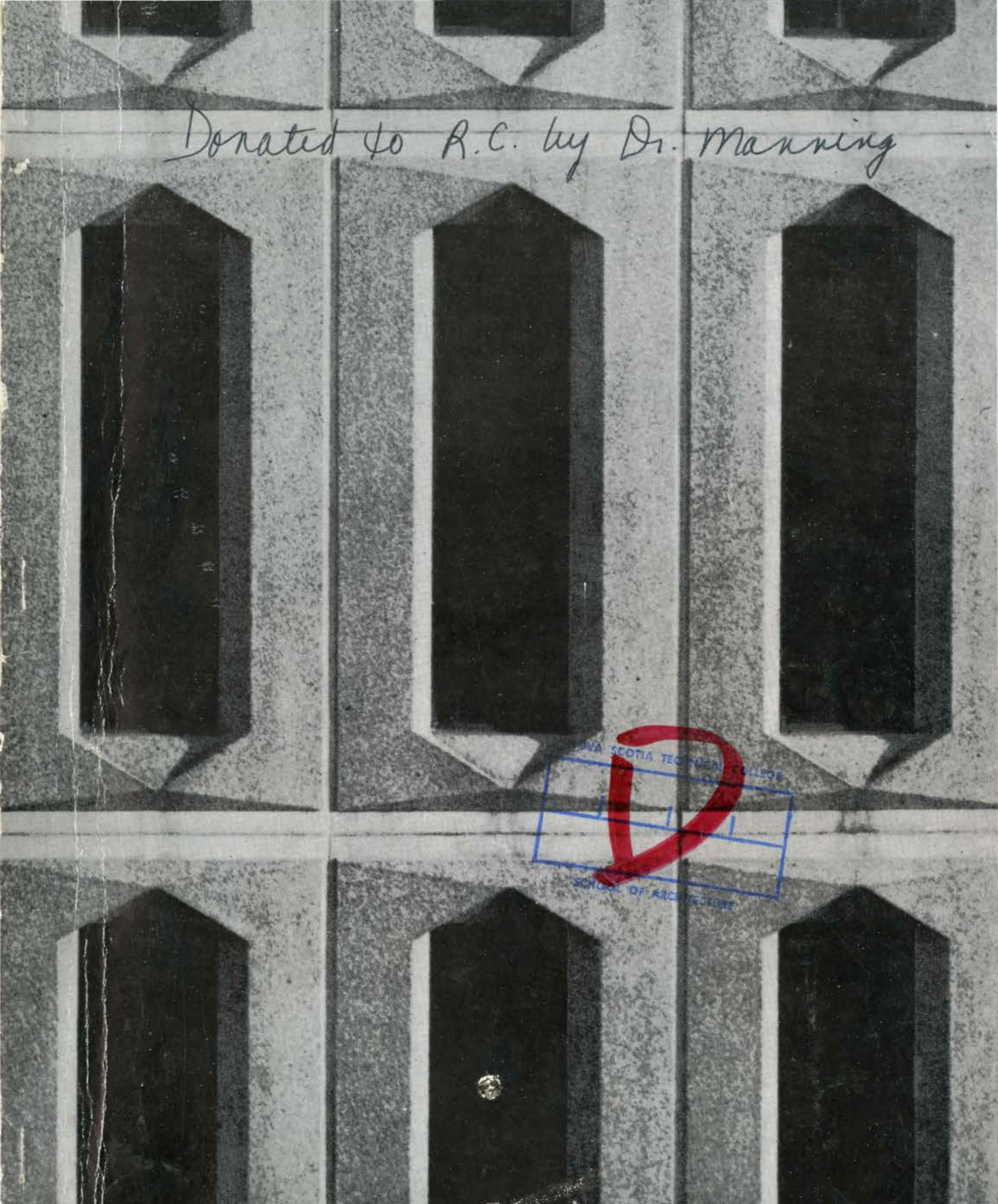

RAIC JOURNAL

ROYAL ARCHITECTURAL INSTITUTE OF CANADA / INSTITUT ROYAL D'ARCHITECTURE DU CANADA AUGUST 1963

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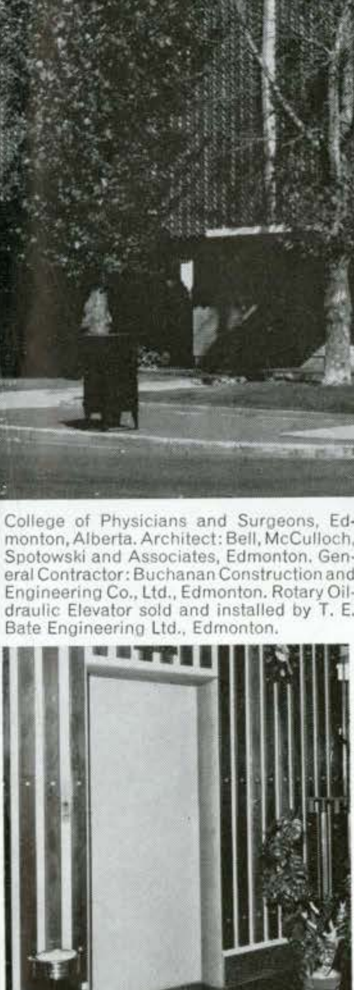

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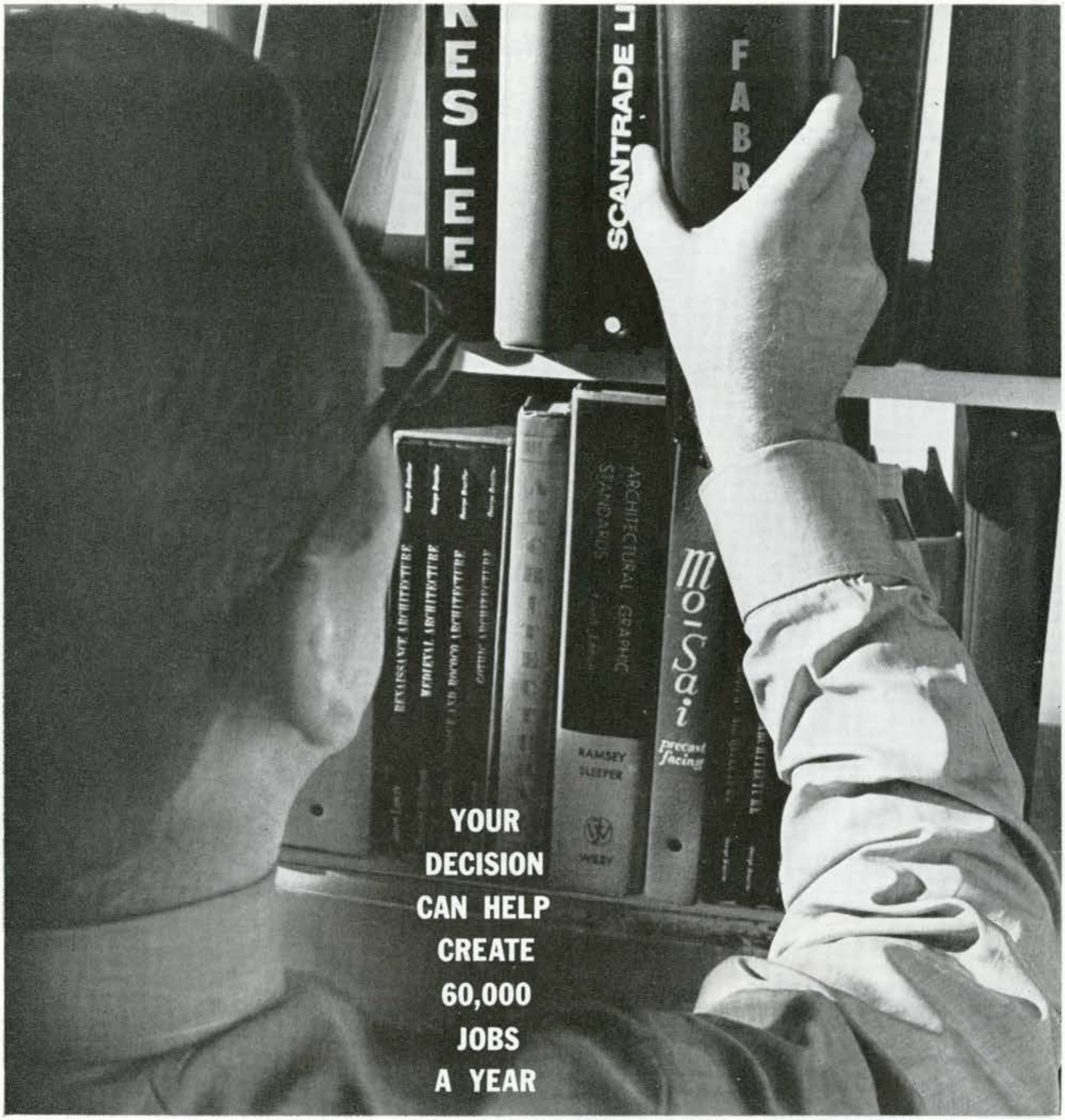

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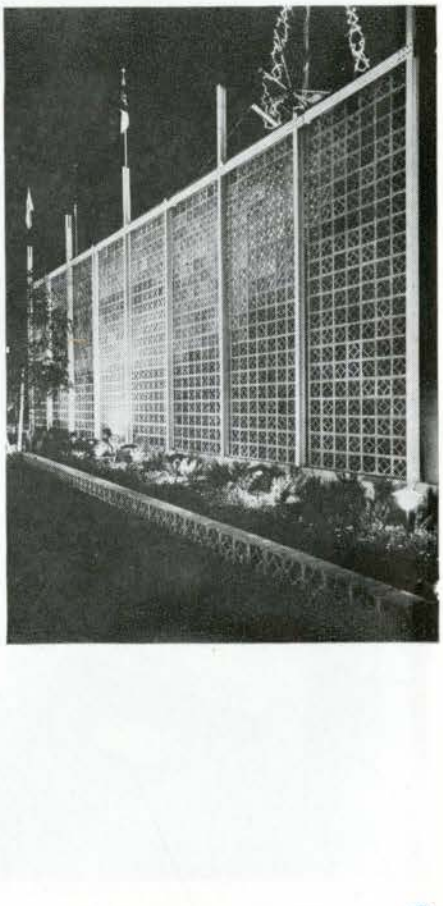

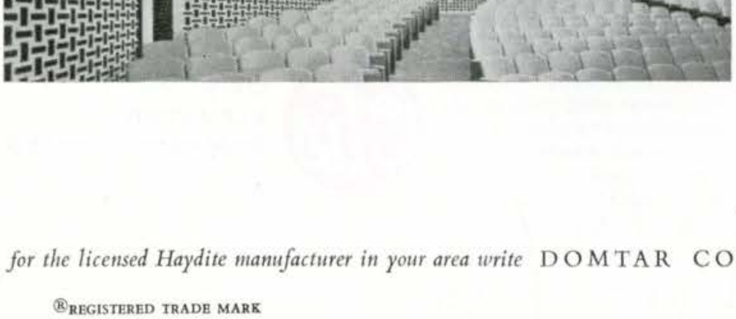

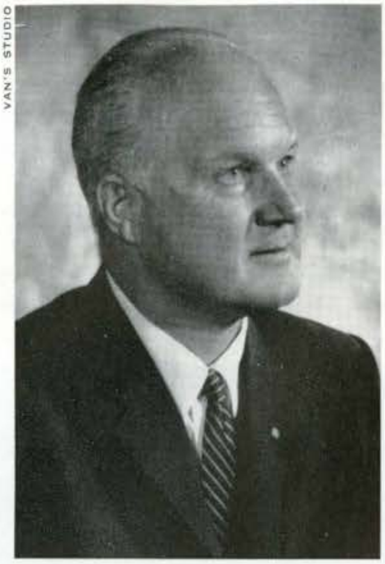

RAIC NEW EXECUTIVE DIRECTOR

Fred W. Price

The appointment of Fred W. Price of Ottawa as Executive Director of the Royal Architectural Institute of Canada, to be effective September 1st, is announced by John Lovatt Davies, President of the Institute. Mr. Price succeeds Robbins Elliott who retired recently to take the position of Director of Planning with the National Centennial Administration.

Mr Price is forty-six years of age and a native of Montreal. He was educated at the High School of Montreal and at McGill University, receiving a Bachelor of Arts and a Master of Arts (Education) degree.

From 1937 to 1946 Mr Price was a high school teacher with the Montreal Protestant School Board. During World War II he served with the Canadian Armoured Corps in Canada, the United Kingdom, and N.W. Europe, retiring with the rank of Major.

In 1946 he joined the Bell Telephone Company of Canada and carried out various staff and supervisory assignments in the engineering and commercial departments. During the period of 1959 to 1962 Mr Price was granted leave of absence to serve as Executive Director of the Canadian Conference on Education, a joint project by leading organizations of educators and of laymen concerned with education, seeking to promote wider public understanding of Canada's educational needs and problems.

During the past two years Mr Price has been manager of Information and Publications with the Research and Development Laboratories of the Northern Electric Company. In this post he has been responsible for information on new developments and products in the communications industry.

A member of the Public School Board of Ottawa, and a member of the Kiwanis Club of Ottawa, Mr Price is fluently bilingual. He is married with one daughter.

M. John Lovatt Davies, président de l'Institut royal d'architecture du Canada, a annoncé cette semaine la nomination de M. Fred W. Price d'Ottawa au poste de directeur administratif de l'Institut à compter du 1er septembre. M. Price succède à M. Robbins Elliott qui a récemment abandonné ce poste pour accepter celui de directeur des plans à l'Administration du centenaire du Canada.

M. Price, 46 ans, est natif de Montréal. Il a fait ses études dans les écoles secondaires de sa ville natale et à l'Université McGill où il a obtenu les grades de bachelier ès arts et de maître ès arts (pédagogie).

De 1937 à 1946, M. Price a enseigné dans les écoles secondaires de la Commission des écoles protestantes de Montréal. Au cours de la dernière grande guerre, il a fait du service dans le corps blindé de l'armée canadienne au Canada, au Royaume-Uni et dans le Nord-Ouest de l'Europe. Il s'est retiré avec le grade de major.

En 1946, M. Price est entré au service de la Compagnie de téléphone Bell du Canada où il a été chargé de diverses fonctions de surveillance et de direction du personnel dans les départements du génie et du commerce. Un congé de 1959 à 1962 lui a permis d'occuper le poste de directeur administratif de la Conférence canadienne sur l'éducation, institution fondée par les grandes associations d'éducateurs et des profanes intéressés à l'enseignement afin de faire mieux connaître à la population les besoins et les difficultés de l'enseignement au Canada.

Au cours des deux dernières années, M. Price a été directeur de l'information et des publications aux laboratoires de recherche et d'études techniques de la Northern Electric Company. A ce titre, il a été chargé de faire connaître les progrès et les nouveaux produits réalisés dans l'industrie des communications.

M. Price est membre de la Commission des écoles publiques et du Club Kiwanis d'Ottawa. Il parle couramment les deux langues. Il est marié et père d'une fille.

FEATURES · TORONTO

The gas station has still not taken its proper place in the city but there is an indication that the present forms are improving. (Even though the management insists on clutter, the buildings do shine through.)

Probably the best in this city is the Shell station by Webb & Menkes next to the Four Seasons Motel on Jarvis Street (1). Besides being a well designed building the usual asphalt spread is contained behind a wall that allows the pedestrian to slip past without the feeling of being completely victimized by the car.

JOWETT

1

Another "break through" is the Canadian Tire Corporation's station on Avenue Road designed by L. C. Bachorz & Associates (2). Canadian Tire has not founded its corporate image on good taste (3) and thus the achievement is all the more remarkable. Despite this past reputation, combined with the problems of getting fast moving traffic, from a highway, into and out of a very confined site and integrating the structure with an existing underground parking system, the designers have overcome the obstacles with grace (if it is accepted that the station belonged there in the first place). Here no wall was necessary since the building sits at the street and service is from behind, and in doing this the architects have developed some delightful details that can be enjoyed by the passer-by.

JOWETT

2

JOWETT

3

The Toronto Parks Board, during the past years, has struggled to maintain a series of swimming pools at no cost to the user. The most recent of these achievements is the Olympic Pool

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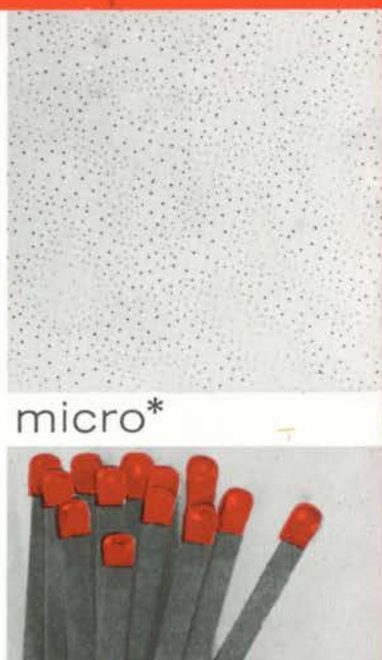

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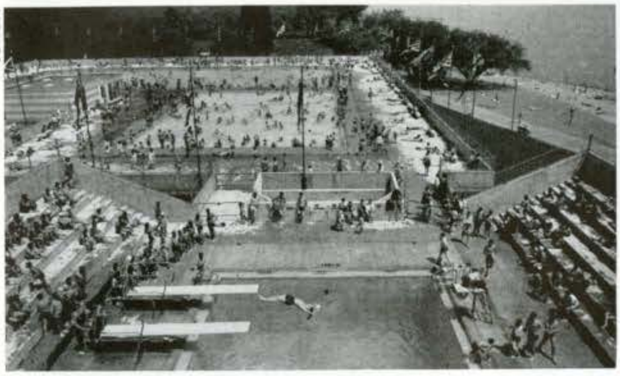

5

designed by Wilson & Newton (4, 5, 6). The site was well chosen for it serves a vast neighbourhood, much in need of this type of recreation, and can be easily reached by a major highway and, as well, by metropolitan users of the adjacent park. Set amongst the trees, it does not interfere as a competitive form with either the park or the dwellings. The raising of the pools is probably a practical solution but on reaching the summit it is disappointing to discover a vast array of glazed surfaces and galvanized enclosures. These features and the degree of sanitary controls, both in and out of the water, tend to reduce the recreational pleasure to a clinical process.

JOWETT

6

BALLARD & JARRETT

Don Mills, now no longer publicized except for the occasional gossip of basements flooding, is the site of a telephone booth designed by Gerald Beekenkamp of King Plastics. And although many details are still unsolved (such as resting the structure on the paving) this is an imaginative and very necessary addition to the Don Mills Shopping Centre, and begins to give the courtyard a more useful purpose other than of separating shops and piping music.

THE ARCHITECT AS AN EXPERT WITNESS

BY MICHAEL DENNIS

Mr Dennis of Michael Dennis & Associates, Toronto is a consultant on architectural and engineering relations. Before going into private practice in 1961 he had worked as editor-in-chief of Roads and Engineering Construction Magazine and been in charge of all contracts, legal work, and government liaison for the construction of major industrial buildings in Canada and the United States.

An expert witness is an individual who, because of education and experience, qualifies as an expert in a particular field and whose testimony of matters relating to this field can affect the decision of a court of law in a trial.

Despite the strange fascination of the law for architects and engineers, every architect with any kind of reputation or awareness of what is involved has a self preservatory dread of being called upon to be an expert witness. It is an instinctive reaction for which there are many reasons, some obvious and some not so obvious, but all valid from the point of view of good architectural relations. One of the most valid is undoubtedly the problem that after accepting the commission, the technical evidence discovered by the architect might very well prove contrary to the client's best interests thus causing a conflict between the architect's obligation to his client and his obligation to his profession. Others are that being unfamiliar with court procedure he may very well be afraid of appearing a fool rather than a distinguished architect; may feel that the technical principles involved could be impossible to explain so that they would be readily understandable to a lay judge or jury; may think that there could be too many conflicting theories possible as to the true technical explanation; or even that his qualifications as an expert would be discredited by the cross examining counsel.

It was Abraham Lincoln, however, who said "It is the man who does not want to express his opinions whose opinions I want" and partly because of a similar sentiment amongst others and partly because of the law itself an occasion will undoubtedly arise sometime in the career of a practising architect when he will find himself in the probably uncomfortable position of having to be an expert witness.

He can find himself in this position in one of two ways. Firstly by being virtually unable to refuse the request of a client or a good potential client and secondly by being legally unable to refuse the demands of the court which can insist that an architect appear as expert witness to explain a report or study which he may have made previously. In the first case an architect can demand his own fee as a professional man. In the latter case he must appear as an expert for the ordinary remuneration paid to any witness in a trial.

If an architect, therefore, is going to find himself in this position it is important that he know at least the essentials of what is involved and something of what he should do and what he should not do in order to handle the situation professionally He must never allow himself to be put in a position where his client tells him how to do his job. Once the assignment has been accepted, being an expert witness is, in fact, just as much a facet of an architect's work as designing a building.

Accepting a lawyer-client's instructions on how to be an expert witness could be just as dangerous to his professional reputation as accepting any other client's instructions on how to design a building.

To begin with there are four different civil trial courts in Canada with which architects could be concerned as an expert witness. In practice if not in theory the amount of preparation required by the architect of his testimony will vary considerably according to the standing of the court which is hearing the litigation. The first, the lowest court in Canada, is the Division Court, in some provinces referred to as a small debts court, and because of the restricted amount of damages which can be awarded by it, an architect is much more liable to be called by this court to explain his own previous work than to be hired by the plaintiff or defendant.

The next highest is the County or District Court, where parties to a civil action may consent to the trying of a case involving any sum of money, and it has jurisdiction within the county or district concerned. It is the court which is most likely to concern the architect as an expert witness.

The highest court with which an architect personally can be involved in this role of expert witness is the supreme court of a province. Higher courts such as appeal courts, the Supreme Court of Canada and the Privy Council, hear only transcribed evidence.

The one other court with which the architect may possibly be concerned is the Exchequer Court of Canada, which tries cases involving patents, trade marks, etc. and claims against the Crown and would obviously more particularly concern engineers who are specialists in patents for example. It is the court however, which could concern the mechanical and electrical aspects of buildings.

When approached by a client to make a study and report on a situation as an expert witness, the first thing to ascertain is the type of court in which the litigation is to be heard (in order to know the amount of work involved), when it is to be heard, and to establish the fee. It should be noted that for the sake of the record it is advantageous to the architect for his official client to be the lawyer in charge of the case rather than the plaintiff or defendant. This is a technicality but can help during cross examination should the architect's impartiality be questioned.

For the same reason the architect's fee should be set at the minimum set by his provincial professional association (in Ontario $129.00 per day, or $21.00 per hour). This is important since, particularly in jury trials, the cross-examining counsel will often try to discredit the expert witness by pointing out that he is paid for his opinion. The impact of this is lessened if it can be stated that he is in fact appearing for the minimum fee suggested by the Association. Of course, under no conditions whatsoever must fees be related to the outcome of the case.

Once having agreed upon the conditions and fees of his employment the first step is for the architect to ascertain from the lawyer exactly upon what he is intending to base the case. From this meeting he should then proceed to make a cursory examination of the problem and advise the lawyer, within two or three days, in writing, of his opinion as to whether there is indeed a case for his client or not. If the technical evidence is not in favour of the client but the lawyer still wishes to retain the architect's services to make a thorough study of the problem and to make a complete report, there is no ethical reason why the architect should not do so. Either way, whether there is a good technical case or not, if the lawyer decides to go on the next thing is for the architect to make a complete examination and study of the problem.

During this study it is of the utmost importance to make detailed notes of every step taken and of any tests or examination made. This is because the method of conducting a study or survey is quite often of as much and sometimes more concern than the findings. When the study is complete the architect should then make up three completely separate reports for the lawyer-client. The first report should outline in detail the procedures carried out during the study and include the description of any tests and a plan showing the position and direction of the camera if photographs were taken. The second report should consist of the architect's findings, test results, photographs, etc. and conclusions together with reasons if practical. The third should simply point out any possible conclusions or assumptions which could properly be made by another architect where tests, etc. were not conclusive or possibly open to different interpretation. Each report should be made in duplicate, should be brief, preferably not more than five pages,

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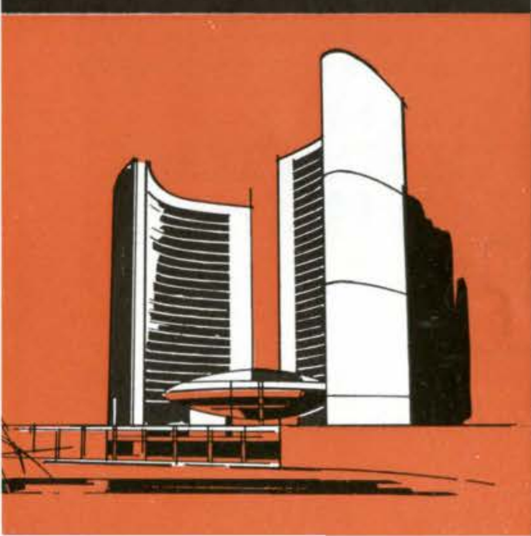


and written in language as simple as possible. Each one should be typed double spaced on 8½ in. by 11 in. bond paper bound in a window folder. The original and one copy of each should be stamped with the architect's seal of registration, in the bottom right hand corner of every page, applying the seal only to the original and having carbon between it and the copy so that an exact legal copy is retained by the architect of his reports.

One point to mention at this time is that both in the reports and in testimony it is almost always preferable to avoid references from a book written by someone else to back up an opinion. If no references to an authority are made by the architect expert witness then none may be cited in court to contradict him. If an authority is referred to however, the same authority may be used to also contradict him and a good lawyer guided by his expert witness can often make effective use of this.

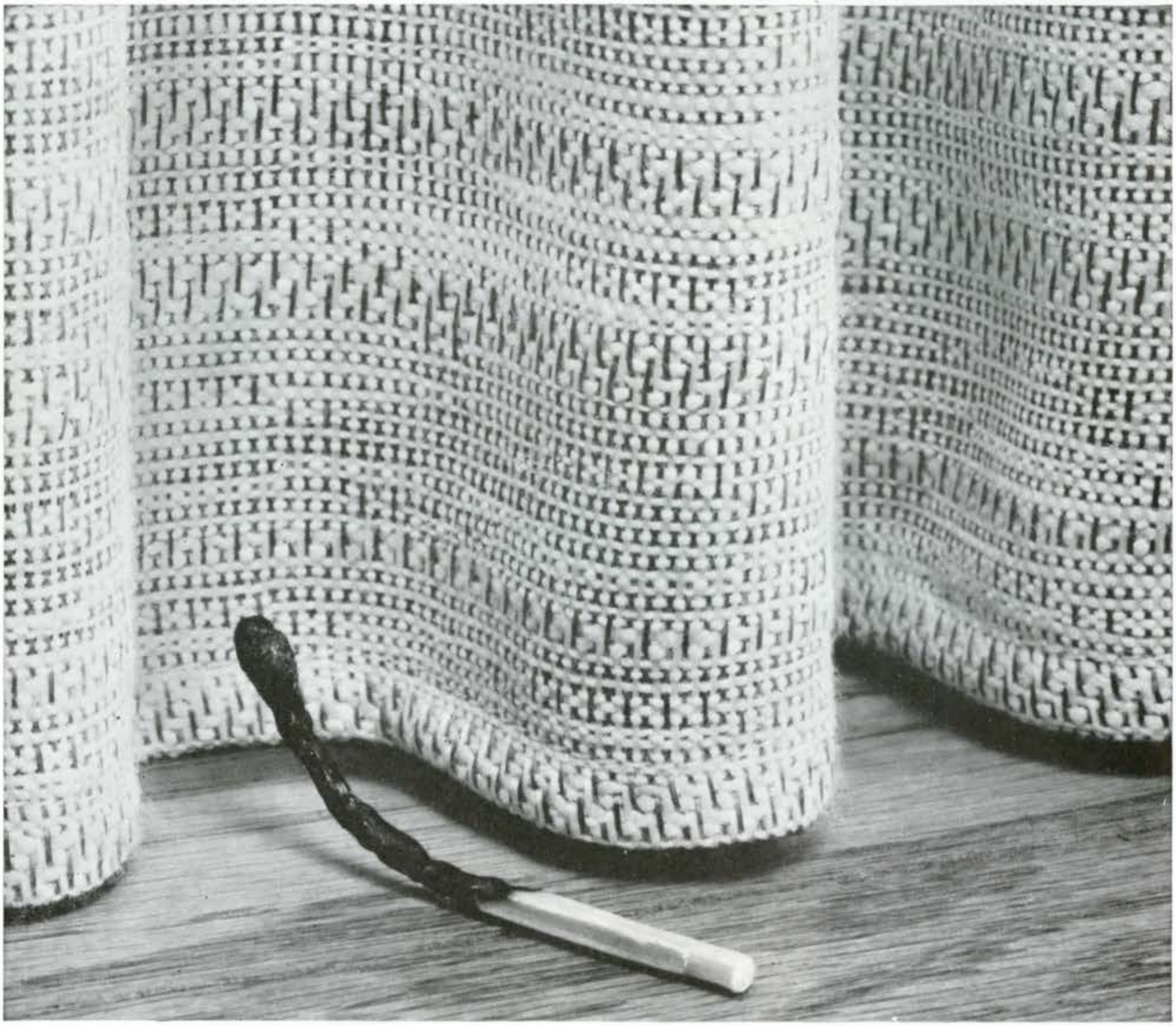
Once the reports have been submitted to the lawyer-client the lawyer will have to decide once again whether to continue with the case or to settle out of court. If he decides to go on the architect must then sit down with him to agree upon a list of questions which the lawyer will ask him during the trial in order to bring out the points the architect feels should be made. This is necessary since in court the architect will only be allowed to answer questions put directly to him. He can also help by suggesting questions for the lawyer to ask the opposing expert witness. To prepare for his actual day in court there are several things which the architect must now do of an elementary but valuable nature. The first thing he will be required to do when on the witness stand is to establish his position as an expert which in no way means proving only that he is a registered architect. The cross examining lawyer will, as his job, try to discredit this position and the architect can help to establish it by bringing with him photostat copies of a resume of his related experiences, his registration as an architect of the Province, copies of books or papers he may have written on the specialty, proof of membership in professional and learned associations and societies, proof of formal education and degrees and a list of important projects he has worked on in the field in which he is testifying. A list of all these salient points should also be prepared for the lawyer's direct use in establishing the architect as an expert.

