however, can be greatly increased by a metallic aggregate surface providing a sufficient quantity is used – not less than 1 pound per square foot.

Investigation by various authorities, including explosive manufacturers, government agencies and others, has disclosed that the heavy metallic surfaces practically eliminate spark hazards from hobnailed shoes and falling metal objects. It should be pointed out, however, that the tendency towards sparking is increased rather than decreased when the floor is struck by stone or other non-metallic substances. In most operations, however, the great danger is from metallic objects.

The application of heavy weights of metallic aggregates (1 to 1.2 lbs. per square foot) require the services of a careful, thoroughly experienced floor finisher. The base slab must be kept as dry as possible to keep the metallic aggregate at the surface and non-metallic particles being brought to surface. In addition, a special formulation of metallic aggregate is generally used not only to provide greater workability, but also to increase the conductivity of dry slabs.

[1]Metallic Aggregates in Concrete Floors, J.A.C.I., September, 1936. By E. W. Scripture, Jr.

[2]Research Paper RP 1252 – National Bureau of Standards. By Schuman and Tucker.

[3]Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete – American Concrete Institute, June, 1940.

The Impact of Large Scale Industrial Developments, with Special Reference to the New Ford Plant near Oakville, Ontario

Donald M. Paterson

BEFORE CONSIDERING the general question of large scale industrial developments, it will be worthwhile taking a look at some of the details of the new Ford Plant near Oakville.

Although the plant itself is to be a large one, the proposed peak employment will only be between 4,000 and 5,000 including office staffs. And although Ford is spending approximately $32,500,000.00 on it, they are also spending an equal amount on the expansion of their facilities at Windsor. Since the Windsor plant, before expansion, employed about 13,700, it is evident that the Oakville plant will represent a relatively small part of the Ford empire, just as it will also be dwarfed by the A. V. Roe plant at Malton, employing 18,000.

With these figures in mind, we may turn to the more general question of the impact of a new industry on a community. Here, we may distinguish between an industry locating near a large city, and one locating far from any large centre. In the former case, the impact of the industry on its local area will be lessened by the fact that it will draw largely on labour living in the large centre, at least for some time. This means that the locality near the industry is not immediately faced with all the problems of providing housing, services, etc. But in the latter case, where the industry locates far from a large centre, all the problems present themselves in the most acute form. It may be well for us to consider these problems in the extreme case, where they stand out very clearly, for the differences in the more moderate cases are largely differences of degree, not of kind.

Let us suppose a large industry has decided to locate near a small community. Before the announcement of this decision, the small community must decide whether it wants the industry. In most cases local fears of the problems which will have to be faced are overcome by dreams of the benefits which will accrue. But in very few cases will a realistic appraisal of both the problems and benefits be made. This is largely because the small community lacks the experience necessary to a sound evaluation of such a complex problem. If the community is not to make bad mistakes and suffer severe disappointments, it needs experienced advice and detailed research on its problems. This is where the planner should be called in. He seldom is, however, partly because planning is usually foreign to the town fathers, and partly because they have no excess funds with which to pay him.

Assuming that the community decides it wants the industry, and that the decision is publicly announced, the effects will begin to be felt. Real estate transfers will increase, and property values will soar, especially near the site of the new plant and along the highways leading to it.

When the first construction workers arrive to begin building the new plant, accommodation will become scarce, and temporary shelter will probably be called into use, such as trailers, etc. New commercial establishments will crop up, and new permanent housing may be proposed. The traffic problem will begin to make itself felt. If serious miscalculations are not to be made, it is essential at this point, that reasonably accurate estimates be made of the number of construction workers who will be used at different phases of construction, and of the number of employees the industry plans to hire, once the plant is completed. Whether the industry will be permanent or temporary must also be ascertained if the community is to plan its expansion wisely. All the expansion of existing facilities should be related to future permanent population.

Once the construction of new permanent housing is begun, the community's financial problems begin in earnest. There is, of course, the possibility that private builders may not want to undertake housing construction if the future permanent population is uncertain, or if the plant is of a temporary nature, as in the case of defence industries. Also, it is unlikely that private builders will be interested in providing accommodation for all the income levels of the future population, so that the lower-paid workers will have to put up with over-crowding unless subsidized housing is built. Subsidization of home construction to some extent would seem to be essential in almost all cases, if adequate accommodation is to be provided. And, in the case of a temporary industry, government-financed temporary housing is essential if widespread makeshift slums are to be avoided. So once the community begins housing construction, it is essential that it make use of the assistance offered by other levels of government.

New houses mean extension of service facilities. Water, sewers, police and fire protection, garbage collection, schools, recreational facilities, etc., must all be increased, in addition to an enlarged municipal staff which must be paid. All this means borrowing money, which may not be available at a reasonable interest rate because the community's uncertain future may deter investors. To service its new debt, the community has access (or will have) to taxes on the new industry and new housing. Here, it is essential that an equalized assessment be instituted and kept up to date by an expert assessor, and that the tax collection department be efficiently organized. The new industry should not be given preferential tax treatment (a mistake which is often made by a small community right at the start when it is trying to attract the new industry). Revenue may be further increased by licenses which the municipality issues, and by traffic fines, which increase as the traffic and parking problems become worse.

But unless the community has shown more wisdom and foresight than is usual, it is likely that the civic leaders will suddenly awake to the realization that bankruptcy is just around the corner. Then a hurried scramble must follow, in which attempts are made to cut expenses, to cancel projected construction, to raise taxes, to attract more industry to the community, and to obtain more government aid. The pattern has become a familiar one; but there are signs that awareness of the problems may help to avoid in the future some of the worst mistakes of the past. Some industrialists have already come to realize the value to their industry of a well planned, financially sound community, and have taken the lead in organizing planning activity in localities where they are building new plants. But such farsightedness is still a rare occurrence among industrialists, and it is more usual for the new industry to ignore as far as possible the problems of the area in which it locates. It may be assumed that most industrialists will only change this attitude when scientific studies have been able to show conclusively that planned community growth pays concrete dividends in the form of greater labour contentment, fewer strikes, lower labour turnover, lower worker fatigue (as the workers are not forced to endure a long, tiresome and frustrating journey to work), lower industrial taxes, and generally better public relations. The planner can no doubt make a contribution here to the education of industry in the facts of contemporary industrial living.

But even if the community is able to solve its financial problems, its social life is bound to undergo serious and often undesirable changes under the impact of a large new industry. The average age of the population will probably drop as the new workers arrive. Depending on the type of the industry, the new workers will probably display social attitudes different from those of the original inhabitants. In general, they are apt to be more rootless, less stabilized by social custom, more restless and impatient. Many of them may consider drinking a major form of recreation, and the habit of "a couple of pints after work" may place a large strain on local 'pub' and parking facilities, besides adding to the dangers of traffic. Their scale of values is apt to be centred upon money to a greater extent than that of the original inhabitants; and the commercial expansion which will accompany industrial growth will tend to attract speculators and innovators whose business practices may seem crude and unfair to the local businessmen. Faced with these changes in their social fabric, the local residents must lose their sense of community, unless they can begin to create a genuine new community based on the participation of the new residents. If the workers are encouraged to settle down and raise families, if decent housing is available, if the schools can accommodate their children, and if cooperation can be established between the new and old residents, a stable social life can be regained. Much depends of course, upon the type of worker employed by the new plant, his marital status, age, national background, etc. But community planning which provides for wholesome recreation and decent living conditions, will always help to avoid many of the worst features of the social disintegration which usually accompanies large scale industrial development in a small community.

