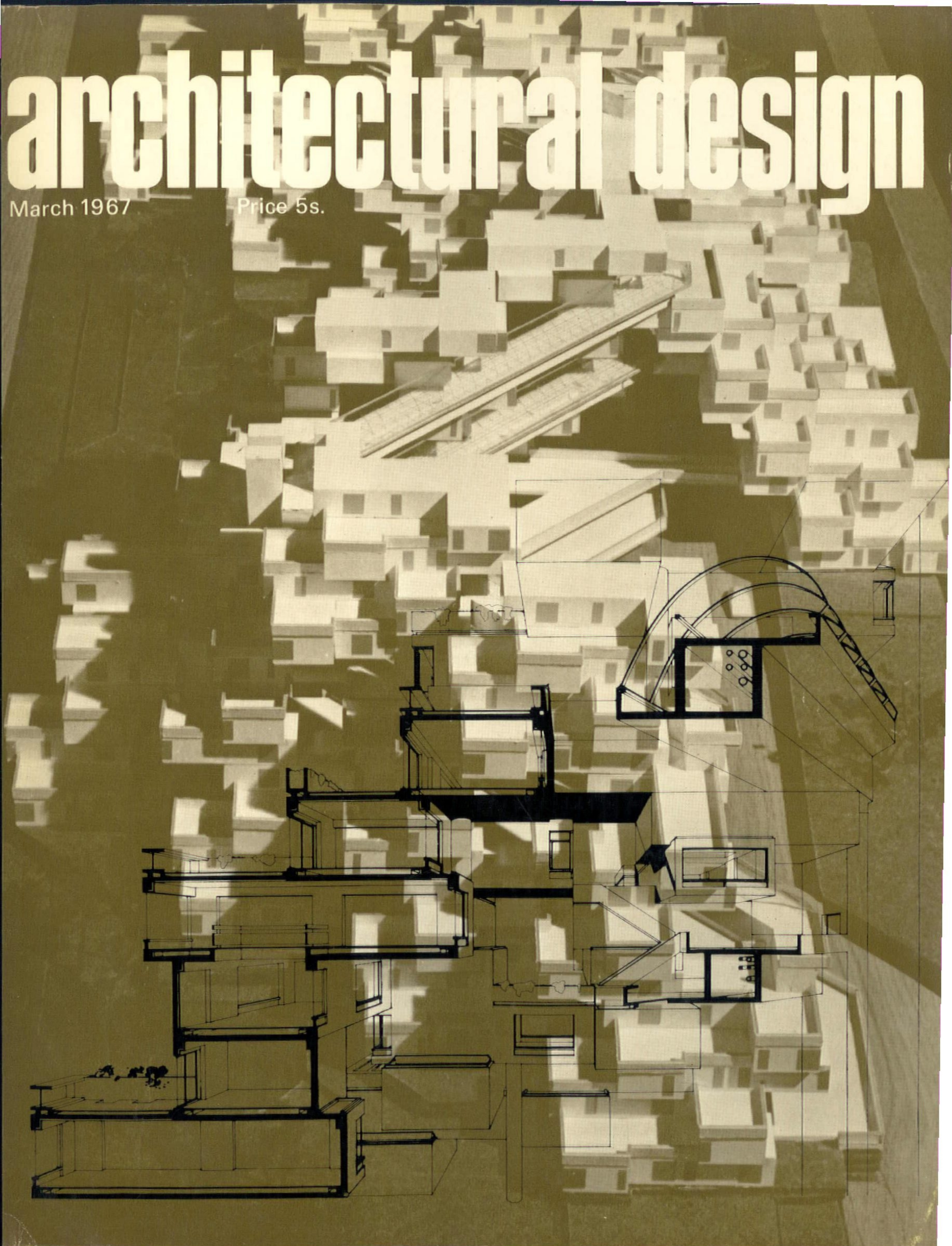
architectural design

March 1967 Price 5s.



Books

Multi-storey housing

Karl Wilhelm Schmitt. The Architectural Press. £4 4s.

This book is a stamp album on housing whose interest is in the fact that it is by a foreigner. The text alternates between philosophical generalizations and little stories based on the author's intimate personal experience. This gives it a quite mad flavour which translation exaggerates, for example:

p. 22: 'The building standard must be in keeping with the forces which govern all human activities; these forces may be of a sociological, political or economic kind—contrasting examples come to mind, such as the opera house in which Caruso used to sing, or the legendary city of the Brasilian rubber planters, now perished, or the inhabitants of Matera in Southern Italy who prefer to return to their old rock caves; alternatively, these forces may be of a biological or bioclimatic kind.'

p. 30: 'In the earliest parts, the strict limitation of the floor area and the need to make do with individual heating can only be overcome by such gimmicks as the built-in bedroom, already encountered in Rading's tower block plans of 1929 . . .'

The book is strong on Germans, and has full plans of Scharoun's still mysterious housing, and work of Ungers which I have never seen before. It also has a good section on the stepping-back housing types of which the most well-known are in Switzerland. These are illustrated in considerable detail, the Swiss ones and also some in Oslo in which the dwellings have floor areas ranging from 2000 to 4300 ft². They are extremely spacious and very well equipped. One cannot imagine three of them selling here, it makes one muse on the very special sort of upper middle-class society which clearly exists in Oslo.

Also in the snowy north, in Gothenburg, there is built what everyone else has always talked about but never done; that is, trays on which removable, all different, houses are placed. Again a thing I have never seen illustrated before and never heard discussed.

Mr Schmitt is good on retrospective references to Germany in the 20s and 30s and has good reminder material on Scharoun. He has the plan of Häring's flats at the Siemensstadt and a very good detail of the room partitioning of Mies' flats, at the Weisenhofsiedlung.

One mysterious omission is all Mies' apartment house work in the United States.

It has good drawings of Kikutake's flats between Tokyo and Yokohama—probably that architect's best work yet—which should be compared to Harumi (which does not appear in this book in any detail).

It is still, however, a strange book which one cannot imagine wanting to own.

Waldo Camini

High density living

Rolf Jensen. Leonard Hill.

Professor Jensen has written, or rather collated, a book on a subject full of new thoughts, and inevitably it already wears an archaic air.

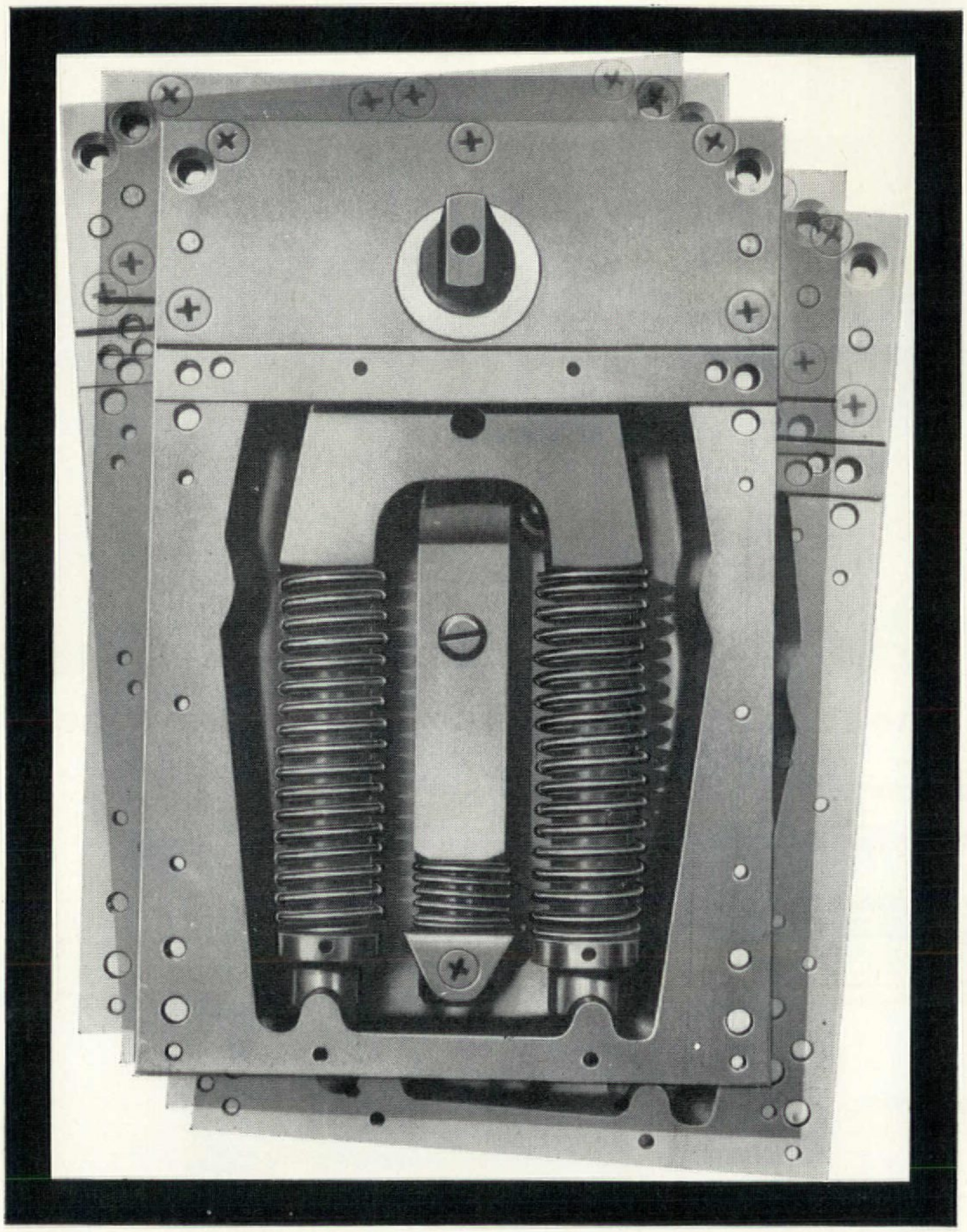
The book is not about high density living at all, as it is now discussed, but a collection of flat blocks in the usual format, giving the moderate densities considered suitable for the masses by well-Whitticked local authorities. The densities illustrated are generally 100 ppa, and few make any pretension to the business of living. They are simply apartment blocks, always in isolation and their interest is a simple formal one. There are no attempts to explore alternatives to the tower block or slab, and the pictures amply illustrate the thorough inadequacy, visually and socially, of this partial and banal solution.

The few schemes that tentatively explore the real problems Golden Lane, Park Hill, Barbican are quite unrecognized in the text, and are happily jumbled in with Picton Street and Jensen's own disasters in Paddington. There is an index, and significantly no bibliography.

Theo Crosby

▷Readers' Service Card

P. Hoftyzer



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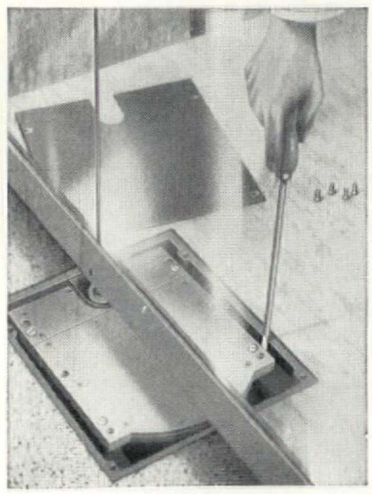

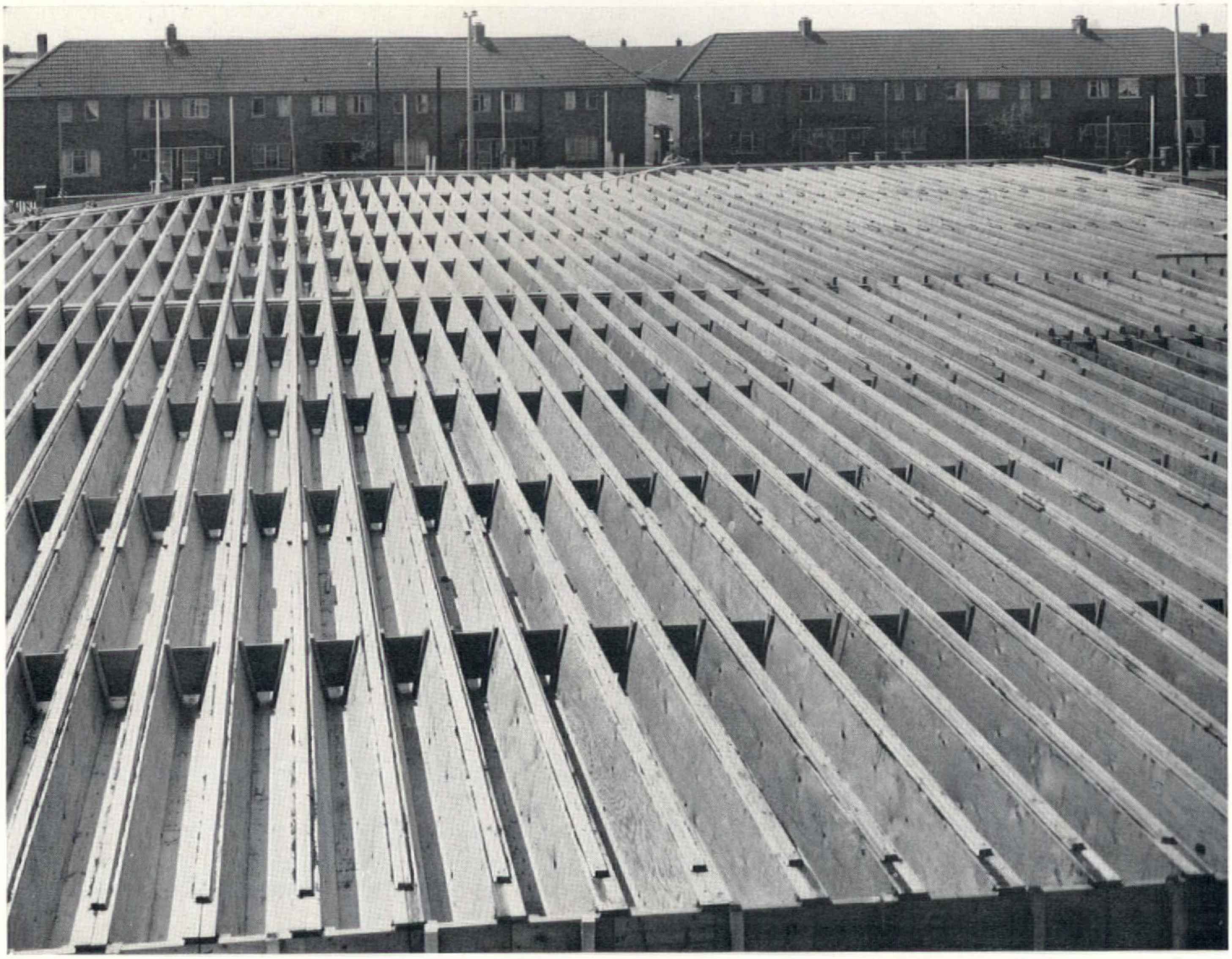

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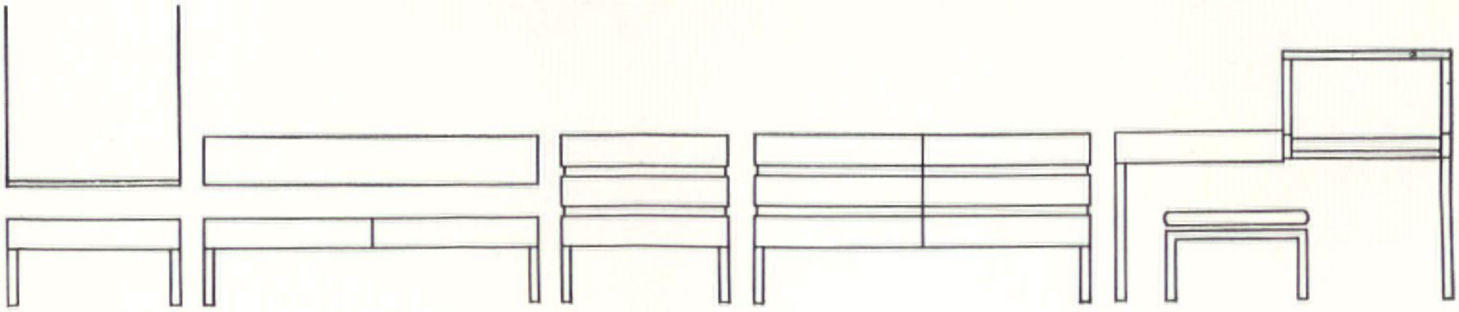

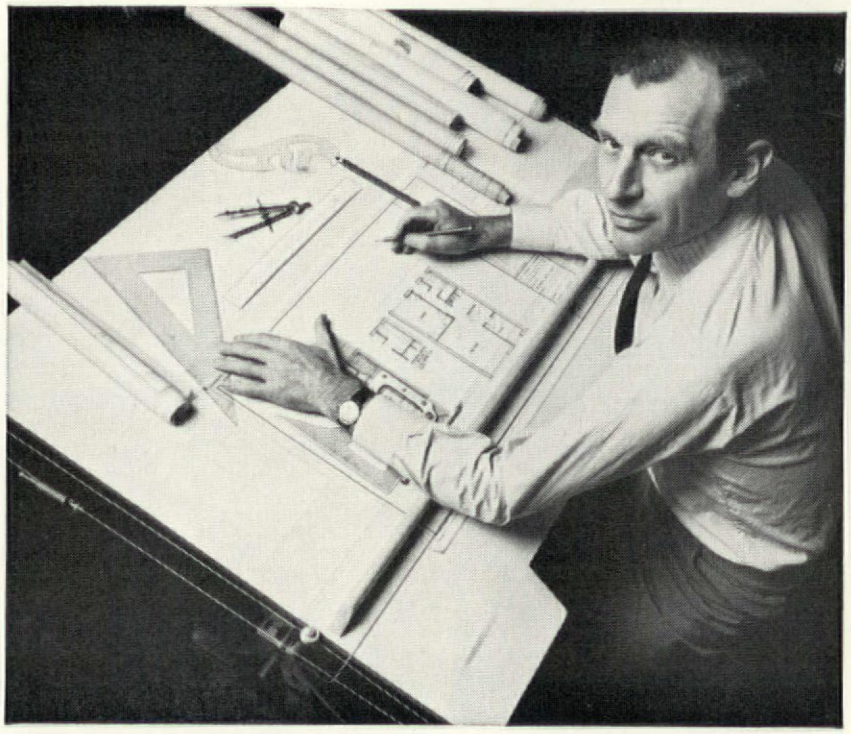

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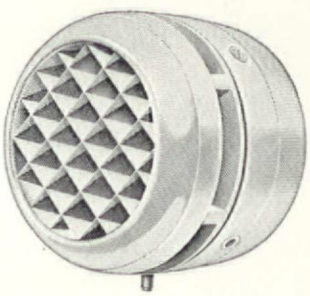

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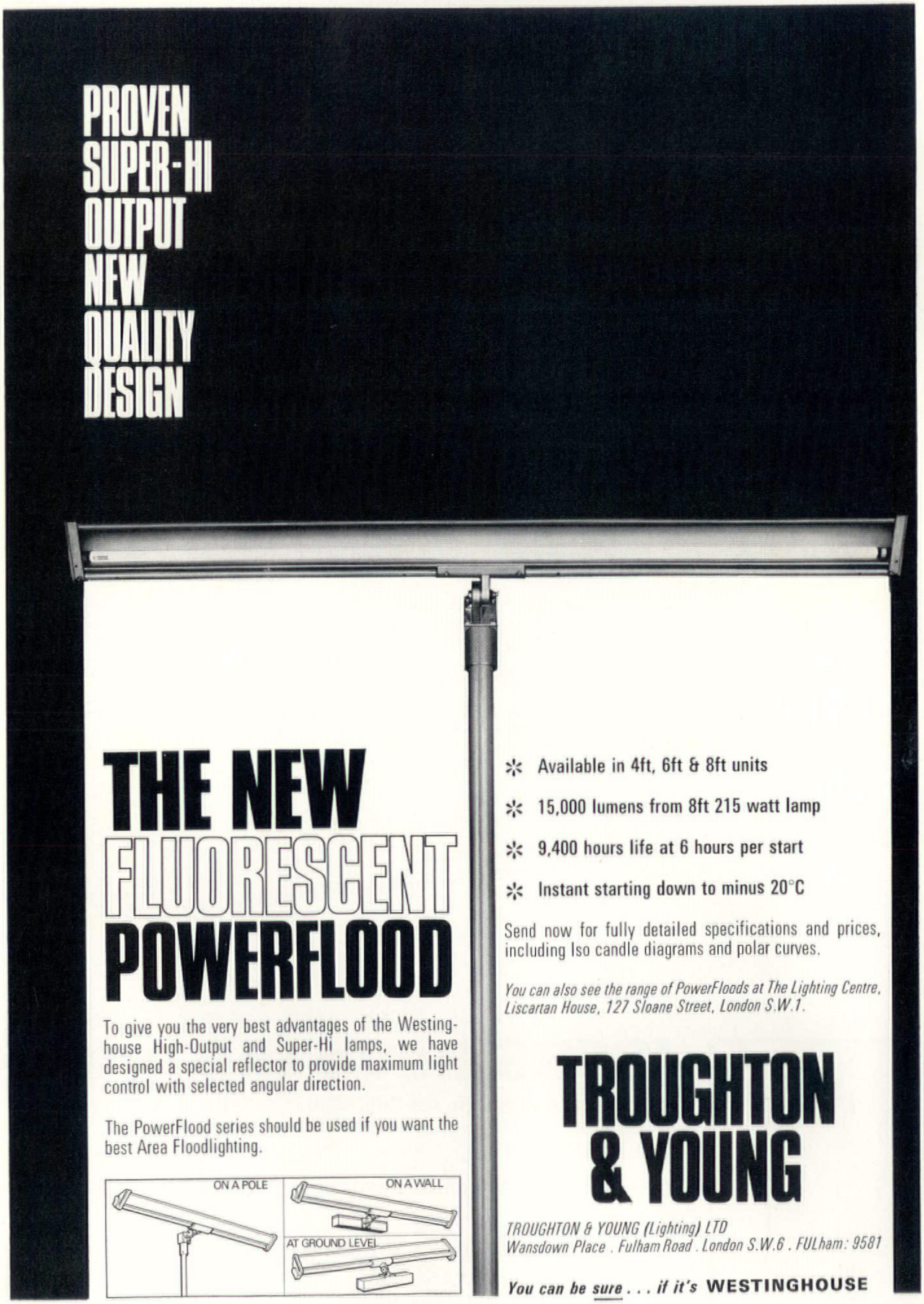

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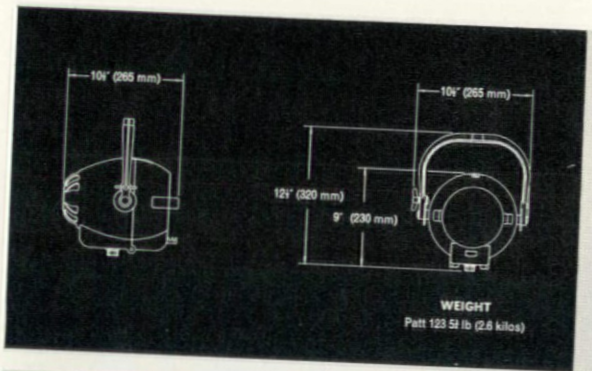
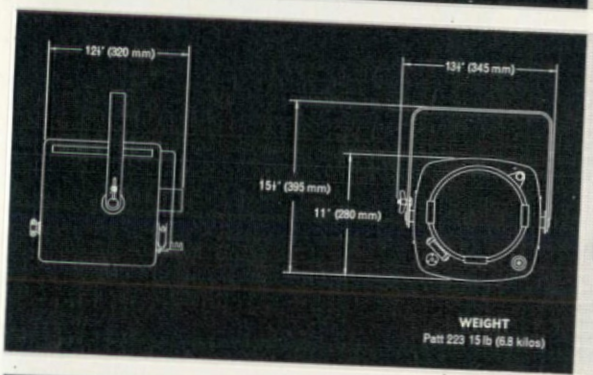


500 watt

Patt. 123. Baby Fresnel Spot

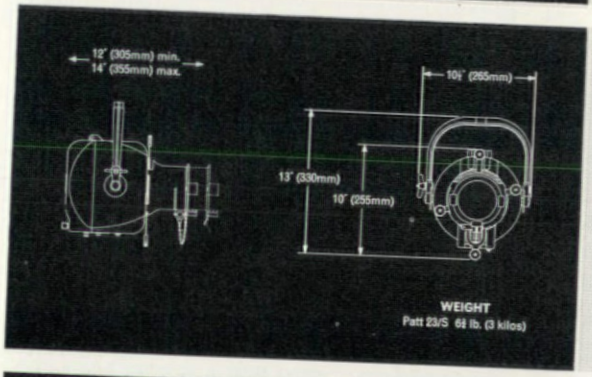
Soft edge beam — spread adjustable from 15° to 45°.



1000 watt

Patt. 223. Standard Fresnel Spot

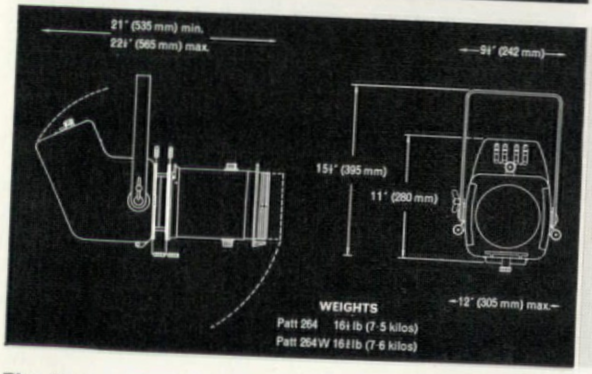
Soft edge beam — spread adjustable from 15° to 55°.



500 watt

Patt. 23/S. Baby Profile Spot

Gate with four separately adjustable shutters and runners for special masks. Lens variants give 11°, 22°, 30° & 37° maximum beam.



1000 watt

Patt. 263. Standard Profile Spot

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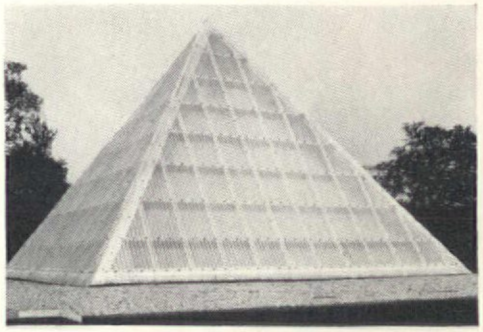
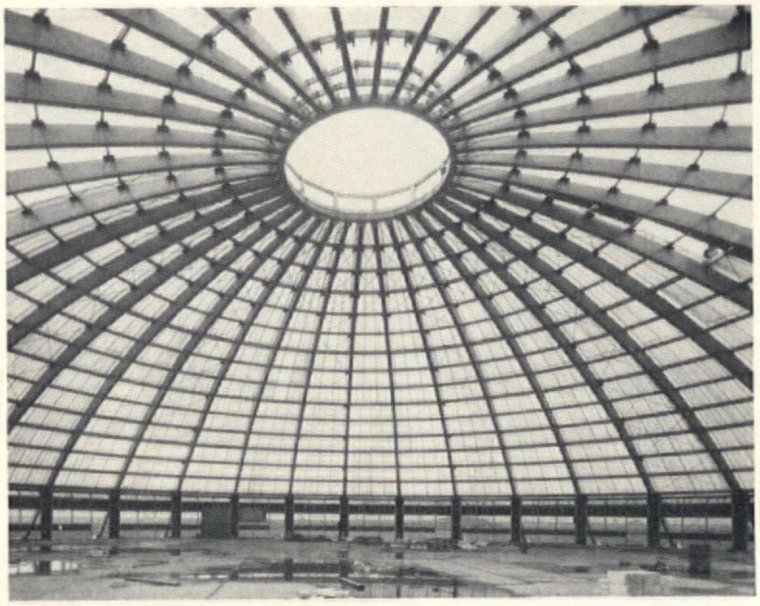


Free Flight Hall, Aberdeen Zoo.
Architects: Aberdeen Corporation Architects Department

William Hulme Grammar School, Manchester
Designed and constructed by Clearspan Ltd



Wharrier St. Sports Dome Newcastle upon Tyne
Architects: Williamson, Faulkner, Brown and Partners.

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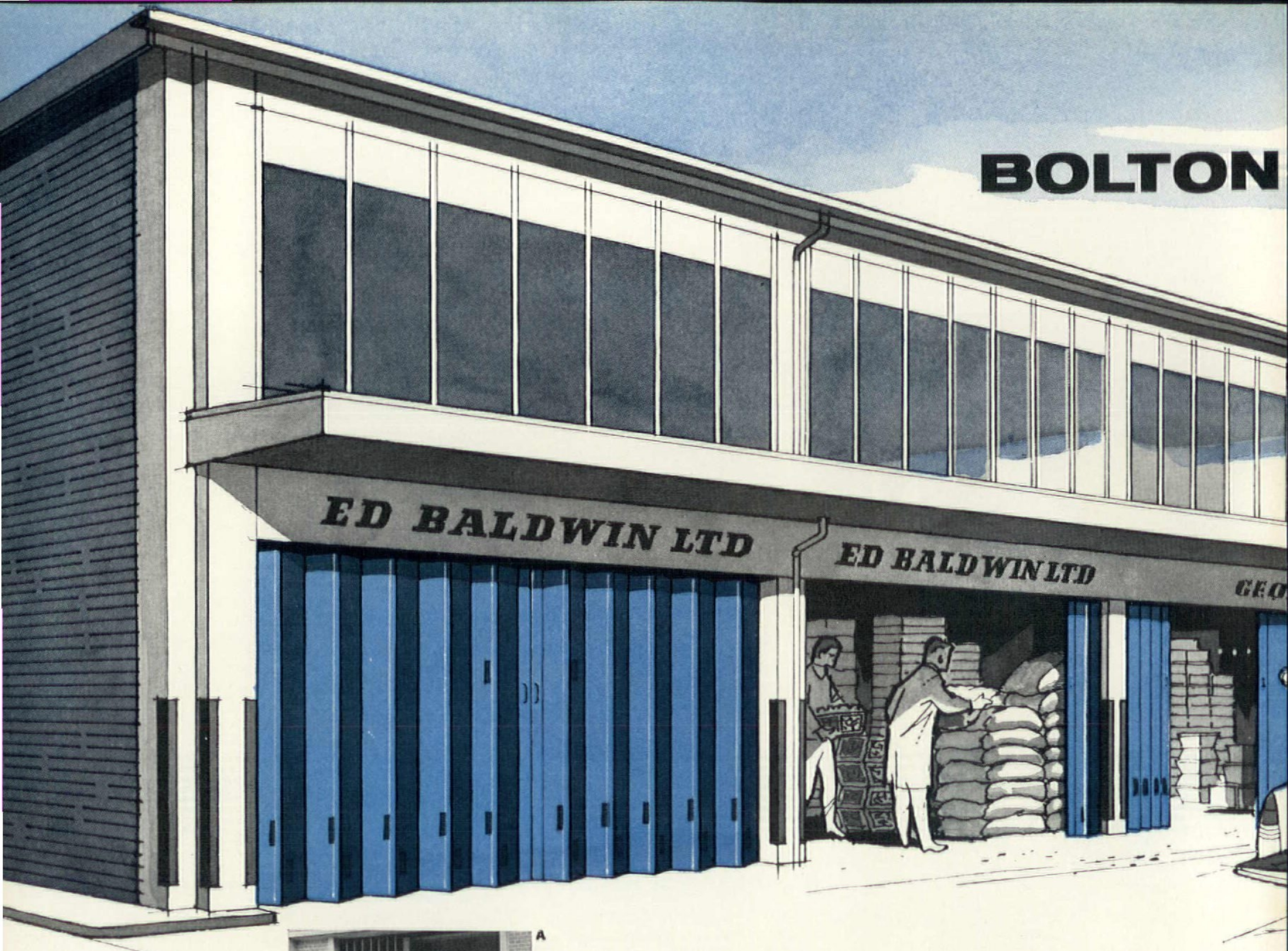

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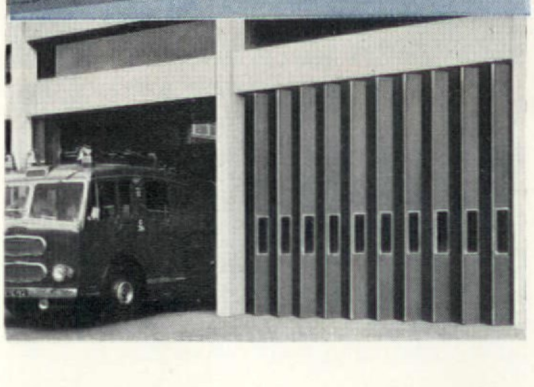

C

A *A factory installation of Bolton photo-cell controlled Shutter Doors.*

B *Bolton Shutter Doors installed in BEA Freight sheds, N. Ireland.*

C *Bolton Electrically operated Shutter Doors at Shoreditch Fire Station.*
Architects: Architect to the Greater London Council, Hubert Bennett, F.R.I.B.A.

