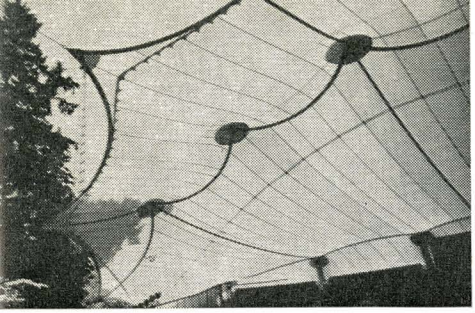


Services and financial assistance from local, provincial and national architectural bodies plus private enterprise and much hard work by architects Peter Goering, Paul Vaughn, engineer Bob Halsall and designer Julian Rowan have culminated in an exhibition of the work of Frei Otto at the Art Gallery in Toronto. See page 5.

Architecture Canada

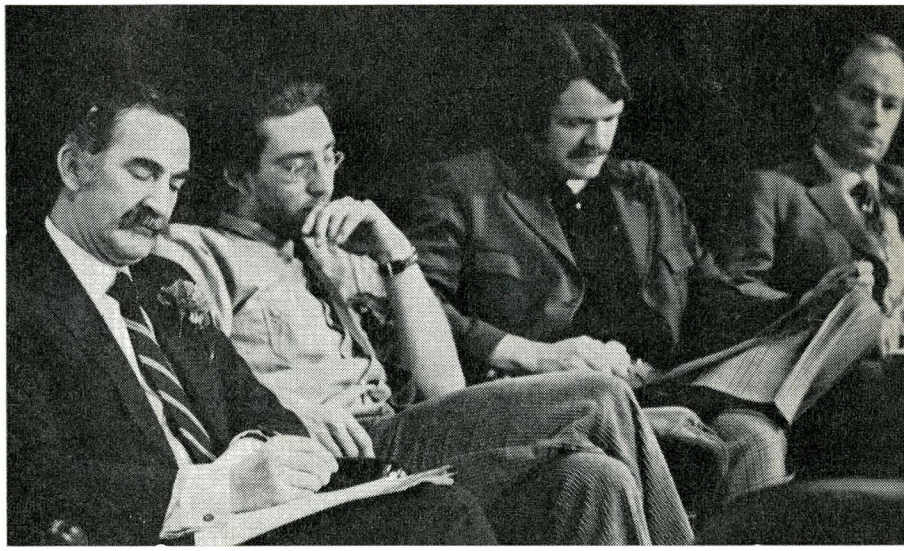
NEWSMAGAZINE

Published every two weeks by RAIC/IRAC June 12, 1972

Playing games in Victoria

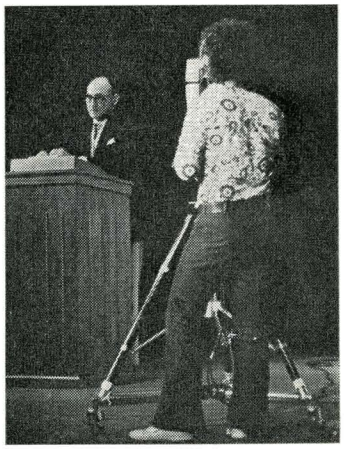
Predictably, making a game of redesigning Victoria's Old Town drew its measure of criticism at the RAIC Assembly earlier this month.

Most architects played along happily suggesting mechanized walkways, pleasant squares for people, etc. until Montreal's Joe Baker sent the whole thing up. His team, one of six, suggested replacing the area with a 105-storey high rise – one side reserved for English Canadians, the other side for ethnics. Architects shouldn't be playing 'instant development' games while real and serious problems need to be solved, he said.



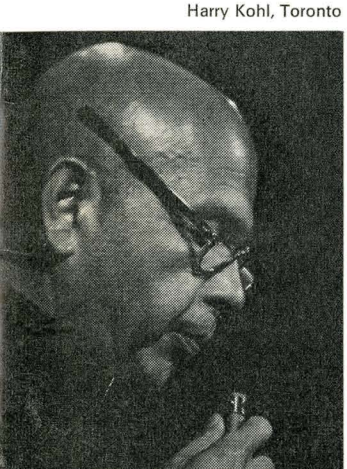
The jury l to r, realtor Philip Holmes, Gene Millar representing citizens, developer Sam Bawlf, Mayor Peter Pollen.

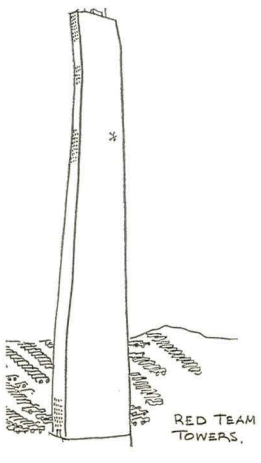
Right, the media at the Design Game. This time the focus is on Dr. Roderick Haig Brown keynote speaker

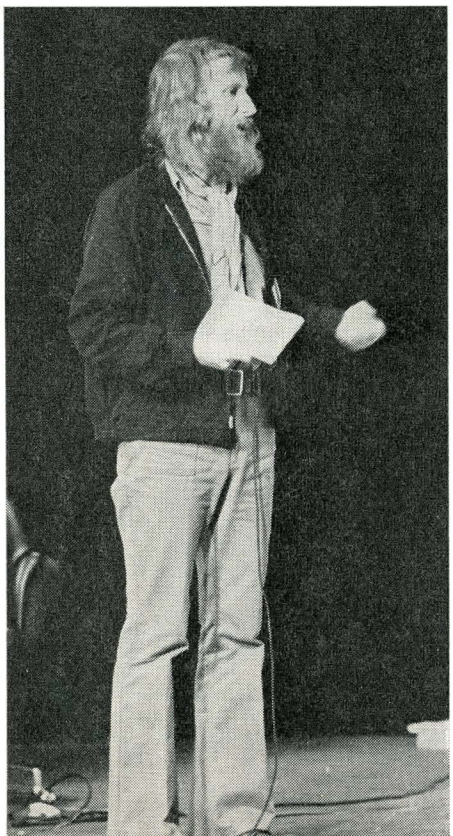


Gordon Atkins, Calgary.

Harry Kohl, Toronto







Stanley King, Vancouver

Left, Joe Baker, Montreal

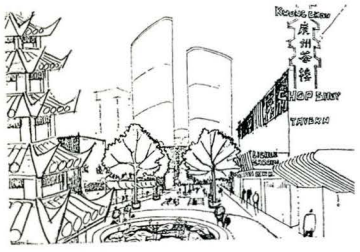
AWARDS

Toronto Chapter rethinks the concept of awards

The Toronto Chapter of Architects which last year broke tradition with the normal practice of giving awards for the design of buildings by striking a special award to the city has carried the idea even further this year.

Last year the Chapter awarded a special medal for the city of Toronto for waiving setback requirements to allow construction of architect Barton Myers' innovative house in the Yorkville area. This year it devoted its awards program solely to recognizing "things and events that contribute significantly to the quality of urban life".

The first of these new awards was given to the citizens of Toronto for their participation in, and contribution to, the three street malls held in the summer of 1971 on Yonge



and Elizabeth streets. "Though certain individuals had been involved in the planning of the malls, no one person was wholly responsible for their success, rather it was the people of Toronto who turned out in such large numbers and demonstrated their enthusiasm for a more liveable city."

The Toronto Chapter feels that the experience with the street malls in 1971 gives a clear alternative to those kinds of decisions in planning and building that diminish city life, and moreover it suggests an alternative that is immediately to hand. The Chapter commends the malls and sincerely urges their repetition.

THE PROFESSION

AIA hit with antitrust suit

The Justice Department has charged the American Institute of Architects with eliminating price competition among its members.

According to an article in the *Wall Street Journal* last month, along with the civil antitrust suit, the department has also filed in federal district court a proposed consent judgment to settle the suit. The judgment would enjoin the institute from pursuing any action to prevent its members from submitting price quotations or competitive bids for architectural services.

Whether the injunction will be effective in promoting price competition seems unclear, however.

The AIA suggests that the antitrust decree wouldn't be effective in the 11 states where architectural registration boards prohibit competitive bidding. Moreover, it says it intends to press in additional states and in Congress for legislation that would prevent competitive bidding.

The antitrust suit, one of several the Justice Department has filed in recent months against professional associations, charged that the AIA and its members for many years have combined to violate the Sherman Antitrust Act by including in the institute's standards of ethical practice a provision prohibiting members from submitting competitive bids.

The suit asserted that, as a result of the practice, price competition in the sale of architectural services has been eliminated and customers have been deprived of the benefits of free competition.

The proposed judgment would enjoin the AIA from barring its members from submitting price quotations. It also would prevent the AIA from adopting any rule implying that competitive bidding is unethical.

The AIA issued a statement insisting that clients and the public are "best served by allowing an architect to be commissioned on the basis of qualification and capability." The organization said the consent decree won't limit the freedom of the AIA or its members "to persuade clients, Congress and state legislatures that competitive bidding isn't the best way to assure quality design." Further, the AIA said delegates to its recent convention voted to assess each corporate AIA member $10 "to finance a program of public education on the issue."

The institute added that, in an exchange of interpretive letters between the AIA and Justice Department lawyers, the AIA retained the right to "influence" any branch or agency of government. For instance, the institute said, it can request a state architectural registration board to take action against any architect who violates state rules and regulations. Registration boards in 11 states prohibit competitive bidding under their own regulations, the AIA noted.

RAIC

1972-73 RAIC President C. F. T. Rounthwaite

Toronto architect Cyril Frederic Thomas Rounthwaite, a senior partner of Marani, Rounthwaite & Dick, was born and educated in Sault Ste. Marie, Ont. and at the University of Toronto, where in 1942 he received his architectural degree. He has been active in the Canadian armed forces and was awarded the Efficiency Decoration for twenty years' commissioned service.

In 1947 he joined in partnership with K. A. Cameron, J. A. Murray and R. C. Fairfield. In 1964, upon the death of Robert Schofield Morris and Morris Francis Allan of the firm of Marani, Morris & Allan, Rounthwaite merged his practice with the remaining partners of that firm to form Marani, Rounthwaite & Dick.

His community and professional activities have included being a Co-author of the Mid-Canada Development Report; Member Arctic Institute of Canada; Consultant to Department of National Defence for Environmental Studies in the High Arctic.

Président de l'IRAC, Cyril Frederic Thomas Rounthwaite

Cyril Frederic Thomas Rounthwaite est un associé principal de la firme d'architectes Marani, Rounthwaite & Dick.