Returning now to a consideration of the Ford plant at Oakville, it is evident that in many respects its impact will not be as severe as that of the hypothetical example used above. Total permanent employment will not be too high, and in addition, many of the permanent workers will commute from Toronto or other centres remote from the factory, at least for some time. The plant is not of a temporary nature (although it might suffer severely in a depression), so no temporary housing will be required. In addition, Trafalgar township and the town of Oakville already had quite a bit of industry when Ford decided to locate there, so the municipal officials were somewhat familiar with the problems to be expected.

On the other hand, traffic is bound to be a serious problem, enhanced by the fact that many workers will commute. The path to Oakville's licensed hotel will probably be a well-beaten one. Parking at the plant will accommodate 1300 cars, but this can be enlarged. The Department of Highways is already planning a new 4-lane approach highway from Clarkson to the plant, and a new cloverleaf and access roads along the Queen Elizabeth highway in the vicinity of the plant are also projected. With these improvements, the traffic problem should be manageable, though still serious. More parking facilities will be needed in Oakville, at least until a new commercial centre is provided. The peak production of about 470 cars and 150 trucks per day will add materially to the highway burden and to the noise, for most of the vehicles will be moved to the market via highway.

In-shipments will be largely by rail from the Windsor plant, and it is planned that about 200 freight cars will be moved per day. The company has built its own freight yard, and will use diesel locomotives for shunting, but the noise level will, no doubt, still be high, especially with the whistling required at level crossings, although it is planned to remove one nearby level crossing within 2 years. Smoke nuisance should not be serious. The company has built its own water and sewage systems, and this has relieved the municipality of a large burden, although drinking water is to be supplied by the municipality. Considering the nature of the plant processes, water contamination should not be a problem.

The housing situation is complicated by the fact that the area was growing rapidly as a suburb of Toronto, and also in response to other industries near Oakville, before Ford decided to settle there. Residential development was already well under way, and was bound to expand; the new plant merely gives a very strong impetus in the same direction. In July, 1952, a proposal to install $708,000.00

worth of water and sewage services in a 6,000 acre tract adjacent to the plant, was deferred by the township council pending a clarification of the township's financial position. Meanwhile, assessments have been equalized and generally raised considerably, in spite of ratepayers' protests. The council appears to be trying, with fair success, to avoid financial disorders. A planning board exists, and Dr Eugenio Faludi is retained as consultant.

It would appear that the immediate impact of the plant on the finances of the township will be beneficial, but that the increased tax revenue may be rapidly eaten up by increased debt charges, if services are expanded at a rapid rate to allow new housing on a large scale. Since many of the Ford workers will, for some time, live outside the township, the council may, by holding housing in check, retain the benefits of Ford taxation. But it should be noted that this merely shifts the burden of housing the Ford workers onto other municipalities. Pressures exerted by real estate and building interests may be expected to prevent the township from doing much more than keeping new housing costs within its financial resources; especially since the plant has been declared a defence industry by C.M.H.C., permitting Ford workers to purchase new homes with 10% down payments. Temporarily, however, the township's financial picture looks better, not worse, because of the Ford plant. But other municipalities which will house Ford workers without the benefit of Ford taxes, must suffer in proportion to Trafalgar's gain.

Socially, the plant's impact is hard to calculate. Some of the more skilled workers will be moved from Windsor, but it is expected that the majority will be hired from the labour pools of Toronto and Hamilton, with some 500 drawn from the Oakville-Bronte region. Since there are already many from Toronto and Hamilton who live in the area, further social change will result mainly from the greater number, and possibly from the predominance of unskilled workers on the Ford payroll. Union activity will make itself felt in the district on a considerable scale. But the union can itself become a major progressive force in the community, and if it is able to work closely with the company and the municipal leaders, much should be possible in the development of better community facilities for the workers. The U.A.W. is already on record as favouring subsidized housing for the lower paid workers, and its support could do much towards the implementation of such a program. In addition, the union may be expected to encourage the development of worker's residences in the area, although not immediately adjacent to the plant. In this, of course, it is likely to meet some opposition from the township council. The company has already adopted a fully company-paid pension plan for its employees, and this has done much to encourage workers to stay with the firm for their life's work. This pension plan may be regarded as a long step towards overcoming that "rootlessness" which lies at the bottom of so much of the social disintegration of an industrial civilization. It should encourage the workers to settle down and develop into good citizens, if the facilities are made available for them to do so.

In summary then, it may be hoped that the overall impact of the Ford plant near Oakville will be beneficial to the community. In many ways it presents a challenge which, if met with courage and imagination by all concerned, may lead to the development of an industrial community far superior to most.

Comparison of Industrial Lighting Systems and their Costs

J. W. Bateman

SHOULD FLUORESCENT, mercury, or incandescent light sources or combinations be used in industrial lighting today? Should 20, 50 or 100 foot-candles of light be provided for production now and in the future? These are typical of the questions which have to be answered by architects, consulting engineers, and industrial management. They are important questions because on the answers depend initial investments, maintenance and operating expenses, production costs, and working conditions provided.

Sometimes for a particular lighting job one system may stand out in preference to all others, but often more than one will be applicable so that a choice depends on the weight placed on the different factors involved and even on personal preference.

Light Sources: Consideration will be given first to the various light sources and their characteristics.

Tungsten filament lamps are simple to use; they are relatively low in first cost; they come in a wide range of shapes and sizes; and they provide light of an acceptable colour.

Mercury vapour lamps are relatively high wattage sources, providing about twice as much light per watt as tungsten filament lamps, but require transformers and have some characteristics which are disadvantages.

Fluorescent lamps are relatively low wattage sources, but come in a variety of sizes and wattages. They are highly efficient, and are finding increasing favour in industrial lighting.

Tungsten Filament Lamps: Tungsten filament lamps have been the principal light sources used during the past 40 years. They are simple to operate, require no auxiliary equipment, and are relatively low in cost, which usually means lowest initial cost of lighting installation.

The incandescent filament approaches a "point" source of light, which permits accurate and flexible control of the light. Direct concentrating types of reflectors can be used if required – high wattage sizes are suitable for high mounting, and fewer fixtures are required.

There is rapidly increasing use being made of lamps with reflectors as a component part of the bulb. Many of these use the same efficient aluminum reflector as the all-glass sealed beam automobile headlamp. One new lamp for general use is in the same size of bulb and made with the same heavy glass. It is a 300-watt 115-volt lamp which gives a narrow beam of light of approximately 80,000 candle-power. A smaller 200-watt size produces about 45,000 candle-power. These are companion lamps to the more familiar 150-watt PAR-38 spot and flood lamps used for interior and exterior lighting. The heavy glass in these lamps will not break in rain or snow.