This isometric drawing shows the ideal fixing for Bolton Shutter Doors. Suspending the box track from the inside face of the lintel allows the doors to bunch clear of the opening by folding behind the walls. The cover plate (3) and the end panels (4) make the installation draught-resisting.

1. Welded mild steel suspension bracket.
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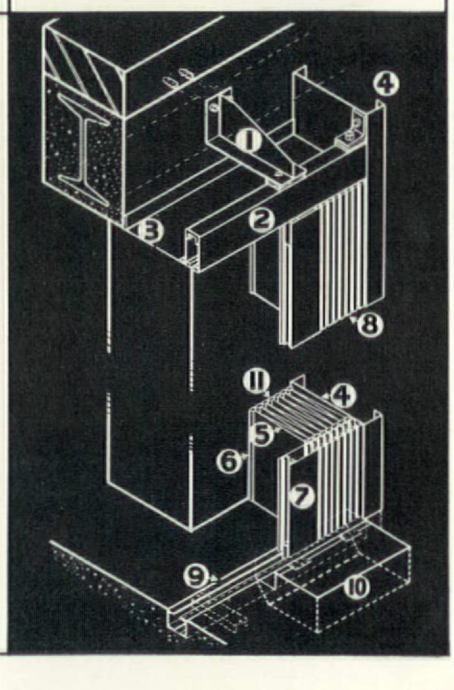
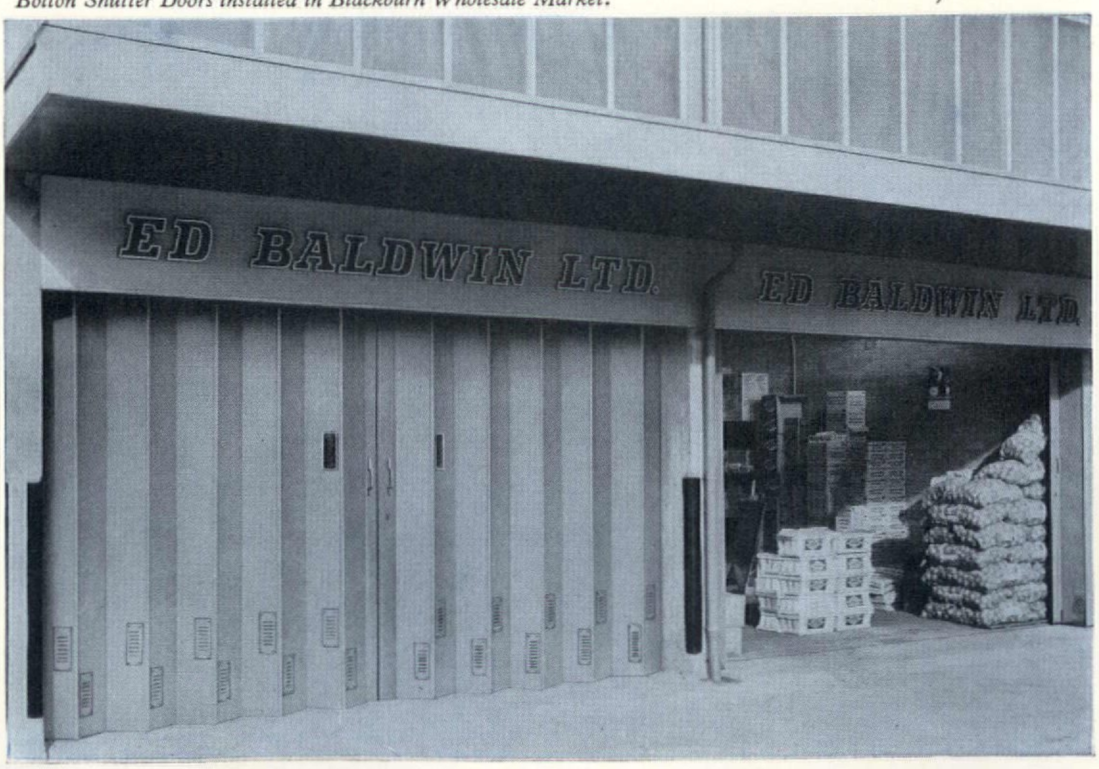
6. Non-ferrous hinging strip.
7. Rigid front to accommodate locking arrangement.
8. Steel pickets on which the door is built.
9. Self-cleaning bottom track, built up from rolled steel channels.
10. Mild steel sump-box with hinged lid to facilitate cleaning out.
11. Shutter leaves rolled round $\frac{1}{8}''$ (3.2 mm.) diameter wire reinforcement to give great vertical strength.



SHUTTER DOORS ARE BUILT TO LEAD A BUSY LIFE - AND LAST!

Bolton Shutter Doors installed in Blackburn Wholesale Market.



Fruit market .... fire station .... freight sheds .... factory .... four typically busy situations for which Bolton Shutter Doors have been selected. In some of these they will have to withstand rough, heavy usage - they're built to! In others they must provide instantly easy operation - they're designed to! The basic reasons why Bolton Shutter Doors satisfy so many needs are shown in the detail drawing. There are many variations - from standard sizes to purpose built doors accommodating overhead cranage or other special requirements. Sherardising is the standard finish: you can also have Stelvetite leaves or cellulosed leaves and they can all be fitted with vision panels up to 2′ 6″ deep. Bolton Shutter Doors can be power operated, and control methods vary from simple push button to remote radio.

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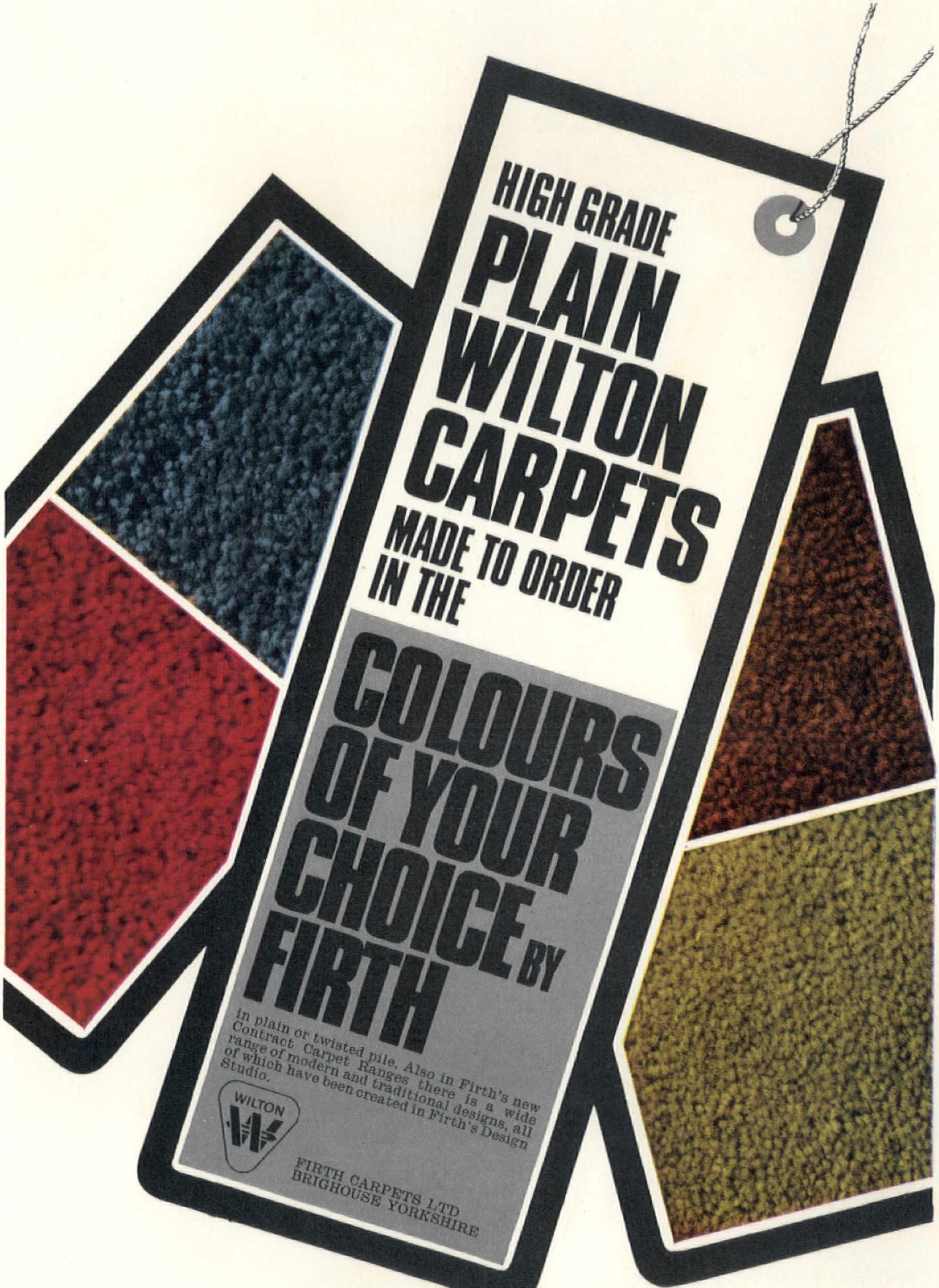
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The Editor would like to know of a London-based architect who speaks fluent German but whose mother tongue is English, who would undertake occasionally to translate technical articles from German into good English for publication in *AD*.

Cosmorama

The month in Britain

Michael Manser

A report entitled *The Municipal Surveyor & his Office* revealed that less than half the principal building control officers in the country are professionally qualified, and this was no surprise to anyone. Even more indefensible is the aesthetic control still wielded by lay planning committees. It is one thing for the blind to lead the blind but quite another for the blind to lead the sighted; and to drive the point home, Bath City Council rejected a Robert Matthew & Partners building on an Abbey adjacent site. Sir Donald Gibson proposed new cities instead of new towns and had a vision of a new hovercraft-served London Airport made of concrete surfaced, expanded polystyrene, floating on the Thames estuary mud flats.

The Association of Industrialized Building Component Manufacturers Limited commissioned Hutton and Rostron to prepare a report on a components catalogue. Two hundred and sixty products were submitted to the Council of Industrial Design for the 1967 Capital Goods Awards, and the RIBA discourse was announced for 4th April next to be given by Norwegian Professor Christian Norberg Schulz on *Expression in Architecture*. July 17th to 20th has been selected for a conference on *Roads in the Landscape* at the University of Keele.

Archigram Group are currently invading Oxford's Museum of Modern Art, the Scottish Hospital Centre at Edinburgh have an exhibition on *Outpatient Departments* until March 24th; Exeter University is having an Arts festival until March 17th, and on March 14th a talk at the RIBA will be entitled *The Building Regulations 1965: an impediment to Design and Production?*

The AA offer a study tour to Morocco (May 18th to 28th), and the Concrete Society offer a study tour to India, Hong Kong and Japan (Oct 26th to Nov 12th). Cost £550–600.

Mr Callaghan said mortgages would be easier.

Another nasty Embassy from the MoPBW was revealed to disgrace us in Athens: what about the competition system? Agreement was sought at the RIBA for British, Canadian and American architects to practise in each other's countries. And the RIBA was also the venue for a confrontation by BR planners and preservationists on the future of St Pancras Station.

Stocks of unsold bricks rose by more than 96 million, but rumours that price levels of housing eligible for subsidy have been cut below those attainable by 'systems' may swing us back to another brick famine.

Hooray for the ill wind! Coventry Council battled to preserve a contemporary building of architectural quality, Jane Jacobs condemned 'dead-end planning', and the corpse of Holford's Piccadilly was re-examined.

The Minister, Mrs Barbara Castle, hand-picked a group of architects to keep her urban transport research programme in close touch with the latest thinking on urban design: Colin Buchanan (naturally), Andrew Darbyshire, Terence Gregory, Arthur Ling, Richard Llewellyn-Davies, Brian Richards and Hugh Wilson.

To keep up with the piratical times we live in, and after the success of their tear gas and ammonia-proof communication window, Messrs Starkie Gardner launched a bullet-resisting version.

Deaths

Raymond Wilson, who determined to think his way beyond the image of Industrialized Building to provide a fundamental theory for its design and application, died on February 17th, aged no more than 27. He worked on the MoHLG heart units and the initial IBIS system.

The Russian-born engineer *Vladimir Bodiansky*, long-time collaborator of Le Corbusier, Beaudouin and Lods, and founder of ATBAT, died in Paris last December (see *AD* 1/65, p. 25).

SFI building system

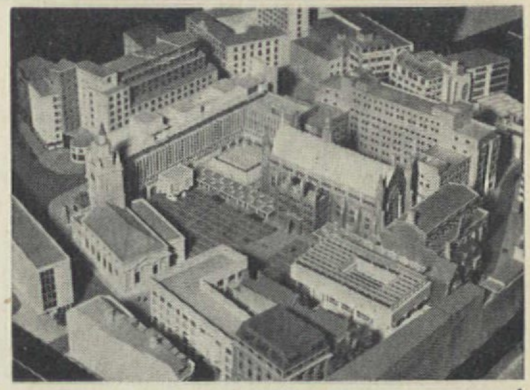
J. W. Davidson, author of the feature on page 138, is himself the architect of the buildings described. The International Conference of Steel Information Centres at which he will be presenting his paper, is to take place at ESSEN (not Essex as misprinted in our footnote).

Redevelopment of Guildhall precinct 1

Hermione Hobhouse

Sir Giles Scott, Son & Partner have put forward a £5½ million scheme for the reconstruction of the Guildhall precinct which has now been accepted by the Common Council of the City. Design requirements are complicated since accommodation is needed not only for the usual administration of an area like the City of London—Council chamber, offices, courts, library and archive space—but also for the entertainment of the Sovereign and visiting Heads of State. This last has conditioned the treatment of Guildhall Yard. Setting-down space and the necessity of getting VIPs under cover from their cars to the reception area has dictated a long glass and concrete ambulatory screening the front of Guildhall, with the exception of the Dance porch, which is to be cleaned and restored. The Yard is to be cleared so as to create an intimate precinct, and care has been taken to set the new buildings back so that Guildhall is not dominated by higher buildings (as it is by the same architects' 1954 block to the north). Sir Horace Jones' Gothic Library is to become the Council Chamber and a reception area. A new library will be built west of Guildhall linking it to the new offices in Aldermanbury. The courts now housed in Dance's 1790 Justice Room are to be moved to a new building on Gresham Street, and to facilitate this the architects plan to demolish the Regency Irish Chamber.

The architects report that Guildhall is considered to be one of England's 'finest secular medieval buildings', an interesting statement in view of the fact it was burnt down in 1666, restored within and without by Wren, added to by Dance, restored again by Sir Horace Jones, and reconstructed by this very firm after the Blitz. It is, however, an historic group of buildings whose charm lies in their relationship—individually undistinguished. They are together, more effective than the restoration of the area designed to show one aspect only of architectural history. For this reason, it is a pity that the plan includes demolition of the Irish Chamber, a building less undistinguished than Scott's post-war office block.



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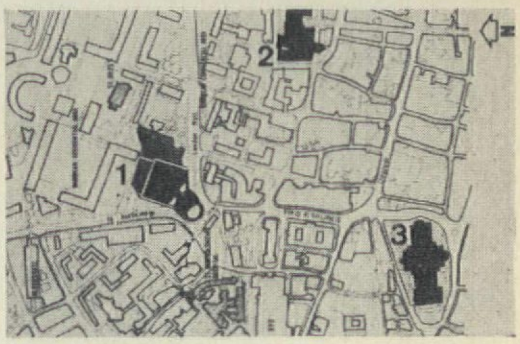
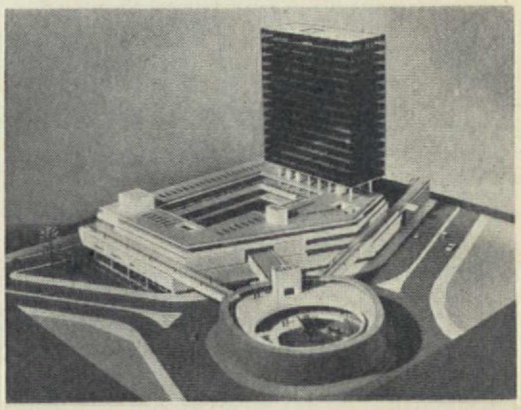


Plan of the area showing: 1 the new Museum of London, 2 the Guildhall, 3 St Pauls Cathedral

Museum of London 3

A new museum is proposed on a site at present occupied by Ironmongers' Hall at the junction of London Wall and Aldersgate Street (the SW corner of the Barbican). To be called the Museum of London, it will combine the collections of the London Museum and the Guildhall Museum (both currently in temporary accommodation), and will be administered by a Board of Governors constituted in 1965 representing the Cabinet, the GLC and the Corporation of London.

Powell & Moya were appointed to design the Museum premises and a surmounting 14-storey office tower to relate to the other curtain-walled office towers lining the Barbican's south boundary. The scheme which they presented for approval last month to the County Common Council of the City of London consists of a three-storey museum presenting a white, mosaic-clad, blank concrete face to the outside, with a contrasting, tinted glass tower above. All access to the museum is by a raised walkway from a fort-like island rotunda. Even visitors arriving by car have to use the rotunda's lift to reach its upper level which also connects with the raised pedestrian network of the whole Barbican development.



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The museum is developed round a central garden, not only so as to turn its back on the outside world, but also because it was felt that visitors suffer far less museum fatigue, in the sense of being cut off from that outside world, if they are given views into a central court, thereby retaining a sense of locality. Visitors to the rotunda's restaurants, below the museum entrance level, will also have the pleasure of looking into a pleasant garden.

Competitions

House

Britain's best designed family house, to cost no more than £3750, exclusive of site costs, is sought in a competition organized by Thermalite Ytong Ltd.

First prize 500 guineas; second and third prizes 250 guineas and 150 guineas respectively.

The closing date for the competition is May 31st, 1967. Particulars from Thermalite Ytong Ltd, Hams Hall, Lea Marston, Sutton Coldfield, Warwicks.

Wood

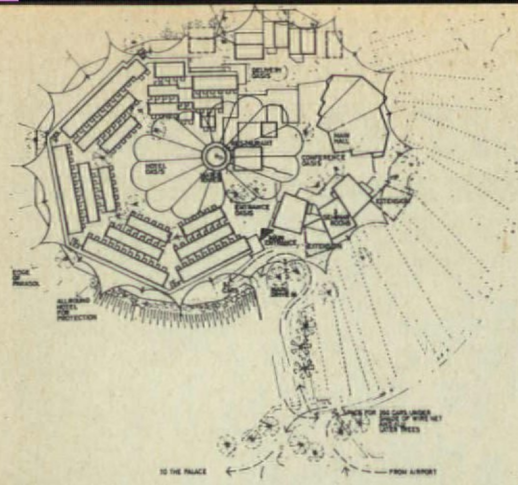
United Africa Co (Timber) Ltd are offering a first prize of £100 and other prizes, for functional designs using woods. Prizes are £100, £50 and £25. Closing date June 30th, 1967. Details from UACO, Shelley House, 3 Noble Street, London, EC2.

Open 100

This is the title given to an exhibition of one hundred works to be selected in a competition open to all artists working in the United Kingdom and Eire and exhibited during the 1967 Edinburgh Festival. It is to be organized by The Richard Demarco Gallery in association with the University of Edinburgh.

Prizes totaling over £4000 will be awarded (including three of £1000 each).

Details from Exhibition Secretary Dr Jean Russell, 8 Melville Crescent, Edinburgh 3.



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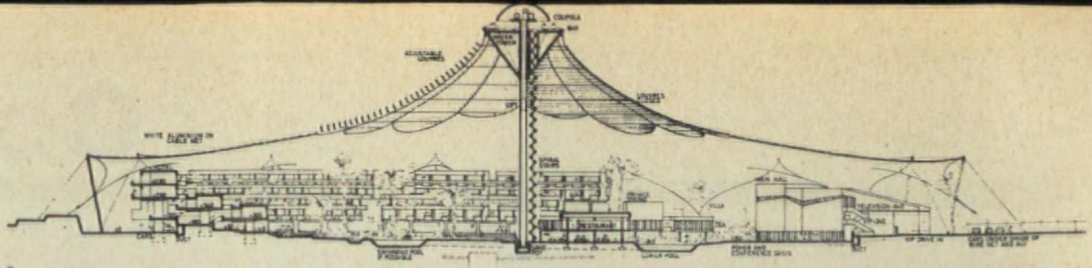

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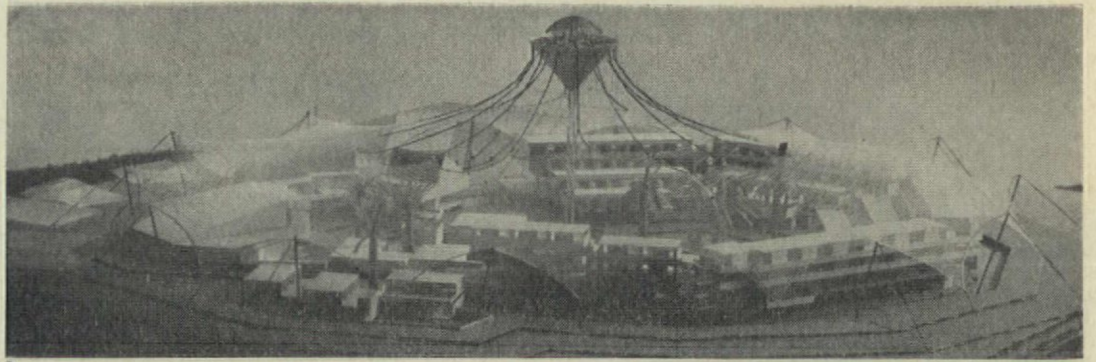

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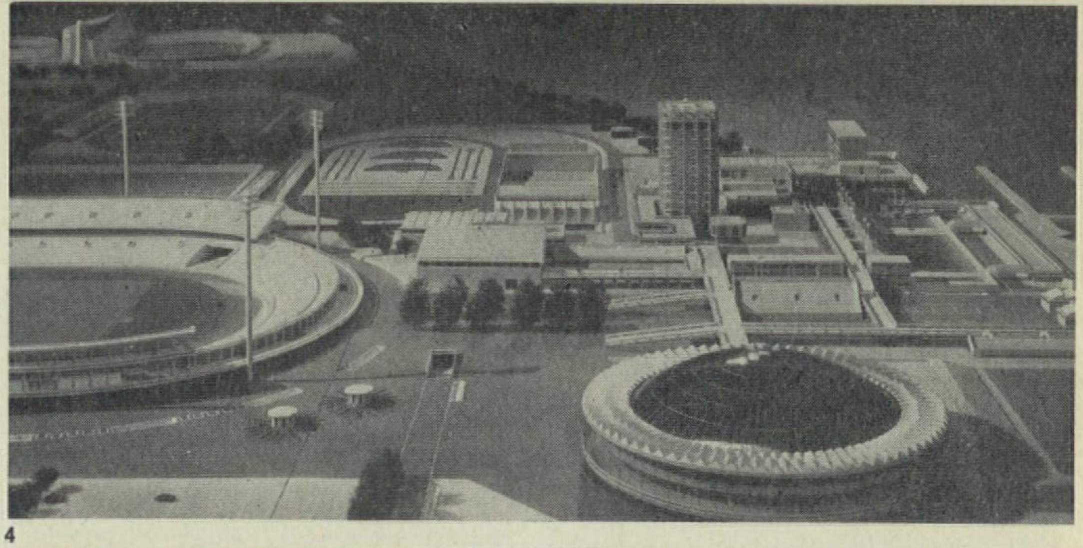

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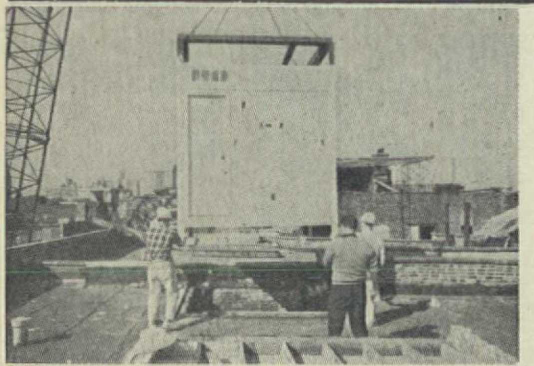
The architecture of politics

Architecture is already being invoked as an aid in the internecine skirmishes of the Arab states. Prestige, it seems, can still be bought with a building. Bright and flashy hotels and, of course, a mammoth casino have established Beirut as a centre of special significance. But earnestness of intent to wield power cannot be left to reside in hotels—however comfortable they are. Conference centres, sports centres and universities are now planned for the most unlikely places. Soon cultural centres too will be springing up in the deserts (not much talk yet of housing, though it is fair to note that several years back Doxiadis Associates did build two large schemes for Iraq).

Trevor Dannatt's winning design for the conference centre at Riyadh is illustrated on page 135 of this issue, Frei Otto and Rolf Gutbrod's runner up is shown here **1, 2, 3.** A tent in the desert seems almost too ludicrously appropriate a design—one can well imagine why the assessor demurred—but the design is not to be discarded. Otto and Gutbrod are to prepare a variant for construction in Mecca itself.

Meanwhile in Libya **4**, not to be outdone by Jordan (see *AD*, Oct. 1966), two sports cities, costing £12 million each, are now being built, 600 miles apart at Tripoli and Benghazi, for the 1969 Pan Arab Games. The designs are by Munce and Kennedy, who were commissioned over three years ago. Each city measures roughly a mile by a half-mile and has almost identical facilities.



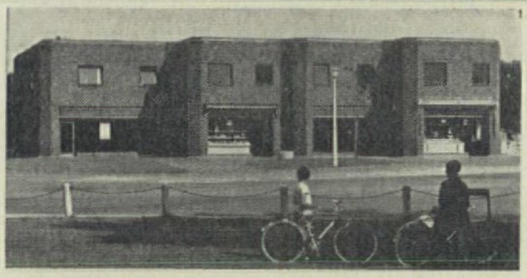
Rehabilitation in Harlem

Two and a half million people live in Harlem. It has been estimated that if all Manhattan Island were as densely populated as Harlem, the population of the whole of the United States could be housed there. Very few buildings in Harlem are over six storeys. The density and overcrowding is terrible. Federal Housing Administration, faced with the problem of replacing the 870,000 odd apartments in the area or making the existing slums habitable, determined, both on economic grounds and to avoid disruption of communities and families, to rehabilitate the late nineteenth century buildings. Their structure, fortunately—or perhaps unfortunately—was sound. The T. Y. Lin organization put forward a proposal for cutting a hole through existing buildings and inserting a prefabricated core. The total time for conversion of a flat is 48 hours.

AIA Journal January 1967; *Engineering News*, January 1967.

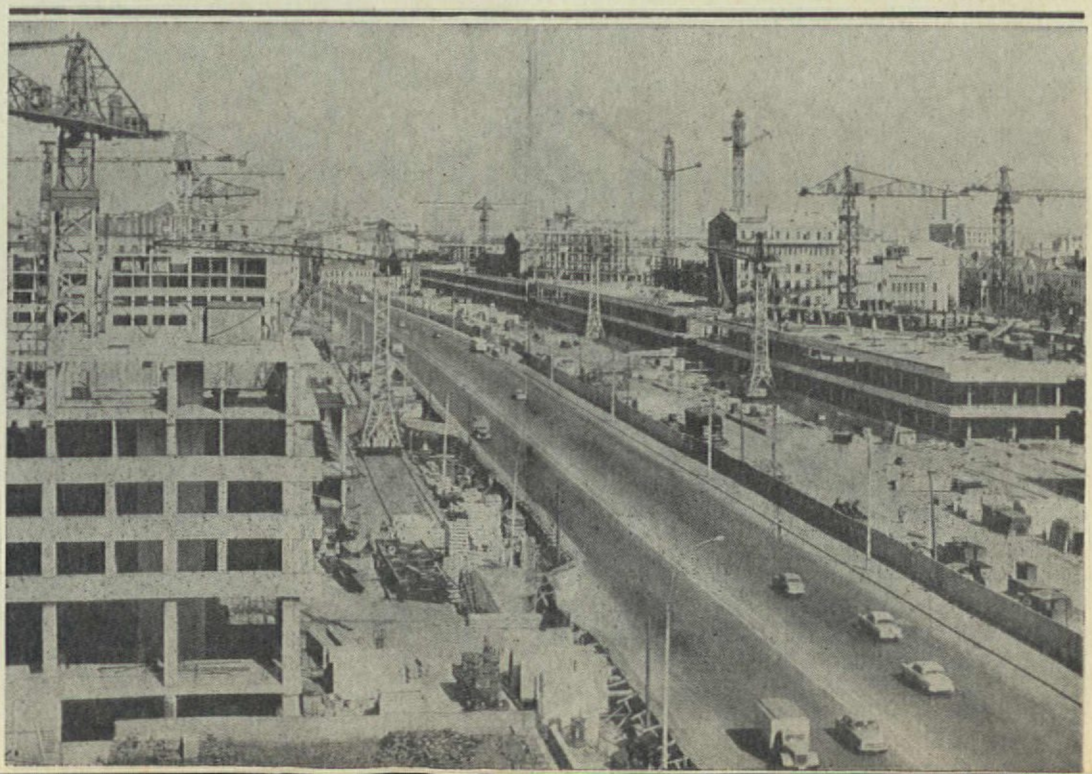
Rehousing in Moscow

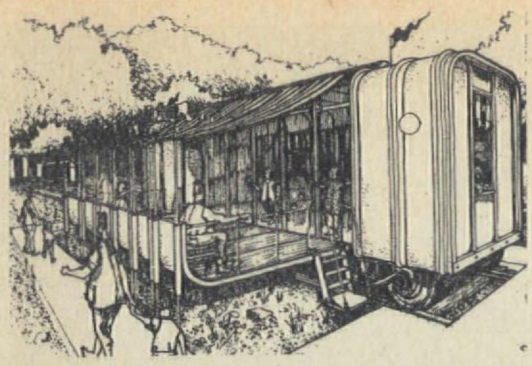
The Moscow solution to rehousing (see *AD*, Nov. 1966) is more drastic, and no less dramatic—one and a half million new dwellings between now and 1980, which demands the plethora of cranes seen on the right.