Il est né à Sault Ste-Marie, Ontario, où il a fait une partie de ses études qu'il a complétées à l'Université de Toronto. C'est là qu'il obtenait son baccalauréat en Architecture en 1942.

Après avoir servi avec le Corps Canadien d'Entraînement des Officiers du contingent de l'Université de Toronto de 1937 jusqu'à la remise de son diplôme, Frederic Rounthwaite est entré en service actif avec le Corps Royal des Ingénieurs Canadiens en 1942. Alors qu'il était en Angleterre, il a suivi le cours de l'Ecole Royale du Génie Militaire. Après avoir servi au Canada, au Royaume-Uni et dans le nord-ouest de l'Europe, il entra dans l'armée permanente en 1946 où il poursuivit ses activités militaires jusqu'à sa retraite avec le grade de major, Corps Royal des Ingénieurs Canadiens de l'Armée canadienne. Il se mérita la décoration pour services efficaces (E.D.) pour ses vingt ans de service comme officier. En 1946 et en 1947, il enseigna à la Division Ajax de l'Université de Toronto sur le personnel de l'Ecole d'Architecture.

En 1947, il entra en société avec K. A. Cameron, J. A. Murray et R. C. Fairfield. En 1964, à la mort de Robert Schofield Morris et de Marvin Francis Allan de la firme Marani, Morris & Allan, M. Rounthwaite fusionna sa pratique avec les autres associés de cette firme pour former celle de Marani, Rounthwaite & Dick.

M. Rounthwaite a participé à diverses activités communautaires et professionnelles.

Conversation with the new president

On becoming 1972-73 RAIC president C. F. T. Rounthwaite of Toronto elucidated his ideas on a number of topics affecting the architect. Below a synopsis, ranging from his thoughts about the future of the RAIC to the Quebec controversy over the hiring of a French architect to design the Montreal Olympic Stadium:

Due to the fact that a national body in Canada is remote in terms of distance, the major problem facing the RAIC is the individual member's question "What does it do for me?" It can do little for one individual in terms of his precise personal needs or aspirations. It can do a great deal for the person who is prepared to work for the Institute and much for the common weal of the profession.

A significant part of our membership undertakes full time practice with various governments, industries, corporations, universities, colleges and similar institutions. A few years ago the American Institute of Architects estimated that 80% of the private offices in the United States consisted of small firms employing an average of 6.1 people. We think this situation is the same for Canada. For these reasons the RAIC must take care to ensure its undertakings relate to the needs and interests of the majority of its members. The Institute must adopt a national overview which expresses the will of the profession.

A national association can do much for its members when communications are in excellent working order. It is possible that the RAIC can be more precisely correct in its expostulation of the overall national needs and attitudes than the provincial organizations which present regional opinions. Being further away from the trees the RAIC should more clearly distinguish the woods.

The RAIC abroad

The only justification one can advance for the RAIC as a national institute to join and pay membership in other international architectural associations is the hope that its individual members will benefit from an exchange of information and ideas. For any of our individual members or provincial associations to follow international developments by themselves would be

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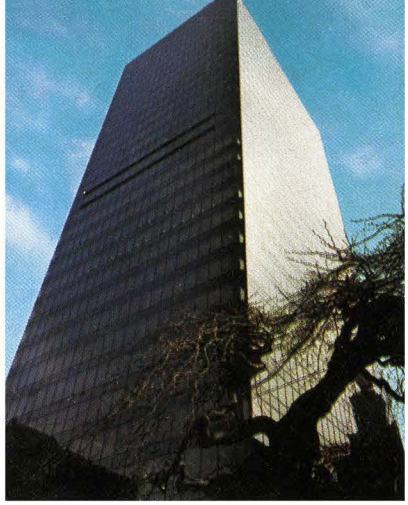
Steel & space

Structural steel-the key to spacious flexibility at the Pacific Centre



TORONTO-DOMINION BANK TOWER, VANCOUVER
Owner: Pacific Centre Limited
Architects: Gruen Associates and McCarter, Nairne & Partners
Consulting Structural Engineers: Unecon Engineering Consultants Limited
Steel Fabricators & Erectors: Dominion Bridge Company Limited

The spaciousness of the structural steel frame of the TORONTO-DOMINION BANK TOWER, allows the tenant to use office landscaping to achieve overall attractiveness and flexibility.

The new Pacific Centre with nearly 4,000 tenants in its first 30-storey Toronto-Dominion Bank Tower, is more than just a shopping centre. It is Vancouver's forerunner in the trend to integrated shopping cities, enabling people to work, shop, eat and find entertainment within one complex.

As rental requirements could be changed in the future, a system of complete and spacious flexibility had been required. The answer: a structural steel building, with clear spans of over 40 feet providing maximum usable space for maximum flexibility. In addition speed of erection meant an earlier return on investments. It's easy to understand why structural steel is the key to modern building design.

For more detailed information on the advantages of steel construction, contact the nearest office of the Canadian Institute of Steel Construction. And remember, when you are planning a building with a future, the answer is steel. And when it comes to quality steel, the name to remember is Algoma.

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costly and time-consuming. We must achieve a condensed and practical system which will keep all our members up to date within a sharply reduced period of time.

A faster international reporting system is required. Possibly this could be organized at the International Union of Architects level. This would mean that all architects (ours and those in other countries) would get quarterly synopses of what is going on in every part of the globe.

Should this happen, our own publication *Architecture Canada* would acquire dimensions far beyond that of a national newsletter. Not only would we publish articles relating to architectural cosmetics, but techniques, educational trends and professional experiences. With improved communications we can expect that the real thrust of our national secretariate will change from an administrative-oriented service to that of a resource centre.

The practical results of a centrally located clearing house must justify its consequent cost of operation. It is to be hoped that our RAIC representatives to the forthcoming IUA conference in Varna, Bulgaria this summer will emphasize the importance of an increasing exchange of useful professional information.

Public education

While we may be involved with the question of the education of our own candidates for practice in the profession, we also believe that there are broader education efforts required in Canada. We endorse the fact that there have been recent and noticeable efforts upon the parts of both federal and provincial governments to inform the people of Canada with respect to the consequences of ignoring matters such as upsetting the ecological balance, short-sighted urban planning and the ruthless exploitation of non-renewable resources. It is hoped that this year's RAIC council will lend its voice in support of all measures which reflect a sensible approach to each and every one of these important issues. We Canadians are like the children of millionaires – we have inherited vast natural resources – it remains to be seen how well we manage our stewardship.

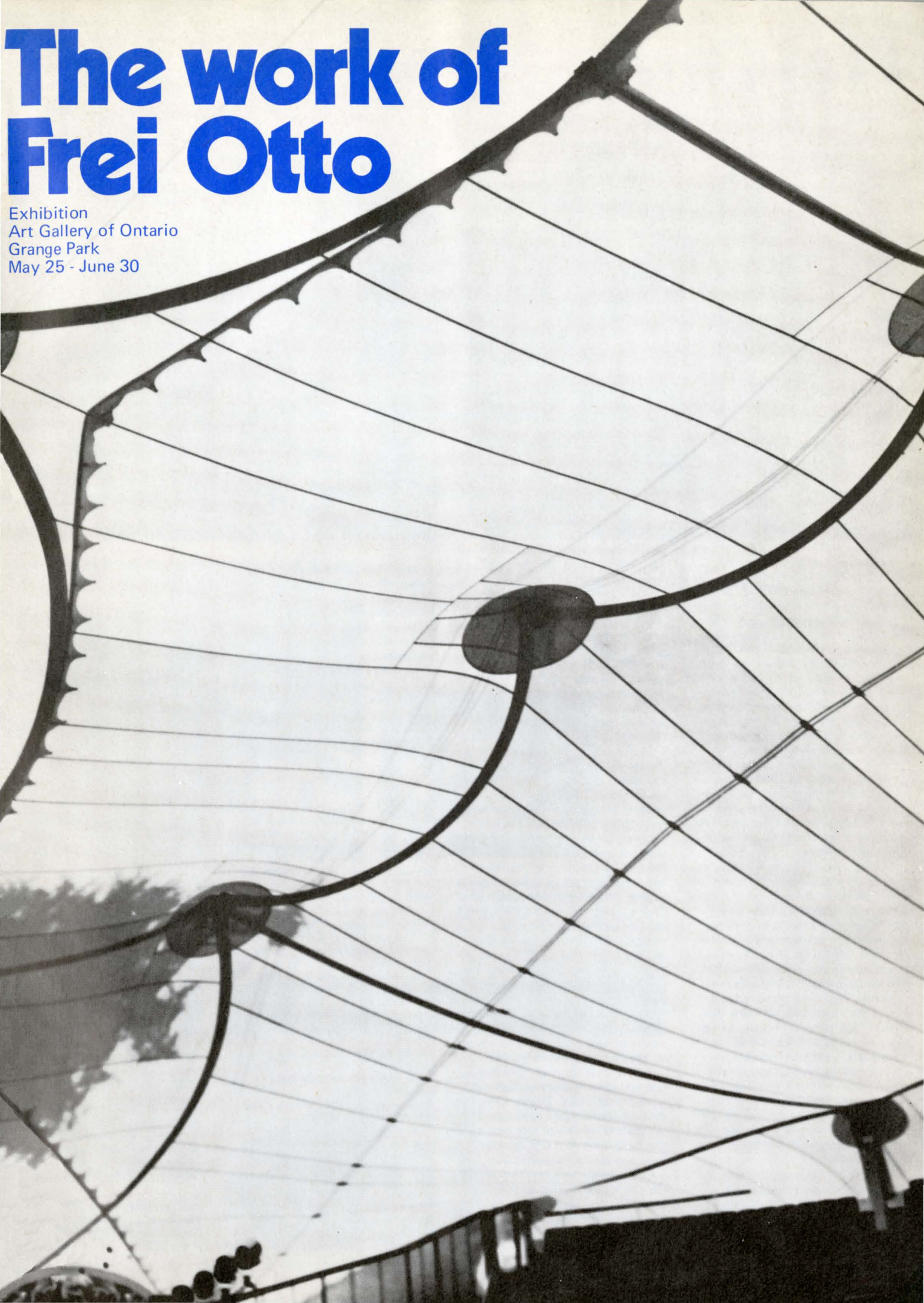
The architect and the construction industry

The architects of Canada consider themselves as one of the design components of the construction industry of Canada. As such they are involved in a $15 billion a year GNP industry along with the Canadian Construction Association, the Specification Writers' Association of Canada, etc. It must be realized that each year hundreds of millions of dollars are directly or indirectly spent under the auspices of the architects in both the public and private sectors of practice.