Blown bulb reflector lamps are made in various sizes from the 75-watt R-30 to the 500-watt R-40, and some are made with hard glass for outdoor service.

A relatively new type of reflector lamp is of particular interest to industrialists. It is the R-52 bulb lamp which comes in 500-watt and 750-watt sizes. The shape of the bulb is such as to provide an efficient distribution of light for medium and high bay applications. The relatively flat lower part of the bulb through which the light is distributed will collect practically no dust or dirt, and any which does settle on the neck or sides of the bulb has no effect on the efficiency since the reflector is on the inside. This reflector maintains high efficiency with very little depreciation throughout the life of the lamp, and each time a lamp is replaced, a new reflector is obtained.

ENGINEERING DATA ON SOME TUNGSTEN FILAMENT LAMPS

Wattage	*Bulb*	*Type*	*Design Life Hours*	*Candle-power or Lumens*	*Beam Spread Degrees*
75	R-30	Spot	2000	2000 c.p.	30
100	A-21	I.F.	750	1630 lumens	
150	PAR-38	Flood	2000	3500 c.p.	60
300	R-40	Spot	2000	16,000 c.p.	30
300	PAR-56	Spot	2000	80,000 c.p.	15 x 20
500	R-40	Flood	2000	4,000 c.p.	60
500	PS-40	Clear	1000	9750 lumens	
750	R-52	Reflector	2000	11,500 lumens	
1000	PS-52	Clear	1000	21,500 lumens	

Mercury Lamps: Mercury lamps are useful in general industrial lighting, particularly high bays. The most popular size has been the 400 watt, although 1000-watt and 3000-watt sizes have been used as well. The chief advantages in using mercury light sources are high efficiency in producing light, and long life.

The A1 lamp has a lumen output of 15,000 lumens, approximately that of a 750-watt incandescent lamp, and the E1 20,000 lumens, or nearly the light output of a 1000-watt incandescent lamp.

New mercury lamps have been introduced recently, and their use is increasing. The standardizing of frequency at 60 cycles in central Ontario has been a contributing factor in the greater demand for these lamps in Canada. While there is equipment available for operating the 400-watt size on 25 cycles, the flicker which results makes this lamp unacceptable for interior use. It has been used to some extent in street lighting and floodlighting on 25 cycles. Also the 100-watt size is used on 25 cycles for black light applications.

There are now five different 400-watt mercury vapour lamps. These are listed in the table. The A1 lamp has been available for many years. The E1 lamp, which uses a higher pressure arc tube, was introduced a few years ago. It has a light output about ⅓ higher than the A1 lamp, for the same 400 watts consumption, and the colour of the light is a little better. The R1 lamp uses the same arc tube in an R52 bulb which has a reflector on the inside of the bulb. The J1 and RCI are colour-improved types. They have a thin phosphor coating on the inside of the bulb and reflector respectively which, by the action of the ultra-violet in the arc, produces light with a red component to improve the mercury colour. The result is a very satisfactory colour of light for general industrial purposes. This colour compares favourably with that from a mixture of mercury and incandescent lamps.

The 1000-watt A15 and C15 are relatively new lamps. The A15 is regular mercury, and the C15 colour-improved. The 1000-watt mercury lamp provides comparatively low cost lighting for high bay areas.

All mercury lamps require a warm-up time after turning on before coming up to full light output. The time varies from 3 to 14 minutes for different lamps. Also, if the power circuit is interrupted causing the lamps to go out, they require approximately the same length of time to cool off before they will relight again. This characteristic is a disadvantage, and it is customary to recommend combination mercury-incandescent systems on this account, and for better colour rendition. Usually for high mounting, where mercury is most applicable, two 400-watt lamps are mounted side by side, operating from a two-lamp transformer and alternately spaced with 1000-watt incandescent lamps, or one 400-watt mercury and one 500-watt incandescent may be mounted side by side. The overall efficiency of the E1 lamp is 46 lumens per watt and of the combination mercury and 1000-watt incandescent, 33 lumens per watt. The use of the incandescent tungsten filament lamp units not only assures light immediately the circuit is turned on, or power comes on after an interruption, but also provides the desirable red component which is lacking in regular mercury light.

Straight mercury is, however, simpler to install. While tungsten filament lamps should be used on 120-volt circuits, mercury lamps operate just as satisfactorily or more so at higher distribution voltages which means smaller wire sizes. The use of different distribution systems overhead complicates the wiring installation. Straight mercury is upwards of 50 per cent higher in efficiency than the combination system. Therefore, if there is sufficient local lighting using incandescent and fluorescent lamps, or if there is an emergency system which comes on when the power supply fails, this may offset the need for the combination system.

Fluorescent Lamps: The fluorescent lamp continues to assume a place of increasing importance in industrial lighting. The advent of this new type of light source has meant more to factory lighting than to any other application.

While the invention of the tungsten lamp was a great step forward compared to the carbon filament incandescent lamp available before, the development of a practical fluorescent lamp for general lighting was even a greater advance. Year by year lamp manufacturers had striven for increases in efficiency in tungsten lamps of one or two per cent, but with the fluorescent lamp, efficiency went up 100% to 200% for "white" fluorescent lamps, and more than 100 times for some colours.

Not only was more light produced for the wattage consumed, but there was much less radiant heat in the light. Fluorescent lamps are relatively cool, and five times as much light can be used for the same heat sensation as with incandescent lamps.

Furthermore, fluorescent lamps are extended sources of light of relatively low brightness, and therefore are less glaring and minimize shadows. It was these advantages which brought to industry better lighting – much better in quality and distribution than that provided by filament lamps in standard industrial reflectors.

Of course, everything did not favour the fluorescent lamps. It did not work directly off the lighting circuit, but required the use of an auxiliary or ballast, and at the outset, starters. However, in spite of the necessity of the auxiliary equipment, the advantages of fluorescent were so great that the new light source gained immediate acceptance. At the present time it is the biggest lighting factor in new, and relighting of, industrial plants.

Since fluorescent lamps were introduced in Canada in 1939, a great deal of progress has taken place. The light

DATA ON MERCURY LAMPS

	H400A1	*H400E1*	*H400J1*	*H400R1*	*H400RC1*	*H1000A15*	*H1000C15*	*H3000A9*
Lamp Wattage	400	400	400	400	400	1000	1000	3000
Rated Lumens	15,000	20,000	17,000	16,000	12,300	52,000		120,000
Rated Life (hours):								
5 burning hours per start	4000	4000	4000	4000	4000	3000	3000	5000
10 burning hours per start	6000	5000	5000	5000	5000	4000	4000	6000
Bulb	T-16	BT-37	BT-37	R-52	R-52	T-28	BT-56	T-9½
Maximum Overall Length	13″	11½″	11½″	11¾″	11¾″	14¼″	15¹⁄₁₆″	55″
Supply Voltage	118,236	118,236	118,236	118,236	118,236	460	460	230, 460, 575
Approximate time to full light output (minutes)	8	8	8	8	8	5	5	8
Cooling time to restart	5	5	5	5	5	5	5	7

output of light sources is expressed in lumens. Today the lumen output of a 40-watt white fluorescent lamp is 2500 lumens – more than 50 per cent higher than that of the 1939 lamps – the rated average life is 7500 hours, five times the 1939 figure, and the price is only one-third. Thus the number of lumen-hours per dollar received from a lamp today is more than 20 times – exceptional progress in light source development and value due to the contributions of research and improved manufacturing techniques.