He should also have made up three extra copies of the report describing the method of carrying out any study or tests and the report revealing his findings. These are for the purpose of being submitted as evidence or given to the opposing attorney at the lawyer-client's discretion. If the findings are not favourable of course, extra copies need be made only of the report detailing the study and it will be up to the lawyer to phrase the questions so that only points favourable to his client are brought out. In this position the architect need be concerned only with telling the truth and following the principle of making no statement which he would not make before a gathering of architects. Provided he does this, that the evidence may give an erroneous impression because of only one set of facts being brought out is in no way the responsibility of the architect or contrary to professional ethics.

When a jury is involved in the case and sometimes when only a judge is concerned it is a good idea to also prepare any particularly important drawings, sketches or photographs on a large enough scale (approximately 36 in. by 36 in.) to be set on a blackboard and used for demonstration. These photographs or drawings should be mounted on stiff board to facilitate both handling and display.

When being cross-examined there are several things to keep in mind. A "when did you stop beating your wife" type of question would probably be objected to by the lawyer-client, but might for some reason be allowed by him. An architect however, cannot afford to ignore it, and any obscurely worded or hypothetical question put to him by the cross-examining counsel must be clarified or rephrased before he answers it so that his answer cannot possibly be misinterpreted. Another thing is that he must beware, in the heat of cross-examination, of giving the opposing lawyer the slightest grounds for discrediting him or his testimony by insisting that measurements for example are exact or closer than they could be expected to be, or that opinions are fact. These are also points upon which he must advise his lawyer-client if made by the architect witness for the opposing party.

Finally, the architect expert witness must always be content to be just that. The law does have a strange fascination for an architect and many do indeed make a study of it in relation to their own field. In private he may even exercise his knowledge to impress his lawyer-client. In courts though he must refuse point blank to answer questions not directly in his field and must never offer an opinion of law even if requested to.



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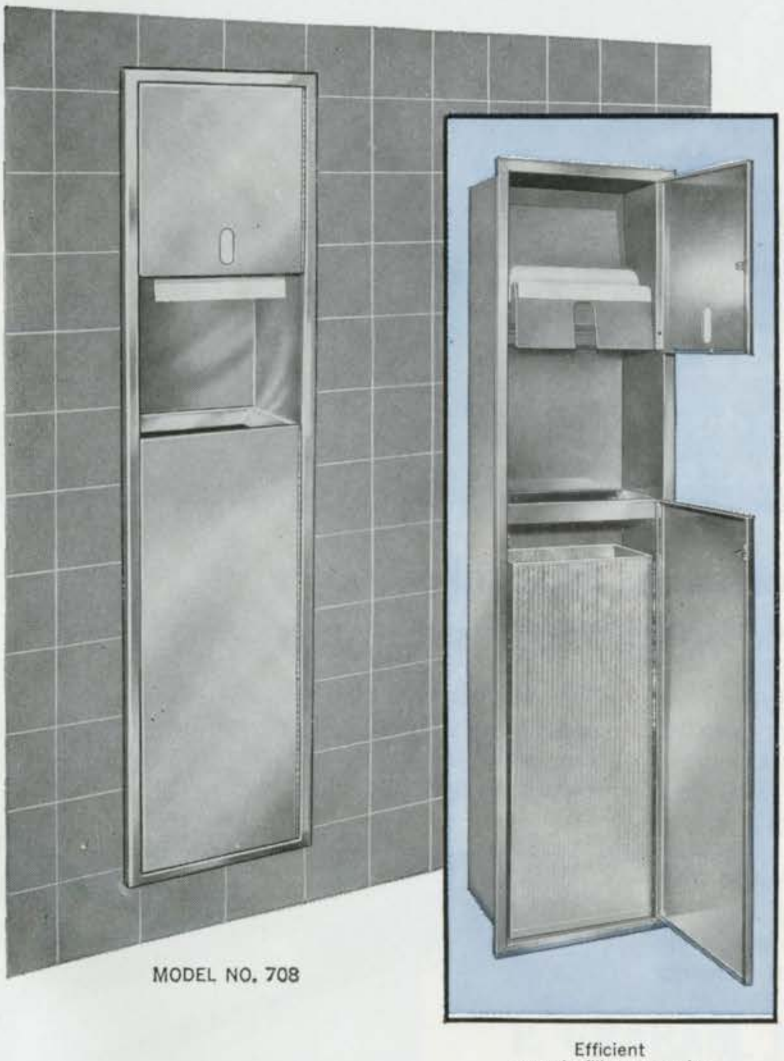

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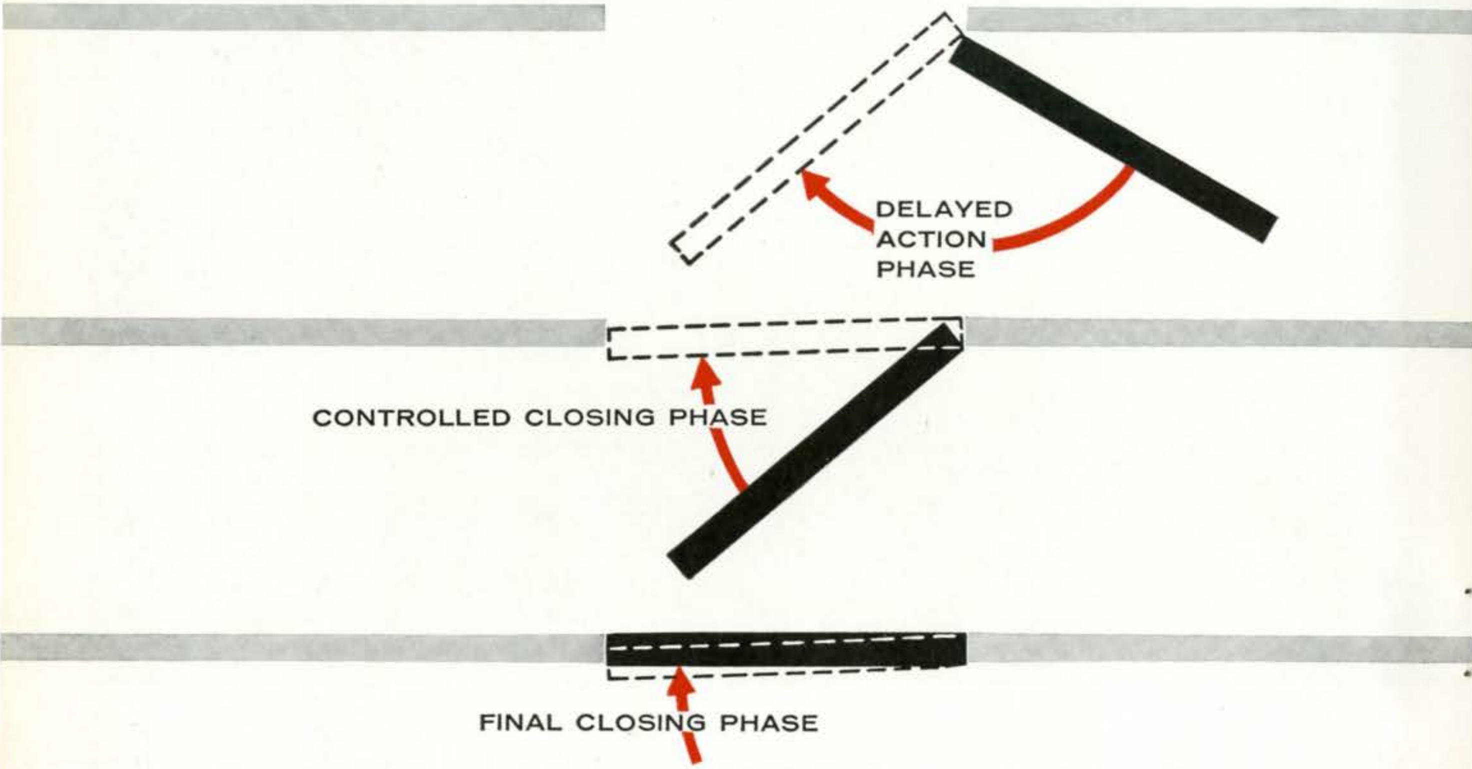

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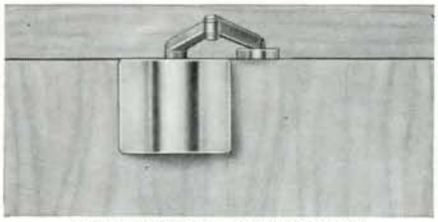

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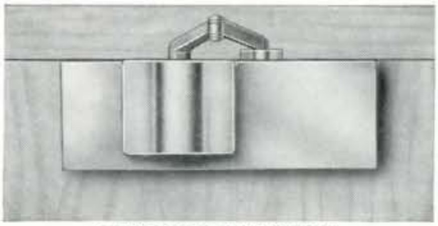

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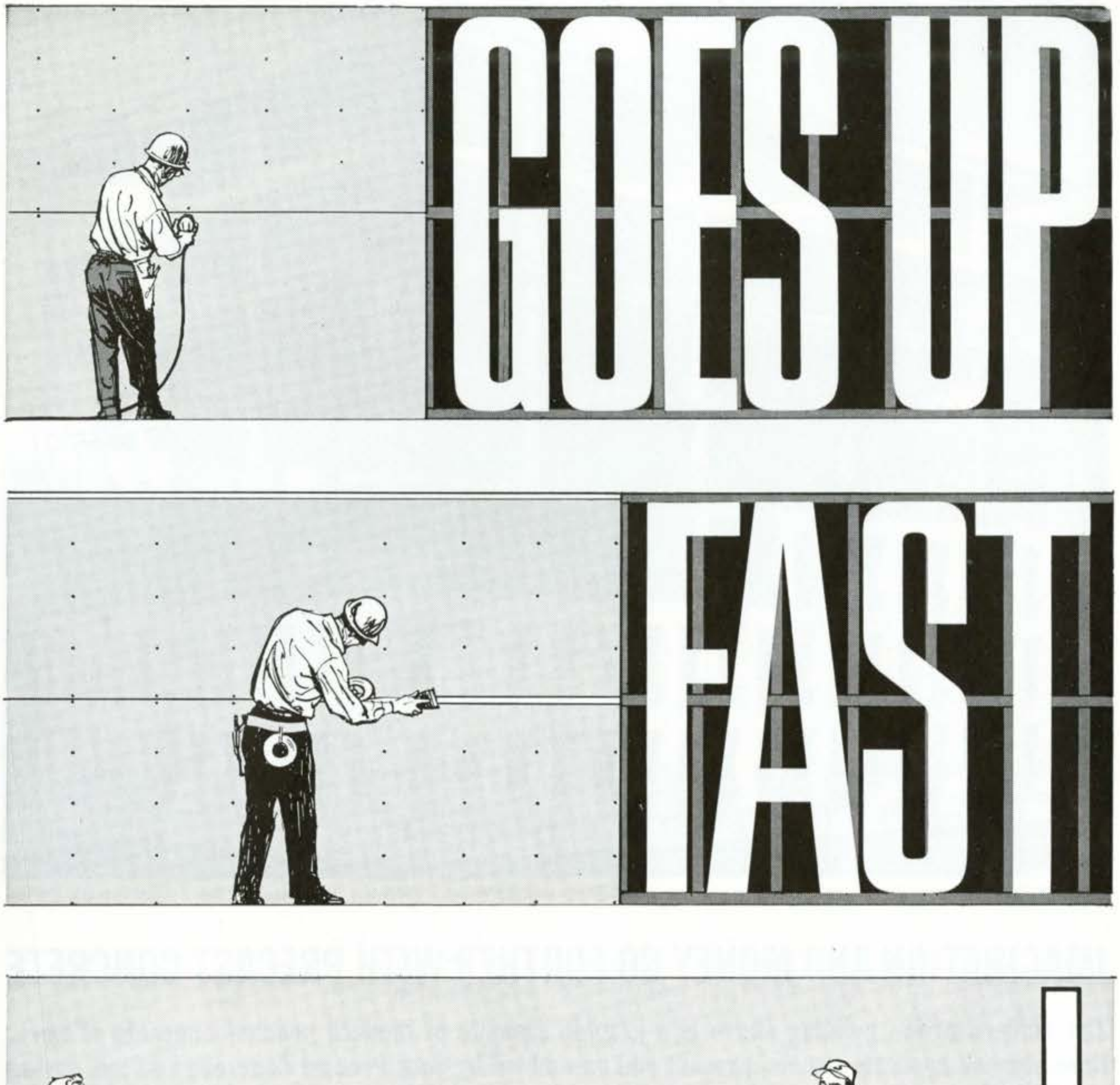
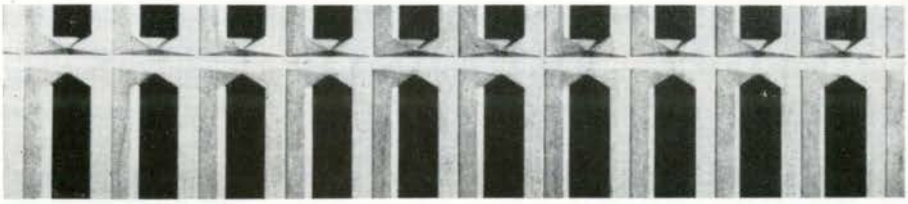

GOES UP
FAST
!



Not so many years ago the term "Precast Concrete", if used, would probably have meant a block, a cast stone window sill, or possibly a sewer pipe. Today we find "Precasting" being applied to whole buildings and large scale building components and assemblies. The development and use of precast concrete materials in building construction over the past few years have been very rapid and one need not look very far or very long to see evidence of their influence on contemporary architecture.

The attractions of precast concrete are many and varied and, to different people, precasting means different things. Designers are probably most excited by the aesthetic possibilities of the new structural forms made possible by precast concrete which may have been stimulated in part by the promise of relief it offers from the tyranny of the glass and metal curtain wall. To builders, precast concrete may mean the achievement of the advantages inherent in concrete construction without the high cost of on-site formwork or it may imply the superior qualities of concrete that are possible with factory production and control. When combined with the principles of "Prestressing", as is so often the case, precast concrete enables longer and more slender flexural members to be poured in a so called "Crackless Concrete". Producers probably see precasting as the logical application of industrial processes to concrete construction, while governmental bodies concerned with the problems of unemployment claim it as a means to extend some of the seasonal employment of the building industry into the slack winter period. Precast concrete building elements have caused the question to be raised as to which union group should be responsible for their manufacture and installation; an answer we understand is soon to be forthcoming.

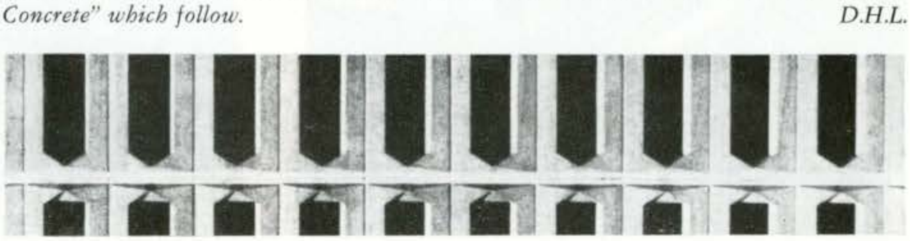
PRECAST CONCRETE

Those familiar with precast concrete agree that it is eminently satisfactory for many contemporary building needs and that essentially it is a new and different building material. To exploit fully the structural, economic, and aesthetic possibilities of precast concrete design and construction methods should not emulate those of the materials which it replaces. This very fundamental principle of design has been so often referred to by the authorities on precast concrete that it seems worthy of emphasis at this time.

During the past decade or so, precast concrete has gone through an "Experimental" stage of its life as a construction material and appears to be entering the second phase of "Consolidation". If the history of other building materials can serve as a guide, we should, over the next few years, see a greater co-ordinated effort on the part of the precasting industry to expand the use of their products by establishing standards of production and performance and providing information and design recommendations to designers. Such steps should be welcomed by our profession for they will undoubtedly influence our work.

The high standard of achievement in precast concrete construction in this country has been due, more than any other reason, to a number of Canadian engineers who have pioneered the design and production of this material. The importance of their work to the development of precast concrete construction in North America has in many instances won them international recognition. They have contributed the major articles on "Precast Concrete" which follow.

D.H.L.



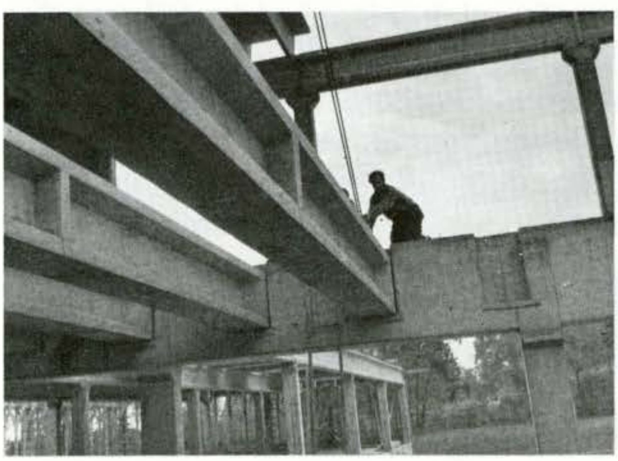
PRECAST CONCRETE AND THE ENGINEER

BY LAURENCE CAZALY

Laurence Cazaly graduated from the University of Bristol in 1950 and was chief designer for the Prestressed Concrete Company in London before starting his consulting practice in Toronto in 1955. The Bristol course, under Prof. Sir Alfred Pugsley, emphasized aircraft structures in light alloys and Alan Harris, then at Prestressed, was determined to outdo any metal with prestressed concrete. Mr. Cazaly was therefore trained to use a Building Code only as paperweight, a tradition he has endeavoured to maintain ever since. He is a member of C.S.A. committees on Prestressed Concrete and Concrete Poles and a member of the P.C.I. Joint Details Committee. Mr. Cazaly is the first winner of the Martin P. Korn award of the P.C.I. and is currently writing, with Prof. M. W. Huggins, the C.P.C.I. Handbook on Prestressed Concrete.

"Precast concrete can be ugly and cheap." PANDA

"Precast concrete can be ugly and expensive." PANDA



The essence of precast concrete for the engineer is **FREEDOM.** The material can be beautiful or ugly, expensive or cheap, strong or weak. It can demonstrate more than any structural material, except perhaps aluminum, the skill of the master and the inexperience of the student. Such freedom, like oxygen, is the stuff of life and paradoxically is noxious when taken in concentrated form. It is almost impossible for a consulting engineer in Canada to support a practice by designing in this powerful material and the blame lies jointly with engineers, with architects, and with our society at large.

Far more than most people realise (including the engineers themselves) technology is subject to emotional decisions. Designers, like anyone else, try to surround themselves with the things they believe in and it is as easy for an engineer as it is for an architect, lawyer, or accountant to find a technical justification for a decision that has already been made. There has not been much structural precast concrete used in this country in the past but there is going to be a great deal used in the future. If I am positive about both these statements this comes from a study of humanity rather than stresses. Let us, therefore, consider some of the human values involved.

PRECAST CONCRETE IS NEW

For a pioneer country Canada has been disgustingly conservative. This seems almost impossible in a giant country with a tough landscape and a tough climate and seems to be largely due to the great shadow cast by the United States. Fortunately a growing intellectual nationalism is causing us to change, but it is still too frequently true that unless a man's greed forces him to expose himself he prefers the tried and true.

PRECAST CONCRETE HAS NOT YET ESTABLISHED TRADITIONAL FORMS

Most precast manufacturers now supply a range of floor slab shapes. To make complete designs of precast concrete more than this is required, meaning that the designer has to work out for himself the framework that is necessary to support such slabs. This in turn means that he has to think, and, having thought, he has to assume responsibility. These two requirements are more willingly assumed by fanatics than by the conservative backbone of the profession, for perfectly rational reasons. The conservative observes that the most important clients engage engineers who do not stick their necks out. Only the fanatic is obstinate enough to lose valuable commissions in order to take a risk — and in addition there is the next factor to be considered.

PRECAST CONCRETE IS TOO COSTLY TO DESIGN

This affects fanatics and conservatives alike because no one can stay in business if he constantly loses money. As has just been observed there is no tradition or standard practice in precast designing and someone has to work out the details. The better consultants do this themselves — and soon discover that to do the job properly requires twice the usual number of drawings. In addition the details shown cannot be left to a junior engineer or draftsman if the design is to be considered safe. Precast design offices average about two engineers to one draftsman rather than the normal proportion of two or three draftsmen to one engineer. Without being unduly mercenary it is just not practical to do this on the kind of fees paid by architects. Consultants, therefore, find that they have to dilute this mixture with a good percentage of more mundane structural design.

PRECAST CONCRETE IS TOO COSTLY TO BUILD

With reasons lying largely in the previous consideration, this need not to be, and it is not so all the time. If the better consultants find they are losing money, the not-so-good avoid this by showing "typical" details which are not typical at all and by taking no account of production methods. There are a tremendous number of architects' and engineers' specifications which read "The contractor shall assume full responsibility for the design." Most manufacturer's overheads are 10 per cent higher than they should be because of the promotional and detail engineering that they are forced to carry out. In addition precast concrete is pre-formed and therefore pre-detailed. Collecting all the data in advance, from an inaccurate and incomplete set of architectural, mechanical, and structural drawings, is time consuming. More serious, however, is the additional shop cost of forming "every piece differently." This cost is important because of the following.

STRUCTURE DOES NOT ADVERTISE THE ARCHITECT

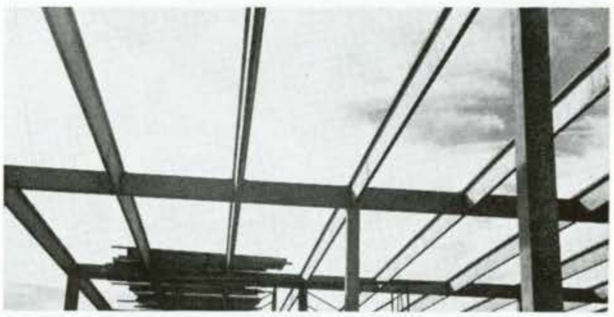
Since the beginning of time architects have skimped on foundations (which do not show) and spent fortunes on elevations (which do). In doing this they have been egged on by the client who wants the public to observe his expenditure. It is significant that while the precast industry has had salesmen trying to build a demand for their cheapest "volume" lines the architectural profession has been demanding more and more costly curtain walls. Modern buildings are literally encrusted with jewels.

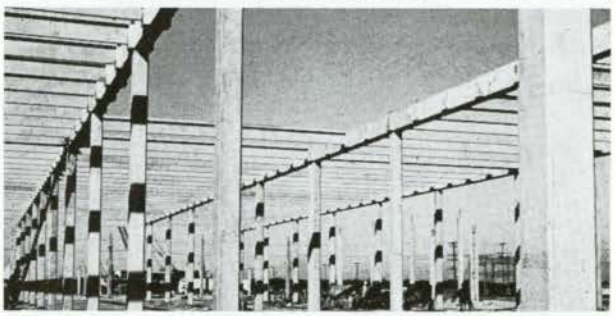
In passing, it is interesting to note that curtain walls are not "structures" and therefore there is no discredit to any party in bypassing the structural engineer. Nearly all curtain walls are engineered by the manufacturer and fortunately the price will stand it. Consequently it will not be surprising if archaeologists of the future find the remains of our modern buildings with the structure still hanging from the cladding.

If the foregoing reasons have been the cause of our inadequate past, what will bring about our rosy future?

CANADA WILL SOON HAVE AN INDUSTRY SPONSORED HANDBOOK

Unlike a text-book, the prime purpose of a handbook is to establish a traditional method of passing instructions from designer to manufacturer. Its advantages are many; financially it cuts the cost of design, and by intelligent standardization it cuts the cost of production. By regularizing office procedures and drawing details the elimination of mistakes is facilitated, even when the handbook is used by comparatively inexperienced designers. It frees senior designers from the chore of excessive detailing and allows them to concentrate on those parts of the design which must be unique.





PANDA

Left top: *"Intelligent standardization cuts the cost of production.* Clean designs like this 80 cent per square ft framing should be easily produced by a combination of handbook methods and manufacturers catalogues." Canadian General Electric Co. Ltd offices and warehouse in Calgary; architects, Chapman and Hurst; engineers, Cazaly Associates. Left centre: Federated Co-operatives Ltd warehouse, Winnipeg; architects, Smith Carter Searle Associates.

Left bottom: *"Beautiful and Cheap."* Royal Canadian Yacht Club, Toronto; engineers, Cazaly Associates.

Below: *"Precast concrete is too costly to design.* 67 beams frame onto each main column of this building. There were 72 shop drawings and a 30 ft strip of erection sketches on a $100,000 job." Grosvenor House, Winnipeg; architects, Libling, Michener & Associates; engineers, Cazaly Associates.

KALEN

Unlike earlier attempts elsewhere, the Canadian handbook is not based on a "standardize at all costs" motive. It is being produced at this time because the industry has matured enough to sort out the known from the unknown and, to offer recommendations which have at least a moderate content of experience. It is hoped that as a result the orthodox will improve in quality and decrease in cost leaving the more adventurous of our society free to experiment and develop new ideas.

MODULAR DESIGNS WILL SOON BE UPON US

At least 80 per cent of our houses, apartments, commercial and public buildings contain no more than a basic architectural content. There is no harm in this, for a city in which all buildings vie with each other for originality would be as sickly as a diet of hors d'oeuvres. The trend throughout the world is towards planning in the large rather than the small and it seems almost certain that, as in other branches of technology, the average building will be made of low cost, good quality, standard components with a limited number of optional extras while in between, acting as focal points, will be the more expensive work of a few good architects.

Standard products have already been developed in the mechanical, electrical, and finishing branches of the building trade. The only reason why structural work has not gone the way of all industry has been because of its low unit cost and its high weight. Bulk materials cannot be shipped competitively more than a few hundred miles and this leads to decentralization. With modern communications, however, people and plans can be shipped more easily than goods. With the large building material suppliers taking a growing interest in the precast industry it is only a matter of time before factory "chains" are supplying the same designs on a national basis. These designs will not be individually produced, of course. By spending hundreds of thousands of dollars on production and field research the combine of the future will offer far better value for money than even the most skilled individual can today. But, in return the purchaser will have to choose from the options offered.

OUR EDUCATIONAL STANDARDS ARE IMPROVING

The other day I was reading a book about the mid-Victorians and the thing that impressed me most was that not only did the 50 or so educated scientists in England all know each other but that they also knew most of the 300 or 400 educated people in Europe.

In less than a hundred years we have built machinery for turning out such scientists by the thousands. There is no problem in technology today that cannot be answered — it is simply a question of priority, money, and time.

Of all the building materials concrete is the one most controllable by the designer. The strength, the shape, the colour, and texture can all be varied with a very small investment in construction equipment. In spite of the tendencies towards standardization there is still tremendous scope for the individual engineer — but if the design is going to be a step forward the design has to be good. Fortunately Canadian education, if not the best in the world, is better than most and young Canadian engineers are much better trained than their fathers. There is every chance that they will make major advances in the concrete industry in the future.

THE POTENTIAL ECONOMY OF CONCRETE IS UNLIMITED

Most modern building materials require a high degree of refining and chemical conversion. Concrete on the other hand is simply broken bits of the earth's crust bonded with baked bits of the earth's crust. For reinforcement prestressed concrete uses high tensile steel — the tensile material giving the most force per dollar. The basic materials, before mixing and assembling are worth less than $10 per ton. They presently sell, finished and in place, for $50 to $100 per ton. The difference in cost is the cost of people and moving equipment. With better designing, manufacturing, and marketing procedures much of this difference can be eliminated.