Further study is necessary in order

The work of Frei Otto

Exhibition
Art Gallery of Ontario
Grange Park
May 25 - June 30



Frei Otto

The man

German architect Frei Otto is concerned with the fundamentals of structure. By pursuing the age-old question of all construction, how to achieve more with less—that is less material and effort—he has not only built exciting structures but a world-wide reputation as one of the most imaginative designers of our time. He has elevated the tent to a modern building type.

Frei Otto believes in modern technology, and, from the beginning, envisioned structures of extreme lightness as well as extreme strength, which were to make optimum use of new materials such as thin cables of high-strength steel or thin membranes of synthetic fabric. He also saw the potential of pneumatically distended membranes, the only building type considered suitable for extraterrestrial conditions.

He developed his new concepts by focusing his investigations on one of the principal forces extant in all structural systems—tensile stress. Because the nature of most construction materials involves only compression forces and the concomitant bending and buckling moments, it is insignificant in conventional buildings. The reverse is the case with tensile structures where only a few members, such as masts, are under compression while all others, such as cables and membranes, are under tension. In order to introduce tension and to ensure rigidity, membranes must have specific shapes, which in most cases are based on anticlastic or saddle-like curvatures. Furthermore, these curvatures can, if correctly determined, generate the smallest possible surfaces within given curvilinear boundaries. These observations led Frei Otto, after years of experimental and analytical studies, to formulate his theory of minimal surfaces.

Otto, born in 1925, the son and grandson of sculptors, spent most of the free hours of his youth inventing and building model planes. Later, flying glider planes, he had his first opportunity to observe the behavior of thin membranes stretched over light frames and exposed to aerodynamic forces. Drafted into the German Air Force, he served as a pilot during the Second World War. In a prison camp at Chartres he was put in charge of a reconstruction crew attempting to repair bridges and buildings without any construction materials. His methodical ingenuity led Frei Otto to structural solutions which, he discovered later as a student, were not common engineering practice but genuine innovations.

Frei Otto returned to Berlin in 1947 and started to study architecture at the Technical University. While the faculty offered only one outstanding teacher of structural analysis, it was an exchange visit to the United States in 1950 which determined his future preoccupation. Among the architects he met was Eero Saarinen who recognized Frei Otto's deeper interests and referred him to Fred Severud. The renowned civil engineer was at the time involved in the State Fair Arena at Raleigh which, designed by Matthew Nowicki was the first large suspension roof to be built. After his return, Frei Otto not only produced a similar scheme, a concert hall with a suspended roof, but the year after his graduation in 1952, wrote a doctoral thesis on suspended roofs.

In the following years, he carried out his research from load-stabilized suspension structures to prestressed tensile systems. His theoretical work was paralleled by executed structures progressing from simple to more complex forms in ever larger spans—the result of his increased knowledge and of the continuing feedback provided by the experimental studies which accompanied each project.

Frei Otto's theory of minimal structures has been summarized as an attempt to achieve, through maximum efficiency of structure and materials, optimum utilization of the available construction energy. As a consequence he sees the architect less as a designer than as a manager of this energy, which is the sum total of material and labor involved in construction. However, economy was not the only objective in developing lightweight systems; freeing architecture from its structural and material restrictions means to Frei Otto making it more livable for man. Thus the reduction in construction elements yields increased flexibility and allows the adjustment of interior spaces according to the changing needs of the occupants. At the same time, tensile structures, which are easily expanded and transformed, also provide external adaptability, not only to specific site conditions but to environmental requirements in general. The facility with which these structures can be erected, dismantled, and transported offers further advantages for increasingly mobile societies.

Frei Otto not only considers the temporary nature of his membrane structures desirable but admits that his objections to making architecture stem from his reluctance to fill the earth's surface with lasting buildings. He hesitates to pursue a project unless he is certain that its realization will be temporary enough not to be in man's way. This endorsement of obsolescence contradicts the traditional view of architecture as a fulfillment of man's need for monuments. Yet, as vernacular buildings of all periods prove, artistic value is not dependent on the durability of a structure, nor on the amount or preciousness of its material. On the other hand, temporariness does not mean improvisation, as is evident from the amount of research invested in each lightweight structure.

Frei Otto acknowledges that current scientific methods have advanced only far enough to deal with elements of structure and to guarantee perfection in buildings that exclude the human element, such as an automated factory. Since the decisive factor in the design process, in his opinion, is the analysis of the problem, he believes that progress depends on new analytical methods.

Chronology

1925 — *Born in Siegmar, Saxony*
1952 — *Graduated in architecture at the Technological University, Berlin*
1954 — *Doctoral thesis, "Das hängende Dach" ("The Suspended Roof")*
1955 — Bandstand, Federal Garden Exhibition, Kassel
1957 — *Founded Entwicklungsstätte für den Leichtbau (Development Center for Lightweight Construction), Berlin*
Café Tents and Exhibition Hall, International Building Exhibition, Berlin
Dance Pavilion, Shelter Pavilion, Entrance Arch, Humped Pavilion, Federal Garden Exhibition, Cologne
Hangar tents mass-produced by L. Stromeyer and Company, Konstanz
1959 — Pneumatic structures (research projects)
1960 — *Visiting Professor at Yale University, New Haven*
Convention and Exhibition Hall, Chicago (research project at Yale)
Roof for Open-Air Theater, Nijmegen (project)
1961 — Dock Cover, Bremen (project)
1962 — *Visiting Professor at the Technological University, Berlin and University of California, Berkeley*
Lattice Dome Exhibition Structure, German Building Exhibition, Essen
Space frame structures (research project)
Published *Tensile Structures, Volume One: Pneumatic Structures*
1963 — Wave Hall, Membrane Hall, Small Pavilions, International Horticultural Exhibition, Hamburg
1964 — *Professor at Technological University of Stuttgart*
Founded Institut für leichte Flächentragwerke (Institute for Light Surface Structures), Technological University of Stuttgart
Exhibition Pavilions, Swiss National Exhibition, Lausanne
1965 — Roof for Terrace, Palm Beach Casino, Cannes
Construction Site Cover, North Peckham Redevelopment, Borough of Southwark, England (project)
Medical Academy, Ulm (project)
1966 — High-Voltage Test Laboratory, Felten & Guilleaume Company, Cologne
Hotel and Conference Center, Riyadh (competition project)
Published *Tensile Structures, Volume Two: Cables, Nets and Membranes*
1967 — Roof for Swimming Pool, Paris
Pavilion of the Federal Republic of Germany, World Exposition, Montreal
Indian Pavilion for World Exposition, Osaka (project)
1968 — Roof for Open-Air Theater, Abbey Ruin, Bad Hersfeld
1969 — Roofs for Sports Center Stadia, Kuwait (project)
1970 — Roof for Olympic Stadium, Berlin (project)
Open-Air Theater, Wunsiedel
1971 — Automatic Umbrella Roofs, Federal Garden Exhibition, Cologne
1972 — Hotel and Conference Center, Mecca
Roofs for Olympic Stadia, Munich

This introduction is condensed from The Work of Frei Otto, Ludwig Glaser, The Museum of Modern Art, 1972.

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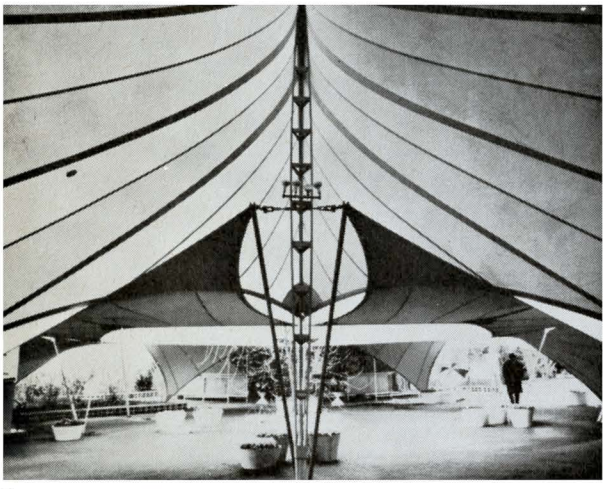

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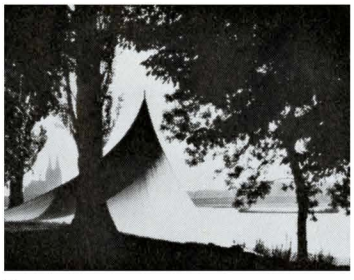
"The most highly developed structural techniques are to be found in nature, such as the human body, plants, trees, and spider webs. Structural studies in lightweight construction could receive much information from an understanding of natural forms. Often man made forms resemble natural forms when structural demands are similar."



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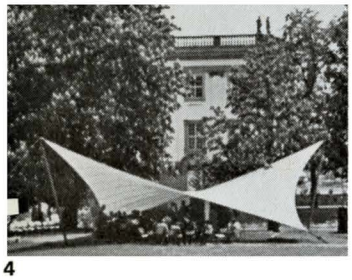

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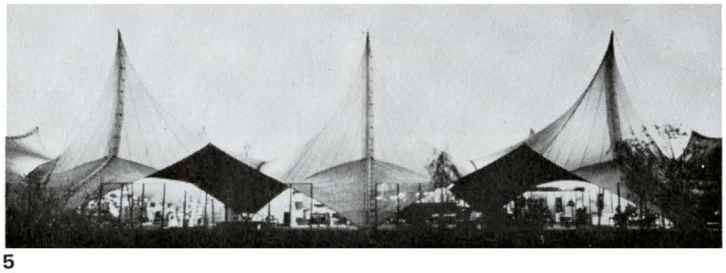

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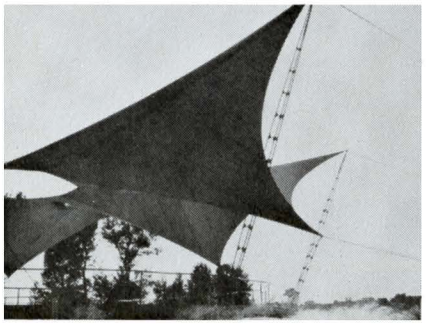
1. Mass-produced hangar tents, 1957. **2.** Small pavilions, International Horticultural Exhibition, Hamburg, 1963 **3.** Shelter pavilion, Federal Garden Exhibition, Cologne, Germany, 1957 **4.** Bandstand, Frei Otto's first tensile structure, 1955 **5.** Wave Hall, International Horticultural Exhibition, 1963 **6.** Dance pavilion, Federal Garden Exhibition, 1957.