Fluorescent lamp characteristics limit them to relatively low wattage, although the light output of the 96-inch T-12 lamp is nearly as great as a 300-watt tungsten lamp. The 96-inch T-12 lamp operated at 425 m.a., and 74 watts, is rapidly becoming the most popular lamp. Its high light output, high efficiency, instant starting, and long life features make it very acceptable for general lighting. As compared to 40-watt preheat installations, the relative number of parts is only 7 to 22. For instance, a two-lamp 93-inch T-12 fixture with lamp lumens of 9900 requires one ballast, four lampholders, and two lamps – a total of 7 – whereas two two-lamp 40-watt lamp fixtures with a light output of 9400 lumens requires two ballasts, eight lampholders, four starters, four starter sockets, and four lamps – a total of 22.

The line of fluorescent lamps is now made up of sizes from 6 inches long to 96 inches long, and wattages from 4 to 100 watts. There are three sizes of circline fluorescent lamps; 8¼ inches and 12 inches in diameter, and a 16-inch diameter circline is just being introduced. Fluorescent lamps come in various colours, as red, pink, gold, green, blue, daylight, standard cool white, deluxe cool white, standard warm white, deluxe warm white, white, and soft white. The standard cool white is generally recommended for industrial lighting. They come in various types, general line, slimline, circline, preheat, instant start, rapid start, trigger start, low temperature, high humidity, cold cathode, black light, etc.

ENGINEERING DATA ON SOME FLUORESCENT LAMPS

Nominal Watts	*Bulb*	*Lamp Current—milliamperes*	*Lumens Standard Cool White*	*Lumens per Average Lamp Watts*
20	24″ T-12	370	915	48
40	48″ T-12	430	2350	60
90	60″ T-17	1570	4850	54
55	72″ T-12	425	3400	62
65	96″ T-8	300	4300	66
74	96″ T-12	425	4950	67

Lighting Cost Analysis: While the lighting requirements for any seeing simply involve enough light of good quality, these requirements can be met in a variety of ways. For most applications, there is no one type of light source, and no one method of lighting, that is the only one that can be used. Illuminating engineers are likely to agree on the amount of illumination, and the degree of quality desirable, but they may specify different types of luminaires and arrangements to accomplish the results.

There are available today a great variety of light sources and these may be applied in many systems of lighting. To help in deciding what source, and what system are best for any particular building or area, a cost analysis is interesting and useful. This is a comparison of the installation and operating costs of different ways of obtaining the required foot-candles. One system may be low in first cost, but high in operating and maintenance expense, or the reverse may be true.

The primary interest in a cost analysis is in relative costs. One method is to compare these on a cost per luminaire basis, and the number of luminaires adjusted for equal maintained illumination. Another basis would be to compare the costs for a specific area.

On the cost per luminaire basis, the relative costs can be converted to actual costs for a particular installation by: 1. Divide the effective maintained lumens per luminaire by the foot-candles desired. This gives the area per *luminaire.* 2. Divide the area to be lighted by the area per luminaire, to get the *total number of luminaires* needed. 3. Multiply the number of luminaires by items 12, 13 and 21 in the table to obtain respectively the *total initial cost,* the *annual owning cost,* and the *annual operating cost.*

A 15% amortization rate is used in this analysis. This is based on a write-off of capital investment over a 10-year period, at 10% per year, plus 5% for interest, taxes and insurance.

The installation and branch circuit wiring costs may vary considerably, depending on the conditions of each installation, such as mounting height, type of ceiling, method of suspension, size of light source, panelboard location, etc. The costs used here are based on some estimates from electrical contractors.

In preparing a typical cost analysis, certain assumptions have to be made. Operating costs have been determined for 2500 burning hours per year, at 1 cent per kilowatt hour power rate. The labour cost of lamp replacement is computed at 50c per lamp, with an extra 25c for preheat fluorescent lamps, to take care of the cost of servicing and replacing starters. The assumed cost of cleaning is 85c per luminaire for the fluorescent, and 37½c for the incandescent unit. These costs can be expected to vary widely with conditions. It is, of course, suggested that for a specific installation, actual figures be used.

Coefficients of utilization for the low bay area have been taken for a relatively large room with a room index of A, ceiling reflection 50 per cent, and walls 30 per cent. For the high bay area, a room index of F has been taken. Standard cool white fluorescent lamps have been selected, inside frosted incandescent, and 60 cycle operation.

The results of this cost analysis indicate that there are different fluorescent systems which may be employed, and that the costs are relatively the same. There are several other fluorescent systems which have not been compared in this analysis, but those taken represent present general practice.

It should be noted that while the initial cost of a simple incandescent system is about 40 per cent of the fluorescent, even at such a low power rate as 1c per kilowatt-hour, the annual operating cost is about double, and the combined owning and operating cost one-third higher than regular fluorescent. At a 2c power rate, this latter figure is about 60 per cent higher for the incandescent system.

Many people may have the idea that fluorescent lighting is high in cost as compared to incandescent lighting, but a cost analysis shows that such is not the case. In addition, in the examples taken, the quality of the light from the

	Fluorescent Preheat Start— 4-40 w. T12 8′ Section	*Fluorescent Instant Start— 4-40 w. T12 8′ Section*	*Fluorescent Preheat Start— 2-90 w. T17 5′ Section*	*Slimline Fluorescent 2-96T12 8′ Section*	*Incandescent 300-w.*
Basic Data:					
1. Rated initial lamp lumens per luminaire	9400	9400	9700	9900	5510
2. Rated lamp life	7500	7500	7500	7500	1000
3. Lamp wattage	40	40	90	74	300
4. Watts per luminaire (including ballast watts)	191	204	218	180	300
5. Coefficient of utilization	0.67	0.67	0.66	0.67	0.70
6. Maintenance factor	0.70	0.70	0.70	0.70	0.70
7. Effective maintained lumens per luminaire (1 x 5 x 6)	4410	4410	4500	4650	2700
8. Relative number of luminaires needed for equal maintained foot-candles	1.00	1.00	0.98	0.95	1.60
Initial Costs:					
9. Estimated luminaire cost	$38.50	$44.00	$40.00	$41.50	$ 9.00
10. Installation and branch circuit wiring cost (estimated)	$20.00	$20.00	$20.00	$20.00	$16.00
11. Estimated lamp cost	$ 4.20	$ 4.65	$ 5.18	$ 6.68	$ .49
12. Total initial cost per luminaire	$62.70	$68.65	$65.18	$68.18	$25.49
13. Annual owning cost per luminaire (15% of 9+10)	$ 8.78	$ 9.60	$ 9.00	$ 9.23	$ 3.75
14. Relative initial cost for equal maintained foot-candles	100%	109%	102%	103%	66%
Annual Operating Costs:					
15. Burning hours per year	2500	2500	2500	2500	2500
16. Annual energy cost 1c/kilowatt-hour	$ 4.78	$ 5.10	$ 5.45	$ 4.50	$ 7.50
17. Number of lamps replaced per year	1.33	1.33	0.67	0.67	2.5
18. Lamp cost per year	$ 1.40	$ 1.55	$ 1.73	$ 2.24	$ 1.73
19. Labour cost of lamp replacement	$ 1.00	$ .67	$ .50	$ .34	$ 1.25
20. Cost of cleaning twice a year	$ 1.70	$ 1.70	$ 1.70	$ 1.70	$ .75
21. Total annual operating cost per luminaire (16+18+19+20)	$ 8.88	$ 9.02	$ 9.38	$ 8.78	$10.73
22. Relative annual operating cost for equal maintained foot-candles	100%	102%	103%	94%	198%
23. Relative total annual cost for equal maintained foot-candles	100%	105%	100%	97%	134%

fluorescent systems is much better – better in colour, cooler, only one-fifth the radiant heat, much less glaring, and avoids troublesome shadows.

