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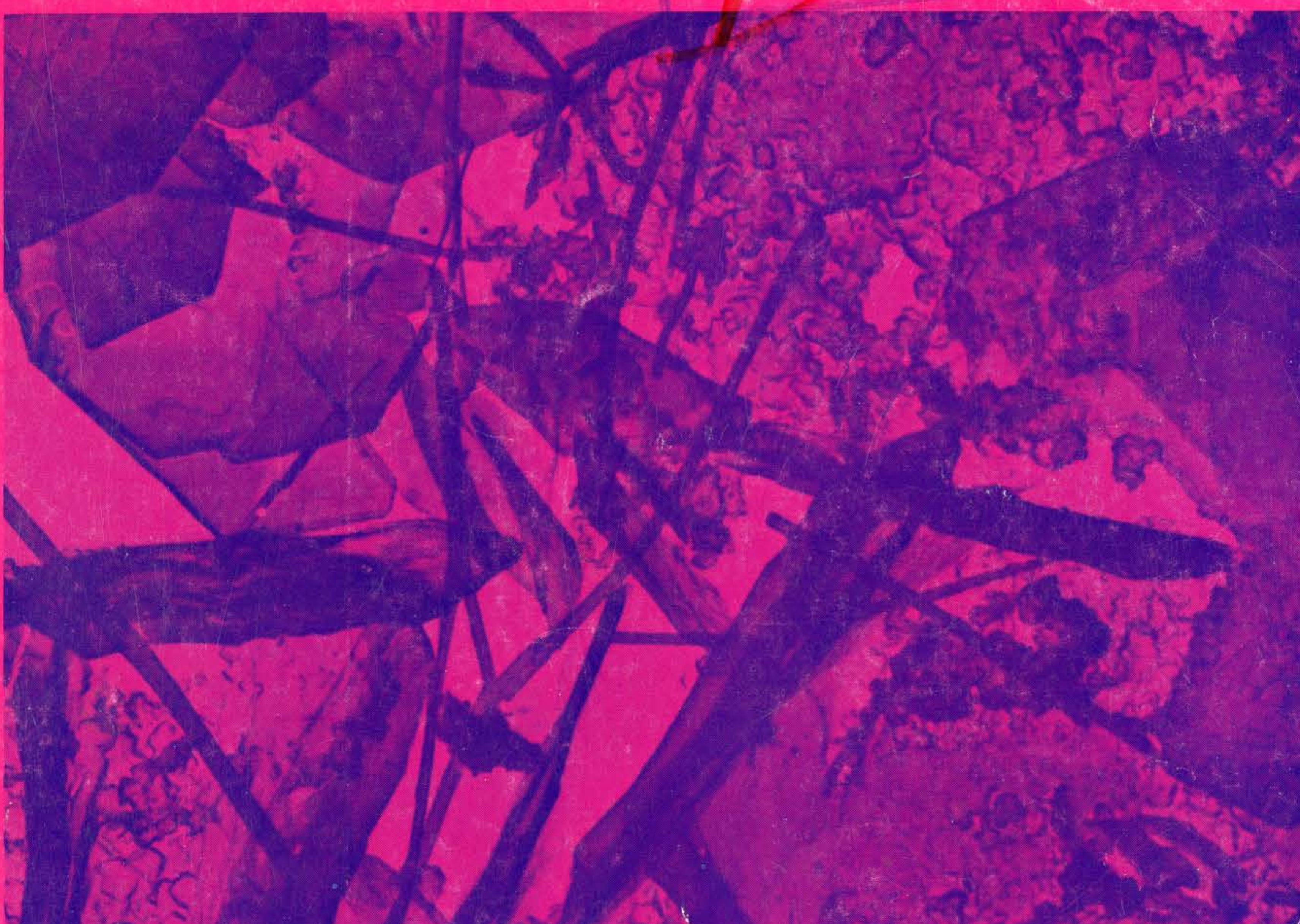
The Allied Arts: All about EAT, the new society for "Experiments in Art and Technology" which brings together science, art and industry

Feature: "Concrete – a Material, a System and an Environment", some of the neglected factors affecting design in converting concrete to built form, edited by Melvin Charney

Technical Section: the national conference on a systems approach to building; Unit prices, for woodwork and moisture protection, from seven centers in Canada



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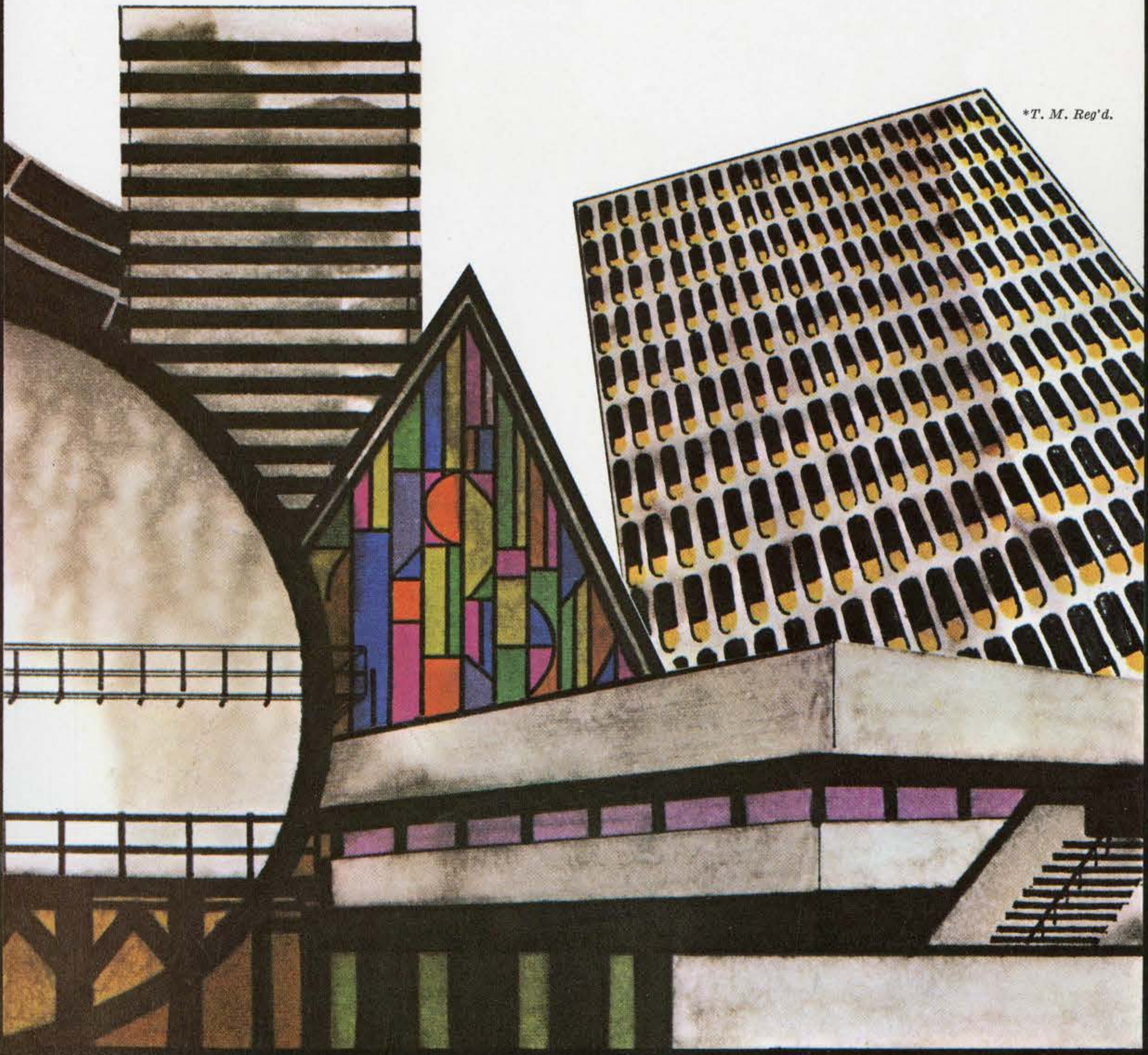

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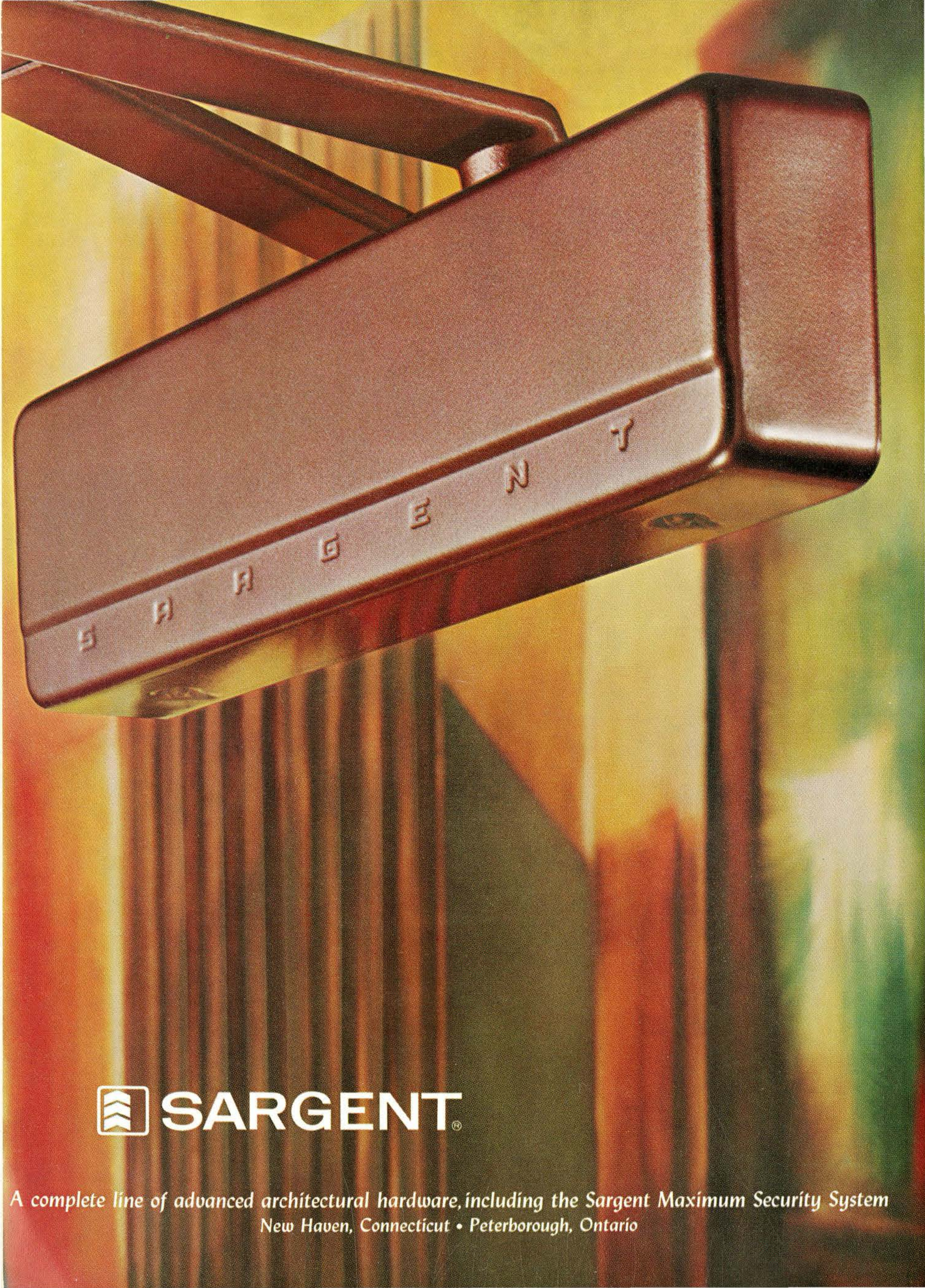
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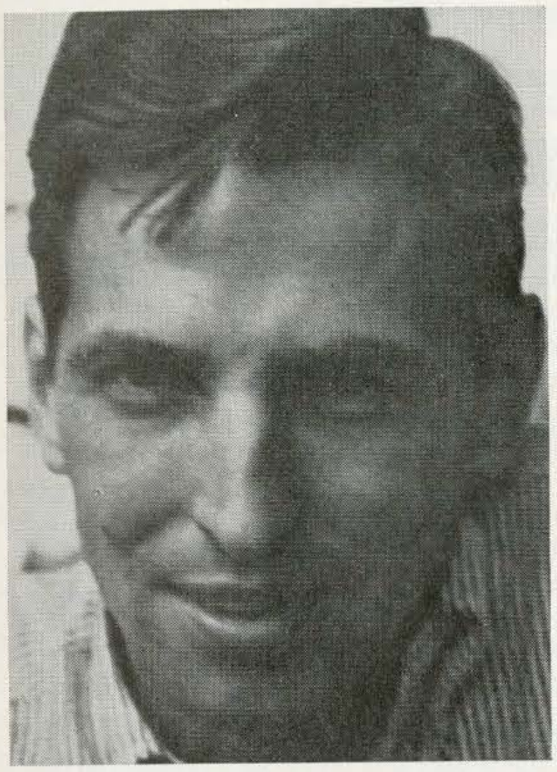

Barton Myers Joins Architecture Canada

Barton Myers, B.Sc., B.Arch (Hons, U of Pa), who was appointed assistant professor at the School of Architecture, University of Toronto last January, has joined the staff of Architecture Canada as an assistant editor. Prof. Myers, a native of Norfolk, Va., was educated at Norfolk Academy and the US Naval Academy and served as a tactical fighter pilot with the USAF in the United Kingdom from 1958 to 1961.
He graduated from the School of Architecture, University of Pennsylvania in 1964 and was afterwards employed in the offices of Louis Kahn in Philadelphia; and Bower and Fradley in Philadelphia.
Shortly after moving to Toronto Prof. Myers was appointed a member of the Architectural Advisory Committee of the National Capital Commission at Ottawa. He is also associated with A. J. Diamond in architectural practice in Toronto.

31 of 47 Competition Entries over Budget

Extract from the Report of the Jury, York Religious Centre Competition (*see Architecture Canada, May, 1968, page 7*)
"The Board of Assessors wishes to express its serious concern for the seeming inability of a high proportion of the entrants to come to terms with the area and cost limitations that were clearly defined in the program. Using two independent costing resources, the Assessors placed in one category some 31 out of 47 entries for non-compliance with the stated budget. Another category of 16 entries was established, where it was evident that with minor adjustments, the architects could expect with a reasonable degree of success to hold to the capital budget. Within the group of 16, only 10 were considered to be definitely within the stated budget, or marginally over it.
While this analysis was undertaken by independent consultants, the Assessors nonetheless made a detailed examination of all submissions which did not comply with the budget, and those which would require major adjustments to maintain the budget. At least one competitor submitted an entry which would have required more than twice the financial resources available.
The question of compliance with cost and competence of design was thoroughly re-examined by the Assessors in the hope of defining factors which would allow them to consider solutions which, while outstanding, would still have the possibility of some practical adjustments to meet the stipulated capital cost. In most cases the findings appeared to indicate an affinity between regard for budgetary consideration and overall design competence."

College of Fellows Scholarships

Two $3,500 scholarships, awarded biennally by the College of Fellows for the "advancement of architectural knowledge through travel, study or research" went this year to James McKellar, 26, of Philadelphia, formerly of Downsview, Ontario and Michèle Bertrand, 28, of Montreal.
Mr McKellar, presently associated with David A. Crane, Urban Planning & Design, Philadelphia, and teaching at the Graduate School of Fine Arts University of Pennsylvania, will continue his studies on the development of a theory of urban form.
Miss Bertrand, now with the architectural practice of Jean-Louis-Lalonde, Montreal, plans to attend the graduate School of Columbia University to obtain a Master of Science degree in Architectural Technology.

Induction of Governor General Roland Michener as RAIC Honorary Fellow, May 1, at Government House. Left to right: His Excellency; College of Fellows Registrar Neil M. Stewart (F) *and Dean, Henri Mercier* (F); *RAIC Vice-President Norman H. McMurrich* (F); *RAIC President James E. Searle* (F) *and College of Fellows Chancellor Peter M. Thornton* (F)

Developer Proposal Competitions: Three Provincial Associations Set Conditions for Sponsors and Members Participation

Concern over the increase in "development proposal competitions", or "building and land developer design competitions", as they are sometimes called, where public funds or grants are concerned, has resulted in action by two more provincial architectural associations, the AIBC and OAA, to regulate participation by their members.

First to move was the Alberta Association of Architects which, on January 27, decided that such proposals constituted illegal architectural competitions, and changed its bylaws to define the word "competition" as "more than one architect knowingly working on the same project at the same time, regardless of the agent commissioning the architect to participate". *(See A/C, Feb., page 10)*

On May 3 a special general meeting of the Architectural Institute of British Columbia voted to approve a proposal of Council that, for a trial period of one year, members be permitted to enter only such competitions as are approved by Council.

Now the Ontario Association of Architects has published Section 8 of its new Schedule of Minimum Professional Charges and Conditions of Engagement, which sets a minimum fee of 10 per cent of the professional fee for basic services, based on the competitor's total project price. Also, a professional adviser acceptable to the OAA and the party concerned should be appointed.

The Presidents of both the AIBC and the OAA point out that the rulings reflect the concern of their associations over the potential danger of waste of technical manpower and the lowering of professional standards inherent in competitions where no proper ground rules or criteria exist. "The AIBC recognizes that these competitions have a certain validity, said AIBC President John Dayton. "Our professional goal is to ensure that they are conducted in the public interest and that the entries are judged by persons who have a proper understanding of the criteria involved."

John Spence, OAA President, expressed the concern of his Association that Ontario Student Housing Corporation and Ontario Housing Corporation regulations might result in the loss of the safeguards in formal framework of bidding which has developed over the years unless adequate research is done to ensure that new procedures actually will safeguard the best interests of the public. "The purpose of the provincial Architects Act is to protect the public, not the architect," he said, "and the responsibility of the professional society which is empowered to administer the Act is to foster the development of a competent professional body to ensure that the public is in fact protected. The protection of the public in this day and age of rapidly developing technology requires that the government, as well as the profession, concern itself with the economic use of technological manpower resources. Wasteful use of these human resources is the hidden extra cost to the public, and it is for this reason that the OAA says new procedures should be proven before practices developed over the years for the protection of the public are abandoned."
In his report to the membership, Mr Spence said "the duty of the architect to maintain professional standards of service to the client and the public requires that all innovations in bidding practice be given careful individual attention and open-minded consideration by members of the Ontario Association of Architects."

OAA President's Letter to Members

The President's letter accompanying copies to members of the new Section 8 of its fee schedule said that while the section applied specifically to OHC and OSHC work, it also established conditions under which members can participate jointly with building construction firms in developer proposal competitions generally.

The views of members were solicited in March on a proposed 15 per cent of 6.5 per cent minimum mandatory fee for OSHC developer work. Only six of the firms replying opposed the proposition restriction. Subsequently the OSHC agreed to further limit presentation requirements. The OAA proposed no perspectives be required and that models should be 1/16"=1.0'. massing models only. As a result, the proposed 15 per cent mandatory fee was reduced to 10 per cent. At the same time the OAA made it clear that this action does not mean that it endorses the present detailed OSHC regulations for this type of proposal call.

It is recommended that the OSHC retain and pay the architect to carry out proper supervision of the project, including certification that the work has been constructed in accordance with the plans and specifications.

The OAA recognizes that the OSHC in assuming its management function has sought to bring an economic discipline to the individual client's program, and to relate the various programs throughout Ontario to a common standard of value.

The Corporation apparently experienced instances of a lack of design cost control on the part of some directly commissioned architects. Assuming that such errors are genuinely those of the professional members and not misdirection by the clients, the OAA has expressed its concern that such examples should not have been forwarded by the OHC to the OAA for investigation.

The Corporation has also been concerned with the "wasted time" involved in the lengthy sequential decision pattern of the method of appointing consultants to draw up comprehensive contract documents. Wasted time was particularly critical when projects had to be re-tendered because of excessive costs. Many immediate advantages were considered to be obtained by changing to the Development Proposal Call System.

1 Shorter time from inception of program to completed work. (The OAA has asked the OSHC for the opportunity to substantiate this).
2 Reduce building cost by obtaining developer proposals on short form specification and common standards, with negotiation of price, quality and design.
3 Choice of several different basic designs of the submissions in the event that their bids were within budget.

All these possible advantages were the result of the initiative of the OSHC in assuming the management role between client and developer-architect.

Unfortunately, perhaps because of the existence of the developer proposal format already in use by the Ontario Housing Corporation, the management role was not pursued to its ultimate value of effecting the maximum efficiency and cost saving for the total building industry.

In the opinion of the OAA, some of the disadvantages of a development proposal call system are:
1 It is extremely wasteful of the expense, skill and time of the design professions – construction managment and subcontract.
2 The make up of the proposal price would appear to be too informally obtained for work of substantial magnitude particularly when substantial amounts of public money are involved.

It would appear that normal subcontract bidding may often be precluded in favour of awarding contracts to sub-trades with whom the developer "can get along". While this method does avoid a duplication of estimating, it may also tend to restrict sub-trade bidding and opportunity. An informal method of letting subcontracts is open to all the questions raised by informality of bidding at not only this, but at general contract level. Rather than continuing this informal practice as a matter of convenience, steps should be taken to retain formal contractual bidding at all levels by revising the system. This is considered particularly desirable when corporations deal with public funds. A saving of first cost, or documentation, or even time, is not *necessarily* in the public interest.

The OAA has therefore recommended that OSHC consider extending its role in management to include cost control as a departmental function from the inception of the program with the client to the completion of the construction contract. When this function of cost is assumed by the management Corporation with its background of experience from projects already

under way, it has been further recommended that the developer proposal call system of bidding revert to a revised consultant-appointed, contractor-bid system with Management cost control in order to retain the formal method of competitive tendering for projects involving public funds.
The inclusion of the Corporation cost control function would do much to update the traditional bidding system if considered in conjunction with the following suggestions:

1 Prequalification of architects, taking into account expertise and satisfactory cost control experience in the particular area of practice.
2 The commissioning of an architect dependent upon his ability to satisfy the cost control requirement of the Corporation throughout the evolution of the design and the construction documents.
3 The preparation of bills of quantities by the corporation cost control function during the preparation of documents, both for use in checking the pre-tender estimate of cost, and for issue to all general contractors tendering the project for the purpose of substantially reducing the duplication of competitive estimating time and quantitative errors involved in the traditional bid system.

The OAA has also recommended to the OSHC that further study should be undertaken of all variations of present bidding systems with a view to improving bidding practice, avoiding duplication of service and effecting an economy in the use of the skilled manpower resources of our design professionals and construction management and estimating specialists at a time when all these skills are urgently needed to satisfy the construction demands of our expanding economy. Many new forms of increasing management participation in the design process are inevitable with the increasing complexity of building technology and the evolution of a systems approach to building. Some of these new 'modern methods of saving time and cost' may make irresponsible claims which cannot be refuted because the truly comparable competitive costs and qualities of such projects are conveniently never obtained or tabled. □

Addition to OAA Fee Schedule

1 The party seeking to hold development proposal competitions involving architectural services should appoint a professional advisor acceptable to a party concerned and the Ontario Association of Architects. The party concerned and the advisor should agree to the rules of the development proposal competition and a provision for an appropriate fee for professional services which should be made known to those wishing to participate.
2 In the event the professional advisor, as above, is not appointed, an architect engaged by a competitor shall charge a fee for work up to and including the submission of the proposal which shall not be less than 10% of the professional fee for basic services based on the competitor's total project price. Where repetitive units are involved, the professional fee may be reduced in accordance with the Schedule of Minimum Professional Charges and Conditions of Engagement. This fee shall include all necessary preliminary sketch engineering but not engineering nor architectural construction drawings.
3 When submitting designs for development proposal competitions, where a professional advisor is not appointed, the architect's fee to the competitor may be based upon the time expended which shall in no case be at a rate of less than $200.00 per day net for the architect's own fee (principal of a firm). If more or less than seven hours in any one day are occupied by the work, the actual number of hours shall be charged at the appropriate per diem rate. Where services of assistants are involved, the architect shall receive, in addition to his own fee, payroll costs of his assistants (architects, draftsmen and operating personnel) plus 150% to cover overhead and profit, plus direct costs such as consultant's fees, printing and models. The minimum fee outlined in 2 above applies to this alternative.
4 An architect engaged as aforesaid shall, on request, submit to the Association details of his professional charges to his client competitor.

Conditions to be Observed by Owner or Sponsor in British Columbia

The new professional ruling adopted by the Architectural Institute of British Columbia for one year trial period states:
1 That a standing Committee of architects appointed by Council approve the project as appropriate for a competition having regard to its nature, complexity and any other factors that the Committee deems relevant.
2 That the Committee appointed by Council as aforesaid nominate a Board of Advisors consisting of such professionals including architects or other persons as the Committee may deem appropriate for the purpose of advising the sponsor, preparing competition conditions and enforcing performance thereof; determining qualifications of competitors, establishing compensation of competitors and in general, deciding on the method of competition to be held.
3 That the Board of Advisors, together with such other persons as they may choose to add to their numbers for the purpose, act as a jury of assessors with power to select the successful competitor.
4 That the sponsor will subscribe to the terms of engagement of the successful entrant recommended by the Board of Advisors.
5 That the members of the Board of Advisors and any persons added thereto for the purposes of assessing entries, be paid by the sponsor such amount as may be agreed upon.

Mr John Dayton, President of the AIBC, pointed out that the ruling reflects the AIBC's concern over the potential dangers of waste and the lowering of professional standards inherent in competitions where no proper ground rules or criteria exist.

The resolution carried by the membership was as follows:
1 The Council of the Institute referred the matter of developer competitions to a Committee for study;
2 The Committee has prepared a detailed report in general concluding that in many cases competitions result in waste, overall increased costs, reduced standards of design and otherwise, and are to the detriment of the participants and not in the best interests of the public generally;
3 Council has interpreted the by-laws of the Institute in that more than one architect may not submit any form of service for the same project except through the medium of an approved competition or as may be specifically approved in writing by Council;
4 Council has concluded that under some circumstances developer competitions may be justified and that for a trial period architects be permitted to enter into certain competitions hereinafter described and approved by Council.

Members' Expenses at RAIC/AIA Chicago Assembly-Convention ARE Deductible

We regret exceedingly the consternation which resulted from publication in the May issue of a bulletin exactly as received from the Deputy Minister of Internal Revenue about convention expenses and the Income Tax Act. The Department found it necessary to issue the bulletin because business and professional organizations are exposed to a good deal of persuasion from tourist and convention centers all over the world and, of course, from the transportation facility that gets you there. The latest one is self-contained: "Make your convention an ocean cruise". Hence the warning.

The warning does not apply to members' expenses for the joint RAIC/AIA Assembly-Convention at Chicago next spring.
In response to a request for a ruling, the Compliance Branch, Taxation Division, Department of Internal Revenue on June 10 wrote RAIC Headquarters as follows: "Re Information Bulletin No 38, Convention Expenses: Referring to your letter of June 6, this is to confirm the advice that was conveyed to you orally that the above-mentioned Bulletin is not applicable to the 1969 Convention to be held in Chicago, Ill., that is being sponsored by the American Institute of Architects and the Royal Architectural Institue of Canada. It will be in order for you to so notify your membership, and we shall advise our District Offices and anyone who may inquire directly. (Signed) C. N. Brennan, Chief Technical Officer."

1968 Pilkington Scholarship Winner Killed

We regret to announce the death in an accident in Vancouver on June 16th of Richard B. Jackson, 24, the University of Manitoba School of Architecture Student awarded the 1968 Pilkington Scholarship.

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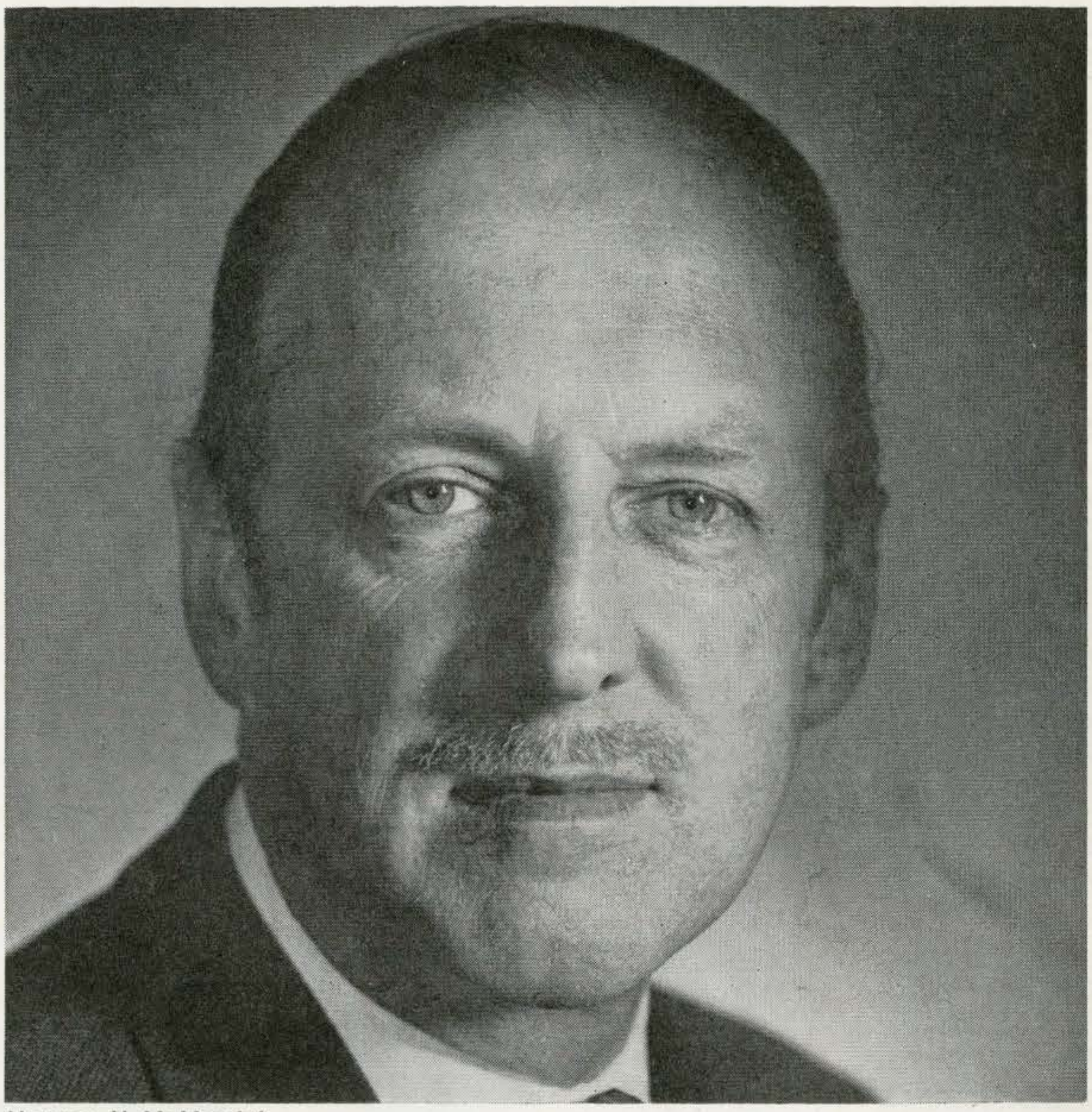
Officers/Direction

Norman H. McMurrich *(F)*, Toronto, Ontario was elected President of the Royal Architectural Institute of Canada for 1968-69 at the 61st Annual RAIC Assembly at Regina, Sask., May 29th - June 1st. He succeeds James E. Searle *(F)* of Winnipeg. Other officers elected were Vice-President, William G. Leithead *(F)*, Vancouver; Honorary Secretary, Gordon R. Arnott *(F)*, Regina; and Honorary Treasurer, Harry Mayerovitch *(F)*, Montreal.

1968 Councillors are: A. W. Davison, Ottawa; Allan F. Duffus *(F)*, Halifax; D'Arcy Helmer *(F)*, Ottawa; M. P. Michener *(F)*, Winnipeg; Jean-Louis Lalonde, Montreal; John R. Myles *(F)*, Saint John; F. Noseworthy, St John's; C. F. T. Rounthwaite *(F)*, Toronto; Robert W. Siddall *(F)*, Victoria; D. L. Sinclair, Edmonton.

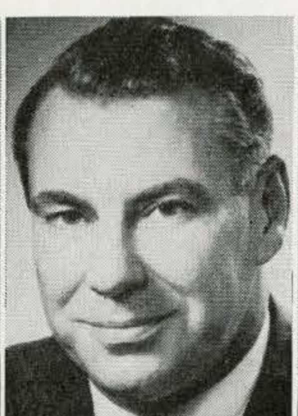
Mr McMurrich, senior partner in the firm of Somerville, McMurrich & Oxley, Don Mills, Ontario was born in Toronto and received his Bachelor of Architecture degree in 1946 at the University of Toronto. During World War II he served overseas with the 48th Highlanders in England, Italy, Holland and Belgium.

Mr McMurrich has served in an executive capacity and on boards and councils of the Ontario Association of Architects, the Canadian Council of the Arts, the Toronto Chapter of the Canadian Cancer Association and the RAIC. He was elected a member of the College of Fellows of the RAIC in 1963. He is a member of the University Club of Toronto and the Arts and Letters Club of Toronto.

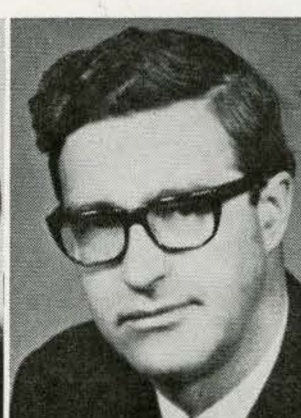


Norman H. McMurrich

James E. Searle



William G. Leithead



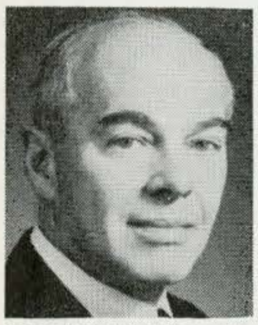
Gordon R. Arnott

Harry Mayerovitch

Norman H. McMurrich *(F)* de Toronto a été élu Président de l'Institut Royal d'Architecture du Canada pour l'année 1968-69 à l'occasion de l'assemblée annuelle qui a eu lieu au Regina Inn à Regina, Saskatchewan et a ainsi succédé à James E. Searle *(F)* de Winnipeg. D'autres officiers élus étaient W. G. Leithead *(F)* Vice--président, de Vancouver, Gordon R. Arnott *(F)* Secrétaire honoraire, de Regina et Harry Mayerovitch *(F)* Trésorier honoraire, de Montréal.

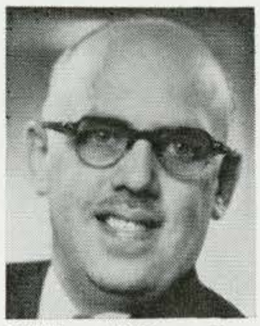
College of Fellows
College des Fellows

New Members, 1968 Convocation
Nouveaux membres, Convocation 1968

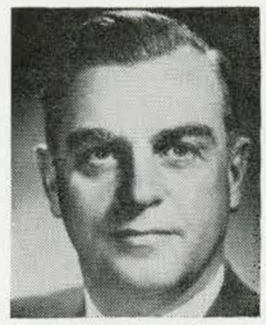


Charles M. Nes, Jr, Honorary Fellow

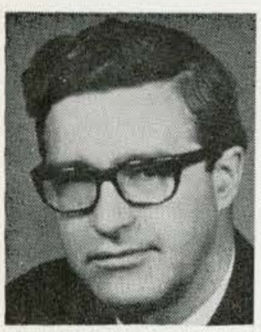
At the 1968 Convocation held on June 1 at the RAIC Assembly, Regina Inn, Regina, the College of Fellows conferred 11 Fellowships and one Honorary Fellowship, the latter to Charles M. Nes, Jr, FAIA, the 1966-67 president of the American Institute. Mr Nes practices in Baltimore, Maryland and is a member of the AIA Headquarters, Octagon House Committee and the Committee on the Future of the Profession. Elected by the College but not present at the convocation were Aimé Desautels, Montreal; Arthur Erickson, Vancouver. The new members of the College of Fellows appear below:



William Edison Barnett, B.Arch, Toronto, graduated from the University of Toronto in 1938. He became a member of the OAA in 1941 and has served on many of its committees. He is a senior partner in the firm of Barnett and Rieder, responsible for many large buildings throughout Ontario including reformatories at Millbrook, Galt, Guelph and Brampton; CFTO Television Station and the Metropolitan Don Jail in Toronto. Mr Barnett was particularly active as a member of the committee concerned with the restoration of St Lawrence Hall, Toronto, and is currently editing a book which will outline its history and the role of Toronto architects in its restoration.



John Michael Dayton, B.Arch, West Vancouver, was born in Vancouver and attended high school there. He graduated from the University of Manitoba in 1948. He joined the firm of Thompson, Berwick, Pratt and Partners in 1946 and became a partner in 1955. Mr Dayton is partner in charge of banks, commercial structures and office buildings, with emphasis on development costs and investment return. He is a past Chairman of the Vancouver Chapter of the Architectural Institute of British Columbia, has served the AIBC as a member of Council, as Vice-President and currently as President.