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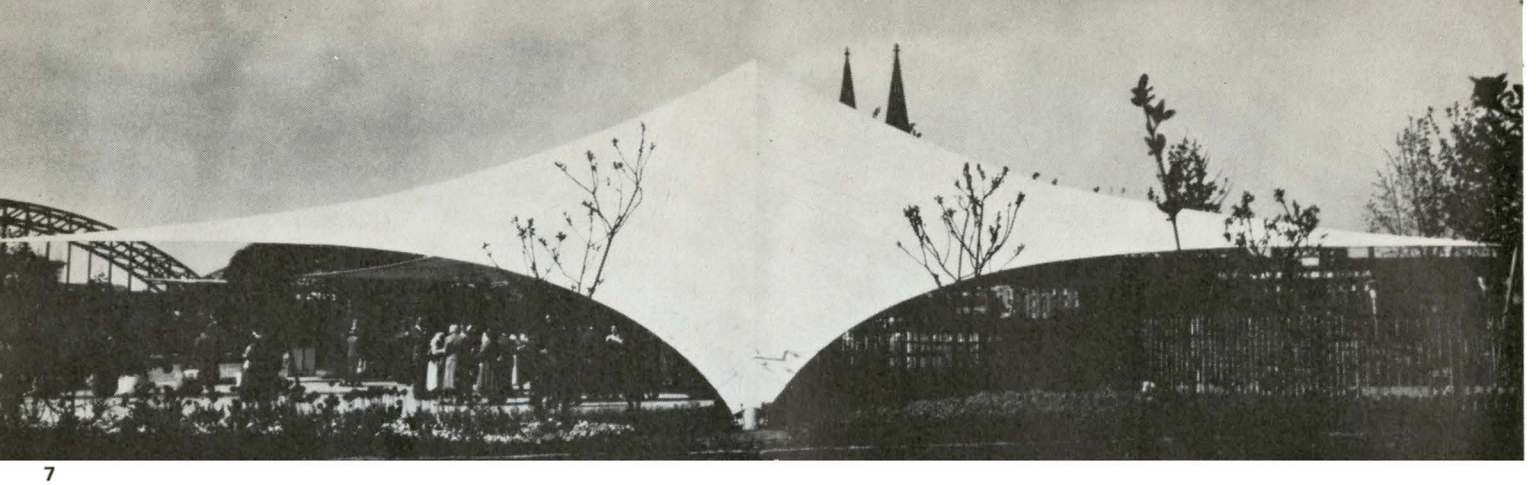

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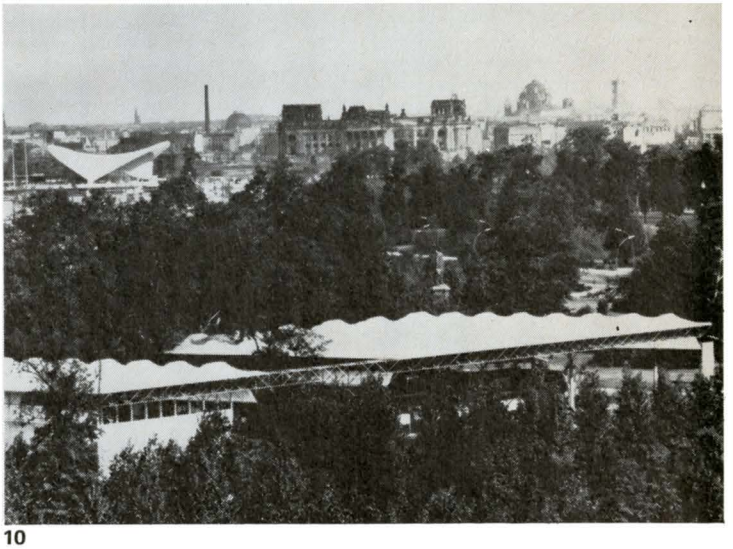
7. Entrance arch, Federal Garden Exhibition, Cologne, Germany, 1957 **8.** Humped pavilion, Garden Exhibition, 1957 **9.** Offshore storage facility, 1958/59 **10.** Exhibition Hall, International Building Exhibition, 1957 **11.** Membrane Hall, International Horticultural Exhibition, 1963 **12.** Projection screen, Industrial Fair, Berlin, 1968 **13.** Dock cover for Bremen, Germany, project 1961 and one of Otto's largest and most daring schemes developed in detail **14.** Medical Academy, Ulm, Germany, project, 1965 **15.** Retractable roof for Palm Beach Casino Terrace, Cannes, France, 1965



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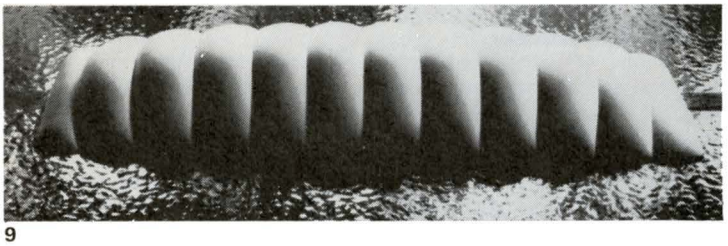

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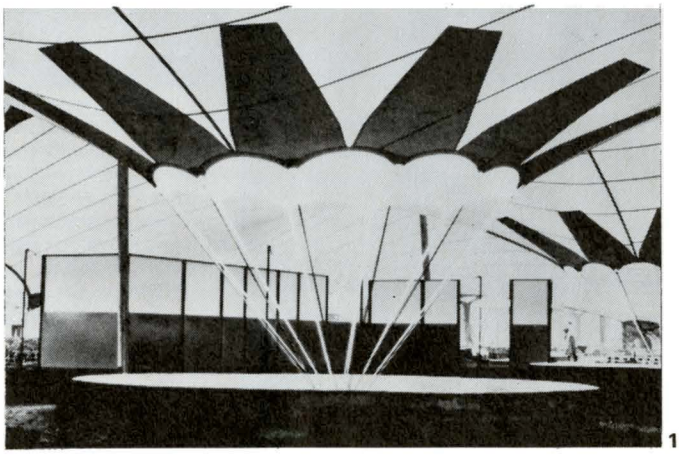
"Any shape which a soap bubble can assume can also be obtained as a pneumatic structure."



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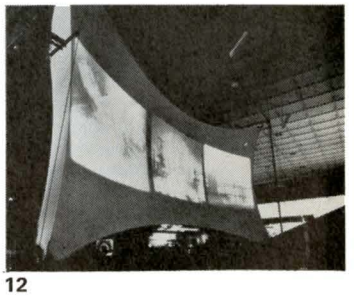

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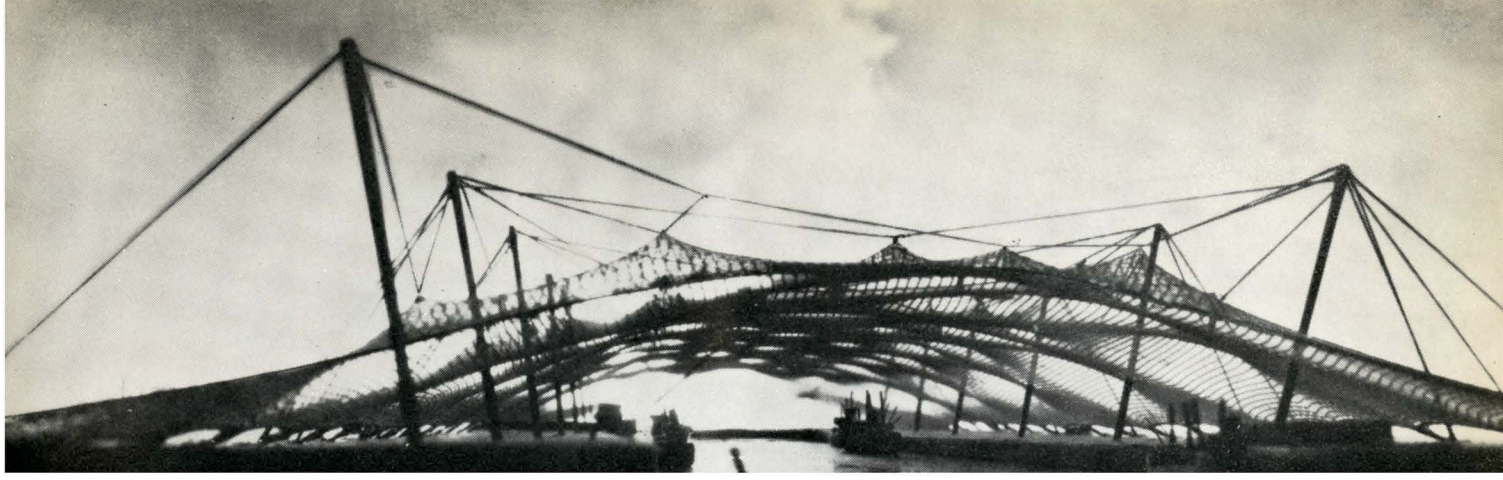