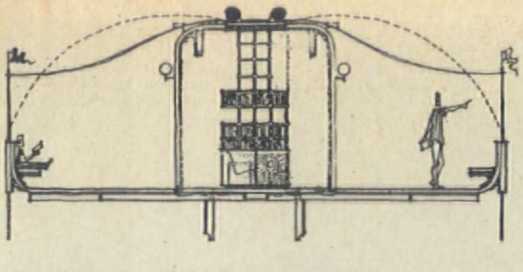


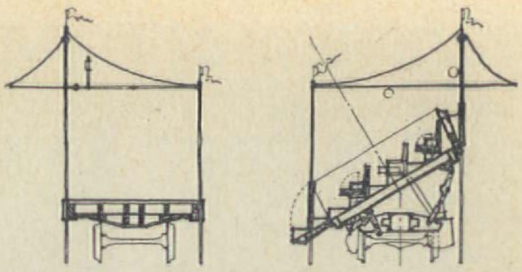
Groovy Toovey

Considerable local opposition preceded the building of five shops on the village green at Cholsey, Buckinghamshire (architect John Toovey). The scheme originally included three terraces of twenty houses, but the land was sold and 'developed'. There are now only the three flats above the shops with access from rear service yard. Although the siting and landscaping are reminiscent of pre-war round-about planning, the design is much dignified by ignoring the hysterical patterns and details that village infill usually spews out to silence disgruntled parishioners.





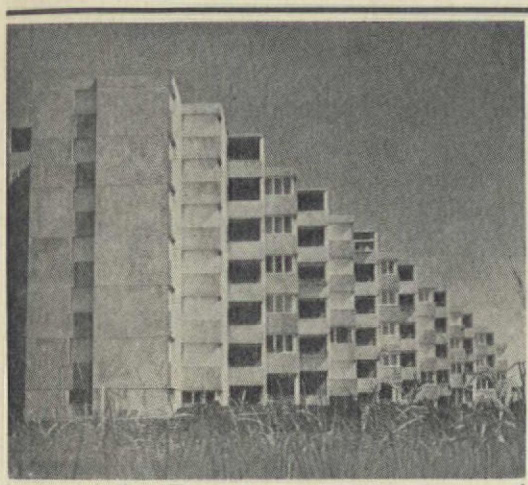




A railroad with a fringe on top

A proposal for using up not only old railway lines but also old railway carriages has been made by Earl Ferguson, a designer from Appalachia, one of the more remote and impoverished regions of the United States. Thirteen old railway trucks, sliced up, hinged and refitted and bedecked with awnings and flags are offered as an itinerant community centre. Sooner or later Lavengro comes to town.

Interiors, November 1966



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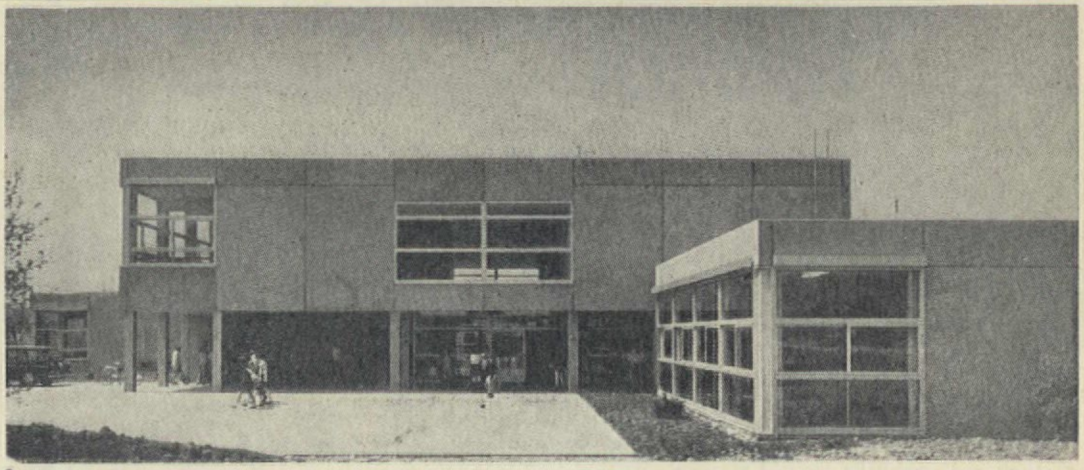

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Industrielles Bauen

Raymond Wilson

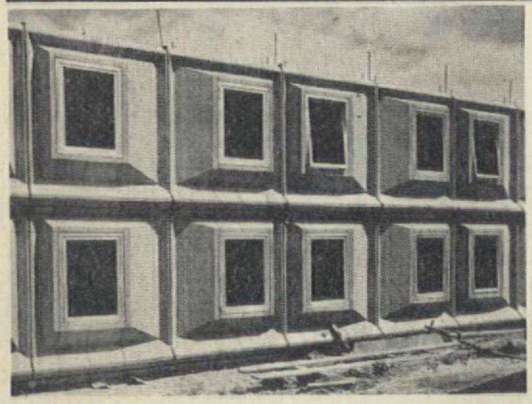
It is curious that a magazine like *Bauen+Wohnen* (November 1966) should devote an issue to argue enthusiastically the case of Prefabrication. The argument runs something like this: we are in a period of transition (*perceptive*), we can achieve savings in time and cost with 'P' (*wow*), objections against (*whose?*) 'P' should be confronted with ye olde prefab component the Tile (*earthy*), it is only a question of scale (*too easy*). Curious, because of the occasional appearance of the magic password 'industrialized'.

Wisely the systems are not shown, we have seen all that, only the built results—among others, housing at Grüzefeld, Winterthur by Atelier CJP **1**, and a school at Neckarweilhingen by Gunter Behnisch and Horst Bidlingmaier **2**, which prove emphatically that buildings that use prefab bits look just as good (*or bad*) as ones that don't. That's the point. Buildings have been prefabed in part or whole for thousands of years. In medieval days whole three-storey wall sections were prefabed miles up the Thames and shipped to London. The scale of components that make up the all-time prefabs, the Pyramids of the Nile, was hardly mean. But books have been written about P. Lets not get worked up about the Waltz and the Tango. (And all along I thought that they might be overtaking us there in Europe.)

Industrialization is something to do with factories, and of course one prefabs things in factories. But, with concrete, as soon as the scale of the elements gets large, it is more sensible (*and economical*) to set up the so-called factory on the site. 'So-called' because the operations involved couldn't be further from those we associate with the modern industrial process. The designer and builder need obey no more than the most rudimentary of constraints. The rules of P are grotesquely simple, and can anyway be broken as often as anyone wishes, hardly the case with the modern assembly line. An integral aspect of 'I' is quantity.

The *B+W* issue is merely the European manifestation of what happened five years ago here (*squeaks from the US even?*) when that swinging word 'I' arrived, two hundred years late, on the building scene. Today there is hardly an architect not working on IB (*or at least prefab, or at least tiles and bricks*), hardly a student without a thesis on IB (*or at least quick quotes from Gropius*), hardly a builder without an 'I' system (*or at least a predjudiced 'way' of putting things together*). And yet with all these devotees to IB in this country only three firms completed more than a thousand dwellings in the first half of last year—Wimpey No-fines, Easiform and Bison Wall Frame.

So much for IB. There is a curious point in any culture when people engaged in building things by certain methods (*including prefabrication*) suddenly carry on in exactly the same way, at the same speed, and with the same output, but calling it IB—Industrielles Bauen, Construction Industrielle, etc.—instead. The trouble is (*or who's fooling who*) that the end result even looks the same.



Decoration

Raymond Wilson

Despite the lengthy moral debates on the subject the amount of decoration in building has fluctuated with the simple economics of fabrication. Where decoration can be thrown in without reducing the performance or raising the price it has always flourished despite design doctrine. Moulds are one such situation and cast iron ornamentation the result. The ingredients are heavy material and a malleable mould. Concrete is heavy, but with steel or timber moulds economics do not favour decoration—timber patterns excepted. Reinforced plastic moulds were used to obtain the striated patterning and sharp relief of this Aldershot building designed by Building Design Partnership for MoPB&W. Moulds designed by G80 Developments.

Mobile theatre

In September 1966 Sean Kenny was commissioned by the Welsh Committee of the Arts Council to prepare a feasibility study for a mobile touring theatre for Wales. Four months later, having inspected likely sites, discussed the matter with interested organizations in Wales and consulted specialists all over, he produced a report and a design. It is proposed that the theatre would be transported in five articulated trucks; a toilet and bar unit, a dressing room unit, a seating unit, a roof unit and a stage unit. In addition there would be a generator van and a company coach. The roof and walls of the theatre (in part the inspiration of Colin Grant) would be formed of an 80ft diameter shell of aluminium—stressed skin aluminium with a light-weight insulating core of expanded plastic or balsa as in aircraft construction. The whole, erected hydraulically, could be made ready by a team of five men, eight hours after arrival. The stage, 40 × 23ft, includes a revolve unit and elevators or traps. The theatre would normally seat 350, though alternative arrangements of seats would vary this total. Cost is estimated as £125,000, with an annual running cost of £100,000.

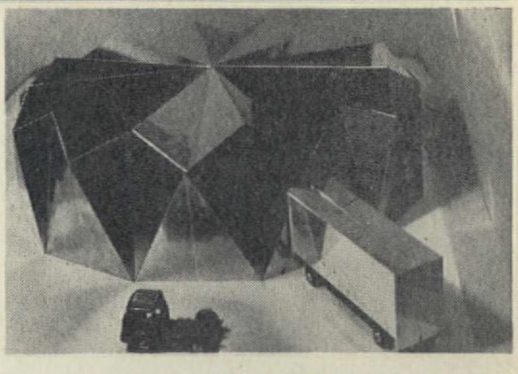
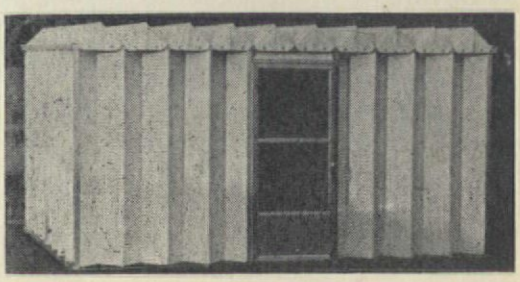


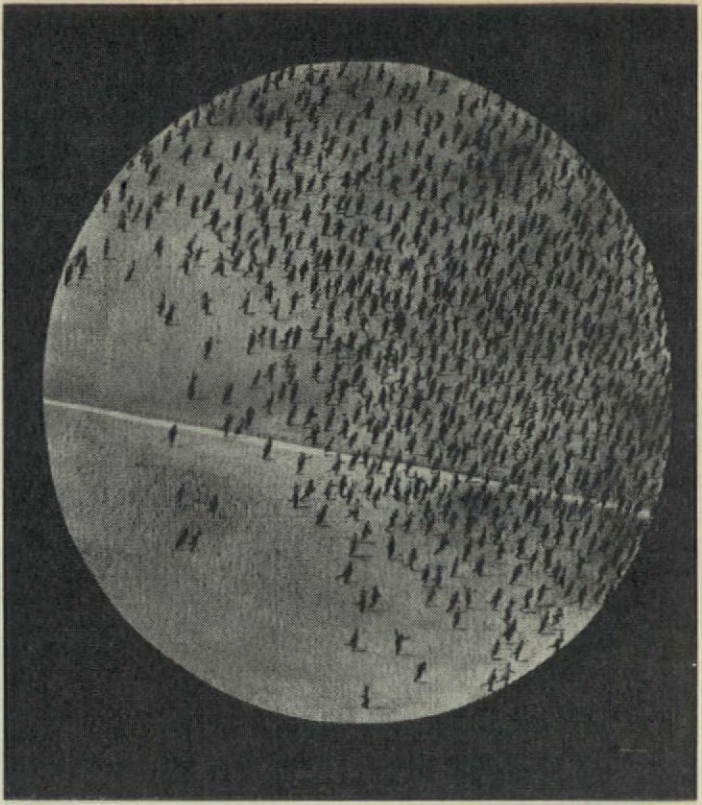
Photo Colin Grant

Low-cost structure

The Plydom (see *AD*, May 1966) is still being extended in usefulness by the architects first responsible for its application—Sim van der Ryn and Sanford Hirshen, who are now designing a collective sewage unit and other such essential services. The International Structures Corporation, the manufacturers, have produced another model, made as before of rigid urethane and Kraft board, but with a light steel frame, necessitated by the new, more conventional and more acceptable, shape. 10 × 20ft $425.



La protesta



Rebasando el limite

Genovés and the image of tragedy

Jasia Reichardt

The paintings of Juan Genovés (Marlborough Fine Art) are recognizably Spanish with an urgent sense of contingency, sombre colours, total lack of frivolity and an obsessive exploration of a single theme. In subject matter and its presentation, Genovés is so specific and exact that it may seem strange that the highly emotional content of his paintings is couched in such a rigidly devised structure. The paintings deal with tragedy and its inevitability, and the subject matter revolves around the hermetic relationship between the oppressor and the oppressed. This relationship is manifested through a narrative series of paintings, many of which represent the stages of an unfolding sequence with the canvas split up into separate areas. They seem to suggest a photographic reportage or the diagrammatic exposition of events. Yet it is the family album with photographs in sepia surrounded by emphatic borders that are evoked rather than a photographic press coverage.

What is particularly interesting about the work of Genovés is the way in which he has reduced his ambitious theme to a stylized and formal language. The oppressed are like the pattern of swarming bees crossing the white line which represents the frontier of a forbidden territory. The oppressor represented by soldiers in uniform is physically absent in some of the paintings, although his presence is only too clearly felt. Some of the narrative sequences are so subtle that it is difficult to realize what is happening. For instance, Genovés has done a number of watercolours where the sequence starts with a woman holding a child; during the next two stages one sees the figure of a soldier cutting across the image of the woman. In the last stage, the woman is still standing in the middle of the picture but the child has disappeared.

These works do not fit into the mainstream of figurative painting today. The images themselves and the way in which they are conceived and painted could have been done 50 years ago. This, however, is only one aspect of the work, because the way in which the paintings are fragmented and reassembled relates closely to the contemporary formalist trends. The combination of these two qualities—anachronism on the one hand and contemporary stylistic awareness on the other—make these paintings remarkably personal, and unlike anything else one has seen during the recent years.

Camping with Fred and James

(*See page 146*)

Cedric Price

The conventional service core demands radial development of serviced areas and requires centralized human access for mechanical control. The so-called 'heart' unit again makes the same demands on units. Thus the provision of 'plumbers' convenience' can generate a Miesian circulatory sequence of rectangulated serviced areas or the more rational circular Fuller plan. The very static nature of the services originally offered in 'core' units has encouraged subsequent additions to the centraloidal servicing kits of servicing gear which, in themselves, do not require central positioning. Indeed such thoughtless concentration has, in many cases, retarded the development of equipment systems (e.g. the domestic fuse-box).

The increase of real electro/mechanical servicing available to all has, of course, been ignored by most architects—a shelf for Braun's latest fall-out is usually considered enough. What if it isn't? Has the avoidance of concentration, domestically, of the increasing range of seemingly more mobile human service plant in fact both reduced their effectiveness and resultant freedom of serviced volumes? The centralized plant devised by Banham and Dallegret (*Art in America*, April '65, cf. Multi-directional projection core, *A.R.*, Feb. '65) takes advantage of the 365 bhp mobile General Motors kit and inflatable skins, while the Archigram robots take advantage of the previously developed 'plug-in' domestic volumetric discipline. Both offer mechanical extensions enabling further volumetric control and conditioning. However, the Archigram lot, by providing screens drawn from the robots start to combine both physical and mechanical volumetric control. Thus the robot could from a single, though not necessarily central, location, part pre-create the desired volume—'dial-your-home'. The drive-in house designed by Webb (*AD*, Nov. '66) provides in effect the ultimate control that the Archigram robot suggests. But there is a basic difference in these two schemes which is best shown by investigating the difference in the required megastructures. The Webb house requires a particular peripheral structural condition providing unit parking and thereby enabling enclosed variable volumetric arrangement. The Archigram robots use—not always too happily—the 'Archigram Traditional' plug-in megastructure with diagonal transit tubes and secondary variable but vertical pylons. Reference to the plan, i.e. the 2-D organization—the limitation of 'open' area—area into which the inflatable skins can expand, shows that the fixed diagonal megastructure will become the limiting factor to individual freedom. It is worth noting that once the individual drive-in owners wish to congregate, then a rather primitive rail and carriage grid-work is required which, while not demanding on economic grounds the same degree of 3-D restriction, still demands a structure unlikely to be structurally ideal—as it is suggested. Webb's Cushicle (*AD*, November 1966), a development of the drive-in house, provides another interesting comparison. The cushicle is offered as a method of reducing wastage caused by triplication of hard- and soft-ware goodies increasingly required in the auto, the town flat and the country fun-pad. Thus it emerges with a near-classic design pedigree—it does 'more with less' (Fuller). The Archigram robot, on the other hand, asks to be bought (cf. Lil Abner's Shmoos). The music nut manages five robots while he may still own only two cars.

The mobile cushicle provides a greater variety of immediate 3-D variation than the robot which, at this stage, has little control or concern with the potential of variable 'floor' and 'roof' conditions. The very fact that such terms can be associated with the robots and not the cushicles does in fact suggest that the former may well be most immediately relevant to the present condition where—at least in Western civilization—society is overstocked with under-privileged rectangular volumes. Again the robots accept controlled yet unused space (the human asleep still makes the greatest demand on horizontal stable space and the least demand on hardware) as an increasingly essential requirement of civilized man and not as a luxury—the cushicle does not and neither does the Calcutta pavement sleeper.

The concentrated development of the robots could through reducing the volumetric cost of additional enclosed space render the drive-in house obsolete only if the capacity to increase the availability of robots became economically viable.

In their present form—superman sized and with their name where their 'face' is—take advantage of the current size of their constituent units.

However, with increasing miniaturization—which in a way they encourage—their actual size will become unnecessary except as a storage stack for their screens, Perhaps these very screens, rigid, folding or post-tensioned have become too dimensionally demanding on the robots.

Perhaps these will provide the key to the Mark 2 robots —fragmented, miniaturized, dehumanized demanding neither formal recognition (robots) nor constant companionship (cushicles).

Dear Philip,

When you came last September to England, I was about to review your lushly illustrated monograph *Philip Johnson: architecture 1949–1965**. Now, having met you, I think the less said about it, the better. It is strictly a book for old friends—or clients. You did well to review it yourself for *Forum*.

This, of course, is one of the problems of encountering face to face, an object of despite. If someone is not exactly a monster you have to start making allowances for their fads and opinions. You have to practise tolerance. The difficulty becomes even more acute when you find that you positively like them. There is no possibility then of vilification. There is not even much chance of dispassionate criticism. All anger is stilled. So perhaps I should try to explain simply, why you are so often and so rudely dismissed in those off-the-cuff comments that appear in *AD*'s Cosmorama. Neither I myself, nor any other contributor, has a vendetta—though, re-reading some of the items, I am inclined to agree with you that they are unnecessarily nasty, not to say bitchy—it is simply that you appear infinitely more intelligent and articulate than most American spokesmen for architecture, that not only are you impassioned and wise on the subject of architecture but, distinguished amateur that you are (and I mean this in the best possible sense of the term) you have been able to influence not only a wealthy and cultured minority in New Canaan and New York, but a far greater range of art conscious hangers-on than you realize. In America you are an authority on architecture—whether you or other architects like it or not. You are an architectural power. You have to be taken seriously. It would be much easier of course, not to take you seriously. A busy, eclectic architect, a master of techniques, a detail-at-a-time genius, a scholarly romantic, a demolisher of all over-earnest beliefs, a scandalmonger, you raise delicious questions—are you in fact in earnest? a charlatan? a mountebank? a juggler?—that are the very stuff of which architectural magazines are made. You are good copy, even in *Fortune*. But this won't do. You are a devil's advocate. Even if you had built nothing, your ideals would have to be denounced as heresy. An Inquisition guarantees a purity of faith. However, you have built, prolifically and diffusely, houses, churches, universities and museums—all in a span of seventeen years, and these works speak for themselves. There is no need to resort to so bizarre an instrument as an Inquisition to judge you, I can look to your buildings—or rather the heavily coloured photographs of them that you have thought fit to publish.

Your early buildings are beautiful contrivances, your Glass House, I am sure, is an object still of pilgrimage. But then there are the post-Miesian designs, most of which I imagine, are unvisited by architects from abroad. What went wrong?

Most obviously, your style-mongering has proved upsetting. Your architecture is now an *exercise de style*. If you see something and admire it, at once it has to be assimilated and subordinated to your own idea of formal, classical completeness. You respond to beauty with a Beaux Arts zest. Few architects since the nineteenth century have made such a prolonged, laborious and fruitful study of the works of their predecessors. You have indulged in scholarly reminiscing from Mayan steps, from the Mosque of Sultan Hassan in Cairo, from the temples of Ancient Greece, through the buildings of the Renaissance and the Baroque, the eighteenth century and beyond. I suspect that you like best that period of early nineteenth century neo-classicism when the revolutionary phase was over and the style was being adapted by polished manipulators. But nothing has been too insignificant to add to your already overflowing stock of resources. Mirrors are borrowed from the Soane museum, pilasters appear on your walls, terraces are adapted from Tivoli and the Kline science tower is approached through a temenos. It is hard to accept the *dixhuitiéme* surfeit of motif in your architecture.

You certainly perceive the essential things in the way of beauty, but you adapt them inaccurately and unnecessarily, turning architectural realities into meaningless fictions and fantasies. You allow your intelligence to treat the architectural scene with a romantic intellectualism that makes the general view stage cardboard, however telling in the mass of details.

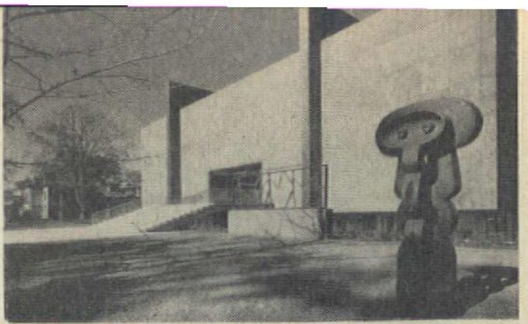
Your whole concept of 'beauty' in twentieth century architecture is suspect—to myself at any rate. You revere the idea of beauty in architecture. You uphold it as an ideal. You conjour up the image of Periclean Athens—though you don't make it quite clear whether you see yourself in the role of Pericles, or Ictinius or even Phidias. You seem to be genuflecting somawhere, along a processional route, before an ideal image of Art, mysteriously sustained by private meens (the Art, I mean, is sustained by private means). Each of your buildings is imbued with the dull complacency of great wealth. I'm not thinking alone of those elegan and expensive houses that you have designed, but even of your many museums (no less than five) that should, one imagines, have provided opportunities for a display of a specifically public architecture. Instead, they are conceived in the tradition of the great palace museums of Europe; they are remote repositories of treasure, designed to emphasize as firmly as possible the distinction between those who can afford to buy and endow such collections and those who are graciously permitted to view them, but may never aspire, either socially or even physically, to the style of life of which they are a token. Your grand entrance halls are shockingly pretentious. Painting itself is rendered remote in these buildings. Pop art even is transmogrified and embalmed.

Art and architecture then are rarefied and remote—and expensive. Your ideals seem altogether inadequate. When architects in Europe talk about 'the route', they usually mean 'the street', as a teeming and lively part of a town; when you talk about 'the route', you think in terms of a stately and unencumbered processional way (with yourself, possibly, in the second or third row of dignitaries). 'Architecture', you write in *Perspecta* 9/10, 'is surely *not* the design of space, certainly not the massing or organizing of volumes'. You would have it that architecture is the movement through space, in time—a procession. But whether static or moving you judge architecture always in terms of organized space and volumes, a concept so formal and inadequate to twentieth century requirements as to be meaningless. One may judge classical temples by those standards (mainly because we don't have sufficient knowledge of what their architects were about to judge them by any other standards) and can apply this academic assessment to Renaissance and Baroque buildings (mainly because their architects conceived them in equally formal terms) but when we come to nineteenth century architecture it is increasingly difficult to apply these criteria and with twentieth century building they become irrelevant. Not that Gropius and other [illegible] all their cant, were not style conscious in an equally limited way—they applied their style, as we know, with a trowel, and their plaster has cracked off far sooner than has Nash's stucco work—but that they were aiming also, and achieving, something else in their buildings. They cared about convenience and use in architecture. You spurn utility. If you had seriously wanted to be a grand old man of Art, you would have done well to have thought even more carefully and to have built less.

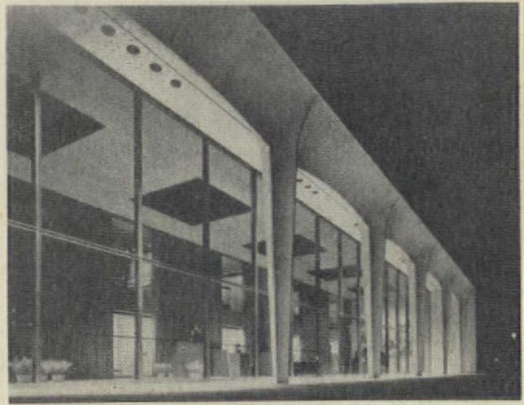
You seem unaware of, or rather deliberately to ignore, the real problem of twentieth century architecture—to build an adequate living environment for an ever-increasing mass of people. Instead you have been intent to revive the follies of nineteenth century historicism for a select few—forgetting even those discoveries that were made by nineteenth century architects. Your work should be shrugged off and dismissed. But it is accepted and defended by other intellectuals in America. This makes me worried and restive. Ridicule and argument are not enough. The dark springs of your activity lie at a deeper level than that of the intellect, and to understand and to stem them critics will have to look beyond reason and policy into the structure and psychology of your whole society. Of all the grim and depressing episodes of modern architecture, your post-Miesian phase is the most curious and perplexing. One only wishes it was unique. But there are a spate of architects attempting to design in exactly the same spirit. The movement you represent has grown horribly in power. And it seems so prissily opposed to all the buoyancy and vigour that is represented to us by the USA itself. In an exuberantly active and expansive country you have the determination and courage, at least, to be effete.

yours, Robin

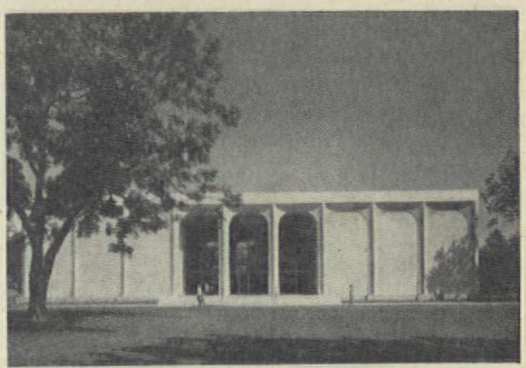
*Published by Thames & Hudson. 5gns.

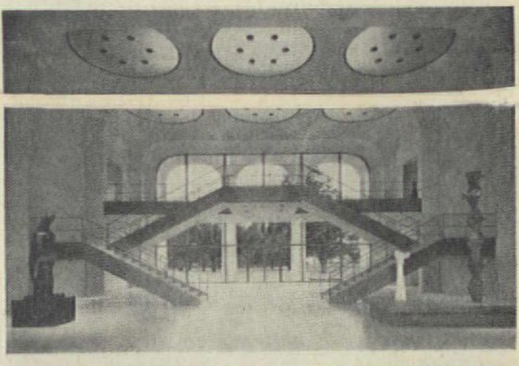


Munson-Williams-Proctor Institute, 1960



Amon Carter Museum of Western Art, 1961

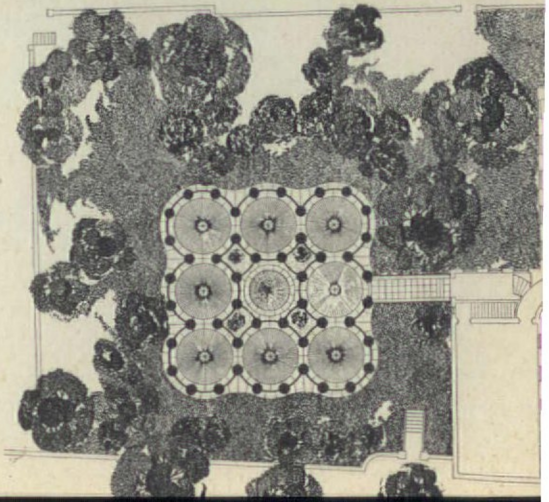


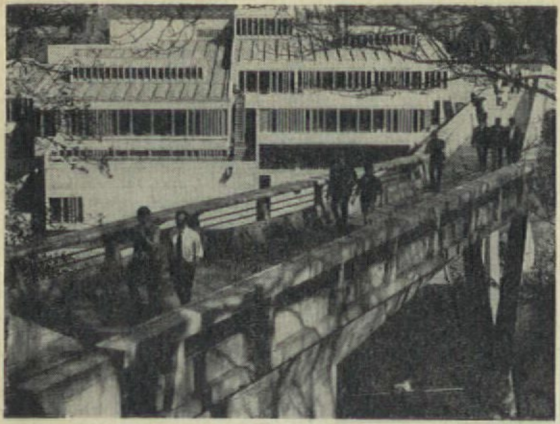


Exterior, Interior, Sheldon Memorial Gallery, 1963

Boston public library extension. Photo *Time* 24/2/67.