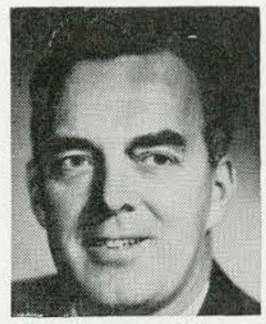
Gordon Ryan Arnott, B.Arch, Regina, graduated from the University of Manitoba in 1948 where he was awarded several scholarships and the RAIC Medal. A member of both the Saskatchewan and the Manitoba Associations of Architects, he has served on the SAA Council since 1959 and was its President in 1961-62. He has been on the RAIC Council since 1962 and this year was elected Honorary Secretary. Mr Arnott has been active in the CPAC, the Norman McKenzie Art Gallery Society and the Regina Community Planning Commission. In 1954 he joined with K. Izumi and J. S. Sugiyama under the firm name of Izumi, Arnott and Sugiyama. Since April 1, Mr Arnott has continued the practice as Gordon R. Arnott and Associates.

James Brock Bell, B.Arch, Edmonton, received his degree from the University of Manitoba in 1950. He entered private practice the following year and is now senior partner in the firm of Bell, McCulloch, Spotowski and Associates, Edmonton. Some of the most recent developments designed by Mr Bell's firm include the Medical Association Building and the Royal Bank Building, Edmonton. His firm received the Precast Concrete Association Award for the Research Laboratories Building. Mr Bell has long been active in the Alberta Association of Architects. He helped to establish the Edmonton Chapter in 1951 and was AAA President in 1960. In 1958-59 he was a member of the RAIC Council.

Douglas Charles Haldenby, B.Arch, Toronto, graduated from the University of Toronto in 1950. That year he joined the firm of Mathers and Haldenby and has been senior partner since 1964. Recent projects for which his firm has been responsible are the National Library and Archives Building, Ottawa, residences for York University, Glendon Hall Campus, Toronto; the addition to University College Library, University of Toronto; and the master plan development of the Toronto General Hospital. Mr Haldenby has been a member of the Ontario Association of Architects since 1952 and has served on many of its committees. He is currently Chairman of the OAA Registration Board.

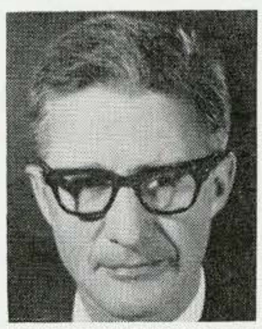
Mel P. Michener, B.Arch, Fort Garry, received his degree from the University of Manitoba in 1952. A member of the Manitoba Association of Architects and the OAA, he has served both as Vice-President and President of the MAA and is a member of the RAIC Council. He is a senior partner in the firm of Libling Michener and Associates, the winners of four Massey Medals and four National Canadian Housing Design Council Awards. Some of their principal works are, the Manitoba Medical Services Building and St. John Brebeuf Church. Mr Michener is particularly active in community work, serving as President of the Age and Opportunity Bureau in 1965 and Chairman, Winnipeg Branch CPAC in 1966.

Victor Prus, Montreal, was born in Poland and studied architecture, engineering and urban design in Warsaw, Paris and England. After graduating in England in 1946, he travelled extensively, taught architectural design and practiced in the U.K.
He came to Canada in 1952. He is an Associate Member of the Royal Institute of British Architects and a member of the Province of Quebec Association of Architects and has served as a member of Council of the PQAA. Mr Prus is in private practice in Montreal and has been awarded various prizes in architectural competitions in Canada and abroad. Among his most recent works are two subway stations in Montreal, and the Expo 67 Stadium.

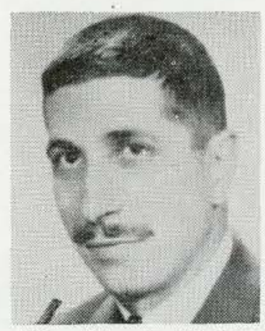


Ray Leonard Toby, B.Arch, West Vancouver, graduated from the University of British Columbia in 1950. He started his own practice in 1954 and is now senior partner in the firm of Toby Russell and Buckwell. Among the buildings his firm has been responsible for are: the West Vancouver Municipal Hall; the Municipal Hall in Surrey, B.C.; and Holy Name Church in Vancouver. He was awarded the RAIC Medal in 1950 and a Mention in the 1965 Massey Medals Competition. Mr Toby has served on the Council of the AIBC from 1961-1964. He is a former member of the Vancouver Civic Design Panel and the Downtown Redevelopment Advisory Board.

John Robinson Myles, B.Arch, Torryburn, NB, was awarded the Distinguished Flying Cross and the American Air Medal during the war. He continued his education after the war and graduated from the University of Manitoba in 1950. In 1951 he was registered with the Architects Association of New Brunswick. He is now senior partner in the architectural firm Mott Myles and Chatwin, in Saint John, having become associated with H. C. Mott *(F) as a* draftsman in 1946. Mr Myles has served the AANB as Secretary-Treasurer since 1959 and is a member of Council of the RAIC. Some of the principal buildings for which his firm has been responsible are the Saint John General Hospital Extension and Lord Beaverbrook Civic Centre and Library.

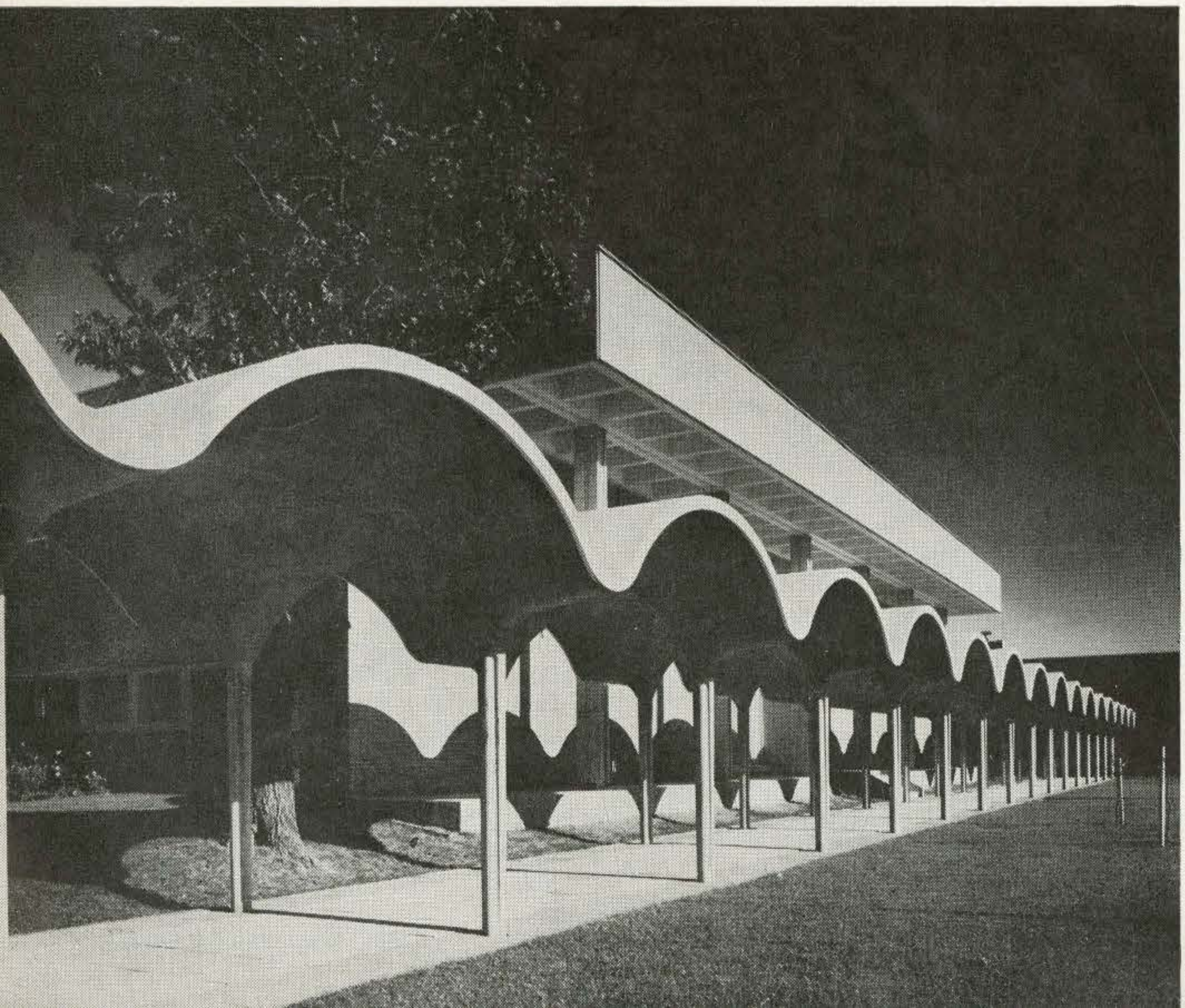


Robert Stirling Ferguson, B.Arch, Ottawa, won the McLennan Travelling Scholarship and the RAIC Student Medal while attending McGill University. He graduated in 1939 and served overseas with the Royal Navy until 1945. After working with the Department of Reconstruction Research and Development, CMHC, the firm of Hazelgrove and Lithwick, Ottawa, in 1948 he joined the Division of Building Research, National Research Council. He has been a senior research officer there since 1957 and has become an outstanding authority on building codes. Mr Ferguson is member of the OAA, the Community Planning Association and the American Society of Planning Officials. He has served on several OAA, RAIC and Government committees.



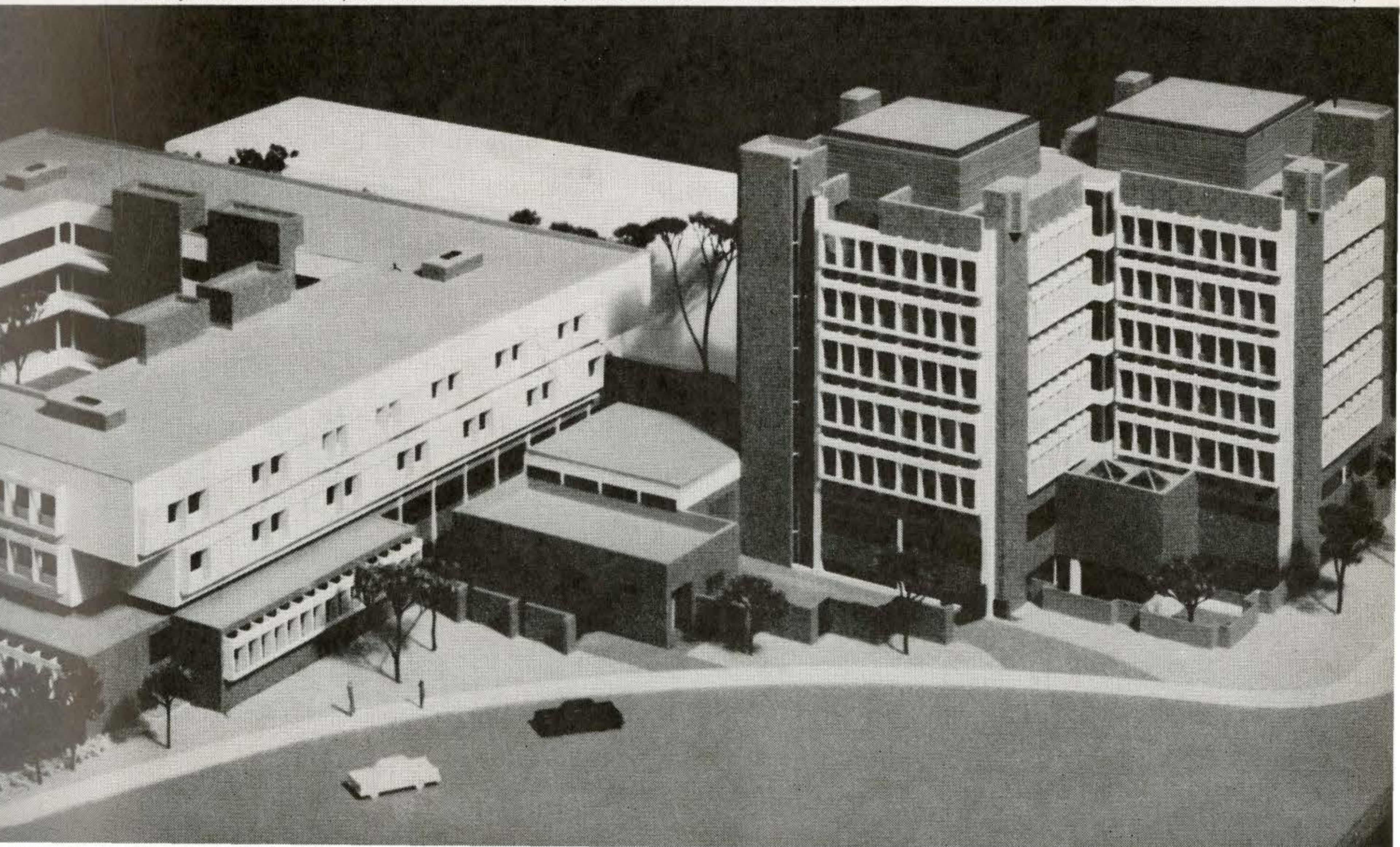
Allan Harvie Waisman, B.Arch, Winnipeg, graduated from the University of Manitoba in 1950. He is a member of both the Manitoba and the Ontario Associations and is an Associate Member of the Royal Institute of British Architects. He was a MAA Council Member from 1961-1965 and has been Chairman of the MAA Committee on Planning and Civic Design since 1965. Mr Waisman was a founder of the Manitoba Design Institute; served as the first Chairman of the Advisory Committee on Civic Design to the Metro Corporation of Greater Winnipeg; is a Director of the Winnipeg Art Gallery and Vice-President of the Royal Winnipeg Ballet. He is a senior partner in the firm, Waisman Ross Blankstein Coop Gillmor Hanna. His firm has won two Massey Medals and several Mentions.

School for the Deaf, Milton, Ontario · Architect: Marani, Rounthwaite & Dick · Contractor: Frid Construction



Jewish Home for the Aged, Toronto • Architect: Marani, Rounthwaite & Dick • Associate Architect: Jerome Markson • Contractor: Redfern Construction

Alcoholism and Drug Addiction Research Foundation, Toronto
A Project of the Ontario Dept. of Public Works • Hon. Ray Connell, Minister • Associate Architects: Marani, Rounthwaite & Dick • Contractor: Robertson-Yates Corp.



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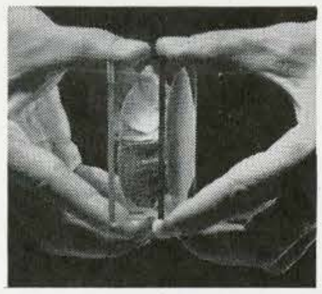

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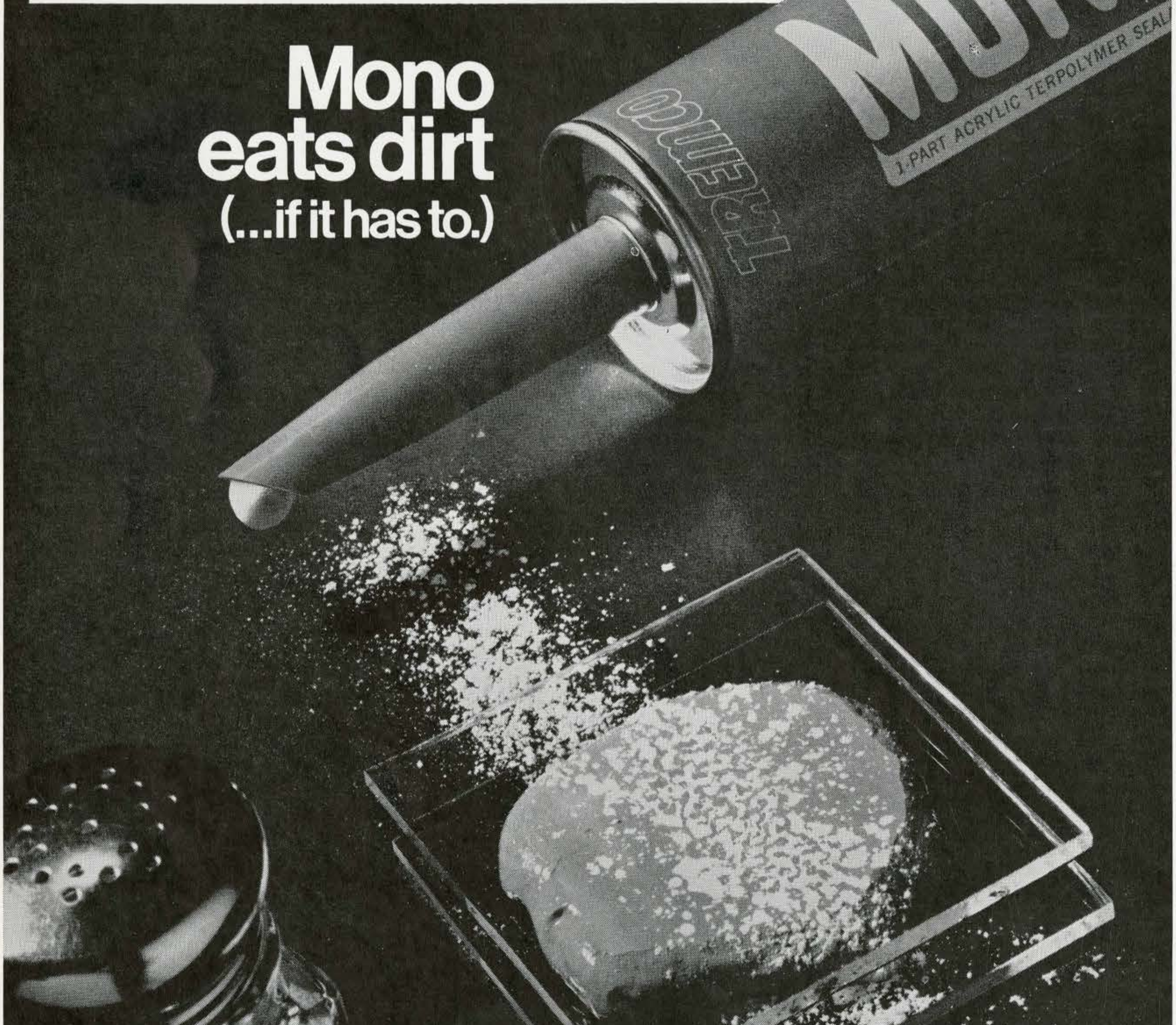

Communiqué 2

Two Conferences

Two conferences of interest and importance to architects took place at the end of April: the first, *Euthenix/68* held at Place Bonaventure in Montreal, April 24-24-26, drew about 150 Quebec architects, engineers, planners and others concerned in the creation of the total environment; the second was the *National Conference on a Systems Approach to Building* held in the National Capital, April 29-30. The Ottawa Conference, co-sponsored by the Federal Department of Industry, the Royal Architectural Institute of Canada, the Association of Consulting Engineers of Canada and the Canadian Construction Association, brought over 450 architects, engineers and construction industry executives together to what is believed to be the first national conference of its kind. Its concern, in the words of Industry Minister Drury, was with "a rational and logical way to co-ordinate the total building effort, so that all segments of the construction industry work in unison to enable proper planning and systematic organization to be applied to the construction of projects. "The result", said Mr Drury "will be greater efficiency and lower costs in the industry." A further report on the conference by Technical Editor Frank Helyar, appears on page 63. President James E. Searle *(F)* headed the RAIC representation; Camille Dagnais the ACEC group and A. W. Purdy the CCA.

Euthenix, as defined by the sponsors of the seminars, is the science of improving living conditions, and the decision to arrange the seminars was made at the annual assembly of the Province of Quebec Association of Architects in January. The Congress was called jointly by the PQAA and the other professional bodies in Quebec, the Corporation of Engineers, the Industrial Designers, the Landscape Architects and the Urbanists. Fred Lebensold, MRAIC, was Congress President, Industrial Designer Henry Strube acted as Congress Director and Andre Payette and Patrick Watson were the moderators. Participants, workshop leaders and panelists included elected members of government, public administrators, representatives of the construction industry, developers, students, sociologists, economists and geographers.

Ian Maclennan *(F)*, Vice-president of CMHC, enlivened proceedings with the forthright statement that provincial governments ignore urban problems because they fear a loss of political power to the cities and therefore will not give municipalities an appropriate share of taxes and powers; at the same time he castigated Toronto for upgrading building standards specially to ensure a higher tax yield from more costly residential properties.

Familiar to Montrealers among the speakers was William Zeckendorf Sr, the New York real estate developer, former head of the Webb and Knapp real estate empire, which built Place Ville Marie. In a speech ranging over the whole subject of Euthenix and his own career, he emphasized, as he has so often in the past, that good development entrepreneurs always try to make their projects a combination of beauty and profitability. Much that was built lacked the first of these qualities, but this was the fault of banks and insurance companies which financed valueless schemes. Mr Zeckendorf's present interest is in domes on a huge scale and these, he predicted, were the coming things for places of public assembly.

Deux Conférences

Deux conférences d'un intérêt particulier et d'une grande importance pour l'architecture se sont déroulées à la fin avril; la première, Euthenix 68 a eu lieu Place Bonaventure à Montréal, et attirait environ 150 architectes, ingénieurs et autres groupes intéressés à la création de l'environnement total; la Conférence Nationale sur l'Approche systématique à la construction, s'est tenue dans la Capitale entre le 29 et 30 avril et fut organisée par le Département de l'Industrie, l'Institut Royal d'Architecture du Canada, l'Association des Ingénieurs Conseils du Canada et l'Association Canadienne du Bâtiment. Elle a attiré 450 architectes, ingénieurs et dirigeants de l'industrie du bâtiment à une conférence, considérée comme étant la première du genre. Son but principal, selon M. Drury, Ministre de l'Industrie, sera de coordonner l'effort total de la construction d'une façon logique et rationelle. Il en résultera, a dit M. Drury, un rendement supérieur et des prix inférieurs pour l'industrie". Un rapport supplémentaire par notre rédacteur technique Frank Helyar se trouve à la page 63. M. James E. Searle, Président conduisait la délégation de l'IRAC; Camille Dagenais le groupe ACEC et A. W. Purdy la CCE.

Euthenix est la science de l'amélioration du standard de vie. La décision pour cette séance d'étude a été prise à l'Assemblée des Architectes de la Province du Quebec en janvier dernier. Elle fut organisée conjointement par cette dernière et d'autres associations professionnelles. Fred Lebensold remplissait les fonctions de Président, Henry Strube faiait office de Directeur et André Payette ainsi que Patrick Watson étaient les modérateurs. Ian Maclennan *(F)* Vice-président de la CMHC a déclaré que les gouvernements provinciaux ne tiennent pas compte des problèmes urbains de peur de céder leur pouvoir politique aux villes et par conséquent n'accordent pas aux municipalités les pouvoirs et fonds nécessaires. En même temps, il accusa Toronto d'augmenter les standards de construction afin d'obtenir des impôts plus élévés pour des propriétés coûteuses. William Zeckendorf Sr, promoteur célèbre de la Place Ville Marie se trouvait parmi les orateurs. Son discours traitait de l'Euthenix, effleurait sa carrière et soulignait que les bons entrepreneurs-promoteurs recherchent toujours dans leurs projets une combinaison de beauté et de profit. Beaucoup de constructions manquent à la première de ces qualités et la faute en incombe aux banques et compagnies d'assurances qui ont financé des projets sans valeur. L'intérêt de M. Zeckendorf se portera désormais sur la construction de dômes à grande échelle, car ceux-ci représentent l'avenir pour les places publiques et lieux de réunion.

Why bolting is the preferred method for all structural steel connections!

6801/2

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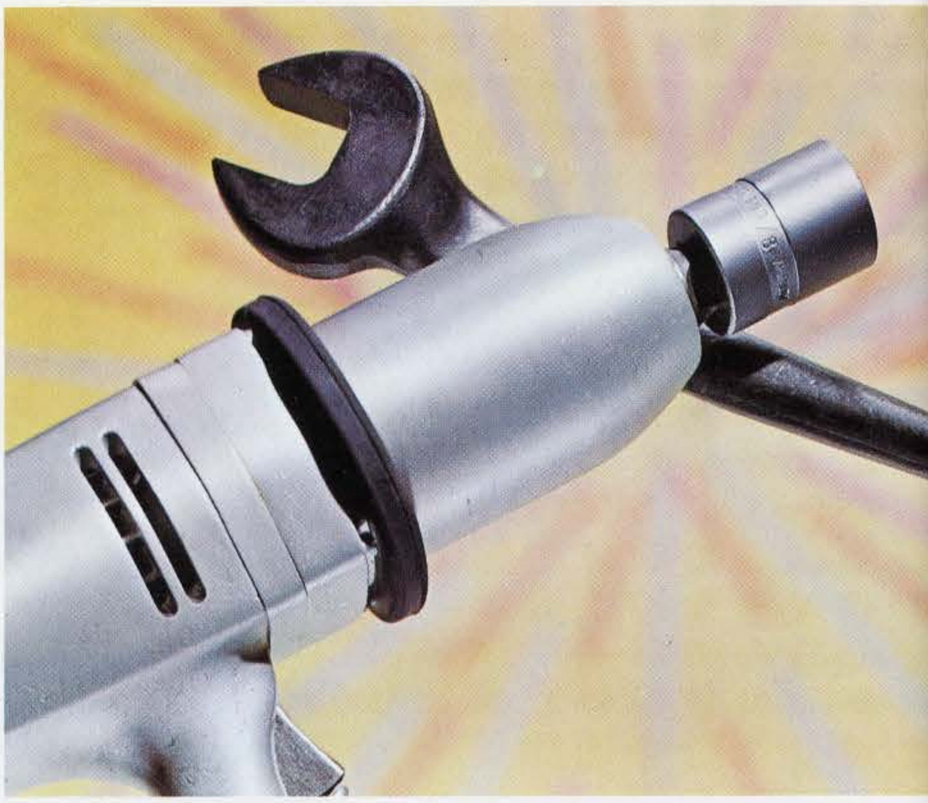

Bolting is simple. All it needs is a spanner and power wrench. Other fastening methods require more costly equipment and more extensive facilities.

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A wide range of sizes manufactured in strict conformity with all required specifications is available.

A booklet covering the latest specifications for High-Strength Bolts is available upon request from Stelco's Department "A", Wilcox St., Hamilton, Ontario.

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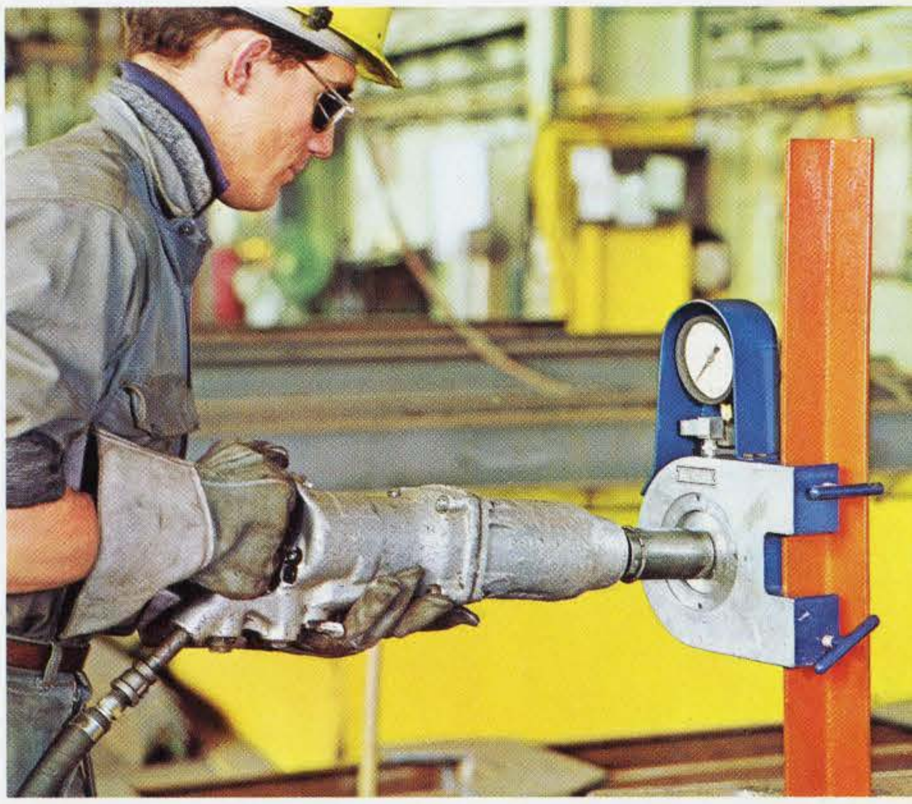

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High-strength bolting helps bring buildings to their income-producing stage earlier. Faster steel erection cuts construction time.

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Otis: Quality leadership, experience, sales and service in all vertical transportation products.

Otis says:
better elevatoring is our business.

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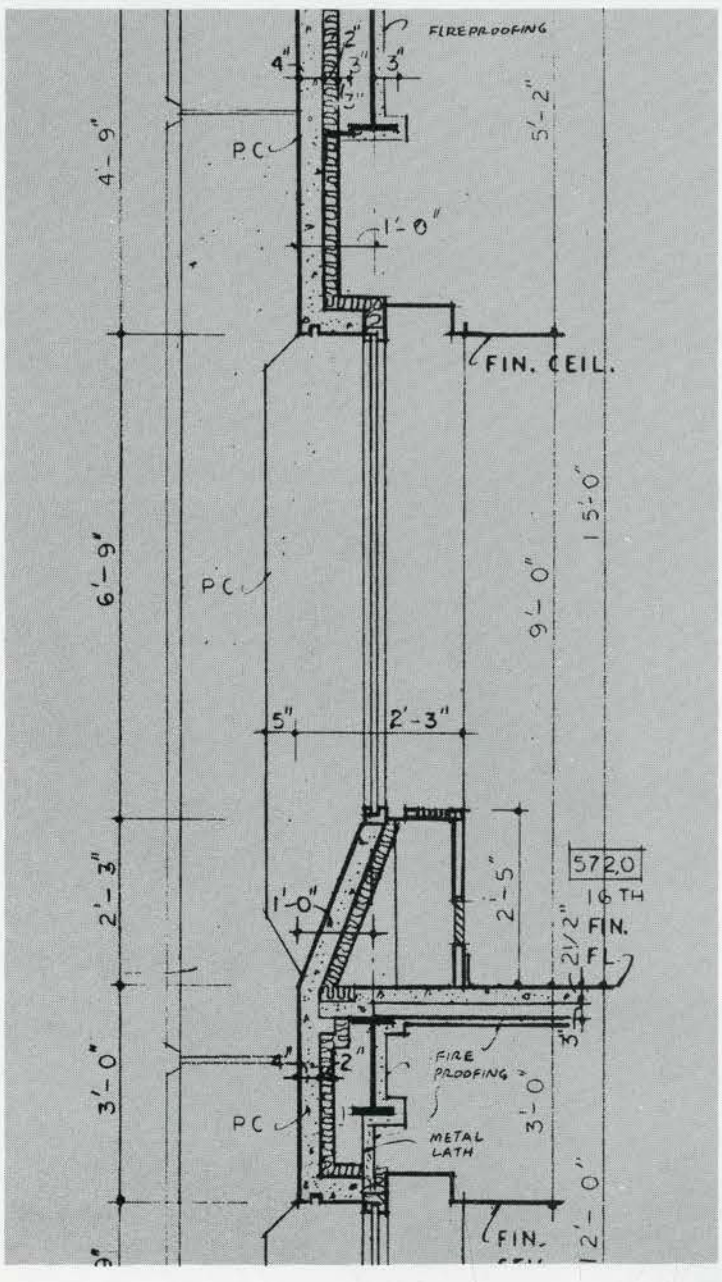
VB1243A

STYROFOAM FR brand plastic foam insulation, Construction Materials Sales, Dow Chemical of Canada, Limited.

Architects: Marani, Rounthwaite & Dick, Toronto, Ontario.
Panel Manufacturers: Pre-Con Murray Ltd., Toronto.
Contractors: E. G. M. Cape & Co. (1956) Ltd., Toronto.

Superior insulation helped the builders of 250 Bloor East strive for perfection in environmental control.



250 Bloor East, in Toronto, is a quality business address in the fullest sense, designed to offer the highest standards of comfort and convenience to its many tenants. One of these also happens to be the owner—Manufacturers Life Insurance Company—whose office-planning expertise is based on world-spanning experience. So more than usually meticulous attention was paid to every detail.

According to Bill Duthie, Manufacturers Life Executive Assistant then in charge of the project, the Architects (Marani, Rounthwaite & Dick) could rarely have had a tougher client. Close attention was paid to research conducted by The University of Toronto Department of Physiological Hygiene, which has established a direct link between finely controlled humidity in the working area and improved employee health and efficiency. As a result, not least among the refinements of 250 Bloor East are balanced humidity with all-season air conditioning and zone temperature controls.

Fundamental to the successful operating of these comfort features is exceptional insulation. The architects wanted a material that: would provide a permanent insulating value; needed no separate vapour barrier; would not rot, mould, settle or delaminate with time; would not attract vermin, insects, or bacteria; would be flame-retardant; could also act as a plaster base.



Obviously, only a rigid insulation was equal to the task; and a polystyrene foam one at that. In its capacity to meet *all* these demands without escalating construction costs, one stood out above all others: STYROFOAM FR brand plastic foam. With its non-interconnecting cell structure that retards moisture vapour, and its constantly low "k" factor (0.26 at 75°F. mean temperature), here was the superior thermal barrier they were looking for.

For the Contractors (E.G.M. Cape & Co.), STYROFOAM FR brand plastic foam offered the immediate advantages of extreme light weight (only 1.8 lb/cu. ft.), high compressive strength (30 p.s.i. at 5% deflection), and the ease with which it handles and cuts. Much of it was preformed and bonded directly to the pre-cast concrete slabs which were later transported and hoisted into place on site. A good indication of its quality is that outside storage, exposing it to the ravages of winter, plus all the heavy-duty handling that followed, caused no significant deterioration.

The remaining STYROFOAM FR brand plastic foam was cut and applied on site, sheet by sheet as the building took shape. In every case, its easy handling and clean cutting properties—with no need for special tools—plus the fact that plaster could be applied directly without lathing, proved valuable assets in saving time and installation costs.

With 250 Bloor East finished and occupied, the advantages that STYROFOAM FR brand plastic foam offered to its specifiers are now being appreciated by the people it surrounds. Few of the tenants may be aware that there is no equivalent to STYROFOAM. Yet every day of their working lives, all of them are benefiting from the presence of this exceptional insulation.

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250 Bloor East, Toronto. An outstanding example of harmony between function and design...engineered to provide the total comfort of controlled humidity. And an ideal example of the functional application of permanent STYROFOAM* FR brand plastic foam insulation. Made exclusively by Dow Chemical of Canada, Limited.

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New Initiatives and the Architect

E.A.T., a New Organization, Forms a Subsidiary in Canada.

Experiments In Art and Technology: a Brief History

The decision to form Experiments in Art and Technology Inc. (E.A.T.) developed from the experience of producing the performance series, "Nine Evenings: Theater and Engineering" held at the 69th Regiment Armoury in New York, October 1966. Forty engineers and ten well known, avant-garde artists worked together to develop technical equipment which was used as an integral part of the theater, dance and music works. During the preparations for "Nine Evenings" it became clear that if a continuing and organic artist-engineer relationship was to be achieved, a major organized effort had to be made to set up the necessary physical and social conditions.

In November, 1966, a meeting was held for artists in New York City to find out if E.A.T. as an organization could work to provide the artists with access to the technical world. Over 300 artists, engineers, and other interested people attended and the reaction was positive. Billy Kluver, a physicist in laser research at the Bell Telephone Laboratories, became president and artist Robert Rauschenberg, vice-president. Membership was opened to all artists and engineers.