It should be pointed out that a cost analysis of this type only compares costs and does not rate the lighting systems from a quality standpoint.

The typical high bay area cost analysis compares six different systems of lighting. These are:

(1) High bay incandescent lamp reflectors, with 1000-watt PS-52 bulb general service lamps.

(2) Reflector type incandescent lamps, 750-watt R-52 bulb, with drip shield, but no separate reflector.

(3) High bay mercury lamp reflectors with 400-watt mercury lamps, H400E1.

(4) Combination mercury-incandescent system, with equipment as in (1) and (3) above.

(5) High bay mercury lamp reflectors with 400-watt colour-improved mercury lamps, H400J1.

(6) High bay mercury lamp reflectors, with 1000-watt mercury lamps, H1000A15.

Thus two incandescent lamp systems, three mercury lamp systems, and one combination incandescent and mercury lamp system are compared. This comparison assumes that all of these systems are applicable to a particular installation. It is true, of course, that one system may be more suitable than another for a specific area. For instance, colour rendition may be very important, and if so, systems (3) and (6) would not be acceptable. Or perhaps conditions are such that the delay in the restarting of mercury lamps is definitely undesirable, and this would rule out systems (3) (5) and (6).

It should also be pointed out that this cost analysis does not compare the quality of the light, either spectrally or from an eye comfort point of view.

Such a cost analysis does compare the efficiencies of the different systems, the first costs, the power consumed, the lamp and maintenance costs, and the overall cost of producing light. It should be noted that high initial cost does not necessarily mean high operating cost – usually the reverse is true. In general, the mercury lamp systems are

	Incandescent 2-1000w. PS-52	*Incandescent 2- 750w. R-52*	*Mercury 2-400w. H-400E1*	*Combin: 2-H400E1 1-1000w. PS-52*	*Mercury Colour-Improved 2-H400J1*	*Mercury 1-H1000A15*
Basic Data:						
1. Rated initial lamp lumens per luminaire group	43,000	28,400	40,000	61,500	34,000	52,000
2. Rated lamp life	1000	2000	5000	(5000) (1000)	5000	4000
3. Watts per luminaire group (including ballast watts)	2000	1500	860	1860	860	1040
4. Coefficient of utilization—Room Index F ceiling 50% refl. walls 30% refl.	.62	.62	.55	(.55) (.62)	.50	.55
5. Maintenance factor	.65	.80	.65	.65	.65	.65
6. Effective maintained lumens per luminaire group (1 x 4 x 5)	17,350	14,100	14,300	22,950	11,050	18,600
7. Relative number of luminaire groups needed for equal maintained foot-candles	1.00	1.23	1.21	.76	1.57	.93
Initial Costs:						
8. Estimated cost of luminaire group (including ballasts)	$40.00	$12.00	$108.00	$128.00	$108.00	$63.00
9. Estimated cost installation and branch wiring	$70.00	$65.00	$50.00	$80.00	$50.00	$40.00
10. Estimated initial lamp cost	$ 6.48	$ 9.52	$29.20	$32.44	$40.00	$40.00
11. Total initial cost per luminaire group	$116.48	$86.52	$187.20	$240.44	$198.00	$143.00
12. Annual owning cost per luminaire group (15% of 8+9)	$16.50	$11.50	$23.70	$31.50	$23.70	$15.45
13. Relative initial cost for equal maintained foot-candles	100%	92%	194%	157%	267%	114%
Annual Operating Costs:						
14. Burning hours per year	2500	2500	2500	2500	2500	2500
15. Annual energy cost 1c kilowatt-hour	$50.00	$37.50	$21.50	$46.50	$21.50	$26.00
16. Lamp cost per year	$16.20	$11.90	$14.60	$22.70	$20.00	$20.00
17. Labour cost for lamp replacement	$ 5.00	$ 2.50	$ 1.00	$ 3.50	$ 1.00	$ .50
18. Cost of cleaning twice a year	$ 5.00		$ 5.00	$ 7.50	$ 5.00	$ 2.50
19. Total annual operating cost per luminaire group (15+16+17+18)	$76.20	$51.90	$42.10	$80.20	$47.50	$49.00
20. Relative annual operating cost for equal maintained foot-candles	100%	84%	67%	106%	98%	60%
21. Total annual owning and operating cost per luminaire group (12+19)	$92.70	$63.40	$65.80	$111.70	$71.20	$64.45
22. Relative total annual cost for equal maintained foot-candles	100%	84%	86%	92%	120%	65%

higher in first cost than the incandescent systems, but lower in operating and overall costs. For most applications, mercury lamps are not very acceptable on 25 cycle electric supply, on account of the flicker produced. It is expected that their use will be much more widespread with the standardization of 60 cycle frequency in Ontario.

Lighting Value: High efficiency of building design and equipment is an industrial requirement today. As more efficient machines are developed, they replace outmoded equipment. This results in relatively large capital investment per worker. One sizeable Canadian manufacturer states that it takes more than $6,000 invested on building equipment and inventories to provide one person with one job. Yet the workers are often expected to use these expensive tools and machinery with a minimum investment in lighting. Often industrial designers and industrial management fail to realize the great contribution that proper lighting can make to increased production, a better product, less spoilage, improved safety, better housekeeping, better space utilization, improved employee morale, and generally lower production costs.

Some studies made in the past have shown that the lighting installation accounts for about 2% of the investment value. In the case referred to above, this would mean 2% of $6,000, or $120, which seems like an extremely low proportion. The figure varies a great deal depending on the type of building, the type of work, and the type of lighting installation, but in any event, it is relatively low. Other estimates indicate that lighting costs as a part of operating costs amounts to approximately one-half of one per cent of production costs, or to produce a $1.00 item, the lighting cost is one-half cent.