Museum of Pre-Columbian Art, Dumbarton Oaks, 1963





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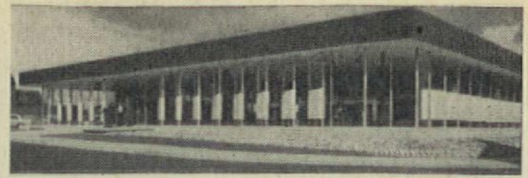

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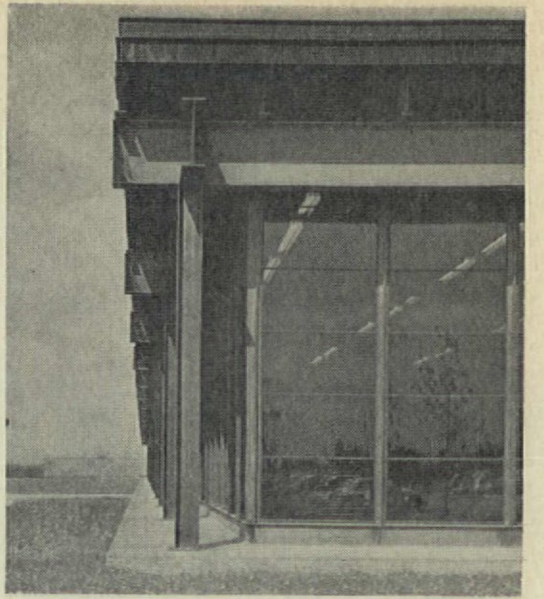

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Around Britain

The North East

James Collier

Far from picking up regional variations, this *AD* feature appears, through the months, to have provided ample evidence that all regions are treading the same path with a three-year time lag between London and the outer Hebrides. The time lag might be explained by following the trail of the lightly sprinkled public and private monies up and down the country which has attracted a retinue of valued retainers who build in their most recent, or most improved manner wherever the revenue falls to earth. This year the UGC's droppings have borne fruit in Durham and Newcastle where ACP, Whitfield, Spence and Sheppard have contributed to or decorated their chosen areas. In Durham where the esoteric *tours de force* are more acceptable, ACP have built a good students' union **1** (at the time of writing, 15-2 on for the RIBA Architecture Award) which is a simple, humane, beautifully contrived/design'd affair. Quite right, with Arup's bridge and St Cuthbert's Cathedral.

At Newcastle—an altogether more serious and urban establishment—a big serious Richard Sheppard, Robson & Partners complex, is grinding along with a completed Building Science department looking out sceptically from its sparingly glazed walls to 100 per cent top-lit studios for the School of Fine Art **5**. The simple brick and glass vocabulary is stretched with some discomfort over structure and services alike in the recognizable company style. This desire for simplicity and repose is laudable and even satisfied; but somewhere this styling will become, and appear to become, a preconceived surface treatment. Perhaps the next University.

Newcastle University School of Architecture has extended itself by cramming rather a lot of staff rooms and studios into a solid Edwardian establishment adjoining the original premises. The alterations have been unable to make the whole department comprehendable or to demonstrate any truths of architecture due to the complications of the brief and the construction.

Commercial money has also appeared fitfully, bringing a standard Rank hotel and bowling shed at Gateshead by Hubbard Ford and Partners, Chrysler Cummings and Cummins Engine factories at Darlington by Kevin Roche and John Dinkeloo **4** (*AD*, Jan. 67, p. 2), and a promising piece of Owen Luderism at Gateshead which speaks louder criticism of other developers' architecture than I could.

It is perhaps a distinction for the area to have recognized the work of Eero Saarinen's successors Roche & Dinkeloo with a Civic Trust Award.

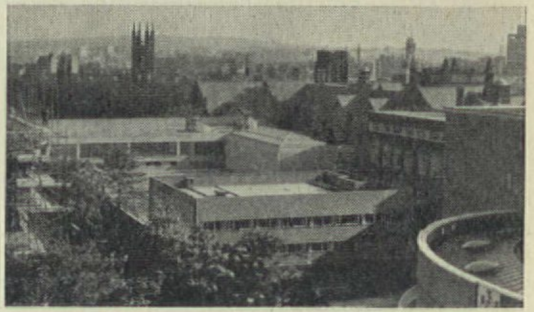
Several other national outfits (Culpin, M.R.S., Mountford Piggott), are providing serious competition for the local practitioners.

The response to competition would in some cases warm the heart of Mr Heath. The new Library at Wallsend **2** by Williamson, Faulkner Brown, a very sophisticated deadpan work (2-1 against, for the RIBA Architecture Award) is a thoroughly designed and detailed building demonstrating why its designers are building in the South as well. Civic Trust Awards and commendations have come the way of two little housing schemes, one public, one private, both encouragingly pleasant, by Ryder and Yates **6** and Brian Robson **3**.

The City of Newcastle Housing Architects seem equally attracted to developers' 26-storey packages and their own developments of one- and two-storey layouts. Sunderland have completed a seven-storey deck access scheme in the Sectra system without anyone noticing.

In the abstract, the region has its embryonic planning unit in the Northern Economic Planning Council which produced its embryonic plan in a document 'Challenge for the Changing North'. This book, apart from asking for a national plan, pointed out the relative backwardness of the region with its high proportion of council and tied houses, high rate of room occupation, low rate of building, high rate of school leavers at 16, high proportion of extractive industry, low proportion of manufacturing and research units, lack of industrial training, lack of buildings for the arts, etc. The area has great resources of natural beauty and power, but its future depends on a national commitment to real planning and some measure of national prosperity. Should the means become available, the North East is more plannable than the trend-accumulations elsewhere. Our deprivation makes us more sympathetic to the whole planning business including the more fundamental examinations of resources and administration now being canvassed internationally. ICI, with a large Teesside investment, have a research team involved in prediction alone. They have also pushed the Government into flooding an area of scenic, botanical and scientific interest in order to slake their industrial thirst at Cow Green. £100,000 has now been given to further botanical studies in the area (non-swimmers need not apply).

In February 1967, the North Region Passenger Transport Coordinating Committee was set up, featuring many names from NEPC with a brief to speed up public transport, coordinating road and rail facilities, and to improve traffic management in the region. It is essentially a short-term approach which leaves larger strategies to the NEPC and the government, with the danger that expedient measures will inhibit large-scale planning in the future. It will have responsibility to envisage keeping the private motorist out of city centres by planning car parks adjacent to good public transport services. Traffic management is beginning to make its mark, an efficient one-way system in Gateshead keeps traffic moving and pedestrians stationary. Sunderland has introduced a standard fare on its buses in place of conductors.



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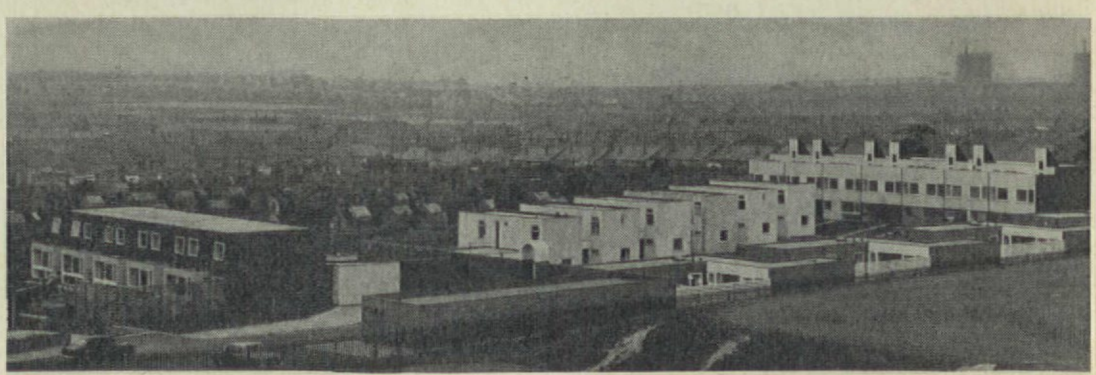
Both the above bodies could contribute to the development of Washington New Town, now under way without guidance on modes of public transport, restraints on private car use, or its effect on other industrial areas within the region, as well as being unable to consider the best way of dealing with urbanization in the long term. (See *AD*, Feb. '67).

Wilfred Burns, Newcastle City Planning Officer has introduced PAG procedures into local planning. A local plan for Jesmond, an inner suburb to be isolated by motorways, has been put out for discussion and aroused the interest and controversy amongst a fairly literate population including university people, architects, planners, etc. An action area in the proposal involving a new road and shops has been the subject of an articulate debate and professionally organized opposition. The residents viewpoint on a vital issue of scale-determination for the shopping areas has been accepted by Dr Burns. Serious debate on the traffic management and road proposals has begun and will continue through informal meetings and formal hearings. A network of bodies for local consultations is going ahead and valuable experience should be gained in time. Anything that can speed up the administration aspects of planning should be investigated, but the main value at present would appear to be the heightened awareness amongst the residents of their environment.



6

The ability of the unprofessional*

Julian Beinart†

The discovery of African sculpture, by artists in the early part of this century, had a profound effect on European painting and sculpture. Whether it was the discovery of African or merely tribal art from many parts of the world that had this impact is a moot point: it is much more likely that it was the latter. But whether tribal art has in any way been a direct source of twentieth century design—as I see design—I very much doubt, this has been largely concerned with the machine, and its protagonists have generally looked on anything that resembles handwork, craft or individual eccentricity with distaste.

Tribalism is something of the African past. It was destroyed in most of the western world a long time ago, replaced by a larger sense of association, a wider sense of community. In Africa as a whole, tribalism is either dead or dying, and with its death tribal art has also died. No longer is there the limited frame of reference, the cultivated audience and the religious impetus to propel the artist. No longer can the tribal artist make things for his own sake, as an act towards his gods; no longer can he be concerned only with the act of creation and not with the object itself. No longer is the society its own museum; now it has to build museums to preserve and restore. Post-tribal society cannot produce tribal art: it does not want to, no matter how much sentimental bystanders or deprived nationalists may want otherwise.

But human resources have not died, they never do—they are only stifled. Human resources survive and adapt in spite and because of cultural change; only outworn ideas of what things should be, prevent understanding and capitalizing on these resources. One of the largest human design resources in Africa today is the ability of ordinary people—untrained and unprofessional—to make things for themselves and their communities.

There is a powerful and basic urge of people to describe—often with the passions of love and hate—their own coming to terms with a new world. In Africa this is the new urban world: tough, hostile, dense, heterogeneous and abrasive. Urbanization has catapulted people from a rural, contained, magico-religious situation into a worldly, economic and multi-cultural one. And in giving form to their response to this collision, these ordinary people have found an outlet.

The examples of the visual response of these unprofessionals are chosen from three places. The first **1, 2** are made by people who live on the edge of Johannesburg, on the edge both geographically and spiritually. They make their own houses and then paint them. They buy their paint in the city and their iconography is strongly influenced by the city. They are still tribal people, however, although very far along the process of detribalization.

The second group **3, 4** of examples is by people who squat on the outskirts of the city of Lourenço Marques, the capital of Moçambique. In 1956 when the President of Portugal visited this province, his route from the airport took him through this area. People were given paint and told to make their houses look better. This was the first stage of their decoration. Later they did it all on their own, this time painting only their doors. And the third group **5, 6** is from a township in the heart of the Johannesburg complex, Western Native Township. Here I have been working on and off for five years trying to understand why and how these people invented a system of decoration to come to terms with their environment. WNT was built in 1920, the oldest township in Johannesburg. Townships are low density housing layouts in which non-white people live and have no freedom of locational choice. WNT had 2000 identical houses, small, unplastered with no facilities, 400 sq ft of shelter. In 1961 these 15,000 people were evicted to new townships further from the city and

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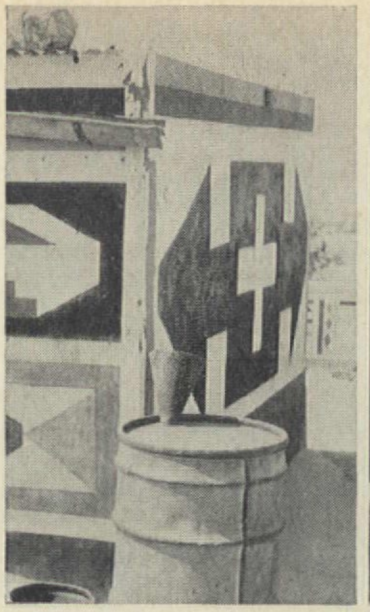
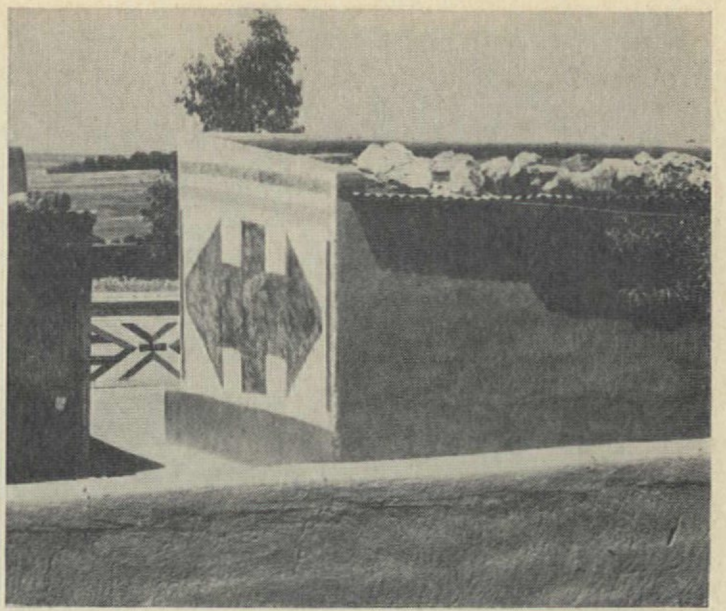
**Based on paper given at the International Design Conference, Aspen:* Sources and resources of twentieth century design, *June 1966*

†Professor of Town Planning University of Cape Town

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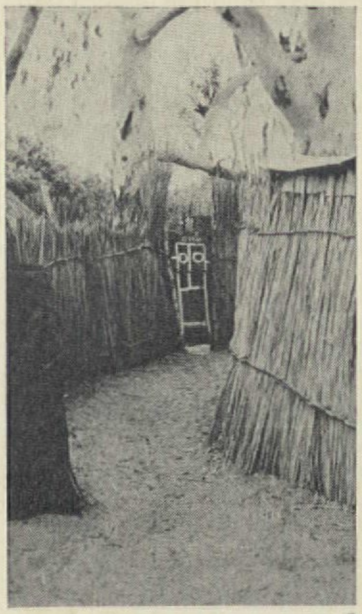
Arrow symbols on side walls of Ndebele houses, Ferndale, Johannesburg

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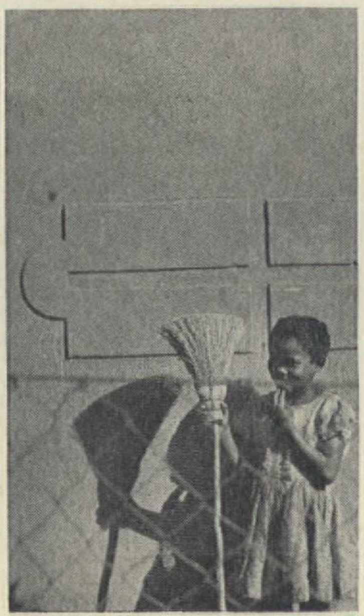
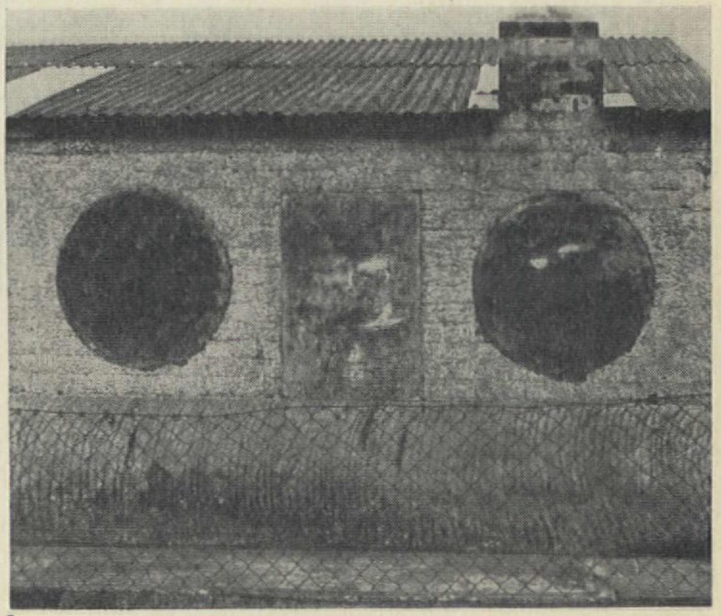
3 & 4
Wall and door paintings, Chinambanine, Lourenço Marques

5 6

5 & 6
Rectangle and circle shape families, Western Native Township, Johannesburg

WNT is now being pulled down. The important thing about WNT is that these people faced up to the immense difficulties that beset them and instead of capitulating fought back. Slums are places where the power to resist is less than the natural tendency to decay. WNT was a community of resistance: in WNT people rebuilt the fronts of their houses and what they put on the faces of their houses was a language of resistance. In this context there are three issues:

In the first place, these people changed their environment because the unfinished, unserviced houses which were rented to them were so incomplete that they were forced to do something about them. Don't all people want to involve themselves with their own things? How much of this desire does the designer crush with concepts of design which do not measure the need nor allow the community to partake in the life of the product: particularly architecture which resists change but which is nevertheless overtaken by it: the closed aesthetic, the complete artifact, the ideal form? I think I was misunderstood at last year's ICSID congress when some people suggested that I was advocating open-ended refrigerators—whatever they may be—or perhaps the open-ended umbrellas that Reyner Banham speaks of. Of course the user cannot always take part in the process of making things—it obviously varies with product and place—but I am inspired by the fact that these people in WNT made the place work much better than the architects who built it could ever have dreamed of. Tomas Maldonado says I live in a visual culture: maybe, but we cannot write off the rest of the world as easily as all that. Certainly architects who have to make places for people to live in can hardly afford such arrogance.

In the second place, these people changed their environment because they wanted to resist the sterile, mass-produced, faceless world given to them. They wanted to mark their own territory, show friends how to get to their home, make of their small impoverished world a unique place. And the word *place*, significant place, describes it best. Oskar Hansen, the Team 10 architect, talks about this major problem, the problem of the number, and the WNT solution is one way of making places out of numbers.

And thirdly, although each wanted to make for himself a unique place, he did it within the communal language that the community had made. I am sure these people could have individuated like crazy, but there is less evidence that they wanted to compete with each other than that they were happy to improvise on a simple abstract visual language. There seems to be a significant relationship between the things they did as a community—and there were many—from stopping people throwing dirty water into the streets to vigilance guards against juvenile delinquency, and this limitation of language. Can we make communities like this? Do we want to—or do modern urban communities exist only at more complex levels in the way Melvin Webber suggests?

In **7** and **8** the resources of the unprofessional have found an outlet not because of movement into a new physical environment but because people were faced with a new technology, new materials, and new needs within the framework of a traditional environment. In West Africa the city is centuries old and the Yoruba of Western Nigeria have lived in them as long as anyone can remember. Once upon a time they were taken across the Atlantic to Northern Brazil as slaves and when they came back at the end of the last century, they came back with the ideas about the Portuguese colonial architecture they had seen there. Now they built houses in Nigeria of cement, not any more of mud. And it was a new kind of house, large, spacious, well adapted to the climate, using cement in a rich plastic way, so unlike the timid, self-conscious architecture of the new imported architects with their handbooks on climate and their thinness and international restraint. The Yoruba cannot make tribal sculpture any more; now they make cement sculpture. Faced with the new need to advertise they make advertising signs. The same signwriters paint paintings on glass for a new middle class to hang in their living rooms **8**.

And here we can make another point about those human resources that maintain themselves because of and in spite of cultural change. Whereas tribal sculpture was serious, full of complex meanings and messages, hidden; the new work is humorous, relaxed, unconcerned with posterity and the hereafter. In this lies an important quality of the unprofessional: his ability to relax, to be unconcerned about what art is and just to let it happen and let art come after. This is the same quality that comes across in his music: the ability to relax and improvise whether it be in West African ju-ju music where the improvization has both a word and sound message, or in jazz.

This particular ability is probably the major characteristic of the remaining illustrations **9**, **10**. Here the human resources have been released in an artificial way: through teaching. I wanted to see whether education could produce similar results to the work which I had seen around me, similar of course in a very special sense. We had very little idea of what to expect before we started: the programme grew out of certain ideas of basic design teaching modified all the time by the limitations of material, money, language and place that we had to face.

It strikes me now that there is a great virtue in this sense of uncertainty, in being willing to allow the teaching situation to develop out of joint improvization and mutually felt needs. It reduces the teacher from the status of a feared god and does not destroy the dignity of those taught.

The teaching took the form of seven short-term schools —each about two weeks—where anyone who wanted could take part. In Nigeria, for instance, we had janitors, motor-car salesmen, schoolteachers, and housewives; in Kenya some nuns as well; in Zambia boys who walked 15 miles to our premises in a showground shed; in South Africa, jazz musicians, clerks, factory workers; in Moçambique, building labourers, students, anybody. Virtually no one at these schools had any previous visual training: most had never seen what we call art, many were illiterate.

The experience of running these schools is a limited one and I do not want to generalize too much from it. Only when we have permanent institutions in Africa which can experiment with educational methods, will we be able to see the real dimensions of these human resources and the best ways of guiding them. Unfortunately there are either none—South Africa I am ashamed to say, has not yet trained a non-white architect—or they are trying as hard as possible to be as good as the worst of your schools. There is nothing in education that seems to be as exportable and acceptable as wrong and outworn ideas.

These schools have however given us some insight into the kind of teaching that is needed in Africa and similar areas of the world. Here the scale and nature of the educational problem requires a much bolder attitude towards teaching than most are willing to adopt. To do this the city must be used as a teaching instrument, a tool which is already working in many parts of Africa and which can be made to work better. It is an idea similar to Marshall McLuhan's 'age when the environment itself is arranged as a teaching machine'. It is an interesting commentary on apartheid in South Africa that the authorities legislate against allowing people to come to the city, and once there, against allowing them to learn. The authorities believe in the country: to them it equals tradition and peace. But all over Africa people believe in the city. They want it: for them it means growth even if it involves conflict. And this is a choice many low-income areas of the world have to face up to; limiting urbanization or putting every resource into the city and hoping that the chaos is temporary. I am not even sure that there is a choice. In Africa we have about 30 million living in cities right now; by the year 2000 we expect to have 290 million.

As well as the city, the buildings we make in these areas must be educational instruments capable of coping with the way people use them to learn. (Western Native Township was a physical environment where people could learn and change and in turn change it.) In a developing situation the rate of change must be fast often if only to survive. And this means that buildings should not always be permanent but made so that they can be changed by people, even destroyed, through which process people can learn. This implies another kind of failure which we are all too keen to avoid. It might sound paradoxical, but in using buildings to teach people, the most successful architecture may well be that kind that allows people to make it fail.

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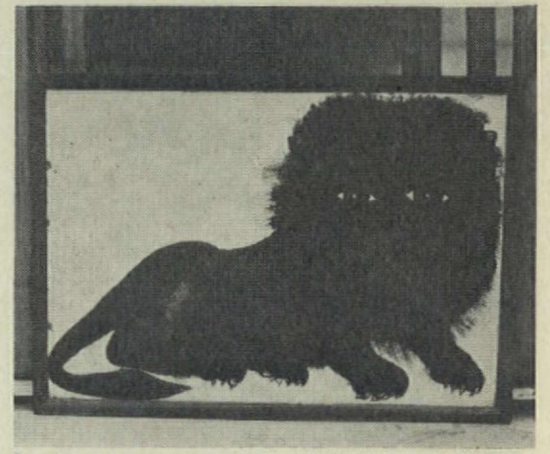

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7 & 8
Mr Alade's Brazilian-type house, Ibadan and signwriter's lion painting, Onitsha

9 & 10
Student projects, Ibadan summer schools, 1961 and 1962

Habitat '67*

Moshe Safdie and David, Barott, Boulva

Structural consultant: A. E. Kommendant
Structural engineers:
Monti, Lefebvre, Lavoie, Nadon and Associates
Mechanical and electrical engineers:
Huza-Thibault, Nicholas Fodor and Associates
Contractor: Anglin-Norcross Quebec Ltd.
Concrete subcontractor: Francon Ltd.

1
An aerial view of Habitat under construction on the Cité de Havre (Mackay Pier) Montreal

The large, complex or experimental project is often vulnerable to successful attacks and unable to avoid the swings of financial axes. Though criticism can therefore be levelled at the result, blame can rest on causative interference. The familiar gulf between conception* and realization is evident in the diluted version of the original Habitat '67 now nearing completion in Montreal. Many of the essential propositions broadly expressed at the outset have been retained—privacy, fresh air, sunlight, suburban amenities in an urban location, and the unit character of the construction—but the scale of commercial accommodation has been reduced and it is questionable whether the total environment and the communal amenities initially claimed as objectives will be even partially realized by the Phase I structure, unless it is ultimately reinforced by the completion of the whole. The minimum population to support a community of the nature of habitat was originally stipulated as 1000 living units. It has not been made clear that the conception of Phase I has been modified to make it a self sufficient entity in these same terms, with the greatly reduced content of 158 dwellings. Neither have the amendments to the constructional units to justify economic quantities been incorporated.

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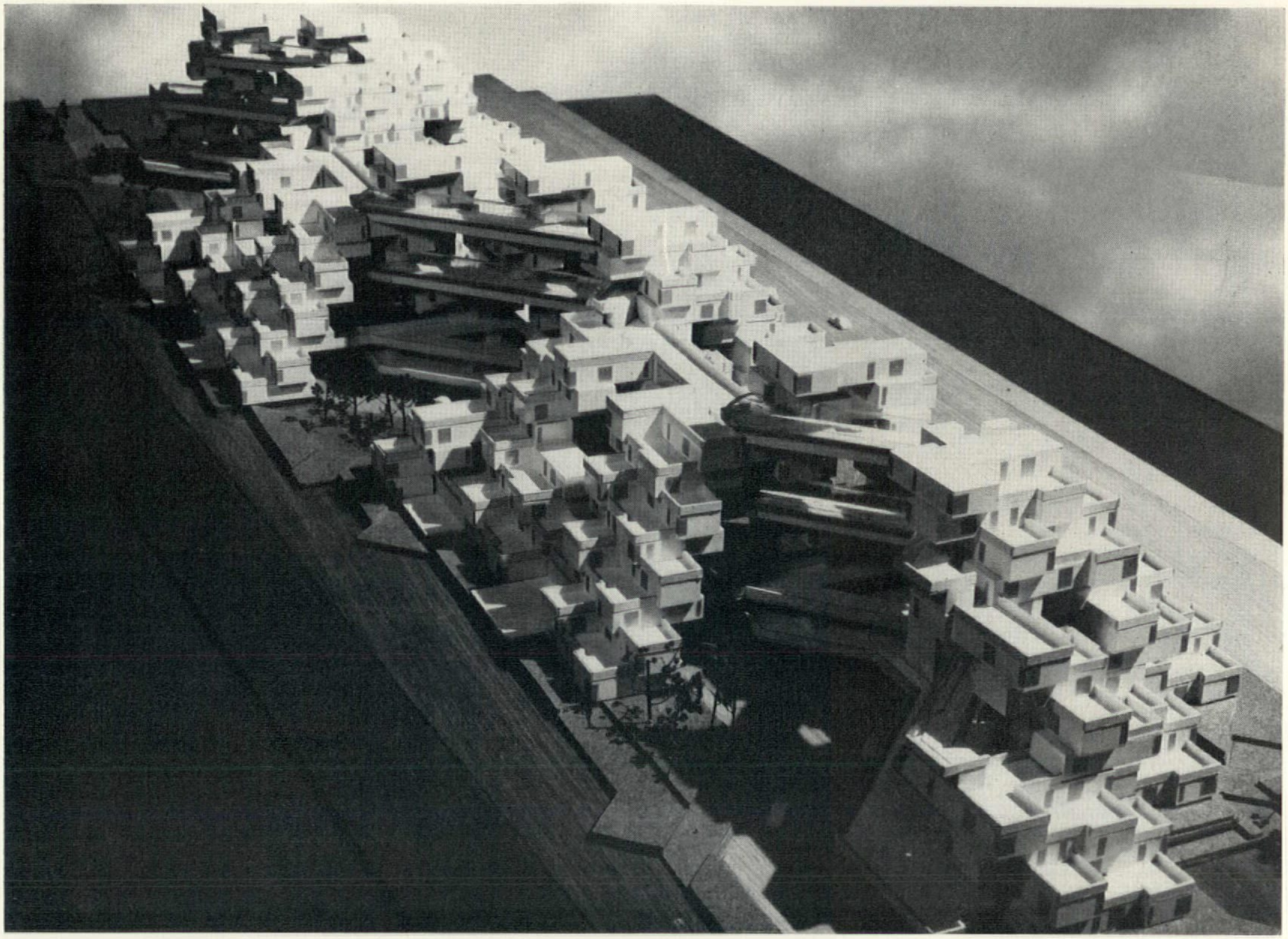
*See *AD* 12/1964 for the original design of Habitat '67



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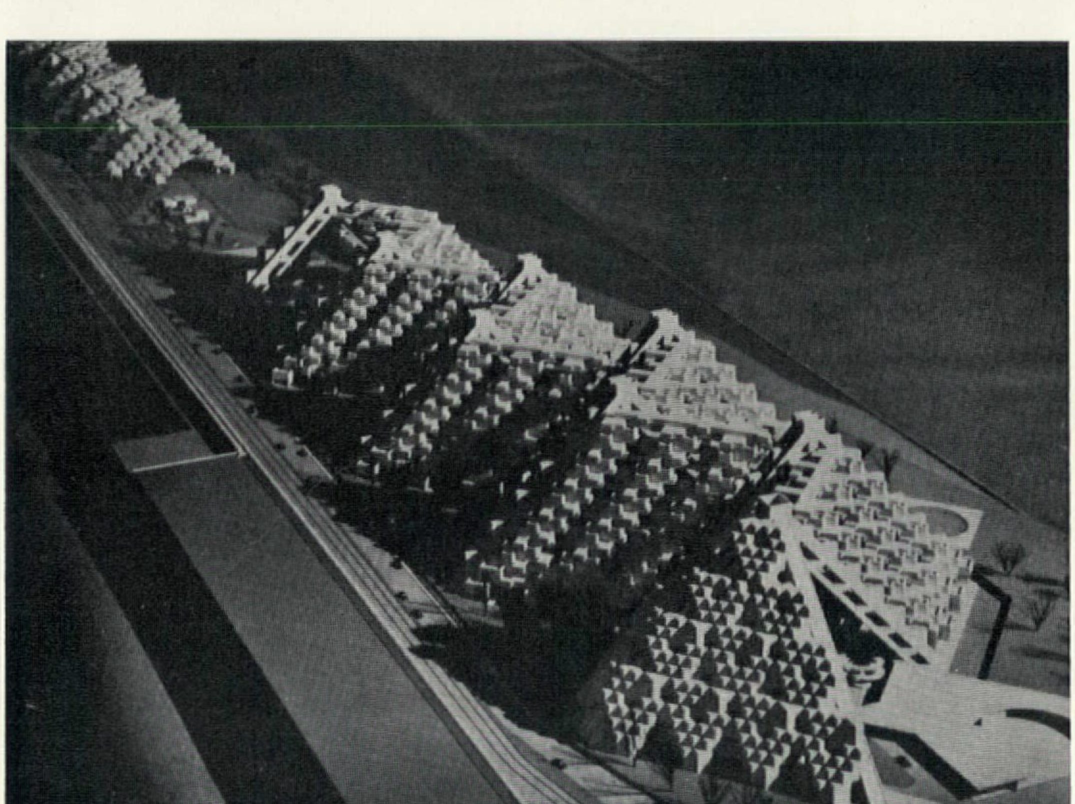

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The construction of the units follows the form in which they were first envisaged—box units 17ft 6in × 38ft 6in × 10ft high, weighing between 70 and 79 tons, arranged in combinations of one, two and three elements to create dwelling units varying between 600 sq. ft (one bedroom) to 1700 sq. ft (four bedrooms).
The basic circulation system has been retained. A pedestrian network connecting all parts of the project through walk-ways, bridges and plazas, is completely separated from the service road one level below, connecting all service areas and parking facilities. Vertical circulation is through three vertical cores, with lifts stopping at every fourth floor, serving horizontal pedestrian streets which give access to the dwelling units one level above or below. The pedestrian streets are protected from wind and snow by a plastic cover and are provided with planting and sitting areas. Playgrounds for the younger children, not old enough to go independently to parks at ground level, are located along the streets at fifth and ninth floor levels.
Viewed as a breakthrough in urban design, Habitat may achieve a limited measure of success—probably less than it deserves. Viewed as an experiment in technology, any failures may have widespread repercussions, vindicating the claims of the pessimists and creating waves of antagonism against the hard-won principles

3

of industrialized building. These two viewpoints are unfortunately less divisible than they may at first appear. Habitat is seen as an inseparable advance in construction technology and town living, and a failure in one could mean failure for both.