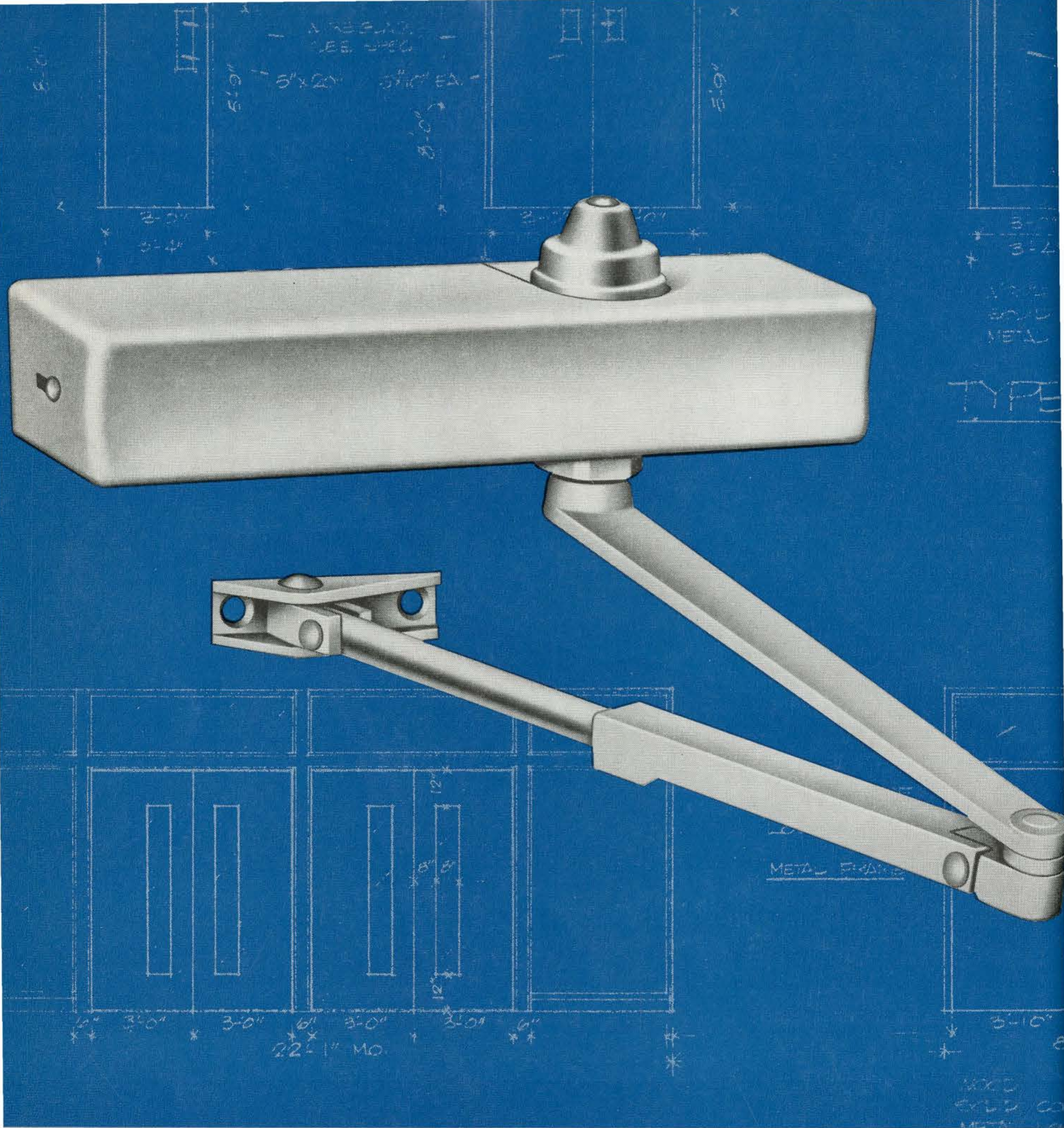
To involve the artist with the relevant forces shaping the technological world, the artist must have access to the people who are creating technology. Thus it was decided that E.A.T. act as a matching agency, through which an artist with a technical problem or a technologically complicated and advanced project be put in touch with an engineer or scientist who could collaborate with him. E.A.T. not only matches artists and engineers to work on collaborative projects but also works to secure industrial sponsorship for the projects that result from the collaboration.

E.A.T. aims to involve industry and also to gain the interest and support of other institutions in society: universities, foundations, labor, even politics. These broad contacts will cut across traditional boundaries and facilitate the completion of projects initiated by the artist-engineer collaboration. E.A.T. is founded on the

1

A theater and engineering experiment begun as an American contribution to the 1966 Stockholm Festival. After ten months of development, and collaboration between artists and engineers it emerged as a series of performances in New York's 69th Regiment Armory. Painter and choreographer Alex Hay's piece (his face is projected on screen by TV in front of him and artist Rauschenberg carries the flag)

La pièce d'Alex Hay, qui a débuté comme expériment tecnique et théatral, fut la contribution américaine au Festival de Stockholme en 1966. Après dix mois de collaboration entre ingénieurs et artistes elle est maintenant sortie à New York. Sur l'écran apparait l'image de l'auteur et en face de lui Rauschenberg, porte-drapeau.



2
Dancer and choreographer Deborah Hay's piece
Deborah Hay, danseuse et chorégraphe

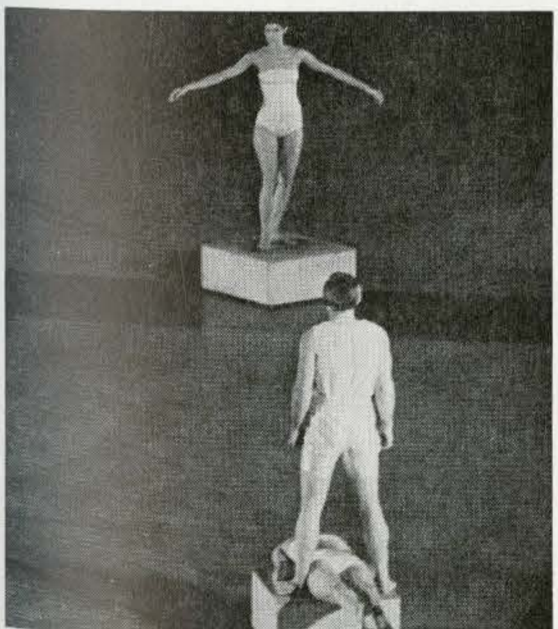
3
Engineer Fred Waldhauer moves flashlight bulb over electronic board which triggers lights and speakers across a room. Studying the correlation of visual reaction to the position of the flashlight bulb are (left to right) artists David Tudor, Deborah Hay and engineer Billy Kluver
Fred Waldhauer en déplaçant l'ampoule au dessus du tableau électronique, délenche les lumières et hauts-parleurs de la pièce. Regardant l'expériment (de gauche à droite) les artistes David Tudor et Deborah Hay ainsi que l'ingénieur Billy Kluver

4
Artists and engineers examine ground effect machine which permits dancers to literally float on a cushion of air with no physical exertion
Artistes et ingénieurs examinent la machine qui permet aux danseurs de flotter sans aucun effort sur un coussin à air

strong belief that an industrially sponsored, effective working relationship between artists and engineers will lead to new possibilities which will benefit society as a whole.

It is not surprising that in view of activity in Canada of art and industry (see series in Arts section, *Architecture Canada,* February and March) that interest in this organization resulted in a subsidiary group being founded under the sympathetic encouragement of the Ontario Art Gallery in April.

Amongst the forty people invited to attend were: Anne Brodzky, editor, *Arts Canada;* Anita Aarons representing *Architecture Canada;* Professor Leslie Mezei of the Department of Computer Science, University of Toronto; Paul Sommerskill, Ontario Council for the Arts; Avrom Isaacs, Isaacs Gallery, Toronto; William J. Withrow, director, Art Gallery of Ontario; Udo Kasamets and various engineers working in electronics. After a lively and vocal meeting very positive decisions were made for an E.A.T. group to be formed with temporary headquarters at the Art Gallery of Ontario. The first aim, to increase membership by awareness of activity, was to arrange an informal demonstration evening at the studio of artist, Bob Wise, 567 Queen Street, Toronto.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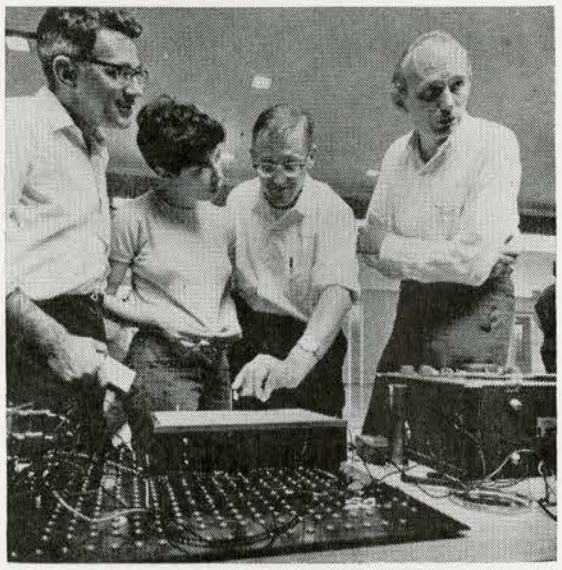
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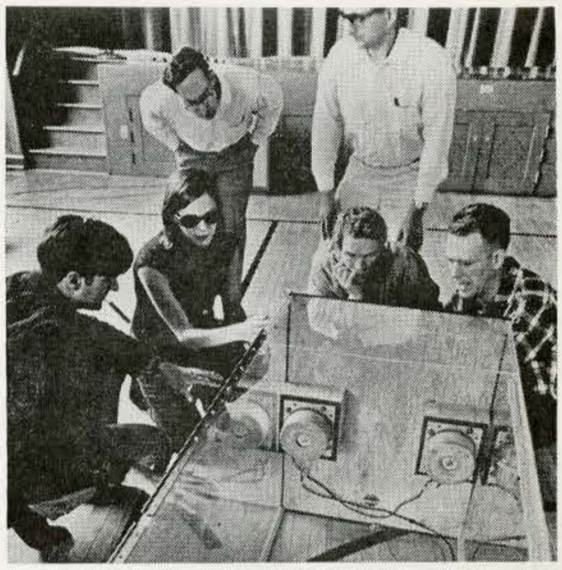
And so to the relevance of this column, which is to make architects, artists, and engineers aware that E.A.T., a new and vital organization, is part of the new scene, and that you may become a part of it. Membership is free, all it costs is curiosity and involvement.

E.A.T. in a very short period has grown to an international level of interest with time and money being contributed by powerful supporters from many countries, Holland, France, Canada and others.

Art and new technology is not organized just for the benefit of artists but is a manifesting interaction between two areas of human endeavor, to quote E.A.T. President Billy Kluver, "The collaborative projects will explore new and relevant uses of technology, they will give the artist and the engineer a new awareness and insight, and they will require the positive involvement of industrial leadership, labor and politics. This interaction will generate a fusing of specializations from which a new responsibility will emerge".

What of the readers of these columns– architects, artists and engineers? Already powerful patrons and curious, imaginative individuals have become interested in taking an active part in this new industrial and art development . . . are you interested? Have you a role major or minor in this vitally stimulating natural development in the social integration of the disturbing sixties.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Two E.A.T. brochures, easily obtainable by membership, contain a great deal of information on activity and development. The positive nature of this growth makes it imperative to "eat" at the source rather than partially digesting from these columns. At present, all enquiries may be directed to E.A.T., Art Gallery of Ontario, Grange Park, Toronto.

What interests me is that, from information available, with one exception I cannot find any architects amongst those actively interested in this project. I like to think that in our society the architect is somewhat of an artist-engineer and as such would have a true and proper part on both sides of the fence in such a dynamic force for future society. Is the architect once again "remote and aloof" as once was the criticism levelled against the artist? Is he lagging behind his fellow creators to be *with* the scene or is it a matter of lack of information and interest? Losing initiatives on all levels will result in the architect becoming the builder of "husks and shells" once designed for living organisms, man of the past, but now inhabited by man of the future adapting himself like a hermit crab to an environment whose original inhabitant is dead. Is this to be the fate of architecture built by architects who stand aloof from the new movements in aesthetic society? E.A.T. is food for thought . . .

Anita Aarons

The Argument for new Dampa 10 linear ceiling system.

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And it's non-progressive: the strips clip to special U-channels, spaced 4 feet apart.

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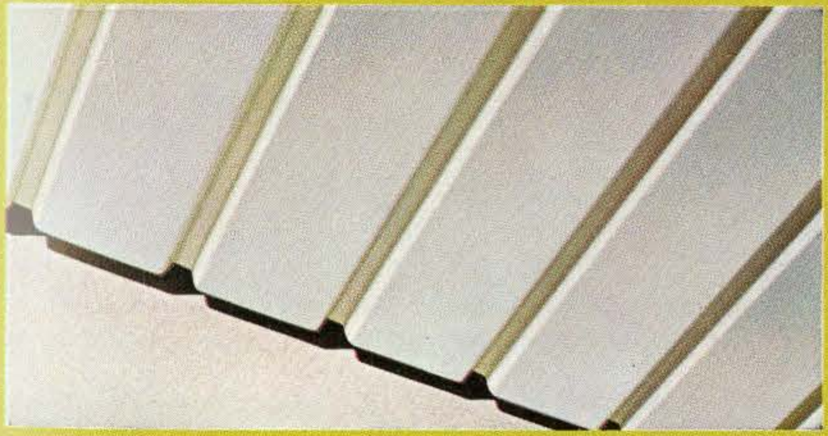

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2. A variety of concrete masonry units for the Riviera Motor Hotel, Edmonton, Alta.

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6. The Rodighiero Building near Montreal, a modern all-precast concrete building.

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7. The all-precast concrete Man and Music Pavilion at Expo 67 can be dismantled.

8. The precast concrete Bishop Grandin Academic & Vocational High School, Calgary, Alta.

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General Contractor: Taylor Woodrow of Canada Ltd.
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Ready-mixed concrete: Red-D-Mix Concrete Ltd.

2. Architects & Consulting Structural Engineers: Maxwell & Campbell Consulting Engineers Ltd.
General Contractor: Alta-West Construction Ltd.
Ready-mixed concrete: Rex Underwood Concrete & Aggregates Ltd.

3. Architects: Moody, Moore & Partners
General Contractor: Malcom Construction Co. Ltd.
Precast concrete members: Supercrete Ltd.

4. Architects: Affleck, Desbarats, Dimakopoulos, Lebensold, Sise
Cons. Struc. Engrs.: Adjeleian & Associates Ltd.
Gen. Contractor: Thomas Fuller Construction Co. (1958) Ltd.
Ready-mixed concrete: M. F. Schurman Co. Ltd.

5. Architect: Bertrand Dallaire
Cons. Struc. Engrs.: Morin & Doucet
General Contractor: Bouchard & Gravel Inc.
Ready-mixed concrete: Arvida Mix & Supply Co. Ltd.

6. Architect: F. A. Dawson
General Contractor: Rodighiero Construction Co. Ltd.
Precast and prestressed concrete members: Francon (1966) Ltd.

7. Architect: Paul-Marie Côté of Desgagné & Côté
Consulting Structural Engineer: Ernest Dauphinais and Surveyer, Nenniger & Chenevert,
Gen. Contr. and supplier of precast and prestressed concrete members: Francon (1966) Ltd.

8. Architects & Consulting Structural Engineers: Cohos Delesalle and Evamy
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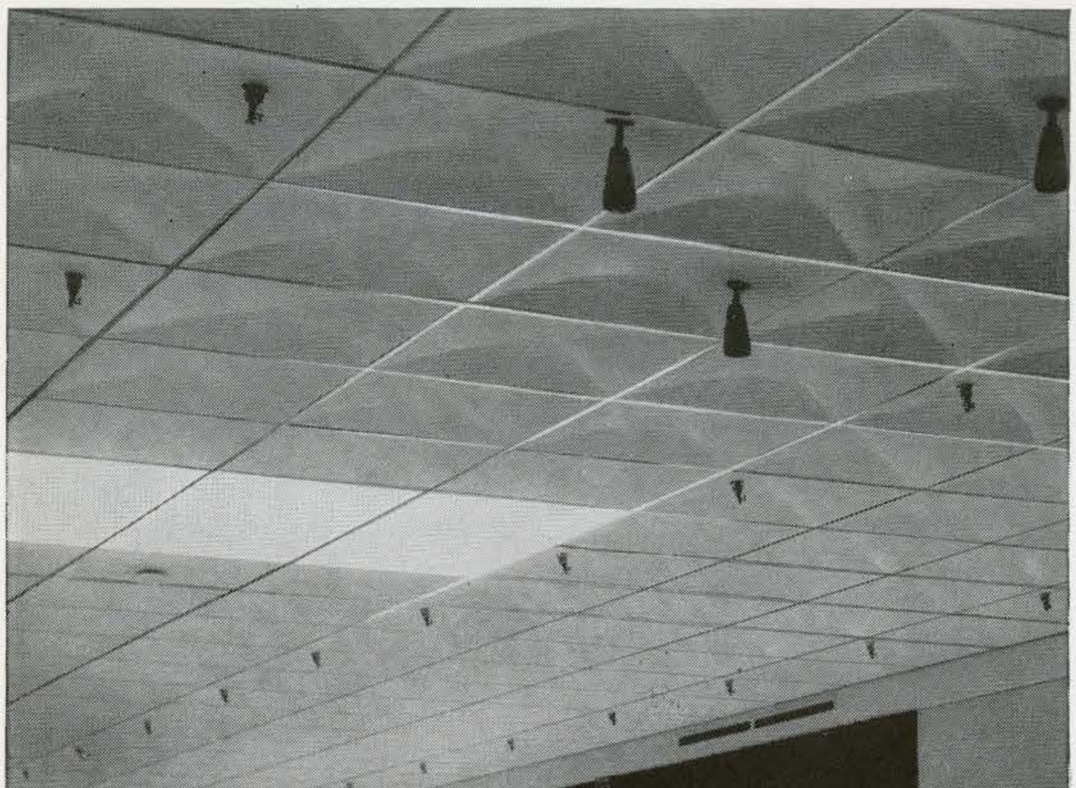

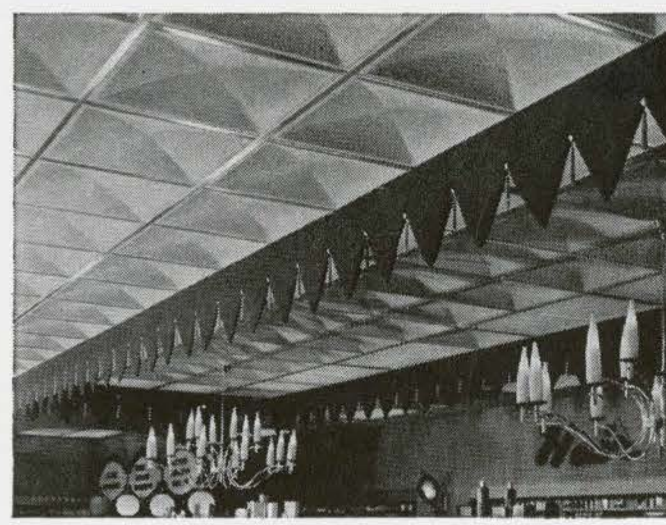

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Review
Revue

4

Accommodate: to provide for; lodge; contain comfortably . . . *Encyclopedia Britannica*

In our April issue we featured James Stirling whose architecture is often the expression of the accommodation of the functions that make up a building. In March we reviewed an article from *Forum* by Robert Venturi whose message is somewhat similar–a call for an architecture that is "accommodating rather than excluding, *both - and* to *either - or,* black *and* white, and sometimes gray to black *and* white".

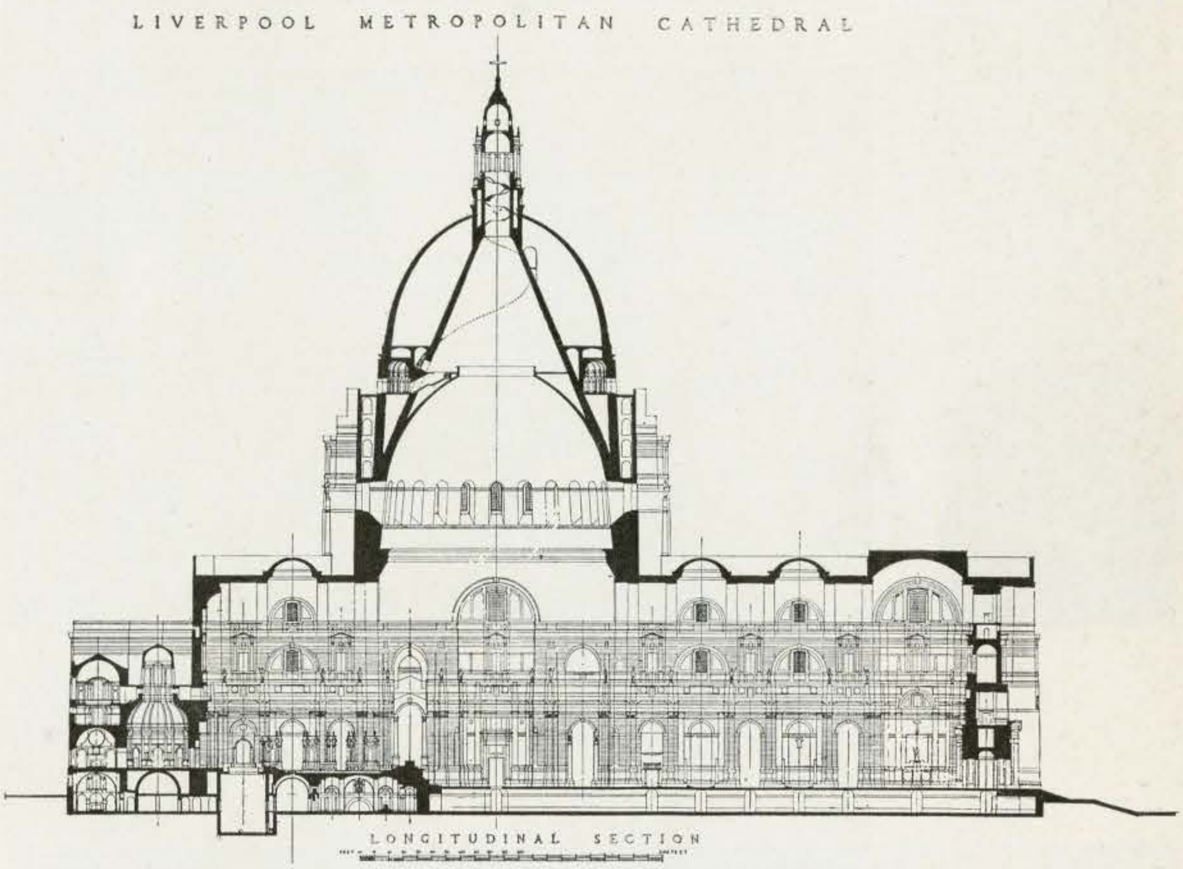
Since the 1950s, the hard party line of Modern Architecture, which repudiated history, has modified to the point where to-day the dogma permits the accommodation of architects who, but a few years ago, were unmentionable.

Edward Lutyens (**1**) was such an architect who has been excluded. He had, according to those who had seen the light, singlehandedly held back the modern movement in England for a decade. On this side of the Atlantic, Stanford White was similarly castigated by the avant garde.

While architecture was supposed to be a reflection of society, McKim Mead & White *and* Wright could not both be accepted as representative of the age. The nagging dilemma was banished to an architectural Siberia–out of sight out of mind. In the destalinization of architectural dogma, the RIBA plans to mark the centenary of E. Lutyens' birth, which falls on March 29 next year.

This will be celebrated with an exhibition of drawings and possibly a symposium *(RIBA Journal March 68).* We welcome the Lutyens revival, and hope the exhibition will be shown in Canada.

A new form of accommodation now in an embryonic state, but none the less vital, exists. Its implications are staggering. It promises an architectural revolution never experienced by the Modern Movement. It also promises not to be a fraudulent, look-like technological architecture of the



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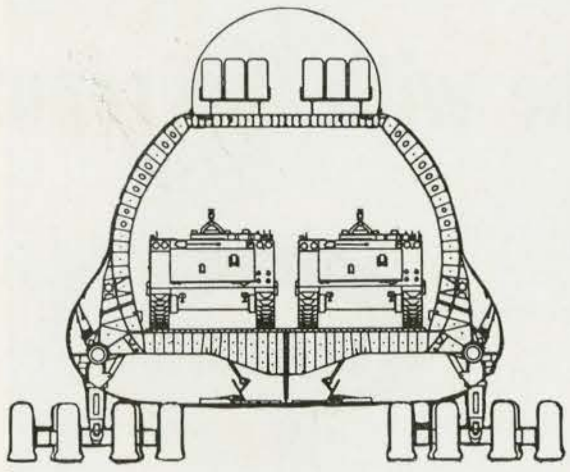

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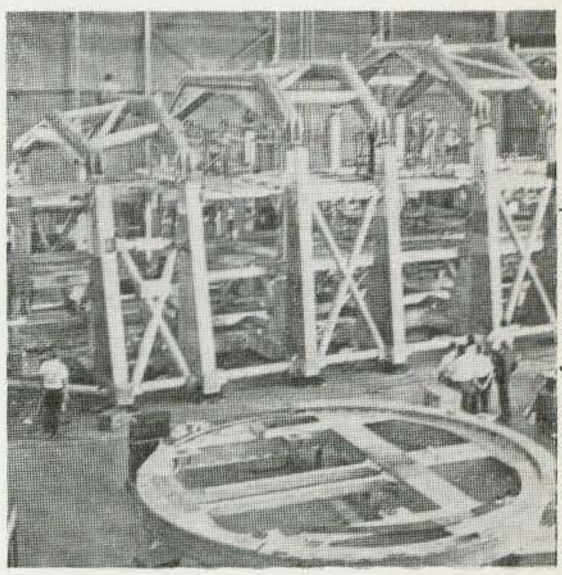

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twenties or Peter Cook and Archigram either. We refer to the assimilation into the profession of the managerial systems that have revolutionized business and production on the North American continent since World War II, and, established the superiority of the aero-space industry.

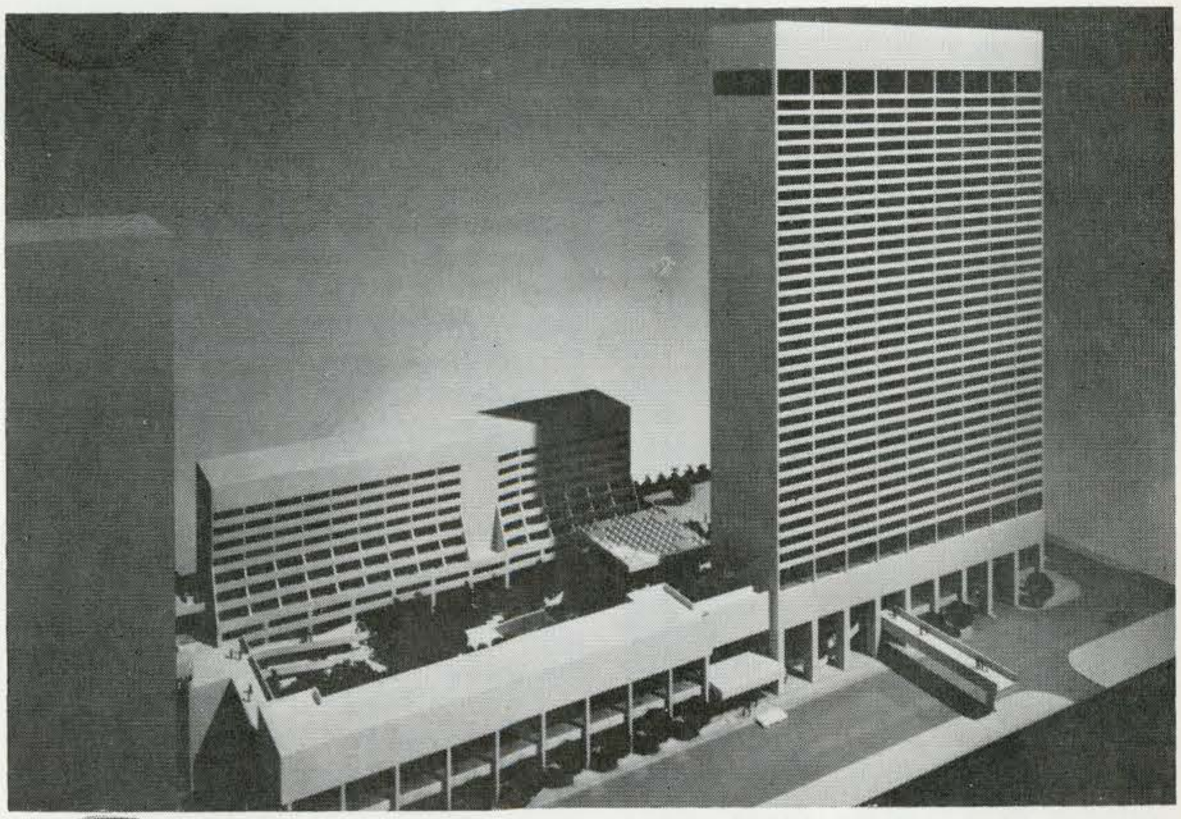
Recent issues of *Aviation Week,* particularly the November 1967 issue, dedicated to "The Giant Jets, the Next Revolution in Air Transport", are of especial relevance. Both the magnitude and complexity of the Boeing 747 and Lockheed C-5A programs, and the final product, is impressive. Here are the tools and techniques, and the scale of enterprise, which are necessary to tackle urban problems. **(2, 3,** *see page 33*)

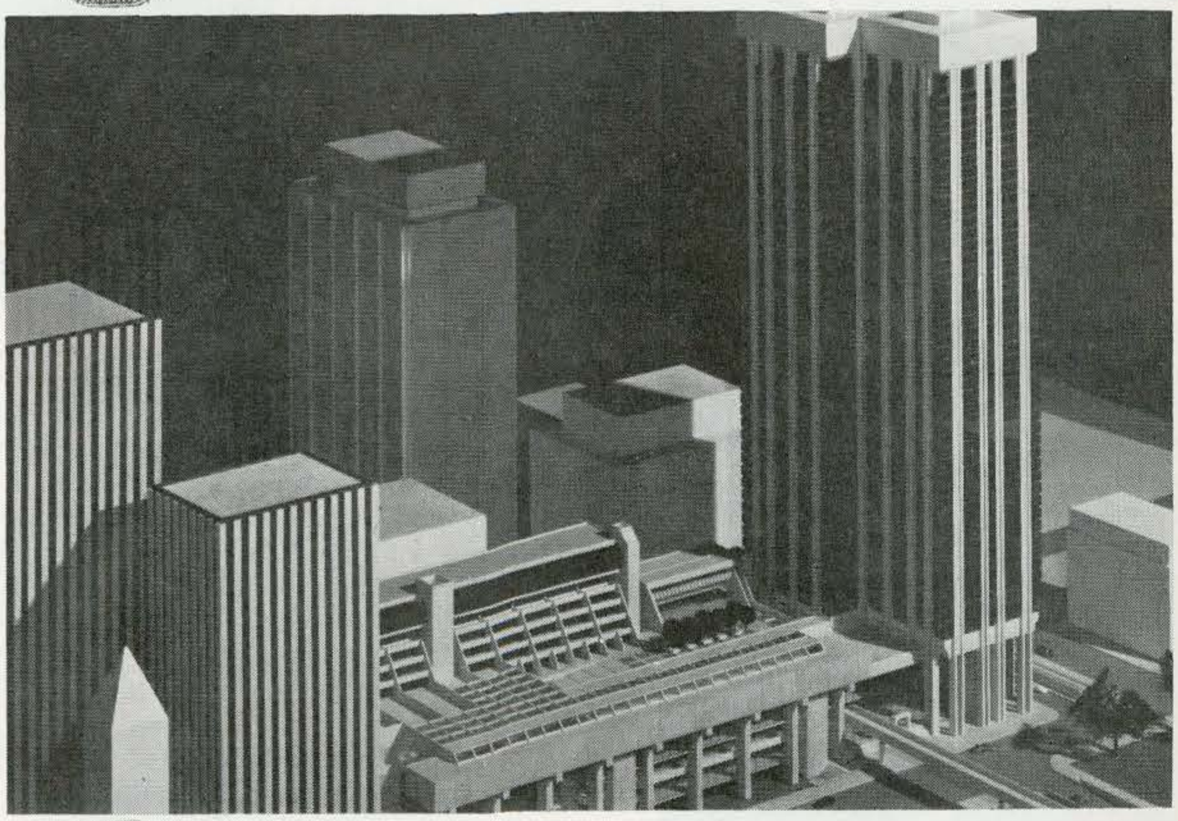
The following is a quote about the Boeing organization: "Nearly 70% of the aircraft weight and more than 50% of the effort has been subcontracted to 1,500 major and 15,000 secondary suppliers in 49 States and six nations outside the US. In addition, 747 work is being performed in six Boeing subdivisions that are not a part of the Everett branch, which is responsible for the 747 program.

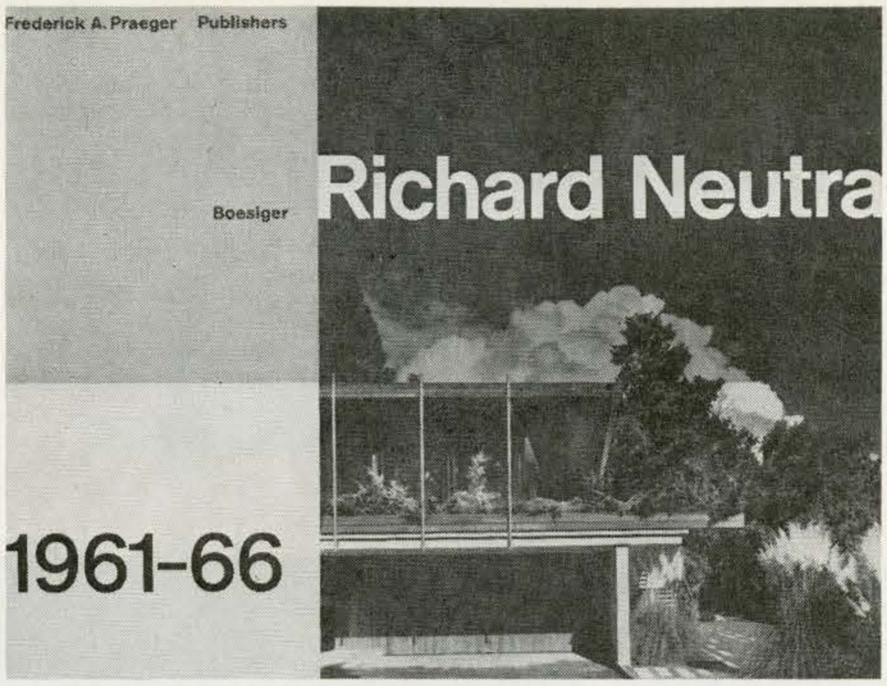
"While the financial risks and design responsibility undertaken by the major subcontractors might seem to warrant for them the title of Associated Contractors, Boeing has shied away from that term. 'This is a Boeing Airplane', one official explained. 'We do not want to give the impression that it was designed by a committee'."

We publish the two competing schemes for the south side of Queen Street development competition, Toronto, without comment, save for two well known identifying symbols *(above, the scheme by John B. Parkin and Associates, below, the winning scheme by Webb Zerafa Menkes).*

B.M. and A.J.D.







Richard Neutra 1961-66, Buildings and Projects

Edited by W. Boesiger
Frederick A. Praeger, New York, in Canada Burns & MacEachern Limited, Don Mills, Ontario; 1967, 256 pages, $23.00.

This volume comprises the third in the series of the collected architectural works of Richard Neutra, edited by Willy Boesiger. In the well-known set of books which presented the work of Le Corbusier, Boesiger, an early assistant in the Paris studio of the Swiss master, first made famous the new bold type of format and manner of layout for architectural books. Both the above series of books were originally published by Girsberger of Zurich. The Neutra volumes have been republished in America after the original manner.

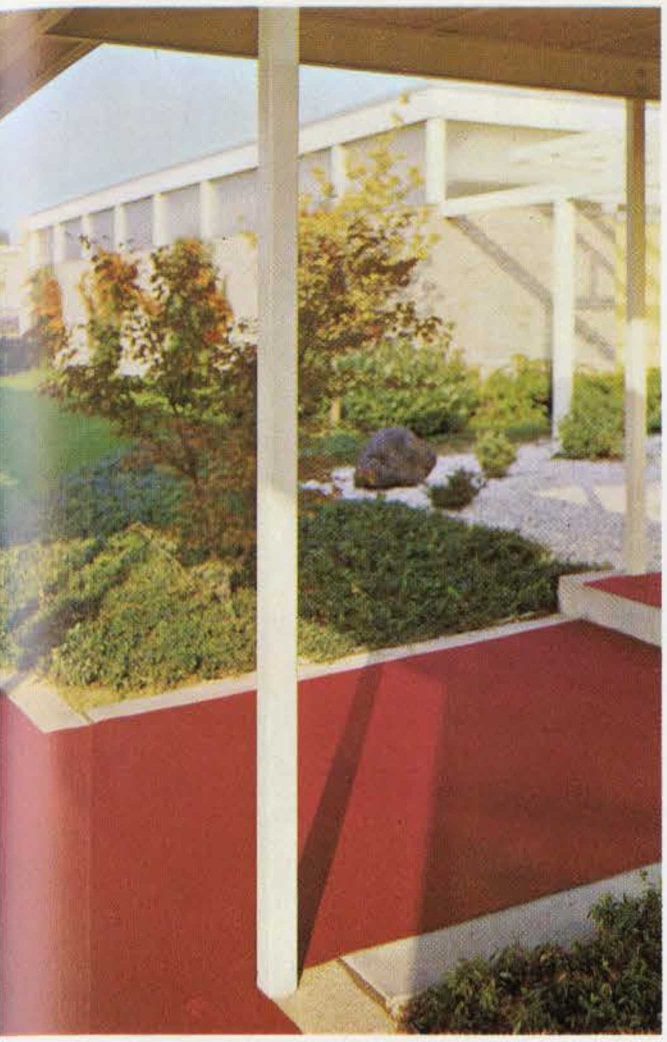
An emphasis on the style of these publications is important since the presentation indirectly emphasizes the connection of Neutra with the European stream of international-style architects. On the other hand, Neutra was among the first of the emigrés, and much of his development and many of the direct influences on his work were received on American soil.