ARCHITECTS MIGHT CHANGE THEIR FEE STRUCTURE

Architects are becoming purchasing agents and specification writers. They should be free to recommend the purchase of a completely engineered package on one hand or the retention of a first class special consultant on the other. In either case all costs should be paid by the owner. It is the owner who benefits and it is unbusinesslike and unethical for the architect to be charged with the duty of financing the difference.

This is done in other countries and it works well for all parties. If something like this is not done then "package deal" supply houses will take over and the architect will become a subconsultant. I, for one, would consider it a sad thing for our culture if this were to happen.

The "pioneer" phase of the precast industry, when every job was news, has been left behind. We are now in the "critical" phase, when everyone knows that a solution is possible but seeks the method of making that solution the best.

Because of the freedom offered by precast concrete the industry makes a range of products from the automatically produced concrete block to the individually sculpted bas-relief panel. In the past the bulk of this work had been done on the basis of a manufacturer recommending a limited number of standards which the consulting engineer used in his own "design": a nineteenth century concept based on the assumption that consultants are educated and manufacturers are not.

The future will probably show a decrease in this compromise. Mass produced designs will be done by the manufacturers, at a cost exceeding the average consultant's lifetime income. Individual designs will be works of art, as good or as bad as their creator. In either case the purchaser should get more for his money and we, in the profession, should find a deeper satisfaction and delight.

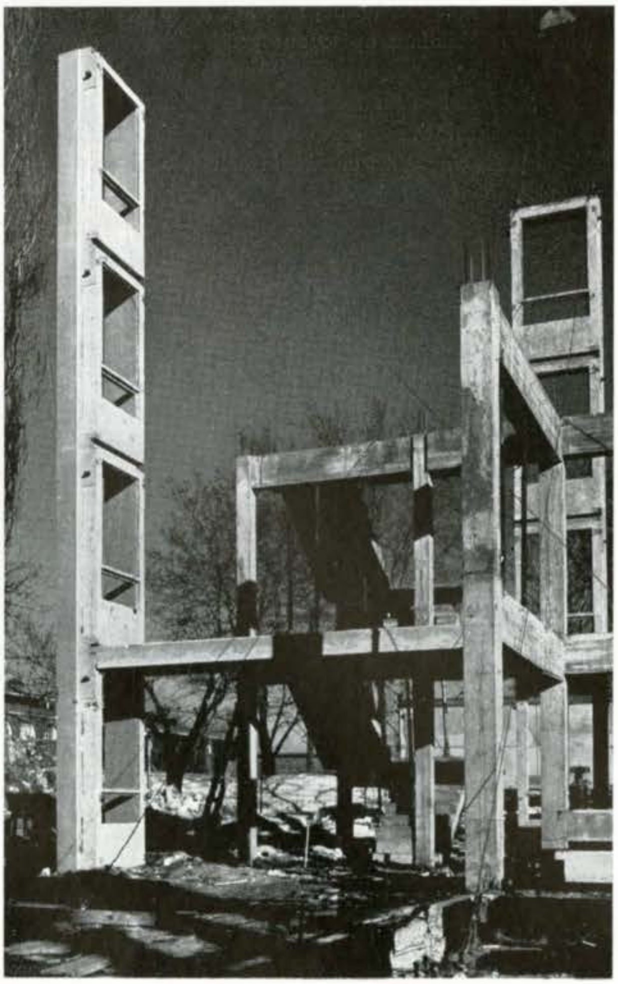
If this prophecy cannot yet be demonstrated, the point on which it is founded can. The structural engineer has tremendous control over the cost of precast concrete and its usefulness to the purchaser. This allows him to wield a stick much bigger than his slide rule. It will be interesting to see what changes he and his stick will make in the years to come.

PRECAST CONCRETE
PAST · PRESENT · FUTURE

BY KAI HOLBEK

Kai Holbek graduated from the University in Copenhagen with a Masters degree in Structural Engineering (1942). After wartime service and up to 1948 he worked in England in the construction of chemical plants, and continued with the Construction Division of American Cyanamid out of New York until 1950, and out of Toronto until 1952 in the same field. After working for four years as chief engineer with Murray Associates, along with Harry Lay, he launched Standard Prestressed Structures Limited and served as president. In 1961 S.P.S. obtained the Schokbeton licence for Canada and began operations as Schokbeton Quebec Inc. Kai Holbek is one of the founding members of the Canadian Prestressed Concrete Institute and served as its first president. He is a registered engineer in New York State, Ontario, and Quebec, a member of the Engineering Institute of Canada and the American Concrete Institute.

Residence Building, Loyola College, Montreal. Webb & Menkes, architects.



For the purpose of this article discussion will be limited to plant manufactured concrete elements that are used as part of a building whether for structural, architectural, ornamental, or a combination of these purposes.

The precast industry is so new that very little can be said of its past, but its rather impressive showing in the last few years may well call for a review of its present stage and (without trying to predict its future) the examination of the reasons for its growth and the factors which will influence its future.

The following reflections are written by an engineer who happened to get into the precast industry practically from its birth, in this country, but who has often been baffled by specific developments which did not make sense from a purely engineering or production point of view; who was influenced by architectural trends or by a combination of such secondary causes as construction practices, trade union rules, government regulations and tax rulings, building code rules or lack of same, the economic conditions, the financial structure of the industry, transportation developments, climatic conditions, or the zest and zeal of a few pioneering individuals, either in the designing field or, more likely, in the production industry.

Precast concrete came to this continent from Europe where it grew from a small pre-war industry of such items as sills, lintels, and paving slabs to its dominating position today where, in some respects, it is well ahead of the North American usage. Reasons for this growth are a combination of the following factors:

1. The high level of engineering skill utilizing materials to their limits and in turn developing ever increasing standards of quality.
2. An ability by the industry to turn improvements in materials and design into economically feasible units.
3. The ability of precasting to make concrete work an all-year industry while eliminating payment of premiums for poured in place concrete during the winter.
4. An increase in government research, partly to help winter works, and partly to promote a high percentage of native products in ample supply.
5. Specific developments, such as prestressing and the use of light weight materials.
6. A high level of research and promotion by the cement industry, specifically tailored to advance the precasting technique.
7. A growing understanding of the product and its possibilities by the architectural profession.
8. Some tangible steps towards standardization.
9. Design and application codes which have kept pace with the technological development of the product.
10. An expanding economy with a high level of construction activity.
11. A corresponding development in material handling equipment, facilitating the site erection of ever increasing sizes of concrete units.

The development of precast concrete in this country started somewhat differently and with little or no support from either the government or the cement industry, although this has recently changed for the better.

Early precasting, in the context of this paper, was in the form of mass production items like channel roof and floor

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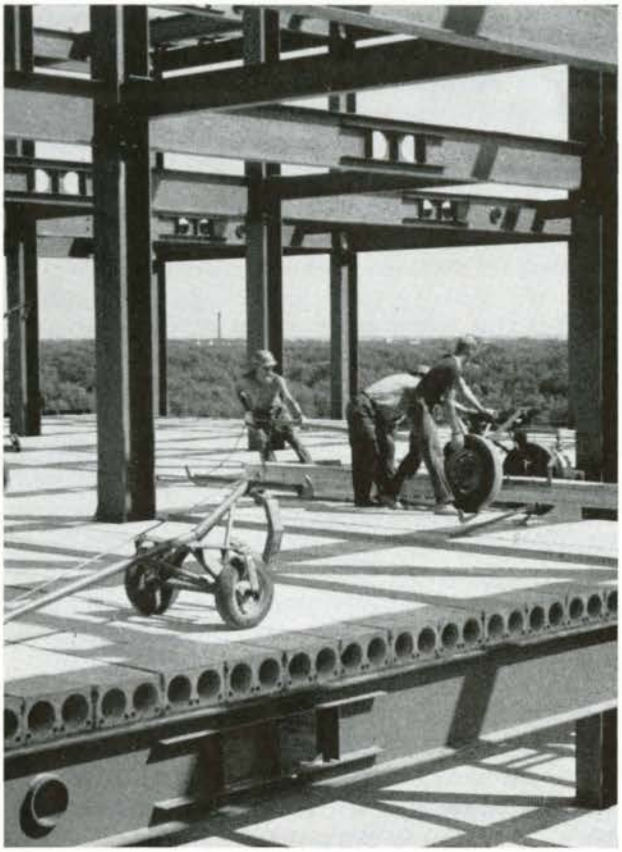

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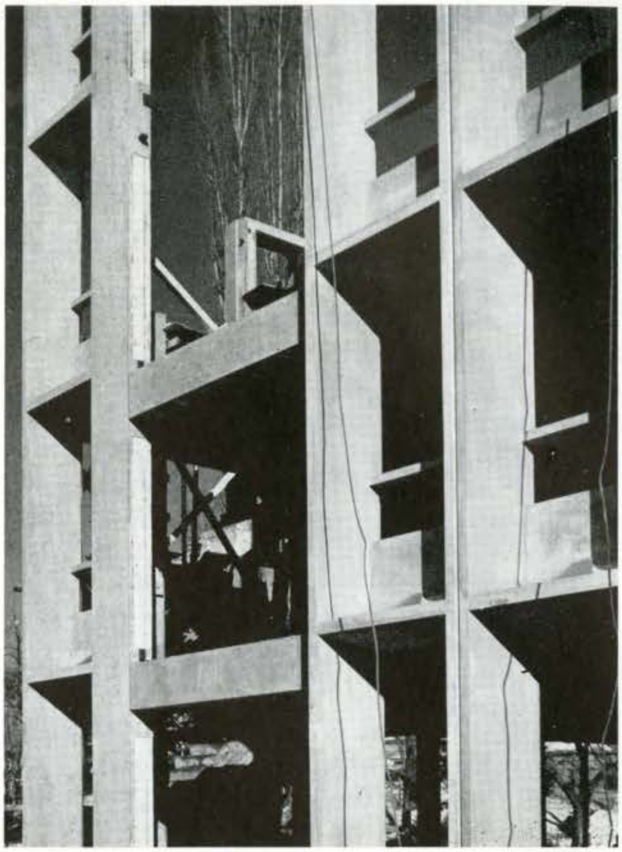


slabs and the cored flat roof or floor slabs called "Flexicore". Here Canada was neck-in-neck with the U.S.A. and Canadian pioneers like V. S. Murray and H. J. Hoseason saw the possibilities of using this product in combination with electrical services so that under-floor electrical wiring has become an accepted practice and other materials for floor construction have been forced to follow suit.

The group of people around pioneers like V. S. Murray in Toronto and Ken Paget in Calgary became the new disciples of the precast cult and were joined by the cast stone people who saw the architectural possibilities of the product. The Beer family of Toronto has developed this part of the industry to a status which today is setting a pace for the entire continent. The precast industry today has the following product range:

Precast, prestressed floor and roof slabs such as: (a) flat hollow slabs varying from 16 in. to 48 in. in width, with spans up to 30 ft; (b) double tees also called twin tees, wing slabs, etc. varying from 4 ft to 8 ft in width and from 12 in. to 24 in. in depth, giving spans up to 75 ft; (c) single tee slabs or lin tees varying in width from 8 ft up to the giant tees of 10 ft, in depths from 8 in. to 54 in., giving spans above 100 ft.

Precast beams and columns of all kinds covering one or multistorey buildings. In the case of the entire structure being precast height is normally limited to one-length columns or 60 ft. The beams are prestressed wherever loads or spans justify it.

Special shapes like precast folded slabs, arch members, frames, etc. whose only limitations lie in economic factors and the architect's imagination.

Concrete cladding ranging from normal flat panels, to more intricate panels, and to a complete concrete curtain wall.

Within these four broad groups we find most precast concrete products for buildings up to our present time. However, a quiet revolution is now taking place which will greatly influence the future of precast concrete and change its engineering aspect. This is the concept of making architectural concrete walls load-carrying, thus eliminating all columns and beams at facades.

A most striking example of this construction is in the new residences for Loyola College in Montreal, designed by Webb & Menkes, architects. Here a structural panel 5 ft wide, 25 in. deep, roughly channel shaped in cross-section, was cast in one piece through four stories or for a total height of 41 ft. This panel supports 5 ft wide precast channel slabs spanning from face to face of the building and also supports spandrel beams at each floor elevation to pick up brick in-fill between the concrete wall panels.

The wall panels weigh nine tons each and although the column section is approximately 6 in. by 25 in. the horizontal concrete mullion between a fixed and an operating window is only 3 in. by 5 in., cast as an integral part of the entire panel, with no shrinkage between this small section and the larger column section.

On the new Humanities Building for Laval University in Quebec, designed by architects Fiset & Deschamps, the concrete panels do not carry any floor loads but the six storeys of panels (65 ft) carry their own weight straight to the foundation walls with connections to the cast-in-place structure designed only to take horizontal loads.

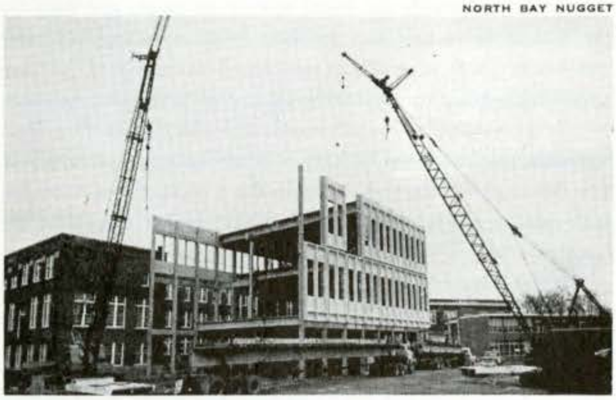
In the Algonquin Composite School in North Bay, designed by Gerald B. Cox, architect, 10 ft by 22 ft wall panels, each with four window openings, were designed and cast, as a truss

3

PAUL ST. PIERRE

NORTH BAY NUGGET

4



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1. Manitoba Telephone Administration Building, Winnipeg. Smith Carter Searle Associates, architects. Typical cellular floor on a steel frame.

2. Residence Building, Loyola College, Montreal. Webb & Menkes, architects.

3. Humanities Building, Laval University, Quebec. Fiset & Deschamps, architects.

4. Algonquin Composite School, North Bay. Gerald B. Cox, architect.

5. Arts Building, McGill University, Montreal. Affleck Desbarats Dimakopoulos Lebensold Sise, architects. (See p. 57.)

between precast columns (60 ft high) and supporting 72 ft prestressed concrete lin tees, from face to face with no interior columns.

Finally on the new Arts Building for McGill University by Affleck, Desbarats, Dimakopoulos, Lebensold, Sise, architects, full advantage is taken of precast concrete. A central core containing most service areas and carrying most of the mechanical floor is cast-in-place. On either side 20 ft special precast floor slabs span to the exterior walls consisting of 10 ft wide by 11 ft high precast panels. The panels have two window openings and only the centre mullion carries a load. At the vertical joint between panels only a 7 in. concrete skin covers the space for mechanical services. Panels thus cantilever from the central mullion and this has been emphasized in the architectural features of the wall. Here this construction is used for seven storeys in a nine storey building but could easily be extended beyond this height.

The central core is designed to carry all horizontal loads allowing connections between walls of precast slabs to be of a simple hinge construction type. Only the vertical loads require careful attention to joint details in order to close tolerances in execution rather than the complications in the design.

This particular design has an added feature, important from an overall construction schedule, and this is the reasonable division of the cast-in-place volume to the precast one, enabling the precaster to execute his manufacturing contract while the contractor is casting the central core. The solution keeps site casting away from delicate finished wall panels, avoiding any staining of these during construction.

The four Canadian examples above were designed for the Schokbeton process and all but the McGill building have now been executed by the first Schokbeton plant in Canada, located near Montreal. The general contract for the McGill building has just been let and construction should start soon.

This latest development, described in the above examples, is now being followed by several in the Toronto area (either in the design stage or under construction) and many more will be seen all over the country in the years to come. This development will not eliminate any of the products listed in the four product groups above, but will gradually erase the borders between the items as we manage to make the elements do double and triple duty in a future building design and open the way to completely new design features which will equally test the skill of the designer and producer with results in buildings well removed from the "flat-chested" look which Frank Lloyd Wright detested in the post-war construction boom.

As an example of this extra duty the panels on the Laval University job vary in depth from 12 in. to 36 in., partly for architectural reasons and partly to eliminate direct sunshine on any windows or glass units, resulting in very marked savings in air-conditioning costs.

As for the future, let us again review what will influence it. The factors mentioned in the beginning of this paper will apply in varying degrees and a producer can only guess at the influx of new unknown factors which always crop up to change the best development plans by the manufacturing plants. Architectural and engineering skill is now taxing the production plants to their capacity, forcing them to use a high percentage of highly skilled engineers. Before long the more advanced firms may have architects on their staff as is now often the case in Europe.

Europe is today ahead of North America in two major aspects of the precasting industry. In discussing those two aspects I will bring out some of the factors influencing the future of the precasting industry here.

THE HOUSE AND APARTMENT BUILDING FIELD

The house building field has practically been untouched by the precaster on this continent. This is partly due to a customer resistance to radical changes in their houses, other than in the gadget field; partly due to the good supply of reasonably priced lumber; and finally but not least, due to the individuality of this segment of the building industry where a multitude of small and medium sized builders cater to a highly speculative market making standardization of building units and reasonable planning almost impossible.

In northern Europe nearly all houses are architect designed and ample use of prefabrication has been possible without resulting in the look-alike appearance which consumers normally associate with perfabrication. The Canadian consumer buys a house which differs only in orientation and colour from his neighbours and considers it the "safest". This is a viewpoint which has some justification in Canada where over 20 per cent of the house owning population moves every year against an estimated 5 per cent in the Scandinavian countries. There, with the intention of staying in it for life, a man builds a house subject to codes and regulations which would make a Canadian shout about personal liberties but which raise the standards, especially concerning fireproofing, well above the average home here.

So at least one producer thinks very little of the local housing market for precasting and this, to a great extent, includes the apartment field as well. Great emphasis on speculative features makes all research and promotion by the industry or individual firms a risky affair at best.

The exception may be the slum clearance and rebuilding of blighted city centres in the future but this field in North America is tied up in local politics, again making research and promotion unattractive for the producer.

Refinement of the precast field in apartment construction in Europe, where entire units are shipped to the job site complete with electrical and mechanical services down to venetian blinds in the windows and curtain racks on the walls, is, in the author's opinion, due to the following factors.

1. In Europe most prefabricating firms have greater volumes and markets. Only the leading, big firms are in this field and considerable research has been undertaken by them.

In Canada we hope the industry will soon be big enough to do some research on its own, either by individual firms or through its organization, The Canadian Prestressed Concrete Institute, which has now made a small start by preparing a comprehensive handbook covering most aspects of structural concrete — a valuable tool for the designing architect or engineer.

2. Those firms, in Europe, doing the research have apparently managed to maintain highly refined resulting products due to rigid specifications by the architects, even when this has meant splitting up the specifications to suit the varying degrees of quality required. Often several precasting firms are on the same job with the top firms supplying the more difficult and close tolerance products which they can safely guarantee from an economical and engineering point of view, while the more standardized materials are open to a series of smaller firms specializing in the particular items.

This is a particularly difficult point in Canada today where most contract awards are based strictly on price, and only by the specifications can the architect have some control over quality. In most government sponsored or approved jobs no provision is made for protection against unqualified contractors — often a sore point with the score of leading precasting firms across the country. Together they handle 90 per cent of sales, and presales engineering, and maintain the personnel necessary for high quality control. Naturally they have higher costs than the multitude of additional firms bidding on most jobs today.

On the other hand quite a few products do not require the high quality maintained by the leading firms and a solution to this problem might lie in more realistic specifications only demanding the ultimate in quality when really necessary. This places a heavy burden on the architect, but maybe the industry could help by developing plant and product standards of varying classifications and not "over-selling" the architects on a higher quality than the project or the client demands.

3. In Europe precasting firms have gone into general contracting where a subcontract of precasting might otherwise be from 25 to 75 per cent of the overall construction cost or the general contractors have established their own precasting firms.

With the deeply entrenched subcontractor to contractor relations in Canada this is not too likely to happen although the temptation for the general contractor to intervene in this business is increasing. The subcontractor, in turn, may want to defend himself against the resulting pressure.

Another solution, already in use by some architects, is to allocate precast contracts (for a specific sum) and a chosen firm to the general contractor at the bidding stage. The architect's selection is based upon his own special tender call between the approved suppliers or an independent bid depository.

A recent trend in the industry which would discourage the European practice is the acquisition of quite a few independent concrete product firms by larger firms supplying the industry, notably the cement industry. This is a unique Canadian development which has no parallel in the U.S.A., although, there too, every year the industry is consolidating with more plants but fewer firms. It is too early to predict what influence this development will have but it should strengthen the industry.

4. In Europe special handling equipment at the site, such as travelling tower cranes and huge gantry cranes, have been developed to speed erection and in many cases specially designed transport trailers have also been used.

After a slow start in Canada tower cranes are now commonly in use. If the best of them can be combined with the mobility of the normal truck crane (as already in evidence) we may soon surpass the European technique.

5. Contracts with housing authorities or private building societies have been large or repetitive in Europe.

This condition is difficult to forecast in Canada and with apartment building being so highly competitive it is not likely to be realized for some time to come.

6. Finish of exposed concrete, in Europe, has not been called for in the top range of aggregates. Perfection in the uniformity of colour and texture has normally been limited to either one or the other and in most cases only to texture allowing some variation in colour, thus enabling the producer to mainly use grey cement.

There is now, in Canada, a strong trend among architects to consider finish and aggregates as an overall pattern of the exposed concrete structure rather than as a "dressing-up" for a facade. This will undoubtedly help the industry to reach a more realistic approach to costs and to produce more "honest" concrete structures.

7. A better understanding of the precasting technique in Europe has been resulting in a high percentage of repetitive units with special conditions being solved around the standard units. Other considerations are subordinated to this philosophy.

Here the industry has a big job to do in clarifying these points to the designing architects and engineers. A good start is being made.

As an example, on the Laval University job, the architect extended his desire to break up the formed panel facades (in some places) with plain flat panels. He solved all the special conditions, like stairwells, corners, expansion joints, entrances, etc. by using simple flat panels which resulted in a design where the formed panels are basically out of four standard molds. Additional molds were the concern of production and erection time rather than design requirements.

At present the future of the precasting industry looks very bright with full advantage of the unlimited forms yet to come. Basic design improvements are well under way; we are approaching a better understanding, among both designers and producers, that architectural concrete and structural concrete are not two different products but basically one. This should take place without compromising either the structural efficiency of the material or its most alluring quality which is basically that of remaining a piece of concrete not to be covered up with other materials. There should be no apologies for its requiring a direct relationship between load and shape.

For a producer, who today must also be a designer, it is often frustrating to have to take into consideration (in promotion and bidding) the restrictions which modern society imposes. Sales taxes vary from province to province and the new federal sales tax may undo what the industry and the National Research Council have accomplished in improving the qualities of concrete and helping make the industry an all season industry. The problem of trade unions has also held back development by jurisdictional disputes at the sites and by restrictive seniority clauses making proper training difficult and expensive. However, as the industry is coming of age there is now hope of a more realistic approach by the unions. They may eventually form special unions or locals for the special skills required by the industry. The requirement of a high degree of workmanship is one of the industry's major selling points and must be stressed if the full advantages of combining architectural and structural concrete are to be realized. Automation can never erase this factor. However, the main difficulties listed are man-made and should therefore be soluble.

If he seems to have an over-confidence in his products and its potential, is the producer not justified in this confidence. It is based upon his advances in design and technology generally; his industry, within little more than a decade, has developed from a humble start to its standing today. Practically all its design criteria on qualities have doubled or even tripled in this decade.

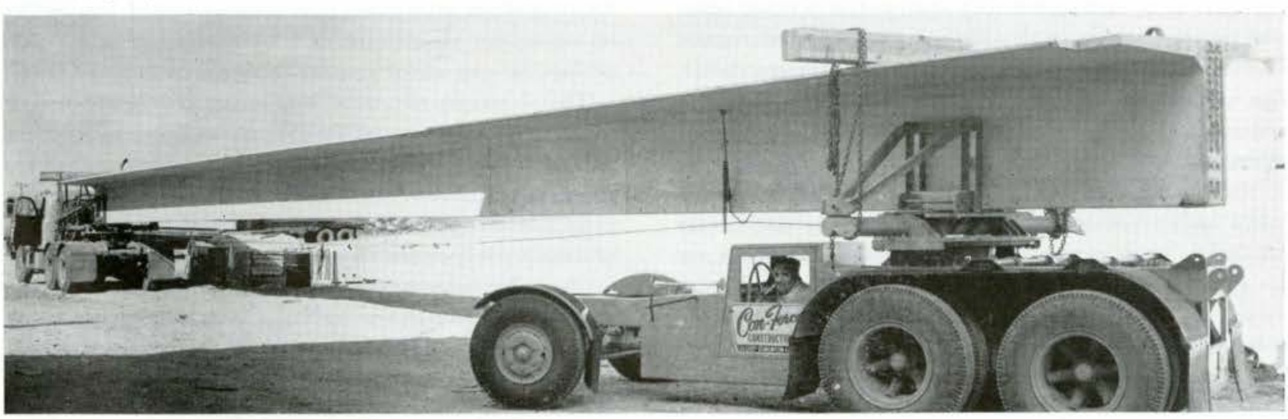
The Schokbeton process is today one of the top producers of high quality concrete cast with only a small percentage of excess water beyond what is necessary for hydration and consequently practically eliminates shrinkage and its problems. The process, with no increase in normal cement content, produces strength in the order of 10,000 p.s.i. and densities resulting in water absorption factors from one to two per cent.

Other techniques are obtaining these results and exciting new prospects are developing. By combining the basic ingredients of concrete with new materials to reach still higher goals or by extending concrete to fields where it may do a better job itself or in combination with other materials such as improved plastics, metals, etc. further advances the industry.

Is it strange then that the concrete producer today, if he ever has time to pause and reflect a little on such matters, can be carried away with these possibilities and can begin to think of concrete as the material which can do nearly everything.

A rear steering dolly.

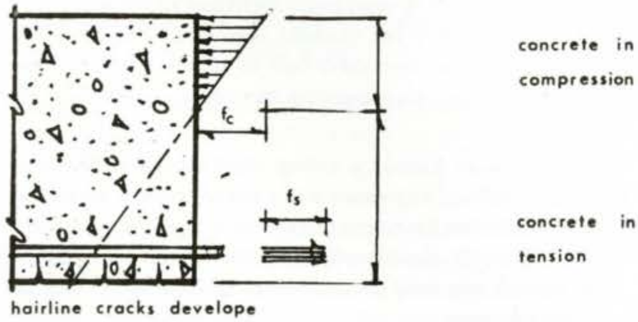
CON-FORCE



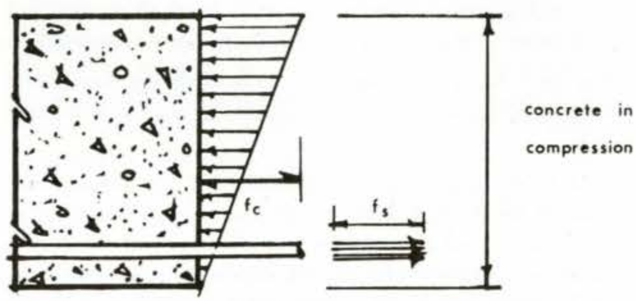
BETTER PRECAST CONCRETE

BY KEN GIDDINGS

Ken Giddings graduated from the University in Manchester receiving a Bachelor of Science degree (1951). He is manager of technical services for Precon Murray Limited and has been with the firm since its conception. The design details of the National Trust building in Toronto, the Science Building at Loyola College, and the Health and Welfare building in Ottawa are recent achievements in his capacity with precast concrete. Mr. Giddings is a member of the Engineering Institute of Canada and the American Society of Civil Engineers.



NORMAL REINFORCED CONCRETE



PRESTRESSED CONCRETE AT WORKING LOAD

Today many architects and engineers accept precast and prestressed concrete as worthy construction materials. There is a growing realization that they are much more than mere substitutes for cast-in-place reinforced concrete. Their properties are significantly different and the designer, whether an architect or engineer, must understand and appreciate these properties if he is to obtain the maximum benefit from the new materials.

In reinforced concrete, tensile stresses occur and have to be carried by the reinforcing steel. Large quantities of low strength steel have to be used so that only small strains develop, otherwise severe and unacceptable cracking will occur in the concrete. Prestressed concrete is compressed concrete and under the design loadings will not suffer tensile stresses. Consequently small amounts of high quality steel can be used with high quality concrete.

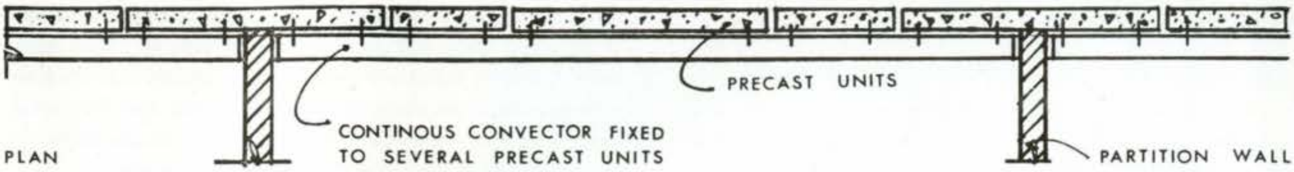
This is not just an improved form of reinforced concrete — it is a new kind of concrete. It allows designers to plan slender cantilevers which cannot deflect because the resultant forces are axial. Similarly, extremely long beams can be made with parabolically draped prestressed cables. These cables try to shorten themselves and in doing so exert an upward thrust which counters vertical dead and live loads — a property not present in reinforced concrete. Also, prestressed concrete resists the development of cracks and so damage caused by moisture is much reduced.