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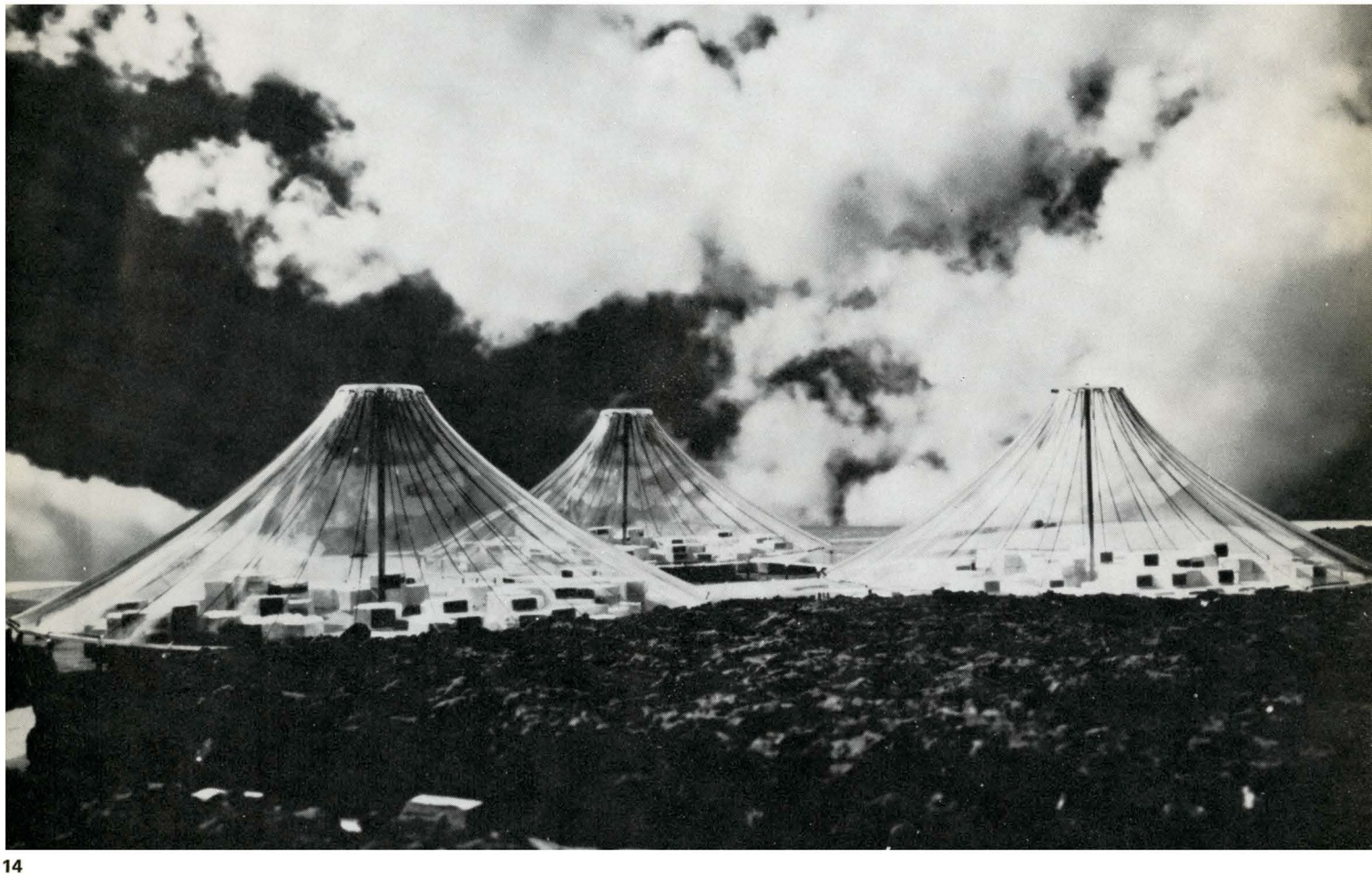

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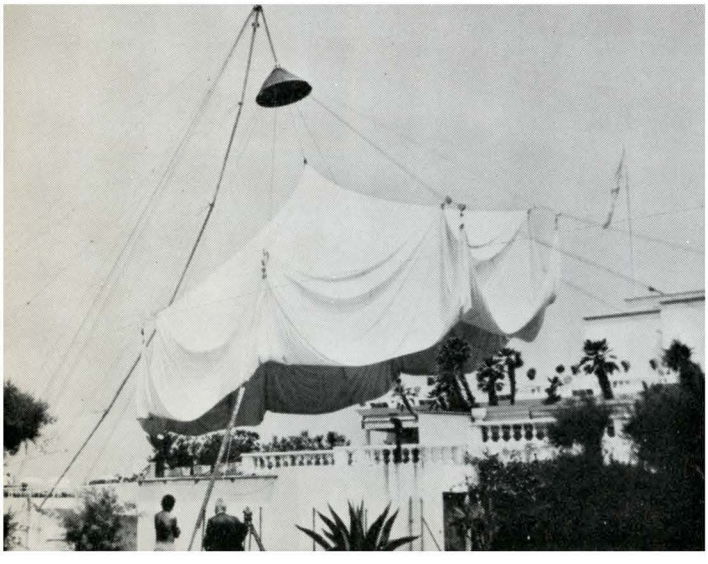

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"Animal and man exhibit the essential features of a lightweight structure: tension in pneumatically slightly prestressed skins and fibres enables them to support broadly distributed surface loads, while all compressive and bending stresses are locally concentrated."

Stelco Tower is more than just a big, new building.

It's a big, new idea.

In fact, the Stelco Tower designers have packed it with ideas. Practical ideas. Good looking ideas. Money-saving ideas. Ideas you should know about.

We can say this with some objectivity, because although our company is the prime tenant, we do not own the building. The steel concept had to prove itself, cost-to-cost, against several other design submissions. And did.

How is the Stelco Tower different? Consider the main features. It consists of a reinforced concrete core to which are attached open web steel joists. These support the steel floor deck and connect the core with the square steel hollow structural section exterior columns.

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Because it's made almost entirely of strong, lightweight steel, the Stelco Tower costs less in time and money to erect than most other types of high-rise structure.

We will be pleased to answer your questions about the Stelco Tower. Write The Steel Company of Canada, Limited, Department "A", Hamilton 23, Ontario.

stelco

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Architect: Arthur C. F. Lau

Consulting Engineers:
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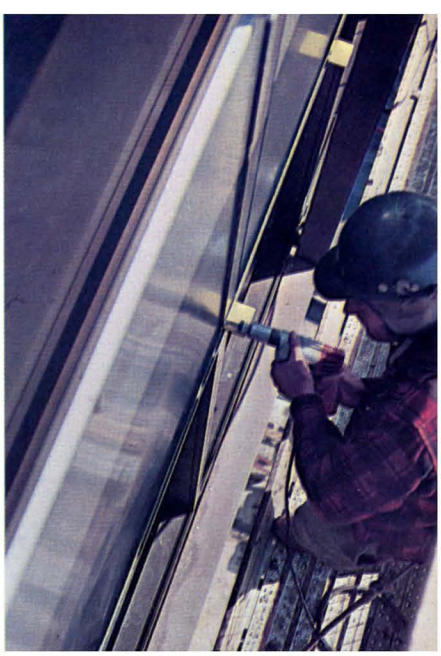