To a Canadian, living east of the Rockies, one of the first impressions of the work of Neutra is that it appears to have been designed for a climate less rigorous than that of the northern so-called temperate zone. Form and color of buildings, emphasize this character and the handling of materials and construction tend to confirm this impression. Light-colored walls, wide-spread plans, an easy transition between indoors and out, and deep overhangs at eaves are more suited for milder climates. Another and simultaneous reaction to the expression of this work has to do with the sensing of a certain high-style of modern life, relaxed and easy, socially and technologically advanced, luxurious and rich, even if spare and empty. No doubt we see the influence of the place of origin – the wealthy and rapidly developing city of Los Angeles in Southern California.

Any harshness stemming from the actions of nature in this environment, which architectural design might need to temper, would be the result of excessive sunlight. The severity of the visual geometry and the smooth tautness of the planes have not necessarily been evoked by the milieu, but may be the result of a certain dogma; an aesthetic and ethical vision of restraint.

The compositional elements from which these synthetic wholes are built up show little if any filiation with the familiar or vernacular forms of the original inhabitants or settlers of the southern West Coast, neither those of the Indians, the Spanish, nor of the westward-thrusting easterners from beyond the Appalachians. One detects, rather, in the private houses or small to medium size institutional buildings, perhaps the most interesting of the works in this volume, the influence of precursors in the Midwest, such as Sullivan and Wright. This influence shows itself most clearly in the manner of employment of balanced arrangements of asymetrical form, windmill type plans, the openness and connectedness of interior spaces, and in the contrasting and yet harmonious juncture between buildings, especially dwellings, and site. To the influence of Neutra's original mentor in Vienna, Adolf Loos, might be added that of an earlier Southern Californian architect, Irving Gill. A dogmatist and purist in the likeness of Loos, Gill had brought the taste of Californians back to a starkness of silhouette and simplicity of surface even more severe than that which early Spanish ranch-houses exhibited. The inspiration of a fellow Viennese, R. M. Schindler, an assistant of

(continued on page 73)



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Page 41
Le Béton: matériau, système et environnement
Melvin Charney

Les caractéristiques essentielles de stabilité et de solidité et les méthodes de construction en béton sont soulignées dans la presse architecturale. Dans le sens d'un concept d'ambiance le béton est soumis aux méthodes, traîtements, changements chimiques et la volonté du dessinateur. L'idée qu'un matériau composé possède des qualités meilleures ou différentes que ses composants a acquis une grande signification dans la technologie moderne (Voir le "Scientific American", sept. 1967). Dans ce sens, le béton armé est un système de matériaux modernes. Les variantes permettent un potentiel de contrôle qui prédispose le système au développement d'une diversité de matériaux, d'éléments fabriqués, de caracteristiques de performances et d'innovations. Deux tendances – la mécanisation sur chantier et la fabrication en atelier affectent le plus les changements dans la construction en béton; la production devient des systèmes. La traduction de bâtiments en produits façonnés dépend de la demande, l'implication de l'industrie ainsi qu'un bon dessin orienté vers l'usager. Le style doit être considéré également comme intégral au système. L'effet des cybernétiques sur le dessin et la production et l'introduction de nouveaux composants (résines et fibres) pourraient être développés. L'usage du béton dans la catégorie en dehors de la construction des bâtiments doit être souligné – tout ce qui constitue une infrastructure d'objets ouvrés en béton adaptés spécifiquement aux besoins humains – le béton étant le matériau qui domine l'organisation urbaine. Mais le matériau ne s'est pas montré à la hauteur des prévisions de nouvelles innovations ont mis à jour de nouveaux problèmes et à leur tour, un nouveau "potentiel". Malgré cela, on peut remarquer quelques nouvelles attitudes – un changement dans l'usage du béton reflétant une fragmentation du matériau en systèmes et méthodes d'usage divers. Alors le dessin s'est porté sur les rapports entre l'usage du béton et les conditions environnementales, telles que les logements urbains et l'éducation. Redéfinir l'environnement physique, c'est trouver les vraies innovations dans l'usage du béton.

Page 44
Avant-propos

Depuis dix ans, l'importance du rôle du béton dans l'architecture moderne s'est accrue. Architecture Canada présente des articles venant de: "Scientific American" (1964), d'une compagnie spécialisant dans la fabrication des additifs, du C.N.R. (Building Research Division), de "Concrete Construction" et un rapport écrit spécialement pour Architecture Canada par les éditeurs de "Progressive Architecture".

Page 45
La Matrice du Béton
L. E. Copeland

Le ciment Portland est le ciment hydraulique employé le plus dans la fabrication du béton. La matrice griseou pâte durcie remplissant les vides entre les particules d'agrégat est le produit de réactions chimiques entre le ciment et l'eau. Ses caractéristiques déterminent la qualité du béton. Un matériau contenant de la chaux et une matière argileuse est employé; ces matériaux sont soigneusement mesurés, pulverisés et chauffés à environ 2700°F. afin de produire les réactions chimiques. Un petit pourcentage de gypse est ajouté au "clinker" refroidi et le mélange est broyé afin de produire une poudre fine – le ciment Portland. 90% à 95% du ciment Portland est composé de quatre phases, dont trois sont des matières presques pures, et le ferrite, une solution crystalline solide. Quant aux matières pures, deux, qui constituent 75% à 80% du ciment, sont le silicate de tricalcium Ca_3SiO_5 et le silicate β-dicalcium Ca_2SiO_4 contenant des impuretés d'aluminium et de magnésium. L'autre est l'aluminate de tricalcium et contient quelques impuretés d'oxides d'alkali. L'hydratation du ciment commence dès son mélange avec l'eau et la réaction produit une chaleur. La prise définitive du ciment coïncide avec le plus grand taux d'évolution de chaleur. Tableau 1 indique les réactions chimiques des matières. Figure 1 indique les particules sortant des grains de ciment. Lorsque le taux de libération de chaleur atteint son maximum, l'hydrate de silicate de calcium prend l'apparence indiquée à la Fig. 2 qui suggère que la prise définitive pourrait être produite par l'interaction des particules qui se forment sur les grains de ciment et les crystaux d'hydroxide de calcium. La pâte durcit et gagne de la solidité pendant l'hydratation du silicate. A l'épuisement du gypse, une nouvelle réaction (équation 4) commence. La quatrième et cinquième réaction suit en séquence jusqu'à l'hydratation complète de l'aluminate de tricalcium. On pense que la première réaction de la phase férrite est analogue à l'équation 4, Table 1 et qu'elle continue jusquà l'épuisement du trisulfate d'aluminate de calcium. Des solutions solides plutôt que des matières pures en résultent. La pâte durcie de ciment Portland ainsi produite est un composé de plusieurs sortes de produits d'hydratation. Ces produits existent en particules trop minuscules pour être visibles au microscope ordinaire. Le terme "gèle" est employé pour indiquer le manque de structure visible et parce que lors de la saturation à l'eau, le gèle contient un assez grand volume d'eau qui peut être enlevé par sèchage, ce qui suggère une structure poreuse. Quelques détails de la structure ont été obtenus par microscope électron. (Voir Figs. 4, 5, 6, 7). D'importance pratique est la compréhension de trons des aspects physiques de l'hydratation du ciment.
1. On sait que les produits d'hydratation sont précipités seulement dans les vides entre particules de ciment. 2. Dans chacune des réactions le volume total des produits de réaction est inférieur au volume des réactants, mais le volume des produits solides d'hydratation est toujours supérieur au volume des réactants *solides*. 3. Le volume en masse de la pâte reste presque constant après la prise ce qui suggère qu'un réseau continu de particules solides s'est formé à travers la pâte à la prise. Puisque les produits d'hydratation ne sont précipités que dans des vides remplis d'eau, l'hydratation ultérieure et dont les caractéristiques de la pâte durcie dépendront de la disponibilité d'eau pendant le traîtement après prise. La porosité est également un facteur important. Elle est déterminée par le rapport initial d'eau-ciment et par la quantité de ciment qui a hydraté (Voir Fig. 8) La porosité minimum, dite "porosité de gèle" serait environ 25%. La porosité capillaire est celle en excès de la porosité du gèle. L'hydratation incomplète du ciment diminue la porosité de gèle et fait accroître la porosité capillaire (Fig. 9). Fig. 10 montre l'effet de la porosité

capillaire accrue sur trois propriétés importantes de la pâte. La solidité linéaire diminue avec l'accroissement de la porosité capillaire. Le module d'élasticité diminue avec une porosité capillaire accrue plus rapidement que la solidité. Cette comparaison entre l'effet de la porosité capillaire sur les différents caractéristiques de la pâte suggère qu'un usage plus effectif du béton pourrait en résulter si la propriété appropriée à l'usage spécifique serait employée comme critère de dessin plutôt que de se préoccuper toujours de la solidité.

Page 49
Le Béton – Caractéristiques et usages
E. C. Anderson

Le béton est le seul matériau de construction livré sur chantier en état plastique, dont les avantages sont bien connus: plasticité, continuité structurale, résistance au feu, variations en texture et couleurs et adaptabilité. Pour le gros oeuvre, un mélange typique de ce "pseudo-solide" consiste de 75% d'agrégats et de 25% de pâte de ciment devrait être réduit au minimum puisqu'il coûte cher et contribue à la contraction. En incorporant le maximum de gros agrégat on obtient une meilleure qualité en réalisant une économie. En gâchant, coulant et traîtant le béton, l'agrégat est peu affecté mais la pâte de ciment peut être soumise aux changements profonds; la solidité et durabilité du béton dépend donc de la qualité du ciment, ce gèle étant le produit d'hydratation le plus important. Personne ne connait exactement la nature d'une particule de gèle mais c'est probablement l'interaction de beaucoup de particules qui donnent sa solidité considérable étant donné que le gonflement dû à l'addition d'eau est minime. Pendant l'hydratation du ciment, les composants couvrant les nucléus de particules de gèle se gonflent progressivement et deviennent plus imperméables à l'eau au point que l'eau ne peut plus pénétrer et l'hydratation cesse. La quantité d'eau ajoutée est également importante; plus d'eau, moins de solidité. Bien que le gèle de ciment devienne imperméable après durcissement, la fissuration peut augmenter la perméabilité de 70%, donc un traîtement continu pendant la prise est de la plus grande importance. Il est évident que la qualité du béton dépend des caractéristiques physiques et chimiques de la pâte de ciment et des agrégats employés.

Page 51
Les Additifs et le Béton ciment Portland
E. G. Swenson

L'architecte et l'entrepreneur doivent mieux connaître les capacités et les limitations du béton, surtout lorsqu'il s'agit des additifs. Ce "cinquième" ingrédient modifie une ou plusieurs propriétés du mélange plastique et du mélange durci. Malheureusement, quelques additifs produisent des effets nuisibles; l'architecte ou l'entrepreneur devrait être en mesure de pouvoir en discuter avec le fabricant. Au Canada, l'agent d'entrainement d'air est peut-être le seul additif "obligatoire" pour agir contre l'action du gel. Des variantes au chlorure de calcium sont souvent préférables du point de vue économie et qualité. D'autres additifs employés moins souvent sont conçus pour augmenter l'étanchéité, réduire la perméabilité, produire des gaz et détrainer l'air. L'application d'additifs varie suivant les exigences et les problèmes de chaque procédé de fabrication et de mise en place. La fabrication de précontraint et le bétonnage à pied d'oeuvre sont bien contrôlés par une seule autorité mais le béton prémélangé est controlé par le fabricant et puis par l'entrepreneur – cause de difficultés possibles, donc nécessitant une protection et un contrôle spécial. Le choix d'un additif approprié pose des problèmes – deux marques différentes du même additif peuvent avoir des effets différents et le dessinateur devrait s'en rendre compte, ainsi que des problèmes de manutention, entreposage, préparation des additifs. Après des années de développement il existe des spécifications de performance pour additifs exigeés par la CSA A23 1-1967. Un additif ne peut pas compenser des matériaux inférieurs ou une main d'oeuvre incompétente et dans la plupart des cas, des contre-choix existent qui sont dignes de considération du point de vue économie et qualité. L'architecte se doit d'être au courant des types, de la nature et des effets des additifs.

Page 54
Une Contribution au Béton
Progressive Architecture
Forrest Wilson

Les conclusions personnelles suivantes sont tirées de deux numéros de P/A. Les trois types du béton sont: le béton structural, structural décoratif et décoratif. Seul l'architecte ayant une bonne formation technologique et l'architecte traditionnel qui considère un matériau de construction comme défi sculptural ont tiré de bons résultats. En béton décoratif, le plus grand problème était de décider si le béton pouvait remplacer le mur rideau. Le désir de sculpter leurs bâtiments a décidé bien d'architectes. On déplorait les défauts de la technologie du béton et l'insuffisance de renseignements techniques disponibles. Des efforts à produire des surfaces décoratives étaient incroyables. Néanmoins, la demande pour une exécution meilleure a formé des ouvriers spécialisés de compétence phénoménale en béton précontraint et dans la fabrication de coffrages produisant un béton aux tolérances inouies et aux surfaces fines et miroitantes offrant à la profession le choix d'un béton qu'elle n'a jamais eu auparavant. Quant au béton structural, l'ingénieur contemporain peut exécuter presque tout ce que l'architecte lui demande, mais l'entrepreneur par contre oppose bien des innovations présentées. Comme l'argile, le béton n'a pas de structure mais offre une liberté d'expression que la plupart des architectes ne savaient pas exploiter. Le béton en tant que système de construction était sujet aux limitations inhérentes dans toute notre technologie de construction. Le manque de formation technique et les tabous de sa profession isole l'architecte de son dessin – il prend ce qu'il peut et ses capacités perceptives sont par conséquent sévèrement limitées. Il semble aussi qu'on hésite à exploiter la préfabrication en série des éléments en béton. P/A, en conclusion, a exposé les anciens, non les nouveaux problèmes de construction. Le béton ne s'est pas montré "la panacée plastique". Nos reportages ont montré que la technologie du béton ne semble pas s'orienter vers la flexibilité. C'est aux lecteurs d'Architecture Canada d'en juger.

Page 55
Conclusion

L'usage du béton dépend de l'ingénuité et du prestige des architectes et ingénieurs, de l'esprit de compétition (Scientific American, Sept. 1967). On identifie le béton psychologiquement comme étant le matériau de l'époque. Le rôle du dessinateur devrait être de produire des objets ouvrés identifiables créant ainsi un style qui se trouverait une place dans l'environnement industriel. Le style implique la complexité technologique et le matériau pour ces créations "uniques" est le béton. Il va de soi que le béton n'existe pas pour lui-même; il est plastique et ses caractéristiques suggèrent que le béton soit modelé à ressembler à autre chose – à la maçonnerie, par exemple. L'idée même de concevoir un "bâtiment" en béton le met dans un contexte traditionel — une série de "syndromes look-alike" peut être tracée dans le dessin courant du béton. Le "Pop-Art" a influencé le dessin de notre environnement – et en béton, le résultat consiste en "super shapes", tel qu'un enfant pouvait fabriquer avec ses blocs "Leggo" – mais en béton précontraint. Une variante est l'assemblage d'éléments raccordés en blocs de béton articulés avec des trucs neo-classiques. La persistance d'une esthétique de maçonnerie se voit dans l'idiome de Louis Kahn – qui se repète au College Scarborough en béton et à la Place Bonaventure où les surfaces en béton ont été fabriquées de façon à ressembler à des surfaces en d'autres matériaux. Le béton s'exprime actuellement dans la tradition "fait main" ou "naturel" sans égard aux systèmes de consturction utilisés. Le rapport de l'institut Batelle Memorial Research de 1963 considère la profession architecturale nuisible aux développements technologiques de même façon que les traditions de codes et de zoning. On peut dire en conclusion que ces exemples montrent que le dessin de bâtiment n'a pas tellement changé depuis 100 ans sauf en échelle et en méthodes et que le béton n'est que le plus malléable des matériaux. Concevoir une "architecture autre" que les formes traditionelles sytlisées constitue le véritable climat et les vraies procédures de dessin.

Concrete
A Material, a System and an Environment

Melvin Charney

Melvin Charney, guest editor for this issue on concrete, is an architect and Associate Professor in charge of graduate studies in architecture in the Faculté de Amenagement, Université de Montréal. He has been a consultant to industry in the development of concrete systems and chairman of the session on architectural design at the recent gathering of the Prestressed Concrete Institute. Recent publications include a contribution to the book Planning for Diversity and Choice published by MIT, 1968

It has become a standard feature of the architectural press to pay at least annual homage to concrete as the dominant building material of the time. However, the commitment of the press to the singular role of the architect as a creator and "Master Builder" of unique, interesting shapes, that somehow relate to people, has tended to cloud many of the basic issues involved.

Rather than report on the variety of recent concrete buildings or products, which are well illustrated in any case in advertisements, the following pages deal with several conditions in the conversion of concrete into built form in an attempt to suggest a few of the neglected issues that affect design.

The basic characteristic required of concrete is its strength and stability. Structural developments are particularly emphasized and well documented elsewhere, and they do not need to be reiterated. Nonetheless, it is inevitable that the essential structural character of the material pervade the text.

It is also inevitable that the emphasis here is on process. That a sense of process imbues the physical state of the material with a sense of form is one of those truisms which, unfortunately, has to be repeated from time to time as some banal aphorism that resists becoming fact.

In an environmental design sense, concrete has no existential nature of its own. It is a composite, plastic material that is subjected to forming, reinforcing, machine handling and chemical change. It is subjected, futhermore, to the will of a designer who is concerned with the appearance of the product, and its image as a cultural artifact, as well as with its function.

The concept that a composite material has qualities that are better than the components alone, or radically different from any of them, has acquired a broad significance in modern technology (see "The Nature of Composite Materials" by Anthony Kelly in *Scientific American,* September 1967). In this sense, reinforced concrete, as one of the first composites to be extensively used in construction, represents a modern materials system. The variables in the system allow a control potential; the degree of control depends on the extent to which the mechanisms of the process can be qualified and quantified. This control potential predisposes the system to the development of a diversity of materials, fabricated components, and systems of varying performance characteristics. A composite is also predisposed to concepts of industrial technologies that have recently been developed which, in turn, allow further innovation.

The extensive use of this building material in competition with other materials, the tendency towards the scientific formulation of empirical building techniques, and the subsequent "600 percent improvement in the performance of reinforced concrete achieved in recent years" (W. O. Alexander, "The Competition of Materials", *Scientific American,* September 1967), has resulted in an overwhelming quantity of technical information. Developments have tended to expose new problems and spawn more development. Perhaps the major innovations may be the quantity of data on concrete that is currently being put on paper. Handbooks have either become too specialized, too complex or too simple-minded about problems (4 parts sand, 1 part lime, 1 part cement, etc. . . .). The informaton overload is psychologically threatening, and the role of the designer as a "Master Builder" who sports a comfortable overview offers a safe retreat.

In order to begin to find some coherence there are several themes which could be developed. Recent innovation in the technology of material systems – from the restructuring of molecular bonds to the introduction of the computer – tends to be submerged in production and fabricaton. Therefore, one could begin by drawing on recent research on the chemistry of concrete. Despite the familiarity, antiquity, and the extensive use of this material (consumed, in 1963, at the rate of one ton for every human being, which places it second only to man's use of water), major advances in the chemistry of concrete have been made only in the last two decades. As in many other industries, theory has tended to follow application.

A second theme could be drawn from the recent developments in forming and handling methods – concrete as a production technology. There are two basic and diverse tendencies that can be distinguished. Construction processes have tended towards on-site mechanization very early in the use of reinforced concrete: slip-form construction using a lever or screw jack system was innovated at the beginning of this century in the building of grain silos, a sidewalk paving machine that extruded slabs behind it, and a concrete pump that used compressed air were introduced in 1909. Currently, the almost total on-site mechanization is bringing many factory conditions to building – in some cases portable factories themselves. Concrete constructon has tended also towards the reduction of buildings into standardized preformed components that could be factory fabricated and assembled on-site as finished units. A development of both these tendencies – on-site mechanization an doff-site fabrication – are tending to merge into processes which affect the change from concrete construction to concrete production. Both merge into production systems, which depend on a sizable market base and on the translation of buildings into industrial artifacts. This requires a direct involvement of industry, as well as a user-orientation in design.

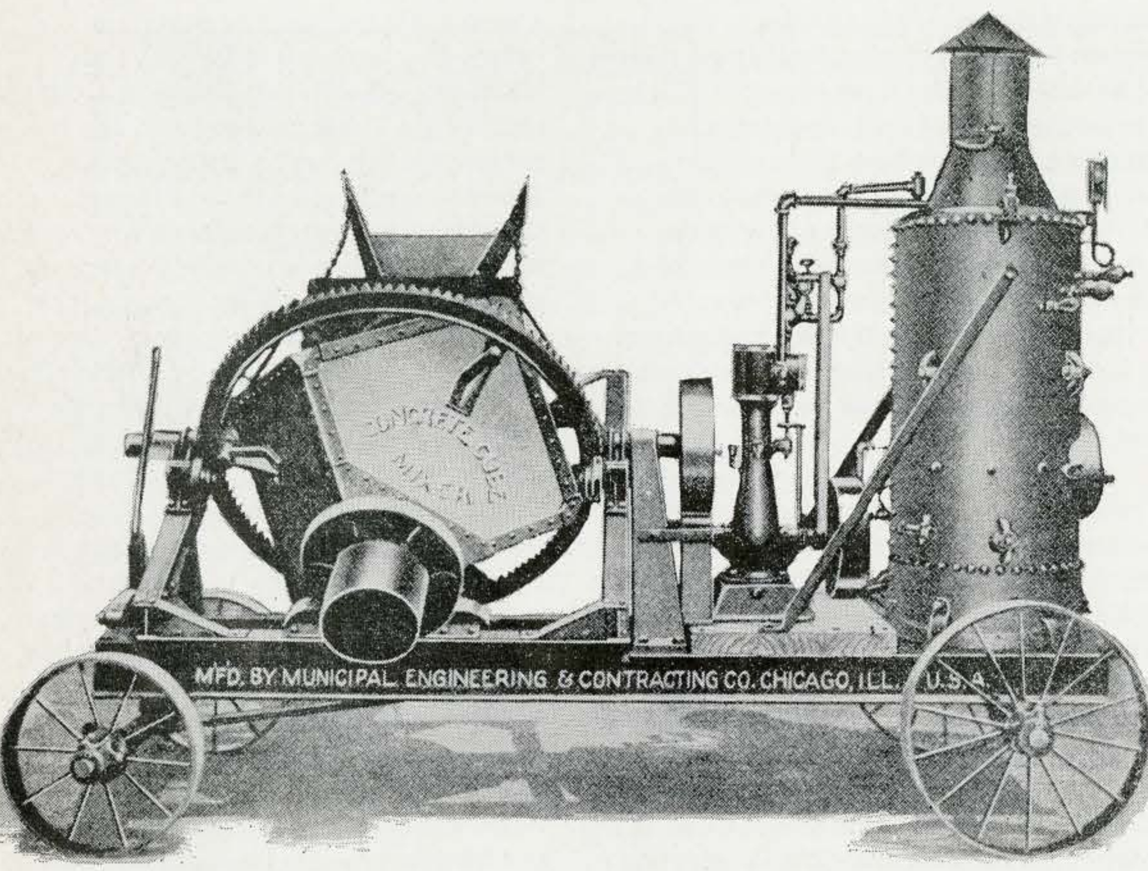
In the same way that a systems view of the production of an artifact destined for the market would include styling considerations, so in the production of concrete artifacts the styling characteristics of concrete buildings can be considered to be an integral part of the material system. The process by which concrete is turned into built form can be considered from within the design process itself. No one designs in a vacuum, yet styling is one of the unmentionables of current architectural discourse, even though design is, by its very nature, oriented to the filter of changing sensibilities that determines the look of concrete and the look of the appropriate image of technology itself.

Other themes can be developed: The impact of computer technology on design and production; the forecasts of material

1
A concrete mixer used at the end of the 19th century; revolved by steam power
Une bétonniare à vapeur vers la fin du 19ème siècle

2
A concrete mixer first employed in 1871 As is common with most early concrete mixing vessels, a cube shape was used
Une bétonniàre en 1871. La plupart des premiers malaxeurs de béton en usaga à l'époque étaient de forme cubique

3
Lifting Jack in slip-form construction used by the Canadian Stewart Co. in the construction of the Fort William Grain Elevator completed in December 1910
Cric d'élévage pour coffrage glissant utilisé par la Compagnie Canadienne Stewart lors de la construction d'un silo à Fort William qui fut achevé en décembre 1910



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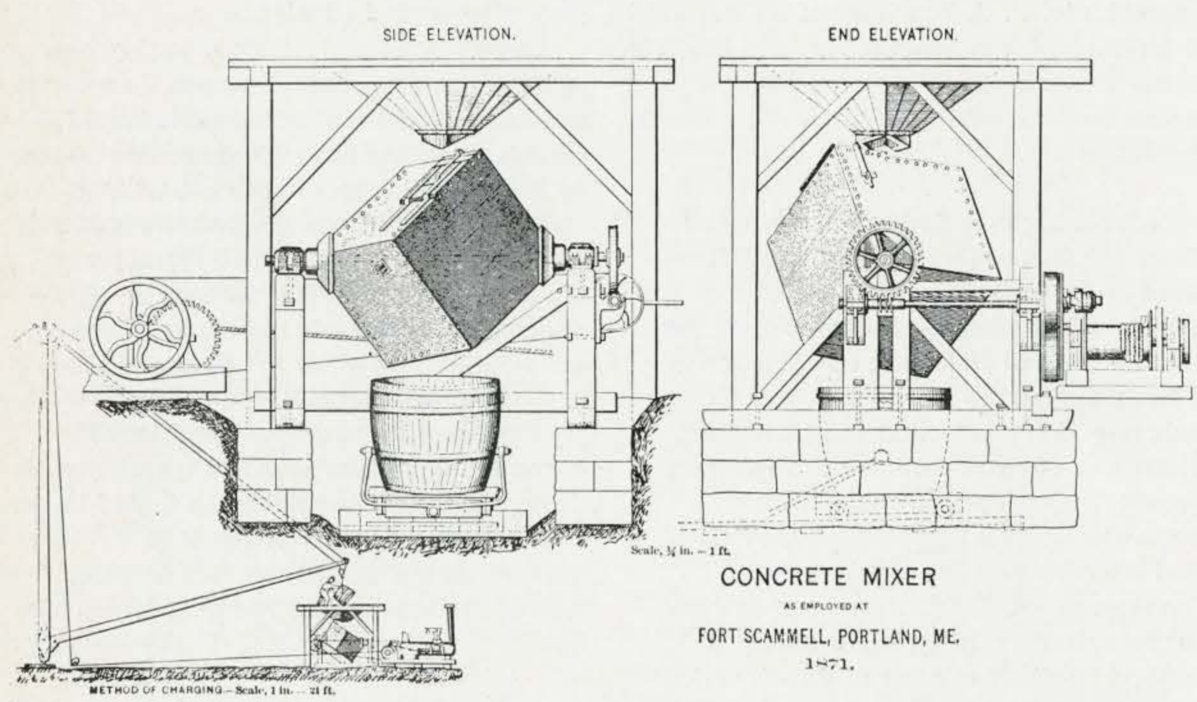
resources that indicate the further innovation in the composite nature of concrete – the introduction of new constituants such as light-weight resins and high strength fibers. The major use of concrete in the so-called "non-building" category of the construction industry could also be noted. Tunnels, bridges, dams, highways, airport runways, wharfs, streets, piles and foundations, form a superstructure of concrete within which are found smaller environmental artifacts that are specifically fitted to human needs. This simplified overview offers a vision of concrete as the dominant material system which structures large urban organization.

In the design of the physical environment, current events are ahead of current design. Design depends on concepts with which the designer comprehends conditions immediate to him and renders them instrumental in his work. Buildings and application, can be found in the existing fabrication techniques, and concepts of milieu that exemplify attitudes that are as



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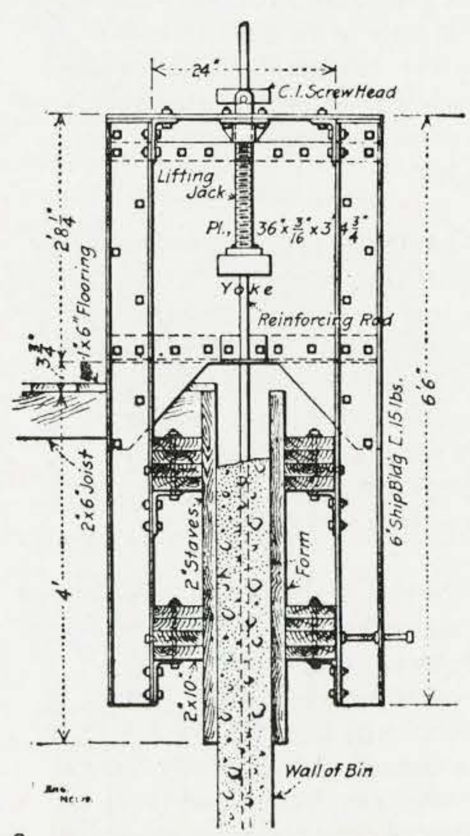

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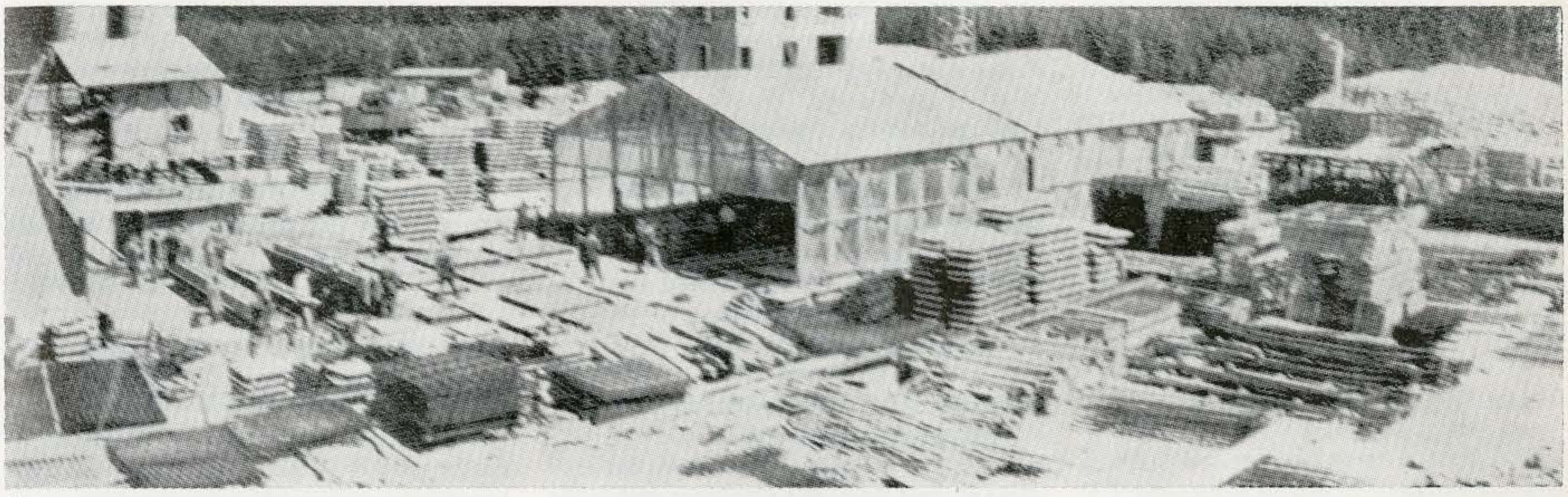
4
An on-site portable factory used in the construction of Marburg University.
The panels and columns can also be cast in the form of boxes, but the process is essentially the same
Usine mobile à pied d'oeuvre utilisée pour la construction de l'Université de Marburg.
Les agglomérés et poteaux peuvent être assemblés en forme de coffret, mais les deux méthodes se ressemblent essentiellement

5
Total mechanization of "non building".
Slip-forming of the San Louis Canal in 1967. Four rigs-trimmer, modifier liner, joint inserter, and finisher – pave at a rate of 600 yds/p/hr, the capacity of a batch plant. One operator controls the movement of the unloader
La mécanisation en de la construction des routes. Coffrage glissant du Canal San Louis en 1967. Quatre machines préparent le terrain à la vitesse de 600 yards à l'heure ce qui représente la capacité de travail d'un groupe mélangeur. Un ouvrier surveille le fonctionnement du déchargeur.

6
Factory casting of "architectural" concrete still involves slow production runs
Le coulage de béton en atelier donne encore un rendement insuffisant

7
On-sit mechanization using automated casting and crane rigs still involves hand-made connection systems
L'automatisation du chantier nécessite toujours un système d'assemblage à la main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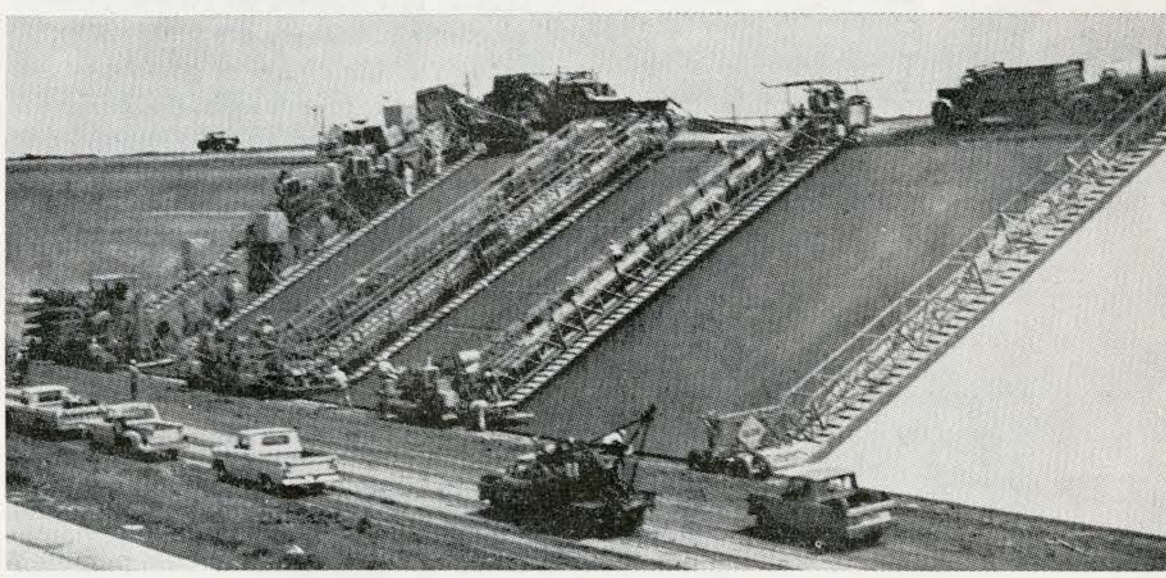
yet to be incorporated in the working style of building design. Concrete was the "new" material of Modern Architecture which was oriented in its goals to the state of technology at the beginning of the century. Habitual gestures reminiscent of these goals, rather than the goals themselves, have tended to persist, and, 50 years later, concrete is still being used to demonstrate contemporary design. Accordingly, the material has not lived up to design expectations; new innovations in concrete systems have also exposed new problems, and, in turn, new "potential".
In the current generation of designs in which concrete is extensively used however, new attitudes can be distinguished. Regardless of the styling in some buildings, or because of it in others, there is a change in the use of concrete that reflects a fragmentation of the material into systems and varying networks of use. For each solution there are alternative systems using other materials which are economically and technically feasible. and reasonably applicable. This has tended to shift the design emphasis onto relationships between the use of the material and environmental conditions. Further change can now be found in the design breakdown of environmental problems such as urban housing and educational facilities. It is in this redefinition of the physical environment in which real innovation is found in the use of the concrete. And it is in this context that the architect can make an important contribution.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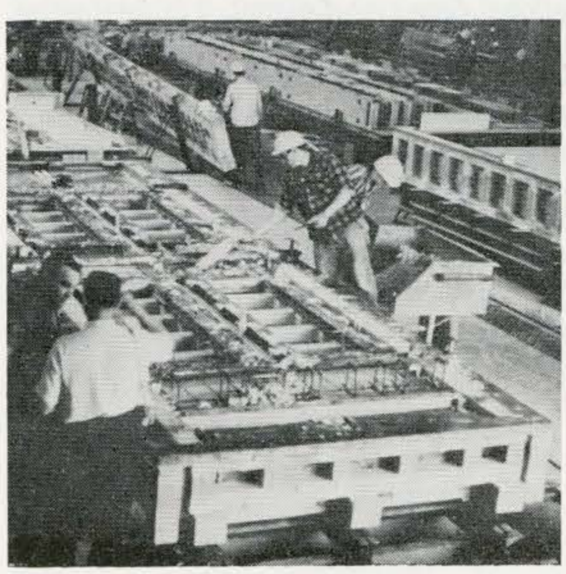
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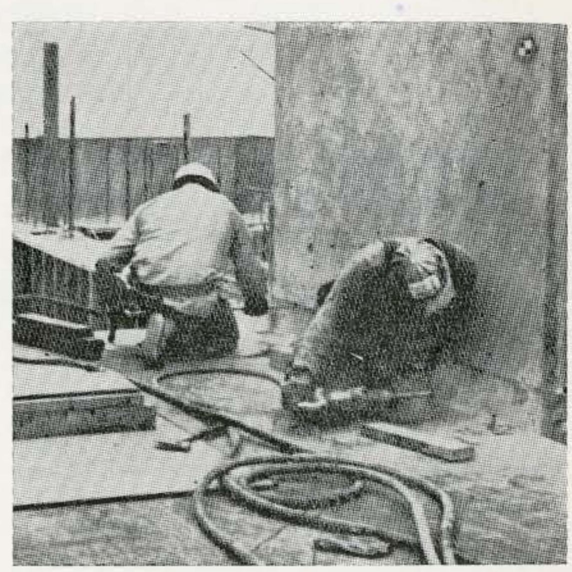
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The April 1964 issue of the magazine Scientific American attracted attention because of a study that it published on hallucinogenic drugs. However, the excursion into the "inner spaces" of matter for which this issue is noted is found in an article by two scientists of the Portland Cement Institute on research into the chemical reactions that occur when concrete sets. One of the authors has updated this article for this issue of Architecture Canada.