Success as an urban environment could be totally dependent upon completion of all future phases of the project, which now appear to stand in jeopardy through the rocketing costs of Phase I. The original estimate for 1000 living units was $42,000,000. Government approval was obtained to award the general contract for Phase I in the sum of $10,510,000 (approx. $66,500 per unit) and the overall budget allocation was extended from $11,500,000 ($73,000 per unit) to $13,500,000 ($85,500 per unit) to cover other necessary expenses including consultant's fees, erection equipment rental and reinforcing steel. As considerable prestige attaches to the project, favourable tenders have been received from suppliers of windows, doors, bathroom units, acrylic roofing to pedestrian

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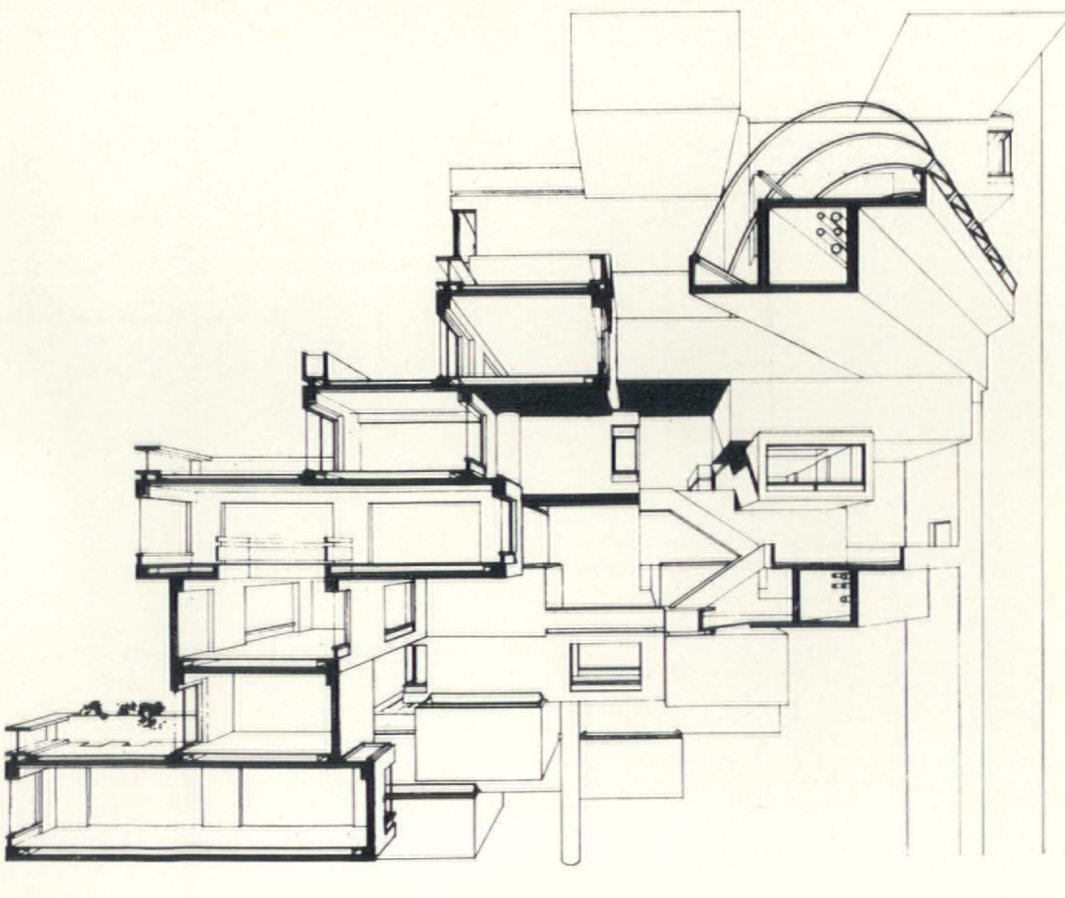
1
Model of Habitat now under construction
2
Model of Habitat as originally proposed
3
Habitat under construction
4
Diagrammatic section



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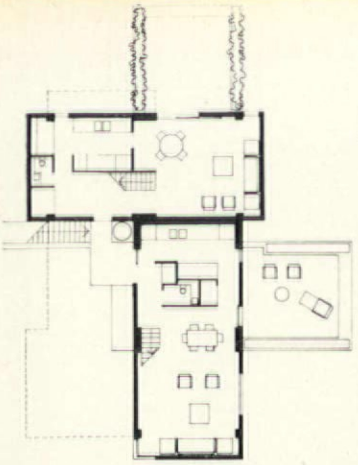

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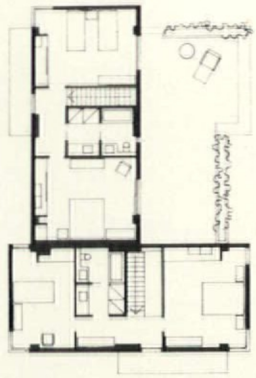

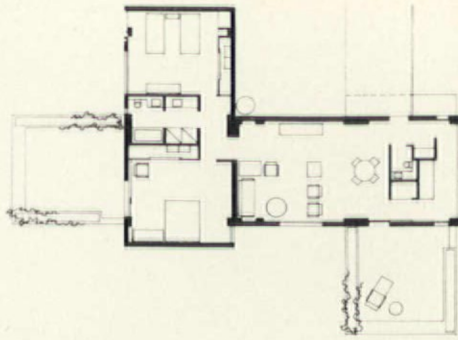

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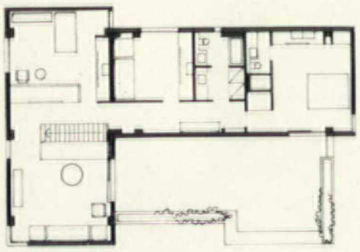

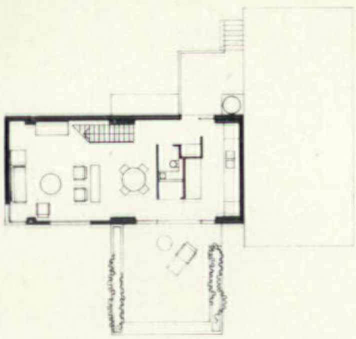

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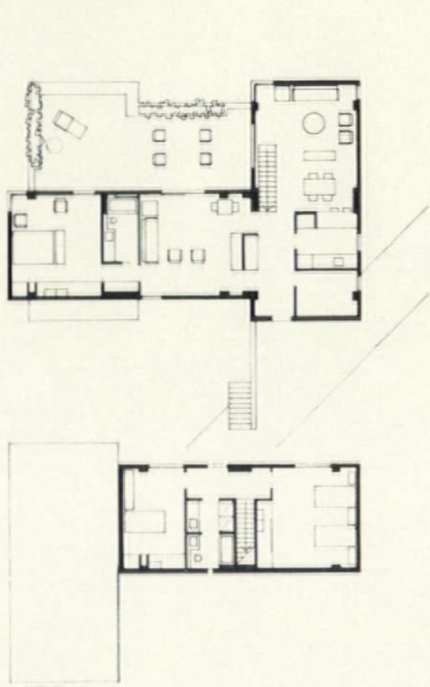

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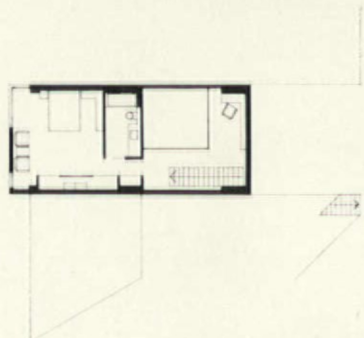

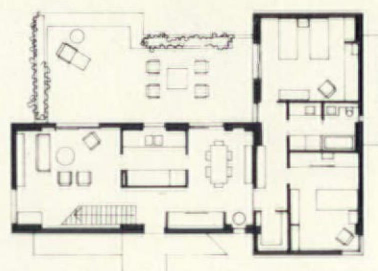

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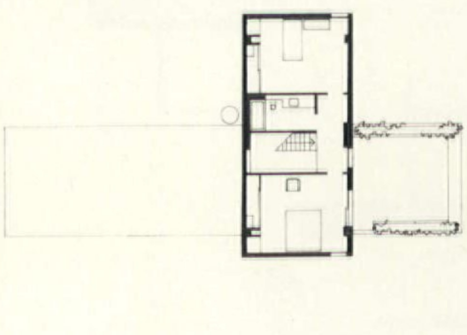

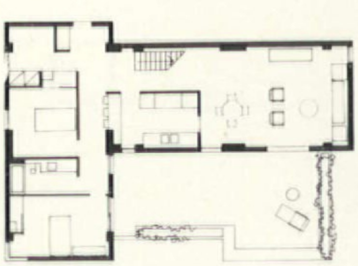

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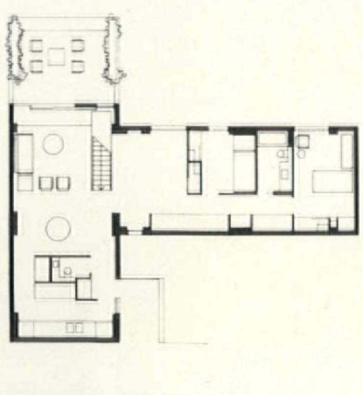

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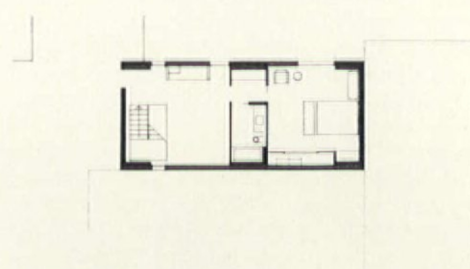

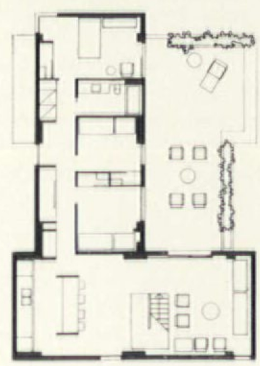

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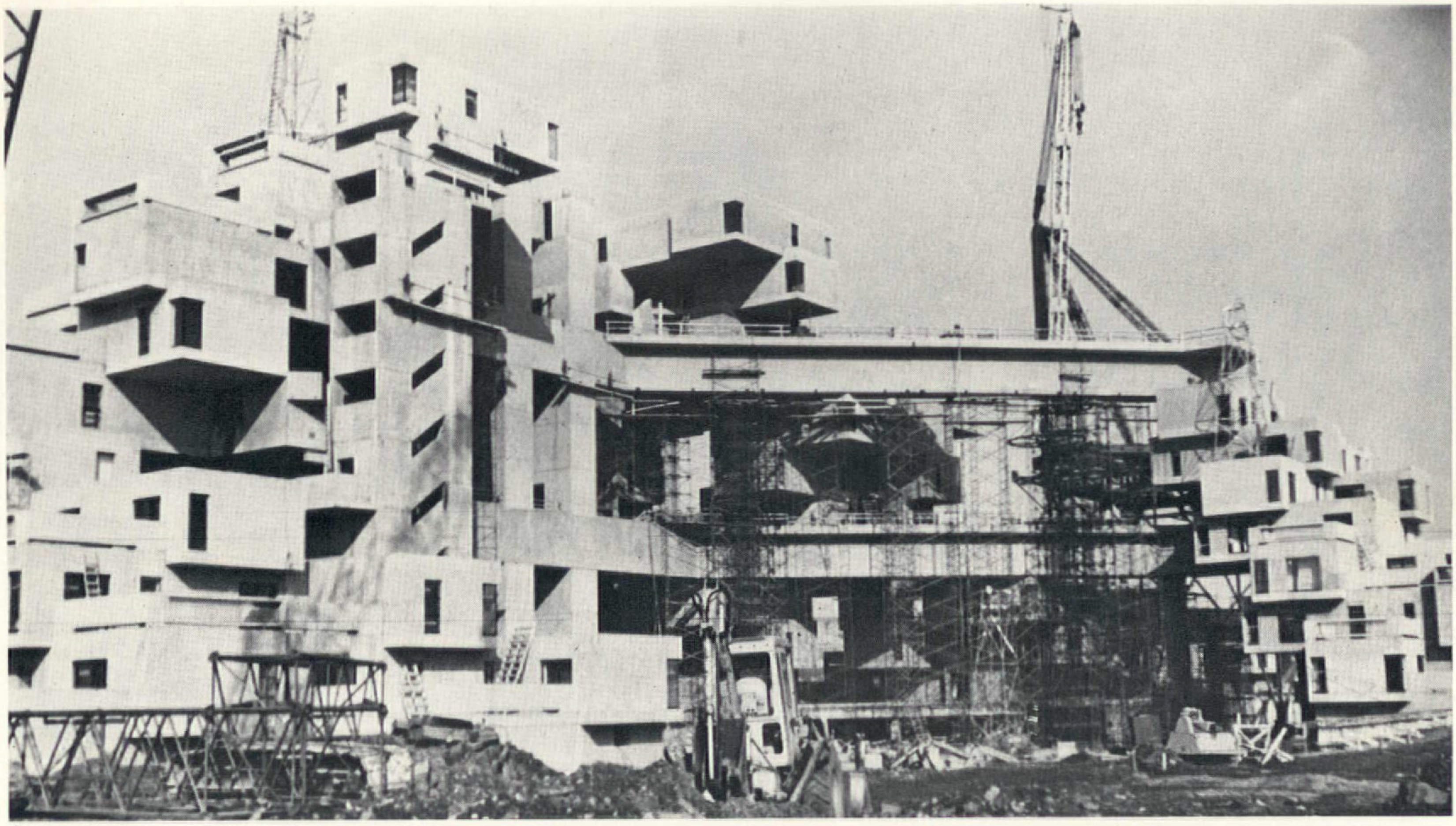

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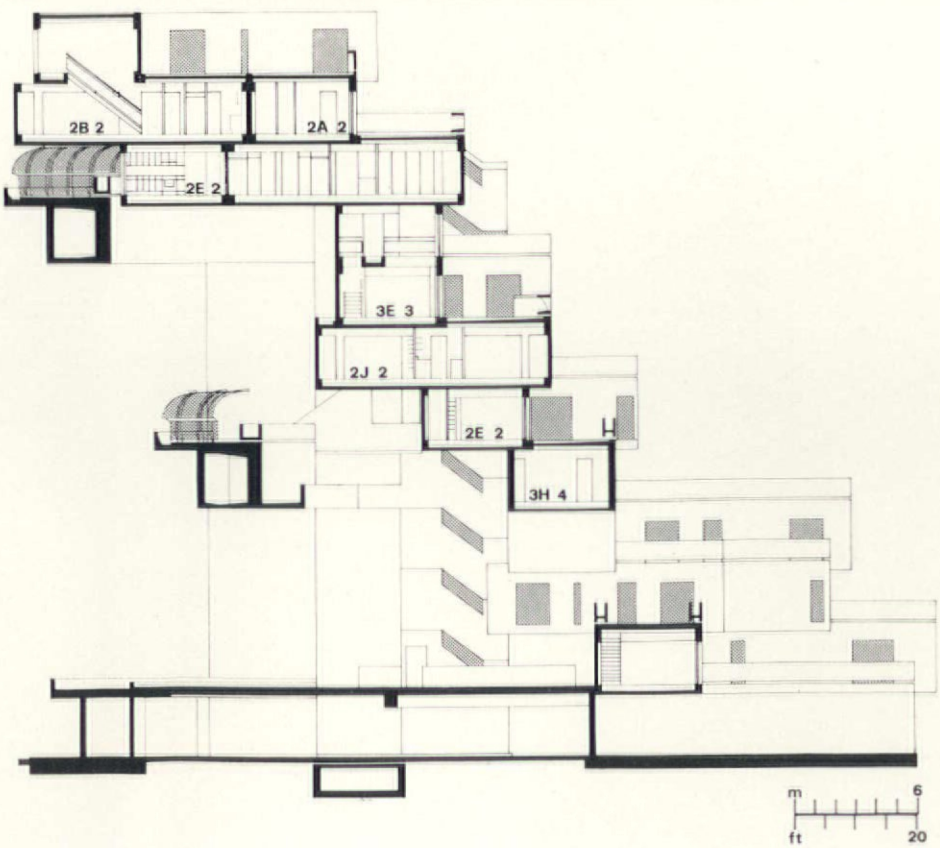


Opposite
Some plan types

2A & B, 2 bedrooms on two levels, 1168 sq. ft

2C, 2 bedrooms on one level, 1168 sq. ft

3B, 3 bedrooms on two levels, 1752 sq. ft

3C, 3 bedrooms on two levels, 1752 sq. ft

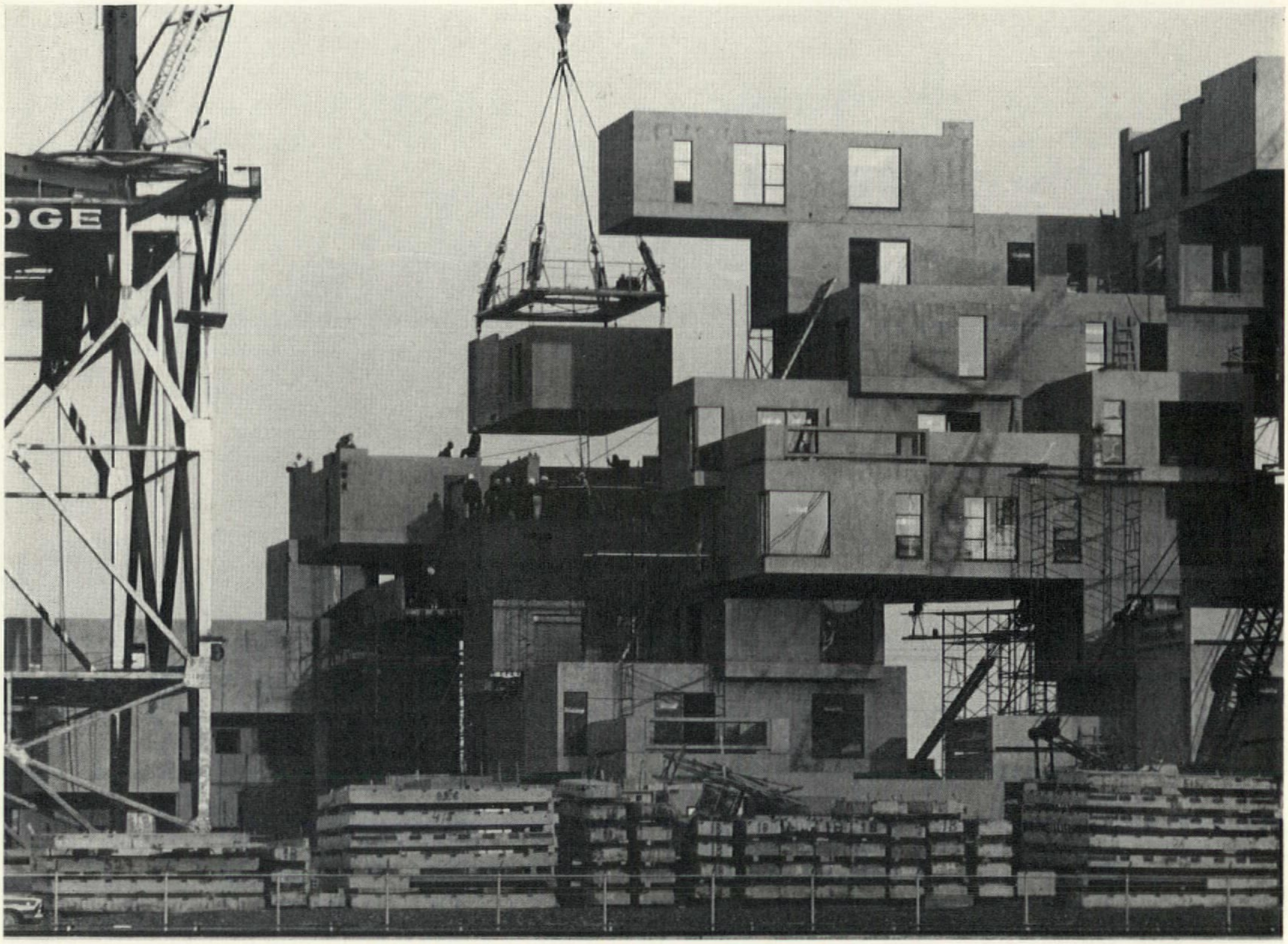
3F, 3 bedrooms on two levels, 1752 sq. ft

3F, 4 bedrooms on two levels, 1752 sq. ft

3G, 4 bedrooms on two levels, 1752 sq. ft

3H, 4 bedrooms on two levels, 1752 sq. ft

1
Habitat under construction showing the vertical and horizontal circulation routes
2
Cross section showing position of various flat types



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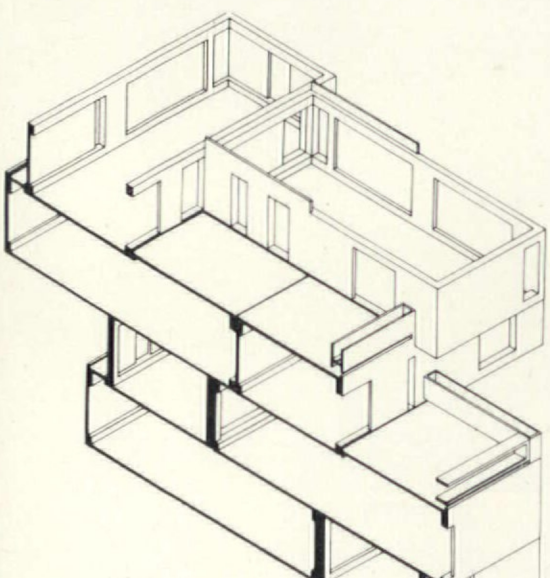

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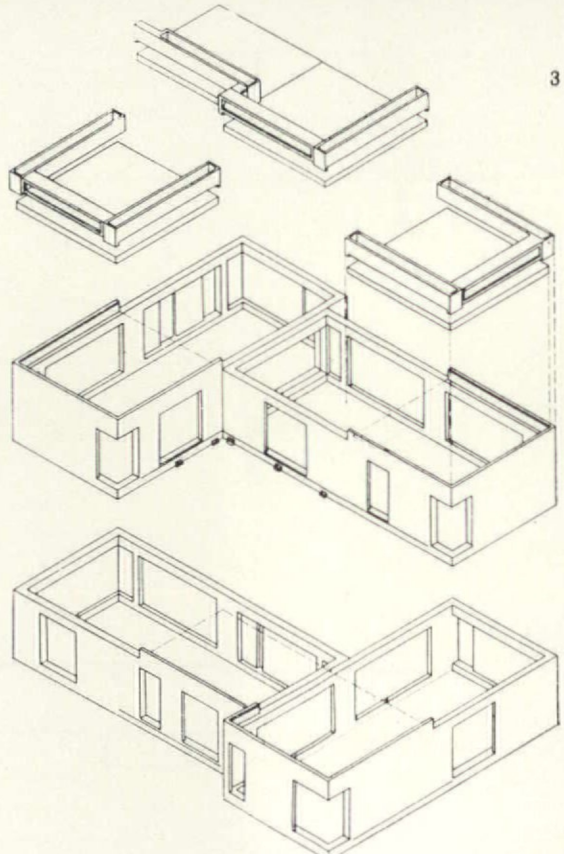
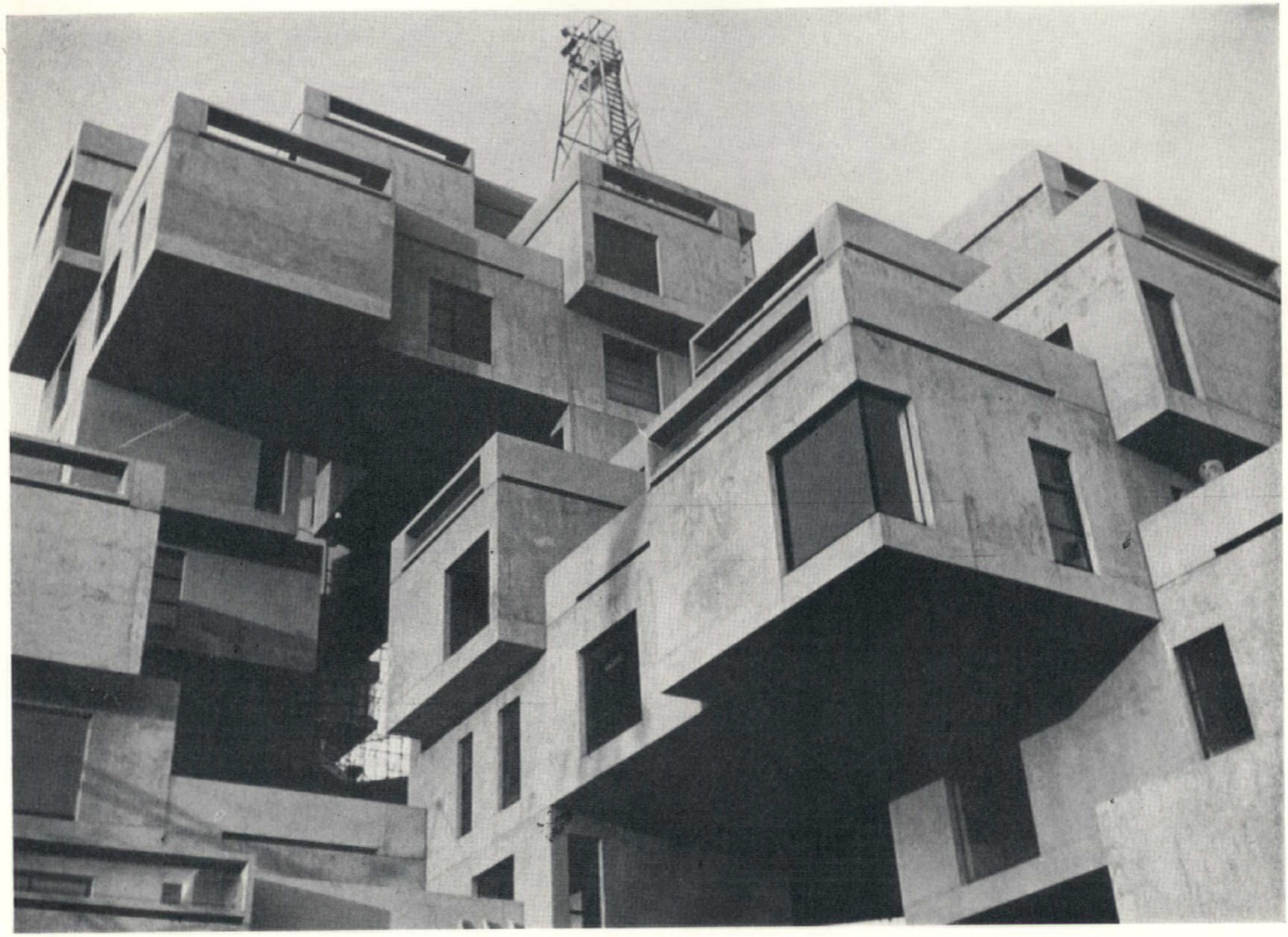


1 & 4
Habitat under construction
2
Isometric section of concrete units
3
Exploded isometric drawing indicating how concrete units are stacked together



4

◁113

streets, etc., who are prepared to sponsor the scheme; and the kitchens provided by Frigidaire Limited have been estimated to cost between $150,000 to $200,000 over the cash allowance. These figures represent development costs which would be justified by subsequent large-scale production, a calculated risk with this type of project, but they nevertheless tend to obscure the overall economic assessment and rely on the future construction of the remaining phases. Local opinion is that the final cost will exceed an average of $100,000 per unit.

Extremely controversial claims have been made for Habitat. In his thesis design, Safdie considered modular units installed in a multi-storey frame but abandoned this because there were no suitable lightweight materials for the units. Local building codes required that the concrete be ridiculously thick for a non-loadbearing unit and therefore frames were eliminated. Safdie has claimed that 'we should try to eliminate the redundancy of a frame with plug-in units' from which we assume that the box-units he employs attempt to reduce superfluous material. However, it is difficult to reconcile the degree of standardization claimed for this project with a type of unit which logically demands greater strength for each successive supporting layer.

Habitat has encountered severe problems in this respect. The 354 box-units comprising the scheme are in no way completely standard, as the reinforcement must be modified to accept the loads relative to the location, and in one instance it was discovered that the 5in thick walls required 6in of steel. One would imagine that redundancies due to standardization of a frame system might show greater economies than either of the choices between redundant material or lack of standardization in box-units.