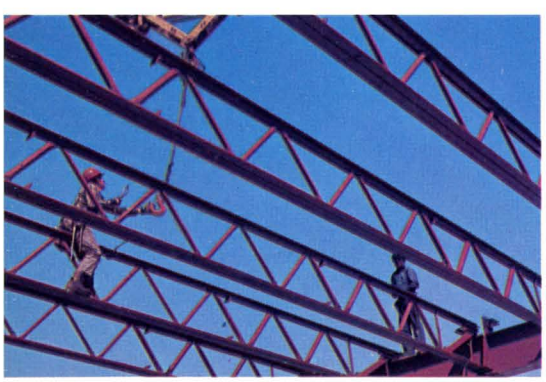

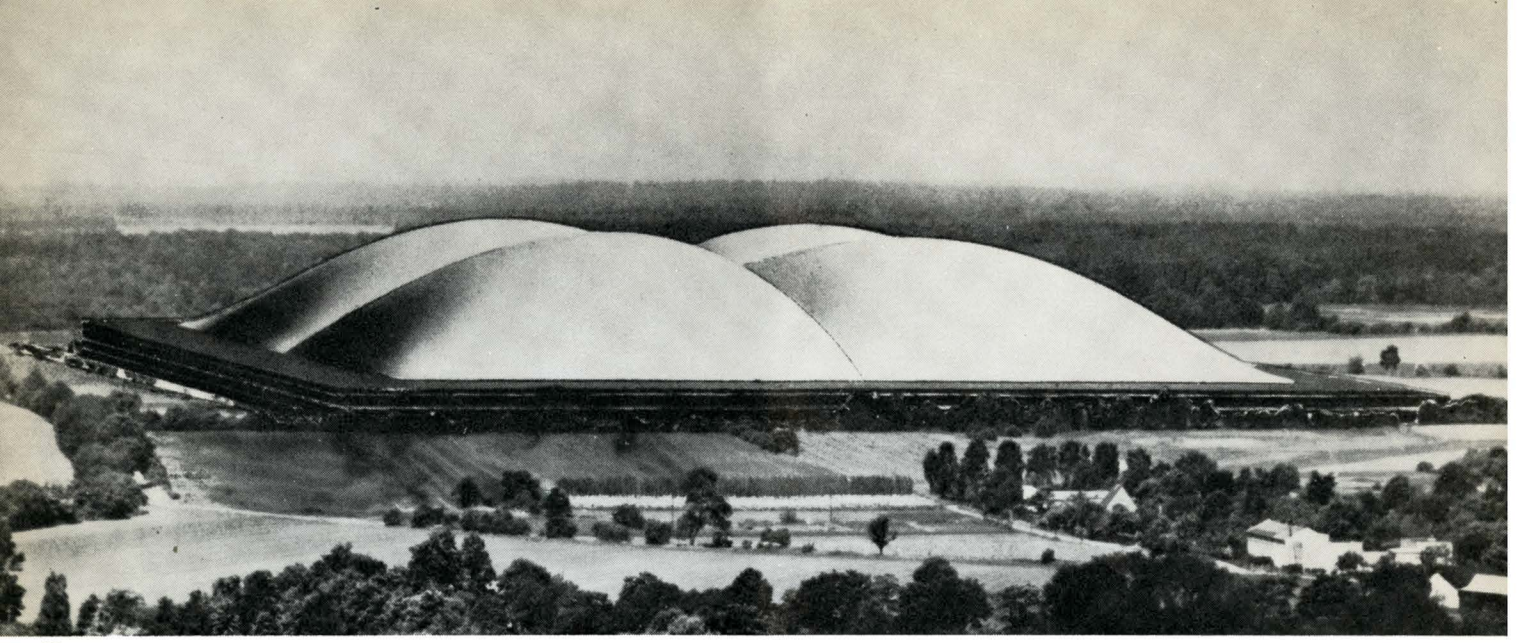

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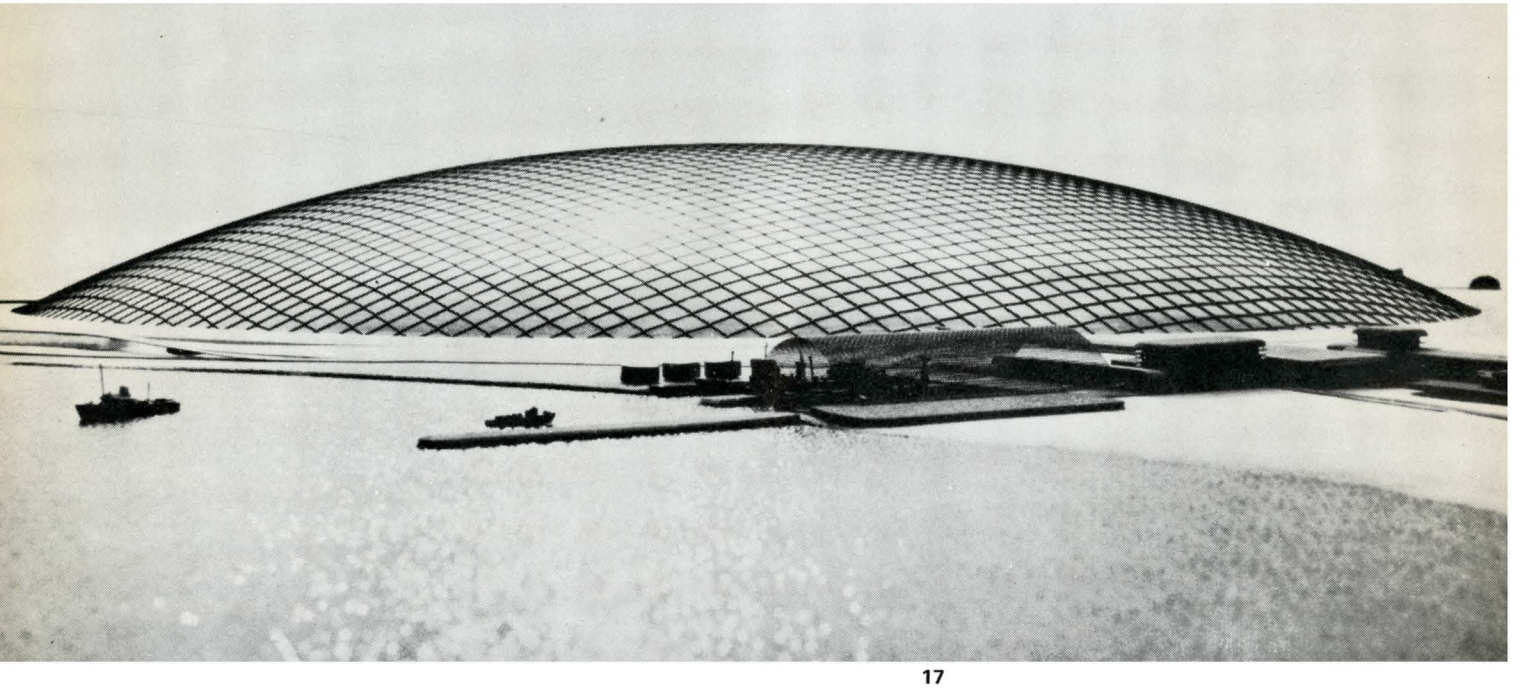

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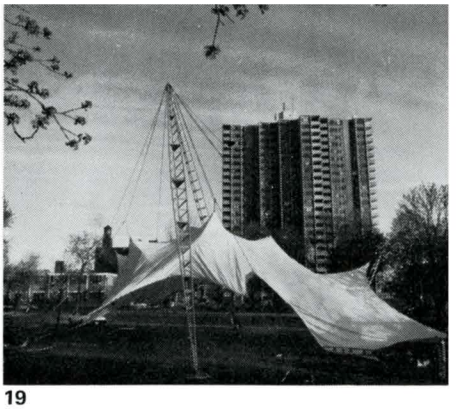
16. Pneumatic factory roof, project, 1959 **17.** Proposed envelope for an Arctic City of 45,000 inhabitants, project, 1971 **18.** Otto's retractable roof structure for The Work of Frei Otto exhibition **19.** Below, being erected in Grange Park **20.** Right, in the Garden Terrace, the Museum of Modern Art, New York City.



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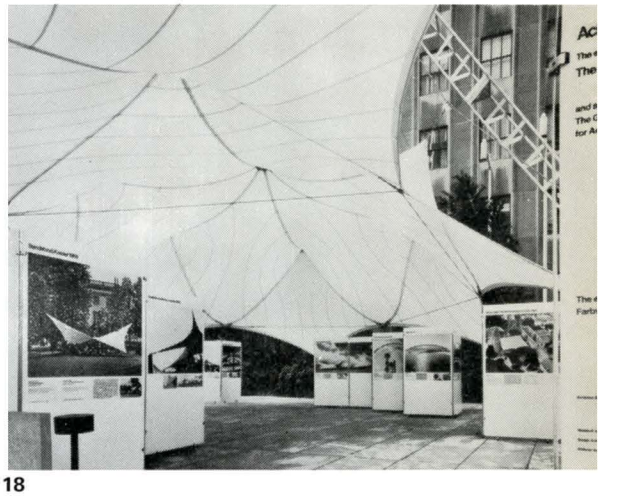

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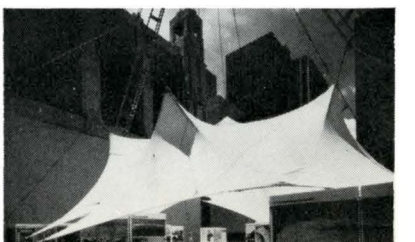

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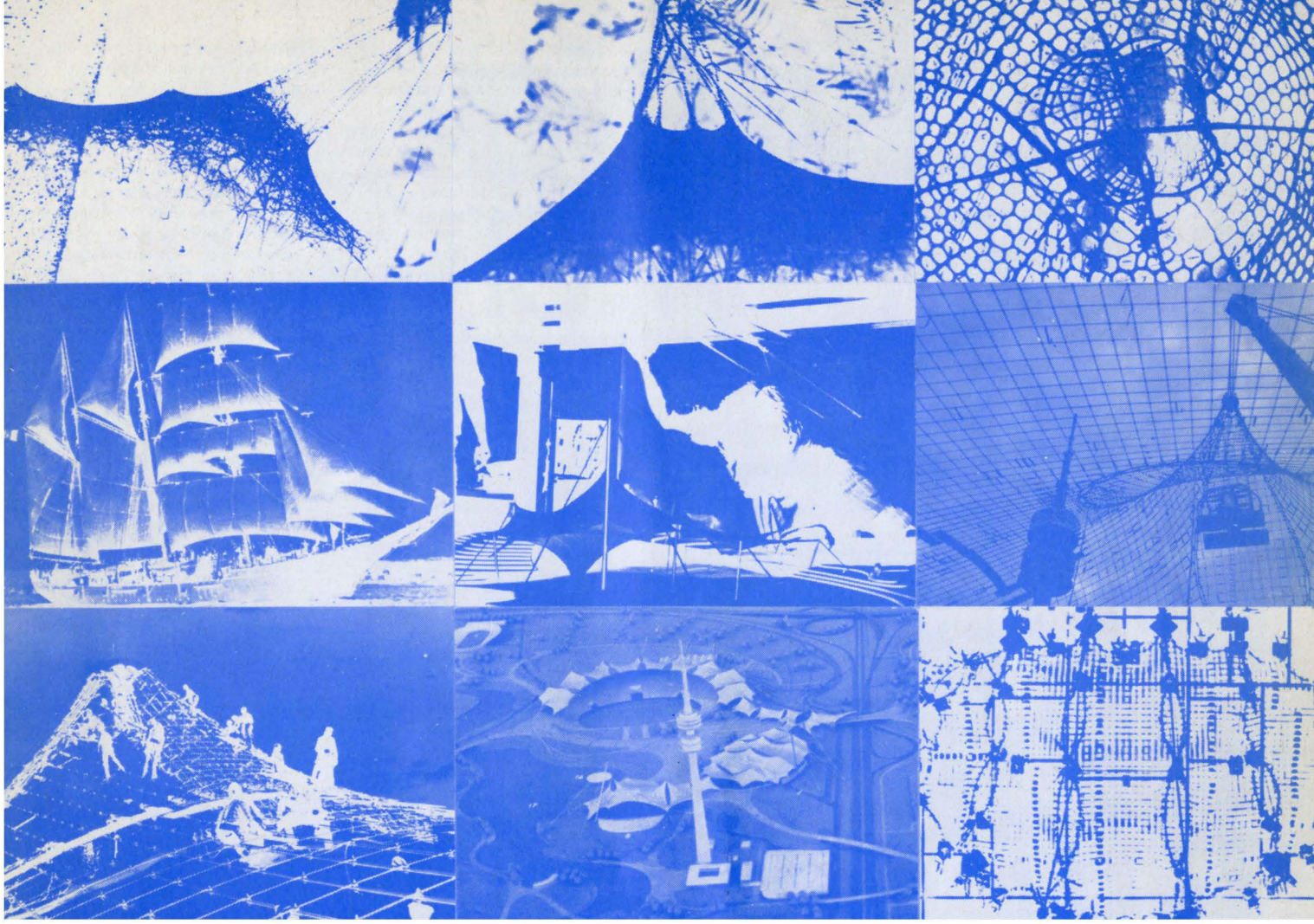


Otto's ideas

Fascinated by the world of Frei Otto, two architecture students from the University of Waterloo decided to go directly to the source, and study lightweight structures in Germany. Peter Dandyk and Allan Cain, last fall, went to Munich and Stuttgart to study the structures and speak with the people building them. Allan Cain worked in Otto's studio near Stuttgart and Peter Dandyk worked in Munich where the world's largest roof is now under construction for the '72 Olympics. This article filled with their enthusiasm is a basic explanation of lightweight structures with emphasis on the Olympic roof. The students also give their impressions on various points of principle and controversy concerning Otto's tent roofs. It serves as a good introduction to this unique and little explored avenue of architecture.

Man has throughout history used gravity to give stability to the structures he has built. The great arches and domes of antiquity were constructed of materials of low efficiency with an unfavorable strength to weight ratio such as stone and brick. Massiveness was necessary to ensure strength but created a huge dead-weight, far larger than any applied loads that the structure would have to carry. So, historically architects have tended to deal with massive constructions.

The technology for the building of many of Otto-type lightweight structures has existed, however, for thousands of years. The tent is one of the earliest forms of man-made shelter, and the sail an early form for transportation. Both these forms have gone unexplored outside their immediate functions, until very recently. Air balloons, parachutes, and automobile tires are well known, yet not until the last few years have designers and experimenters such as Frei Otto and Walter Bird begun exploring the principles of membrane construction.

Otto first developed an interest in pneumatic structures—membranes held in tension by the outward thrust of trapped air. A study of the soap bubble and soap film forms naturally evolved, the soap bubble being the most efficient, thus most perfect lightweight structures in existence always using the minimal material to span any given configuration. Also no form could develop smaller surface tensions.

In parallel with pneumatic experiments Otto became interested in catenary structures (forms derived from hanging chains) traditionally found in suspension bridges. These shapes are purely tensile, having no compressive stresses or bending moments to deal with. Only light members, such as cables, are needed to take up tensile forces. Three dimensional catenary forms are true lightweight structures, using little material to cover large areas.

Otto's research in tensile membranes and cable structures came together in the building of his "cable net - membrane roofs" such as the German Pavilion at Expo '67 in Montreal and the roof for the 1972 Olympics in Munich.