Precast, reinforced, or prestressed concrete, properly cured, is not subject to cracking from shrinkage as the major portion of the shrinkage occurs before the unit is restrained by its fixings. The ill effects of creep are reduced considerably by precasting.

Precast concrete made in a factory is substantially better in all common properties than site concrete; sufficiently so to qualify for recognition in building code provisions. And last, but by no means least, precast concrete is independent of the weather, perhaps its most useful property in a country such as Canada.

The advantages mentioned here imply some of the reasons for the very rapid growth in the precast-prestressed concrete industry in the last decade. However, this surging growth has pointed out a number of problems which require the attention of architects, engineers, and manufacturers if the full potential of these marvellous materials is to be realized.

The writer belongs with the manufacturers and would like to direct his comments to architects because he believes they can effect a material improvement in the quality of precast concrete with little extra effort on their part and therefore must play a leading role in overcoming all problems. This direction



of comment should not be construed as indicating that manufacturers have no troubles. They are well aware of their weaknesses and shortcomings and know they must overcome them if they are to prosper. Moreover, if you are tempted to say "That is a manufacturer's problem, too", we will not deny it for you are likely to be right.

DESIGN STAGE

In all projects, the architect is deeply concerned with the quality of goods, workmanship, economy, and timing — this is true whatever materials are used. What is not so evidently appreciated is that perhaps 90 per cent or more of the success, or lack of success, of a precast or prestressed project lies in the hands of the architect when he conceives and initiates the preliminary design.

Good detailing, manufacturing, and erection will not ward off the trouble in store for the architect responsible for a poorly conceived and planned project. Too often we see buildings, conceived in the mould of brick or stone, titivated with precast concrete. This is a poor use of precast concrete and generates little enthusiasm for this material.

A well conceived and planned precast structure will reflect the characteristics that are peculiar to this material and show a high degree of co-ordination between the architect and structural engineer. Placing philosophy aside, there are in the design stage many small ways in which an architect denies himself top quality precast concrete.

One shortcoming, which is too wide-spread amongst architects for any to feel that this doesn't really refer to them, is their illogical habit of agreeing that casting and erection tolerances are necessary, while a point is reached in their design layout where they have ignored this fact of life. A not uncommon example of this kind of error by omission is the use of a one-piece convector shield across the back of two or more precast wall panels framing separate window openings. The individual window frames can be attached to the panels with little difficulty but a straight convector shield made to a close linear tolerance is not going to mate intimately with four or five separately made and erected surfaces no matter how much will-power the architect exerts.

This ostrich like retreat from the truth allows the architect to approve shop drawings of all trades in the blithe hope that all will be well. Then comes the pain of the harsh reality of the site conditions and, against his strongest feelings, he knows he must accept a make-shift alignment repair.

The moral of this story is that in today's mechanized construction industry all fixtures and fittings must be arranged to absorb the manufacturing and erection tolerances of the preceding trade. In the case of precast wall panels, the preceding work is often a poured frame and it has been agreed that an impossible situation would occur if the panel fixings were not adjustable to the vagaries of site poured frames.

Another failing in the design stage is caused by a lack of understanding that large, flat, and nearly flat, plate-like units such as precast wall or floor panels are subject to some warpage. Such warpage is common in all materials formed in extended thin sections, even though the reasons for the warpage may vary from one material to another. Some exposed aggregate panels warp and when they do the panel is always convex on the exposed aggregate face. The bow, or displacement, seldom exceeds 1/360 of the span on even the largest units and, of itself, is neither troublesome during erection, nor does it read in the finished structure.

However, if the architect is not aware of this tendency, and draws the lips of metal sills or mullions tight against the outside face of the long precast units, there will be an erection problem for the men installing the sills. Additional lateral restraints can be used to reduce the warpage but a certain remedy is to allow a small space between the lip of the sill and the outer face of the panel. At the middle of the span this space may be reduced by the bend in the panel but it would still be possible for the sills to be installed straight and true (within their own tolerances) and this adjustment space would not read afterwards.

There are other design weaknesses, mainly omissions, but the two described above illustrate the need for the thorough preparation of contract drawings and attention to the limitations of precast units.

Perfection is beyond our collective grasp and so is not significant. What is fundamental to good precast design is a thorough knowledge and understanding of the acceptable degree of imperfection consistent with the real needs of the project and the capabilities of reputable precast manufacturers. Tolerances closer than normal should be imposed only when a high degree of accuracy is an essential part of the design for it is likely to increase the cost of the project. On the other hand, and within reason, it is good practice to widen the allowable tolerances where no harm can be done.

SPECIFICATIONS

Specifications can be a breeding ground for poor quality precast work. The honest, hard-working specifiication writer is required to know everything and trust no one in his search for a fool-proof way of calling a contract. He deserves praise for the excellent job he does with his unrewarding and never-ending task.

We can ease his burden in the area dealing with precast by realizing that the precast industry is a service industry.

The tools of the trade are available to all. Anyone can buy sand, cement, and stones and mix them with water to make concrete! What the architect actually gets from a reputable manufacturer is a capable and experienced staff, skilled craftsmen and labour, joined by long experience in the art and science of making good concrete.

It follows that architects should learn all they can about the manufacturers, their plant facilities, the quality of their staff and workers, their experience, knowledge and reputation. They should qualify acceptable precast suppliers on this basis, taking into account the type and scope of the units they produce.

In this way the specification writer can name only the suppliers you will allow to bid on your precast work, secure in the knowledge that unacceptable standards are locked out. This practice is being followed, by some of the larger architectural firms, with success, leading to improved performance without loss of the competitive factor. A secondary, but no less pleasing, benefit is obtained as many of the descriptive and weasel clauses can be dropped from the specification, saving time and tears.

PRODUCTION

At this time the architect's role in quality control is that of an observer. For the majority of projects this role of observer is delegated to an independent testing company which reports directly to the architect. The testing company acts as a watch dog to see that the terms of the specifications and contract drawings are met.

The routine is necessary, but the approach is a negative one. The most unfortunate result of this system is that the testing company learns a great deal about precast concrete and the architects learn nothing. Worse still, the valuable experience gained by the testing company is wasted because, by its very nature, the testing company looks for business in all materials and is not keen to advance the merits of one material over another. Had the architect gained this experience it could have been put to use in the design of his next precast project.

At this stage of development, in the use of precast, architects should take every opportunity to visit the manufacturer's plants, particularly when one of their own jobs is being made. There is so much they can learn that is not in any textbook.

The writer's company employs full time inspectors who report directly to the plant manager and are held personally responsible for the quality of our products. They check the set-up of forms, reinforcing assemblies, insert and fixing locations, vibration of concrete, finishing, etc. and an inspection tag follows each unit through the various stages of production. This tag provides a record of the inspection activities, the state of the unit, and enables us to trace any faults to their source.

A visitor can see wood, steel and concrete forms in use, and can discuss their pros and cons with the plant superintendent. For many projects, steel forms are ruled out because they cannot be designed, made, and delivered in good time by a steel fabricator. Concrete forms are available to a precast manufacturer whenever he needs them (he makes his own) and they avoid many problems associated with wood. Good concrete forms are rigid, accurate, long-lasting, sturdy, and inexpensive.

Parallel faces in a shaped, precast unit lock it into the form, which has to be collapsed before the unit can be extracted. Tapered faces allow the unit to be lifted out of a rigid form. Less labour in the preparation of the form and in the handling of the units lowers the cost and produces fewer damaged edges. The rigid form is cheaper and better.

All production activities can be viewed, reviewed, understood, appreciated, and remembered simply by visiting the plants.

ERECTION

"The proof of a good precast design is in the erection". In the production stage the architect is an observer and as the building goes up he sees how well he and his engineer did their jobs.

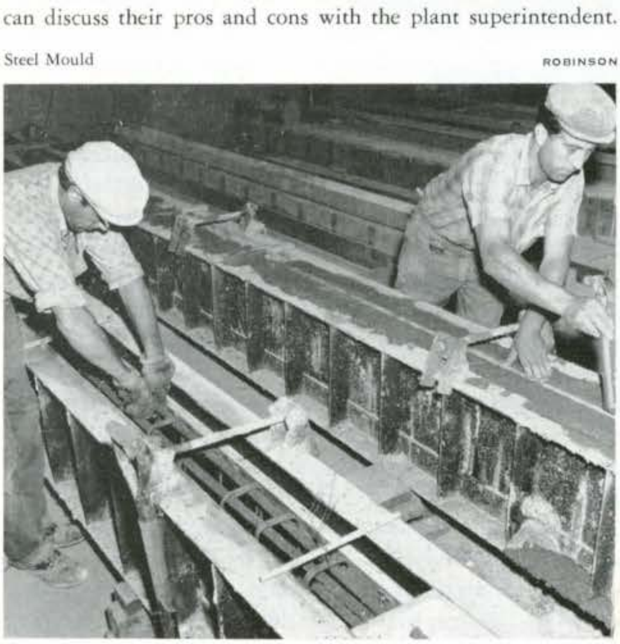
If the precast design is effective, the units will be erected quickly with little fuss and no damage. The architect can gauge the efficiency and thoroughness of the erection crew, who usually are employees of the manufacturer.

In the early stages of erection of precast columns, particularly those two or more storeys high, adequate bracing is essential. If the bracing is insufficient, wrongly set, or removed too soon units may fail, crack, warp, or twist. Poorly braced units can pose a difficult alignment problem and may be dangerous.

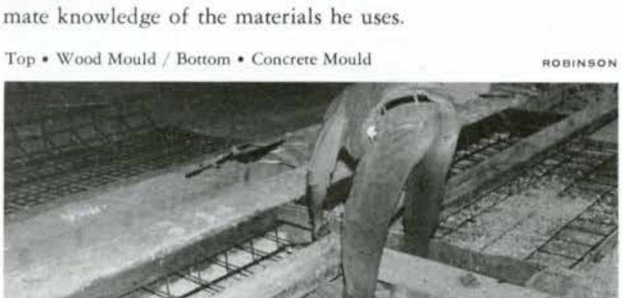
The architect can note the condition of the precast units as they arrive on site. Damaged units are likely to indicate poor packing or careless haulage. If the precast units are long or slender, the haul is one of their most severe tests.

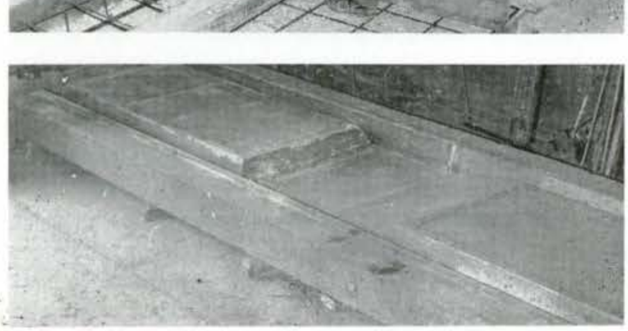
The writer has laboured over some points and ignored many others in his attempt to illustrate the architect's role in quality control of precast concrete. In truth, all the parties concerned in a contract share the responsibility for quality control but the architect, by virtue of his seniority, has a special responsibilty to client and contractor. He must know what he wants and recognize what he is getting. To do this he needs to have an intimate knowledge of the materials he uses.

Steel Mould ROBINSON

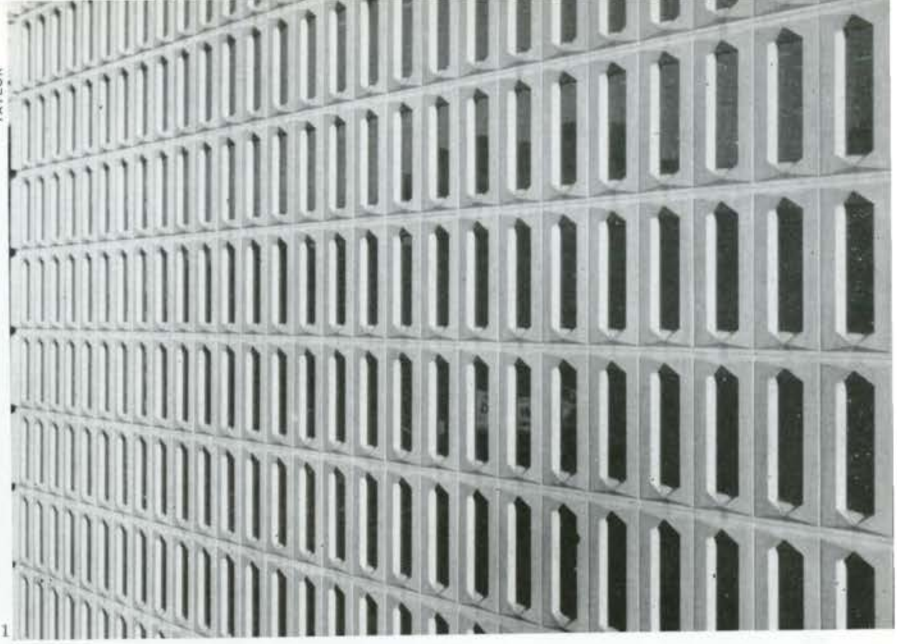


Top • Wood Mould / Bottom • Concrete Mould ROBINSON





TAYLOR



1

1. Royal Trust Building, Ottawa; architects, the Architects' Collaborative; partner in charge of design, James Strutt.

2. Norman Wade Building, Pointe Claire, P.Q.; architects, Affleck, Desbarats, Dimakopoulos, Lebensold, Sise; partner in charge of design, Dimitri Dimakopoulos. The beams (63 ft. 6 in. long) are precast post-tensioned single Ts.

3. The Airport Inn, Richmond, B.C.; architects, Thompson Berwick & Pratt. The precast concrete mural by George Norris is 10 ft. by 20 ft. and consists of a quartz aggregate in concrete mix.

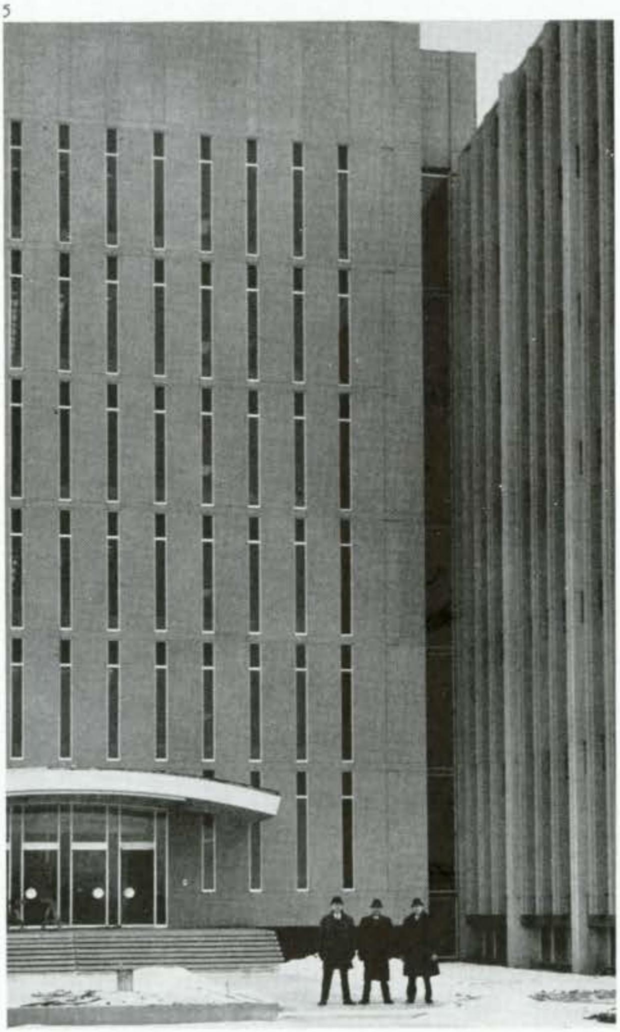
2

3

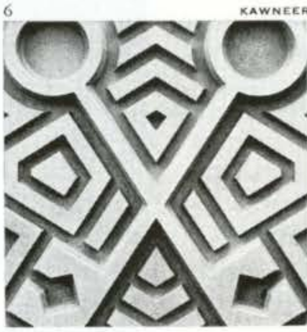
PULLAN

4 NEWTON

5



6 KAWNEER 7 CAZALY



4. Ontario Region Office Building for Imperial Oil Limited, Don Mills, Ontario; architects and engineers, John B. Parkin Associates. View from south-east.

5. Manitoba Telephone Administration Building, Winnipeg; architects, Smith Carter Searle Associates. South elevation.

6. Decorative panel. 7. Acceptance testing. 8. Norman Wade Building. (2).

9. School of Architecture, University of Manitoba, Winnipeg; architects, Smith Carter Searle Associates. West elevation.

10. Wawanesa Insurance Building, Edmonton; architects, Annett & Bettorf. Precast bearing walls and clear span single T slabs.

11. Transportation of a 140 ft long precast post-tensioned girder.

8

CANADIAN

BUILDING DIGEST

DIVISION OF BUILDING RESEARCH • NATIONAL RESEARCH COUNCIL CANADA

THERMAL BRIDGES IN BUILDINGS

by W. P. Brown and A. G. Wilson

UDC 697.133

Walls and roofs designed today often incorporate details that have a lower resistance to heat flow than the main construction. In general, these details are thermally weak because high-conductivity structural elements project partly or wholly through materials of lower conductivity; in this Digest they are referred to as "thermal bridges."

Thermal bridges can seriously interfere with the performance of buildings. The temperature of the inside surface over a thermal bridge is lower than that of the adjacent construction during the heating season, and may even be lower than that of double glazing; consequently, it may be impossible to maintain the desired relative humidity without surface condensation (CBD 42). The difference in the temperature gradient through the bridge and adjacent construction will cause thermal stressing that may result in structural damage. The corresponding exterior surface temperature over a thermal bridge is higher than that over the adjacent wall. This can result in increased wetting of the wall by melting of wind-driven snow, thereby increasing the possibility of damage on subsequent freezing. Thermal bridges result in higher building heat losses, although this is not usually regarded of itself as a major problem. In designing a curtain wall to meet a specified maximum over-all heat transmission requirement, however, thermal bridges at structural ties and joints are usually the major obstacle. The lower surface temperatures over thermal bridges can also lead to dust marking.

Thermal bridges are often formed by steel or concrete beams and columns incorporated in exterior wall or roof construction. Insulation applied to the interior surface of a wall is bridged by floor slabs and partitions; if these project on the exterior of the wall they form "fins," which provide a large surface exposure area for heat loss. Metal ties in cavity walls are another type of thermal bridge commonly found in masonry construction. Serious problems may also occur at metal window frames and sash (CBD 4) and at metal curtain wall mullions, which either partially or completely bridge the wall and often present a fin exposed to the outside.

Problems with thermal bridges can be readily overcome where insulation is placed over the entire exterior of a building, enclosing all structural elements and excluding only a rainscreen cladding (CBD 40), which requires a minimum of structural support. In most conventional construction, however, many thermally weak configurations occur. To provide a basis for recognizing and minimizing the problems presented by thermal bridges, this Digest will deal with a few examples and illustrate factors that influence their thermal performance.

Analysis of Thermal Bridges

Figure 1 represents a dense concrete structural member (thermal conductivity, k, of 12 Btu per (hour) (sq ft) (°F per in.)) that bridges a lightweight concrete wall ($k = 2.4$), except for the interior plaster coating. The temperature gradients through the structural member and through the adjacent wall have been calculated on the basis of one-dimensional heat flow, as outlined in CBD 36; that is, it is assumed that there is no interchange of heat

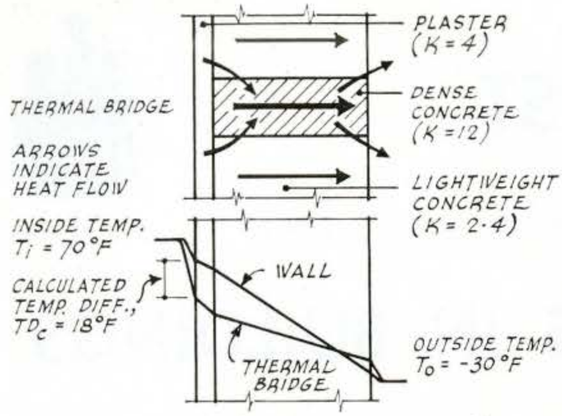


Figure 1 — Calculated temperature gradients.

between the member and the adjacent wall. For a 100°F temperature difference between inside and outside air there is a calculated difference in temperature between the inside surface over the thermal bridge and that of the adjacent wall (TD_c) of 18°F. It will be noted that the bridge is colder than the wall toward the inside and warmer than the wall toward the outside; heat must flow, therefore, from the wall to the bridge on the warm side and from the bridge to the wall on the cold side (see arrows). The calculation, however, does not take account of this lateral heat flow and thus there is an error in the calculated temperatures.

In Figure 2 the measured inside surface temperature pattern for the construction in Figure 1 is given for two widths of the struc-

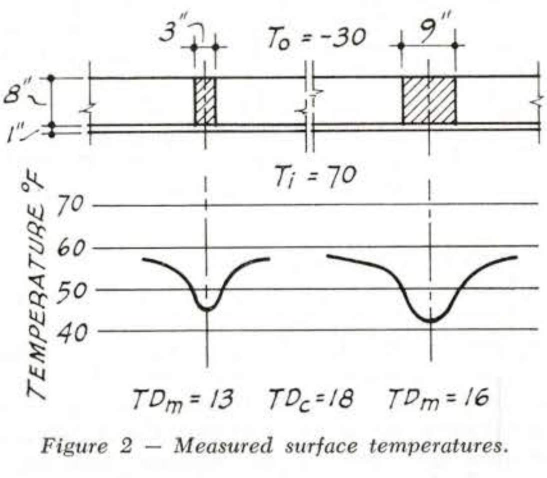


Figure 2 — Measured surface temperatures.

tural member. Also given in each case is the difference between the inside surface temperature over the wall, measured remote from the bridge (equal to the calculated value), and the minimum inside surface temperature measured over the bridge. This difference is designated as TD_m. Values are again based on an over-all temperature difference of 100°F. Values of TD_m or TD_c for any other over-all temperature difference will be in direct proportion.

It may be noted that TD_m is less than TD_c for both widths of member, and that TD_m approaches TD_c as the width increases. This is a result of the lateral heat flow taking place between the structural member and the surrounding wall; toward the inner side (of the wall) this warms the structural member and cools the adjacent wall. If the member is narrow the lateral heat flow may be enough to maintain the surface temperature considerably above the temperature predicted by simple theory. If the member is wide, however, the lateral heat flow does not extend to its centre and the actual minimum surface temperature approaches the value predicted by one-dimensional heat flow theory. With this type of bridge actual surface temperatures are warmer than those predicted by simple theory.

Insulation is sometimes placed over thermal bridges to increase inside surface temperatures, but its effectiveness will depend on how it is applied. Figure 3a shows thermal bridges similar to those of Figure 2, with insulation just covering the inner surface of the members to a thickness that will ensure the same calculated U-value at the member as that of the rest of the wall. In such a case $TD_c = 0$, but measurements show that $TD_m = 8$ for the narrow bridge and $TD_m = 13$ for the wide bridge. With insulation placed in a similar way on the outer surface of the members (Figure 3b) $TD_m = 14$ for both. Insulation thus placed is not very effective in raising the minimum surface temperatures, although the (surface) temperature patterns are altered.

If insulation is placed on the inside, the structural members are colder than those in the uninsulated case, and toward the inside there is greater lateral heat flow into the member from the adjacent wall. Minimum surface temperatures thus occur on the wall adjacent to the member, and the temperature over the member is increased. With insulation on the outside, lateral heat flow out of the member into the adjacent wall (in the outer part of the wall) largely nullifies the effect of the insulation.

With insulation extended on both sides of the members by the width of the member (Figures 3c and 3d) the surface temperatures are improved appreciably, particularly for in-

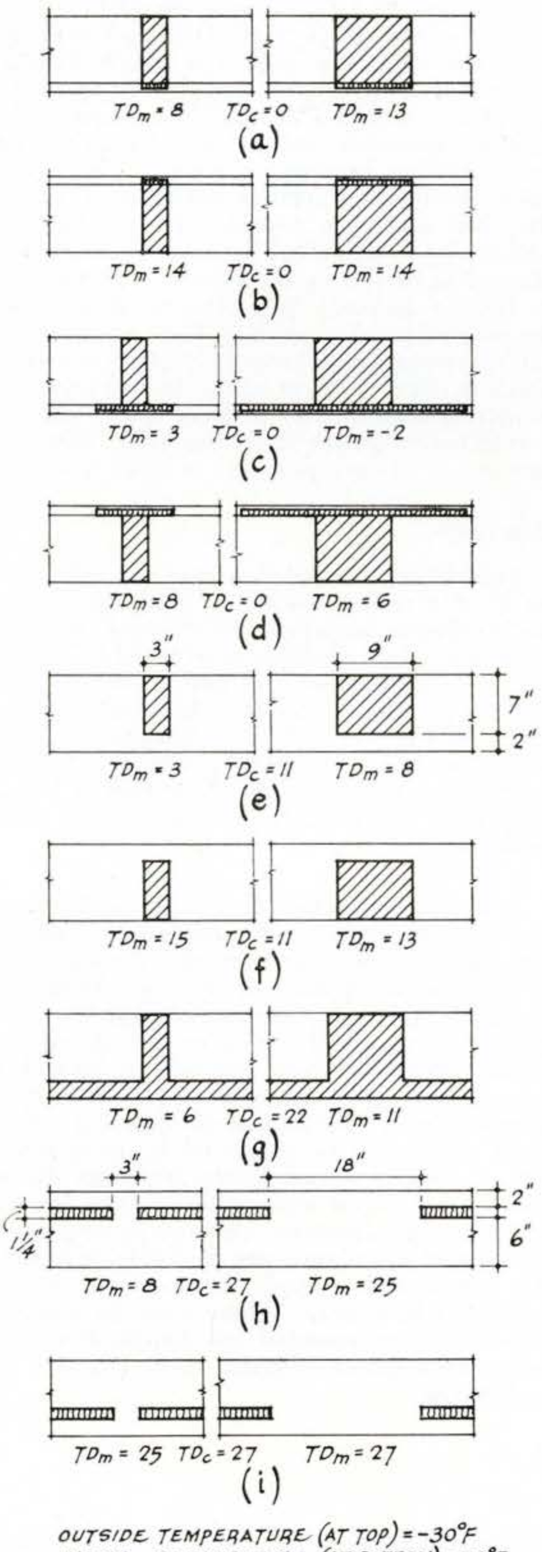


Figure 3 – Surface temperature characteristics of thermal bridges.

terior insulation. The negative value of TD_m indicates that the surface over the bridge is warmer than the surface of the wall. To reduce TD_m to zero, using exterior insulation, would require that the insulation overlap the members by a considerable amount. It will be noted that with the insulated members the actual inside surface temperatures can be lower than those given by one-dimensional heat flow calculations (TD_m is greater than TD_c), in contrast with the results for the thermal bridges in Figure 2.

With partial thermal bridges in masonry, where the structural members do not extend through the wall completely, the wall material between the member and the wall surface acts in part as insulation. With the member placed toward the outside (Figure 3e) lateral heat flow in the wall material on the warm side raises the surface temperature over the bridge and TD_m is less than TD_c. In contrast, with the structural member placed toward the inside (Figure 3f) the surface of the bridge is colder and TD_m is larger than TD_c, as it is with exterior insulation.

It now becomes clear that one means of improving surface temperatures over a thermal bridge is to induce lateral heat flow on the warm side of the wall into the region of the bridge. The thermal bridges of Figure 3g are similar to those of Figure 2, except that the plaster coating has been replaced by 2 inches of dense concrete; TD_m is less, even though TD_c is greater.

A further example of the effect of lateral heat flow on surface temperature distribution is given in Figures 3h and 3i. These illustrate a panel consisting of two concrete slabs ($k=12$) with foamed polystyrene insulation between ($k = 0.24$); examples of two widths of joint are given. The TD_c value for the panel is high because the U-value of the section at the joint is much higher than that at the insulation. With a narrow joint, however, actual surface temperature variations are greatly reduced by lateral heat flow from the heavy slab on the warm side of the insulation into the joint (Figure 3h). This lateral heat flow does not extend far enough into the wider joint to alter significantly the temperatures at the centre. If the slabs are reversed so that the narrow slab is on the inside (Figure 3i), lateral heat flow in the inner slab is greatly reduced and that in the outer slab correspondingly increased. This has the effect of lowering the surface temperatures over the joints.