Safdie points out that 'costs for Habitat units are meaningless' as the budget includes the capital cost of the precasting equipment moulds, transporters and a special crane. This is to some extent true because although a 1000 unit was suggested as a minimum required for the development of a community, it was considered 5000 units would be required to justify the economics of the scheme. On this basis the total Habitat would not have been an economic proposition, far less the present scheme, one-sixth the size. Furthermore, the present rate of construction is disappointing. The vastly reduced scheme will not be completed by the time Expo '67 opens, it will be necessary to use the completion of the scheme as a demonstration of the method of erection.

Financially the project has encountered the vicious cycle of low volume of production/high unit cost/low demand, a hazard well known to prefabricators, and as unlikely to be resolved in this project as it has been in many of its predecessors.

Experiments in architecture tend to be expensive but total failure is rare and results can usually be justified on a subjective basis. Because the degree of failure can be fairly accurately measured, experiments in technology can be even more expensive, and before embarking on such a project it is necessary to take rather more than a backward glance over the shoulder at the results of past work in the same field.

Technical history can in some instances prove to be an impediment, exposing precedent hazards to condone inaction, but examples of prefabrication on a commercial basis now extend back over a half a century and form a corpus of expertise which should not be irresponsibly abandoned.

The antecedents of Habitat can be traced back through several generations. In the recent past Russian examples of box-units have been employed in a very unimaginative way, but their weight has normally been limited to 30 or 40 tons and the problems of hoisting loads of this order have been acknowledged, resulting in experiments using box-units and large panels in combination. ▷118

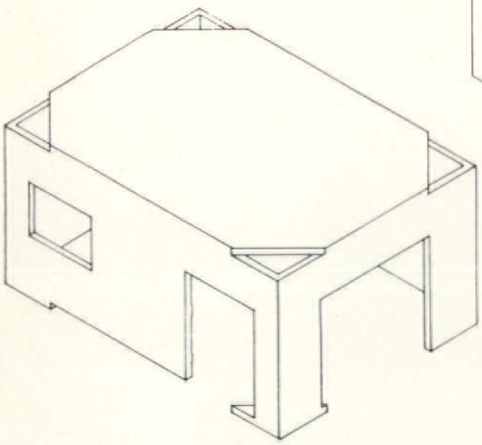
◁117

Twenty years ago both the Le Tourneau and the IBEC systems employed giant house size moulds, using transporters for site movement on which the design for Habitat mechanical equipment appears to have been based.

The claim that it is the first project to exploit a system of production which competes with that of the car industry is a naïve cliché, and must stem either from ignorance or deceit. Like claims are repeated with monotonous regularity, and often with greater justification, as for example the case of the Lustron project for which an entire factory was constructed with a projected rate of output of 100 houses per day, financed by a loan from the US Government of the order of $35,000,000. The project failed hopelessly, and it is interesting to note that one of the major reasons for its downfall was inability to appreciate the difficulty of sales and marketing of the product, a feature which appears to have been similarly overlooked in the Habitat project.

Final judgment on Habitat can only be made on the scheme as originally conceived and proposed, a fully integrated urban unit. As the high capital costs for development and equipment that must necessarily be incurred by such a project have been borne by the Federal and Provincial Governments and the City of Montreal, it is not expecting too much to hope for the emergence of a private developer prepared to carry Habitat to its conclusion so that we may see the results of what still appears a most interesting experiment.

Alexander Pike



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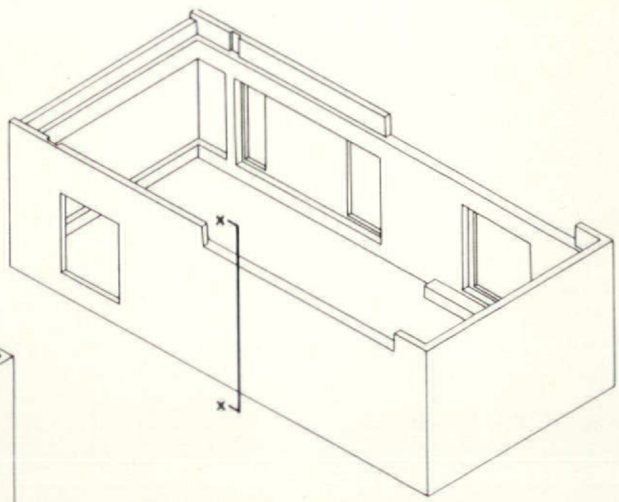

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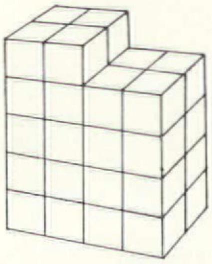

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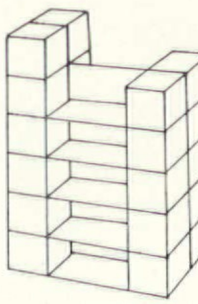

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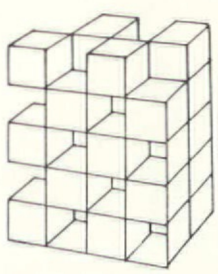

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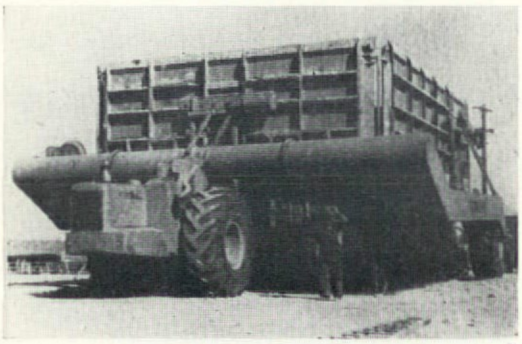

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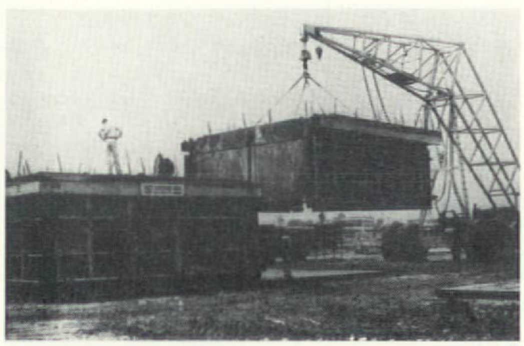

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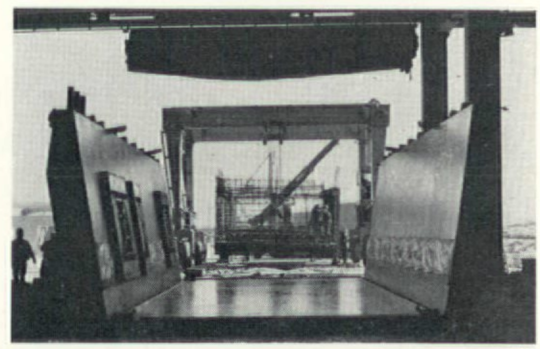

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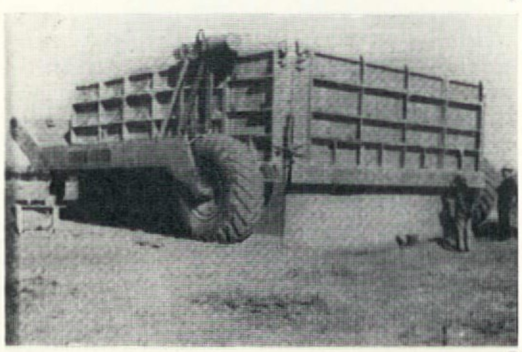

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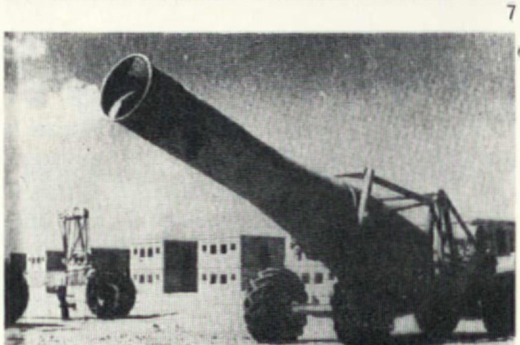

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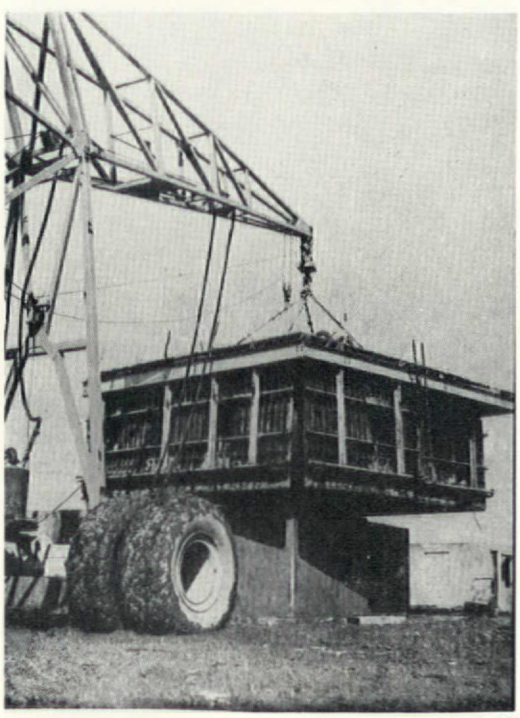

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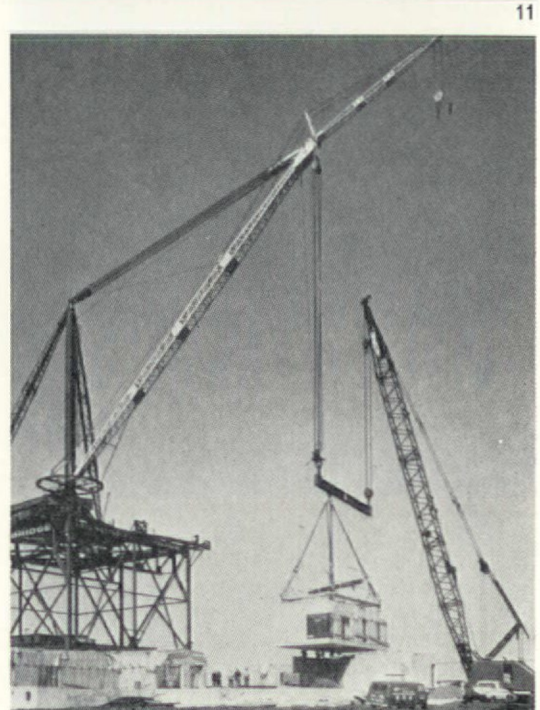

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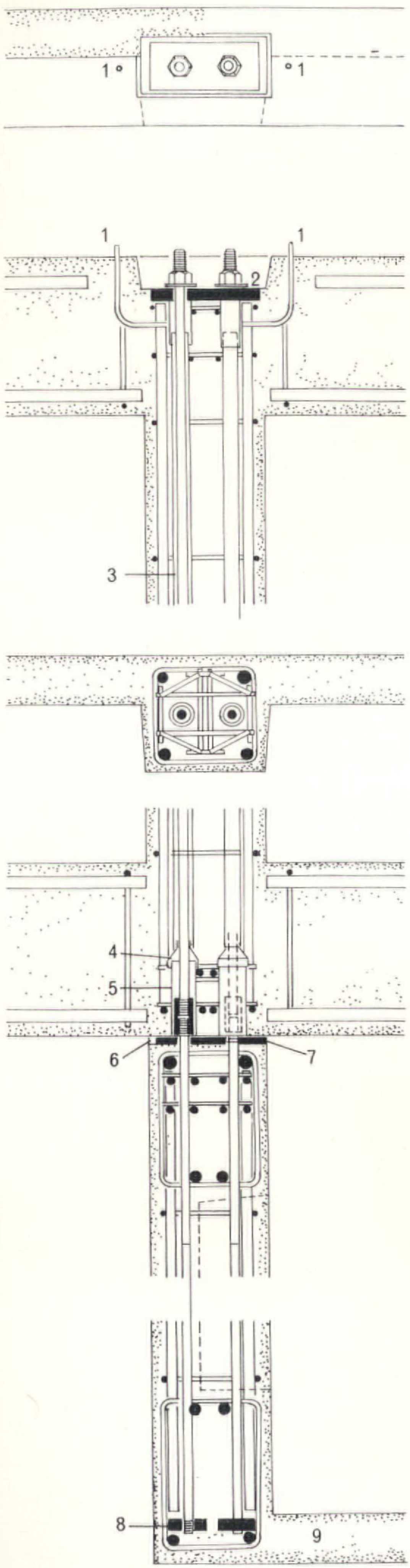


13–16 (top to bottom)

1
The room-size unit (weighing 12 to 15 tons in mass concrete or 4 to 8 tons in RC) is still more common in the Soviet Union than the multi-room unit, due to the difficulties of transportation and erection encountered with the larger unit. This example, employing what appears to be an unnecessary complicated interlock, was designed in Hungary by M. Vadász, and developed in Russia

2
Habitat box units are large even by Russian standards. A typical unit, weighing between 70 and 90 tons. The speed of placing of these units has proved to be slower than the rate of casting, involving a considerable amount of double handling on expensive transporters, causing unanticipated delays

3–5
The Russian systems of box unit construction place architecture a poor second to technique. The conventional juxtaposition of room-size units, **3**, is criticized not on the grounds of prosaic monotony, but for reasons of functional economy. The modulated treatments, **4** and **5**, with alternate rooms created either by large precast panels or by a chequerboard arrangement, derive not from aesthetic considerations but from the desire to eliminate wasteful double walls between rooms

6–8
The Le Tourneau system, 1946, employed a house-size mould consisting of an outer form fitting over an inner form leaving a 5in gap for the reinforced concrete core. After pouring, the inner form was stripped and the house moved to its site, where the outer form was lifted off by the transporter

9 & 10
By contrast, the IBEC system placed house-size forms on the site and lifted them clear of the unit after pouring
The Le Tourneau transporter was capable of moving a load of approximately 50 tons, but whereas the lifting loads for both systems was similar, the equipment for IBEC was larger and more complicated due to the higher lift involved

11
Habitat units are cast under cover in hydraulically operated static moulds and moved into storage yards by specially designed transporters. Apart from double and sometimes triple handling, this process necessitated the provision of temporary roofs to protect the units

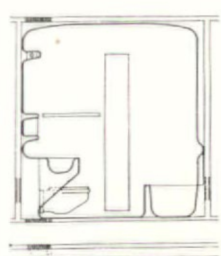
12
Despite the publicity given to the design of special lifting equipment considered as an essential feature of the scheme, no impression of consistency of purpose is given by this illustration of the main crane receiving rather makeshift assistance from an auxiliary in the hoisting of a box unit
Photos: Concrete Quarterly 70, *1966*

13–16
Plans and vertical sections showing the reinforcement and structural detailing at position XX on diagram 2
1 $\frac{1}{2}$" diameter plastic grout pipe
2 5" × 11" × $\frac{1}{2}$" steel plate
3 1" diameter tendon
4 end shield
5 coupler shield
6 sponge rubber
7 $\frac{1}{8}$" neoprene pad on $\frac{3}{8}$" steel pad
8 4" × 4" × $\frac{1}{8}$" anchor plate
9 5" floor slab

17–20
Sections and plan of prefabricated bath, w.c. and shower unit

21
Bathroom unit being hoisted into position

22
Interior view of bathroom



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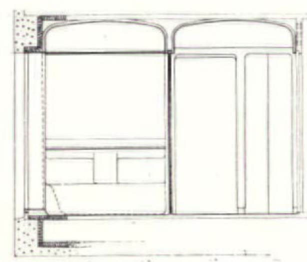

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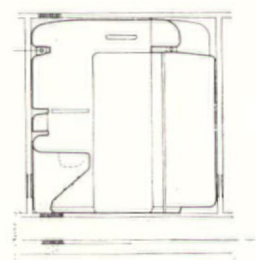

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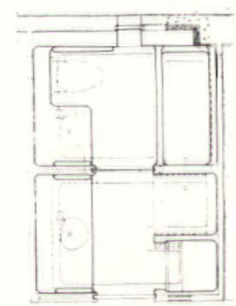

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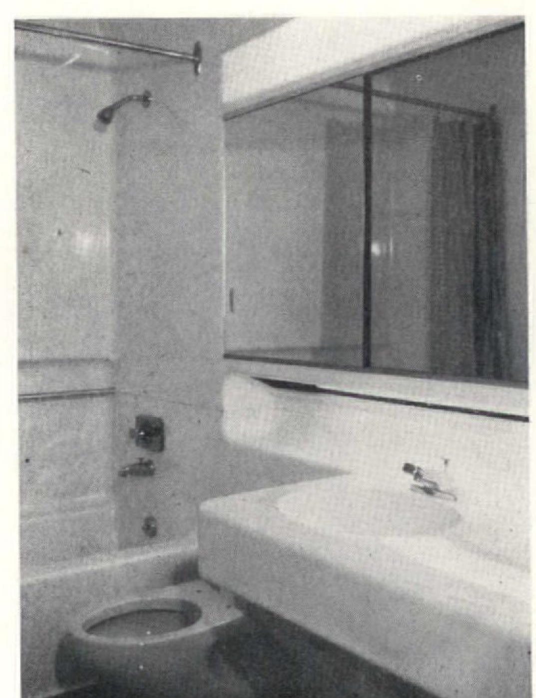

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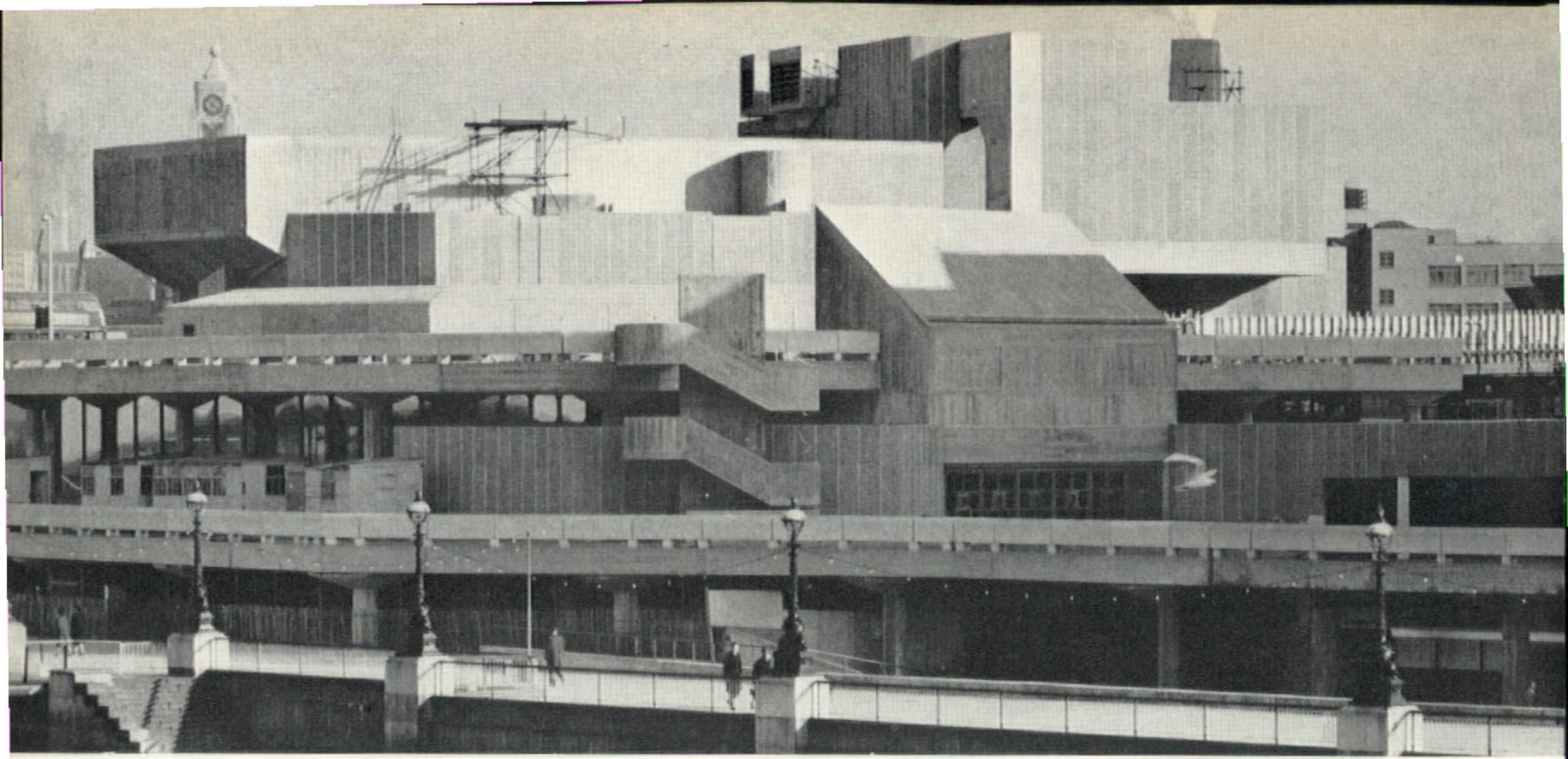

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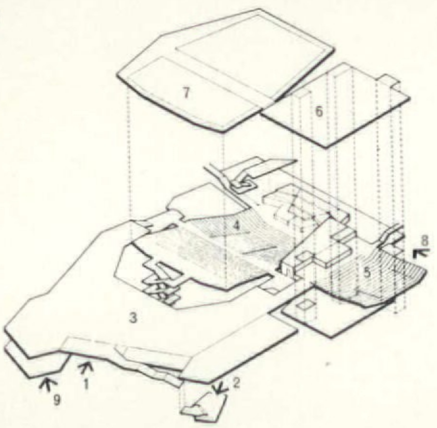
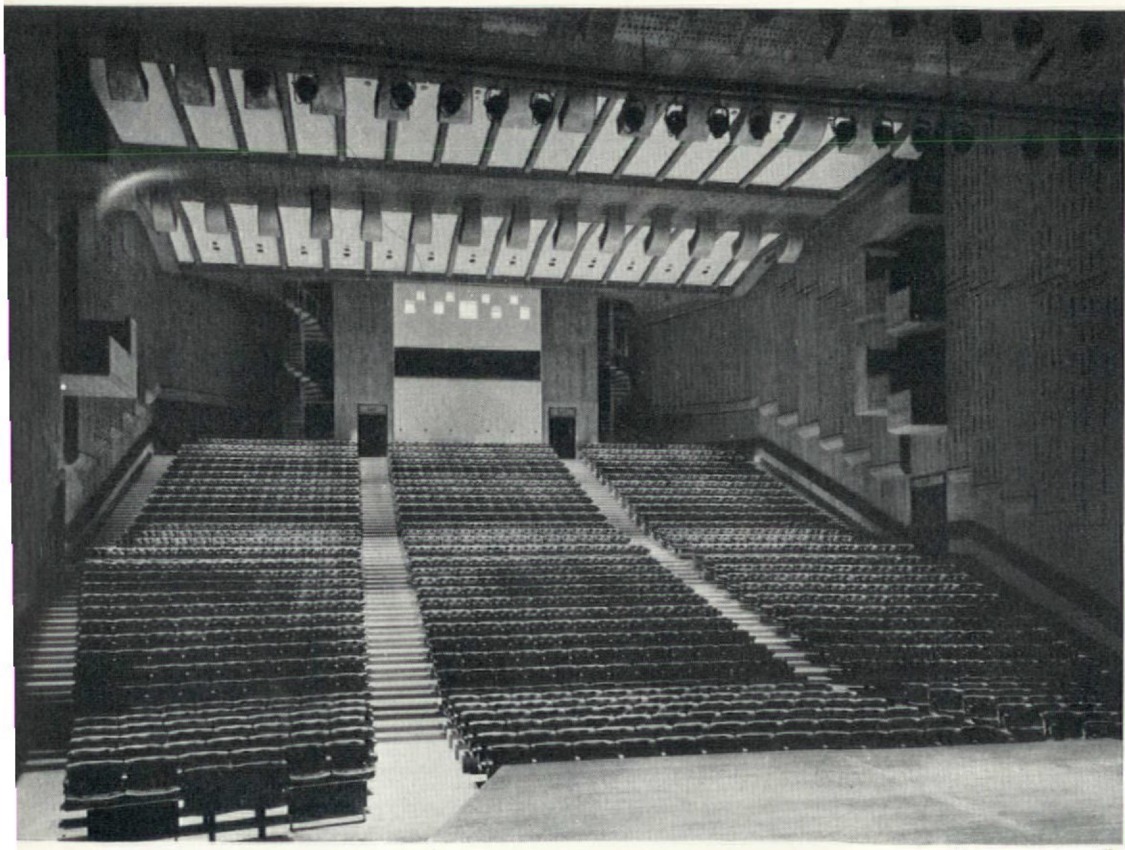


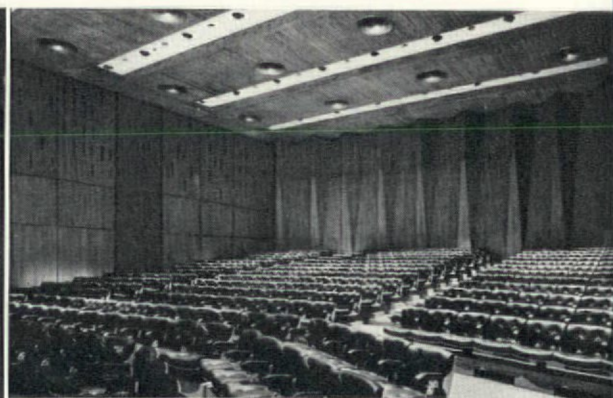
South Bank Arts Centre, London

GLC Architects' Department.

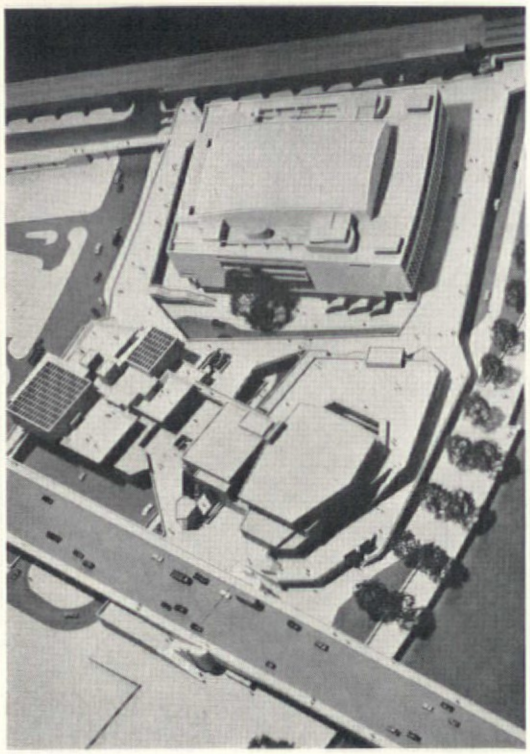
The design of the South Bank Arts Centre was started a little over seven years ago, though there were many previous proposals dating back to 1955. In 1960 the plans and model were announced to the press—the same year that the Twist was introduced heralding a new era, which gives an indication of the agonizingly slow process of getting architecture off the ground. The lack of immediacy from which the building now suffers is the result of a deflation of values current at the time of its inception. Retrospectively, it is worth recording some of these early preoccupations.

The design was one of the first attempts by the LCC in the pre-Buchanan period to recognize the conflict between the pedestrian and the motor vehicle. This was not seen only as a simple problem of segregation; the different nature of their moving was exploited, the inspiration being the '51 Exhibition site and 2 entries for the Hauptstadt Berlin Competition of 1958, that by the Smithsons and that of Arthur Korn. The acoustic geometry of the Queen Elizabeth Hall followed that of the Leipzig Gewandhaus and the Zurich Tonhalle, designed to produce longer reverberation periods than those of the fan-shaped concert hall loved at that time. A liking for exposed sawn-board shuttered concrete and pre-cast exposed aggregate slabs was another favourite of the period and probably marked the end of the 'struggle' for their acceptance that began with the pre-Roehampton set in the LCC (referred to in the Howell, Killick, Partridge and Amis issue of *Arena*, by A. E. J. Morris). Again of interest was a response to 'the history of the immediate past' which gave rise to a reference to Sir Owen Williams in the mushroom-headed columns and flat slab





3 4, 5



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constructions. The other major ingredient in this eclectic flirtation was the Corb-inspired architecture of Japan—evident particularly in the heavy detailing and balustrades to the walkways and terraces.

A special trap the architects were determined to avoid was the nautical whimsy of the 1951 Festival of Britain. The accommodation brief, by its size and complexity posed considerable problems. The site is restricted, hemmed in by Waterloo Bridge, the Royal Festival Hall, the river Thames and the Shell building.

The cluster now opened comprises the Queen Elizabeth Hall, seating 1100 people, the Purcell recital room for 372 people, a common foyer at first-floor level (with access from the riverside terrace and from a car users' entrance at ground level), and artists' accommodation grouped around the backstage area. The Hayward Art Gallery with 20,000 sq. ft of exhibition space, with 170 car spaces below it, at road level, is still incomplete. ▷122

1
Queen Elizabeth Hall from the west and the river, with Hayward Art Gallery behind

2
Exploded diagram showing the relationship of the Queen Elizabeth Hall and the Purcell Room

1 main entrance
2 car users' entrance
3 foyer
4 Queen Elizabeth Hall
5 Purcell Room
6 plant room
7 roof void
8 artists' entrance
9 service entrance

3
Queen Elizabeth Hall

4 & 5
Purcell Room

6
Model of total development, from the north

7
Section BB

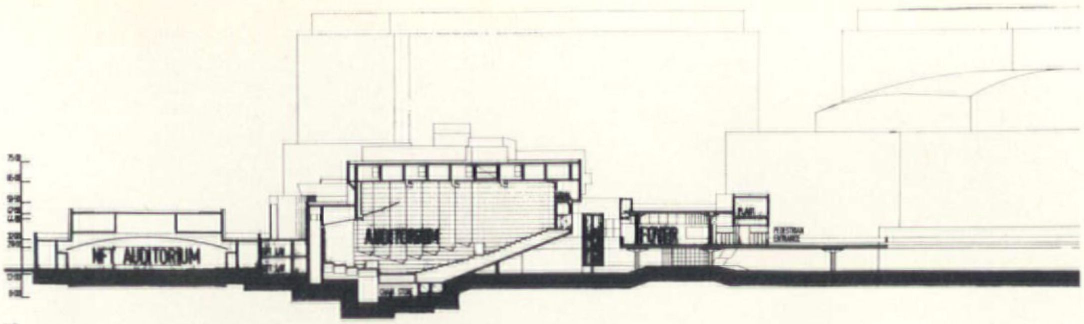
8
Plan at level 22.75

9
Plan at level 32.00

Photos: 1 & 3-5 GLC Photographic Unit

The cost of the South Bank Arts Centre, including the Hayward Gallery now being built, the setting in the riverside gardens and the associated walkways, is about £2,700,000. Of this sum about £1,750,000 is for the Queen Elizabeth Hall and the Purcell Room.