Material systems have developed to the point where alternative solutions are feasible. The capacity of producers exceeds demand, and they are actively promoting the competition of materials and the expansion of their markets. Both the producers of cement and of the chemical additives have taken an initiative in research into the chemistry of the system so as to improve and develop concrete products. This can be seen in an article prepared by a leading company in the field of development and manufacture of concrete admixtures. It can also be seen that producer-based research tends to emphasize the properties of the material rather than the composition of the system.

The importance of chemical "admixtures" as one of the basic constituents which controls the quality and performance of concrete is described in an article prepared by the Building Research Division of the National Research Council. It is interesting to note the attitude of government based research in addressing the hardcore content to the architect/designer as if he were as a delinquent spec-writer; the article is more telling of the approach of the NRC than that of the problems of the designer working with a complex materials system.

Ordinarily, the aggregates in concrete composites are considered to be inert. However, research at Rensselaer Polytechnic Institute has shown that aggregates are affected by cold weather, and the freeze-thaw cycle is challenged as the reason for deterioration in concrete. It was thought important, because of the Canadian climate, to reprint a report on this study and which appeared in Concrete Construction.

Even though concrete has had an important role in contemporary architecture, the recent popularity of concrete in design dates back ten years. At that time, the magazine Progressive Architecture planned the first of several issues devoted to the problems of concrete construction and building design. Whether their first issue predicted a design tendency, or whether it was itself a symptom of that tendency which it helped to confirm is difficult to say. However, the magazine did contribute to the setting of the style, and the editors of P/A were asked to reconsider their findings for Architecture Canada. By definition P/A, as other similar magazines, is architect oriented, and what emerges is a vivid description of some of the agonies of the designer in the face of technologic complexity, the change in the scale of his work, and his role. ☐

M.C.

The Matrix of Concrete

L. E. Copleland

Mr. Copeland is Manager, Basic Research Section, Research and Development Laboratories Portland Cement Association, Skokie, Ill.

In 1824, Joseph Aspdin was issued a patent on a new hydraulic cement; he called it portland cement because the "stone" produce by mixing the cement with water looked like a stone quarried on the Isle of Portland, England. Improved manufacturing techniques and understanding of the chemistry of producing cement has improved the product, although the raw materials used today are essentially the same those Aspdin used: a lime containing material and a clay-like material. The raw materials are carefully proportioned and interground and then heated to approximately 2700 degrees Fahrenheit to promote chemical reactions. A few percent of gypsum is addd to the cooled "clinker", and the mixture is interground to a fine powder. This powder is portland cement.

Four phases, three of which are almost pure compounds, comprise 90 to 95 percent of the portland cement. The other phase, the major iron containing phase, was at one time thought to be a compound and was named tetracalcium aluminoferrite, $4CaO{\cdot}Al_2O_3{\cdot}Fe_2O_3$. The ferrite is a crystalline solid solution phase having a fairly broad range of composition, but in most portland cements its actual composition is nearly that given above. Two of the phases that are nearly pure compounds have been identified as tricalcium silicate, Ca_3SiO_5, and β-dicalcium silicate, Ca_2SiO_4. The impurities present in these phases are predominately aluminum and magnesium. The two silicate phases together comprise 75 to 80 percent of portland cement. The fourth major phase is almost pure tricalcium aluminate; it sometimes contains alkali oxide as impurities. Microscopic examinations have been used to analyze portland cement for its compound composition, but this method is tedious. X-ray diffraction analysis is a more suitable method. Wet chemical methods give only the oxide composition, which can be used to calculate the "potential" compound composition.

The development of X-ray diffraction techniques has also made it possible to analyze for the hydration products of portland cements, most of which exist as crystallites that are too small to be seen with the light microscope. Electron-microscopy combined with electron diffraction provide the means to determine the sizes and shapes of the particles of hydration products and their arrangement in hardened paste.

Cement starts to hydrate immediately when it is mixed with water. Heat is evolved in all the hydration reactions; the rate of heat evolution can be measured in a conduction calorimeter. There is a rapid evolution of heat during the first few minutes, after which there is a slow evolution of heat for a "dormant" period of about two hours. After the "dormant" period the speed of heat evolution increases, passes through a maximum at about six hours after mixing, and then drops off slowly. Final set occurs at about the same time that the maximum rate of heat evolution occurs.

During the last decade world research has produced a fairly good, though not complete, understanding of the relationship between the heat evolution and the hydration reactions of cement.

The immediate heat evolution is caused by solution of soluble cement components, such as alkalies and gypsum, and partly by the immediate reaction of tricalcium silicate and tricalcium aluminate with water. Tricalcium aluminate reacts immedately with calcium sulfate and water to form the calcium aluminate trisulfate hydrate in the reaction given by the first chemical equation in Table 1. The trisulfate is deposited as stubby hexagonal tablets; primarily upon the tricalcium aluminate surfaces; some also precipitates from the solution phase as long thin hexagonal prisms at locations that are comparatively remote from clinker grains.

Water removes calcium hydroxide from and leaves an unreactive coating upon the surfaces of tricalcium silicate. The films

Hydration Reactions of Components of Cement

Table I

1.

$$3CaO{\cdot}Al_2O_3 + 3CaSO_4{\cdot}2H_2O + 26H_2O \rightarrow 3CaO{\cdot}Al_2O_3{\cdot}3CaSo_4{\cdot}32H_2O$$

tricalcium aluminate	gypsum	water	calcium aluminate trisulfate hydrate

2.

$$2(3CaO{\cdot}SiO_2) + 6H_2O \rightarrow 3CaO{\cdot}2SiO_2{\cdot}3H_2O + 3CA(OH)_2$$

tricalcium silicate	calcium silicate hydrate	calcium hydroxide

3.

$$2(2CaO{\cdot}SiO_2) + 4H_2O \rightarrow 3CaO{\cdot}2SiO_2{\cdot}3H_2O + Ca(OH)_2$$

dicalcium silicate	calcium silicate hydrate	calcium hydroxide

4.

$$2(3CaO{\cdot}Al_2O_3) + 3CaO{\cdot}Al_2O_3{\cdot}3CaSO_4{\cdot}32H_2O + 4H_2O \rightarrow 3(3CaO{\cdot}Al_2O_3{\cdot}CaSO_4{\cdot}12H_2O)$$

tricalcium aluminate	+ calcium aluminate trisulfate hydrate	calcium aluminate sulfate hydrate

5.

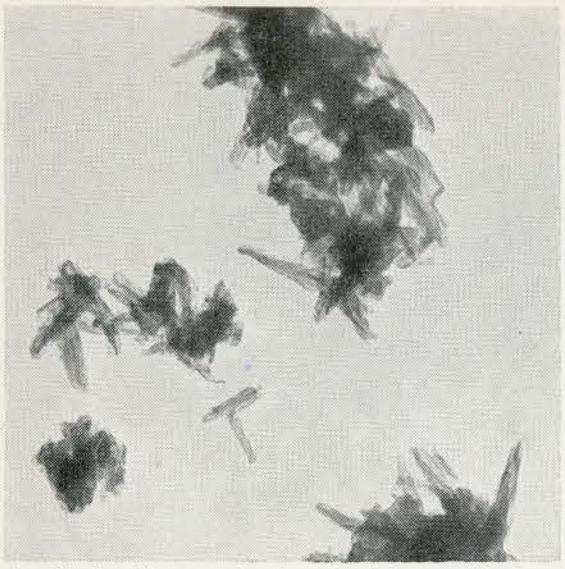
$$(l\text{-}y)(3CaO{\cdot}Al_2O_3{\cdot}CaSO_4{\cdot}12H_2O) + y3CaO{\cdot}Al_2O_3 + yCa(OH)_2 + xH_2O \rightarrow 3CaO{\cdot}Al_2O_3{\cdot}(l\text{-}y)CaSO_4{\cdot}yCa(OH)_2{\cdot}(1\text{-}y+x)H_2O$$

calcium aluminate sulfate hydrate	tricalcium aluminate	calcium hydroxide	calcium aluminate hydroxy-sulfate hydrate

6.

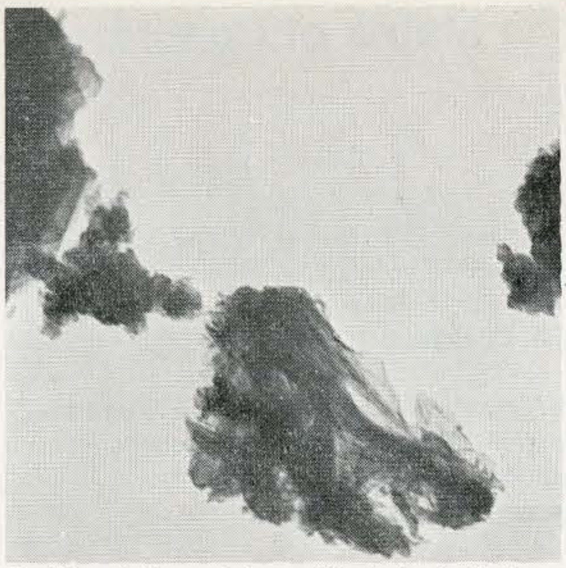
$$3CaO{\cdot}Al_2O_3 + Ca(OH)_2 + 18H_2O \rightarrow 3CaO{\cdot}Al_2O_3{\cdot}Ca(OH)_2{\cdot}18H_2O$$

tricalcium aluminate	calcium hydroxide	tetracalcium aluminate hydrate



1 *Hydration products of calcium silicates in cement 4 hours after mixing. Mag. 50000X*

2 *Hydration of cement 6 hours after mixing –about the time of final set. Mag. 50000X*



3 *Sheet-like calcium silicate hydrate in cement paste cured 24 hours. Mag. 50000X*

formed on the anhydrous silicate and aluminate phases retard their hydration durining the "dormant" period. The gypsum content of the cement is usually adjusted to keep the hydration of tricalcium aluminate retarded for about 24 hours.

Electron microscopic examination of pastes four hours after mixing shows lath-like particles protruding from cement grains, see *Figure 1.* Crystals of calcium hydroxide have precipitated throughout the solution phase. The coating on the tricalcium silicate phase is transforming to the stable calcium silicate hydrate, and as it disappears the tricalcium silicate hydrates more rapidly, see *Equation 2, Table 1.* When the rate of heat liberation reaches its maximum, the calcium silicate hydrate has the rather lath-like appearance shown in *Figure 2.* This field suggests that final set may be caused by the intergrowth of those particles which form upon cement grains and calcium hydroxide crystals. At about 24 hours most of the calcium silicate hydrate has changed to thin sheets, see *Figure 3,* tightly packed into larger aggregations.

Simultaneously the dicalcium silicate phase slowly hydrates to form the same hydrate that is formed from tricalcium silicate, see *Equation 3 of Table 1.* The paste hardens and gains strength as the silicates hydrate.

After the gypsum has been depleted a new reaction, *Equation 4 of Table 1,* begins; the excess tricalcium aluminate combines with the product of the first reaction to form calcium aluminate monosulfate hydrate. This reaction proceeds more rapidly than the first reaction. Usually there is tricalcium aluminate in excess of that required to form the monosulfate. The fourth and fifth reactions follow in sequence until the tricalcium aluminate is completely hydrated.

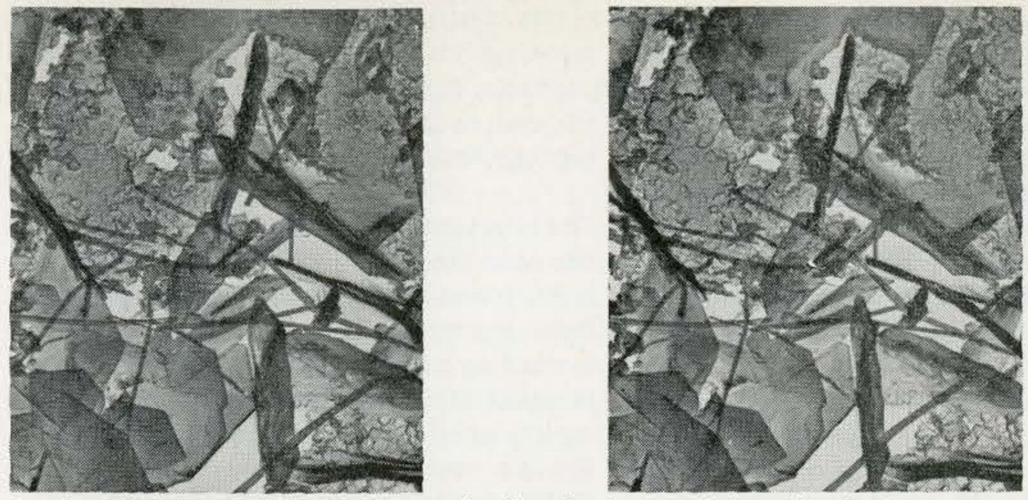
The first reaction of the ferrite phase is thought to be analogous to Equation 4 of Table 1 in which calcium ferro-aluminate monosulfate hydrate is formed. This reaction continues until the calcium aluminate trisulfate is depleted. The hydration reactions are more complicated than is implied by the equations in Table 1 because solid solutions rather than pure compounds are formed. Iron and aluminum are seemingly completely interchangeable in all of the aluminate hydrates. In the silicate hydrates limited amounts of alumina and calcium sulfat are dissolved.

The hardened portland cement paste is produced is a composite of several kinds of hydration products. These hydration products, other than calcium hydroxide, exist in particules that are too small to be seen with a light microscope. Consequently optical examination reveals little about the structure of the paste that fills the space between unhydrated clinker grains.
The term "gel" has been applied to hydration product of cement because of its lack of visible structure and because when saturated it contains a relatively large volume of water that can be removed by drying, which implies a porous structure. Some details of the structure of hardened pastes have been obtained by electron microscopic examination of surface replicas. The replicas are made by first depositing a thin layer of carbon on paste surface; then the paste is removed, leaving a thin shell of carbon that has the same shape as the original surface. *Figure 4* is a stereo view of a field from paste, watercut with a diamond saw, which contained both calcium aluminate trisulfate hydrate and calcium aluminate monosulfate hydrate.
The paste was mixed with a water-cement ratio equal to 0.45 by weight and cured continuously moist for 14 days. The thin hexagonal plates in the micrograph are the calcium aluminate monosulfate hydrate, the long thin rods are hexagonal prisms of calcium aluminate trisulfate hydrate.
It appears that some of the hexagonal plates have either grown around the prisms, or possibly that the prisms served as nuclei to start growth of the plates.

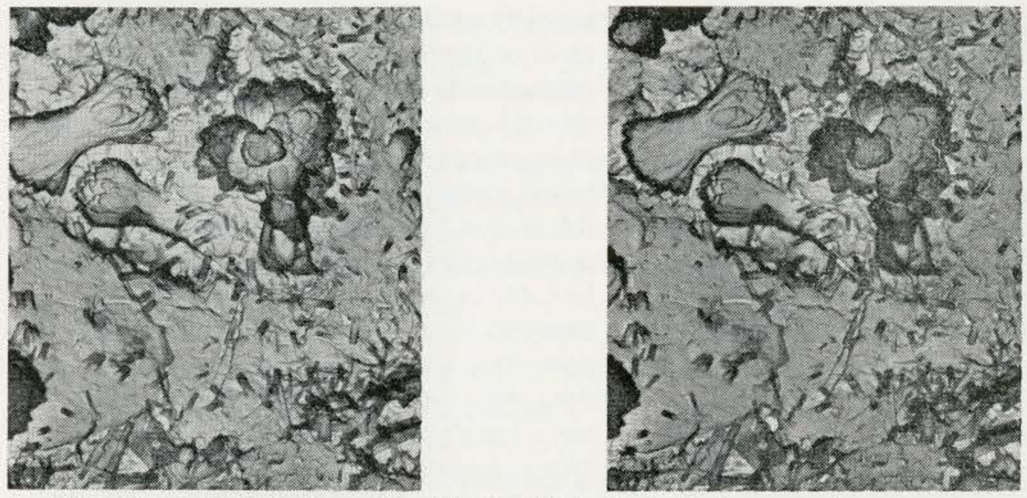
Another field from the same hardened paste shows one of the characteristic forms of the calcium silicate hydrate, see *Figure 5.* The sheaf-like growths appear to be aggregations of the thin sheets of the calcium silicate hydrate found in direct electron microscopic examination of powdered hardened pastes. It is not hard to visualize that the denser gel in the background is formed by intergrowth of aggregations such as these.

Surfaces formed by splitting pastes give little information about the shapes and sizes of aggregations of gel, although occasionally a sheaf such as is shown in *Figure 5* is seen in large pores. *Figures 6 and 7* show fields from a replica of a fracture surface formed by splitting the same hardened paste used in obtaining *Figures 4 and 5.* The fracture passes through, rather than around, aggregations of gel. A large capillary pore, shown in *Figure 6,* is lined with lath-like gel particles that were seen to form in the very early stages of hydration. Frequently calcium aluminate trisulfate can also be seen protruding from the walls of the pores.

The field in *Figure 7* illustrates the close intergrowth of gel and calcium hydroxide crystals. The crystal orientation of the calcium hydroxide is the same in all the regions where it exists in this field. It is likely that the calcium hydroxide in this field is a single crystal that grew simultaneously with the deposition of the cement gel to form a stratified composite of crystal and gel.
An understanding of three of the physical aspects of hydration of cement is of great practical importance: (1) We know that hydration products are precipitated only in water filled space between cement particles. For example, air bubbles in plastic paste remain air filled voids in the hardened paste. They do not contain hydration products unless they have become partially filled with water from prolonged soaking of the paste, in which case crystals of calcium hydroxide can form in them. (2) In every one of the individual hydration reactions, the total volume of the products of the reaction is less than the total volume of the reactants; yet the volume of the solid hydration products is always greater than the volume of the *solid* reactants. (3) The bulk volume of the paste remains practically constant after setting occurs implying that a continuous network of solid particles has formed throughout the paste by the time of final set. Since the bulk volume of the space occupied by this network does not change during continued

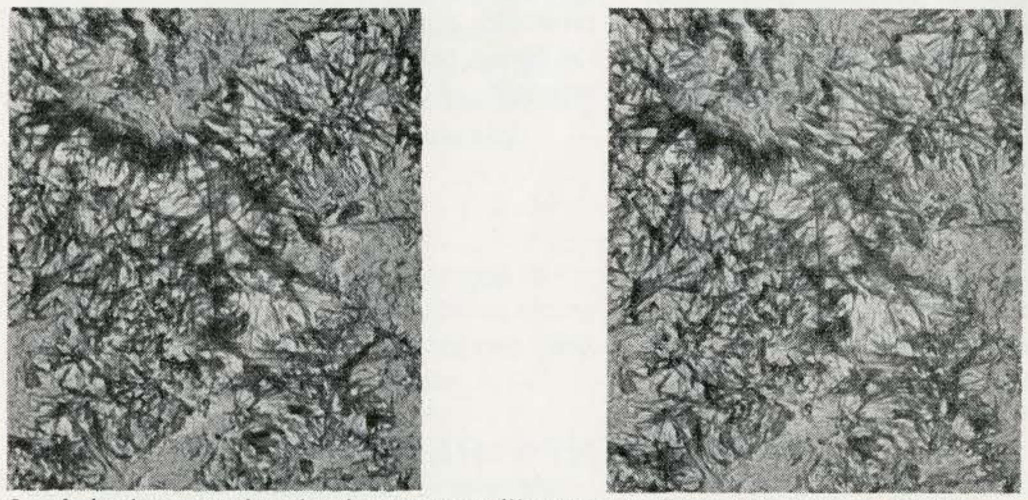


4 *Coexisting calcium aluminate trisulfate hydrate calcium aluminate monosulfate hydrate in cement paste. Cut surface, 4200X*



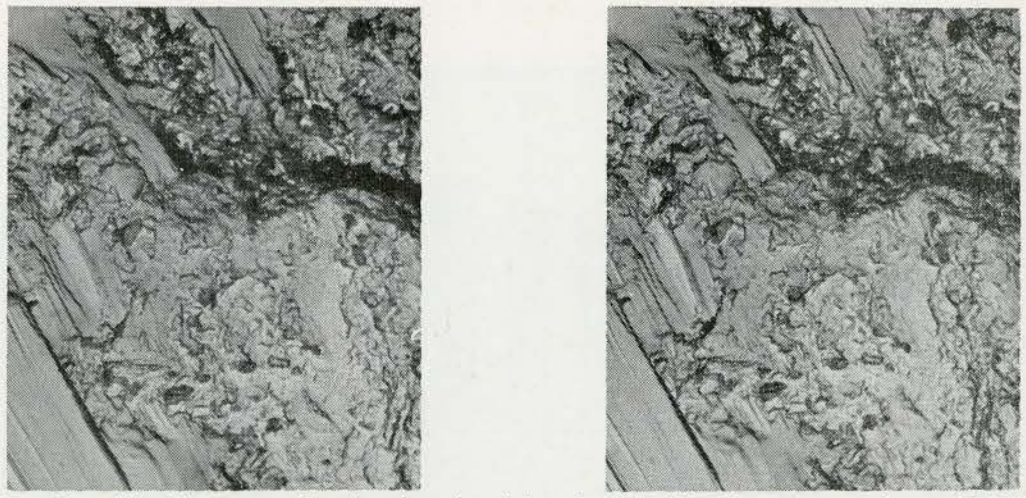
5 *One characteristic form of calcium silicate hydrate in cement paste. Cut surface, 4200X*

It is not difficult to learn to see stereoviews without optical aids. Place the page flat on a firm support at normal reading distance from the eyes. Relax your eyes as if looking at a distant object; you will become aware of three frames instead of two. Adjust the position of the head, or page, so that the top edges of the three frames are collinear. Then concentrate on the center frame and refocus your eyes to see it. A piece of cardboard placed so that the right eye sees only the right frame, and the left eye sees only the left frame, is an aid to some people while learning the technique.



6 *Acicular growths of gel across capillary pores. Fracture surface, 4200X*

Il est possible d'apprendre la stéréovue sans instruments optiques spéciaux. Placez la page à plat sur un appui quelconque à une distance normale des yeux pour la lecture. Reposez vos yeux comme pour fixer un objet éloigné; vous aurez alors l'impression de voir trois images au lieu de deux. Ajuster la position de votre tête ou celle de la page pour que les bords des trois images soient collinéaires. Puis concentrez votre vue sur l'image centrale en la regardant. Un morceau de carton placé de telle façon que l'oeil droit voit seulement l'image droite et l'oeil gauche seulement l'image gauche, est le meilleur moyen, pour certains gens, d'apprendre cette technique.



7 *Stratified intergrowth of gel and calcium hydroxide. Fracture surface, 4200X*

hydration of the cement it is clear that if water is not supplied to the pastes then air will be drawn into part of the initially water filled space. Furthermore, since the hydration products are precipitated only in water filled space, continued hydration and thus the characteristics of a hardened paste will depend upon the availability of additional water during curing.

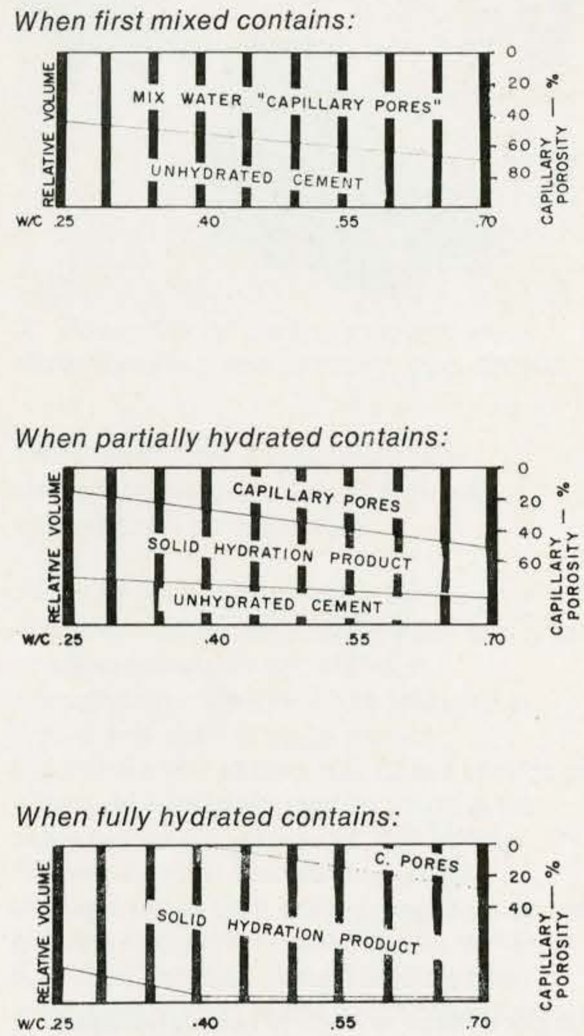
One of the most important factors influencing the properties of hardened cement pastes, and consequently concrete, is its porosity. The magnitude of the porosity is determined by the initial ratio of water to cement in the mix, and the amount of cement that has hydrated. *Figure 8* illustrates that the volume of paste, and hence its porosity, increases rapidly as the ratio of water to cement increases.
All pastes are porous because the gel itself is porous. The minimum porosity of a paste in which all the cement was hydrated would be approximately 25 percent.
This porosity, which is characteristic of the hydration products, is called "gel porosity". Recent studies using nuclear magnetic resonance indicate that the water in gel pores is similar to the interlayer water in clays.

The porosity in excess of gel porosity is called capillary porosity. A fully hydrated paste having an initial water-cement ratio of 0.7 contains about 20 per cent gel pores and 30 per cent capillary pores. Incomplete hydration of the cement decreases the gel porosity and increases the capillary porosity, as illustrated in *Figure 9.*

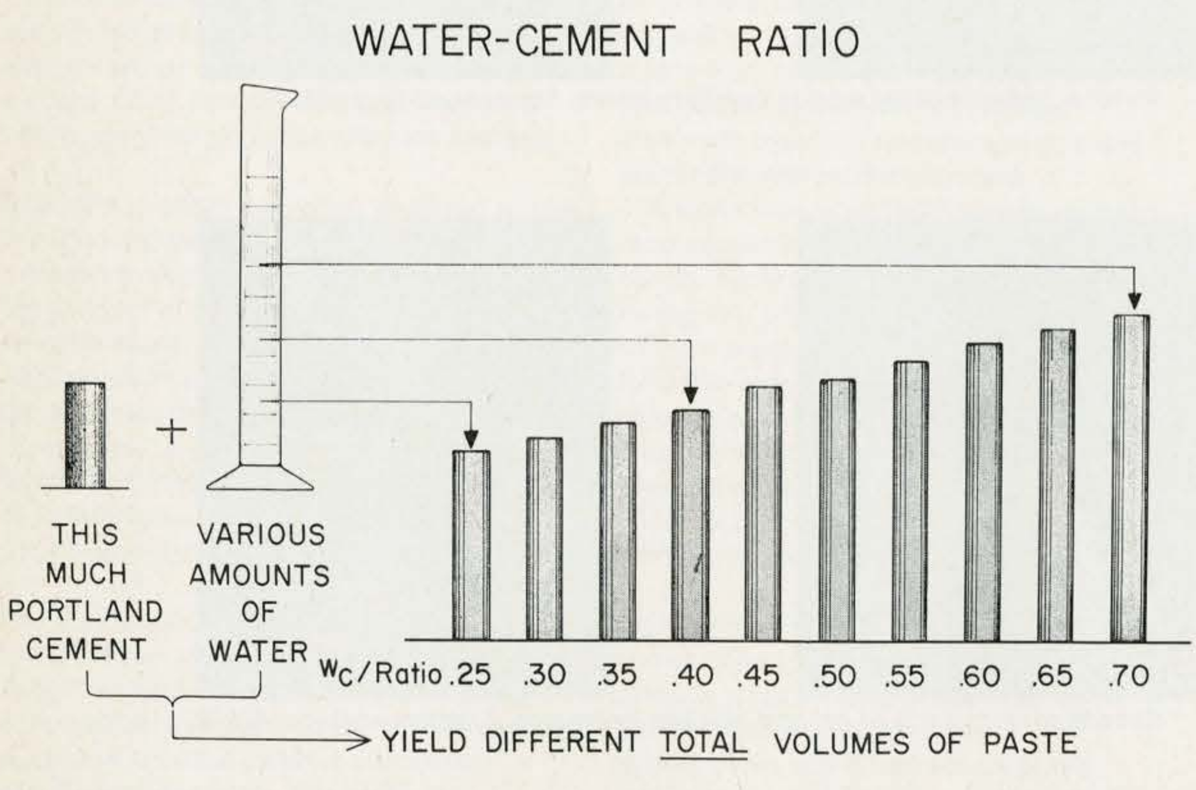
In this illustration of the volume of gel pores is included in the volume of hydration products. The size of pores range from a few microns, such as those seen in the carbon replicas, down to 10 or 20 Angstrom units.

The effect that increasing capillary porosity has upon three important properties of paste is illustrated in *Figure 10.* Drying shrinkage increases rapidly, at low porosities, with increasing capillary porosity, while permeability of the paste to water increases rapidly when capillary porosity increases above a moderate level. The drying shrinkage of concrete is only about 10 percent as great as that of neat cement paste because the aggregate serves to restrain shrinkage; nevertheless increasing porosity of the paste in concrete increases its drying shrinkage. On the other hand, permeability of concrete of moderate or inferior quality is apt to be greater than that of its paste because of microscopic fissures below pieces of aggregate. Strength decreases linearly with increasing capillary porosity throughout the usual range of porosity in concrete. The relationship between the elastic moduli and capillary porosity is more complicated, but it decreases with increasing porosity relatively more rapidly than does strength.
This comparison of the effect of capillary porosity upon different properties of paste suggests that a more effective use of concrete for many purposes would result if a property especially desirable for the particular purpose were used as a criterion for design rather than always to use strength. PCA. R & D. Ser 1376

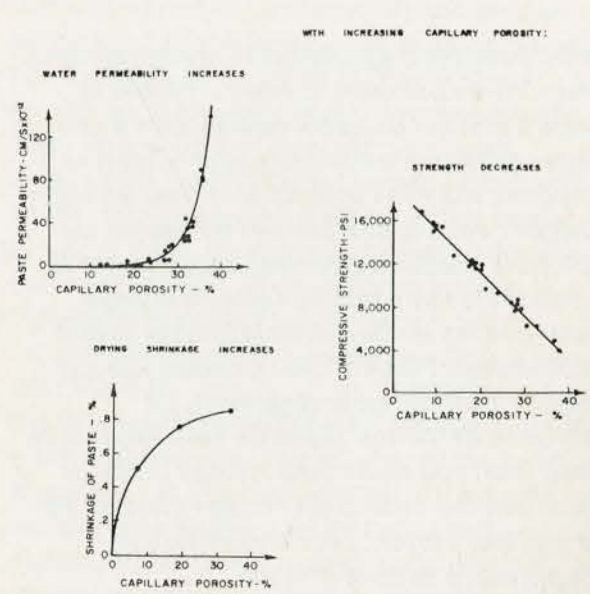
This volume of the cement pastes



9 *Formation of solid products during hydration reduces capillary porosity*



8 *Water-cement ratio and amount of hydration determine capillary porosity*



10 *Capillary porosity controls most paste physical properties*

Concrete
Properties and Purposes

E. C. Anderson

Mr Anderson is Vice-President of the Master Builders Company Limited

Concrete is the only major building material which is delivered to the job site in a plastic state. This unique characteristic makes possible several of the advantages htat concrete enjoys: mouldability to practically any form or shape; easy provision for continuity of structural action: high resistance to damage by fire; wide latitude in surface textures and colors; and adaptability to many uses ranging from super highways to private homes.

Gross Structure

Concrete is a composite, that is, it is composed of several materials held together in one mass. It is aggregates bound into a mass by cement paste. Concrete has been termed a pseudosolid because, although resembling one, it does not behave as a true solid.

Every aggregate particle in properly mixed concrete – from the finest sand grain to the largest stone or gravel size – is completely coated with cement paste. No aggregate particle touches any of its neighbors. Therefore, concrete becomes, in theory, a complete, unbroken network of cement paste with aggregate interspersed throughout.

In a typical mix, aggregates constitute about 75 percent and cement paste 25 percent of the concrete volume. Because cement is the most expensive of the ingredients of concrete and the cement paste contributes most to shrinkage for a given set of materials, the aim of concrete mix designers is to minimize the volume of cement paste in a mix and maximize the volume of aggregates, commensurate with needed aggregate coating and workability.

By using the largest maximum coarse aggregate size (consistent with available materials) permitted by form dimensions and reinforcement spacing, it is possible to incorporate the greatest volume of aggregate in the concrete and the greatest quality and economy will result. Ready mix plants stock several sizes of aggregates which can be blended scientifically with modern batching equipment to produce a mix that will be both economical and workable and which will approach maximum density.

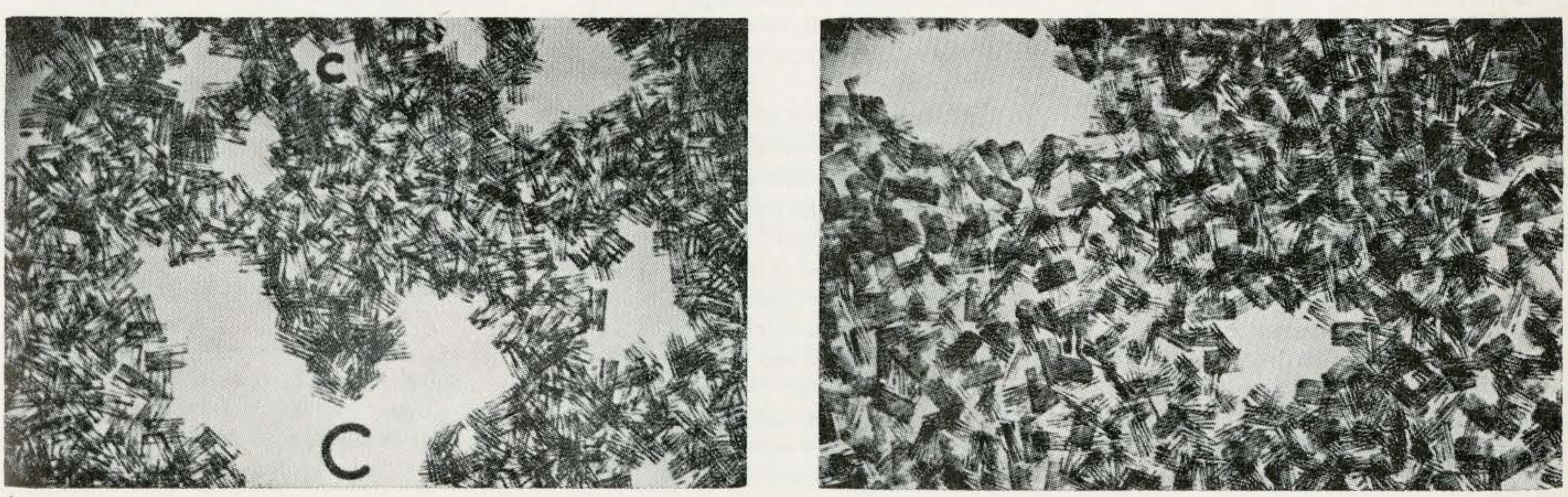
Paste Structure

Like the chain that is no stronger than its weakest link, concrete can only be as strong as its weakest component. Aggregates used in concrete generally have higher compressive strengths than will be developed by the cement paste. In addition, aggregates are comparatively unaffected physically or chemically by the treatment they receive in concrete batching, placing and curing. On the other hand, the cement paste can be profoundly affected by the conditions encountered in all of these stages. Because of these factors, the strength and durability of concrete are greatly dependent upon the cement paste.

When cement and water hydrate or react with one another, the product is the hydrated cement paste or "glue" which binds the aggregates together into a workable construction material. All cement paste is composed of water, unhydrated cement and the products of hydration, the latter being the only elements which contribute to structural strength. There are several products of cement hydration, but by far the most important is cement gel.

Portland cement is composed mainly of four chemical compounds (excluding gypsum which is used to control the rate of setting). During the hydration process these compounds react simultaneously but at different rates, so that some reactions are completed while others are still in their initial stages. But all of the products formed by these several chemicals reacting at different times is, curiously enough, cement gels capable of adding to the strength of concrete.