The webs in hollow and insulated concrete blocks and the ties in cavity brick walls or in metal curtain walls are thermal bridges similar to the joints in insulated concrete panels. In most cases the temperatures over such bridges are considerably warmer than those predicted by simple theory, because of lateral heat flow in the interior slab or skin.

Thermal weaknesses often occur at wall-floor or wall-partition intersections. Figure 4a represents a heavy concrete slab intersecting an exterior wall of lightweight masonry. Thermal properties of the materials are the same as those in Figure 2. This will be recognized as similar to the partial thermal bridge of Figure 3f, but with the bridge extended into the building. There is a drop in the wall surface temperature toward the corner, giving a TD_m value of 9 compared with 13 for the partial bridge. With the slab extended to the outside of the wall the TD_m value is 11.

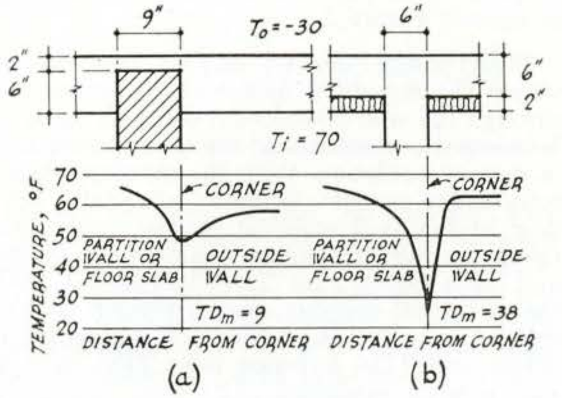


Figure 4 — Surface temperatures at floors and partitions.

The wall temperature pattern at the intersection of exterior walls and partitions will be distorted even if the partition does not extend into the wall. This is due in part to the reduced air convection in the corner that lowers the surface temperature there. It is also due to the influence of the partition on heat flow into that part of the wall that it covers. If the partition is of low conductivity (lightweight masonry) it will reduce heat transfer into the wall and this, combined with the reduced air convection, may cause a significant lowering of the wall surface temperatures at the corner.

In Figure 4b a heavy concrete slab ($k = 9$) bridges insulation ($k = 0.22$) placed over the inner surface of the wall. The temperature at the corner is greatly reduced in relation to the rest of the exterior wall and TD_m is very large. This is a situation that makes it impossible for many modern insulated masonry buildings to carry the level of relative humidity of which they are otherwise capable. The problem is further aggravated if the floor slab or partition is allowed to project on the exterior, for example, to form a balcony slab. The fin formed by the projection increases heat loss from the wall and correspondingly lowers inside surface temperature. The problem might be overcome by insulating both interior surfaces of the slab for a sufficient distance from the wall, although this is not always practical or even possible.

Conclusion

Application of insulation over the entire exterior of a wall provides an ideal solution to the problems presented by thermal bridges. Although a light cladding is required to protect the wall, the number and size of the supporting ties that pass through the insulation are small. These ties will be attached to large high-conducting structural members located inside the insulation, and there should be no significant effect on the inside surface temperatures.

It should be stressed that many of the thermal bridges occurring in present-day construction can be avoided, or their effects minimized, if they are recognized in the early stages of design. Simple one-dimensional heat flow calculations will greatly assist in identifying potential problems from thermal bridges, but temperature values so obtained can be in considerable error. Judgement in applying calculated values can be improved by comparison with measured values where available. Those used in this Digest were obtained from French and Norwegian sources. Although more precise methods of calculation are available, it is usually impractical to apply them except in very simple configurations. Where accurate temperature data are essential for complicated sections, appropriate thermal tests should be undertaken.

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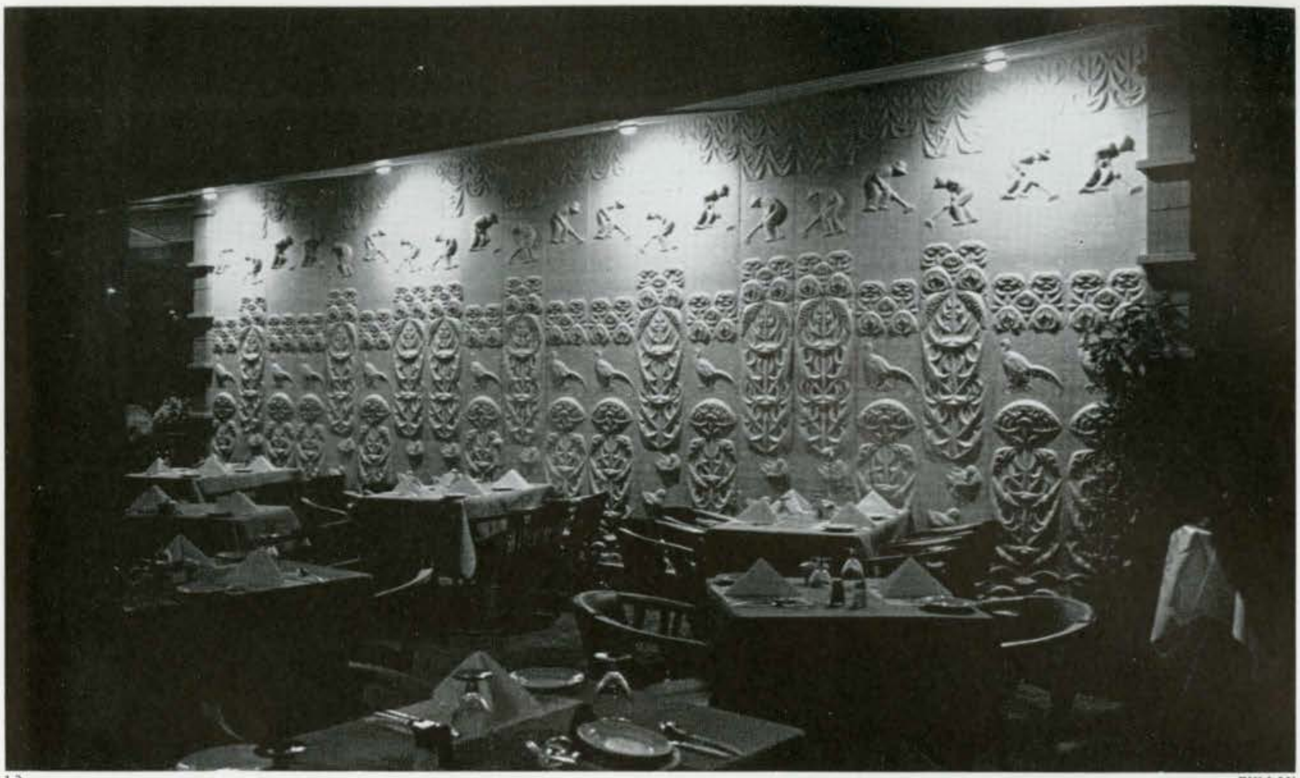
9 KALEN

10 PROCTOR

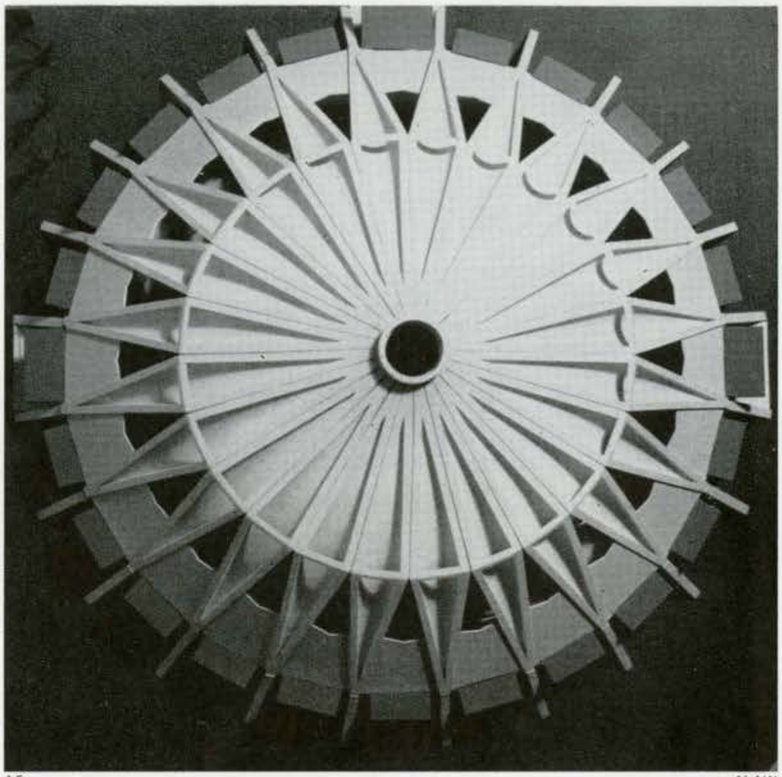
11 CON-FORCE



12 PULLAN

13 KORAB

KALB'S 14



15 ALAIN

12. Airport Inn mural by George Norris showing the variety in two repetitive panels.

13. University of Saskatchewan, Regina Campus; architects, Minoru Yamasaki & Associates; project architects, Izumi Arnott & Sugiyama. Model of stage one showing classroom buildings of precast columns and spandrels.

14. Residence building, Loyola College, Montreal; architects, Webb & Menkes. Stage showing precast bearing walls with brick infill panels on spandrel beams.

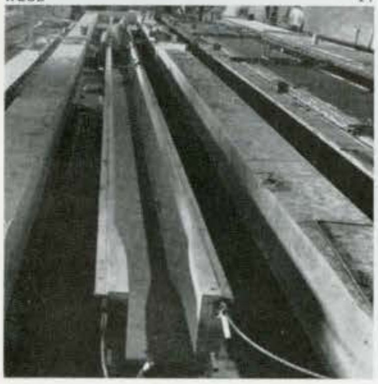
15. Church building for the Roman Catholic parish of St. Barbara, LaSalle, P.Q.; architect, John Bird. Site plan of project showing precast, thin sheel units.

16, 17. Forming the precast spandrels and columns for the Regina Campus buildings.

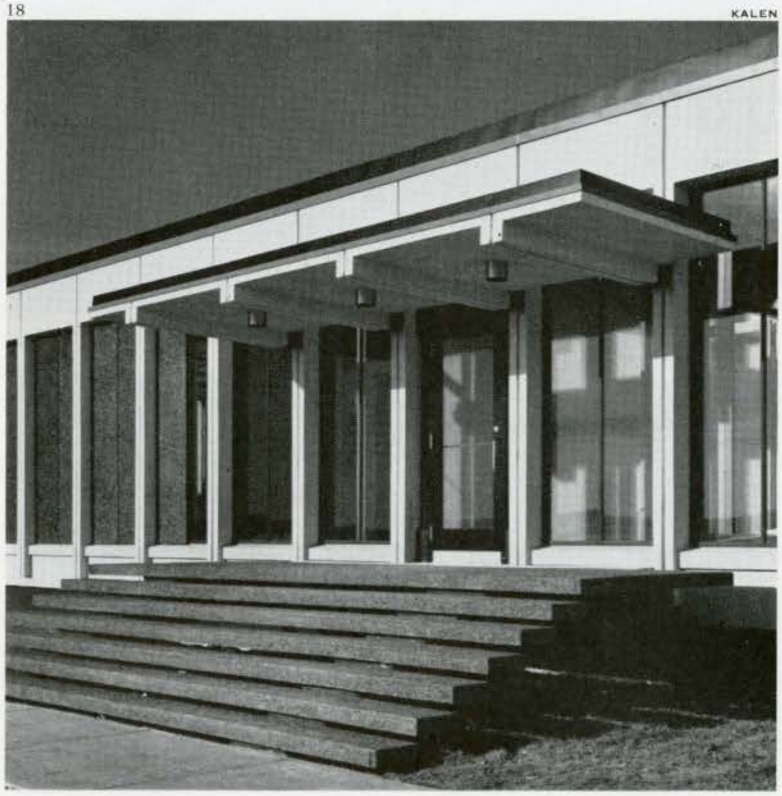
18. Head office building for the architects, Smith Carter Searle Associates, Winnipeg.

WEBB 16

WEBB 17



18 KALEN



MATHIESON 19

20 ZUKOWSKI

19. Happy Valley Swimming Pool, Calgary; architects, G. R. Beatson and Associates. 115 foot Lin Ts.

20. Simpson-Sears building, Halifax; architect, C. A. Fowler & Co. Precast units of 29 ft by 4 ft attached directly to the structural steel frame.

21, 22. Foothills Aviation Hangar, Calgary; architects, Craig and Broake. 5 feet deep by 10 feet wide prestressed folded plate 125 foot span roof slabs cast in three pieces, post-tensioned in the field.

23. Killarney Community Centre, Vancouver; architects, Mercer and Mercer. Decorative diaphragms are cast on the ends of the 50 foot and 100 foot T roof beams eliminating separate facia units.

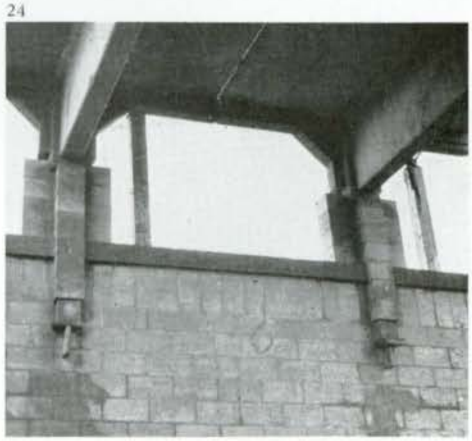
24. Detail, Killarney Community Centre, Vancouver.

MATHIESON 21

MATHIESON 22

23 WILLIAMS

24



THE EVOLUTION OF PRECAST CONCRETE

BY JAMES STANNERS

James Stanners graduated from the University of Toronto with a Bachelor of Science degree in Civil Engineering (1943). He has worked with John Inglis Co. Ltd. as process engineer, and the London Steel Construction, the Hydro Electric Power Commission of Ontario, C.D. Carruthers & Wallace, and A.D. Margison & Associates as a structural designer. In 1955 Mr. Stanners joined the staff of Shore & Moffat & Partners as chief structural engineer and in 1962 was appointed partner in charge of structural engineering. He is a registered engineer in Ontario and Saskatchewan, a member of the Engineering Institute of Canada, the American Concrete Institute, the Committee on Concrete Specifiications of S.W.A.C., the C.S.A. Committee on Concrete Materials and Construction, and the Committee on Welding of the Canadian Institute of Steel Construction.

"I am deeply convinced, and this conviction is strengthened by a critical appraisal of the most significant architectural work of the past, as well as of the present, that the outward appearance of a good building cannot, and must not, be anything but the visible expression of an efficient structural or constructional reality. In other words, form must be the necessary result, and not the initial basis, of structure. Constructional complications, or designs that require structural acrobatics, are always a sign of false structural concept — even to the untrained eye of the non-technical observer." *Pier Luigi Nervi*

In order to understand what this means in relation to the construction of modern buildings we must take a brief look at the past. In ancient history we find the Egyptian and Greek post and lintel stone temples followed by the Roman masonry arches and domes and subsequently the Gothic vaults of the Middle Ages, all good examples of exposed structural forms. At the turn of this century there was a progression from masonry vault construction to the modern steel and concrete frame with its glass or masonry skin.

Within the last decade however, there has been a marked tendency to return to the expressed or exposed structural architecture in timber, steel, and reinforced concrete. The most promising of these exposed construction forms is certainly reinforced concrete and three Twentieth Century developments in concrete production have consequently had, and are having, a radical effect on architecture. The first is concrete shell construction; the second, precast concrete construction; and the third, prestressed concrete. These three systems are being used and do, in fact, exemplify modern structural architecture.

From the viewpoint of a consultant who designs and supervises the construction of buildings, no material has made such rapid advances in the last ten years as precast concrete.

The use of precast concrete was preceded by a tremendous advancement in cast-in-place concrete structures, specifically the multi-storey structures which in a short time grew from six to sixty storeys. However, the greatly expanded use of concrete in all types of structures very soon reached the stage where economy and competitiveness could only be coped with through mass production in factories. The natural solution to the problem was precast concrete sections. The 1950's may in fact well be referred to as the first decade in the evolution of precast concrete construction. At this time precast concrete rose from a meagre beginning as "imitation stone" lintels and window sills to become the principal framework and cladding of many outstanding buildings. The superior hard durable surface of precast concrete has been accepted by architects as a finished surface both on the exterior and interior of many types of buildings, and the development of exposed aggregate and other special surface treatments has given precast concrete a range and versatility beyond that of any single building material. It also follows that exposed concrete buildings give ample freedom for architectural and structural solutions.

The cause of such a rapid evolution in the use of precast concrete is significant. Since the close of the Second World War cyclic building booms have been occurring throughout the world. In order to meet accelerated construction schedules and yet maintain reasonable economy it was essential that, wherever possible, the maximum use of local materials and prefabrication be employed. Since the ingredients of concrete are universal and the cost of a precast concrete fabricating shop is comparatively inexpensive, it was not surprising to find precast concrete plants springing up in all parts of the world. There is no doubt that the world-wide shortage of structural steel during the early 1950's gave precast concrete its opportunity to seriously enter the construction field. From that obscure beginning the evolution of precast concrete design appears to have progressed through three major stages.

Use as a substitute for structural steel and cast-in-place concrete frames.

Use as the principal structural framing system, sometimes in conjuction with non-bearing precast wall panels.

Use as the prime architectural structural system in the form of bearing wall panels.

MAX FLEET

Thomas A. Blakelock High School, Oakville, Ont. Shore & Moffat and Partners, architects.

U. OF W.

Arts Building, University of Waterloo, Waterloo, Ont. Shore & Moffat and Partners, architects.

Early in 1955 when we were involved in an extensive building programme of secondary schools, the problem of an available structural material became evident. Buildings were designed with alternative structural systems. Cast-in-place concrete was found to be undesirable mainly due to a lack of erection efficiency. When precast concrete was investigated as a structural system, Murray Associates were the only firm to consider the production of precast columns and beams. (Up to this time the only available forms were 20 ft. floor and roof slabs in channels and hollow core).

In 1955 the Thomas A. Blakelock High School in Oakville was designed incorporating precast columns, spandrels, and hollow core slabs using the exact dimensions of the available forms. Although used as a substitution material the precast framing system of the school was so successful that it was used similarily in many subsequent secondary and vocational schools.

At about this period the advent of the prestressing technique in precast concrete permitted the development of longer span floor units in the form of double Ts with spans of up to 40 ft. for average floor loadings and 50 ft. for roof construction.

In 1958 the first of a number of buildings for the new University of Waterloo were designed as fully precast concrete structures. The major requirements, by the University, for these buildings was speed of construction, a high degree of fire resistance, maximum flexibility for future installation of electrical and mechanical services through the floors, and durable interior surfaces with low maintenance. The Chemistry Building housed classrooms and laboratories totalling 50,000 sq. ft. in a three storey structure. The structure consisted of exterior columns and beams, and double T floor slabs, with a cast-in-place concrete "spine" centre corridor. All present members were exposed on the interior of the building which was constructed and occupied in seven months.

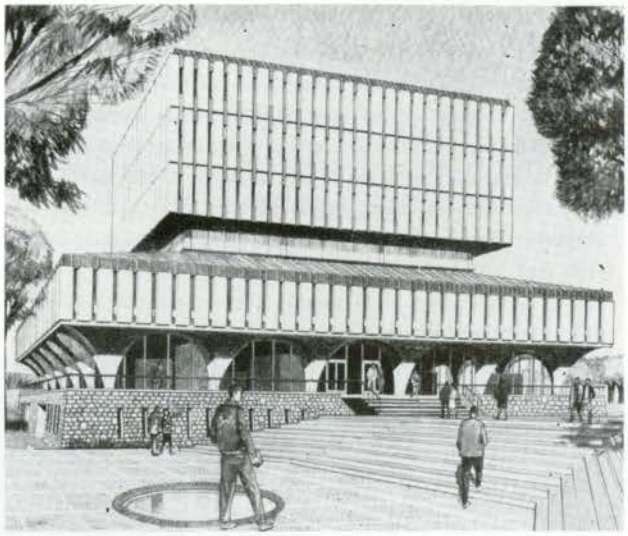
By 1960 it became apparent that the previous production restrictions on shapes and sizes of precast members were no longer in existance. The increase in production facility and versatility had undergone a phenomenal growth. A new giant in the standard precast section emerged in the form of the prestressed single-Ts which had span capabilities exceeding twice that of their predecessor, the double-T. The successful development of exposed aggregate surfaces resulted in the provision of an unlimited scope for texture and colour for permanent finishes. However, the most important development was in the advancement of production and erection techniques which signified the maturity of the precast industry as a cladding material.

In 1961 the Gordon E. Perdue High School in Oakville was constructed using precast concrete as a principal structural system. The precast frame consisted of columns, spandrels, and floor slabs all of which were exposed on the interior of the building. The exterior surfaces of all columns and spandrels were finished in a white dolomite exposed aggregate surface. Spans up to 42 ft. utilized prestressed single-T units. The roof of the double gymnasium consisted of 72 ft. long and 8 ft. wide prestressed single-Ts fully exposed, both interior and exterior, with inset windows accenting the end profile of the single-Ts.

One of the most difficult aspects of the use of precast concrete is the development of beam column connections. When the architect desires to expose the precast structural system as a composite part of the architectural design, the challenge to the structural engineer is not just one of designing structurally adequate connections, but also of providing connections which have a "good appearance". Where the joints are exposed to weather there is the additional problem of providing proper and permanent weatherproofing in the joint. It was in the Perdue High School that the architects decided to try a new solution to the question of joints. By increasing the width of the joint to approximately ⅜ of an inch more practical and efficient caulking was achieved, permitting an accent of the joint.

It was also during 1961 that the Arts Building for the University of Waterloo was designed utilizing a two storey precast column combined with the adjacent spandrel beams to form a cross. This reduced, by 50 per cent, the number of joints of spandrels to columns. Spandrel joints on either side of the column were replaced by a single joint at mid-span at the spandrel. The exposed surfaces were clad with integral form panels.

Research and Development Centre for the British American Oil Co. Ltd, Clarkson, Ont. Shore & Moffat and Partners, architects.



Arts Library project, University of Waterloo, Waterloo, Ont. Shore & Moffat and Partners, architects.

Designed in 1962, the British American Oil Company Limited's Research and Development Centre at Clarkson (a complex of four buildings) is presently under construction. It was in these buildings that the final step of the evolution in precasting was introduced by the use of load bearing panel walls. In the main building of the complex the bearing precast panel walls are two storeys high and are placed side by side for the full length of the building. The floor and roof slabs rest directly on the bearing panels and in the centre of the building rest on a cast-in-place concrete "spine". The exterior finish of the panels is made up of quartz aggregate. Window frames have been eliminated from the panels by the use of rubber gaskets into which the double glazing is installed. The installation of the rubber gasket is part of the precast contract and is installed at the plant. It has been our experience that when the complexity of the construction process is reduced and use made of maximum repetition the result is economical with the added possibility of a refinement of architectural details and freedom of form. It has now been established that if precast concrete is a combined architectural and structural unit, a system can be both aesthetically and technically successful, yet sufficiently economical.

There will be under construction this year two more buildings designed by Shore & Moffat for the University of Waterloo, namely, the Chemistry and Biology Building and the Arts Library Building. Both buildings make extensive use of precast concrete. The Arts Library Building, serving as the focal point for the entire campus complex, is designed as a ten storey building. The exterior of the main floor consists of cast-in-place concrete elliptical vaults with the main building facade of bearing precast concrete wall panels above.

The success of a precast concrete design has been so far ensured by complete and unreserved collaboration between architect and structural engineer. If the architect and structural engineer are to have a realistic approach to the design and construction they must maintain close liaison with the precast concrete industry itself. The successful alliance of the three specialists (architect, engineer, and precast contractor) is reflected in every creditable exposed precast concrete building.

Development of precast concrete as a building medium continues to depend on four important considerations: 1. structural adequacy; 2. architectural shape and appearance; 3. construction practicability; 4. economy.

The progressive development of the use of precast members depends largely on the development of a rational design of connection details which have been proven by tests and experience to be constructually practicable and economical. During the development of the various structural systems there has been the ever present problem of divising connections or joints for the material being used. In the case of wood, masonry, and metal the rate of development was directly affected by the invention of new and better connection details. In the case of cast-in-place concrete the monolithic nature of the material obviated the problem of devising ancilliary connections. In the precast concrete system the matter of connections is of paramount importance. Like its predecessors, the potential use of the precast concrete system is limited more by the lack of development of proper connection details than by any other single factor. In view of the increasing use of exposed precast concrete it is apparent that future considerations in precast connections will give particular emphasis to the appearance of the connection details. To date much of the precast concrete construction is, in fact, the post and lintel system and the connections are some form of a "bearing" support type.

In choosing the size, shape, texture, or colour of a unit, the architect must be guided by a full consideration of the structural adequacy as decided by the structural engineer and the fabrication and erection practicabilities as determined by the precast contractor. To realize success there must be a close tie with the architectural concept and construction reality in order to avoid the use of a non-traditional or formalistic innovation in structures which is not based on an appropriate or contemporary means of construction.

Two of the most important ingredients in any successful structural system are simplicity and repetition. These two ingredients are the essence of the precast concrete framing system.

COMMENTS ON PRECAST

M. S. YOLLES • ENGINEER • TORONTO

Designers in this country have rarely been bold in their use of precast concrete. The major application of this material has been in the use of standardized floor and roof units, custom curtain wall panels, and simple plane, one to three storey exterior frames for buildings such as schools. In the case of the standardized units, their use has been predicated primarily upon their cost competitiveness with other systems. However, precast curtain walls and simple precast frames have been used primarily because the architect prefers them. Precast concrete provides a wide opportunity for shaping, a variety of high quality finishes, and it is durable. Cost, always within limits of course, has been a secondary factor. In fact, more often than not cost comparisons with other systems are not made.

In other countries, particularly in Europe, precast concrete framing is more competitive; it provides a considerable saving in labour with the result that designers in these countries have generally been more ambitious with the material, using it in structures such as fully integrated multi-storey frames and in various shell forms and long span roofs. The work of Nervi is, of course, the outstanding example. We must face the fact that, with the present state of the industry, similar structures framed in precast concrete will almost invariably be more costly than his, but not generally exorbitantly so. It can be seen then, that the architect must make the decision, at the outset of the design, that precast concrete is the material he wishes to use because of its unique qualities. He must then be prepared to budget the choice of other portions of the building in order to keep the building within its allotted cost.

In designing with precast concrete the architect should also be prepared to devote the utmost care to meticulous planning and detailing. He should expect the highest degree of co-operation and co-ordination between himself and the structural and mechanical engineers and finally he will also require the necessary, careful job planning and co-ordination from the contractor.

C. A. E. FOWLER • ARCHITECT • HALIFAX

Precast concrete is, of course, an ancient material but most of us when we use the term today are referring to what is almost a new product and, based on improvements in production and handling, a product which is denser, stronger, more dimensionally stable, and available in far larger sizes with a variety of available treatments.

In the light of these improved qualities, the architect now has a reliable and very plastic medium to add to his design repertoire. As the techniques of production further improve to give greater consistency, which at present can only be obtained from certain limited sources, there should be increased freedom of design for modern structures incorporating precast concrete. When we consider that one of the new methods was reportedly discovered by a workman pushing a wheelbarrow along a bumpy road, and that promise is towards ever larger units which can potentially take over more and more of the skeleton and service functions of the buildings, we should recognize this material as a challenge to the architects, in making proper use of it, to improve design, economics, and basic service to clients.

It should be hoped that we are not in the process of moving from the glass box to a concrete box and that Canadian architects will have the maturity to absorb this technique to the ultimate benefit of our Canadian environment.

R. R. NICOLET • ENGINEER • LONGUEUIL, P.Q.

The rapid development of precast concrete technology is certainly one of the most manifest and significant indications of the evolution towards mechanization and standardization in the building industry. The ever increasing importance of concrete as a building material is largely due to the progress made by the precasting technique.

As a construction instrument, precast concrete has, in general, not yet been used in a manner imaginative enough to give full justice to its great potential. The difficulties inherent in the problem of developing properly detailed stress carrying joints between adjacent elements have often led to structural systems which are more akin to wood or steel than to the monolithic material which concrete essentially is, and should remain.

Except in cases where the price of formwork is a predominant factor in cost equation, precasting is often found to be of little advantage unless the controlled fabrication process, under plant conditions, can impart to the product certain particular physical characteristics which could not readily be obtained by conventional building techniques. The structural properties bestowed by the prestressing operation illustrate this point particularly well, as structural applications of precast concrete were largely expanded by the advance of prestressing.