Architect to the GLC: Hubert Bennett
Deputy architect: Jack Whittle (and LCC predecessor—F. G. West)
Senior architect, Civic Design and General Division: Geoffrey Horsfall
Deputy architect, Civic Design and General Division: W. J. Appleton
Group leaders: E. J. Blyth, N. Engleback
Job architects: J. A. Roberts, W. J. Sutherland
Director of mechanical and electrical services: C. A. Belcher
Electrical services: P. C. Hoare
Mechanical services: R. J. Dickson
Structural consultant: Ove Arup & Partners
Acoustic consultants: Hugh Creighton, P. H. Parkin, BRS
Contractor: Higgs & Hill Ltd.



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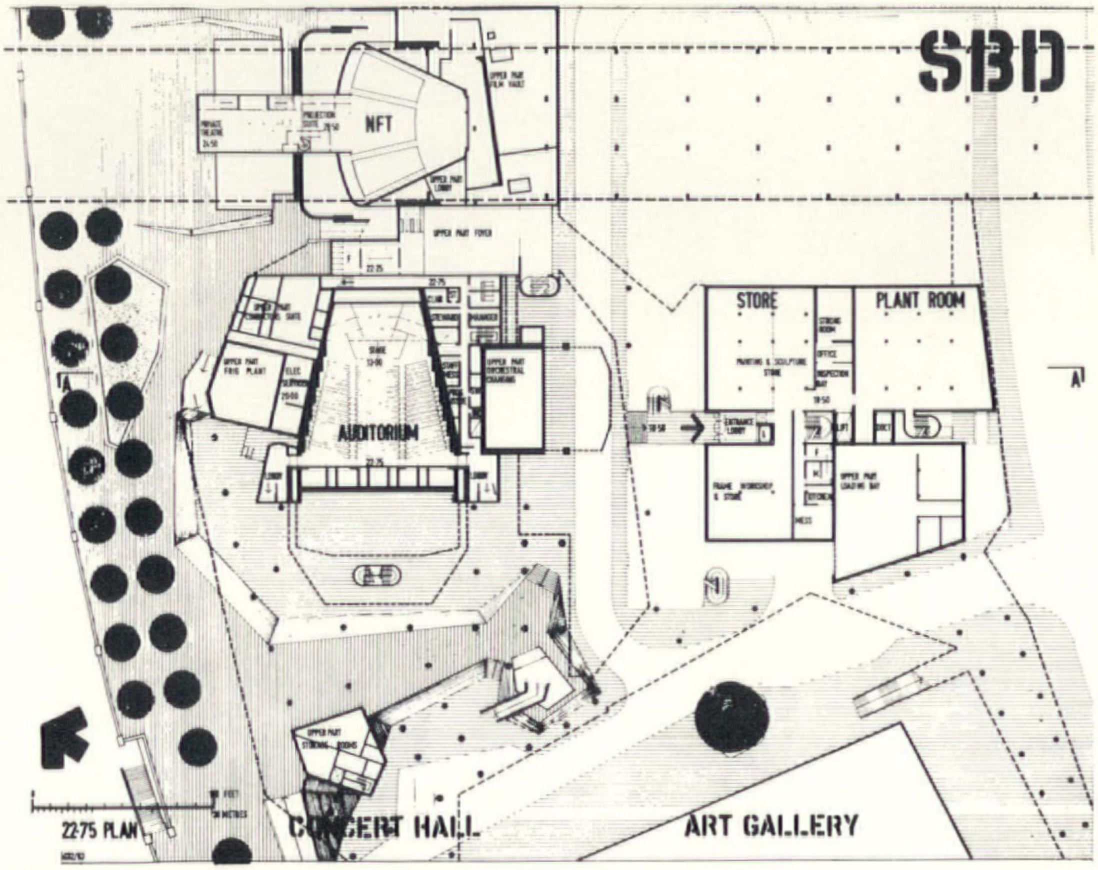

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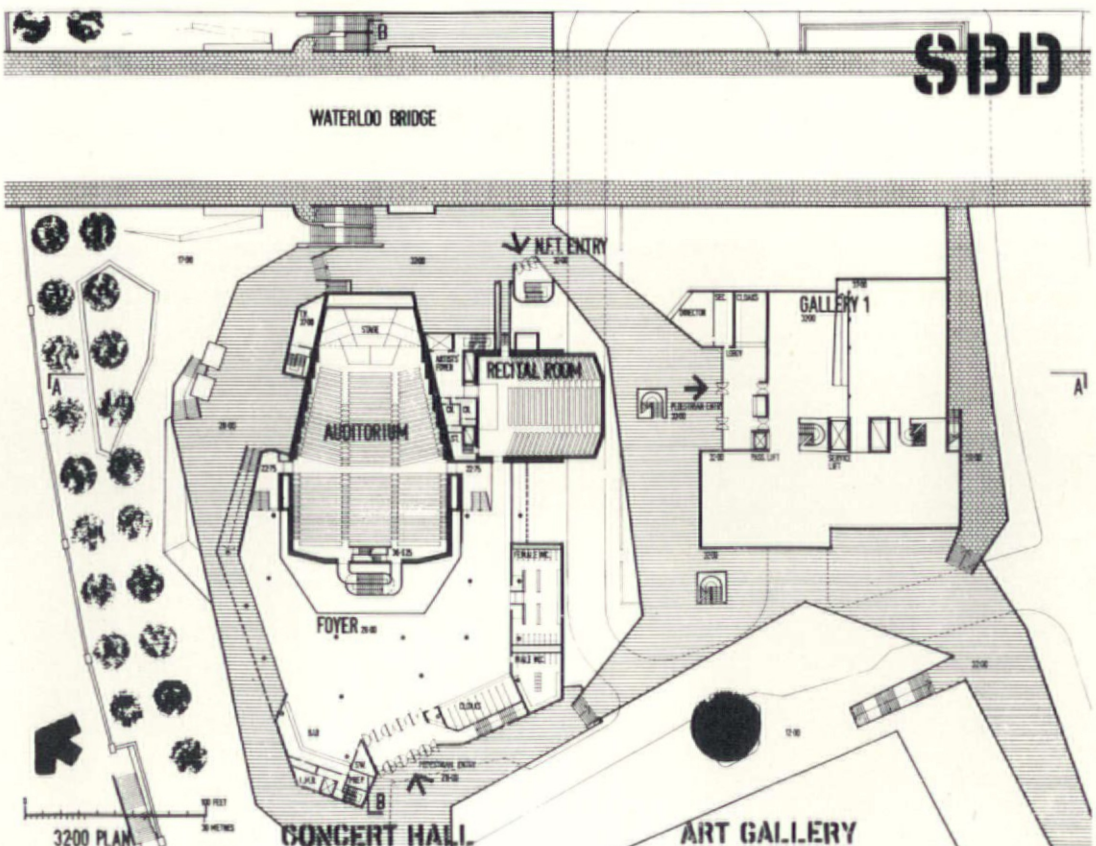

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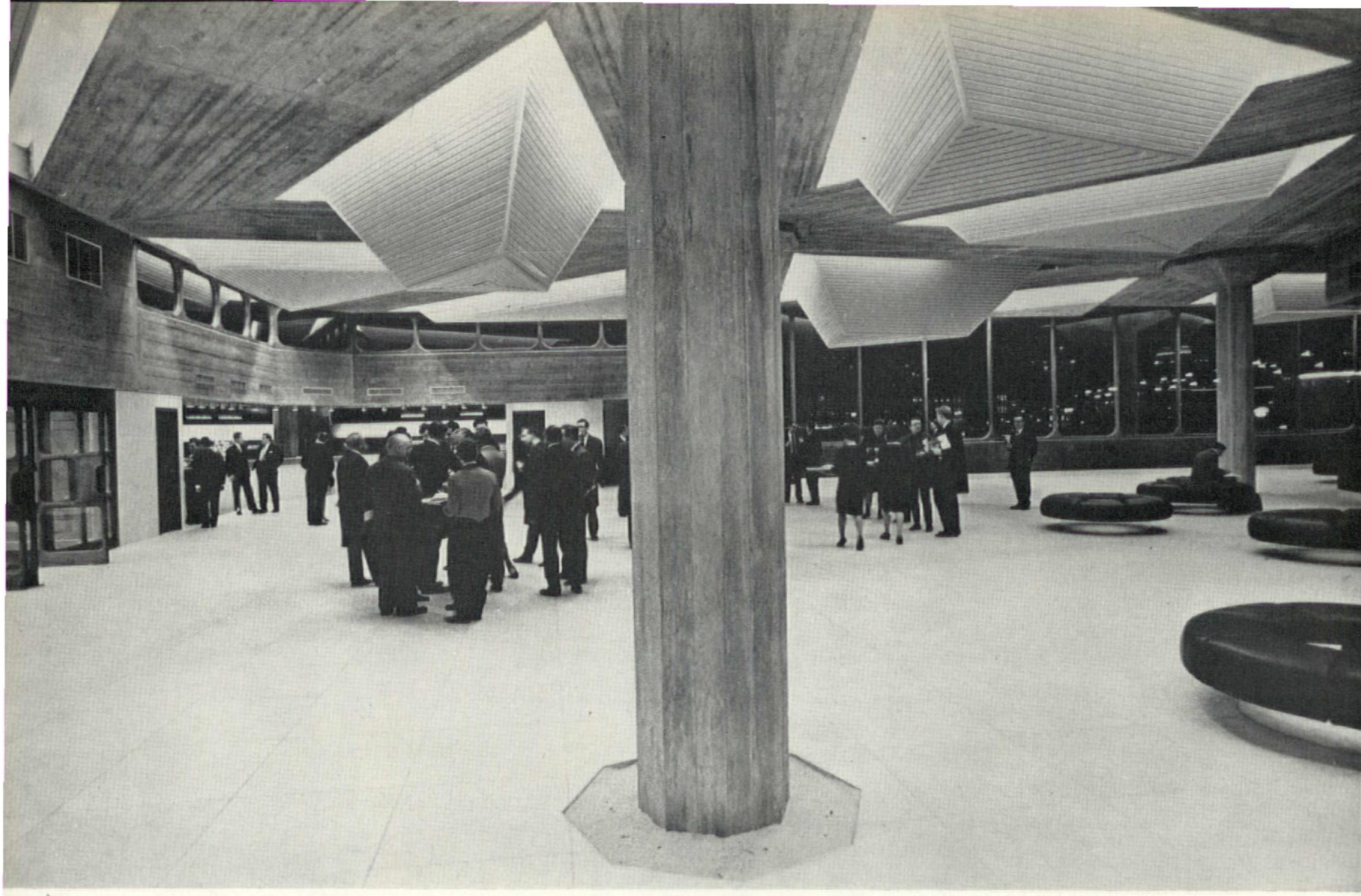

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◁121

A final detailed assessment of this group must await completion. Nevertheless, the lack of compromise between the original design and the first completed building is rather remarkable. The only real change being the timber, rather than concrete finish, in the interiors of the QE Hall and the Purcell Room (resulting in a cigar-box atmosphere). Certain detailed afterthoughts, such as the picture-framed duct louvres in the back wall of the QE Hall platform area and the disastrous design of the organ, were not part of the early project.

The success of the building is due largely to the uncompromising inventiveness of the design; but credit is also due to the group leader and the job architect for seeing it through.

Maybe Banham was right when he said, 'The Department will find its most obvious monument in the only major example of the quasi-fortified/neo-antheap/more-crumbly-aesthetic manner in the country, the extension to the Royal Festival Hall, now raising its mini-Ziggurats over the parapet of Waterloo bridge.' At the time it was designed, the architects thought they had something to say, and said it consistently: through the mixed vocabulary of the building came the message of the city as a single building.

Warren Chalk

1
Main foyer looking north towards the Thames

2 & 3
South gallery of the foyer leading to the entrances of the Queen Elizabeth Hall and Purcell Room

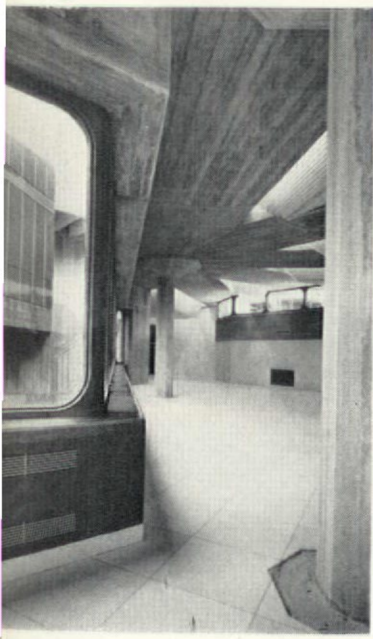
4
The Thames-side gallery looking towards the bar and main entrance doors

5
The foyer looking south, main entrance to the right

6
Main foyer looking north across the Thames

Photos: 1 & 6 Frank Herrmann; 2–5 Sam Lambert

2



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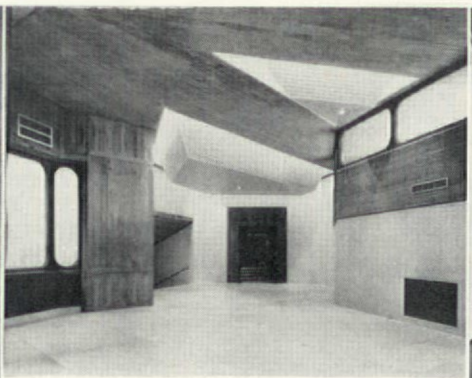

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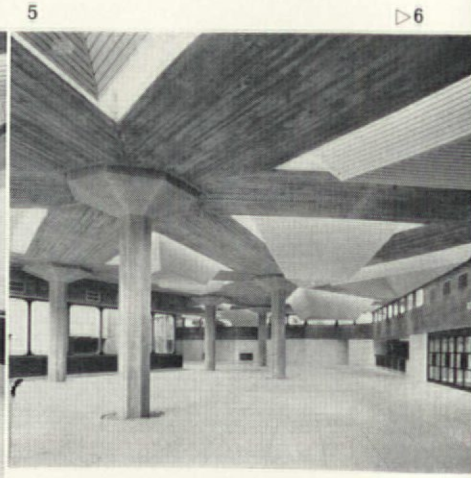

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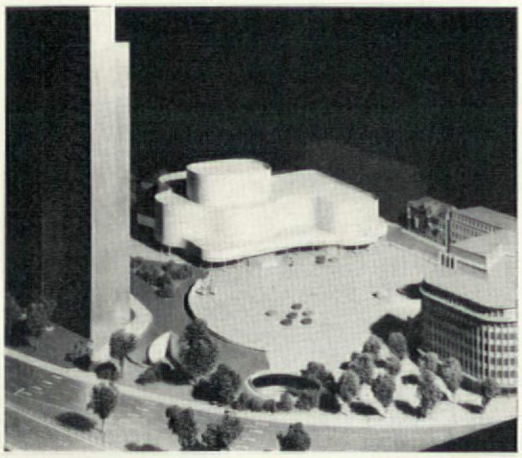


1

Düsseldorf theatre

Bernhard M. Pfau

Theatrical consultant: Willi Ehle
Structural engineer: Haeserts
Acoustic consultant: H. Graner

The design of the theatre was evolved in competition; the first stage being judged in October 1959, the second in February 1961, when Bernhard Pfau was commissioned as architect. Alterations and refinements have since been made in consultation with Willi Ehle, but construction has been under way since 1965 and the theatre is due to open late in 1968.

The form of the building was conditioned not only by detailed planning considerations, but by the nature of the prominent site on the north side of the newly formed Jan-Wellem Platz, overlooking to the north the Düsseldorf Royal Gardens, and overlooked on the west by the tall slab of Hentrich and Petschnigg's Dreischeibenhaus (Thyssen Building). Pfau was determined, from the start, not to seal off the one side of the Jan-Wellem Platz with his theatre; for not only would it be almost impossible to evolve a building form that would link up with those already around the area, to create a continuous wall of enclosure, but the internal requirements of the theatre would be thus dictated by considerations external to the needs of the plan. The building is a freestanding free-flowing and isolated structure, standing between the square and the park. It is intended that its function as a theatre—or rather two theatres—should be explicit.

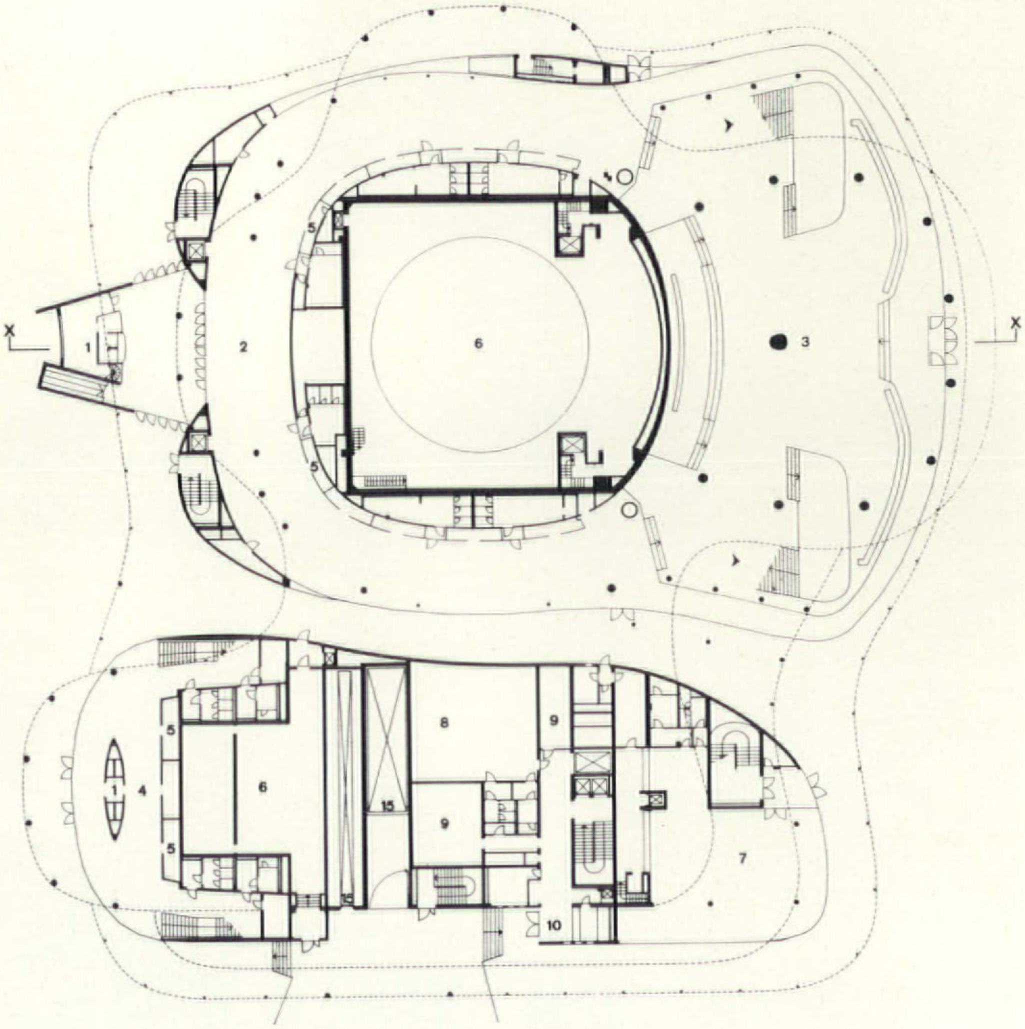
The large auditorium (1024 seats) has a traditional stage and proscenium opening, though the apron can be extended into the auditorium to provide a theatre-in-the-round. The small auditorium is far more flexible, the finished floor and stage being on the same level, but with two adjustable platforms that can be raised and lowered to provide a threatre-in-the-round (345 seats), an ordinary proscenium arched stage (244 seats), or a deep forestage (219 seats).

Both auditoria have common changing rooms—all at stage level—workshops and administrative offices.

The auditoria are at an upper level, foyers and vast cloakrooms (with a one-way traffic system to avoid congestion) are at ground level.

The frame structure is of reinforced concrete and steel, clad in standard pre-cast units, punctured, where needed, with openings over which frameless glass or Perspex windows are to be bolted.

Cost is estimated as DM31·5 million (£2·6 million)



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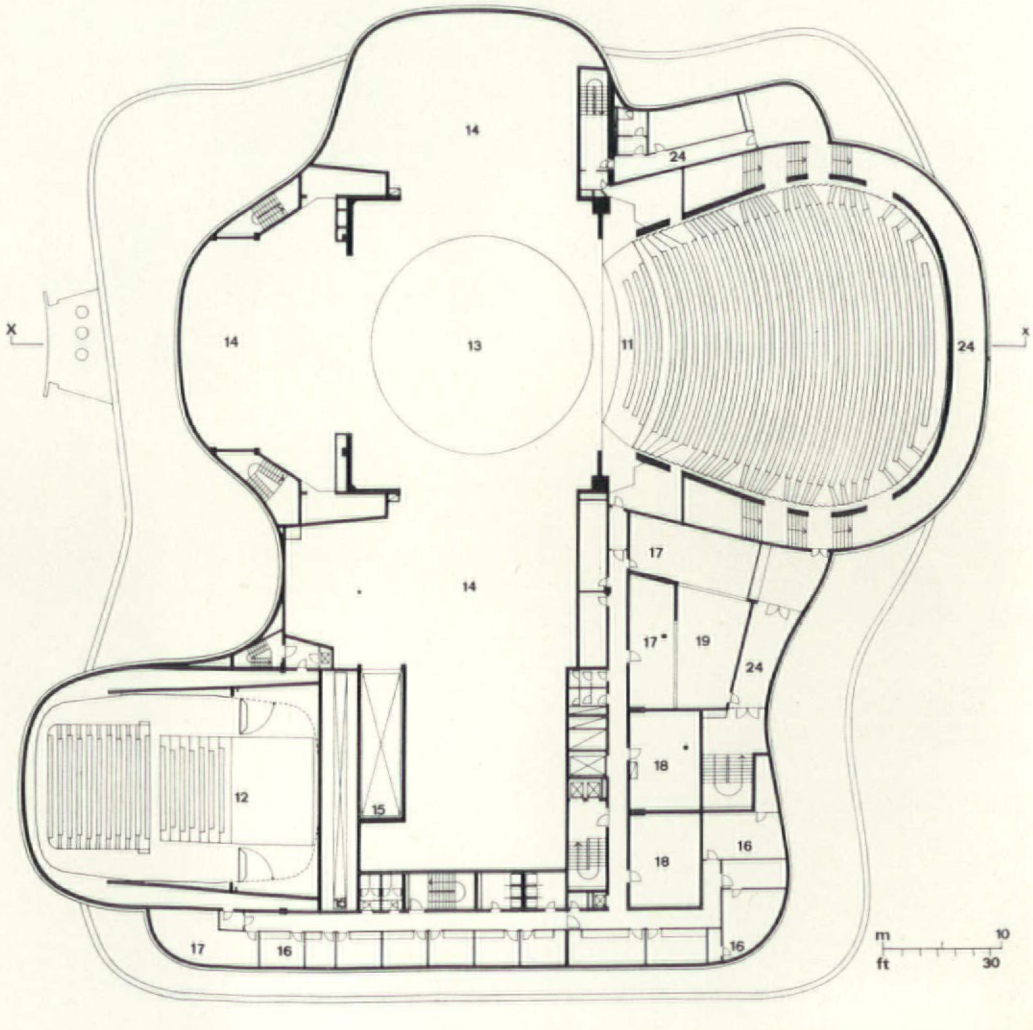

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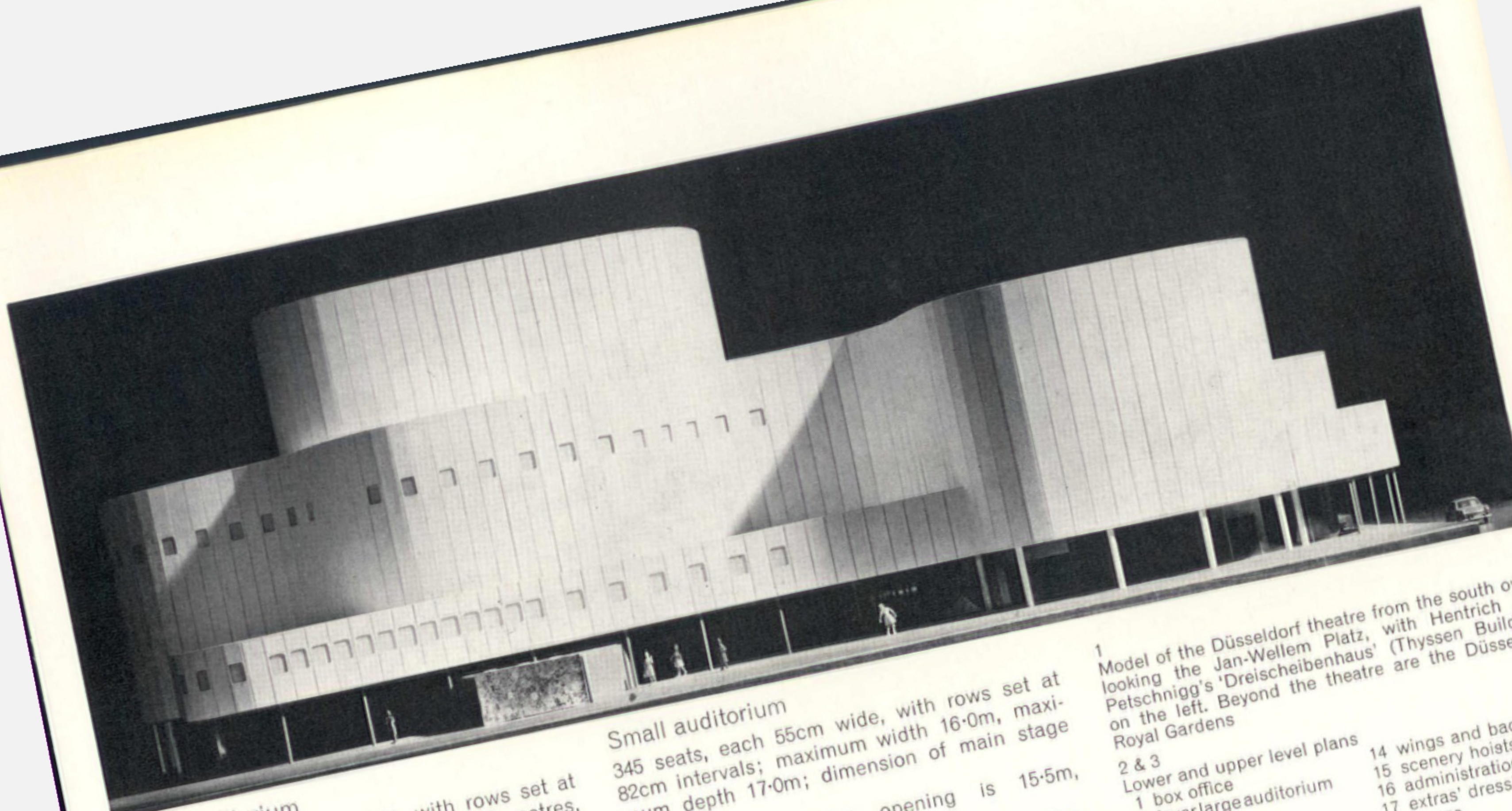

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Large auditorium

1024 seats, each 55cm wide, with rows set at 90cm intervals; maximum width 28·0 metres, maximum depth 30·0 metres; dimension of main stage 24·3m × 21·5m, to which must be added a backstage 15m × 15m, a right wing 16m × 15m and a left wing 32m × 15m.
The revolving, adjustable stage is 19·3m diameter.
Maximum proscenium opening is 18m, the minimum 10m.
Height of rigging loft to base of pulleys is 24m.
Orchestra pit 64sq.m.

Small auditorium

345 seats, each 55cm wide, with rows set at 82cm intervals; maximum width 16·0m, maximum depth 17·0m; dimension of main stage 9·0 × 7·0m.
Maximum proscenium opening is 15·5m, minimum is 9·5m.
Height of rigging loft to base of pulleys is 12·50m.