Form finding process for a tensile structure

1) Soap bubble experiments produce minimal tension shapes where the surface has the same force per unit area at all points. Having established an approximate configuration for the area to be covered, soap bubbles will define the actual minimal surfaces between support points.

2) After the basic minimal shapes have been simulated and established in soap film tests, canvas models are constructed to materialize the form, and to enable the experimenter to handle and manipulate the structure in order to establish final support locations and to work out specific details. The characteristics of the canvas are similar to those of the final cable net and produce reactions very similar to those of the real structure.

3) The final stage of the design process involves construction of a very precise structural model of the forms established in earlier tests. This step in the empirical design method employed for these membrane roofs involves the use of an actual scaled wire mesh which is subjected to a variety of stresses and loads. Deformations are recorded photographically and direct tensions are measured in the wires with special gauges developed by the Institute of Lightweight

Structures in Stuttgart. From this data, cable lengths and cross sections, support sizes and final slopes are precisely determined.

4) A computer program is written in parallel with these experiments. Results of physical tests are fed into the computer and a program evolved. Although the test net is only nine feet of mesh, equations with upwards of 10,000 unknowns have to be solved.

Olympic Roof, Munich 1972

In 1967 Gunther Behnisch and his partners were awarded first prize in the architectural competition for the 1972 Olympic Games to be held in Munich. One of the key elements in their winning entry was the lightweight tension structure for the roof of the Olympic stadium, the swimming hall and the indoor sports stadium. Since construction began in 1969 the roof has taken on an ever-increasing significance and popularity among visitors to the site, as well as architects and engineers who see it as a viable alternative to conventional construction systems.

Due to his experience in this area of lightweight structures, Frei Otto and his Institute for Lightweight Structures in Stuttgart were asked to join the design team. They in fact took Behnisch' proposal and went through the process described above to develop the final roof design.

In many ways the Munich roof is a further development of the one for the German Pavilion at Expo '67 on a much grander scale—it covers 720,000 sq. ft. or 16.4 acres. It consists of a steel cable net on a 29 x 29 inch mesh spanned over pylons between 162 and 255 feet high and up to 12 feet in diameter.

The galvanized cable net forms the basic structural element. Then acryl glass panels some nine feet square act as the actual roof covering. In the original concept three alternative roof coverings or infill systems for the mesh were considered: PVC coated polyester fabric on a wooden formwork; three layers of bituminous felt covered by a metal foil; liquid plastic sprayed onto lightweight concrete. But the broadcasting of color television which required a shadow-free interior space had to be considered—this implied some kind of transparent or at least translucent covering. Three new alternatives were formulated, the third of which became the final solution: Translucent PVC coated polyester fabric (Membrane); translucent fibre glass reinforced polyester panels; and transparent (tinted) acryl glass panels. Acryl glass was selected over the other alternatives because it provides unhindered transparency; protection from solar radiation (tinting); is more durable against mechanical influences and decomposition from light or chemicals; and provides greater fire safety because it does not ignite easily and if ignited does not smoke or drip.

Panels are bolted to the cable net on neoprene buffers (to accommodate defections under loadings) and overlap each other in a serial fashion, somewhat like large scales. Neoprene buffers at the edges also provide the necessary weather protection at seams.

In the indoor swimming hall and the small sports stadium ceilings are suspended below the cable net to provide heat, light and noise insulation.

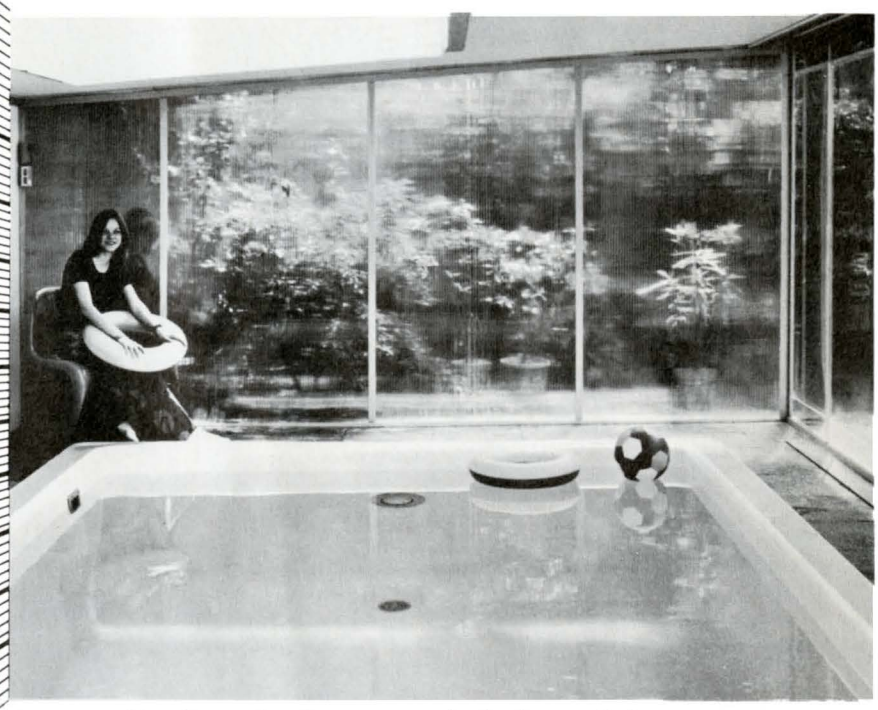
Previous experience was not sufficient for designing many of the structural members, particularly the cables and anchor points. The results of new tests and experiments have provided new developments which will be of benefit not only in the building of the Olympic roof but also for all future cable net construction.

The entire Olympic roof is prefabricated. After suspension between the fixed support points and guy points it must conform exactly to the projected prestressed condition. Therefore, prior to assembly, every structural member, in particular each individual cable, must be shorter by exactly the degree of subsequent stretching due to prestress. This stretching comes to an average of 10 cm. for a 45 m. long cable. If a cable is 5 cm. (2") too long over such a 45 m. (48 yd.) span, the tension will be off by 50 per cent. Consequently the demand for accuracy in determining the pattern and actual assembly of the net is greater than in any other method of construction.

What the skeptics have said

After Behnisch had won the competition for the Munich Olympics, a great deal of controversy developed over the various aspects of his design, especially the roof. Munich architects were upset that a Stuttgart architect had won the competition and did their best to find flaws in this unique and exciting project. Rumors about spectacular collapse of the roof under the winter snow load began to circulate. As complications in constructing the roof did arise, grist was added to the mill. Its experimental nature yielded some unexpected complexities and the cost began to rise significantly. Naturally this encouraged a large scandal and most of the "I told you so" architects in Europe revelled in it. Granted the roof did cost more than planned, but that is the case with any new structural form. Nonetheless, it provides a great deal of useful experience for future projects and long after the critics finally exhaust themselves, the roof will continue to stand as one of the few signs that architecture and building hasn't stagnated, that there is a future, and a very exciting one.

Treat yourself to the best!



For yourself or for a client's project, only the best will do.

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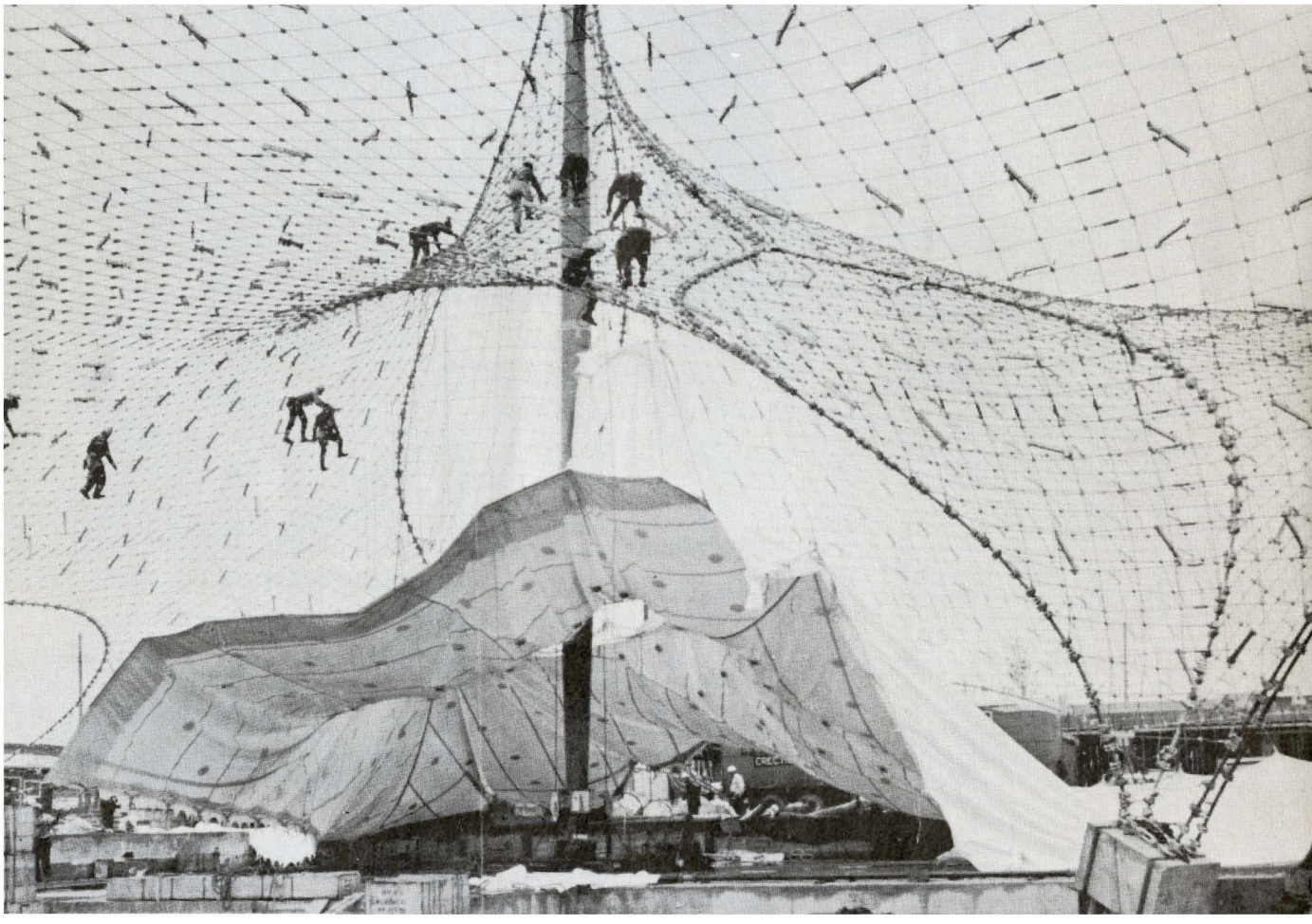
Chemical Fabrics Corp. could have made this a permanent structure



German Pavilion Expo '67, Montreal

All the exciting fabric-covered structures of recent years: from small air-supported shelters for swimming pools to giant Expo pavilions like the one above, or the huge U.S. inflatable at Expo '70, have had one thing in common. Because their covering fabric lacked sufficient weather and fire resistance, they could not qualify as permanent constructions.