It is interesting to compare the cost of lighting with the hourly labour rate of employees. Take the simple case of a worker occupying a space of 100 square feet which can be lighted for an annual owning and operating cost of $20.00. If the hours worked per year are 2,000, and the rate

GENERAL RECOMMENDED VALUES OF ILLUMINATION

	Current Recommended Practice Foot-candles in Service. (On task, or 30" above floor)
Most Difficult Seeing Tasks	
Finest Precision Work....................	200-1000
Involving: finest detail poor contrasts long periods of time	
Such as: extra-fine assembly; precision grading; extra-fine finishing	
Very Difficult Tasks:	
Precision Work..........................	100
Involving: fine detail fair contrasts long periods of time	
Such as: fine assembly; high-speed work; fine finishing	
Difficult and Critical Seeing Tasks:	
Prolonged Work.........................	50
Involving: fine detail moderate contrasts long periods of time	
Such as: ordinary bench work and assembly; machine shop work; finishing of medium-to-fine parts; office work	
Ordinary Seeing Tasks:	
Involving: moderately fine detail .... normal contrasts intermittent periods of time	30
Such as: automatic machine operation; rough grading; garage work areas; switchboards; continuous processes; conference and file rooms; packing and shipping	
Casual Seeing Tasks:	
Such as: stairways; reception rooms; washrooms and other service areas; active storage	10
Rough Seeing Tasks:	
Such as: hallways; corridors; passageways; inactive storage	5

is as low as \$1.00 per hour, then the cost of the lighting is 1c per hour. Or the cost is \$1.00 per hour for worker with no artificial light, and \$1.01 per hour with good light, and presumably in between with poor or mediocre lighting.

Illumination Standards: The present standard of industrial lighting in Canada is the "Recommended Practice of Industrial Lighting", CESA Standard Z92-1943. A committee of the Canadian Standards Association is at the present time working on a revision of this standard, required on account of the progress during the last ten years in new light sources, new lighting techniques, and new concepts of what good lighting can do.

The quantity of illumination required for a particular seeing task depends on the difficulty of the task, the surroundings, and the eyes. Quality of illumination is equally as important, but more difficult to specify. General recommendations of amounts of illumination, based on researches in vision, experience in practice and the ability to provide the desired values efficiently and economically, have been prepared.

Industrial Lighting Trends: In high bay areas there is a trend to the use of mercury vapour lighting, and with the new developments in these sources more mercury vapour lighting will be used.

A growing use has also been noted of reflector type lamps such as the R-52. Initial investment is low, and maintenance is simplified.

There is a definite trend to the uses of fluorescent for general industrial lighting today. Fluorescent has contributed more to the industrial lighting field than perhaps any other application. It has meant better quality lighting, less glare, fewer shadows, better distribution and more light, usually at lower cost of operation.

There is a new trend in industrial lighting, as evidenced by the increasing use of lighting fixtures which direct a portion of the light to the ceiling and upper walls. This results in better appearance and greater seeing comfort. In the lighting of offices and schools, attention has been paid to high quality in lighting, and it has been usual practice to direct some light upwards. The seeing tasks in the factory are often just as complex, and therefore it is only reasonable that the best in seeing conditions be provided.

Fluorescent fixtures with slotted tops are now available in a number of different designs, and several of the new and important lighting installations are using these fixtures. The results show a marked improvement in industrial lighting.

It has always been difficult for Architects to be sure that they will receive credit for material supplied by them to the newspapers.

Sometimes perspectives of future work leave their hands and are obtained from others for publication. In this case the appearance of his drawings in the newspaper — almost always without credit — is the first knowledge the Architect has of the matter.

While the Architect normally retains copyright, if he should wish to enforce his rights, he would have to sue for damages. He may, for a small fee, however, register his copyright, having done so, unauthorized publication becomes a breach of the Copyright Act, and the Architect, therefore, is protected and may insist on receiving the credit to which he is entitled.

On a recent occasion, when a page of perspectives appeared in a Toronto newspaper without the knowledge of the Architects concerned, and without their names being mentioned, the matter was referred to the Institute Solicitor for his opinion. He reports as follows :

Dear Sir:—

The President of the Royal Architectural Institute of Canada has requested you to obtain from us some general directions which might be followed by Architects in registering perspective drawings, plans, elevations and specifications.

We find that it is not necessary to actually file copies of any of the documents in order to obtain registration. The author or authors of the work which it is desired to protect are simply required to fill out an application in the form enclosed herewith and to forward the same with a marked cheque or money order for $3.00 payable at par in Ottawa to the order of the Commissioner of Patents and he in turn will send a certificate to the applicant covering the registration.

When the writer was in Ottawa recently he interviewed the Chief Officer of the Copyright Office and discussed the practice in such matters in that office, so that we might pass on to you any special information we could obtain that would facilitate registration.

We found that it is the practice of the office to regard plans and elevations all as "literary" works, first because they are in the nature of directions for the builder, and second because they come under the definition of "literary work" as defined in the Copyright Act. Specifications would, of course, be in the same classification.

On the other hand, perspective drawings or pictures of a finished building are treated as "artistic" works and should be so described in the application.

There are three other points which should be regarded if an Architect is to protect himself as thoroughly as possible. The plans, perspective drawings, elevations and specifications should be signed by the author or authors of them.

After the certificate of registration has been received the words "Copyright Registered" should also be placed on the documents, although there is no specific provision of the Copyright Act requiring that this be done. The effect of adding these words, however, is to give clear notice that the copyright is protected by registration.

It is also very important that the Architect should protect himself when accepting his retainer by making it perfectly clear to his client, preferably in writing, that the copyright in the plans, specifications, perspective drawings and elevations is to remain in the Architect.

You will observe that the enclosed form states that the work "has not been published". The word "publication" is given a special meaning in the Copyright Act, namely, the issue of copies of the work to the public and does not include the exhibition in public of an Architect's work. It would only be in a very rare case that an Architect would have issued copies of any of his works to the general public before he made application for registration of his copyright. In such a case the following words should be inserted in the application in place of the words "has not been published" — "was first published by the issue of copies thereof to the public on the day of 19 in (city, town) of (province)."

Yours truly,

Arthur L. Fleming

Application for Registration of Copyright

I, (here insert the name of the Architect or Architects) of the (city, town, etc.) of (Province of) hereby declare that I am the owner of the Copyright in the (literary or artistic, as the case may be) work entitled (for example, the Marani Mansions, being the plan of the ground floor of an apartment building) by (here insert the name and address of the author), and that the said work has not been published; and I hereby request you to register the Copyright of the said work in my name in accordance with the provisions of the Copyright Act.

I hereby forward the fee of $2.00 for registration of the said Copyright, and the further fee of $1.00 for certificate of such registration.

DATED at the day of 19 .

(Signature)

To The Commissioner of Patents,
Copyright Office, Ottawa.

N.B.—The Application must be legibly and neatly written, printed or typewritten on foolscap paper 8″ x 13″ and shall be signed by the applicant or by an agent duly authorized. A partner may sign for a firm. A Director or Secretary or other principal officer of a Company may sign for the Company.

Copies of the work are not required for registration of copyright.

REPORT OF THE JURY ON ADVERTISING DESIGN IN THE JOURNAL 1952-1953

The second annual judging of advertising design in the Journal shows a definite improvement by a few companies and it was most gratifying to be able to select some thirty pages out of over a thousand for final selection rather than about ten as in the first competition.
However, the remainder of the advertisments leave much to be desired in their design and the general standard is so low that the few good examples stand out to the great advantage of the advertisers.