First, let's consider a single gel particle. What is its shape? No one knows for sure,

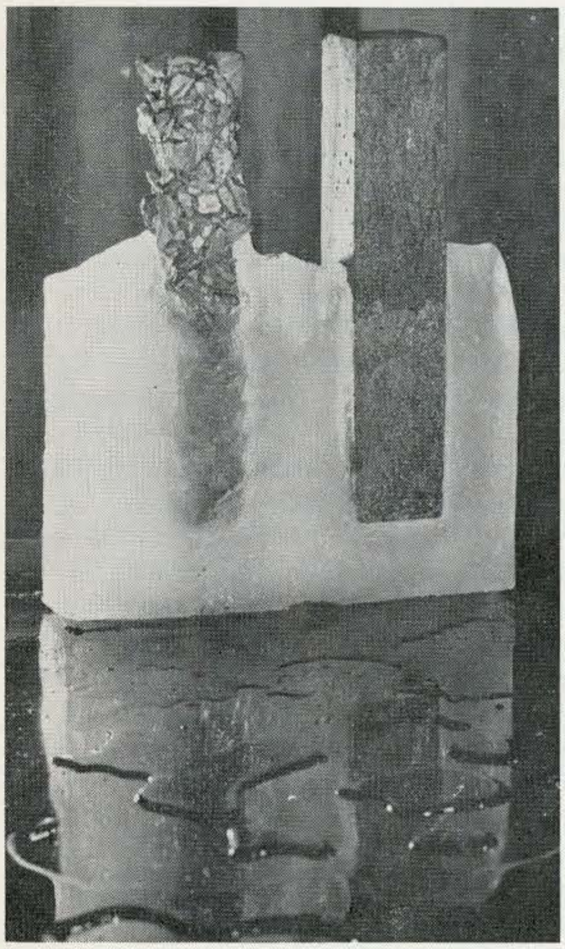


1

1
It is likely that gel particules are fibrous or platy. In the right illustration the drawing is constructed to correspond to a capillary porosity of 20 percent, which is that of a well-cured paste having a water cement ratio of 0.5 by weight. The illustration on the left shows the effect on capillary porosity of reducing the water cement ratio from 0.5 to 0.3. In this model the capillary porosity is 7 percent
Il est probable que les parcelles gelées soient fibreuses.

2
The results of air-entrainment are dramatically illustrated in this photograph. Both of the concrete specimens were subjected to the same number of freeze thaw cycles. The badly deteriorated specimen on the left was non-air-entrained concrete with a high water content The concrete specimen on the right had an optimum amount of purposefully entrained air and a low unit water content

Les résultats du traitement d'air sont démontrés d'une façon probable sur cette photo. Les deux specimens de béton armé ont été soumis au même nombre de cycles de gel et dégel. Le specimen à gauche gravement endommage, était du béton armé sans traitement d'air qui contenait une haute quantité d'eau. Le specimen de béton armé à droite a subi un traitement d'air supérieur et de ce fait contenait une quantité d'eau inférieure



2

but many scientists at this time lean toward the belief that gel particles are fibrous or platy. It is believed that the strength of a single gel particle is not great, even taking into consideration its microscopic size. It is probably the interaction of many particles that accounts for the considerable strength of cement paste.

The cement gel particle is termed a limited swelling gel. Cement gel is often contrasted with household gelatin, which is an unlimited swelling gel. They are both composed of extremely fine colloidal particles joined together by some unknown means to form a semi-solid material. However, when hardened gelatin is immersed in warm water, it absorbs a considerable quantity of water, softens, swells and becomes a liquid once again. Hardened cement gel, on the other hand, will absorb a little water and swell a minute amount when it comes into contact with water, but this absorption is limited chemically and never amounts to enough to seriously affect strength or hardness.

What is the physical makeup of the cement gel particle? Initially it has nucleii of unhydrated cement surrounded by the products of hydration. As the cement hydrates the compounds covering the nucleii become progressively thicker and more impermeable. A point is ultimately reached when it is impossible for water to penetrate the covering to the core and the gel particle ceases hydration to all intents and purposes. (Space to accommodate the hydration products is also a determinant.) It is this characteristic that explains the typical curves found in studies of concrete strength gain. Strengths climbs fast at first; but afterwards they level off, indicating that hydration has virtually stopped.

Cement Paste Strength

As has been indicated, the strength and durability of the cement paste (and thus usually that of the concrete) hinges mainly upon the proportions of water and cement, quality of the ingredients, and the practices followed in batching, handling and curing.

When cement particles are mixed with water they disperse throughout the volume of liquid. This will hold true within the limits of water contents found in all concrete mixes. The more water that is used, the farther apart will be the gel particles formed, and the fewer and less extensive will be the points of bond between the gel particles. In this way, cement paste is much like the powdered household glues on the market; the more water that is added to them, the weaker will be the resulting glue.

While we know very little about the strength of the gel particles themselves, there is some evidence to indicate that it is the bond points between the gel particles which determine the strength of cement paste. The evaporation of what is called "water of convenience" (water needed for workability rather than for hydration) leaves spaces between the gel particles. These capillaries undermine the strength of the cement paste. This fact explains the water-cement ratio law. As the amount of water mixed with a given quantity of cement is decreased, the closer will be the gel particles and the more numerous and extensive will be the points of bond between them. Consequently, the strength of the paste will be higher. This denser material also offers greater resistance to practically all the factors which tend to deteriorate concrete. Since considerably less water can penetrate into it, damage by freeze/thaw cycles is dramatically reduced. Chemical attack is also reduced since there are fewer capillaries which can be penetrated by harmful solutions.

Because the combination of cement and water results in limited swelling gels, once the paste has dried out the rate of hydration is reduced markedly. Unlike the household gelatins, cement gels become practically impermeable once they have dehydrated and the core of unhydrated cement in the gel is virtually cut off from its supply of water. Although the cement gel becomes impermeable when curing is discontinued or not commenced, the permeability of the cement paste increases up to 70 percent due to microcracking. It is for this reason that proper, early curing looms so large on the quality concrete scene. Curing is largely a matter of preventing evaporation of water in the concrete, and all available evidence indicates that the best results are obtained with uninterrupted curing.

And so it goes on down the line. Each recommended procedure for quality concrete is firmly rooted in the physical and chemical characteristics of cement paste and the aggregate used. It is dangerous to over-simplify since the fields of concrete technology and research are so highly complex and controversial. Even from this brief look into the subject it is evident that we still have a great deal to learn. However, in most of the basic areas, which have the most important effect on practical field problems, the facts are clear. □

Admixtures in Portland Cement Concrete

E. G. Swenson

Mr Swenson is Research Officer, Building Materials Section, Division of Building Research, National Research Council of Canada

Today when concrete admixtures are mentioned the one that first comes to mind is probably calcium chloride. Its history in cold weather concreting in Canada is long and not without problems and controversy. Equally well known is the air-entraining admixture, especially to the builder of pavements and sidewalks. More recent entries to the field are set-retarders and water-reducers. Much less extensive in use and less well known are such concrete admixtures as corrosion inhibitors, expansion producing agents and color pigments.

Until recent years the building designer has not felt the need to concern himself with details of concrete composition, leaving this to the specialist and to the manufacturer. He has been content to specify certain minimum requirements such as compressive strength. Today, however, more and more is demanded of concrete than ever before. It is being used in a greater variety of structural elements, in more complex situations, and under more severe climate and weather conditions. These developments and the attendant requirements of job scheduling and general economics have made it mandatory for both building designer and builder to know the capabilities and limitations of the material.

It is owing to these very developments that concrete admixtures are now used more extensively and have now become an integral part of concrete technology and practice. As a matter of fact, nearly all the concretes produced in Canada today, whether precast or *in situ* are made with an admixture, often with more than one. If the question is now asked whether the architect or builder should known something about the nature of admixtures – how useful they are, what problems are connected with their use, where they enter into specification requirements – the answer is a definite yes.

A concrete admixture is the "fifth" ingredient in concrete, an addition to the four basic components: cement, water, sand and stone. It is added to modify one or more properties of either the plastic mix or the hardened state. For example, a set-retarder may be used to delay setting of the plastic concrete in order to allow more time in placing a batch in a difficult situation. Most admixtures in common use are, with the exception of calcium chloride, complex organic chemicals, added in small dosages in the order of about 1 percent by weight of the cement or less.

Unfortunately, admixtures like drugs produce side effects that may be beneficial, harmless, or downright harmful, depending on the situation. The concrete producer may be aware of these, but he may not know whether the design features of a structure can tolerate them. The architect or builder should be in a position to discuss such matters with the concrete supplier, particularly with *in situ* concreting, where the concrete is actually "manufactured in place."

The earliest use of an admixture was probably in connection with improving the workability of plastic concrete. Most of the organic chemicals used, whether air-entraining agents, set-retarders, or water-reducing admixtures, possess this beneficial side effect. It is an important consideration for the architect because it is often associated with elimination or reduction of segregation, honey-combing and cracking. Improved workability of the plastic state is conducive to better formability and surface finish.

On the Canadian scene the air-entraining agent is perhaps the only "must" among concrete admixtures. No alternative has been established that will provide such greatly improved durability with frost action and de-icing salts. Generally, all specifications require air-entrainment in exposed concretes on ground.

Cold weather concreting demands extensive use of protective cover for young concrete, heating, and calcium chloride as an admixture. The latter is not effective as an antifreeze and is therefore not a substitute for the cover or heating at below-freezing temperatures. As an accelerator of setting time, an admixture of calcium chloride can provide such useful applications as: earlier finishing of floors, reduction of form pressures, and quick setting in spray-type processes. As an accelerator of strength gain it can provide for earlier removal of forms and earlier application of load, and, generally, reduction of the time during which protection from freezing would be required in winter concreting.

These accelerating effects provided by calcium chloride can be achieved by means other than the use of an admixture. Examples are: finer grind of cement, higher temperatures, and modification of chemical composition of the portland cement. The alternatives are often preferable from the point of view of economy and quality. One can thus avoid the side effects of the admixture which, although generally small and tolerable if taken into account, are nevertheless usually deleterious.

The all-important matter of cost has greatly extended the use in recent years of the water-reducing admixture. By lowering the mix water requirements the admixture provides for increase in concrete strength for a given cement content and a given slump. This also makes it possible, however, to reduce the cement content for a given strength and a given slump, a practice that can take the use of the admixture as a "cement-stretcher" beyond the limits of good quality concrete. These admixtures are generally of the same type as the set-retarders, and therefore possess similar side effects.

Chemical admixtures other than those already referred to are used to a much lesser extent and only in special processes or job situations. They include damp-proofers, permeability-reducing admixtures, gas-producing agents, and air-detrainers. Another general class includes mineral powder admixtures such as fly ash which are added in much larger amounts.

In the general consideration of application of admixtures one finds that requirements and problems may vary considerably with manufacturing and placing processes. Precast plants, for example, have complete control of all operations, from the selection of component materials to the final curing of product. It is thus possible to reduce problems to a minimum, and in these cases one finds considerable use of accelerators to reduce curing periods, water-reducers to cut cement costs, and retarders to obtain uniformity in large beams. On-site concreting also involves a single authority and therefore good control.

The ready-mix concrete operation poses a special problem in that the producer loses control of the concrete at the point of discharge, when the job contractor takes over. This divided authority is a potential source of difficulty in connection with the effects of an admixture on the plastic properties of the material, and special protection and control are required.

Again, it may be argued that the building designer need not be concerned with such details, and this may apply, in part, to precast concrete, which is a finished product like glass, wood, or steel. With *in situ* concreting, however, the producer and placing contractor, and the builder are involved in the actual manufacturing process, and the quality and performance of the concrete will depend on their combined knowledge and their decisions along the way. Dependence on specifications alone is never adequate, because a meaningful specification for concrete for a given job cannot be developed except through a thorough knowledge of the technology.

Selection of a suitable admixture poses problems, not least of which is whether it is in fact necessary. For any type of admixture, such as a set-retarder, there are usually many brands on the market, and each type usually contains more than one basic functional ingredient. Thus, two differet set-retarders may have quite different side effects. The chemicals used are complex and often variable in composition, and formulas may be changed, frequently with no warning.

The building designer should be aware of these general problems. He should also be aware of the plant adjustments required to accommodate the use of an admixture. These involve handling, storage, preparation and dispensing. For example, special storage is required for admixtures that are sensitive to temperature; and most chemical admixtures form suspensions with water rather than true solutions so that they may coagulate and settle unless a system of stirring is evolved. Dispensing equipment must be calibrated frequently and be foolproof.

It is necessary that the user of concrete has confidence in the producer. Besides his general understanding of the factors involved, he must be assured that the admixture to be used in the concrete he orders has been properly tested. This does not mean test data supplied by the admixture manufacturer or other outside evaluation. It means a proper adaptation in the plant itself because most admixtures are sensitive to sand grading, nature of aggregates, and type and brand of cement. Practically every mix design requires modification when an admixture is to be included.

Today, after years of development, there are true performance specifications for admixtures, required and referenced in the Canadian Standards Association Standard for Concrete Materials and Methods of Concrete Construction, A23. 1-1967. There are essential features of these specifications: in addition to the limits on the specific effect claimed, they require that an admixture does not adversely affect other properties of the concrete. Specific tests have been developed to establish performance. Thus a recognized basis now exists for evaluating concrete containing admixtures.

It may be seen that admixtures can be used to advantage in modern concretes: for "curative" or "preventive" purposes, *e.g.* air-entrainment; as "aids," *eg* acceleratino of hardening; and for purely money-saving purposes, *eg* water-reducers. The full list of benefits is impressive for both producer and consumer. Their success, however, is contingent on proper use and knowledge of side effects and other hazards. An admixture cannot compensate for inferior materials or bad practice, and in most cases there are alternatives worth consideration on economic and quality counts.

Admixtures will continue to have an important place in concrete technology, but their successful use requires not only knowledge of the basics of concrete technology, but also recognition of the fact that an admixture requires modification of usual procedures. It also requires recognition of the essentially chemcial nature of admixtures and the processes in which they are involved. The architect or builder need not become an expert on admixtures, but familiarity in a general way with their types, nature, and effects is to his advantage. □

Freeze-Thaw Theory Challenged

Researchers at Rensselaer Polytechnic Institute have challenged the long-standing belief that the deterioration of concrete exposed to freeze-thaw cycles was due to the expansion of the water present in all concrete. For years concrete engineers have reasoned that as water froze and expanded in volume, it set up disruptive forces within the concrete, creating new and enlarged capillaries and voids within the concrete mass. These enlarged spaces in turn, thought the engineers, permitted greater amounts of water to enter the concrete which, upon freezing, further enlarged the void structure of the concrete mass.
But the information developed by the Rensselaer researchers seems to indicate that in reality the smaller the amount of ice that is formed within the concrete mass, the *greater* may be the likelihood of deterioration. Their findings apply principally to aggregates rather than hardened cement paste matrix.

The Rensselaer findings indicate that simple wetting and drying combined with natural temperature changes are the cause of deterioration of concrete containing these rocks.

Clay minerals contained in rocks which are commonly used for concrete aggregates, such as dolomite and limestone, are the culprits in this deterioration. These clay minerals are also found in shales and porous cherts occasionally found in concrete aggregates. These aggregate types constitute a sizable percentage of all the aggregates quarried.
Dr James R. Dunn and Dr Peter P. Hudec carried out the research sponsored by the New York State Department of Public Works, in cooperation with the Bureau of Public Roads, under a contract for research on the influences of clay on water and ice in rock pores. The research disclosed that some rocks which deteriorate by freezing and thawing also break down by wetting and drying. This suggested that freezing of water in rock may not be necessary to produce failure. "We then wanted to determine how much water actually freezes in the rock and what is the process and nature of freezing," explained Dr Dunn.

To carry on this work it was necessary to develop procedures much more sensitive than those commonly used to test materials. Since freezing liberates heat, the amount of freezing taking place within a material can be gauged by the amount of heat liberated. Cold differential thermal analysis equipment capable of detecting temperature changes as little as 1/1000 of a degree centigrade was developed. This close control permitted the detection of the freezing of a mere 1/1000 percent of the water in an average 40-gram rock sample.

Thirty-two samples of carbonate rocks from the state of New York were used in the tests. They were divided into two types: 19 that had proven to be frost-sensitive in the field that-is, those that deteriorated rapidly in natural exposures such as quarry faces – and 13 comparatively frost-resistant.

Tests showed that relatively all the water in the 19 frost-resistant rocks froze. However, in 8 of the 19 frost-sensitive rocks little or no water froze despite repetition of the freezing up to four times and temperatures as low as minus 40 degrees F. in the remaining 11 frost-sensitive rocks, usually less than one-half of the water contained in the rock froze. In addition, it was discovered that freezing did not take place progressively, but rather took place in a single freezing pulse, between 19.4 degrees and 10.4 degrees F. To check the effect of salt on the resistance of these rocks to freezing, the geologist next used a 10 percent sodium chloride (salt) solution for saturating the rocks. The amount of ice formed when using the brine solution was considerably less than when plain water had been used. Also, as is well known, concrete deteriorates more rapidly when subjected to salt water than it does when subjected to plain water. Thus even though there was less water available to freeze because salt was used, there was an increase in the breakup of the rock structure. The Rensselaer researchers concluded then that the water in rocks which resists freezing is adsorbed. In other words, the water in freeze-resistant rocks is built up into micro-thin layers on the mineral surfaces of the rocks. Since clay is composed of exceptionally fine particles, it is a material with high surface area and consequently tends to contain a high percentage of adsorbed water. Tests run on the sensitive equipment developed for these tests confirmed that the adsorbed water does not freeze. And yet it was found that the rocks containing adsorbed, non-freezable water were frost-sensitive.

To test this conclusion further, the rocks were saturated with formamide, a liquid which is more polar than water. A polar liquid (like water or formamide) is composed of molecules which have positively and negatively charged ends. Such molecules tend to layer and pack readily on charged clay surfaces. The formamide-soaked rocks were then exposed to temperatures alternating between 185 degrees F. and room temperature. The most frost-sensitive rocks broke up after only a few cycles of this temperature variation. When saturated with carbon tetrachloride, a non-polar liquid, the rocks were not affected.

The inevtiable conclusion of the research team was that the deterioration of the rocks was the result of reorienting of polar molecules (such as water) on adsorption surfaces in a warming and cooling environment. Freezing temperatures are incidental to this reaction and need not be present for the deterioration to take place.

If the findings of the Rensselaer scientists are confirmed by other independent reseachers, the results are likely to be significant. For one thing, testing methods to determine the durability of aggregates would likely undergo drastic alterations. It would be possible to relate the test more closely to the determining factors in aggregate performance and the need for expensive refrigeration equipment presently being used would be eliminated. In addition, it would be necessary to take a hard look at our present testing procedures for aggregate durability in the light of the new findings. Since the Rensselaer theory is more closely in agreement with field experiences than the current theories governing aggregate durability, there will no doubt be a considerable amount of additional research devoted to this matter encompassing aggregates of different types and from other localities. It might just be that another significant step has been taken in our quest for complete knowledge of the inner workings of concrete. □

A Contribution to Concrete Exposing Itself – Progressive Architecture

Forrest Wilson

Mr Wilson is Associate Editor of P/A

Eight years ago *Progressive Architecture* predicted that concrete construction was to become a major force in building design and devoted an entire issue to the subject. Six years later the editors went back to survey our claim. We tried to report objectively, leaving the implications of our findings to be interpreted by our readers. Therefore since P/A did not then, and does not now, have an official "line" on concrete the following conclusions are necessarily my personal observations.

The aims of concrete technology could be roughly divided into three goals: the production of decorative, decorative structural and structural concrete. Within these groupings concrete proved to be all things to all designers. Architects who took the trouble to learn the technology or retained competent consultants reported, for the most part, excellent results. Formally oriented architects who conceive any building material as a sculptural challenge, also fared well. It was in the area between, where a designer lacked technical competence and was unwilling to accept the accidental happenings within a material that the sculptor strives for, that disasters occurred.

The most obvious question posed by the use of concrete as a decorative material was the wisdom of lifting tons of cast stone into the sky to replace the light weight metal curtain wall. A curtain wall, which after nearly twenty years of technical development had worked out most of its problems.

The simple answer given by the architects was their desire to sculpture buildings. This conveniently eliminated any valid question of the structural absurdity of the process. Panels with a strength three times the concrete members supporting them could therefore be accepted as art for arts sake.

The designers of decorative concrete were the most prone to lament the shortcomings of concrete technology and their lack of knowledge of the material gave rise to a number of embarrassing generalities in a scientific age. One found old wives tales concerning concrete frequently written into specifications. This is not surprising for the amount of technical knowledge available dealing with concrete placing, form making, transportation, in short, the actual doing was minimal.

For the most part it was found that concrete technology produced a halting dialogue between mutually suspicious characters. There seemed, under these circumstances, some justification for a reexamination of the concept of package builder or some adjustment of the designer's role in relation to the builder.

The contortions gone through for decorative surfaces proved remarkable, particularly in imitation of board forming. Dunnage was trued and nails aligned at astronomical expense. A high point in technical contradiction was reached when a manufacturer of fiberglass forms entered the arena with board formed fiberglass forms, nail imprints and all.

However the demand for high quality workmanship, no matter what the motivations, called into being highly skilled precasters and concrete form makers with phenomenonal abilities. They were able to manicure tons of concrete with unbelievable close tolerances, and produce fine mirror like surfaces. They offer to the architectural profession an option in cast concrete it never possessed before, even in the hay-day of cast stone.

In the area of architectural structural technology there is almost nothing that the archiect can ask of today's engineer that he cannot do. In contrast to this favorable climate for concrete design, there is almost no innovation that the architect can introduce without meeting opposition, either economic or technical, from the contractor. This is proven by the wealth of never to be tried innovation that is invariably shot down in the contractor's preliminary estimates and bids.

The result was a paradox. Concrete construction dependent upon engineering was freer and more sculptural than concrete originating with the unrestricted imagination of the designer but dependent upon the contractor for execution.

Concrete seemed to present architects with the same contradictions that clay does to the sculptor. To the sculptor, clay is the most difficult of materials for it has nothing of its own to contribute, it is shapeless mud. Stone, wood, and metals present logical systems through their natural material composition. Clay has no logic because it has no structure. The architect embracing mud to free himself from the ubiquitious curtain wall found a freedom that many did not know how to use. On the other hand the few that did, produced magnificient sculptures, some of which can also be used as buildings.

Concrete as a building materials system was subject to the extensive limitations inherent in all of our building technology. The architect isolated from his design by lack of technical training and the historic tabus of his profession is told what he can or cannot do and is forced to take what he can get. As a result his finest instrument, his intuitive perceptual abilities are severely curtailed.

Where concrete could make a contribution to industrialized building, such as in mass prefabrication, there is little evidence of this happening in the near future. In short concrete reduced itself to the same problems of any other building material, which is not a problem of technology, architectural ability, or engineering competence as much as one of codes, zoning, planning, financing, etc, in short the encumberances which prevent usual constraints on practice.

In conclusion, *Progressive Architecture,* by reporting the technological aspects of the newest passion of architectural aesthetics exposed old, not very new, building problems. Concrete did not prove a "plastic panacea."

The appropriateness of concrete as a building material in the present day search for environmental flexibility was questioned by our editor Jan Rowan two years ago. Our reporting showed that concrete technology does not seem well disposed toward flexibility. Whether this is a monumental error or not we leave to our readers, and to the readers of *Architecture Canada.* ☐

Conclusion

1
The North York Exbury Towers, Toronto
La Tour Exbury de North York, Toronto

This conclusion considers the subject of design and styling in concrete.

Referring again to the study on the competition of materials that appeared in the September 1967 issue of *Scientific American*, "In construction . . . the use of concrete as opposed to steel depends less on the objective qualities of the two materials than on the ingenuity and prestige of the architects and engineers committed to one material or the other, and on the competitiveness and marketing flair of the producers in the two industries." (Page 264). Design in concrete is related to a spectrum of responses that go beyond the material system itself to a psychologic identification with concrete as the material of the age.

The designer is involved with concrete in the translation of the built environment into industrial artifacts. The analogy of the automobile industry to the mass production and design of building was noted early in the development of modern architecture even though comparisons and attempts at technological transplants have generally failed. If one takes Le Corbusier's words that appeared in *Vers une Architecure* in regard to the Delage automobile of 1921, ". . . if the problem of the dwelling and the flat were studied in the same way as the chassis is . . . by industrial production . . . defensible forms would soon appear", and then looks at any recent Ford or General Motors product, or at an Aston Martin, it is evident that one message for the designer is that his role is packaging identifiable bits of mass-produced artifacts. Many other design roles are probable and possible, but style engineering offers a place for the designer in the industrial environment.

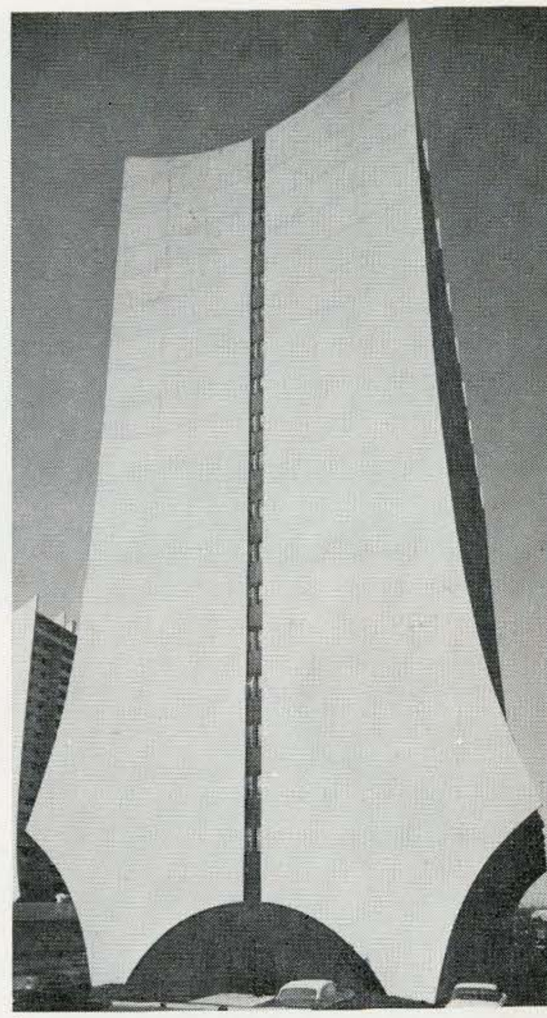
In retrospect, Auguste Perret's stylistic reduction of buildings into neo-classic components of concrete lent itself well to these tenets of production; this was confirmed in the later production of concrete housing in the USSR. To present this episode of concrete styling in trabeated cast stone in the guise of a vision of new architecture, as was done as late as the end of the 1950's, well illustrates the persistence in architecture of reactionary tendencies.

In a recent articles on the "state of architecture" (*Architectural Design* of July 1965), Peter Smithson continues the analogy of the automobile and architecture: he compares the 1920 Bentley to the Constructivist/Sachlichkeit spirit with their composed display of machine products, and the 1960 E-type Jaguar with 900 Lake Shore Drive of Mies as highly integrated smooth machines ". . . modeled in some universal material . . .". The issue that is begged is that of styling; that the "the unique and one-off" 900 Lake Shore Drive is made to *look like* routine catalogue stuff, that styling involves technologic complexity, and that the universal material used to model much of contemporary design of unique, one-off buildings is concrete.

It is self-evident that concrete does not have some preformed existence of its own and that it represents many things to many designers. As a material it is similar in many ways to plastics – the dependence on process, the use of surface structuring, etc . . . The same characteristics of concrete that dispose the material to a systems approach in the design and production of environmental artifacts are those that suggest that the concrete be made to look like something else (as in plastics). Presently, that "something else" is predominantly a masonry aesthetic. Even when the intention is to be "natural", to let the nature of concrete come forth, the "natural" becomes a device representative of what is thought to be the appropriate look and form of concrete. The very idea of designing a concrete "building" to start with sets the exercise of design in a traditional context.

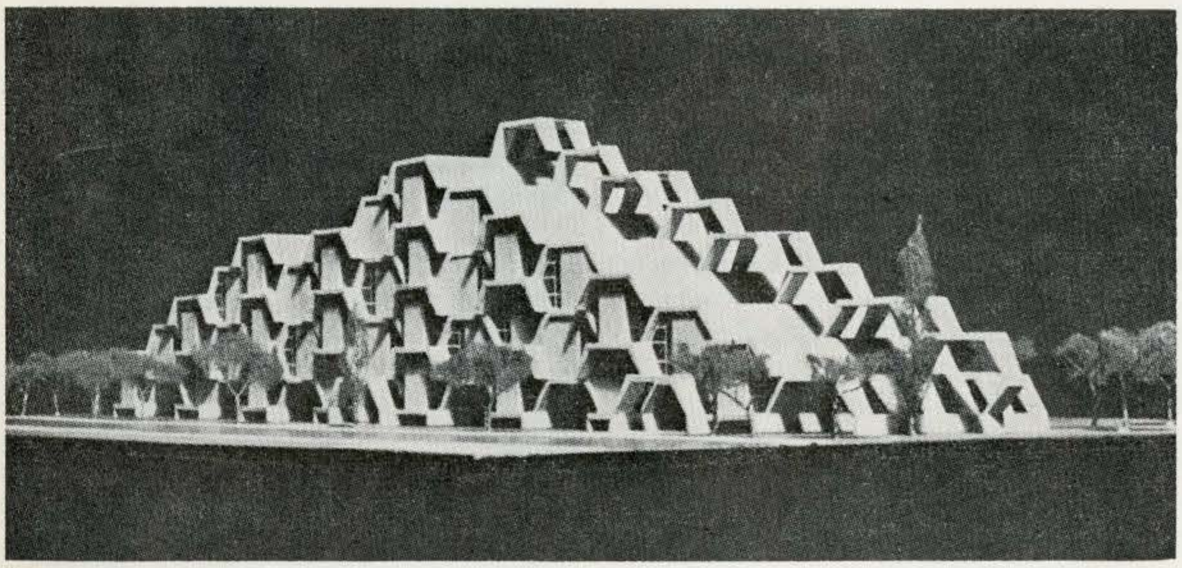
If one is to follow Husserl and "go to the things themselves", or heed what Robert Venturi said, that "learning from the existing landscape is a way of being revolutionary for an architect", a series of "look-like" syndroms can be readily traced in current concrete design.

The use of super-identifiable, super-hero devices was one of the lessons of Pop Art in regard to the design of the artifactual environment with which we surround ourselves. In concrete design this can be seen in the use of supershapes – large

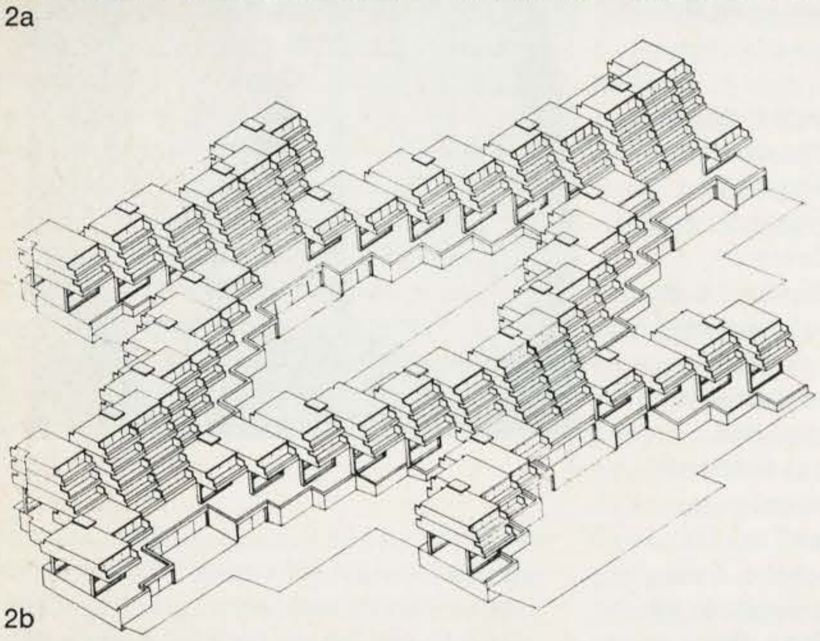


1

2a
Prefabricated housing, Ministry of Housing Development, Israel
Logements préfabriquès ministère de la construction, Israel
2b
Prefabricated housing, a study done at Ulm, Germany
Logements préfabriqués, étudiés à Ulm, Allemagne
2c
Habitat



2a



2b

2c

contrived elements fitted into compositions that could have been put together by *"Captain Marvel"* and the joints grouted by X-ray vision. This tendency is related to design overviews in which the "synthesizing" hero role of the designer is confirmed by reducing complex problems into large building blocks; housing, for example, that is resolved in terms of oversized *Leggo* blocks, precast in concrete and stacked one on the top of each other in a fixed position in which corners are left sticking out, for bravura into the wind.

A variant of this method of handling concrete is the fitted piece hang-up. This consists of decomposing the building into a finely fitted assembly of interlocking concrete elements. The hand-made industrial look of elements tends to be articulated with neo-classic bits and pieces, and some wood detailing thrown in for good measure; common examples can be seen in Scandinavian, Swiss, Italian and Japenese architecture.

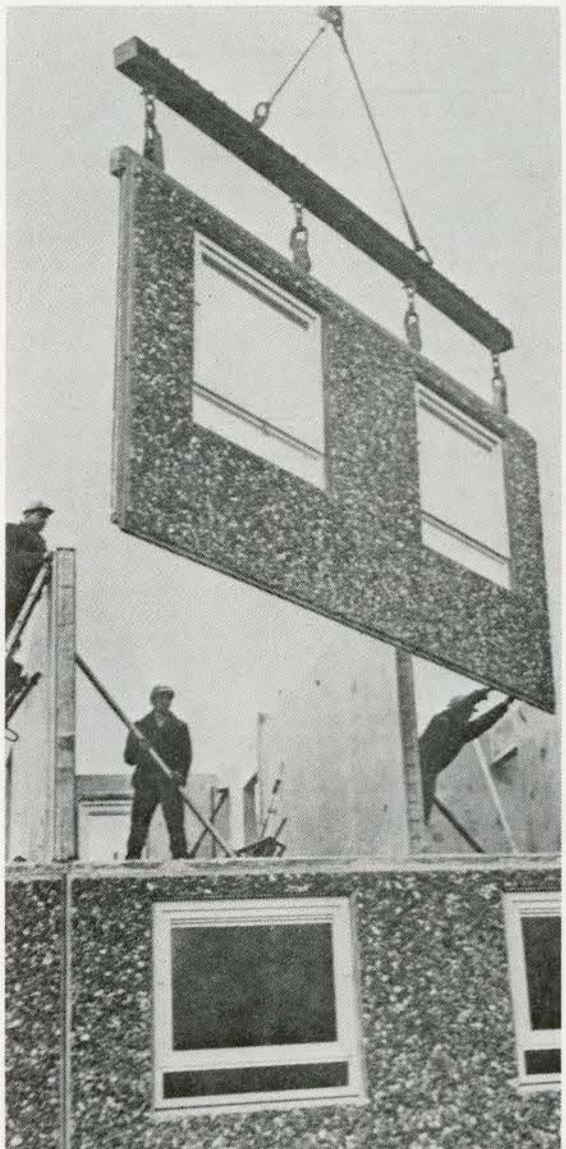
In North America, the attitude of the fitted pieces was developed in precast concrete curtain walls clipped onto office loft construction. It was found less expensive to cast larger components, and by reducing their number, save on assembly and on joints. However, each component was made to look like several pieces, and an articulation was maintained of assembled pieces; wood and stone moulding techniques were revisited in an overt desire to sculpt this cladding. The sculpted look tends to emphasize the moulding of relatively thin panels into deep window reveals and offers the ease of an instant architecture resplendant with reveals and corners scrupulously turned. The obvious structural expression of this cladding has recently been incorporated in the design of totally cast-in-place office lofts in a final return to origins.