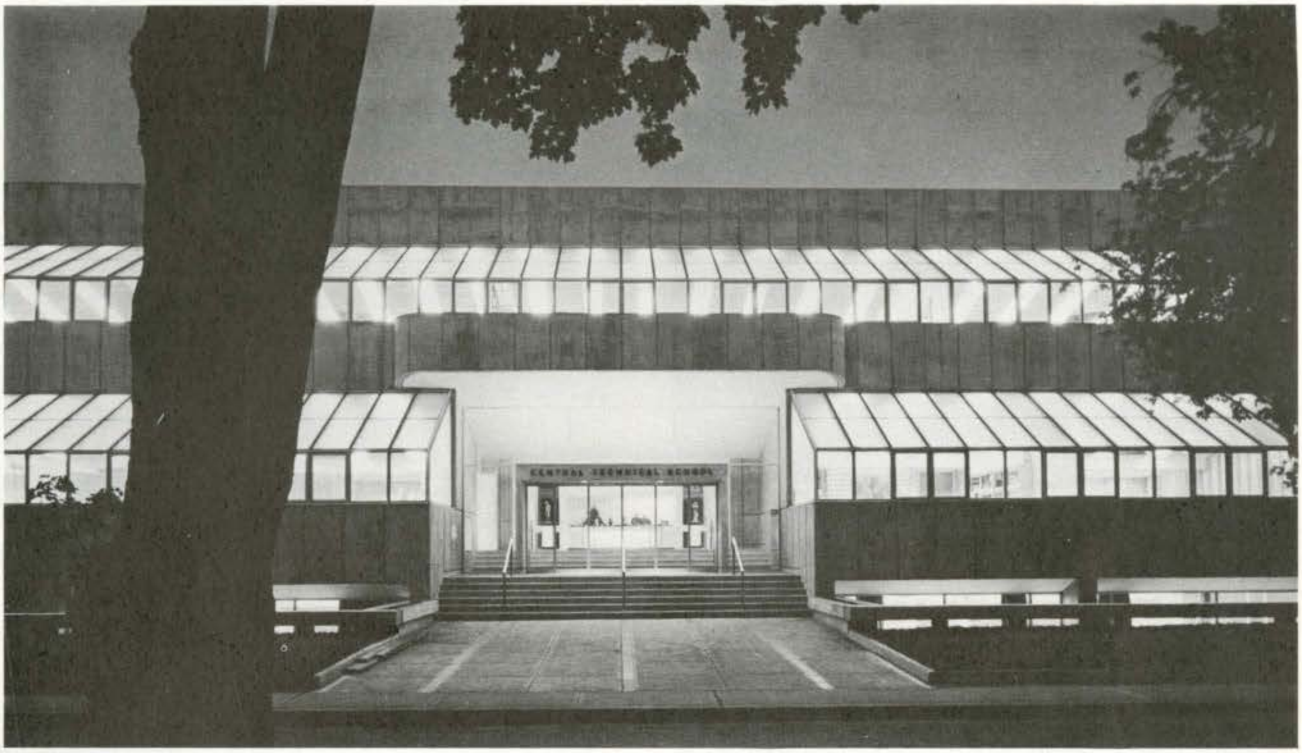
In future the true measure of the success of precasting as a construction technique will largely depend on the ability of the structural designer to reconcile modern industrial fabrication techniques with the evolution in architecture towards greater appreciation and expression of the strong monolithic and sculptural quality of concrete.

Office Building and Garage, Toronto; architect, D. M. Hall for H. G. Winton Ltd.

JOWETT

CENTRAL TECHNICAL SCHOOL ART CENTRE

ARCHITECTS — ROBERT FAIRFIELD ASSOCIATES • PROJECT ASSOCIATE — MACY DUBOIS • CHIEF ARCHITECT FOR THE BOARD OF EDUCATION — F. C. ETHERINGTON • INTERIORS — THE ARCHITECTS CONSULTING ENGINEERS • STRUCTURAL — H. B. TRYHORN • MECHANICAL — R. T. TAMBLYN & PARTNERS LIMITED • ELECTRICAL — G. E. MULVEY & COMPANY LIMITED • GENERAL CONTRACTOR BENNETT-PRATT LIMITED • OWNER — TORONTO BOARD OF EDUCATION



The art centre provides new teaching space for 360 day students and 700 night students previously housed in the original building. The structure is of reinforced concrete with each storey cantilevering over the one below.

AN APPRAISAL

BY PETER COLLINS

If the ultimate value of this building is to be assessed by whether or not it functions well (and one could hardly imagine a more important criterion), there can be little doubt that it is a very good building indeed. The system of natural lighting achieved by the cantilevered floors (whereby each studio ceiling is glazed across half of its surface) is extremely efficient; indeed, if anything it is too efficient, since there is now talk of controlling the excess of illumination by means of blinds or louvres. The circulation area, storage areas, and general disposition of rooms seems to leave nothing to be desired by the occupants. Only the professional critic, haunted — like most of his species — by an occupational obsession as to how the building fits into the historical sequence of modern design, will be moved to reflect at length on the building's other qualities; and such reflections will be motivated more by the habitual urge to compare new buildings with other buildings erected for similar purposes than by any intrinsic dissatisfaction with the new building as such.

There are two buildings with which the Central Technical School's art building obviously invites comparison, so that it seems an excellent opportunity to consider all three briefly together. The Glasgow School of Art immediately comes to mind for two reasons: firstly, because its plan form is very similar, and secondly, because in some ways it can be regarded as a prototype for this kind of edifice. The Harvard Visual Arts Center suggests itself because the influence of J. L. Sert (who supervised its construction) seems very obvious at Toronto, and indeed it is probably no indiscretion to assert that one of the architects principally concerned with this design was a pupil of Sert at the Harvard Graduate School of Design.

First, then, let us compare the Toronto School with the Glasgow School. Even on the most superficial inspection one is made immediately and refreshingly aware of the logic which governs both these buildings and gives them a compositional affinity. They fulfil the same functions in the same rational way, since in both instances the *parti* adopted is that of a long rectangular plan with a succession of studios on the north side. Moreover, in both instances, the lower floor projects beyond the floor above to permit partial glazing of each studio ceiling. Nevertheless, one also notices something less logical in both, namely a deliberate pursuit of asymmetry, on the exterior, of a kind which seems to have little justification with reference to the plan, and can best be explained by the fashionableness of asymmetrical facades.

The artificiality of this asymmetry is perhaps more marked in the Glasgow school than in the Toronto school, but in the latter it seems to have less aesthetic justification since here the building is an appendage to a formal dominant mass, namely the Central Technical School, besides which it stands. The architects of the new extension would doubtless argue that the asymmetrical form was dictated by facilities which could not otherwise be obtained in the planning; but it seems more than likely that an equally efficient building could have been produced with a completely symmetrical composition if such had been the architects' desire, and that this symmetry would have created a greater harmony between the old and the new.

A close comparison between the detailing of the Glasgow school and the Toronto school would be unfair, since despite a certain modish brutality in the treatment of the apertures of the former building, its details have a delicacy one naturally associates with the era of Art Nouveau. Nevertheless, the Toronto school seems to have been treated with even greater brutality than is usual in the 1960s, and this is particularly striking when one compares its surfaces with those of the Visual Arts Center at Harvard.

Such brutality can doubtless be justified, without recourse to accusations of Japanophilia, on the grounds that the building adjoins a structure built of fairly rough masonry. But it seems slightly artificial with respect to the technology employed, for on first inspection the walls seem to be of precast panels, so heavily have the "joints" been emphasized, whereas in fact they were all cast-in-place between smooth plywood forms, and the "joints" are simply the result of nailing fillets to the formwork. Moreover, the pattern of these "joints" does not seem to have been dictated by any profound or sensitive search for pleasing proportions (such as might have been imposed, for example, by recourse to some discipline such as Le Corbusier's "Modulor"), but according to a simple arithmetic sequence of subdivisions based on the total size of each plywood sheet.

In conclusion, therefore, it may be said that whilst this new building seems, in its general composition, to constitute a noble continuation of the healthy functionalist tradition exemplified by C. R. Mackintosh's Glasgow School of Art, it incorporates a number of artificial features, such as the trapezoidal cheeks terminating each floor slab, and the curved stairwells enclosing rectangular stairs, which seem less related to this tradition, whilst the deliberate brutality of the surfaces seems a retrograde development in comparison with the refined exterior of the Visual Arts Center at Harvard. Only one kind of brutality really seems to be of the nature of concrete, and that is the roughness due to formwork left in its natural state. It is perhaps indicative of Le Corbusier's superiority over J. L. Sert that whereas the latter nails rough planking over his plywood so as to produce an "aesthetic" effect more to his liking, Le Corbusier expresses the technological refinement characteristic of the country in which he builds.

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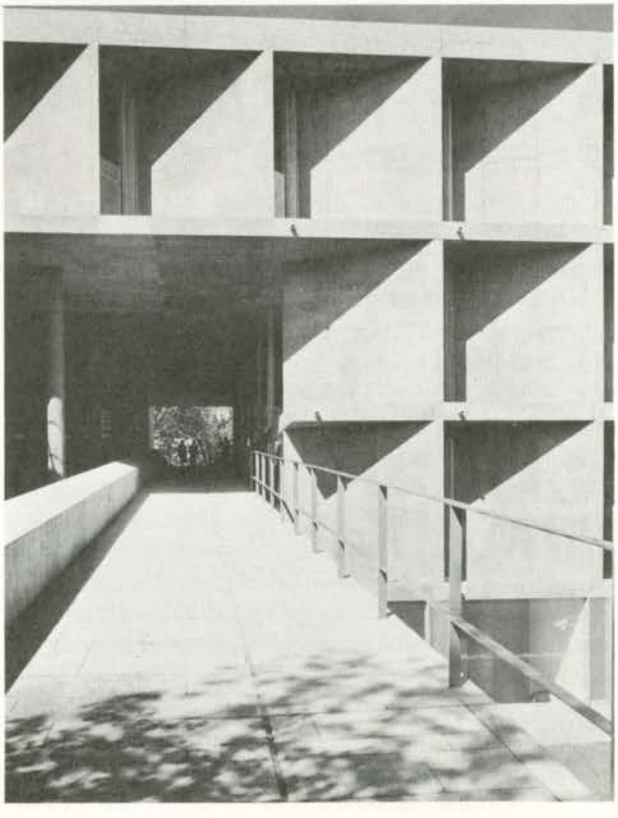
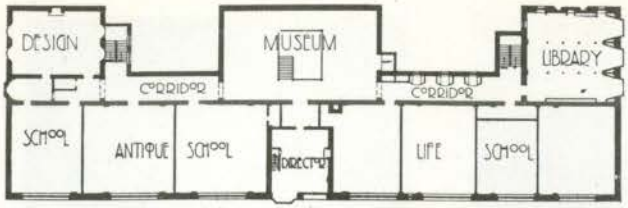
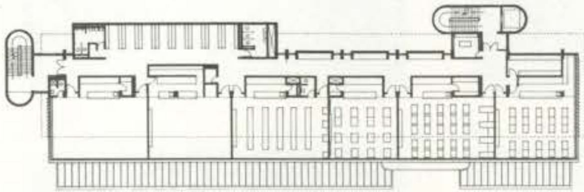
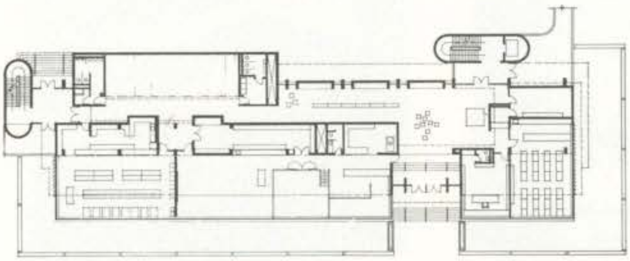




FIRST FLOOR PLAN, GLASGOW SCHOOL OF ART



SECOND FLOOR PLAN, CTS ART CENTRE



FIRST FLOOR PLAN, CTS ART CENTRE

1. The north-east entrance facade of the Glasgow School of Art; architect, Charles Rennie Mackintosh. (Designed in 1896.)

2. Carpenter Center for the Visual Arts at Harvard; architect, Le Corbusier. Detail of the sun breakers at the ramp entrance.

3. Central Tech., detail at the south-east entrance.

4. The west elevation of Central Tech. showing the south-west platform entry.

5. Carpenter Center, general view of the ramp entrance. 6. Central Tech., general view of the ramp entrance.

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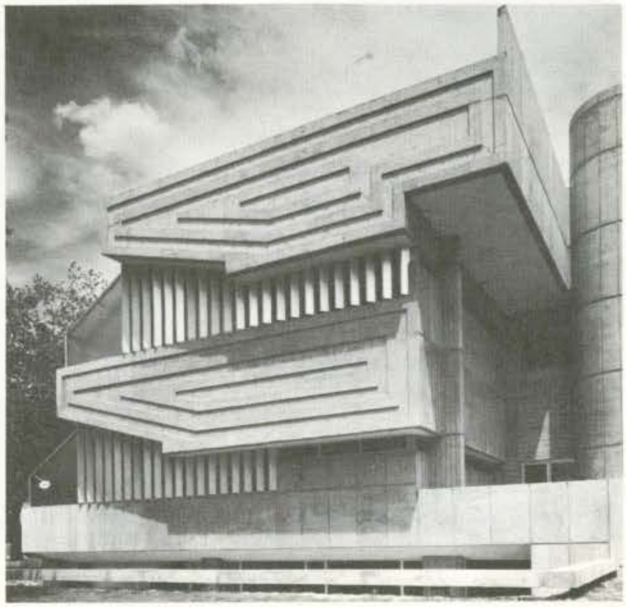

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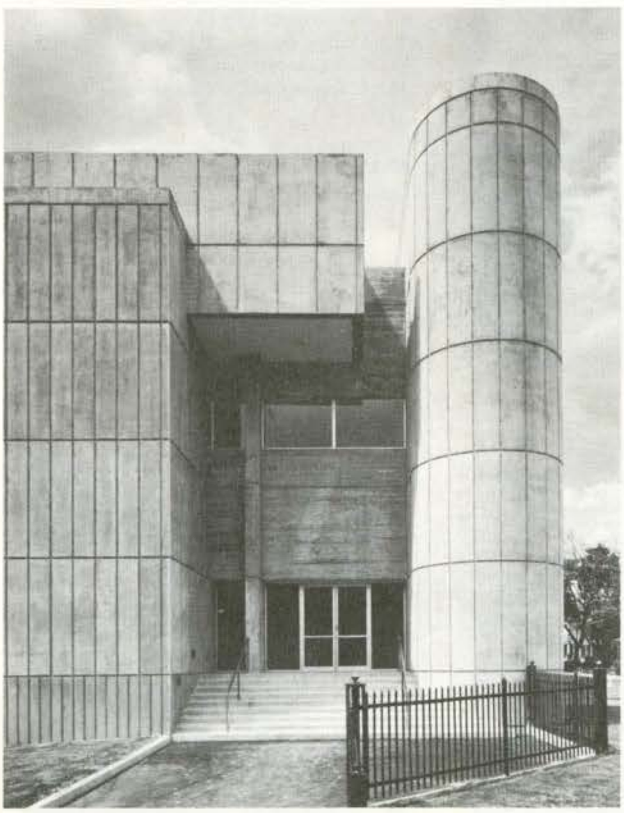

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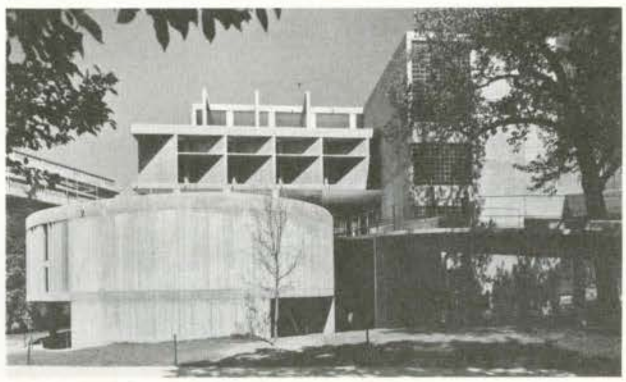

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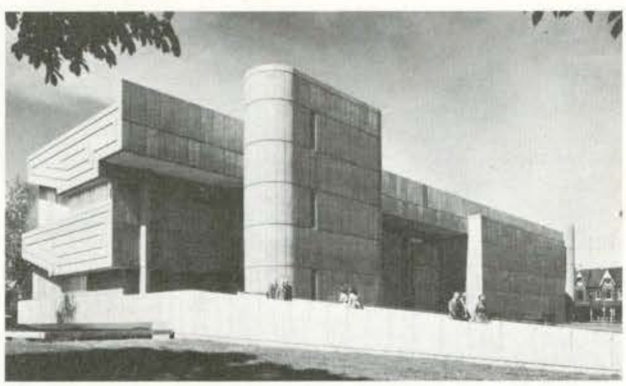

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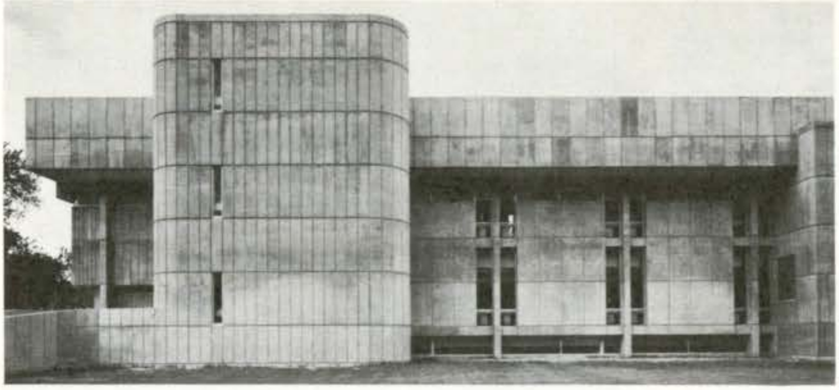

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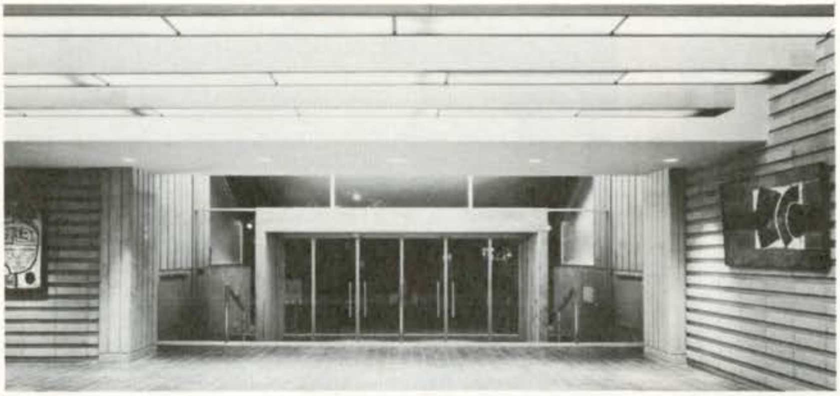

7. The south elevation with niches at column.
8. View from the south-east.
9. A typical corridor. 10. Detail of niches.
11. View from the north-east.
12, 13. Entrance details. 14. A sculpture studio.

All photos are by Panda unless otherwise noted.

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LE BETON PREFABRIQUE

RESUMES PAR JEAN GAREAU

LE BETON PREFABRIQUE ET L'INGENIEUR PAR LAURENCE CAZALY

Pour l'ingénieur, l'essence de béton préfabriqué, c'est la liberté qu'il octroit. Cependant, comme personne n'échappe aux décisions prises sous l'empire de ses émotions, il semble que cette liberté et les risques qu'elle comporte aient justement retardé l'utilisation du béton préfabriqué au Canada.

Ce matériau n'a pas encore trouvé de forme traditionnelle. A part un choix de dalles, tout est à concevoir, à calculer et à monter. Si les conservateurs se gardent bien d'assumer cette responsabilité et si les fortes têtes préfèrent sacrifier une commission pour courir ce risque, les uns et les autres ne peuvent échapper aux frais des calculs et de la préparation des plans de tels ouvrages.

Le béton préfabriqué est trop onéreux. Les détails types n'existent pas encore et le devis qui impose à l'entrepreneur toute la responsabilité des calculs, le pénalise et le force à mettre au point les détails. Ce matériau étant préfabriqué, il exige la compilation de toutes les données architecturales, mécaniques et structurales; ce qui est laborieux. Par ailleurs, la réputation d'un architecte ne tient pas seulement aux qualités de la structure des immeubles qu'il compose.

Si ce qui précède permet de rendre compte de la situation actuelle, qu'est-ce qui permettra de présager son avenir? Nous disposerons bientôt au Canada d'un code pratique qui aura l'avantage de réduire les frais des calculs et de permettre une standardisation rationnelle, donc de réduire le coût de production. Il permettra de rationaliser le travail d'atelier, libérant l'ingénieur spécialisé qui pourra se concentrer sur les parties exceptionnelles de l'ouvrage.

La construction modulaire sera bientôt chose courante. Des matériaux standards ont été créés pour les systèmes électrique et mécanique et pour les finis. Le faible coût initial de la structure, son volume et son poid avaient jusqu'ici empêché sa préfabrication. Il en ira autrement, les recherches et la production visant à offrir une meilleure valeur à meilleur compte. En revanche, l'acheteur aura l'embarras du choix.

Cependant le béton demeure l'un des matériaux les plus contrôlables au stade des calculs. Sa résistance, sa forme, sa couleur et sa texture peuvent être variées à l'infini à très peu de frais, d'où l'importance de l'intervention de l'architecte et de l'ingénieur malgré la tendance à la standardisation.

La réduction de prix virtuelle du béton est presque illimitée, puisque de 10 dollars avant le mélange, son coût une fois coulé passe de 50 à 100 dollars. Cette différence, portant sur le coût de la main d'oeuvre et l'équipement peut être résorbée par des calculs plus poussés, la préfabrication et le marketing.

Si l'architecte doit devenir un acheteur ou un rédacteur de devis, il devrait être libre de recommander l'achat de tel produit ou de conseiller l'engagement de tel spécialiste, quoique je ne verrais pas sans appauvrissement pour notre culture que l'architecte en soit réduit au rang de sous-spécialiste.

Après la phase initiale, nous atteignons maintenant la phase critique au cours de laquelle chacun sait qu'il y a une solution possible mais cherche encore les moyens pour qu'elle soit la meilleure.

LE BETON PREFABRIQUE LE PASSE • LE PRESENT • L'AVENIR PAR KAI HOLBECK

S'il y a peu à dire du passé d'une nouvelle industrie, l'intérêt de sa réussite justifie sans doute l'examen des facteurs de sa croissance et de ceux qui exercent une influence sur son avenir.

Venue d'Europe où sa production d'avant-guerre avait été limitée à de petits éléments, tels des linteaux et des allèges, l'industrie du béton préfabriqué devait sa croissance aux facteurs suivants:

1. Le développement des connaissances techniques permettant d'utiliser les matériaux à leurs limites et de relever les standards.
2. L'aptitude de l'industrie à trouver des applications aux recherches.
3. La possibilité d'exécuter des ouvrages en béton en toute saison, grâce à ce matériau.
4. Les recherches de l'Etat en vue de ce dernier objectif.
5. Des développements particuliers, tels le béton précontraint et l'utilisation d'agrégats légers.
6. Les recherches poussées et le marketing de l'industrie du ciment.
7. Une meilleure connaissance du produit et de ses usages par les architectes.
8. Des essais réussis de standardisation.
9. Des codes pratiques souvent remis à date.
10. Un essor économique auquel participait le bâtiment.
11. Le développement correspondant de l'équipement des entreprises de construction.

Au pays établissement de l'industrie du béton préfabriqué se fit sous d'autres auspices, du moins en ce qui a trait à l'aide de l'Etat et de l'industrie du ciment. Il en va autrement aujourd'hui.

Les premiers éléments destinés au bâtiment comprenaient des dalles simples, en U ou à cellules. Maintenant, l'industrie du béton préfabriqué produit des dalles d'étage et de toiture, précontraintes ou non, évidées, en simple ou double T dont certaines peuvent franchir des portées de 100 pieds, des colonnes pouvant atteindre 60 pieds, des poutres précontraintes lorsques les charges ou les portées le justifient, des formes spéciales limitées par des considérations économiques ou par la seule imagination de l'architecte, des panneaux de revêtement et même des murs porteurs. Cette dernière utilidation est en voie d'opérer sans bruit une révolution susceptible d'exercer une influence sur l'avenir du béton préfabriqué et tout particulièrement, ses propriétés structurales. Les murs porteurs éliminent ainsi les colonnes et les poutres des murs de façade. Quatre immeubles en construction au Canada conçus pour le procédé Schockbeton en illustrent les possibilités.

Aux nouvelles résidences du Collège Loyola à Montréal des architectes Webb et Menkes, ce sont des murs porteurs et des dalles préfabriquées; à la Faculté des Arts de l'université Laval à Québec des architectes Fiset et Deschamps, ce sont des murs auto-porteurs; à l'école Algonquin à North Bay de l'architecte Gerald B. Cox, ce sont des colonnes préfabriquées et des dalles précontraintes et à la Faculté des Arts de l'Université McGill à Montréal des architectes Affleck, Desbarats, Dimakopoulos, Lebensold, Sise, ce sont des murs porteurs et des dalles préfabriquées.

Quant à l'avenir, les facteurs mentionnées plus-haut exerceront une influence plus ou moins marquée; un manufacturier ne peut que tenter de deviner quels facteurs encore inconnus surgiront pour déjouer les meilleurs programmes d'expansion. Architectes et ingénieurs imposent déjà aux producteurs de mobiliser toutes leurs ressources, les forçant à avoir recours à des ingénieurs spécialisés. D'ici peu les sociétés les plus progressives disposeront des services d'architectes comme cela se pratique en Europe.

L'industrie du béton préfabriqué en Europe est en avance sur celle de l'Amérique du Nord sous deux aspects majeurs. Ils permettent de faire ressortir des facteurs susceptibles d'influencer l'avenir du béton préfabriqué ici.
Le marché de l'habitation individuelle et collective.

Sur ce continent ce marché n'a presque pas été touché par l'industrie du béton préfabriqué. La résistance de la clientèle aux changements, l'approvisionnement facile en bois de charpente, la multiplicité des petites entreprises et la concurrence âpre ont rendu la standardisation et la rationalisation à peu près impossible. Au moins un manufacturier entretient peu d'espoir sur le marché de l'habitation individuelle et collective. Le morcellement de la clientèle rend les recherches et le marketing aussi difficile pour l'ensemble de l'industrie que pour les producteurs individuels. Seuls les projets de rénovation urbaine destinés à l'habitation pourraient constituer une exception s'ils n'étaient pas aussi liés à la politique.

Le développement de l'industrie du béton préfabriqué destiné à L'habitation en Europe tient aux facteurs suivants:

1. L'existence de grands marchés qui ont permis aux entreprises les plus importantes de conduire des programmes de recherches.
2. La spécialisation de la production, tout particulièrement celle de ces grandes sociétés qui concentrent leur production sur les éléments les plus délicats, laissant à d'autres les produits exigeant moins de précision.
3. La création par les producteurs d'entreprises générales lorsque l'importance des ouvrages préfabriqués le permettait.
4. L'utilisation d'équipement lourd en chantier.
5. La répétition des ouvrages par les secteurs public et privé.
6. Des exigences moins sévères pour ce qui est des agrégats et du ciment.
7. Une meilleure connaissance de la technique de la préfabrication, conduisant à la multiplication des éléments standards.

La situation diffère ici en ce que si l'équipement des entreprises est de plus en plus comparable, les recherches techniques aussi poussées et les connaissances pratiques aussi devenues exactes au point qu'on se rende compte de ce que les bétons structural et architectural ne sont qu'une seule et même chose, le régime des taxes de vente différent cependant d'une province à l'autre et les conflits entre entreprise générale et sous-entreprises, les revendications des syndicats ouvriers faisant suite aux exigences du montage et le caractère du marché de l'habitation individuelle et collective soulèvent des difficultés.

La confiance des manufacturiers de béton préfabriqué dépend des progrès réalisés tant dans les recherches que les applications. On a pu relever les exigences et les rendements de deux à trois fois au cours des dix dernières années.

Schockbeton se classe parmi les principaux manufacturiers de béton de haute qualité coulé avec un faible pourcentage de sursaturation d'eau, éliminant ainsi les fentes dues au séchage et les problèmes qui en résultent. Le produit de ce procédé, sans accroître le contenu de ciment, est capable de rendement de l'ordre de 10,000 lb./po.car. et n'a qu'un pouvoir d'absorption ne dépassant pas 2%. D'autres techniques obtiennent ces résultats et d'autres possibilités sont étudiées; elles portent sur l'usage de nouveaux matériaux avec les composants du béton et sur l'apport du béton à des matériaux connus.

Il est étonnant qu'un producteur, emporté par son sujet, se surprenne à penser que le béton soit un matériau à peu près universel.

LE BETON PREFABRIQUE SUPERIEUR
PAR KEN GIDDINGS

Architectes et ingénieurs admettent maintenant de plus en plus que le béton préfabriqué et le béton précontraint aient des propriétés particulières dont ils ne sauraient évidemment tirer avantage sans bien les connaître.

Alors que dans le béton armé des barres d'acier nombreuses doivent répartir dans le béton la tension à laquelle elles sont assujetties, le béton précontraint est comprimé dans le but d'être insensible à la tension; d'où un usage restreint d'acier de haute qualité. De plus, la disposition de l'acier s'oppose aux forces verticales, permettant ainsi de réduire la profondeur des éléments. Le béton préfabriqué a entre autres avantages d'être insensible au climat.