A new fabric called Sheerfill from Chemical Fabric Corp. with the strength of glass fibre and a coating of Teflon for durability changes all that. Already selected for large lightweight structures to house sports activities and a student centre at colleges in Tennessee and California, Sheerfill was created to meet challenging architectural requirements. Strong, fireproof, weather and soil resistant and easily fabricated into complex shapes, it opens up a new dimension in the design of large low-cost lightweight structures—permanence.

Available in widths up to 16 feet and can be easily heat sealed.

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See our catalogue in Sweet's

Consider the possibilities

You're looking at a 'playroof'.

That's right! It's a playroof, not a playground. At Ecole Emile Nelligan in Montreal, Roofmate* FR, the insulation without ''equivalent'' was used in the IRMA (Insulated Roof Membrane Assembly) system. Besides insulating the roof membrane itself from thermal cycling, this unusual concept solved a number of other interesting problems. Overleaf tells the whole story...

BCI 5.13 INSULATION-ROOFING
polystyrene

DOW CHEMICAL OF CANADA, LIMITED

*Trademark of the Dow Chemical Company

Owners: The Montreal Catholic School Commission
Architects: Pauer, Bourassa, Gareau et Jean-Louis Lalonde, Montreal
General Contractor: J. R. Côté Construction Ltée, Mtl. Roofer: Delphis Côté Ltée., Montreal

When there is no room *around* a school to build a play area, you can build it *on* the school!

Ecole Emile Nelligan is a girl's comprehensive school in a high-density housing area of Montreal. Because of the high land values, the school structure occupies an abnormally high percentage of the acreage.

But this meant that there was no area left for a playground. The solution? Build the play area on the roof of the first level. Because of the properties of Roofmate* FR, this unusual requirement was easily accomplished.

The school is a two-level, seven-floor structure. The first level is a two-floor base covering all of the available land area within 15 feet of the boundaries of the property. This level contains the entrance and reception area, courtyard, cafeteria, gymnasium, and administration and services offices and rooms. The 'playroof' covers the top of this first level.

The standard IRMA roof construction of the play area is covered by pre-cast concrete slabs, (4′ x 5′ x 3″) with exposed aggregate surface. These slabs are laid *dry* on gravel directly on the insulation.

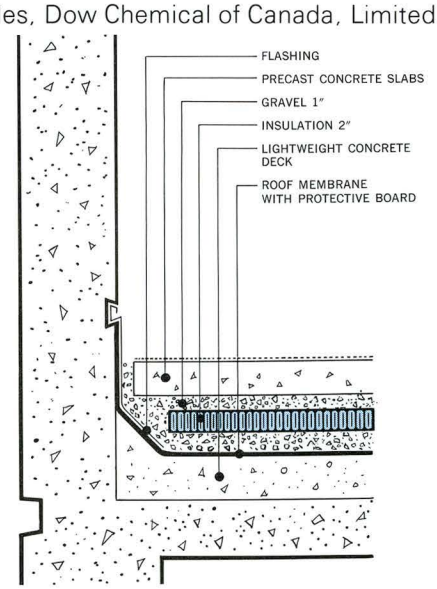
In a conventional built-up roof, the membrane is subject to thermal cycling, with resultant cracking, wrinkling and ridging. But with insulation above the membrane as in our case here, the membrane is protected from extreme temperature variations, and other deteriorating factors. The result is that the life of the roof membrane is greatly increased. Since Roofmate doesn't absorb water, the heat loss or gain is the same as if the insulation were installed under the roofing membrane.

The differential movement of the various roof elements caused by temperature changes is also minimized, simplifying design. Note, too, that the IRMA roof doesn't need a vapour barrier even in high humidity buildings since the roof membrane itself performs this function.

This is particularly pertinent in the case we're citing for this reason: the courtyard has heating cables imbedded in it. Beneath the courtyard is the gymnasium shower room which is obviously a source of high humidity. These two factors could have been a potential trouble source, but with Roofmate* FR insulating them from each other, there have been no difficulties what-so-ever, and three gruelling winters have passed!

The IRMA system is the product of close to 20 years research by Dow; it has been applied in over 100 projects in Canada since 1966. Needless to say, the insulation used with this system is critically important. It has to be permanently impervious to moisture, and must have exceptional compressive strength. This combination of properties, plus a permanently low ''K'' factor, is found in Roofmate* FR.

The detail below shows the construction of the 'playroof' at Ecole Emile Nelligan. If you'd like more information on the IRMA roof system, consult Section 7ri of the current Sweet's Construction File or write: Construction Material Sales, Dow Chemical of Canada, Limited, Sarnia, Ontario.



DOW CHEMICAL OF CANADA, LIMITED

*Trademark of the Dow Chemical Company

to assess why, in the USA, it is estimated that the architects deal with only 15% of the total annual construction volume, and in the U.K. they are involved to a far higher degree in all building endeavors. The figure for Canada is probably comparable to that of the USA.

The architect's public image

Often the profession wonders whether Canada has an *inferiority complex*. This question is provoked by the habits of Canadian corporations who annually spend millions persuading the general public that they are true-blue native institutions and who, at the moment they face a major construction program, rush south or overseas to import foreign professional talent.

Within the domestic context it is worth reporting that the RAIC has joined the PQAA in volunteering free advice and assistance to the City of Montreal with respect to their Olympic stadium. We hope full use of Canadian professional talent will be used in this important undertaking. The public should be aware that there are many exceptionally able architects in Quebec and Canada at large. It is to be hoped that their abilities will be used with respect to what will be a Canadian first – the plans for a national Olympic stadium. Professional expertise can only be developed by involvement in real programs. If such opportunities are denied, national expertise suffers, so does Canadian credibility as a leading nation in technical ability.

Broad goals

Let us examine some of our national problems which touch upon the services of the architect.

1) The need for improved building technology such as an all-out effort which might achieve the $5.00 per square foot living unit.

2) The urgency for developing the safest possible structures for human habitation.

3) Working toward the design of the "white" city – the non-polluting, totally clean urban development. Legislation to encourage the advent of the never-paid-in-full, good for 200 years, comfortable, ageless dwelling units. (We must bet on the country, *not* the individual.)

5) Substituting for minimum standards, quality design criteria for all forms of habitation.

6) Funds for responsible professional organizations to do the necessary research in the development of elements which will improve our living conditions.

7) Canadian input on projects of special scope or nature which would improve the state of the art of architecture in Canada.

ASSEMBLY

Council meetings

Both the final 1971–72 and initial 72–73 meetings of the RAIC Council in Victoria attracted high interest from convention delegates with observers grouping themselves behind their provincial councillors to consult on matters requiring votes.

Highlights of the sessions were as follows:

- The newly organized Association of Architects of Prince Edward Island requested official recognition as an RAIC Component Association. It was resolved that notice of their request be circulated to other Associations in conformity with RAIC By-Laws. Approval of at least two thirds of Component associations is required for the RAIC, in its discretion, to grant recognition to a further representative group of architects.
- Halifax architect, Gregory Lambros, presented report on his investigation into the RAIC Minimum Syllabus program. Council commended the document.
- David Hickman, Vancouver, presented the Policy Report of the Certification Board and commented on the June 1st meeting of the Board.
- Council agreed to maintain the Board's present level of activity until the year end. It was agreed to assist the Board in finding sources of revenues for its 1973 program which includes the hiring of a full time executive director.
- Council agreed that a survey of architects' occupations in Canada be conducted by the component associations, with results compiled by the RAIC.
- It was decided to maintain RAIC

membership in the Federation of Pan American Architects and to accept the nomination submitted by ten countries that the Canadian Section of the UIA (the RAIC) be a candidate to the UIA Council in coming UIA elections.

• Alexander Leman presented a report of his Ad Hoc committee to the UN Conference on the Human Environment (*A/C, 5/8/72*) and Council agreed it be transmitted to the concerned Authorities.

• At the request of the Ontario Association, Council agreed to meet in July to formulate a program for 1972–73, with an accompanying budget.

Réunions du conseil

La réunion annuelle du conseil 1971–72 a eu lieu le 31 mai, et la première réunion du conseil 1972–73, le 3 juin, toutes deux durant la 65e assemblée annuelle de l'IRAC, à Victoria.

En plus des membres des conseils des associations constituantes qui, de par les règlements de l'IRAC, peuvent assister et participer à la dernière et à la première réunion de chaque conseil, l'Institut a invité tous les membres à assister à ces deux réunions à titre d'observateurs.

Quelques mots sur les sujets à l'agenda :

• Greg Lambros a présenté son rapport sur le "Programme d'études minimales" de l'IRAC. Des copies de son rapport seront distribuées sous peu aux associations.

• David Hickman, président du bureau d'accréditation de l'IRAC, a présenté un rapport sur la politique du bureau et a commenté la réunion du 1er juin du bureau. Le conseil a approuvé le rapport et maintiendra le bureau dans sa forme actuelle jusqu'à la fin de la présente année et, d'ici là, assistera le bureau dans sa recherche de fonds pour financer son programme de 1973 qui comprend, entre autre, un directeur administratif à temps plein.

• L'IRAC souhaite qu'un recensement des occupations des architectes au Canada soit entrepris par les associations constituantes et compilé par l'Institut.

• Le Conseil a accepté une nomination de la part de dix pays, membres de l'UIA à l'effet que la section canadienne de l'UIA (IRAC) soit candidat aux prochaines élections du conseil de l'UIA.

• Alexander Leman a présenté, au nom de son comité Ad Hoc, un rapport préparé en vue de la conférence des Nations Unies sur l'environnement humain et le Conseil a agréé de la transmettre aux autorités intéressées.

• A la demande de l'OAA, le Conseil a décidé de se réunir en juillet prochain afin de définir le programme ainsi que le budget de l'Institut pour l'année 1972–73.

• Le conseil a établi un comité provisoire ayant pour but d'analyser les amendements à la Loi sur l'Habitation, dès qu'ils seront déposés à la Chambre des Communes. . . .

More assembly news next issue