The persistence of a masonry aesthetic in concrete can be seen in the popularity of the Louis Kahn idiom. The battered arched walls and diagonal geometry of the brick

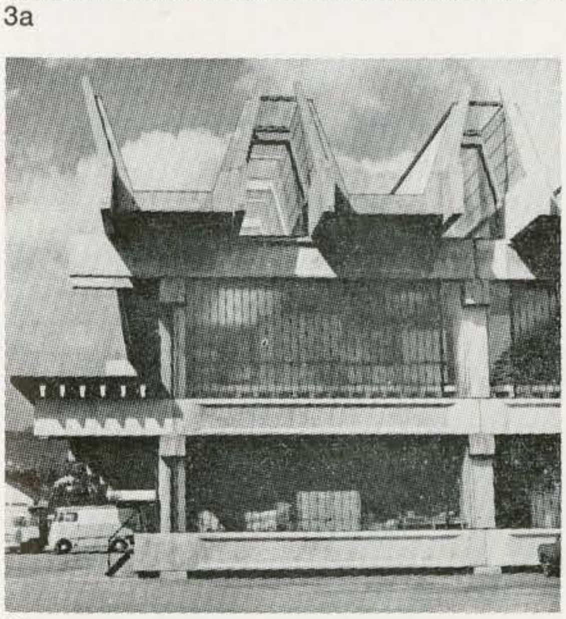
3a
Housing decomposed into panels
Logements divisés en panneaux
3b
Bakery in Bergen, Norway
Boulangerie à Bergen, Norvège

4a
Eden's Executive Center, Wilmette, Illinois
Le Centre administratif Eden, Wilmette, Illinois
4b
Pan Am Building, New York
L'édifice Pan Am à New York

4c
Poured concrete office loft cum curtain wall, Dallas, Texas
Immeuble de bureaux en béton armé à Dallas, Texas



3a



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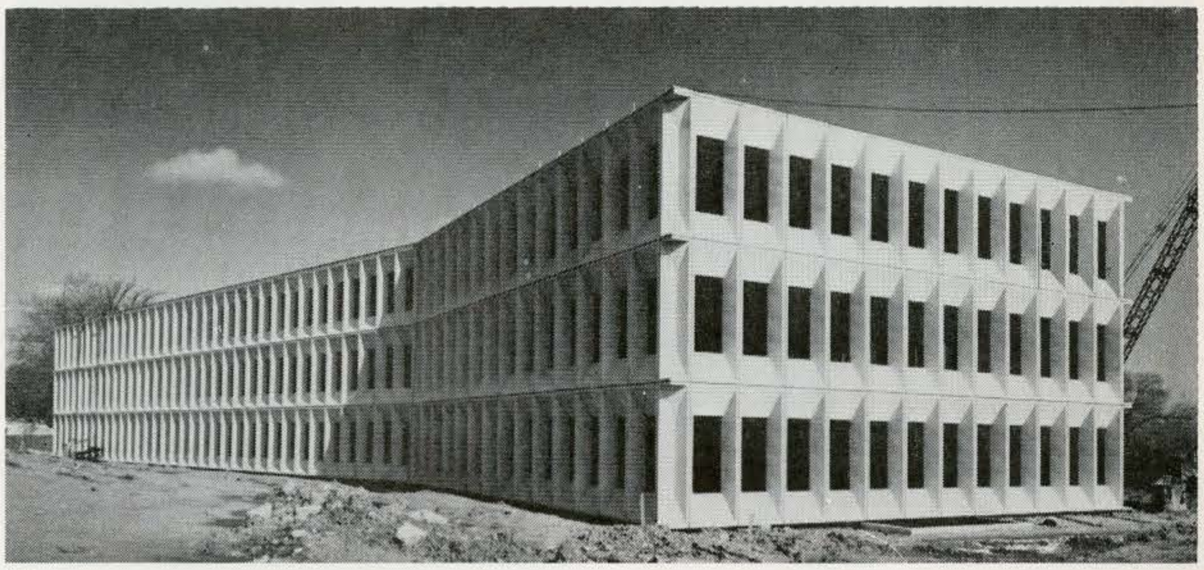
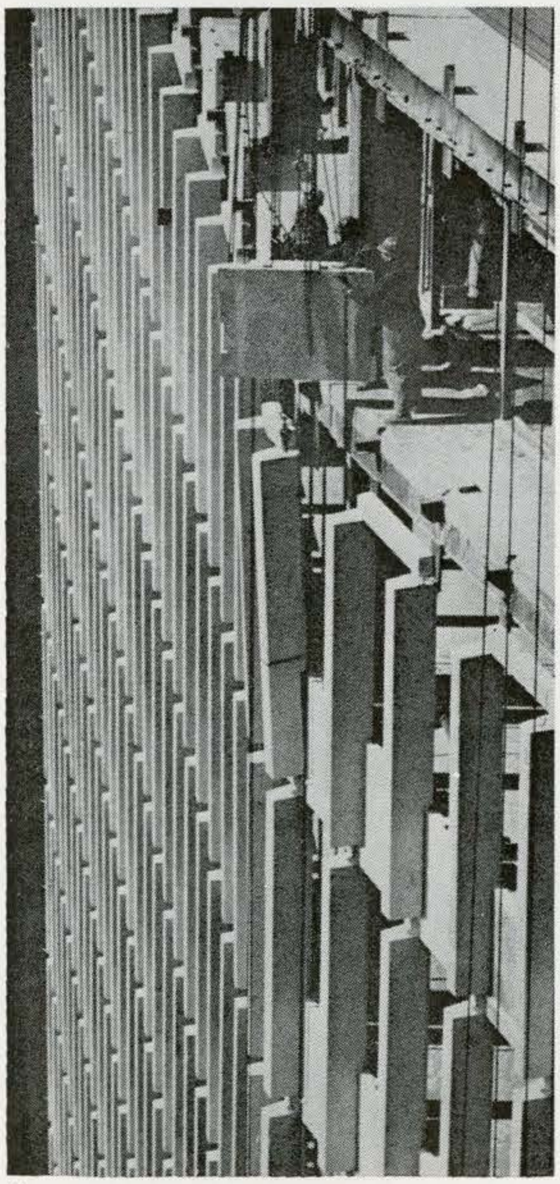


4a



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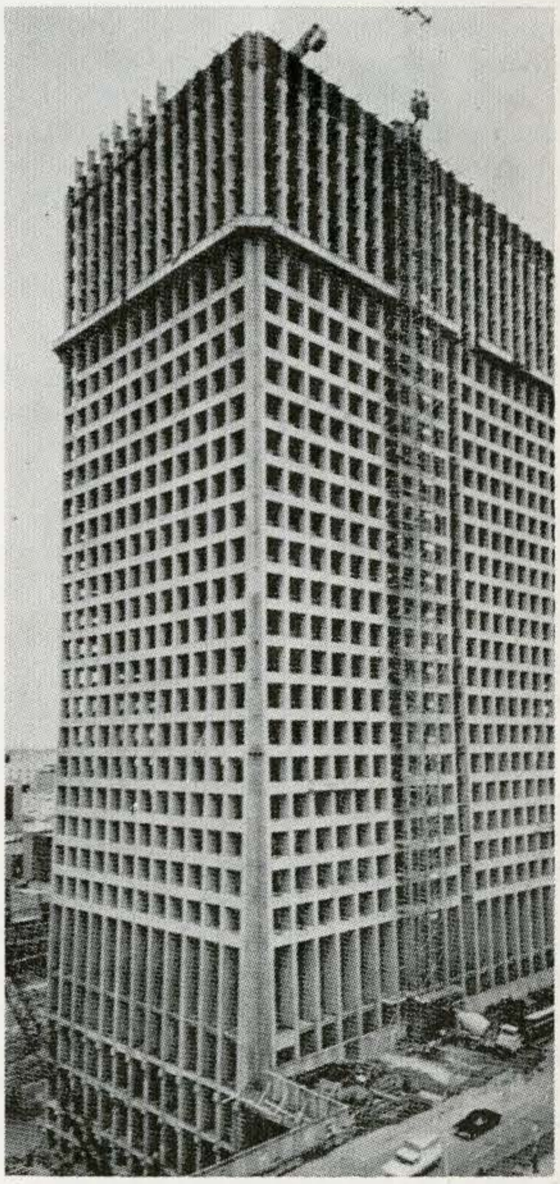
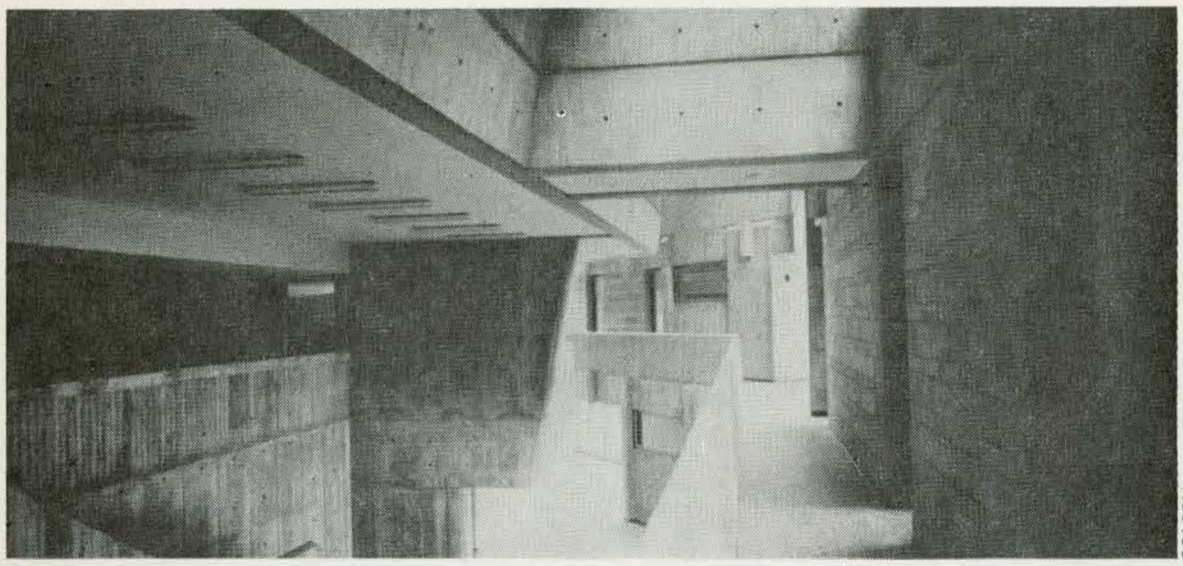


4c

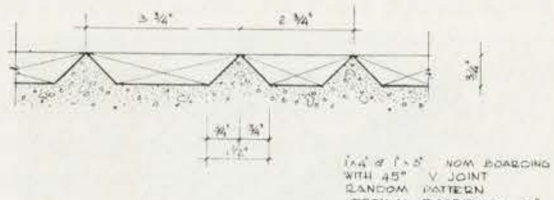
5
Scarborough College
Collège Scarborough

6
Place Bonaventure
7a
Place Bonaventure, detail of concrete formwork for hotel room wings, exterior walls – bushammered finish
Détail du profilé en béton armé de l'aile des chambres d'hôtel, murs extérieurs – finition bouchardée
7b
Place Bonaventure, detail of concrete formwork for interior walls, columns and balustrades
Détail du profilé en béton armé des murs intérieurs, poteaux et appuis

7c
Place Bonaventure, details of concrete formwork for exterior and some interior
Detail du profilé en béton armé extérieur et intérieur
7d
Place Bonaventure, underside of exposed stair slaps
Escalier en construction
7e
Vertical pattern at stairs
Modèle vertical près de l'escalier


Reeves

5



7a

7b

7c

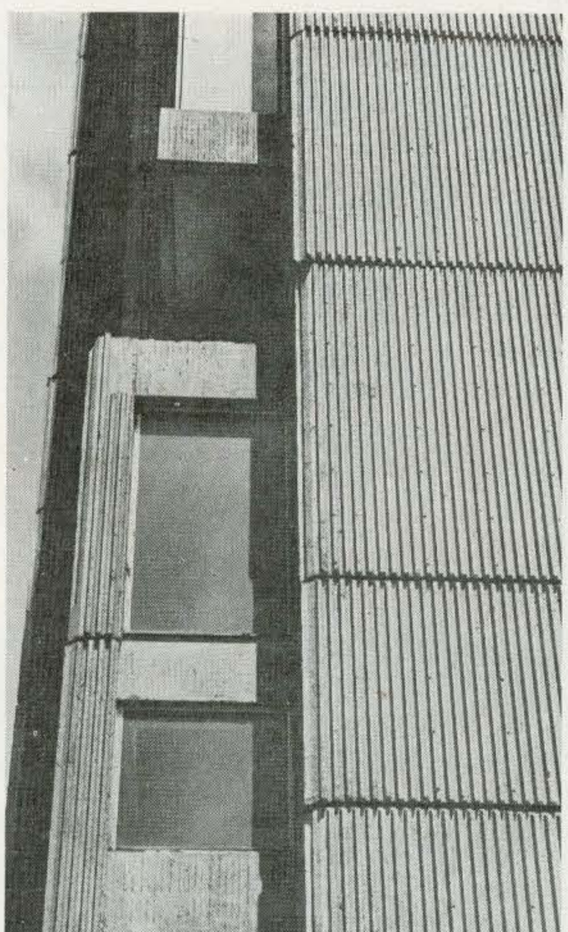
7d

7e

architecture of Kahn's projects for India are repeated by others in concrete. In the heavy battered walls of Scarborough College, for example, the readily identifiable image of concrete architecture is interchangeable with bearing brick; the interior undercutting can be said to express an exagerated corbel.

The current designer's vernacular in exposed concrete is used in the high-styling of Place Bonaventure. Natural surfaces are the result of various processes of manufacture, but here the surfaces were manufactured to look like different processes. The surfaces include the heavily ribbed, Paul Rudolph concrete corduroy (extruded out of the bedrock), boarded concrete with thin wings of cement that penetrated the pre-cut shuttering. In addition, a variety of exposed aggregate finishes was also used. The designer's analogy of a *medieval town* in the conception of this building was translated in the rough surfaces of the analogue.

A "natural" expression is now common in concrete design. Regardless of the building processes involved, there is a tendency for designers to express themselves in a persistent handicraft tradition. The result is an exaggerated tribal gesture, as if the designers were pretending that the building was cut out of concrete, the vertical striations being chisel marks; or that the shuttering for the concrete was made by themselves by cutting trees and sawing the lumber by hands. This recalls the Pop hero

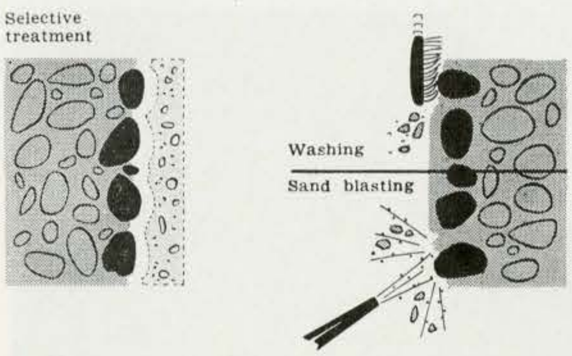


6

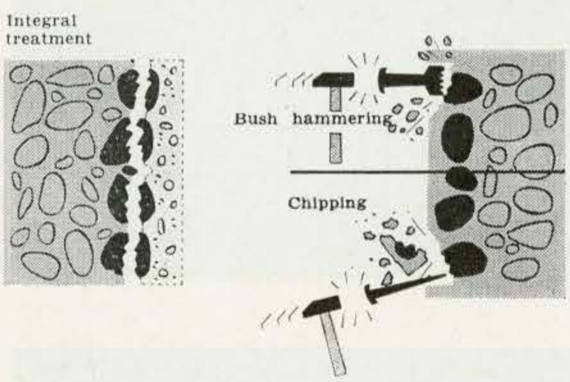
8a - f

Technical information on the engineering of natural surfaces from Cimenteries & Briqueteries Réunies, (Belgium) Data Sheets.

Fiches de renseignements contenant des informations techniques sur la nature du ciment publiées par les Cimenteries & Briqueteries Réunies, Belgique



8a



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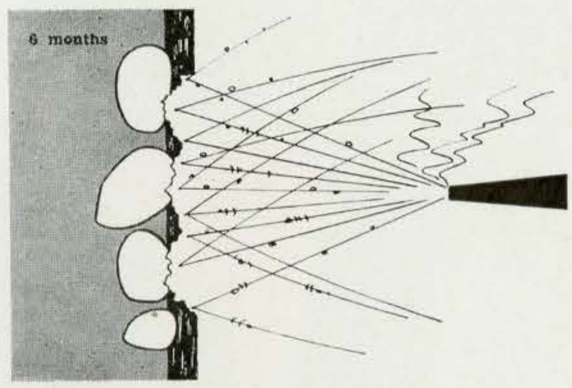
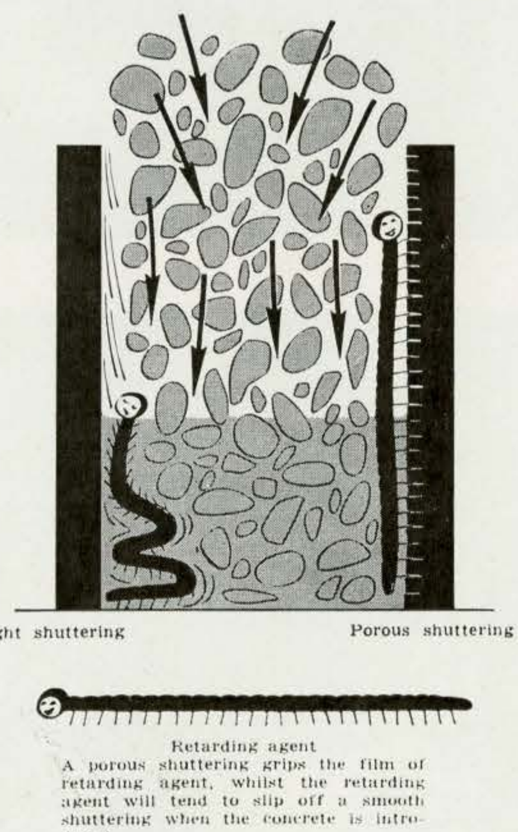


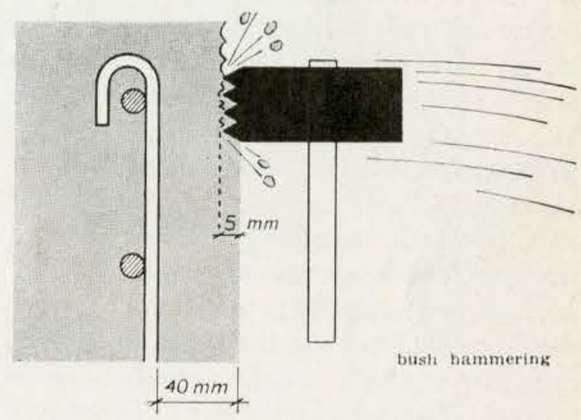
Very hard mortar surface coat.
Sand blasting must be continued for a long time and there is a risk of breaking the large aggregate.

8c



Retarding agent
A porous shuttering grips the film of retarding agent, whilst the retarding agent will tend to slip off a smooth shuttering when the concrete is introduced.

8d



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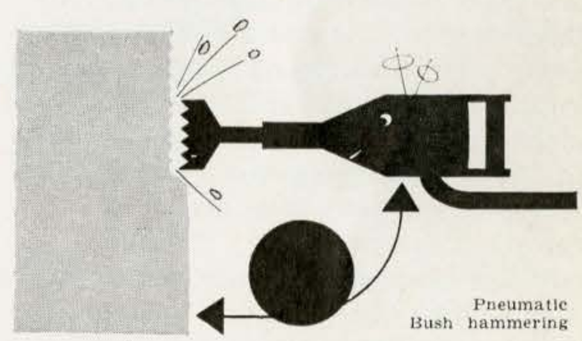


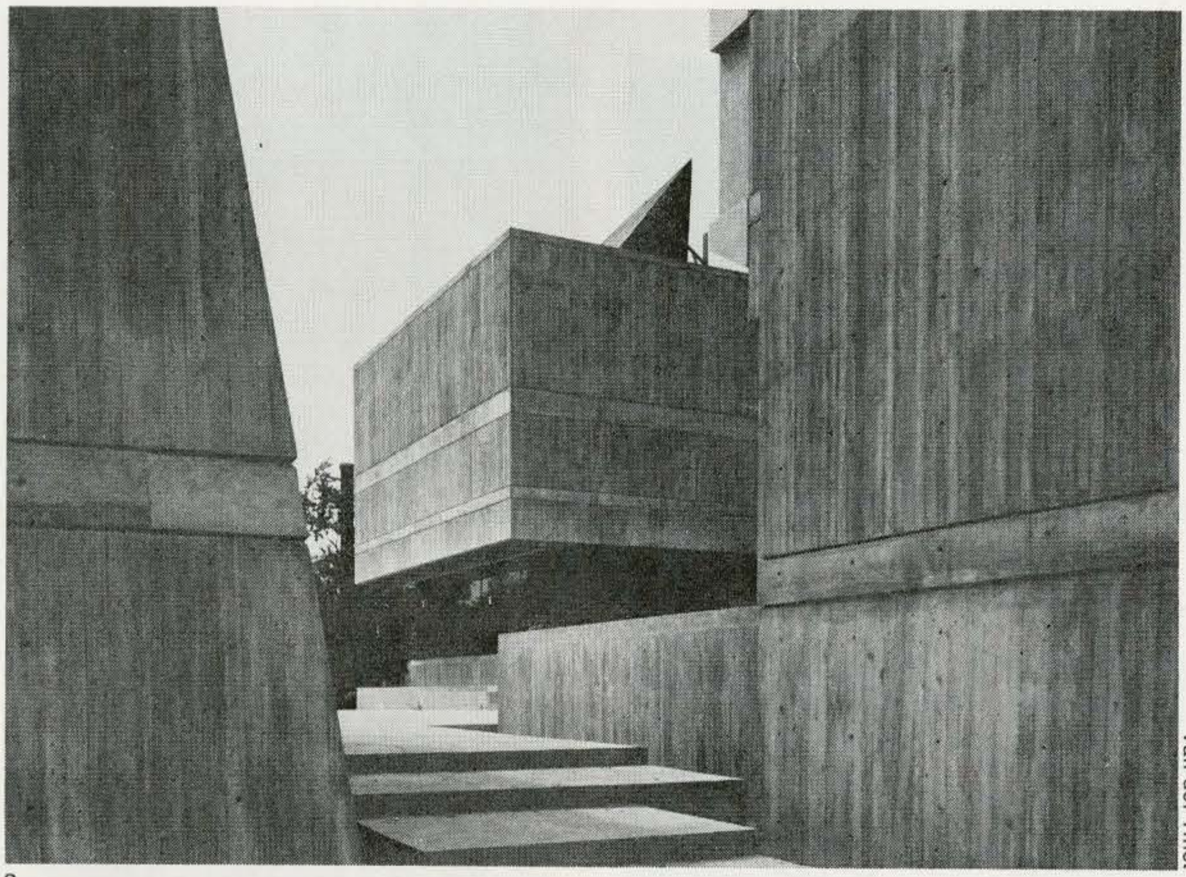
8f

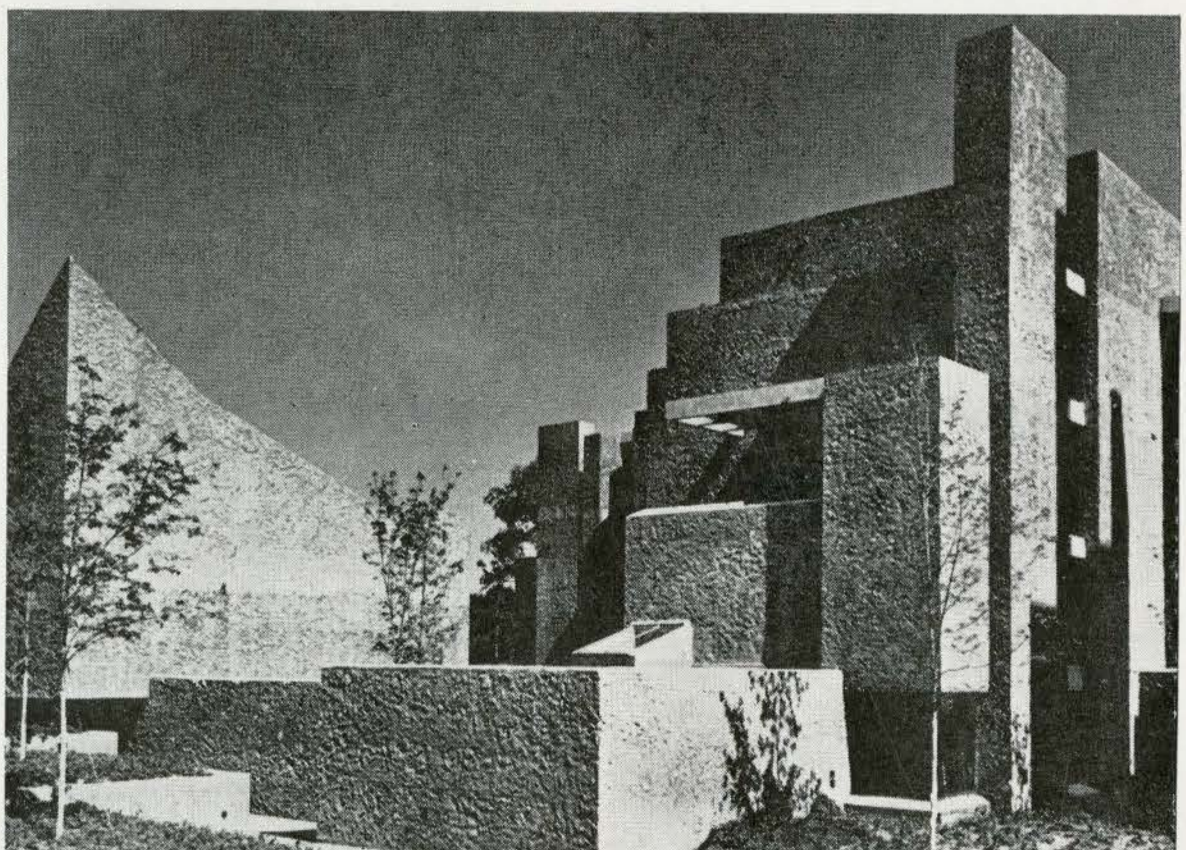
8
Brantford City Hall, Brantford, Ontario
9
Champlain College, Trent University

bit. The recent report that the Batelle Memorial Research Institute (released in March 1963) prepared for the building trade unions on the future of prefabrication, including the concrete industry, and the worker's future in the industrialization of building, includes architecture among the constraints such as zoning, codes, and tradition. The report considers the profession a holdback to technological development. To build the "natural" look, a relatively complex degree of technology is involved. The mass production of vertical striations involves technological output which could otherwise be better used. In the Champlain College of the University of Trent, to quote the engineer ". . . the development and use of rubble aggregate concrete . . . demonstrates . . . a disciplined approach in which prior research and testing answered critical questions related to design . . . the architect questioned me as to the feasibility of using rubble aggregate in a manner similar to Saarinen's Stiles and Morse College at Yale University . . ." Grout mixtures, fabrication methods, and retarders were all experimented with in order to carry out the design in the manner of Saarinen's collegiate style-for-the-job at Yale.

Several conclusions can be drawn from the above examples, and many of them reflect that building design has not changed essentially in the last hundred years except perhaps in the scale and in the manner of the styling devices. Art and science fictions are maintained in the name of human sensibilities, and concrete seems to be currently the most malleable of all materials.

One of the key issues facing the designer today is deciding what the relevent problems are. No one designs in a vacuum, and when working with concrete there is in the mind of the designer a strong climate and residue of existing forms which affect the emergent conceptions. To conceive of something disdainful of formal and stylistic preoccupations, something demonstrably straightforward and demonstrably utilitarian – *une architecture autre* – the very climate and processes of design are relevant problems. □
M.C.


Van der Hilst
8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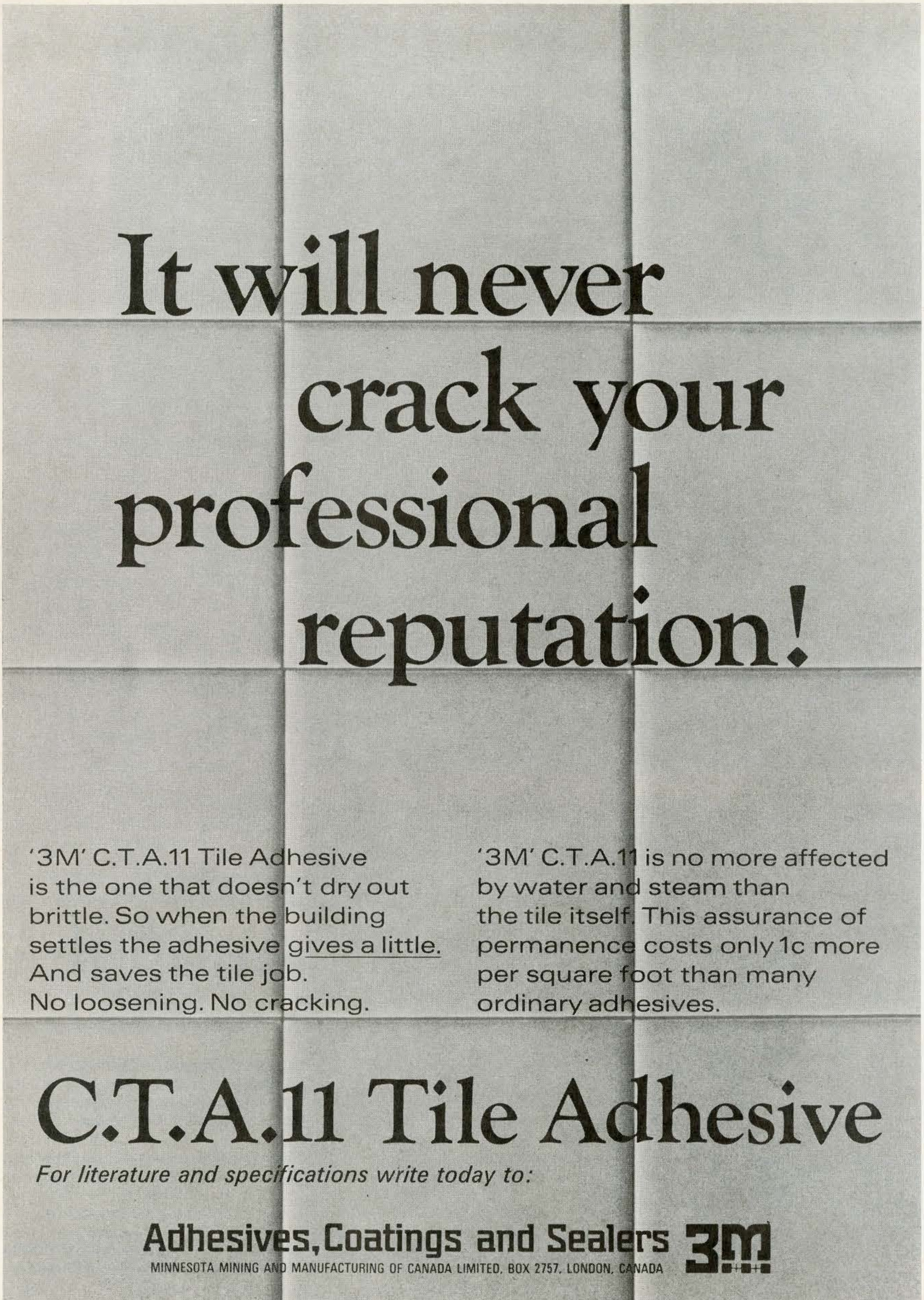
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F. W. Helyar, MCIQS

The question which must have been uppermost in the minds of most architects after the conference on "A Systems Approach to Building" held in Ottawa on 29th and 30th April this year, was the role of the architect in any future developments in industrialized building.

The conference, which was sponsored by the Department of Industry and co-sponsored by the Royal Architectural Institute of Canada, the Association of Consulting Engineers of Canada, and the Canadian Construction Association, dealt mainly with industrialization of the building process, with some reference to modular co-ordination and more uniform building regulations.

The need for improvement in productivity was stressed by C. M. Drury, Minister of Industry, when he pointed out that during the period 1961 to 1967, productivity in terms of output per person employed increased over 21 per cent in manufacturing industries as a whole, over 100 per cent in agriculture, but only 6 per cent in the construction industry. If productivity in the industry were to be increased by 10 per cent the country's wealth would be increased by more than a billion dollars a year.
Perhaps, as a later speaker pointed out, the construction industry's problem is that it regards itself as a service rather than a manufacturing industry, and this has tended to inhibit it from exploring new ways of increasing efficiency.

While the need for research and the systems approach in its broader aspect as an extension of the scientific method was discussed by Guy Desbarats, Director, School of Architecture, University of Montreal, the British and Danish speakers dealt mainly with their experiences in industrialization. In industrialized building, as with any manufacturing process, the manufacturer has to be assured of a reasonably large market and a continuous demand. To create this market there are three approaches which can be adopted.

The Model Approach

In the first approach, referred to as the model approach, a selected range of models is designed and built, and the potential buyer can choose a model from within the range, any variations depending on the flexibility of production. This approach is most appropriate to housing but usually the scale cannot be made large enough, building codes tend to prohibit factory produced houses, and people are too conservative. *In this approach the designer occupies the position he normally takes in any manufacturing process, bridging the gap between what the salesman can sell and what the manufacturer can produce.*

The Component Approach

The second approach is the component approach, in which various components are prefabricated in a factory for assembly on the site, and sizes and jointing conditions are standardized so that they can be assembled regardless of the manufacturer. The Danish Jespersen system, which employs precast concrete wall and floor units, was discussed at some length. The system has been used extensively for government promoted apartment building in Denmark, Sweden and Britain, and has even been used for the construction of a hospital. With this system site assembly is an extension of the factory, the precast units being manufactured, stored, and then delivered to the site with precise timing and in the correct sequence to ensure a continuous assembly process. Modular co-ordination, good quality control to ensure small dimensional variation, well designed jointing systems, and first class management and co-ordination both in the factory and on the site are essential, as is a continuous demand. 75% of school building in Britain is now done on a systems approach and the component approach has been adopted as government policy there. *In this approach the designer has two roles to play, as designer of the system for the manufacturer, and as architect for the building selecting appropriate systems from manufacturers' catalogues for incorporation in the building.* The point was made that an equal partnership between the designer and contractor is preferable to a designer dominated relationship where it is difficult to control profitability, or a contractor dominated relationship where the design suffers.

The Programmed Approach

The third approach, the one most likely to gain acceptance in North America, is the

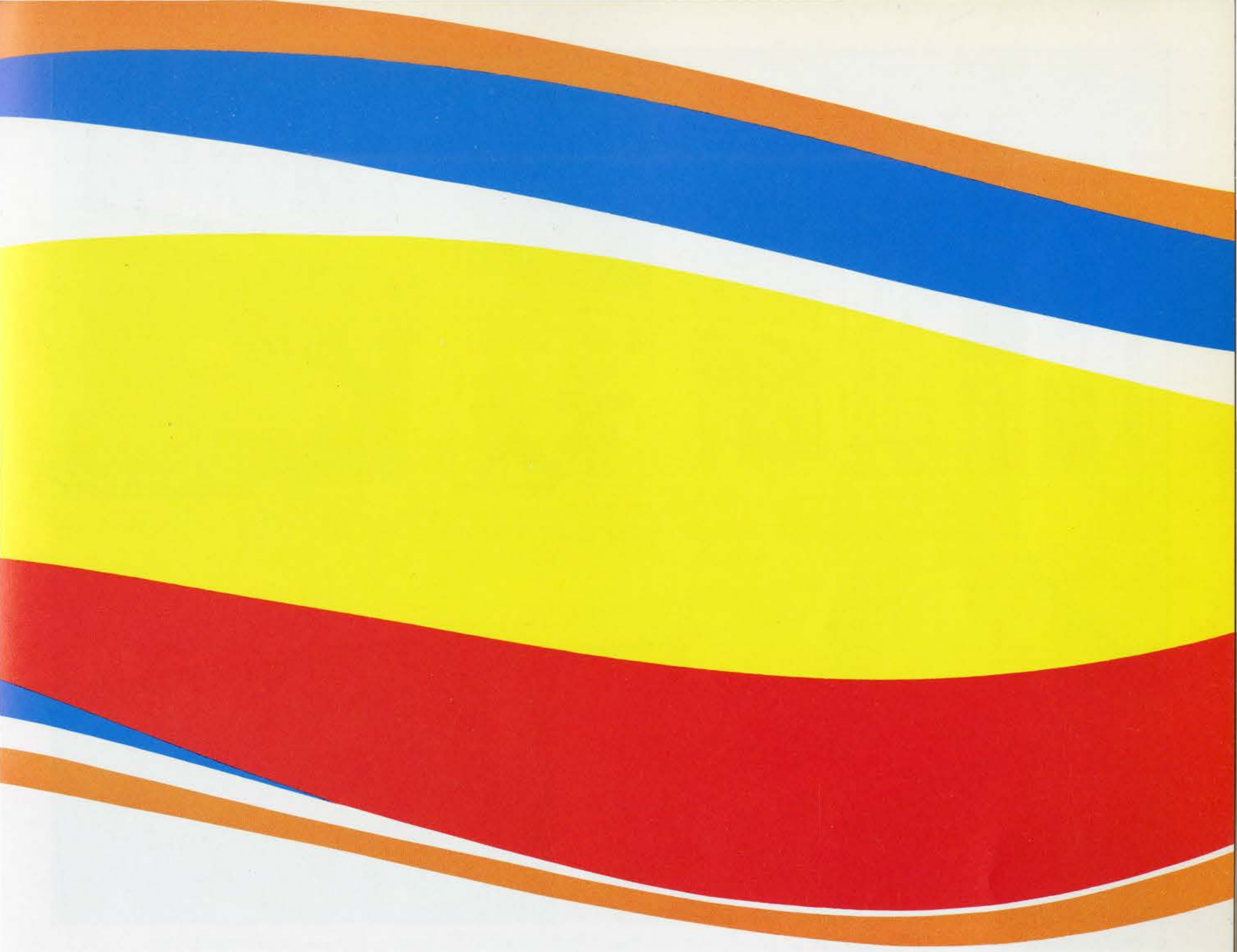
Two participants in the Ottawa conference on systems buildings were Roderick Robbie (left) and Guy Desbarats (F). A panelist, Mr Robbie, Technical Director of the Toronto Study of Educational Facilities, discussed school development in North America. Dean Desbarats, Director of the School of Architecture, University of Montreal, spoke on planning a better environment.