C'est en apportant quelques corrections au stade initial de la composition que l'on pourrait éviter la plupart des échecs. Les détails d'exécution, la fabrication et le montage ne sauraient corriger un projet inconscient des propriétés du matériau. L'inaptitude a admettre les tolérances au montage en prévoyant des éléments continus et non-ajustables à l'arrière de plusieurs éléments préfabriqués, et à tenir compte du voilage des éléments (de l'ordre de 1/360) en détaillant une allège par exemple, sont les plus caractéristiques. Une exactitude exceptionnelle ne devrait être exigée que si elle est essentielle à la composition.

Les producteurs de béton préfabriqué de renom disposent d'un personnel technique qualifié que le rédacteur de devis aura tout intérêt à consulter en même temps qu'il voudra se familiariser avec le matériau. Il pourra faire un choix parmi les producteurs, s'assurant ainsi de la qualité du matériau et du montage et bénéficiant d'une soumission compétitive.

Le contrôle de la qualité du produit sur le chantier est généralement confiée à des sociétés spécialisées, l'architecte perdant ainsi l'occasion d'acquérir une expérience qui lui serait précieuse pour des projets éventuels. L'usage de formes d'acier, de béton et de bois et le décoffrages sont autant de données susceptibles d'exercer une certaine influence sur la composition.

C'est au montage qu'on appréciera la conception et l'étude cohérentes. C'est à ce moment d'ailleurs que les éléments, et en particulier ceux dont les sections sont les plus fines, subiront les efforts les plus grands.

Si toutes les parties en cause partagent la responsabilité du contrôle de la qualité, l'architecte de par ses responsabilités vis-à-vis de son client et de l'intrepreneur, doit savoir ce qu'il veut et savoir reconnaître ce qu'on lui offre.

L'EVOLUTION DU BETON PREFABRIQUE
PAR JAMES STANNERS

La structure apparente est revenue en usage depuis une dizaine d'années et, par rapport au bois et à l'acier, le béton s'impose, qu'il soit sous la forme d'un voile mince, préfabriqué ou précontraint.

L'économie et la rapidité d'exécution qui n'étaient pas satisfaites par le béton coulé sur place exigèrent des éléments préfabriqués. Le traitement des surfaces mirent ces éléments à l'épreuve des chocs lors du montage, et celui des agrégats les rendirent acceptables comme matériau laissé apparent. La rareté de l'acier au début des années 50 a sans doute joué.

Le béton préfabriqué s'est imposé d'abord comme substitut à l'acier et au béton coulé sur place, puis comme système structural auquel s'ajoutaient quelquefois des panneaux préfabriqués non porteurs comme éléments de revêtement, enfin comme élément intégral assurant support et revêtement. Limité à des éléments de 20 pieds jusqu'à ce que la technique du béton précontraint permette d'en doubler puis d'en multiplier plusieurs fois la longueur, le béton préfabriqué fut employé dans la construction des immeubles destinés à l'enseignement, l'industrie, l'administration, le commerce, la recherche et le culte; sous forme de colonnes, de poutres, de dalles évidées, de dalles double T puis simple T, grâce au béton précontraint. Les recherches sur les agrégats exposés accordèrent toute liberté de choix pour la texture et la couleur.

Un des points importants et des plus délicats lorsque l'architecte exige que les éléments préfabriqués soient laissés apparents ou encore lorsqu'ils sont exposés aux intempéries, c'est celui des joints entre les éléments. Des expériences ont montré que s'il était préférable de bien les accuser pour des raisons esthétiques, cette solution n'était pas indifférente du point de vue technique, facilitant ainsi l'exécution de l'étanchéité. Ce point illustre la nécessité d'une collaboration étroite entre l'architecte, l'ingénieur et l'entrepreneur spécialisé.

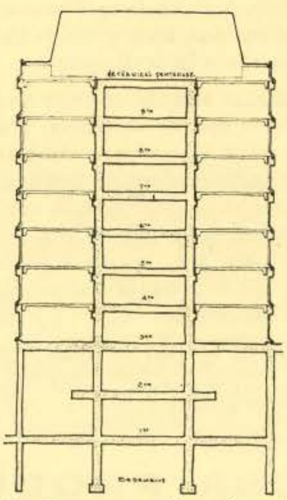
L'usage croissant du béton préfabriqué dépend encore de ses possibilités structurales, de la forme et de l'apparence des éléments, de sa facilité de montage et de son économie. Ce matériau versatile s'imposera encore davantage après des études rationnelles portant en particulier sur la liaison des éléments et des expériences répétées, attentives aux conditions du montage et à l'économie.

ELEMENTS DE BETON PREFABRIQUES POUR L'IMMEUBLE DE LA FACULTE DES ARTS ET DES SCIENCES SOCIALES DE L'UNIVERSITE McGILL

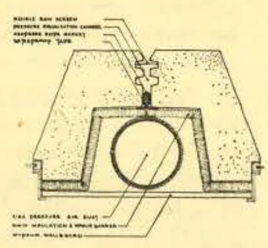
La structure de béton du nouvel immeuble de la Faculté des Arts et des Sciences Sociales de l'Université McGill comporte une partie coulée sur place, le noyau du plan, et une autre composée d'éléments préfabriqués, les murs porteurs extérieurs et les dalles d'étage.

Les éléments du mur porteur ont une hauteur d'étage et dix pieds de large; ils comprennent deux baies. Ils seront soudés les uns aux autres. Les joints verticaux comportent un pare-pluie mis au point en Scandinavie; les joints horizontaux sont couverts et scellés au néoprène. Le découpé des panneaux laisse place aux gaines de chauffage et de ventilation, ajoutant au caractère structural des éléments, une fonction mécanique.

Outre les Architects Affleck, Desbarats, Dimakopoulos, Lebensold, Sise ont collaboré à cette étude les ingénieurs Eskenazi & Baracs pour la structure et les ingénieurs J. P. Keith & Associates pour la mécanique. L'entreprise générale est la Foundation Company of Canada Limited.

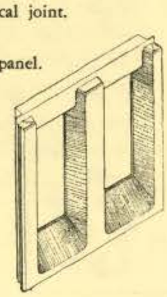


Bearing precast wall panels and floor slabs from 3rd to 7th floor.



Typical vertical joint.

Typical wall panel.



INSTITUTE NEWS

COURTESY LEN NORRIS, THE VANCOUVER SUN

Can't understand why we didn't win . . . 95% of area for parking, ducking pond, secret entrance for Board of Governors, students' pub, faculty club, electric blackboard wipers . . ."

CLAY BRICK AND TILE APPOINTMENT

John Caulfield Smith, MRAIC has been appointed general manager of the Clay Brick and Tile Institute, Toronto. Mr. Smith has practised architecture in Toronto and Montreal; he joined the National House Builders Association in 1951 and for the past eight years has been its executive vice-president.

PRATT, LINDGREN & ASSOCIATES APPOINTMENT

Pratt, Lindgren & Associates, architects, 757 St Mary's Road, Winnipeg are pleased to announce the appointment of Alexander Tomcej, B.Arch. as an associate member of the firm.

CCURR ANNOUNCEMENTS

The Council has announced the appointment of André Saumier of Montreal as Research Officer and his position becomes effective this month.

Françoise Ricour of Montreal and Edward M. W. Gibson of London, Ont. have each been awarded a $4,000 fellowship for advanced urban studies.

ARCHITECT WANTED

Experienced, registered architect wishing to go into private practice and manage an office in a principal urban area of the Maritimes in association with an established architectural firm. Reply to Box number 115 c/o the *Journal.*

DBR, NRC PUBLICATIONS

A new list of its publications issued from 1947 to 1962 is available, without charge, from the Publications Section of the Division of Building Research, National Research Council in Ottawa.

COMING EVENTS

The 1963 fall meeting of the American Concrete Institute will be held at the Royal York Hotel in Toronto on November 11th to the 14th and will focus on significant concrete work being done in Canada as well as technical advances being made by U.S., European, and other concrete experts. General chairman is A. M. Lount of A. M. Lount & Associates, a Toronto firm of consulting engineers.

A photographic display of concrete structures of an unusual or historic character is planned and photographs are being solicited by R. P. G. Pennington, architect, 119 Davenport Road, Toronto. The photos which will be returned to lenders should be completely identified and include the names of the design engineer or architect and the contractor.

COMPETITION
Simon Fraser University

Seventy-one submissions were received for the Simon Fraser University Competition which was open to all architects registered in British Columbia. The object of the competition was stated as being ". . . to choose architects for work to be commissioned, which work has been estimated at approximately fifteen million dollars".

Arthur Erickson and Geoffrey Massey of Vancouver were unanimously chosen by the panel of assessors as the winning team and, listed according to the jury's preference, the other award winners are: William Rhone and Randle Iredale; Zoltan Kiss; Robert F. Harrison; Duncan McNab, Harry Lee, and David Logan. All five have received $5,000; the winners' prize being a portion of their fee for work to be commissioned. Honourable mentions, also in order of preference, went to: Thompson, Berwick and Pratt; Barry Downs and Fred Hollingsworth; Vladimir Plavsic; Alexander Webber; John L. Kidd.

The board of assessors consisted of the chairman, Warnett Kennedy who acted as professional advisor (non-voting); Dr Gordon Shrum, Chancellor of the Simon Fraser University (non-voting); Prof. Henry Elder, Head of the School of Architecture, UBC; Dr Thomas Howarth, Director of the School of Architecture, University of Toronto; E. Stewart Williams, architect, Palm Springs, Calif.; David W. McKinley, architect, Seattle; Aaron Green, chief architect of the Frank Lloyd Wright Foundation, San Francisco.

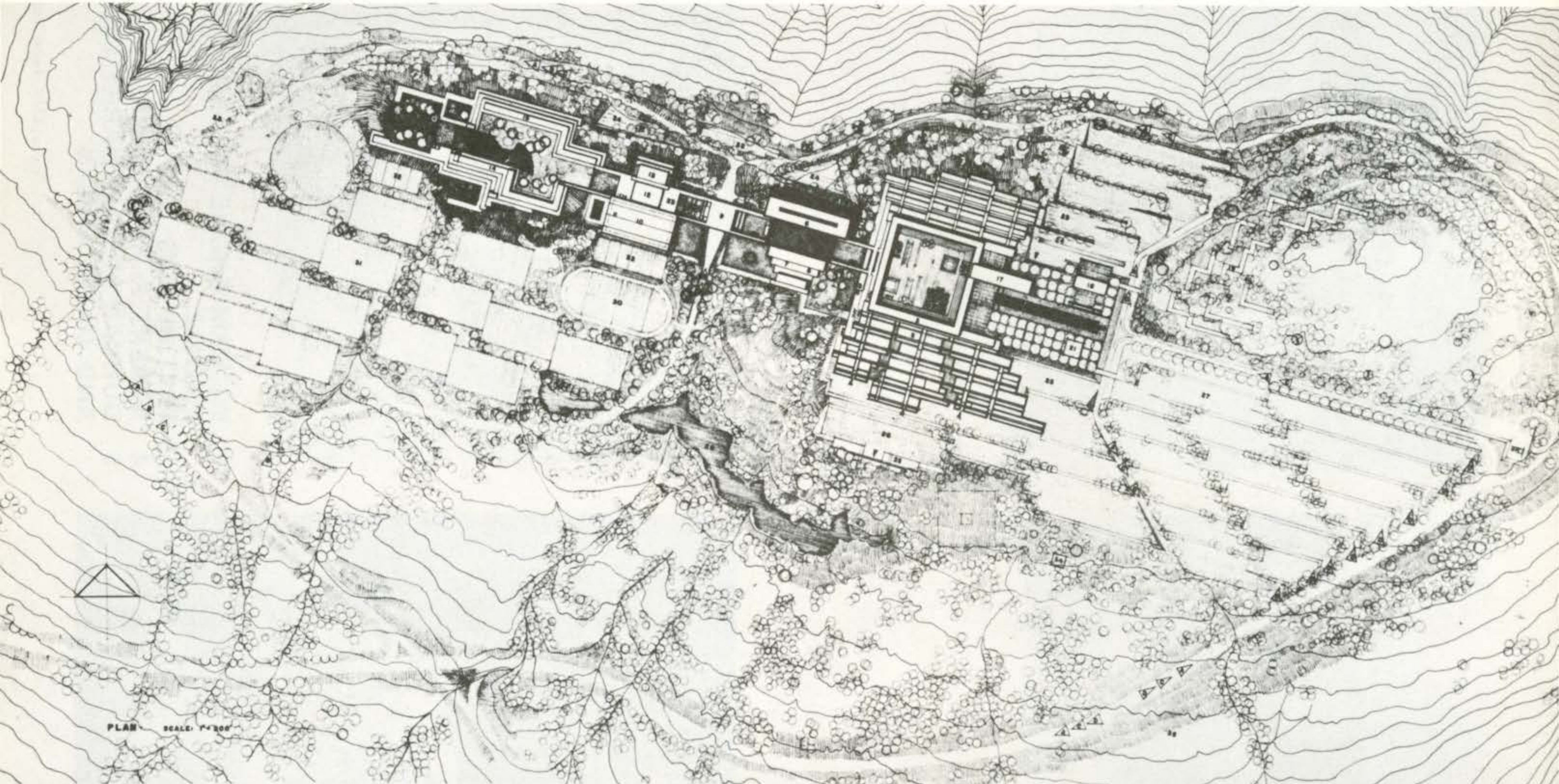
This brief description of the winning design, written by Thomas Howarth, will be followed by a full report of the competition as soon as it is available.

There was unanimous agreement among the assessors as to the outstanding qualities of this design which seemed to meet admirably the requirements of a university programme, and to harmonize with the features of the magnificent site.

The attenuated axial plan is simple in structure. There are two main centres of activity represented by the "academic" quadrangle to the east, and the residential building group to the west; these are connected by a long pedestrian mall about which are disposed the Library, Assembly Hall (theatres) and Students' Recreational Centre. The buildings have been so placed on the site that the highest hill to the east will continue to remain the dominant element. The shallow valley between the twin high-points will be bridged by the pedestrian mall, and the main access road, passing below, will open into a transportation centre or principal distributing point for the complex.

The large quadrangle to the east will be a meeting place for students and staff from all disciplines. On the north side of it are classrooms for the arts and humanities; to the south classrooms and laboratories for the scientific disciplines. The architects have indicated repetitive building elements for each of these teaching areas, a form which suggests economy of construction, flexibility and ease of expansion. The administrative offices, faculty club and heliport are situated to the east on the main approach from the parking lots.
This is a gay and elegant scheme of great potential!

1 ARTHUR ERICKSON AND GEOFFREY MASSEY



LEGEND

1. ACADEMIC QUAD.
2. THE MALL.
3. FACULTY OFFICES. 140,000 SQ. FT.
4. CLASSROOMS. 200,000 SQ. FT.
5. LABORATORIES & SCIENCE CLASSROOMS. 700,000 SQ. FT.
6. LIBRARY & STUDY SPACE. 400,000 SQ. FT.
7. LARGE THEATRE.
8. SMALL THEATRE.
9. TRANSPORTATION CENTRE.
10. GYMNASIA FOR MEN & WOMEN & CENTRE GATE.
11. SWIMMING POOLS. INDOOR & OUTDOOR.
12. STUDENT CENTRE.
13. BALLROOM & BANQUET FACILITIES.
14. RESIDENCES. MEN.
15. " WOMEN.
16. RESIDENCE DINING HALL, LOUNGES, ETC.
17. ADMINISTRATION.
18. FACULTY CLUB.
19. FACULTY HOUSING.
20. PRESIDENT'S RESIDENCE.
21. HELIPORT.
24. VISITOR PARKING 400 CARS.
25. FACULTY " 2500 "
26. STAFF " 1000 "
27. STUDENT " 3900 "
28. EAST GATE & REFLECTING POOL.
29. LAGOON IN PARK AREA.
30. TRACK & FIELD.
31. PLAYING FIELDS.
32. TENNIS COURTS.
33. LOOKOUT.
34. RELOCATED D.O.T. & B.C.H.&P.A. TOWERS.
35. RESEARCH INSTITUTES.
36. WEST GATE.
37. MONUMENT TO SIMON FRASER.

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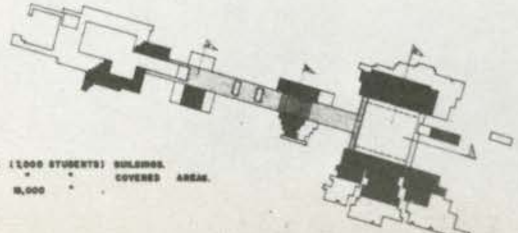
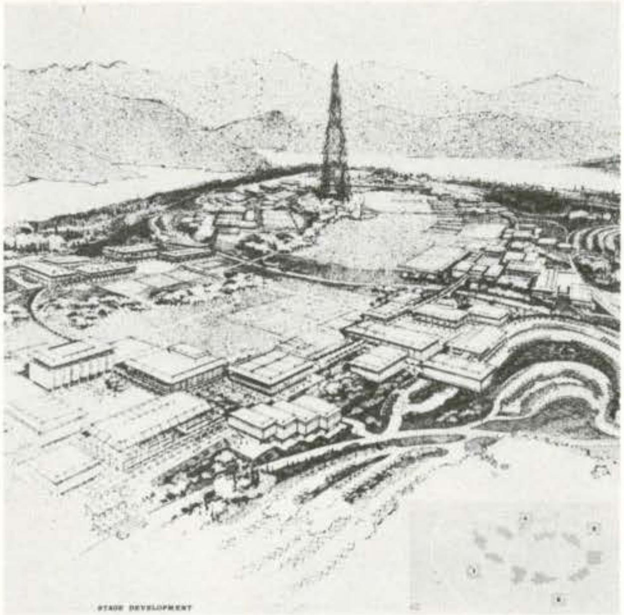
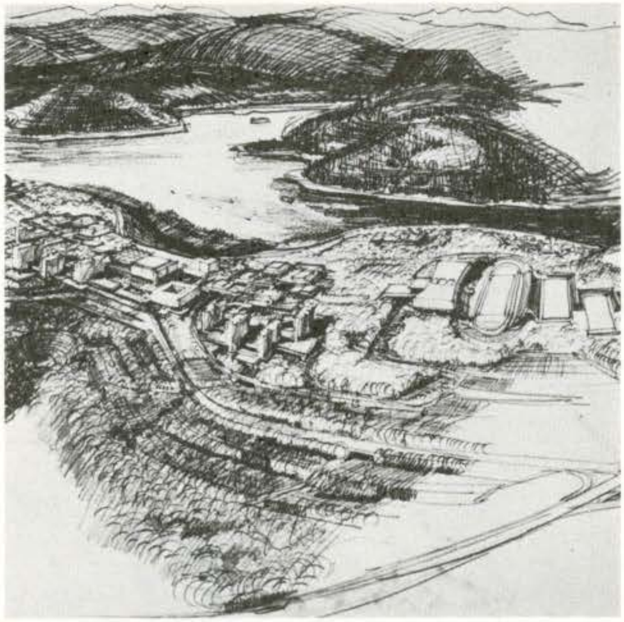


FIRST STAGE (7,000 STUDENTS) BUILDINGS.
" " " " COVERED AREAS.
FINAL " 18,000 " .



TWO

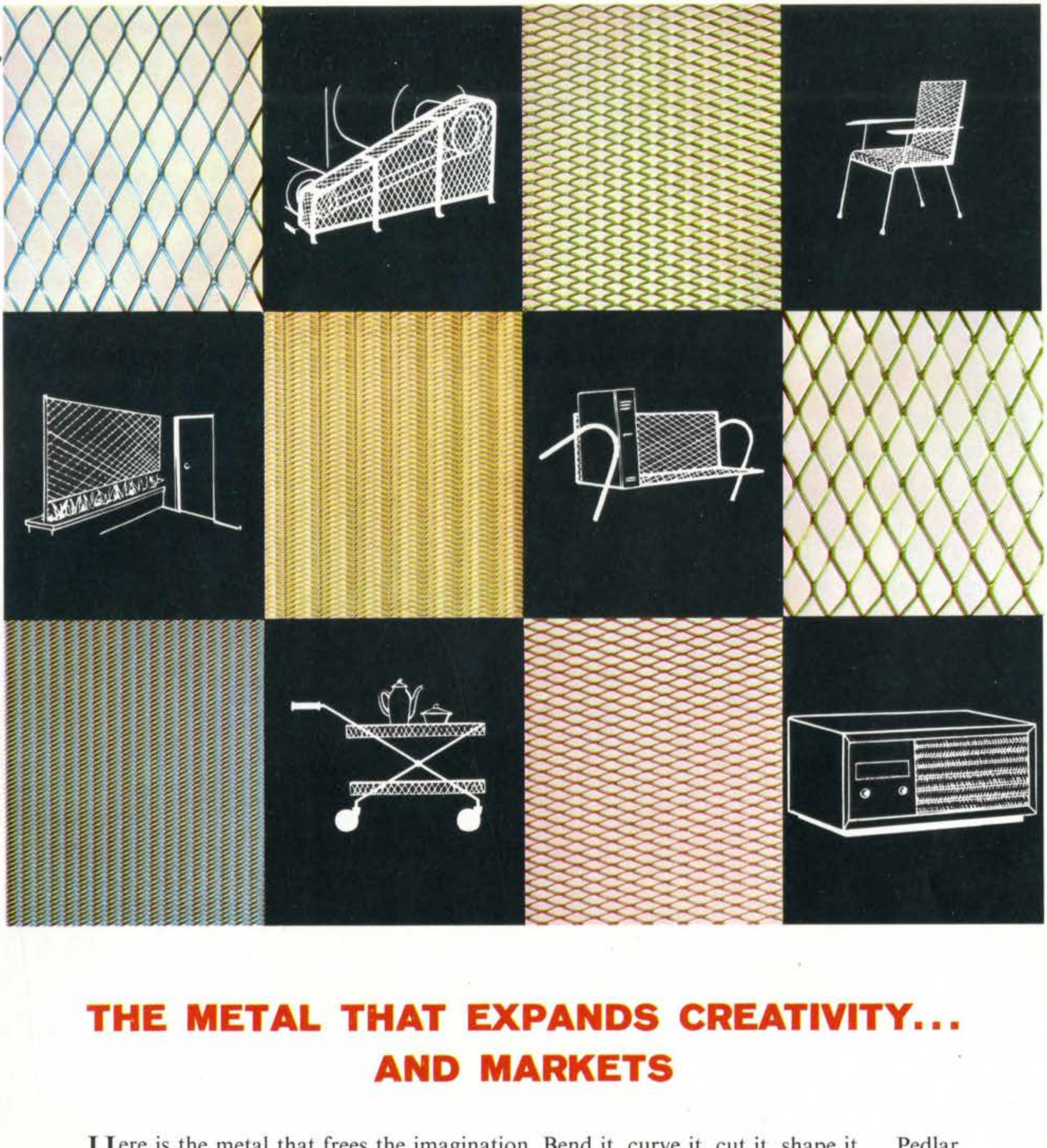


THREE

FIVE

FOUR

2 WILLIAM RHONE AND RANDLE IREDALE
3 ZOLTAN KISS
4 ROBERT F. HARRISON
5 DUNCAN McNAB, HARRY LEE, AND DAVID LOGAN



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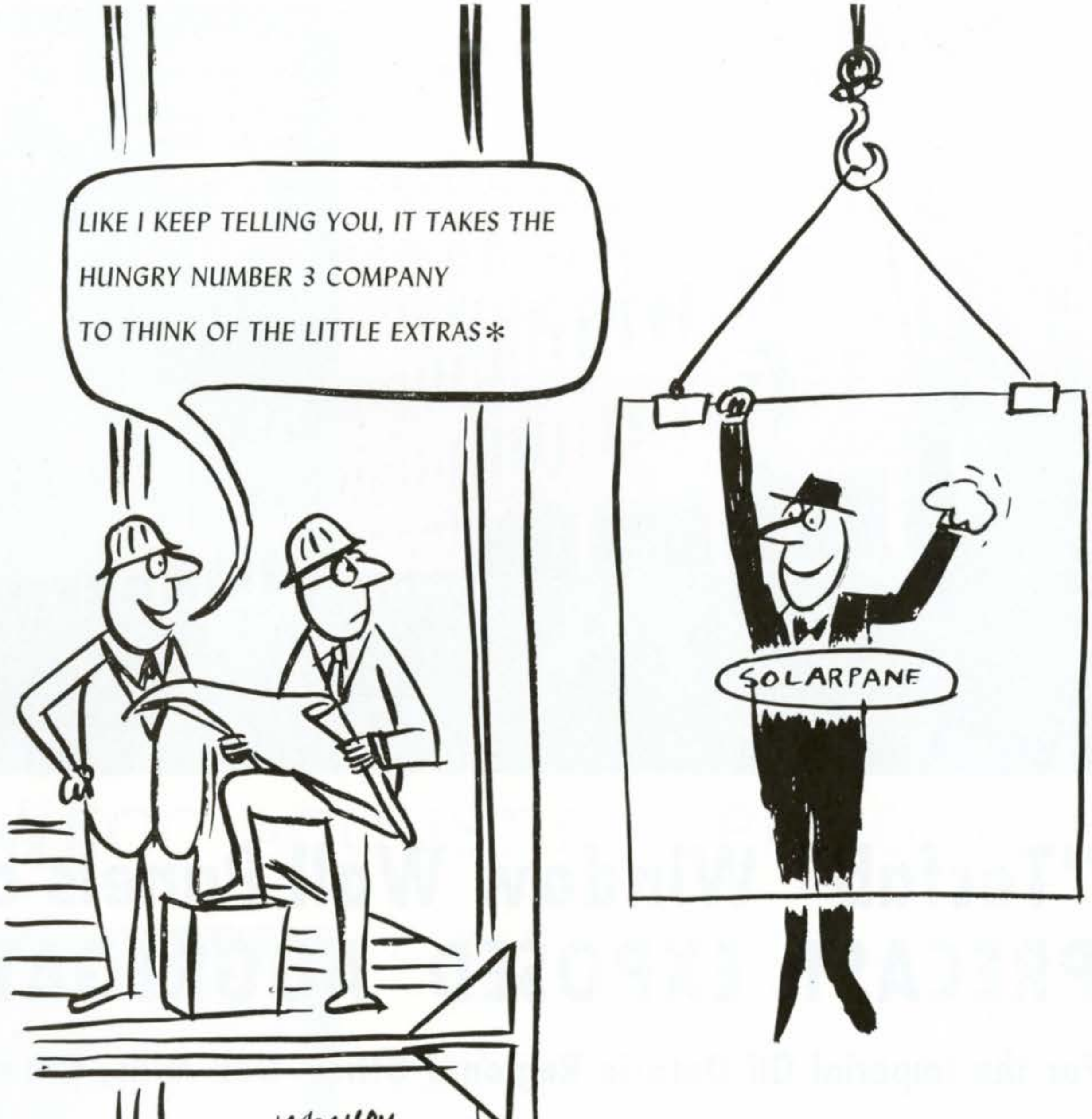
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TO THINK OF THE LITTLE EXTRAS*
SOLARPANE
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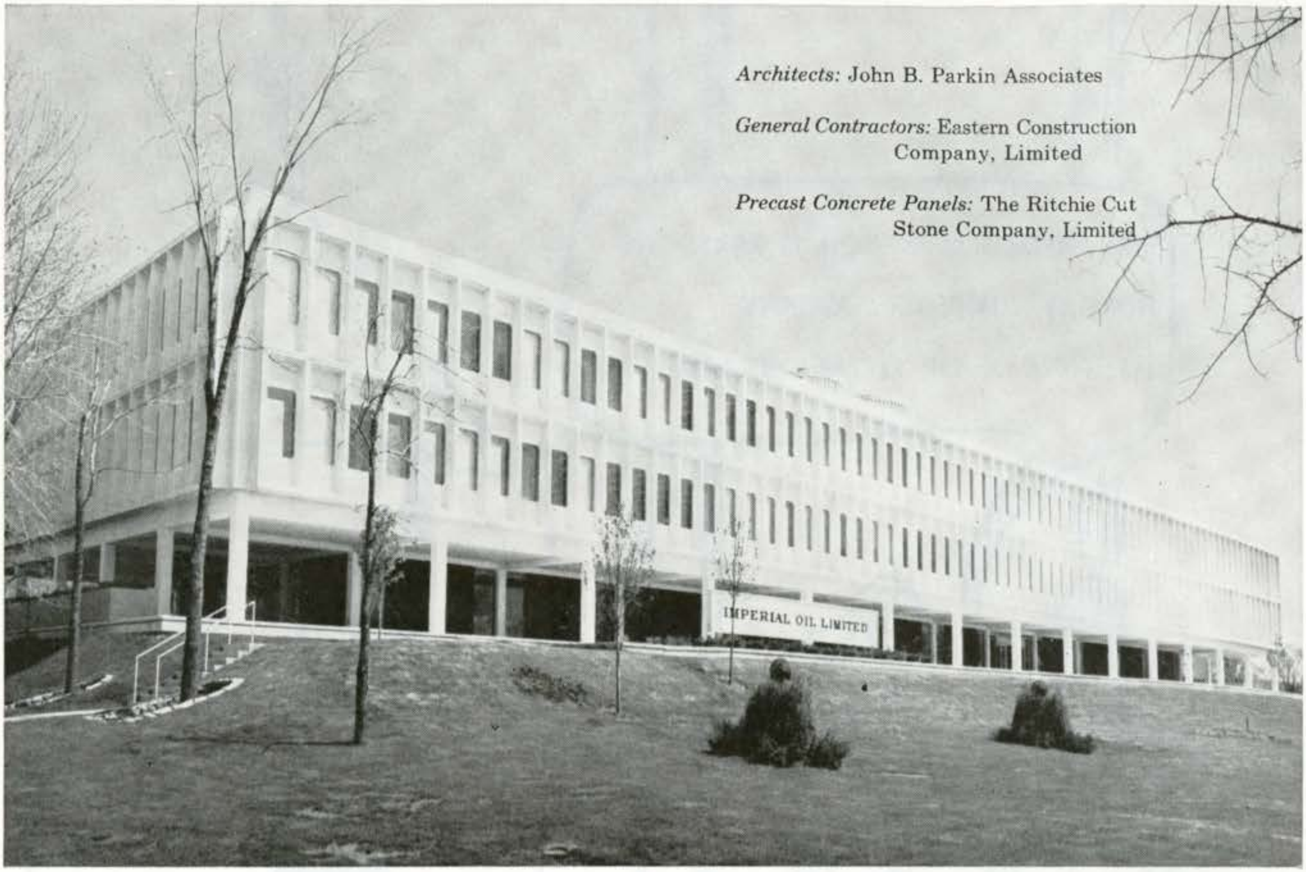
EP. 1