The Jury considered that more awards were justified this year and they are as follow:—

First	*Single*	*Otis Elevator Co. Ltd., December, 1952*
Second	*Single*	*Northern Pigment Co. Ltd., March, 1953*
First	*Spread*	*Atlas Asbestos Co. Ltd., February, 1953*
Second	*Spread*	*Empire Brass Mfg. Co. Ltd., March, 1953*
First	*Part Page*	*Perpetua Furniture Limited, January, 1953*

The following firms are also to be complimented on their advertisements: Northern Pigment Company Limited, November, 1952; Northern Pigment Company Limited, May, 1952; Eagle Pencil Company of Canada, Limited, October, 1952; The Barrett Company Limited, April, 1952; The Barrett Company Limited, June, 1952; Eastern Steel Products Limited, February, 1953; Eastern Steel Products Limited, November, 1952; The Arborite Company Limited, September, 1952; Picker X-Ray of Canada, Limited, October, 1952; Anaconda American Brass Limited, July, 1952; Northern Electric Company Limited, April, 1952; Westeel Products Limited, March, 1953.

Respectfully submitted,

G. E. Wilson, *Chairman*

Forsey Page

Carl Dair

NEWS FROM THE INSTITUTE

ALBERTA

The April issue of the Journal of the R.I.B.A. describes proceedings on the presentation of the Gold Medal of that institute to Le Corbusier. The occasion was evidently one of unprecedented enthusiasm. This indicates how deeply the ideas of this bold seer have stirred thought in the minds of architects and town planners if not also of the general public. Others have envisaged utopias but none of so wide a scope or with the amount of attention to practical application. His schemes envisage no less than new ways of living which in many ways are, in any case, being forced upon us. To make the best of these coming conditions he lays down the plans required, the new ways of communication, of lay-out for working and for habitation. This he does with strictest logic and with invincible courage. The thoughts expressed on the occasion of the presentation of the medal by Sir Herbert Read, by Mr Robert Matthew and by Le Corbusier himself deserve attention.

Sir Herbert Read speaks of him as being a man with a poetic vision of life, not a poetic vision of buildings and cities only, but rather a vision of a poetic way of life, a new manner of living. Life in that vision is above all radiant. The concept of life must be changed and, indeed, we should begin by investigating the nature of happiness. The rest, including a new architecture, will inevitably follow. We should build, says Le Corbusier, not with steel and cement, but with love. He has had but one master, the past. The whole universe, he points out, was raised up by an immense faith in the energy, the future, the harmonious creation of civilization. To this great epoch Le Corbusier has contributed the prototypes. He has given us a new vision of the future and not only a vision but the beginnings white, limpid, clean, clear and without hesitations, a new world opening up like a flower among the ruins.

Mr Robert Matthew noted Le Corbusier's persistent belief in the possibility, if not the certainty, of the emergence of harmony in human affairs,—in spite of the pathetic disorder of our towns. He opens a window on new worlds in the organization of urban space. In his atelier is to be seen nothing less than a new affirmation of the rights of man in terms of sun, light, space, quiet, trees and grass. The translation of this book of rights into architectural terms has been his constant work and recreation. Bureaucracies and academies have been the substantial windmills at which this Don Quixote, this wandering knight,—to use his own words,—has unremittingly tilted. The constant theme of his urban sketches is the re-establishment of nature. The distance covered by an hour's walking is a surer measure than abstract numerical scales. Town planning must be the spontaneous expression of human needs. The law of the land is that it must support houses and not that it shall support the unmerited ascension of private fortunes. "Compensation" means the creation of fresh and splendid conditions of life for the townsman. First things are first and these are human values. (How like Ruskin's "Life is the only wealth").

Some of Le Corbusier's own remarks on the occasion may be quoted. "It is always the human being, man, that I have sought to study, not as a professional architect but as a discoverer, and also as a traditionalist. I have always had my feet in the past, and my head in the past too. My roots are in the past, though not in the Dark Ages of the academies. At the same time, I have tried to take a step towards the future. It has been my object always to be simple and direct, to be both an engineer and a poet."

"I was governed by the cosmic laws of space, by my respect and admiration for nature, by the needs of the family and the recognition of the home as the fundamental unit of society and the hearth as the centre of the home. My work there (at Marseilles) has its roots in the past, in the Grande Chartreuse, which for fifty years has appealed to me by its harmony and its perfect association of the individual and the collective."

Many of Le Corbusier's dicta are hard sayings to most ears. He advocates the erection of vast apartments, each housing hundreds of families. These may be thirty or more storeys in height, raised on stilts with road communications at the first floor level. About the middle storey there would be common restaurants and recreation rooms and on the top open air gardens and gymnasia. These great masses of building would be spaced widely apart and surrounded with parks and trees. The economies of ground occupation and of servicing of all sorts would be immense. Life in them would be of a genuinely community type. In this way only can teeming populations obtain the rights of man to sun, light, space, quiet, trees and grass. All this and much more Le Corbusier has demonstrated with clinching logic. Are we persuaded? The objection constantly raised to apartment dwelling is that it is no way to bring up children. It cuts them off from all intimate touch with nature. People generally, and especially in western Canada, cling tenaciously to the house and garden type of dwelling because they feel a conviction of its benefit to child life, the life of the coming generation. Can apartment life be made truly beneficial for the rising generation? Le Corbusier appears to be confident that it can be made so.

Cecil S. Burgess

ONTARIO

The recent series of competitions sponsored by the Plywood's Association, the *Ladies' Home Journal* and Central Mortgage and Housing Corporation, have given us and particularly the younger architects an opportunity to air their ideas on the subject of housing.

Basically the problem presented through these competitions was one of refinement, the refinement of generally accepted designs of medium and relatively low cost dwellings. At almost any time in the development of architecture, refinement is a necessary reflective consideration and heaven knows it is needed now.

Competitions do provide a concrete problem for those of us who are not able to obtain the commissions privately. They give unknown talent an opportunity to be received and assessed. Invariably though, a competition has to ascertain the view point of the sponsor and govern his design accordingly. This could be considered a legitimate condition of the problem but it might also hinder the use of a more forthright solution.

It is in the nature of this type of competition to answer only the short run problem, so, if a long run view of the housing situation is taken I think that we, as architects, are begging the question. Low cost housing today is hardly low cost and if it is, it is not adequate housing by any stretch of the imagination. Eventually we will come to the conclusion that conventional forms and methods of construction will never solve the problem. To use less material at the moment means a smaller dwelling. What we have to find out is how to make materials work more efficiently, as Mr Buckminster Fuller has stated numerous times. This will inevitably necessitate the use of radical forms and some new materials. It will also impose problems of acceptance and require concrete proof of structural soundness and aesthetic stability.

If, for instance, young architects designed and built these structures for themselves a great deal of the ice would be broken. It all would take time but at least through certain publicity, the people would see what could be done. They cannot be expected to judge what they cannot see.

As far as I am concerned the solution to this problem must always be of major importance to architects. It is part of our moral responsibility to society to strive to house people more adequately.