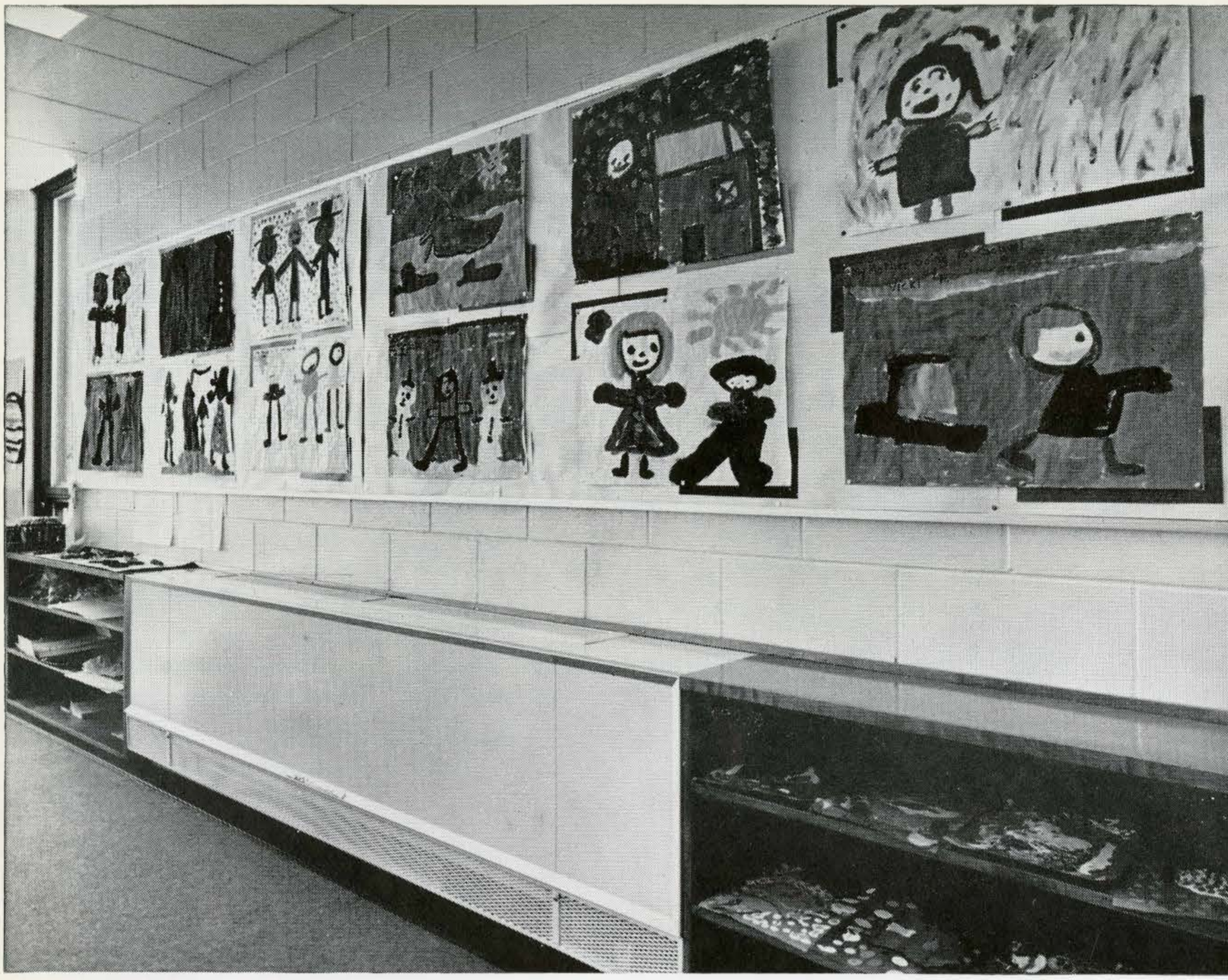
programmed approach. This approach depends upon organizing the demand by gathering together a group of clients, thus providing the mass market to make it worthwhile for manufacturers to develop systems. Tenders based on performance specifiications are called for each system. This means that competition on a structural system, for example, can be between structural steel, laminated wood and precast concrete manufacturers, the main requirement being compatibility between all the selected systems. When the systems have been selected they are used in all the buildings incorporated in the program.
This approach has been used by SCSD in California and is now being developed elsewhere in the United States and by the Metropolitan Toronto and Montreal school boards. The Toronto program incorporates ten systems representing 75% of the cost of schools and will be used for 26 schools during 1970-71. To widen the market Toronto has canvassed many school authorities across the country to join their program. Although the cost of developing a system is high, the rewards are also high because the successful manufacturer is guaranteed a large and continuous market. Even unsuccessful tenderers don't necessarily lose as was demonstrated by a manufacturer who failed to win a contract with SCSD but was very successful in promoting his system outside the program. *There are three roles the designer can play in this approach. He can be employed in providing the performance criteria for the program, in designing the system for the manufacturer, or in designing buildings in which the systems will be incorporated.*
The main impetus towards a systems approach in Europe has been the major involvement of government in building, the lack of skilled craftsmen, and the need to increase productivity. Several speakers mentioned cost savings of anything up to 20% in comparison with conventional methods, although in California they are more concerned with the ultimate cost than they are with the capital cost.
There are no technical difficulties to adopting systems building in Canada. The difficulties lie in convincing everyone in the construction industry of its ultimate advantages. To this end it was suggested that there should be a central agency to represent all parts of the industry and particularly to co-ordinate the design professions in their approach to systems. If the industry does not set its own goals it will not be long before other industries take over. □

Architecture Canada
Monthly Report of Unit Prices

The unit prices given below are average rates for reasonable quantities of work carried out in the locations shown. They are net rates including waste where applicable but without any allowance for a general contractor's overhead and profit. Users are cautioned that unit prices are affected by the location of the project, market conditions including the availability of materials and the availability and productivity of labor, the size of the project and the quantities of materials required, the circumstances under which the work is being performed, the type of construction etc. and these factors must be taken into account when using them. In particular they should not be used for alteration work or for changes in the work during construction.

5. 6 Woodwork	*Unit*		Vancouver	Edmonton	Regina	Winnipeg	Toronto	Ottawa	Montreal
1 2" x 4" and 2" x 6" Wood framing in stud walls	MBF	Low $ High $	190.00 220.00	275.00	260.00	214.00	260.00	—	280.00
2 2" x 10" and 2" x 12" Wood framing in floors	MBF	Low $ High $	175.00 200.00	196.00	240.00	250.00	265.00	—	230.00
3 2" Wood roof deck	SF	Low $ High $	.60 .70	.48	.50	.50	.54	—	.43
4 ⅝" Plywood roof boarding	SF	Low $ High $	.20 .25	.27	.28	.35	.35	—	.34
5 ¾" Plywood sub-floor	SF	Low $ High $	.21 .26	.36	.33	.40	.42	—	.41
5. 7 Moisture Protection *Roofing*									
1 Four ply felt, tar and gravel roofing No insulation	SF	Low $ High $	.25 .30	.50	.35	.18	.45 .55	.20	.22
2 26ga galvanized steel flashings	SF	Low $ High $	.60 .70	.70	.50	.35	.60	.50 .55	.75
3 .032" Aluminum flashings	SF	Low $ High $	.85 .95	.86	.75	.40	1.10	.60 .65	.85
4 16 oz. Copper flashings	SF	Low $ High $	1.70 1.90	2.40	1.25	1.00	2.50	1.40 1.65	1.30
Waterproofing and Dampproofing									
5 Three ply asphalt membrane waterproofing on walls	SF	Low $ High $	.40 .45	.36	.30	.37	.30	.24	.35
6 Metallic waterproofing on walls	SF	Low $ High $	.20 .25	.45	—	.40	.30 .32	—	.43
7 Two coat asphalt dampproofing on walls	SF	Low $ High $	.15 .20	.07	.08	.10	.05 .07	.03	.09





One of the electric unit ventilators at Redwood Public School. Architect: Jean-Paul St. Jacques, M.R.A.I.C. Consulting Engineer: Howard Boland, P.Eng.

Why more than 210 Ontario schools keep their art collections (and their artists) in electrically heated rooms.

The public school Rembrandts who turned out the above work likely couldn't tell you the name of the architect who specified electric heating for their school. But the Fort William Board of Education could. And they could tell you a thing or two about how well electric heating has worked out in their Redwood Public School.

Electric heating has proved itself a major advance in creating a healthful environment for learning. Electricity's simplicity and precision of control ensures just the right amount of fresh, clean, warm air in each room. Quiet, even distribution of warmth completes the comfort picture.

They saved money, too. For example, electric heating reduced installation costs by 30%. Because electric heating is the least complex of all heating systems, requiring no piping or ductwork, valuable time and labour was saved right from the planning stage. And by eliminating bulky fuel-burning equipment 460 square feet of floor space was saved. Result? An overall saving of $30,000 and a very happy school board.

The savings don't end there. Electric heating reduces supervision and maintenance costs considerably. And when it becomes necessary to extend the school, electric heating can be extended, with little interruption to school routine, in less time and at less cost than any other system.

Specify electric heating in your next school project. The students may never remember your name. But they'll always remember your work.

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89th Annual Exhibition Royal Canadian Academy of Arts

Founded by HRH Princess Louise and the Marquess of Lorne, 1880

Clare Bice, LL.D., President, John C. Parkin, FRAIC, FRIBA, RCA, Vice-President; Alan C. Collier, Hon. Treas., Mrs. H. T. Girard, Sec. Treas.

The Royal Canadian Academy of Arts Eighty-eight Annual Exhibition will be held at the Art Gallery of Hamilton from December 5th, 1968.

Jury

All architects practicing in Canada are invited to submit work for consideration by the Jury of Selection – L. E. Shore, *FRAIC, ARCA,* Chairman: Gordon S. Adamson, *FRAIC,* Ian Maclennan, *FRAIC.*

Conditions

1 Buildings submitted shall be limited to two, representing work completed subsequent to December 31, 1964, and not previously exhibited in an R.C.A. Annual Exhibition.

2 Photographs shall be 8" x 10" glossy, black and white or sepia. As many photographs as the architect feels are desirable may be submitted.

3 Submissions are to be accompanied by at least one interior view, and at least one sketch plan (which may be rough,) to indicate internal arrangements.

4 If an architect feels that an existing model of a building submitted would add greatly to its interest, he is particularly invited to include a photograph of same, but should state the dimensions of the base of the model, which he would be prepared to make available for presentation.

5 If accepted by the Jury, the architects shall be required to provide at their own expense, photographs (mounted) of a size to be established by the Jury.

6 Submissions (8" x 10" photographs) and sketch plans must be received at the Royal Canadian Academy, 11 Roosevelt Drive, Thornhill, Ontario, on or before Wednesday, August 21, 1968

7 The decision of the Jury shall be final.

8 While the greatest care will be taken at all times, works submitted for exhibition shall at all times be at the risk of the exhibitor. If the exhibitor requires insurance to cover the work for loss, theft, accident, damage by fire or water or negligence, or other peril, while on exhibit or in the custody of the Academy or Gallery or place of exhibition, or in transit to or from the place of jurying or the gallery where the exhibition is to be held, or in transit or on tour between galleries or places of exhibition, the exhibitor shall provide his or her own insurance and the exhibitor releases the Royal Canadian Academy of Arts and the art galleries concerned and any other place of exhibition or storage and their officers and servants respectively from any or all claims.

9 It is planned to supplement the photographic presentation of the buildings with if available:

(a) perspectives, and design evolution drawings indicating the development of the thematic idea.

(b) photographs of examples of the allied arts commissioned for the building and integrated with the architecture.

(c) photographs of fittings and furnishings, street furniture, etc., which would also better indicate the building's function.

Entry form

Please fill in and sign the entry form on the reverse side and mail it to the Secretary, 11 Roosevelt Drive, Thornhill, Ontario, not later than Wednesday, August 21, 1968

89th Annual Exhibition Royal Canadian Academy of Arts

To be held in the Art Gallery of Hamilton from December 5th, 1968

To the Secretary
Please receive for Exhibition the following works, subject to the conditions of your circular:

Entry Form

No.	No. of Photos and Plans Submitted	Titles of Works Please Print in Block Letters	Year Executed	Is Model Available	Size of Base
1					
2					

Architect's Name..
Please print in block letters

Architect's Signature..

Street Address..

City...Province...

Two works only may be submitted. Please fill in and sign this entry form and return it to the Secretary, 11 Roosevelt Drive, Thornhill, Ontario, on or before Wednesday, August 21, 1968.

Pop Architecture

Guenter M. Lehmann, B.Arch.

Mr Lehman is a Master of Architecture candidate at the Graduate Design Studio at the University of Toronto. He received his B.Arch degree from the University of Illinois.

This is the Pepsi Generation!

A generation constantly being reminded to "Come Alive" and to "Get with it".

It is obviously an action-oriented, youth-directed age. It is an age of machine-made fun and mass-produced culture manifested in the gleaming, glittering and seductive products of Detroit, Hollywood and Madison Avenue. Quite naturally, there exists a dislike for this commercial culture among most intellectuals. But the banality and vulgarity of this Pop Culture, as it has been called, is nevertheless very much part of our landscape. Can or should we, as architects, conveniently ignore this nearly indigenous environment? Does it have no message at all for us or can we learn something from it? Perhaps we can find some clues for answers from the artists.

Artists first to be Positive about the Contemporary World

Artists supposedly are "the only persons aware of the nature of the present". (Wyndham Lewis) It is thus hardly surprising that they were the first to look at the products of this pop culture differently and eventually elevated them to subject matters of a new art: *Pop Art.* It was a decision to approach the contemporary world with a positive rather than a negative attitude. Nevertheless this step should not be interpreted as complacency for it contained an element of hostility towards contemporary values. In England especially, the term Pop Art originated in reference to a group of painters who were committed to a consciousness of their own social restlessness and to a sense of the need for alteration of established values. American painters, however, took life as they found it and instead of derogating and rejecting our vulgar civilization, set out optimistically to celebrate it on a basis of their own devising. They displayed a eulogistic vision of a new American subject, if not necessarily of America itself. Thus hard-core Pop Art is essentially a product of "America's long-finned, big-breasted, one-born-every-minute society". *(Lucy Lippard)*

Such an unabashed reflection of our environment, that was the unexpected end of of two abstraction-minded decades, was based on a tough, no-nonsense, no-preciosity, no-refinement standard appropriate to the 1960's. When Andy Warhol remarked in the early days of Pop Art that he wanted to be a machine, he was misunderstood by a society which felt that some of its long-standing values were threatened by the machine. G. R. Sorenson later articulated Warhol's idea more precisely:
"Art criticism has generally refused to say that an object can be equated with a meaningful or aesthetic feeling particularly if the object has a brand name. Yet, in a way, abstract art tries to be an object which we can equate with the private feelings of the artist. Andy Warhol presents objects we can equate with the public feeling of an artist. Many people are disturbed by . . . the trend towards de-personalization in the arts . . . They fear the implications of a technological society. . . . A great deal that is good and valuable about our lives is that which is public and shared with the community. It is the most common stock responses which we must deal with first, if we are to come to some understanding of the new possibilities available to us in this brave and not altogether hopeless world."

Artists were thus able to choose the existing to creat the new. Architects seem to have found such attitudes much more difficult to attain. After all, architects are rarely permissive; by their very professional "nature" they seek to improve (*ie,* change) the existing environment rather than to enhance it.

However, learning from the existing or gaining insights from the ordinary is neither impossible nor completely new. We have some good examples from the past. Peter Behrens, for one expressed the enthusiasm over the new machine age forcefully. Other early modern architects easily applied an existing and conventional industrial vocabulary. Le Corbusier devotes much of his attention to steamships and grain elevators in *Towards a New Architecture.*

Even though industrial vernacular architecture was acceptable to many architects (and perhaps even primitive vernacular, *ie,* "Architecture Without Architects"), the commercial vernacular appeared to be much harder to acknowledge. Thus standard, anonymously designed products connected with architecture and construction as well as commercial display elements, were rejected for their commonness and vulgarity. They were purposely hidden, "beautified" or if possible, replaced by sophisticated industrial design products. But the fact that the conventional or vernacular elements are banal and ordinary in themselves should not necessarily mean their automatic exclusion from architecture.

Justification for Honky-Tonk Elements in Architectural Order is their Existence

In fact, the simplest justification for honky-tonk elements in architectural order is their very existence. They are what is and what we have. The fact that architects may lament over them or attempt to ignore them hardly changes anything. Yet, even if the architects try to abolish them, their existence is not completely threatened for the architects hardly have the power to replace them (nor do they have a concrete idea what to replace them with), and because these ordinary elements suit existing needs for variety and communication. The old cliches involving both banality and mess will still be in the context of our new architecture and our new architecture significantly will be the context for them.

The architects should learn to accept the methods and the elements available to him. Looking forward to advanced technology is wonderful but must that mean a rejection of the immediate, vital and often vulgar elements common in our architecture and landscape today? Perhaps the architect should use convention and make it vivid by using it unconventionally. The search *per se* for a new form and research for advanced technologies ordinarily exceed the architect's resources at present. But he can achieve an expertise in existing conventions.

Robert Venturi points out:

"The architect, of course, is responsible for the how as well as the what in his building, but his innovating role is primarily in the what; his experimentation is limited more to his organization of the whole than to the technique in the parts. The architect selects as much as creates."

Common Things Seen in Uncommon Context are Perceptually New

There are nevertheless more reasons for using conventional elements in architecture, reasons related to the level of expression. According to Gestalt psychology, context contributes meaning to a part and therefore a change in context brings about a change in meaning. Since the architect is organizing distinct parts into a meaningful whole, he thereby creates explicit contexts for them within the whole. If the architect employed conventions in an unconventional manner, if he organized familiar elements in a new and unfamiliar way, he would change their context and thus alter the original meaning. Even platitudes can be used for a new effect. Common things seen in an uncommon context become perceptually new.

It is at this point that we can draw a direct connection to Pop Art. The Pop painter changes the context or increases the scale of common elements to give them uncommon meaning.

Modern architects have shown an inability to exploit fully the conventional. Very often they reject it as being obsolete or banal. At other times they included it as the symbol of a new industrial order. Rarely, however, did they use the common element with a unique context in an uncommon way. Wright, for instance, almost invariably used unique elements and unique forms, representing his innovating and personal approach. Thus such elements that even Wright was unable to avoid using *(ie,* hardware by Schlage or plumbing fixtures by Kohler & Kohler) read as unfortunate compromises within the particular order of his buildings. Gropius, on the other hand, utilized in his early work elements and forms from a rather consistent industrial vocabulary. He realized the importance of standardization and promoted his machine aesthetic. Current factory architecture was a source for stairways and windows, for instance. Consequently, much of his architecture of those days looked like factories. (Illustrated with the Bauhaus)

Bernard Maybeck may serve as the most obvious (as well as probably the sole) example for an architect using convention unconventionally; he used contradictory combinations of vernacular industrial elements and eclectic stylistic elements (industrial sash and Gothic bracery) in the same building: First Church of Christ Scientists, Berkeley, 1912. In recent times, however, such juxtaposition of seemingly contradictory elements is nearly unknown. Where it exists, it is usually a spontaneous response to a circumstantial condition rather than the result of time-consuming, rationally conceived designing.

We thus find the garish highway-scape: the gigantic paper-mache station attendant, the turkey-shaped diner, the barrel-shaped beergarden, the ostentatious billboards with super-kingsized blow-ups of products screaming for a buyer or with luring invitations to sleep in *this* hotel or to visit *that* historic place.

The epitome of "signage" becoming more obvious and more important than the actual "architecture", is seen in Las Vegas. The signs become the skyline, silhouettes of an enormous scale, visible long before one even gets to "the place". They become an architecture of communication. The message is clear: it is unashamedly commercial. And this commercialism in turn sets free the public taste through unrestrained money. Thomas Wolfe speaks in his *Kandy-Kolored Tangerine-Flake-Streamlined-Baby* of this liberation of plebeian taste:

"Free Form! Marvelous! No hung-up old art history words for these guys. America's first unconscious avant-garde! The hell with Mondrian, whoever the hell he is. The hell with Moholy-Nagy, if anybody ever heard of him. Artists for the new age, sculptors for the new style and new money of the ... Yah! Lower orders. The new sensibility, the new world, submerged so long, invisible, and now arising, slippy, shiny, electric-Super Scuba man! out of the vinyl deeps."

Las Vegas Compares with Versailles

Wolfe also suitably compares Las Vegas with Versailles, calling the two the only architecturally uniform cities in Western history. Both were built for a simple purpose: to celebrate a certain style of life. Louis XIV moved into the countryside to create a fantastic baroque environment in glory of his rule. The uneducated prole Americans built the symbol of their life style –Glamour!–in the isolated Mojave Desert. Thus the "mad money" of the liberated proles produced a culture and a visual style that had been unknown to the world before.

The famous Strip becomes a unique experience of a commercial landscape. At first the image of this commercial Strip is complete chaos. There is no obvious order. However, the consistency of the highway itself and the regularity and uniformity of the street lights offer some apparent order, to which the uneven rhythm of the signs beyond is contrapuntally related. The contrast accommodates both continuity *and* discontinuity, clarity *and* ambiguity. There exists an allowance for variety and change.

Perhaps we have here an example of an order that admits control as well as spontaneity, a consistent order modified by the exceptional inconsistency without leaving us hopelessly confused. Mies has referred to a need to "create order out of the desperate confusion of our time". Kahn, on the other hand, has remarked, "by order I do not mean orderliness". Perhaps a recognition of the "confusion" and variety of the Las Vegas Strip could help resolve this dichotomy.

Henry Bergson called disorder an order we cannot see. The order of the Strip, as shown, is a complex one. It is not the easily intelligible rigid order of most new town and redevelopment schemes, but an order reinforced by inconsistencies. It is not an easy order of exclusion but rather a complex order of inclusion. It includes at all levels, from the mixture of seemingly contradictory advertising media to Neo-Wrightian restaurant motifs. The order, therefore, is not easily discernible, is not easy for the eye. The moving eye has to spot and interpret a varity of varying, juxtaposed orders, very much like the shifting configurations of a Victor Vasarely painting. "It is the unity which maintains, but only just maintains, a control over the clashing elements which compose it. Chaos is very near; its nearness, but its avoidance, gives .... force." *(A. Heckscher)*

A Lesson from Las Vegas

Therefore, Las Vegas may have a lesson for us. Perhaps the flashy ways of persuasion and the skyline of signs offer some great new possibilities. Why not put them to use in the striving for civic and cultural enhancement?

Of course, efforts have been made to take Pop culture out of the realm of "commercialism", "sheer entertainment", "relaxation", or even "escapism" and to treat it with the seriousness of art. These efforts, notably those by a British group (which involved the Smithsons, Hendersons, Reyner Banham, et al.) resulted in proposing expendable art as no less serious than permanent art. Critics were still referring to mass media as "ersatz culture ... destined for those who are insensible to the value of genuine culture ... Kitsch, using for raw material the debased and academic simulacra of genuine culture welcomes and cultivates this insensibility". *(Clement Greenberg)* This anti-populism was then questioned and ways of accepting popular culture into the art world were sought. The idea was of a Fine Art-Pop Art continuum in which the permanent and the expendable, the timeless and the temporary coexisted.

This attitude towards the expendable elements in our culture and technology naturally precipitated architectural thinking. The most vocal advocates of this new

approach are probably those known as the "Archigram Group" named after its irregular magazine *Archigram.* (Peter Cook, Warren Chalk, Dennis Crompton, et al.)
The consideration of expendability as a serious motive for a way of building became an important issue. Thus, ideas about prefabricated, pre-packaged and last–but not least–throw-away dwelling units began to proliferate among this group: Zoom-City, Computer City, Completely Expendable City and Plug-In City all revealed the vision of an architectural concept of indeterminate form assembled from expendable parts.

Dennis Crompton's "Computer-City" and Peter Cook's "Plug-In City" are illustrious examples of seeing the city as an interacting and ever-changing system. As Warren Chalk writes:

"Cities should generate, reflect and activate life, their structure organized to precipitate life and movement. Situation, the happenings within spaces in the city, the transient throw-away world of people, the passing presence of cars, etc., are as important as, possibly more important than, the built environment, the built demarcation of space. Situation can be caused by a single individual, by groups or a crowd, their particular purpose, occupation, movement and direction."

In our technological and consumer-oriented society more and more people will play an active part in devising their own individual environment. The most obvious qualities of mass production are standardization and repetition, but parts can be changeable or interchangeable to suit individual needs and preferences. Thus, housing can become a consumer object, its parts can be traded in and changed, to be juxtaposed in various ways. Dehumanization of the living space and dullness? Hardly! One only has to think of Detroit, of the mass produced automobile. The choice of various bodies, several engines and numerous interchangeable options allow for an almost personal selection. (In fact, if one includes color and furnishings, Detroit claims that the yearly output of nearly eight million automobiles would not have to repeat a single car!)
In housing, therefore, the personality of the inhabitant could be ably expressed by similar choices. Latent creative instincts in the community can be channelled into some tangible and acceptable form.

Participation and Involvement, No Empty Phrases

Popular participation and total involvement are no empty phrases any longer.
In other spheres of our culture they have long been recognized. Pop Music, for instance, undoubtedly is so successful at present because of the possible audience participation: the "Monkey", the "Jerk", the "Frug" are very much vehicles for compulsive self-expression. "Happenings" and participatory art exhibitions are further recognition of the self-expressive desires of much of the public.

And Pop Art showed us how to create our own "art"–simply by observing our present environment. Pop Art opened our eyes to the banal vulgarities of commercialism, but it also demonstrated that much of this vulgarity is the source of occasional vitality in our lives and in our cities.

In conclusion, one can only point out again the vivid lesson of Pop Art: the pure and sacred order that most of us architects tenaciously pursue (often futilely) may not bring about the salvation hoped for, after all. Relentlessly, architects have looked with disdain and pity upon the conventional townscape for its banality, have devised elaborate ways and means to do away with or hide honky-tonk elements, have attempted to substitute them with an order that was "aesthetically" more satisfying and which often only stifled vitality. Books have been written to denounce the chaos of the commercialized Main Street! (Peter Blake's *God's Own Junkyard)*

But–is not Main Street almost right?

The seemingly chaotic arrangements of "Commercialized Modern" make for an almost intriguing vitality and a certain validity. And perhaps, we can, as did the Pop artists, learn from the "lowly" everyday landscape, to develop the new and intricate order for our complex urban world, an order that will aid us in creating the truly living city and make it the "scene to be in".
Architecture can be fun! And to use an old phrase, *"It's all happening, baby!"* □

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(Book Reviews continued from page 36)

Wright who worked on the Californian houses of the master during the Wrightian come-back period, and who later worked on his own in Los Angeles, may also be detected, particularly in structures which are perched on hillsides or on canyon-edges.

In the past, Neutra, like most Californian architects, has excelled in designing the single building or group of buildings for the individual client. The later work, as illustrated in this volume, in the form of large complex developments, done by principal and associates for larger and more anonymous social bodies, is located not only in Southern California but in many other mild-climate, and sometimes undeveloped, parts of the globe. The characteristic touch is less evident and it is difficult to maintain the same interest in this work as in the older.

Neutra spent his first years in America the Midwest. The interests which he developed at that time in technology, production and organization have never dwindled. He has always shown an involvement with the strict and practical rather than with emotional or overtly expressive ways of imagining or doing things. Over the years he has made valuable contributions to architecture, particularly in siting, exterior and interior space-use planning and in the rationalized construction-detail of residences, housing projects and other work. His practice has included public and private schools, hospitals, health-centres, multiple dwellings, institutional buildings, commercial structures, offices, stores, interiors, furniture, and plans for landscaping. A minor but important innovation has been his manner of handling domestic interior living spaces arranged as "en suite" sequences, and the development of the family room in conjunction with the open kitchen.

Since 1929, the date of the famed Dr Lovell house, if not before, Neutra had emphasized the "use-requirements" of modern life, as a criterion for determining forms. His interpretation of these demands has led him to utilize the light wide-span structural frame, partially divided by thin wall planes, which permitted a continuously interlocked series of inside and outside living spaces separated by large glass areas in wide openings. In part, he saw aesthetics in terms of the achievement of hygienic conditions for human life. Architecture became an environment for physical well-being. Any element which did not contribute towards this goal was eliminated. This direction of development led to an emphasis on structural means, mechanical and electrical services and their integration into the final building. The biological direction, as well as the love and respect which Neutra felt for nature, has provided broader, more inclusive and more sympathetic aims than the mere arrangement of physical equipment into convenient groupings.

Neutra holds that science is the best source for improving the knowledge on which architectural practice must be based. He has tirelessly advocated this belief in countless lectures and seminars, and has written a number of books to elucidate various aspects of this theme. That Neutra should stand with the sciences and their power to contribute to human welfare and the improvement of architecture, no longer seems so unusual, but that he should envision this contribution on a broad yet detailed front in terms of increased knowledge by architects in the fields of communication, behavior and environment is of more significance.

Stuart A. Wilson, MRAIC, Montreal

Supplement to Urban & Regional References

The Canadian Council on Urban and Regional Research, Ottawa has issued *a 1965-66 Supplement to Urban & Regional/ References/Urbaines & Régionales* which lists about 900 documents in classified order, with table of contents and author and geographic indexes. Also listed are nearly 150 Canadian urban and regional studies under way at latest report. The pamphlet is an addition to the Councils earlier Urban & Regional *References* of 1964 and 1966, which listed some 3,000 documents on Canadian urban affairs that had appeared since 1945. Every document is listed in the language in which it was written.
The original *References* in binder, as published in 1964, are available at $6.00; the supplement sheets are $3.00.
The combined price for 1964 and 1966 issues in a binder is $8.00. The new self-contained 1967 supplement sells for $3.00. A complete set, listing altogether over 4000 Canadian urban documents, is available at a combined price of $10.00.

Publications

"Sources of Information on Office Buildings: an Annotated Bibliography with Supplementary Notes", by J. L. Pauls, is available from Division of Building Research, NRC, Ottawa.

The transcript of a seminar on the protection of inventions, designs and trade marks by patents, copyright and registration is available from the National Design Council, Department of Industry, Ottawa.

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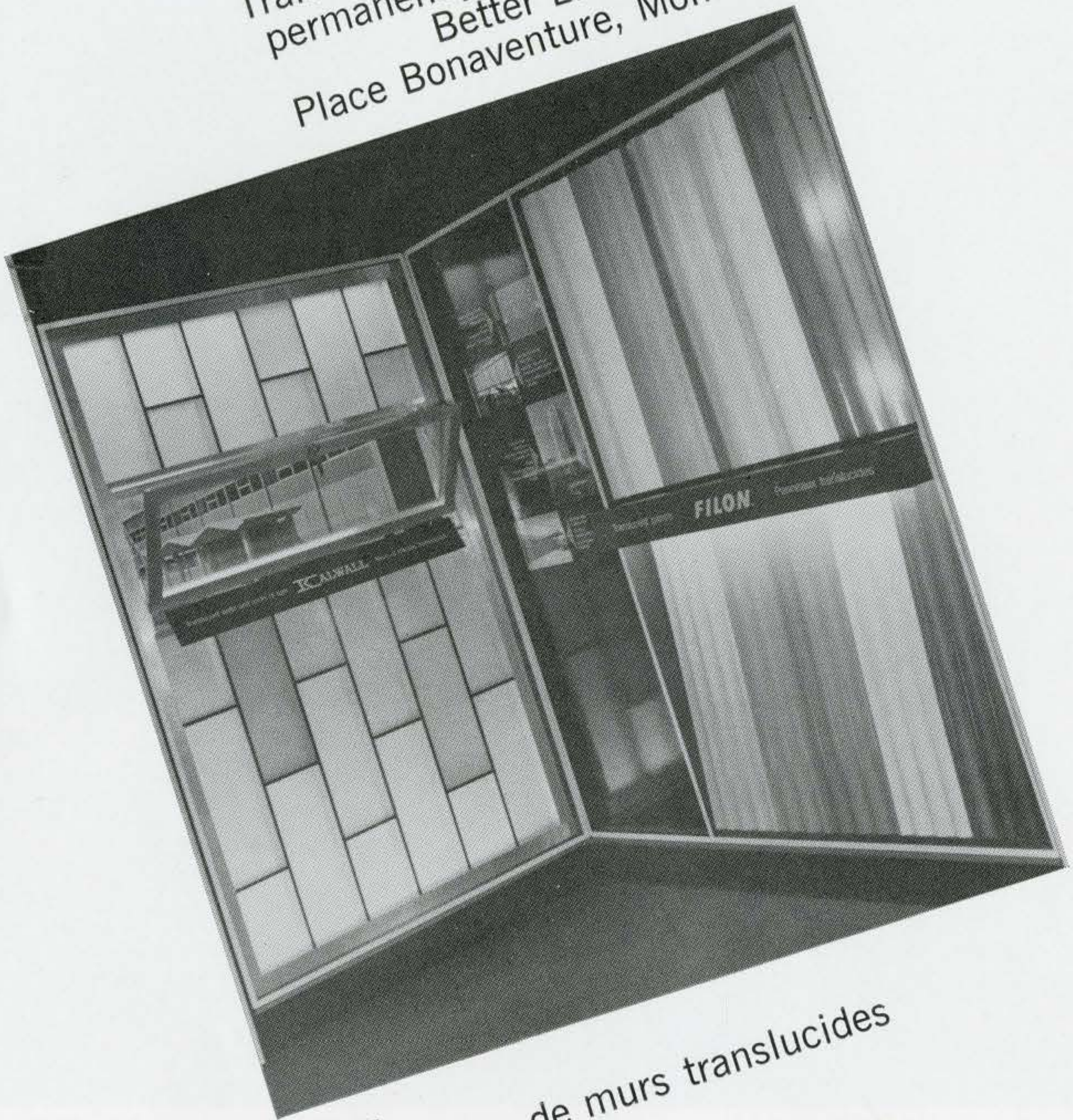
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Advertisements for positions wanted or vacant, appointments, changes of address, registration notices, notices of practices including establishment or changes in partnership, etc., are published as notices free to the membership.

Practice Notes

The practice of Izumi Arnott and Sugiyama will now be know as Gordon R. Arnott and Associates Architects, Engineers, Planning Consultants, 222 Albert Street, Regina, Saskatchewan.

Architect Wanted

Progressive Canadian architect, minimum of five years experience wanted by architect-engineers office in Cornwall, Kingston area. Design, working drawings and supervision experience required, ability to meet clients an asset. Write, including all pertinent information to: Holtshausen Thompson Laframboise Mallette, Architect & Engineers, 132 Second Street East, P.O. Box 187, Cornwall, Ontario.

Architectural Assistants Wanted

Wanted qualified architectural assistants, ARIBA or equal, with minimum two years practical post graduate experience. Apply stating details of education experience, age, marital status and availability to Onions Bouchard & McCulloch, P.O. Box 1362, Hamilton, Bermuda.

Positions Wanted

Architect age 31, seven years experience and three years experience in the US including position of Senior Designer, desires suitable placement with architects' firm in Ontario. Wishes to accept responsibility. Can offer resume and appear for interview. Box #151 *Architecture Canada.*

A. H. Gangadhar, architect and civil engineer with experience in Germany and India and USA seeks position in architect's office in Canada. Address: 35 Kassel/West Germany, Kohlenstrasse 105

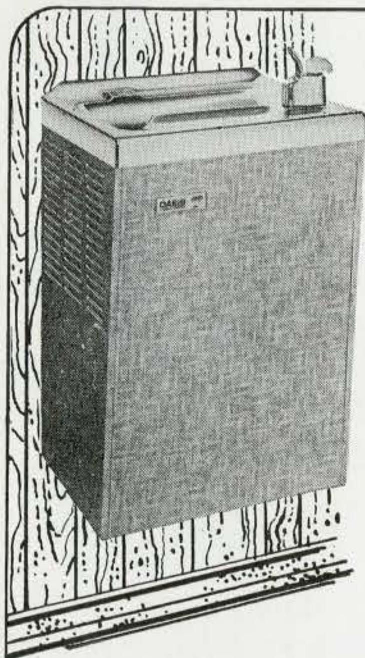
Two students in third year at Hammersmith School of Architecture, London, are seeking employment from January to summer 1969, RIBA probationers sitting intermediate exams summer 1968, experience will be 6 months in an English office. Reply: L. Asher, R. J. Goy, 7 Cairnfield Court, Cairnfield Ave, London N.W. 2, England

B. Arch., Dip. Arch., (ARIBA election April 1968) emigrating to Canada May 1968, two years post graduate experience mainly on commercial and housing projects, requires responsible appointment. Any Canadian province considered, British Columbia preferred. Write: Howard Tozer, 19 Halsbury Road, Westbury Park, Bristol 6, England

Dessinateur, célibataire et diplomé des Arts et Métiers de Beyrouth, Liban, deux ans et demi d'expérience avec une société française au Liban, parlant français et un peu d'anglais, désire position dans n'importe quelle région du Canada. Ecrire à: Mourad Atef, 2935 Maplewood 17, Montréal 26, P.Q. Tel: 931-5876

Five years experience in preparing design, working drawings, detailing of residential industrial buildings of Atomic Energy Establishment, India. Write: Arvind Sawkar c/o Mr Ashok Sawkar, 72 Nina Street, Toronto 4, Canada

Architecte, agé de 26 ans, de nationalité vietnamienne et diplomé de l'Ecole des Beaux Arts de Paris, élève en demière année de l'Institut d'Urbanisme de l'Université de Paris, southaiterait effectuer un stage dans un Cabinet d'Architecte au Canada. Ecrire à: Nguyen Duy Tam Architecte D.P.L.G., 65 Bis, Avenue Victor Hugo, 92 - Boulogne, France.



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