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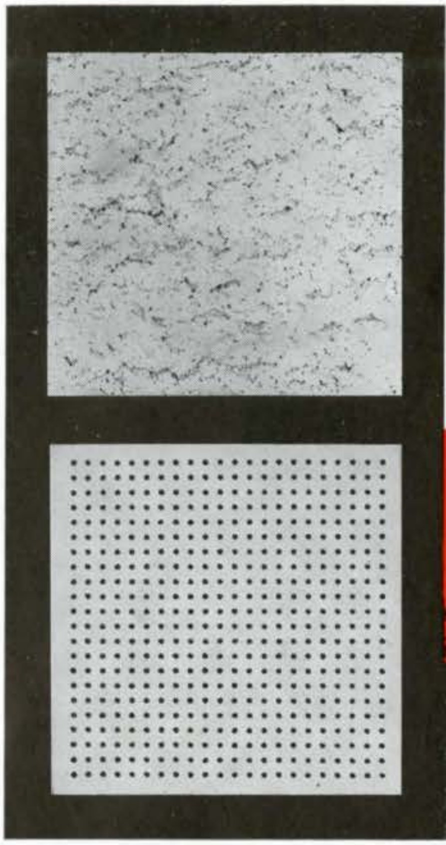

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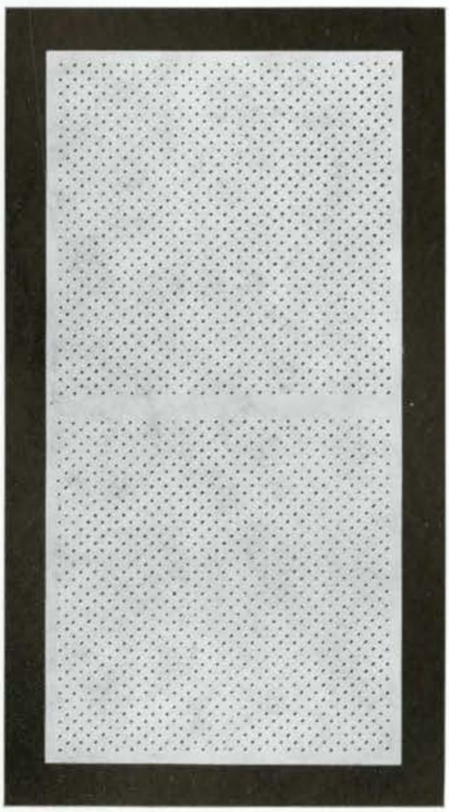

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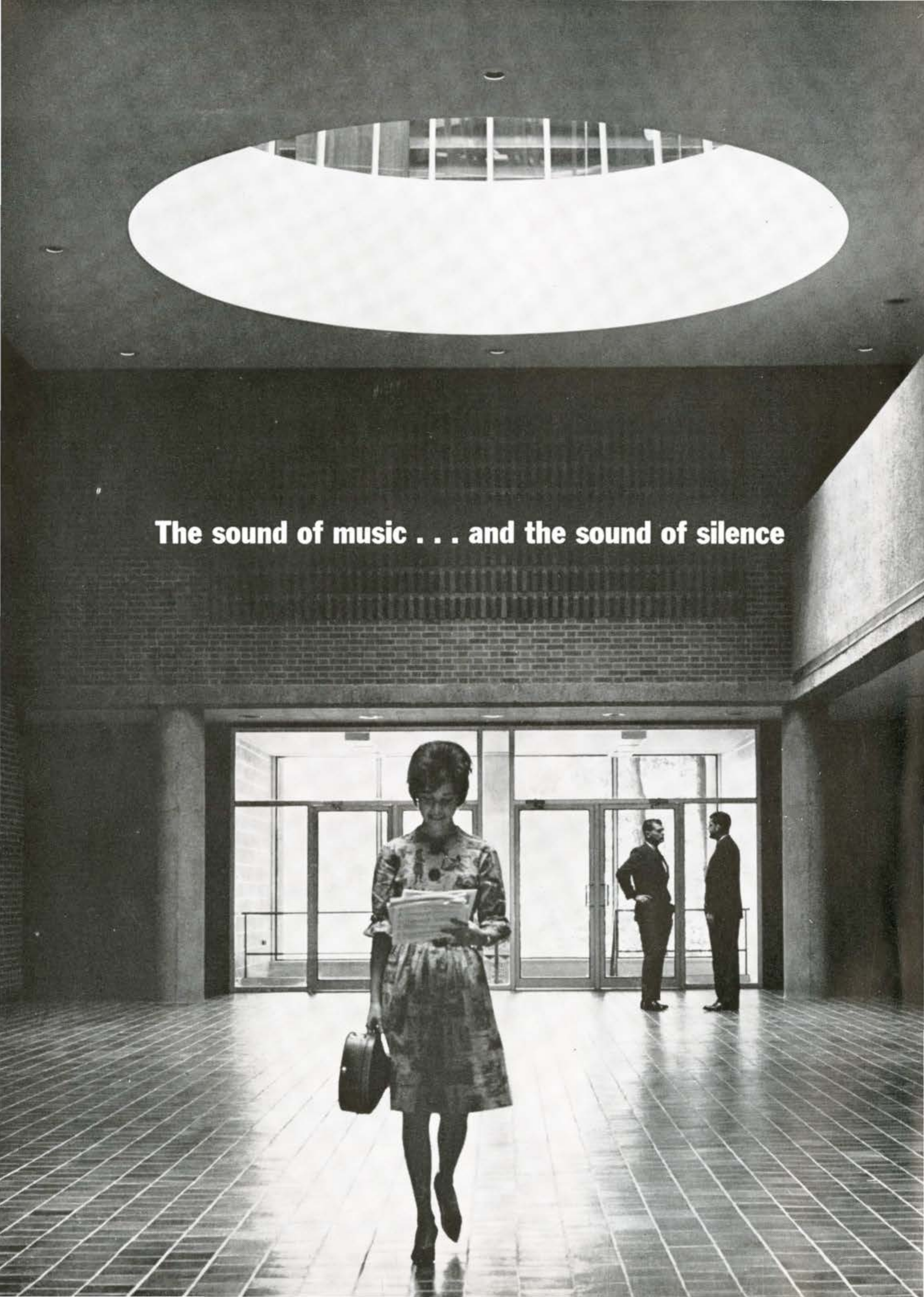
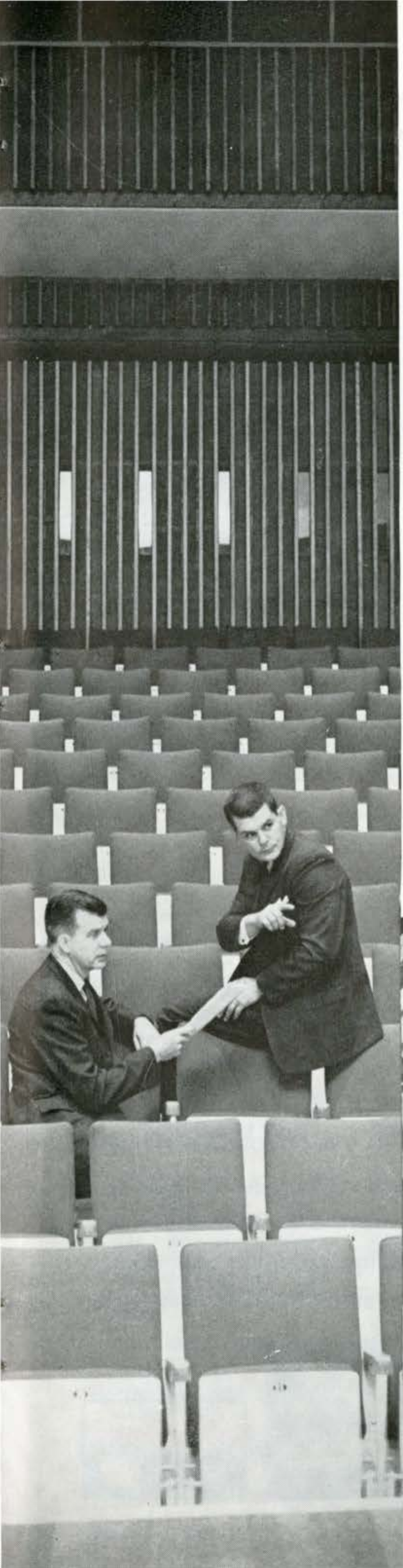

The sound of music . . . and the sound of silence



(Above) J-M Spintone panels were selected for the upstairs library. (Extreme left) A Permacoustic ceiling graces the main lobby. (Left) No. 61 Sound Absorbing Elements were installed in the back of the concert hall.

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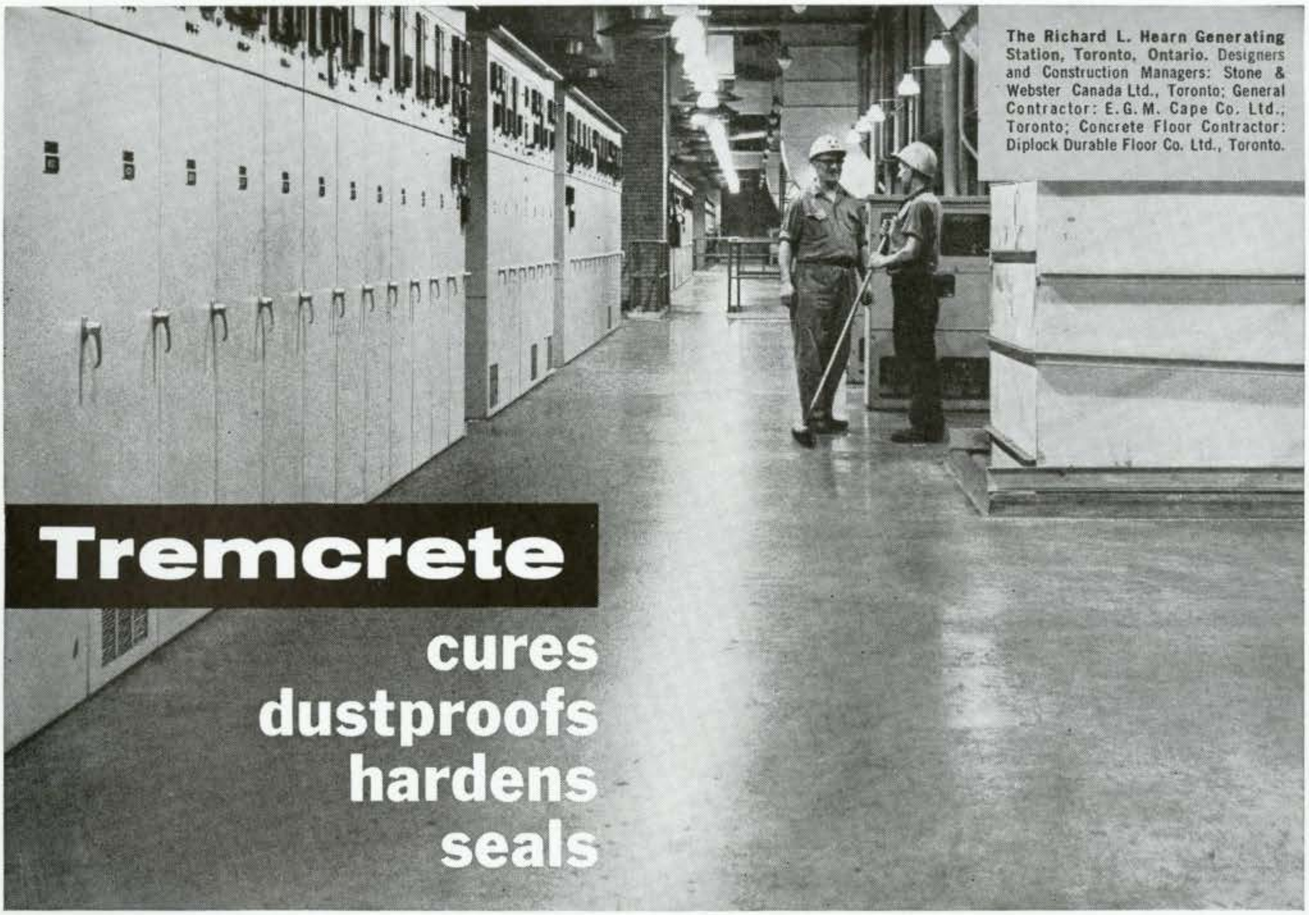

The Richard L. Hearn Generating Station, Toronto, Ontario. Designers and Construction Managers: Stone & Webster Canada Ltd., Toronto; General Contractor: E. G. M. Cape Co. Ltd., Toronto; Concrete Floor Contractor: Diplock Durable Floor Co. Ltd., Toronto.

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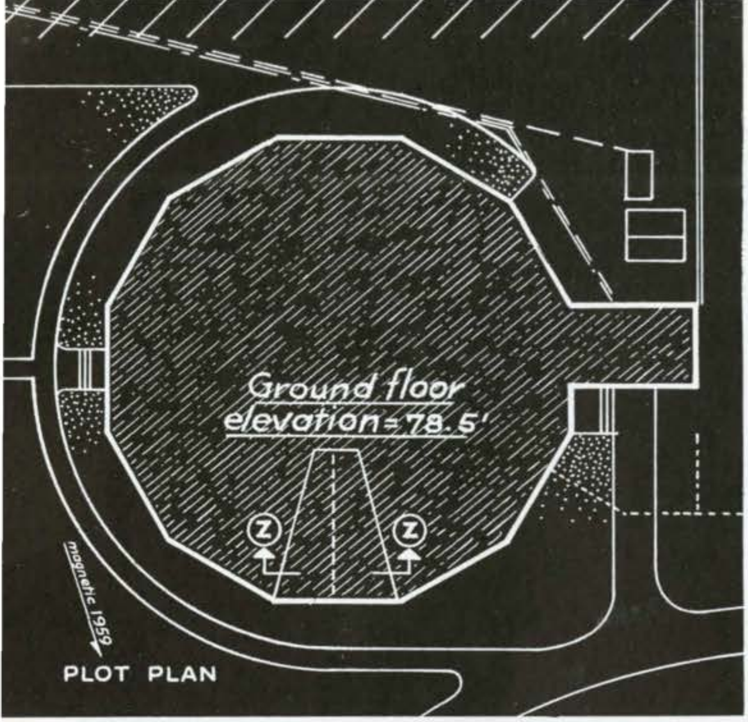
Ground floor
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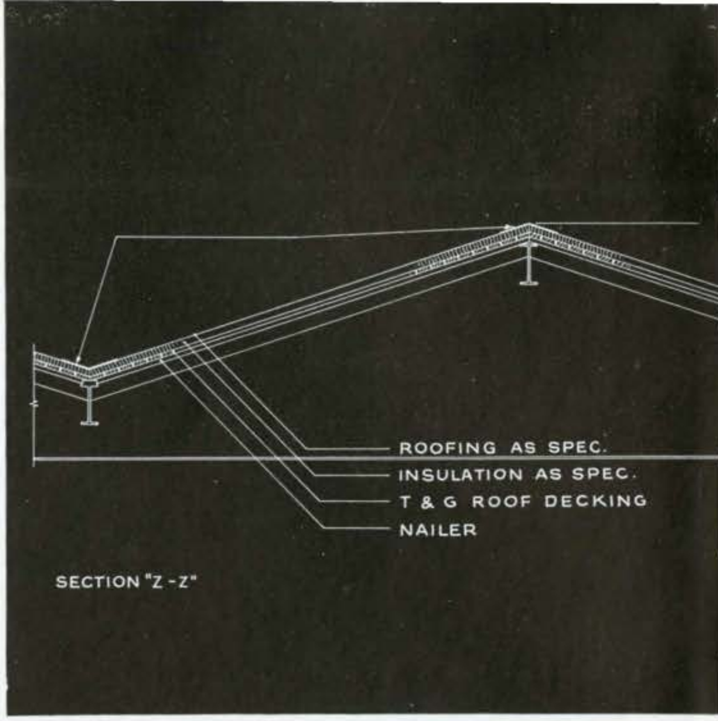
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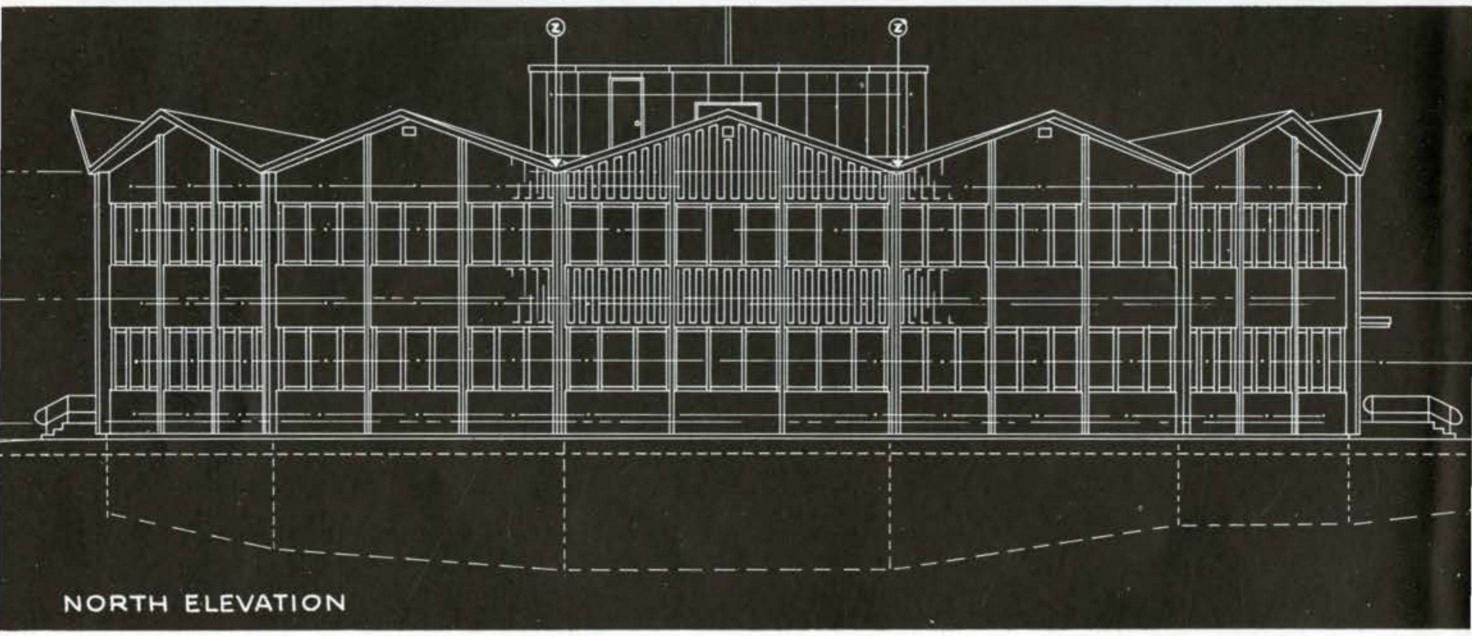
SECTION "Z-Z"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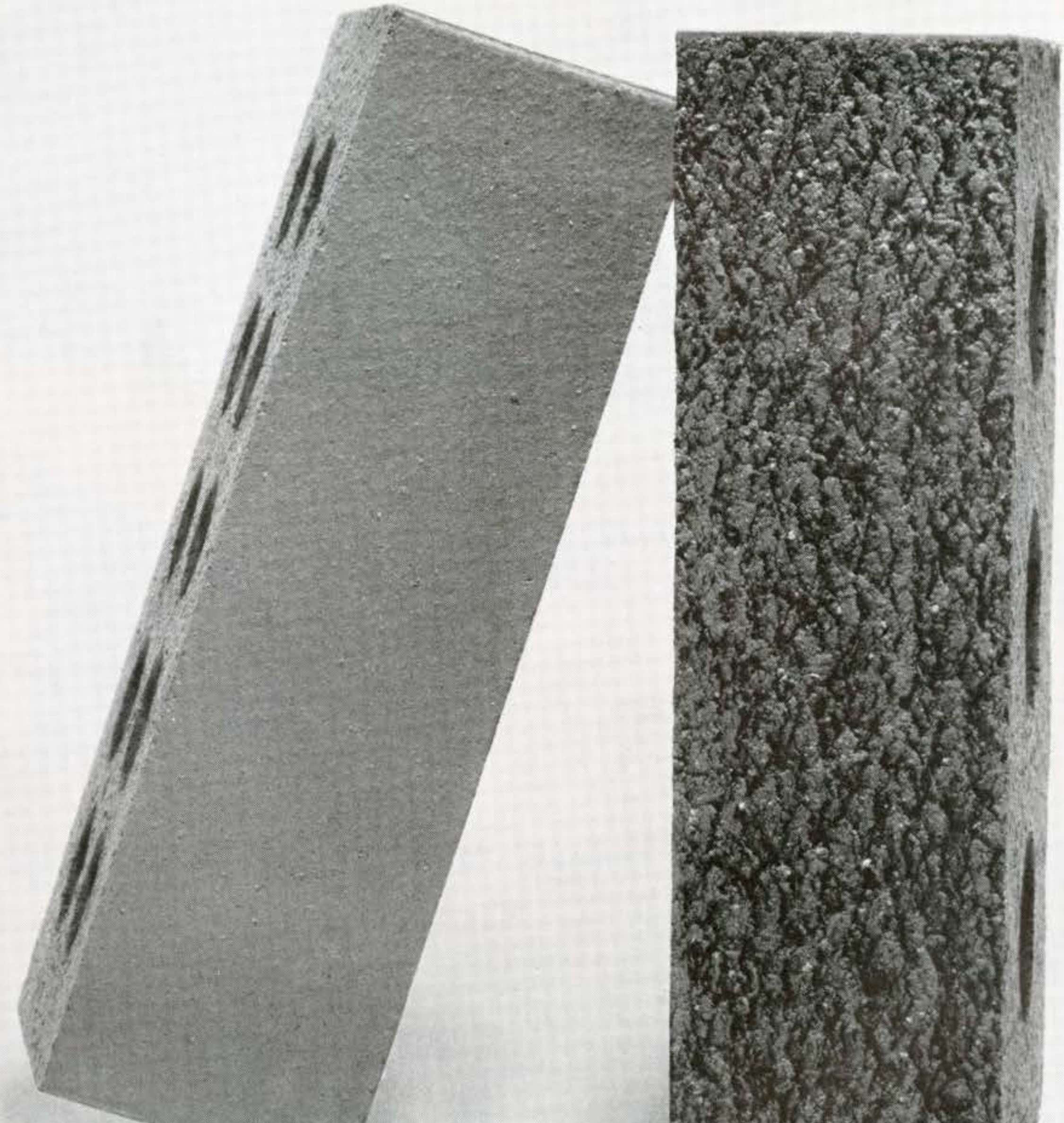

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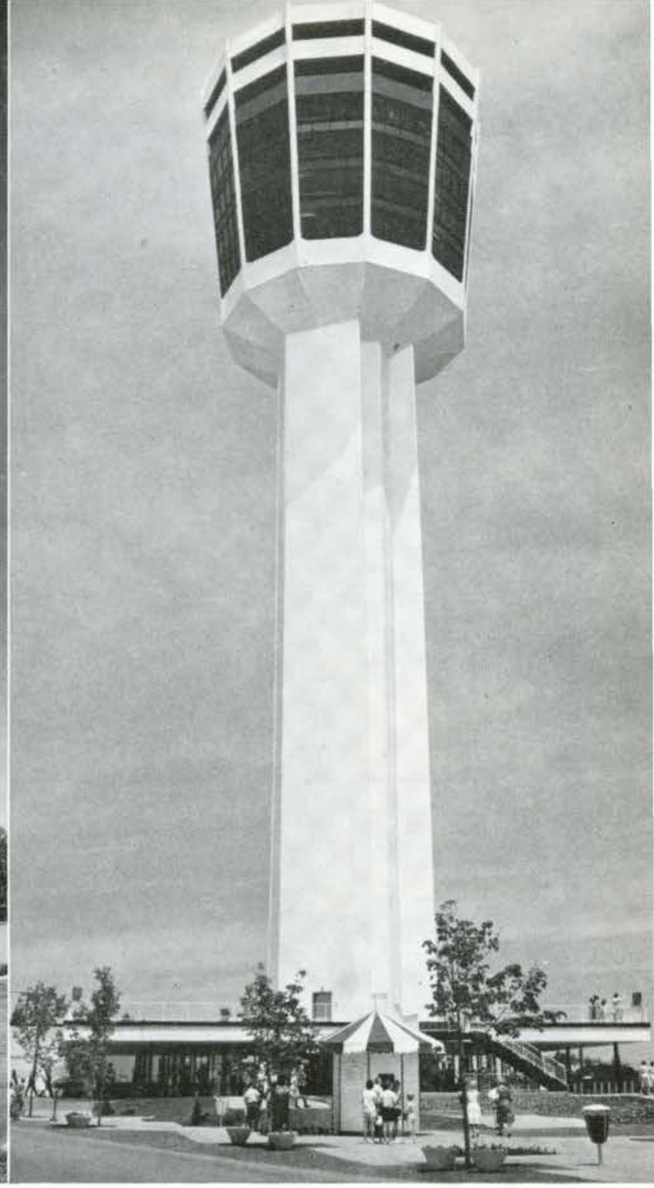

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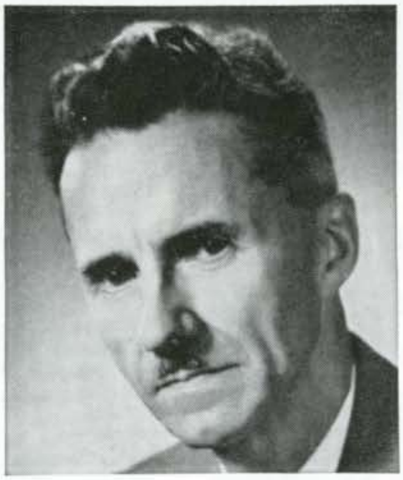

MERRILL C. STAFFORD, B.A.Sc.

JAMES O'H. TURNBULL, B.Eng.

Merrill C. Stafford, B.A.Sc., has been appointed Chairman of the Board of Turnbull Elevator of Canada Limited, it is announced by M. O. Simpson, Jr., President of Turnbull Elevator Limited, the parent organization. James O'H. Turnbull, B.Eng., has been appointed President and General Manager of Turnbull Elevator of Canada Limited, succeeding Mr. Stafford.

Mr. Stafford, who is also a Vice-President of Turnbull Elevator Limited, is a member of T-E-L's Growth Committee. Associated with Turnbull of Canada since 1921, Mr. Stafford is recognized as a leading figure in the North American elevator industry. He will be responsible for planning and co-ordinating T-E-L's expanding elevator business in Canada and the United States. Mr. Stafford will be located at T-E-L's head office at 48 St. Clair Ave. W., Toronto 7.

Mr. Turnbull, a Vice-President of the parent organization and a member of its Growth Committee, has been associated with T-E-L since 1953, and has held executive positions in several of its operating companies. Most recently, he was Vice-President of T-E-L's Industrial Division which includes such well-known manufacturers of engineered products as American Wringer — Farnham, Quebec, Eastern Steel — Preston, Ont., Hamilton Gear — Toronto, Ont., Paramount Gear — Toronto, Ont., Frink Sno-Plows Inc. — Clayton, N.Y. and Frink of Canada — Preston, Ont. Mr. Turnbull's office will be located at 126 John St., Toronto 2B.