James W. Strutt

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J. W. Bateman was born at Tweed, Ontario. After attending school there and at Belleville, he graduated from the University of Toronto in 1923 with the degree of B.A.Sc. in Electrical Engineering. Upon graduation he joined the Canadian General Electric Company taking the special course for engineering graduates, and, in 1924, entered the newly-formed Lighting Service Department. Since 1930, he has been manager of this department, which is now called the Lighting Institute, and deals with illuminating engineering and light source applications.

Mr Bateman is a member of the Association of Professional Engineers of the Province of Ontario, and a Fellow of the Illuminating Engineering Society, serving on several of its national committees.

Clare D. Carruthers was educated at Port Hope High School, Toronto High Schools and the University of Toronto. He graduated from S.P.S. in 1927.

Worked with Bernard H. Prack, architects and engineers, with Toronto Harbour Commissioners on Sunnyside Development, Truscon Steel Company, and with Geodetic Survey Co. of Canada. Since graduation he has been with the firm of Gordon L. Wallace, first as a designer, then as a junior partner, and in recent years as a member of the firm now known as Wallace, Carruthers & Associates Limited. He has been responsible for the structural design of many buildings in Canada, and has had many years of experience on industrial, commercial, hospital and institutional buildings. More recent projects in Toronto area are the C.N.E. Grandstand, Bank of Nova Scotia Head Office, Manufacturers Life Building, Sunnybrook Hospital and General Motors' new plant at Oshawa.

Lane Knight has been chairman for the past six years of the Exhibitors' Committee at the Ontario Association of Architects Convention and Annual Meeting. Vice-President and General Manager of the Master Builders Company Limited, Toronto. Educated in Canada and the United States, Mr Knight is an active member of the American Concrete Institute. For the past fifteen years he has been engaged in the manufacture and field development of cement dispersing agents and application to concrete and masonry mortars.

Donald Paterson studied Political Science and Economics at the University of Toronto after serving with R.C.A.F. in Canada and in Europe. He graduated in 1951 with first class honours, a gold medal and four scholarships to his credit. An M.A. in Economics on a fellowship followed in 1952. This year, on another fellowship, he took the U of T graduate course in Town Planning as part of the work for a Ph.D. degree in Economics. He has recently joined the Department of Development of Toronto Township.

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NOTICES

The R.A.I.C. is making available to all members, at a nominal charge of $1.00 per set, a bound set of R.A.I.C. Documents. This set consists of a foreword with a list of contents, reprints in English and French of three legal articles about R.A.I.C. Documents by the R.A.I.C.'s Solicitor, and also sample copies of the latest editions, including the French editions, of all documents which are used professionally.

The main purposes of doing this are to help members to familiarize themselves with these documents and also to make available a complete booklet for ready reference.

Members are urged to take advantage of this offer by sending their orders to the R.A.I.C. Executive Offices, 88 Metcalfe Street, Ottawa.

C. J. G. Carroll, Secretary

A Dutch architect, C. M. Bakker, wishes to form a partnership with a Canadian architect. He is a graduate of the Delft University Institute of Technology, and is a member of the Ontario Association of Architects. He has had twenty years experience in private practice in Europe and in the west. Mr Bakker's address is 62 Oriole Road, Toronto. Telephone HU. 8-5092.

BOOK REVIEW

THE HEART OF THE CITY: CIAM 8. Published by Lund Humphries & Co. Ltd., London, England. Price £2.10.0.

The Heart of the City: (towards the humanization of urban life) is the Report of the eighth general meeting of the International Congresses for Modern Architecture (CIAM) held at Hoddesdon, England in 1952. This book is an assembly of 16 papers, 2 discussions and 20 examples of "hearts" or cores at various urban levels designed by members of CIAM throughout the world.

In opening the conference, J. L. Sert, President of CIAM, defines the theme–the Heart or Core of the City – as a necessary and timely study to consider centres for community life in the development of social communication and expression and, also, as a physical means of opposing current trends of decentralization. He stresses the basic need for central gathering places free of vehicular traffic and acting as nucleii for administration buildings, art galleries, museums, libraries, theatres, concert halls, conference halls, etc. The creation of such groupings would present an opportunity of expression for architects, sculptors and painters in collaboration.

Giedion (Zurich), General Secretary of CIAM, reviews historical examples of the Core – Egyptian temple centres, Greek agora, Roman fora, mediaeval market centres, and renaissance squares, all in relation to the social conditions of their times. He believes Cores would be used today.

Paulsson (Upsala) accepts historical examples for historical reference only, because the contemporary problem of the Core is completely different in social structure and in the complexity of the daily orbits of the thousands of people using a central core.

Le Corbusier (Paris) sees the Core as a flexible, changing, experimental background of the social arts where the people will have spontaneous meetings and celebrations and joyfully express their momentary life.

Gropius (Cambridge: U.S.A.) believes the Core of the City to be an escape from the restrictive influences of family-level discussion. He also advises objective study of existing satisfactory architectural groupings as a measure for the new cores to be created.

Richards (London) points out that an urban entity exists in time as well as space and that, therefore, a Core should express the collective memory of the community. The majority of modern cores, in his opinion, must, by the nature of the problem, preserve and intensify the character of the various historical building elements while arranging for proper contemporary use.

Bakema (Rotterdam) defines the Core as the place of discovery of the relationship between man and things; and the significance of such discovery is the awareness of a potentially fuller and richer life through co-operative action.

Rogers (Milan) considers the problem of the Core to be the creation, by architectural design, of a centre of humanism which can generate a free and real use of itself by being an alternative for the introspective habits and social indifference of individualism.

The panel discussion on Italian Piazzas observes the functions of the Core by specific examples – the Piazza San Marco and the Piazza San Giovanni e Paulo in Venice, the Piazza del Duomo in Milan, the Piazza Vittorio Emanuele in Florence and the Piazza San Pietro in Rome. This discussion distinguishes between past and present uses and expounds some theories of architectural and planning composition.

Fry (writing from Simla) accepts the basic premise that the Core may be an expression of the good life but he states that the success and usefulness of a core depends upon the efforts and imagination of the citizenry as a whole. He warns against the domination of the architectural idea when a real and sympathetic understanding of the condition of man should be the basic concern.

The twenty Core schemes shown in Part 2 of this book were selected from an exhibition of such plans at Hoddesdon, and represent current work of CIAM members in all parts of the world from Hiroshima to Chicago and from Oslo to Chimbote, at various stages of design or construction.

This book is the first on this subject and, in that respect, is an important addition to current architectural literature and a necessary reference. It is well illustrated by photographs, line drawings and coloured maps. Like many reports of such meetings it is weakened by the theme being repeated rather than developed. The potential sum of ideas is lessened by off-topic, subjective discussion. The architectural problems of the Core are not emphasized to the same extent as the social problems.

The social function of the Core would have to be defined before the architectural aspects could be discussed, but it is a fallacy that architects should include sociology as their direct concern. By doing so they are in danger of misinterpreting the true program because of an amateur outlook; and they may also be wasting energies which should be used on the proper design of the building elements. The theories of society in this book are unconvincing. Most Canadian architects would agree that the individual as such, rather than a population mass, must be the basis of any building program and that an architectural creation can only serve its purpose through this approach. Buildings are for people; not people for buildings. The needs and social functions must be determined at a non-architectural level so that the architect may be free to express himself through his own art.

John Layng