1
Model of the Düsseldorf theatre from the south overlooking the Jan-Wellem Platz, with Hentrich and Petschnigg's 'Dreischeibenhaus' (Thyssen Building) on the left. Beyond the theatre are the Düsseldorf Royal Gardens

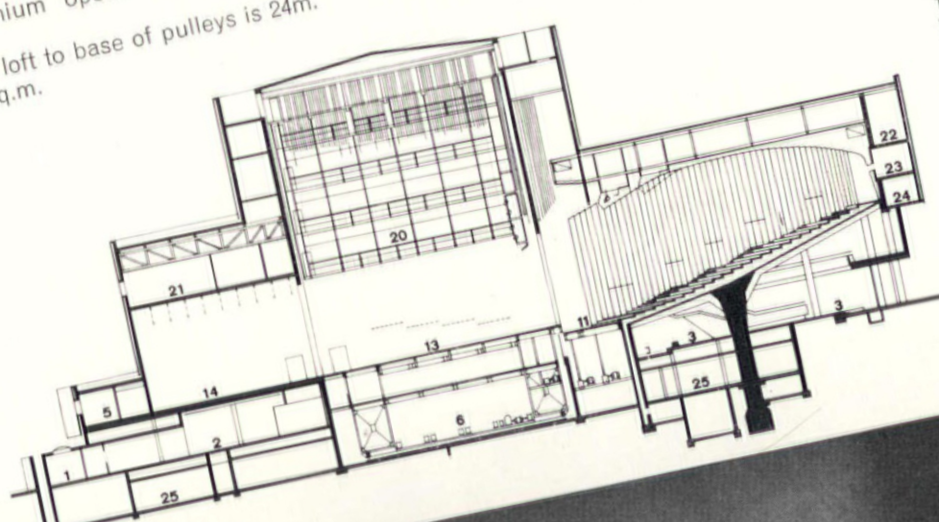
2 & 3
Lower and upper level plans
1 box office
2 foyer large auditorium
3 main foyer
4 small auditorium foyer
5 cloakrooms
6 under stage
7 cafeteria
8 canteen
9 kitchen
10 stage door
11 large auditorium
12 small auditorium
13 revolving stage
14 wings and backstage
15 scenery hoists
16 administration offices
17 extras' dressing rooms
18 prop. stores
19 lightwell
20 fly tower
21 wig store
22 access to lighting
23 production control
24 public corridor
25 plant room

4
Model from south, overlooking the Jan-Wellem Platz

5
Section x–x

6
Model of the main foyer seen from its gallery

7 & 8
Model of the large auditorium
Photos: Rudolf Eimke



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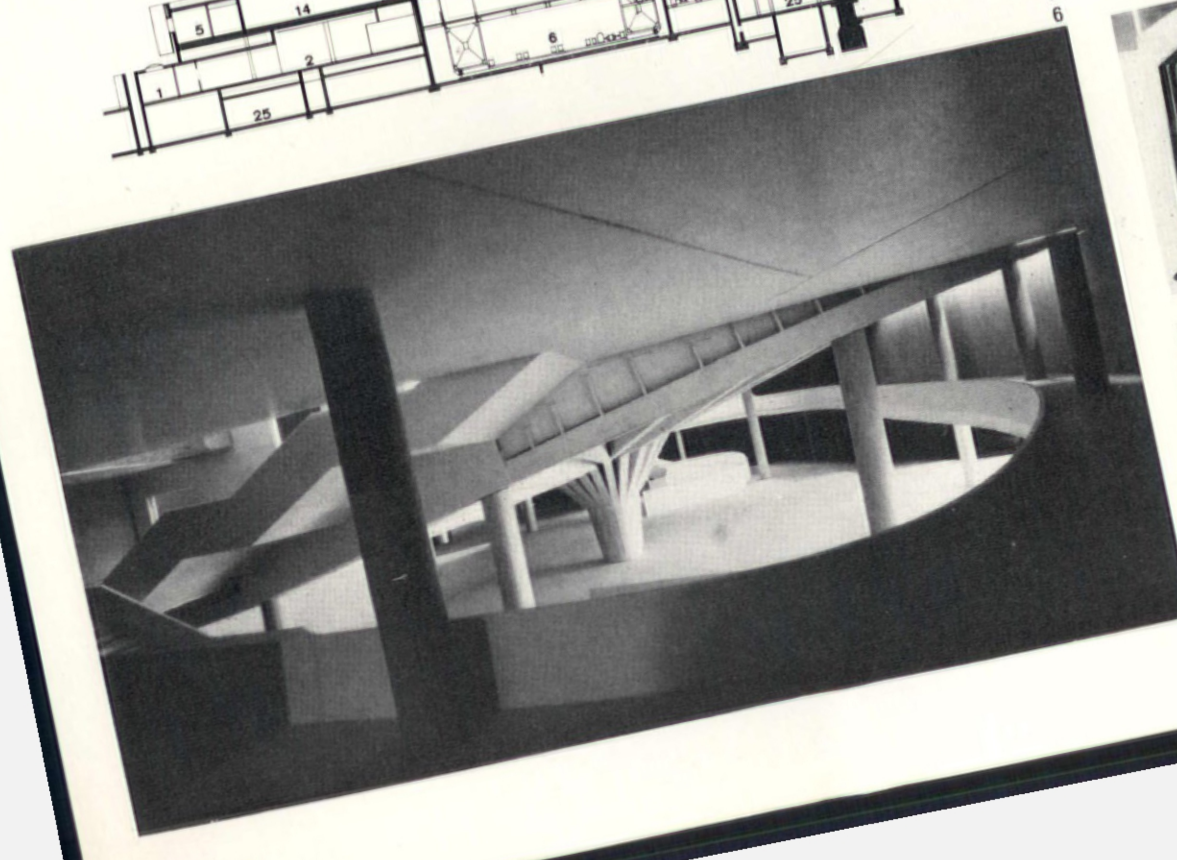

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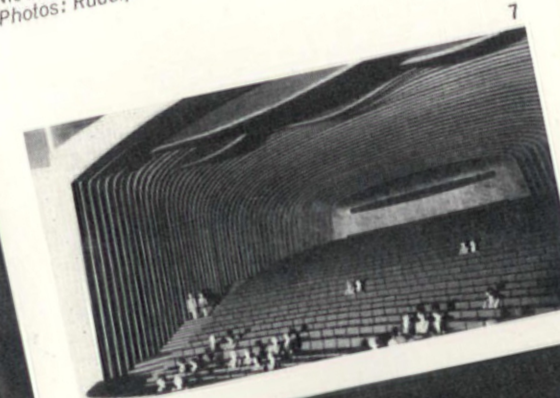

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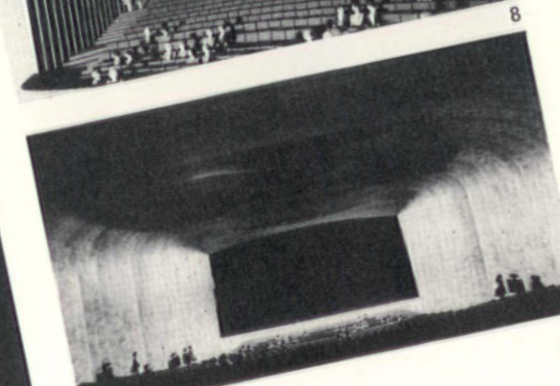

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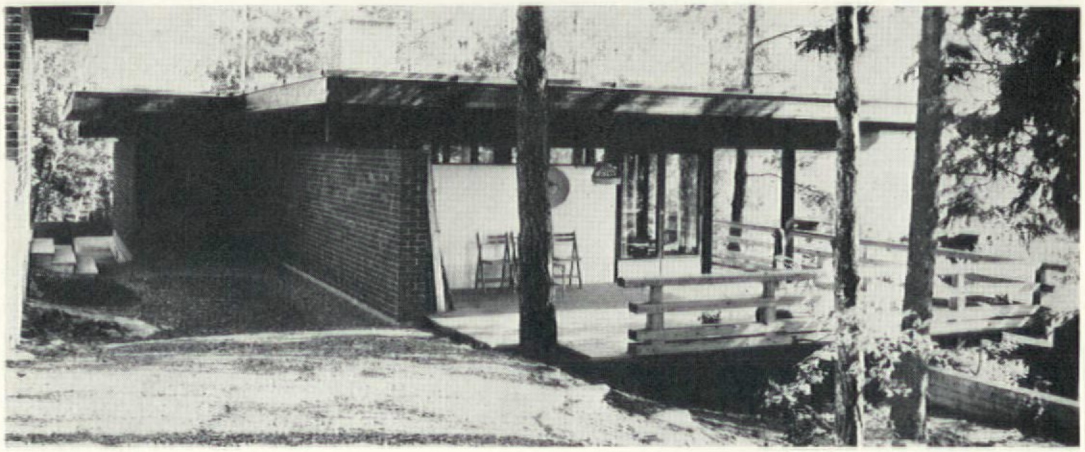

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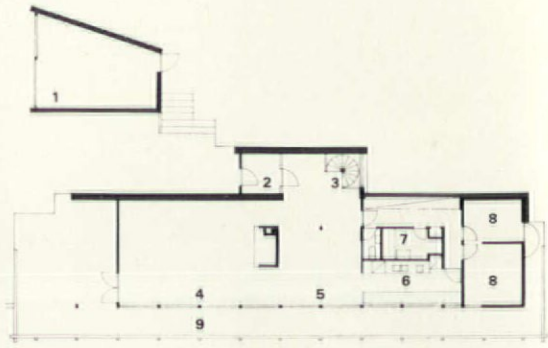

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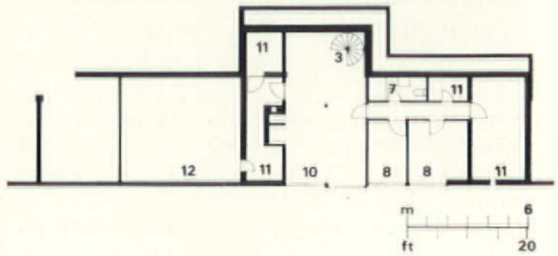


4

House Holmenkollen, Oslo

J. R. Lloyd and H. Mjelva

The house stands on the south slope of the mountain overlooking Oslo Fjord and is beside the tram station which serves the ski jump. The site was very restricted and falls at 1 in 3. The client wished the house placed so as to take advantage of the magnificent view but so that all main rooms should have direct contact with the ground and that the drive should be as short as possible, to minimize snow clearance in winter. All main accommodation was to be on one floor; a separate floor to contain a studio, guest bedrooms, stores, etc, which can be used as a self-contained flat at a later date.

The house was considered in section as a platform on a podium and originally had a strong underlying symmetry in plan, this latter has been lessened throughout development, but has remained an implied discipline. The design was almost finalized (i.e. $\frac{1}{4}$in scale, outline specification, etc.) when J. R. Lloyd had to leave at very short notice to take up a post in Africa. Mjelva generously agreed to take over and carry the work to completion.

1
View of main façade from the south

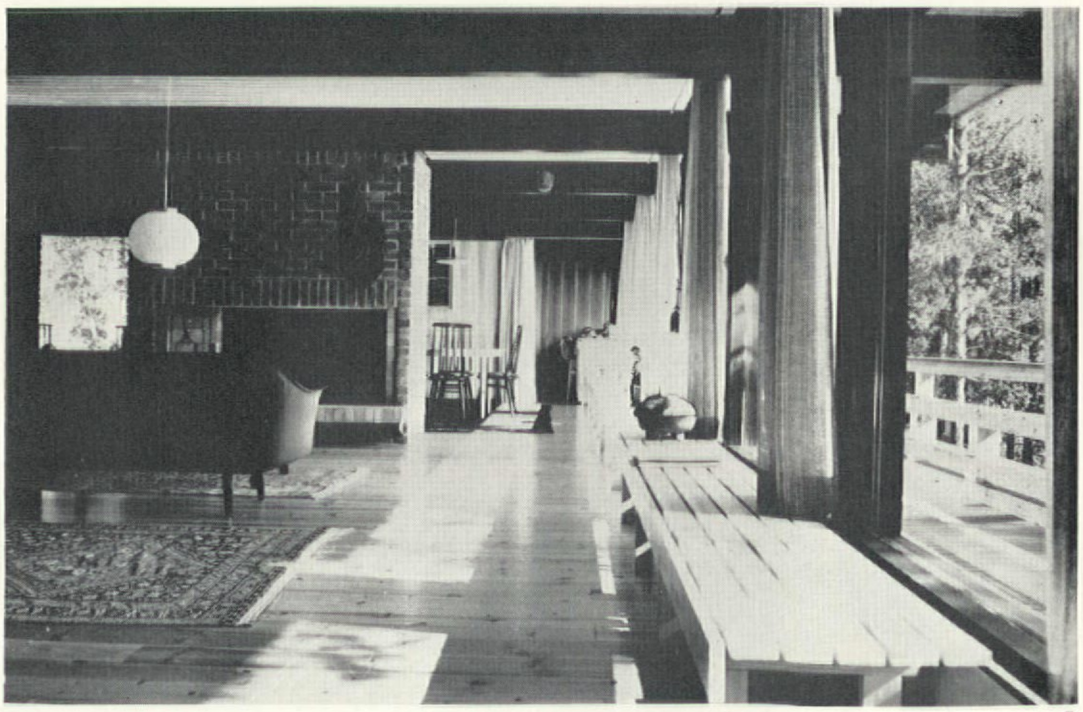
2
Approach from the west

3 & 4
Ground floor and basement plans

1 garage
2 entrance
3 stair
4 living room
5 dining room
6 kitchen
7 bathroom
8 bedroom
9 veranda
10 studio
11 store
12 unexcavated

5
The living room, looking towards the dining area

6
The veranda



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Kiruna, Swedish Lapland

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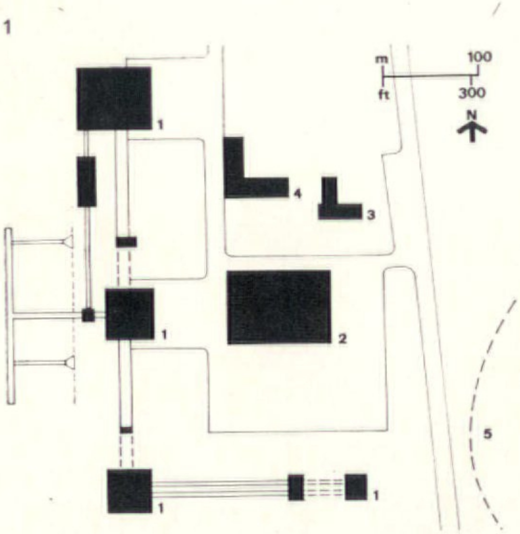


2

Iron ore processing plant, Svappavaara

Örjan Lüning

All the buildings illustrated on this and the following four pages are well north of the Arctic circle, in the area around Kiruna,. The climate there is severe and trying. For long periods the temperature is at –40 °C. The *raison d'être* of the whole development is of course, the lure of the rich iron ore deposits, mined by the nationalized LKAB.

In 1961 Örjan Lüning started work on the processing plant at Svappavaara which was in production three years later, although building was not complete until this year. The forms are clear-cut and crisp, sheathed in aluminium glistening sharply in the clean, cold air. Even the dust from the iron ore cannot dull this splendour—it is too heavy to be blown about.

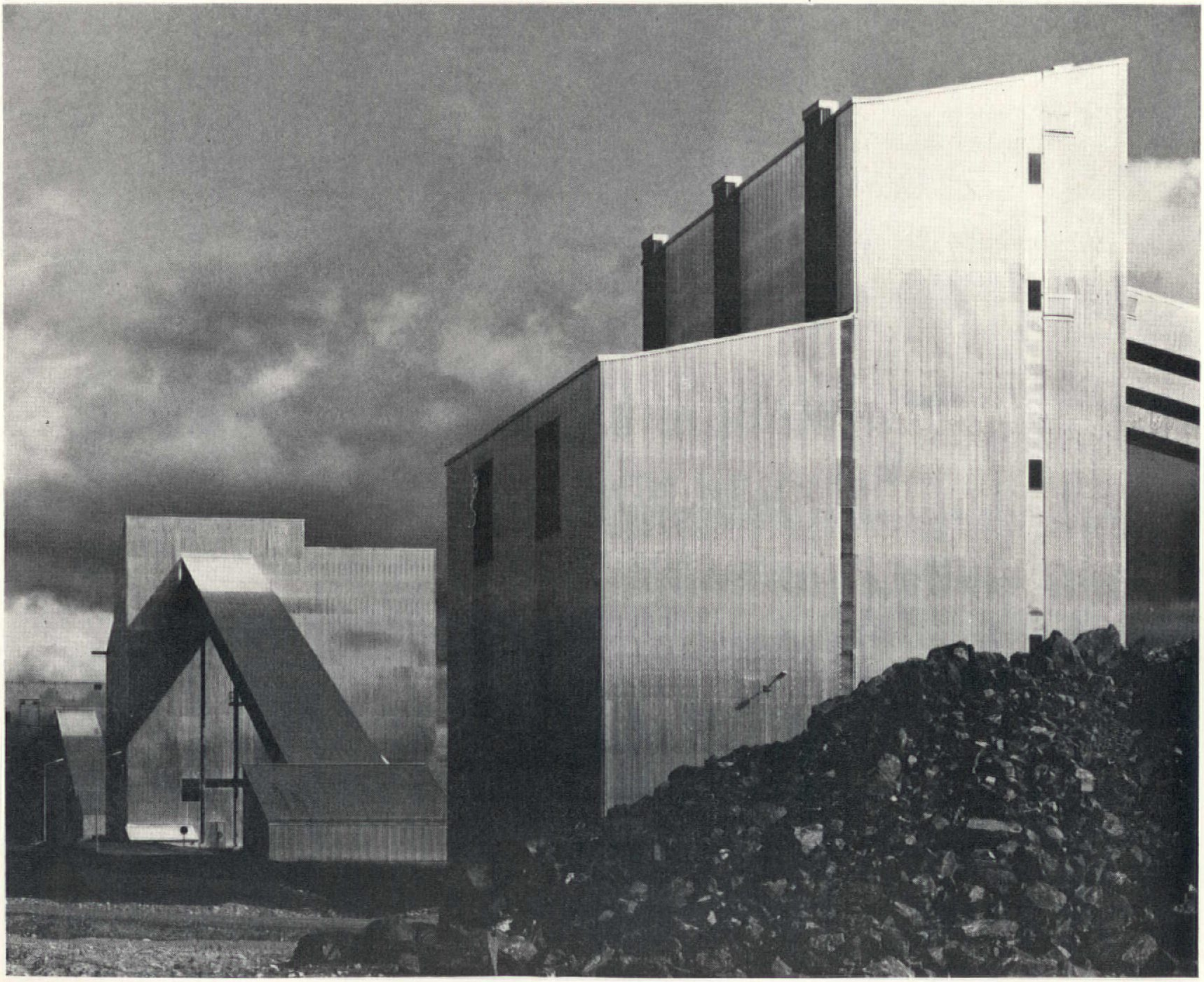
1
Site plan of Svappavaara iron ore mine by Örjan Lüning
1 processing plant
2 workshop
3 compressor and boiler plant
4 administration and restaurant
5 open cast mine

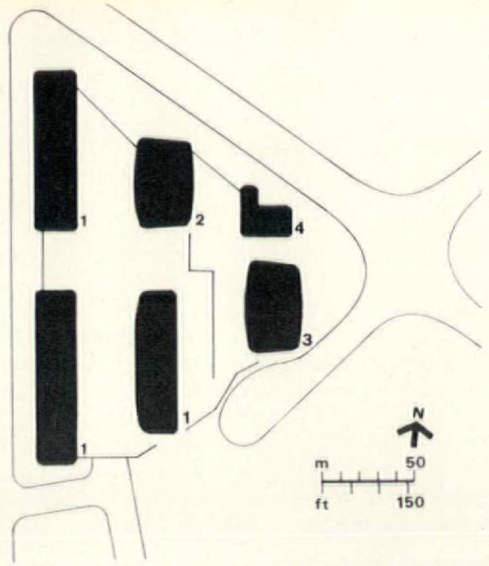
2
Svappavaara iron ore processing plant from the south
Photo: 2 Rolf Dahlström

Housing at Svappavaara and Kiruna

Ralph Erskine

These new residential buildings in the Kiruna area are all by the English architect Ralph Erskine, now living in Sweden. He has designed before in this sub-arctic zone—his best known works being the hotel at Borgafjäll and the Lulea shopping centre, which has proved so successful that ten years after its completion an admission fee is charged to limit the number of customers. His experience here resulted in observations, jotted down in a 'grammar' for designers in the northernmost regions, and used by him in preparing the plans for the Kiruna and nearby Svappavaara developments: Cold *demands a reduction of exterior surfaces and a grouping of many different functions under one roof for common shelter and warmth.* The warm period *is short, leading to a peculiarly intense desire to enjoy it to the full. The architecture must be adaptable to summer activities.* Snow *necessitates roads under cover. There must be space for snow-clearing equipment and snow ridges alongside the roads. One has to master the snow, enjoy the snow's beauty.* ▷128





1

◁127

Frozen earth. *In the southern parts of the region the ground has a more constant temperature than the air and should be used as a protection for the buildings. In the northern area the risk of frost cracking buildings suggests that they should be lifted off the ground or set on cushions.*
Light conditions. *Extremes of summer light and winter darkness cause psychic stress. The need to screen off the sun at night during the summer and to have as much light as possible during the winter determines the need for adjustable window openings. Outdoor lighting and reflections from the snow reduce the winter darkness. The low angle of the sun greatly affects planning.*
Wind *moving cold air causes intense discomfort. Screening from the wind is necessary, but in a flexible form so that the summer winds can be used to help keep away mosquitoes. The diversion of wind on to the snow can be used to clear it and to provide 'snow art'.*
Draining off cold air. *In very cold weather it is often comparatively calm. The movement of cold air to low-lying areas is marked and can result in big differences of temperature. One*

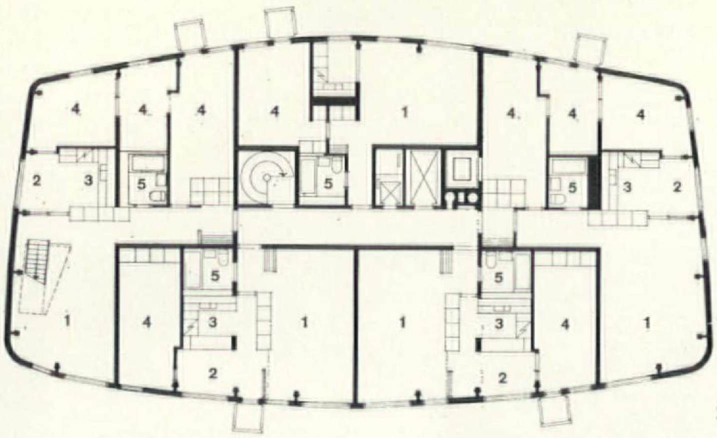
▷130

1
Site plan of the Kiruna development by Ralph Erskine
1 3- and 5-storey flats
2 medium height block
3 thirteen-storey block
4 church

2 & 3
Typical and twelfth-floor plans of high block of flats
1 living
2 dining
3 kitchen
4 bedroom
5 bathroom
6 storage

4
Kiruna development from the south-east

5
Thirteen-storey block of flats at Kiruna



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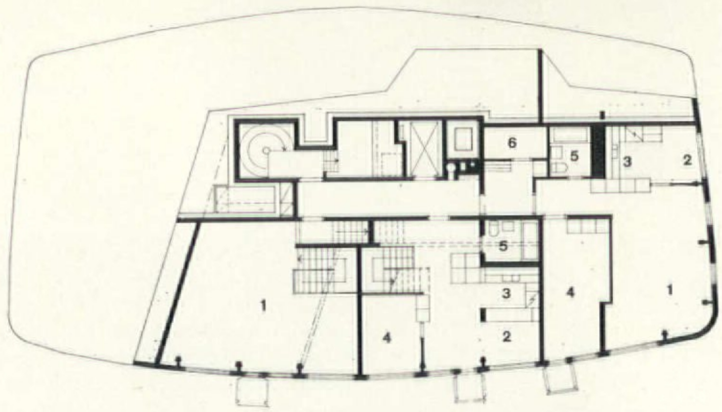

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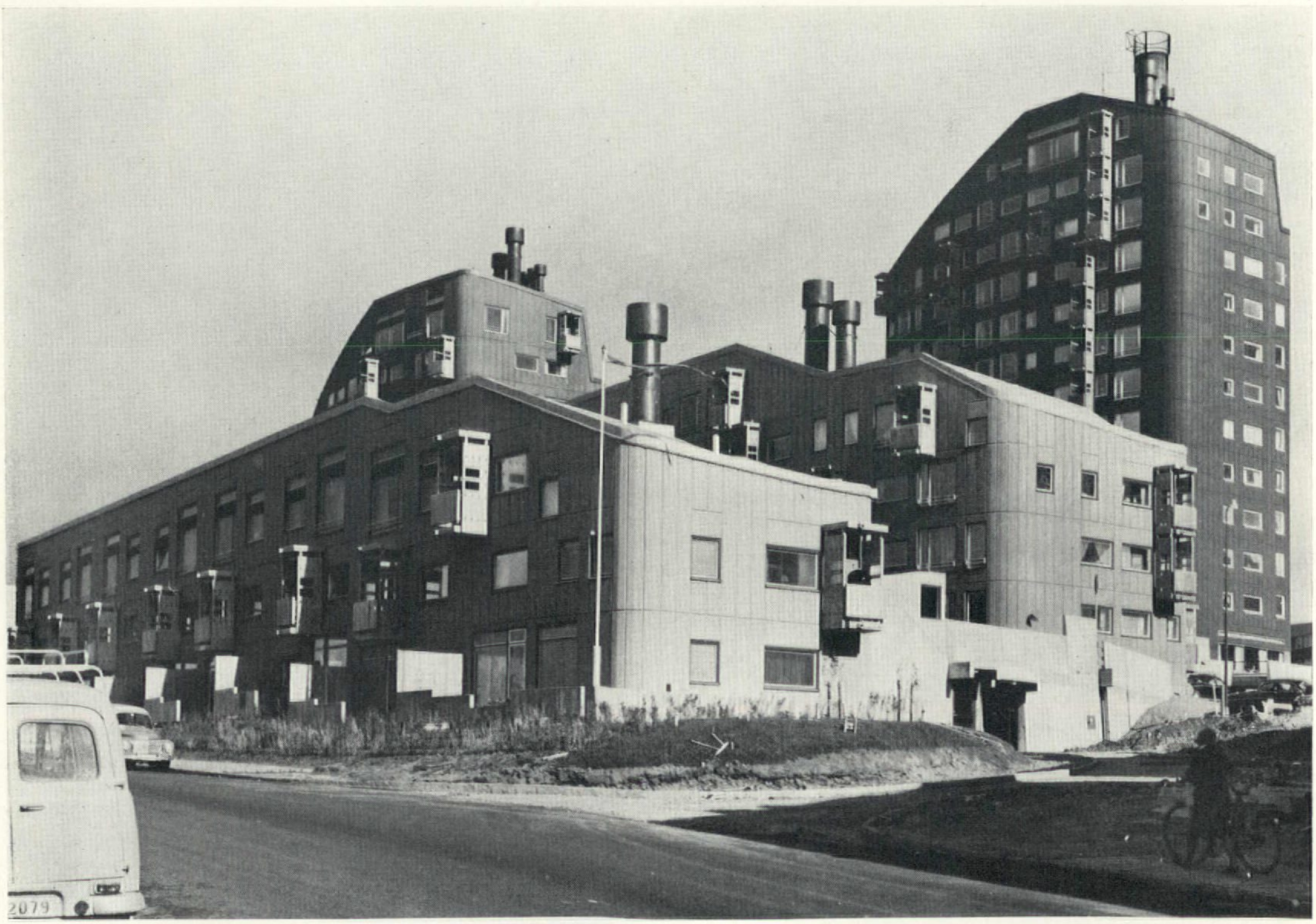

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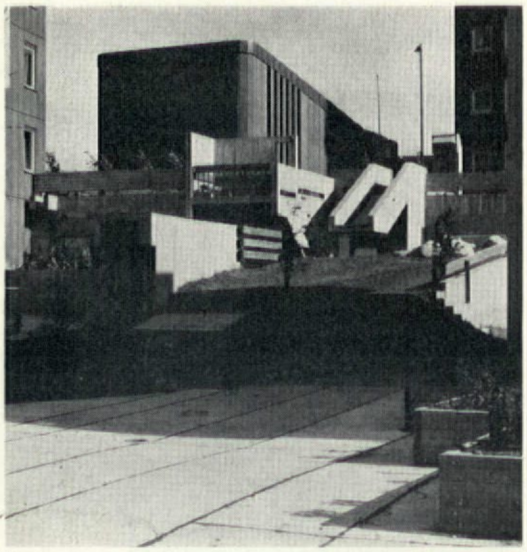

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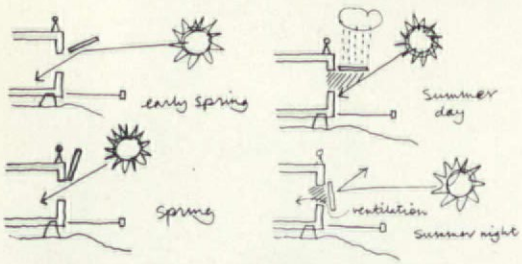

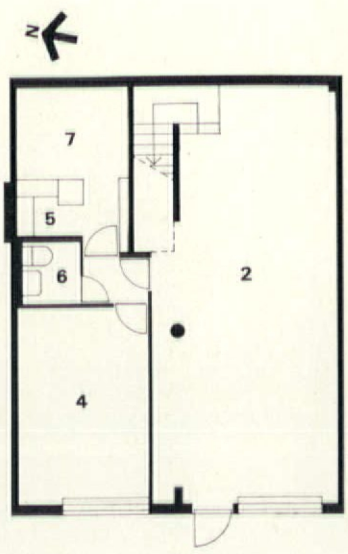

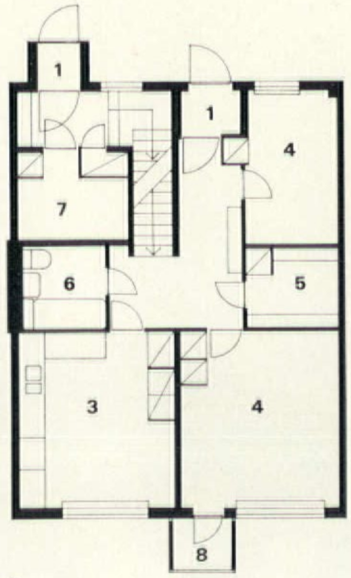

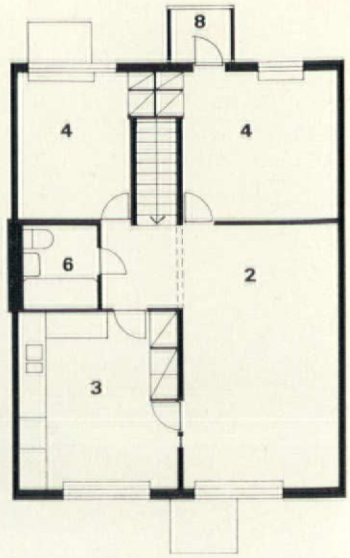

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2 3

4

must be able to drain off cold air. Building in low-lying areas and valleys must be avoided.

Radiated heat. *Positive, except for summer nights. Since radiation from the sun is usual, but warm air exceptional, shade is not, in general, desirable. North windows induce cold during the winter and warmth during the midnight sun. South slopes and walls are a source of well-being and heat saving—in addition they give shade on summer nights.*

Fauna. *The moors provide hunting, fishing and open-air life all the year round. The mosquito problem necessitates control with nets and spraying.*

Flora. *In winter snow, dead skeletons; in summer, green everywhere; in autumn, red. The limited number of plants and their sensitivity demands a carefully protected and limited use of both indoor and outdoor gardens.*

Isolation. *Severe conditions create tension. This can be reduced by concentrating buildings and providing a high level of social and cultural*

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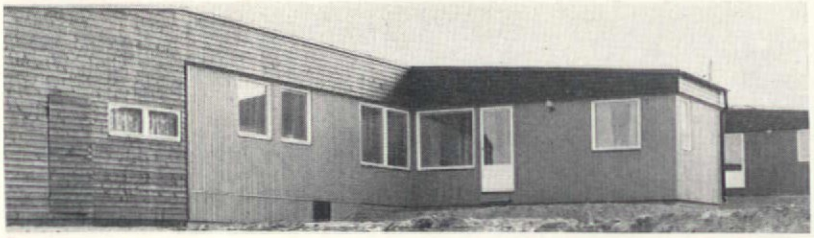

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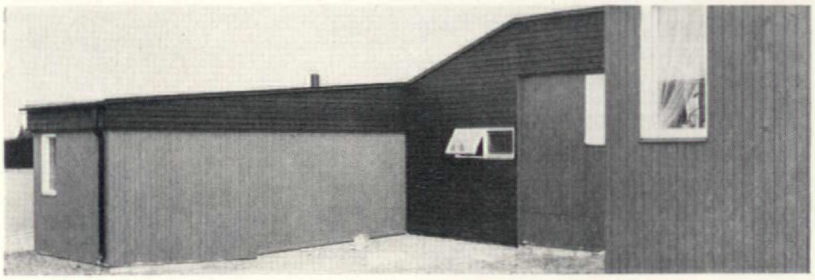

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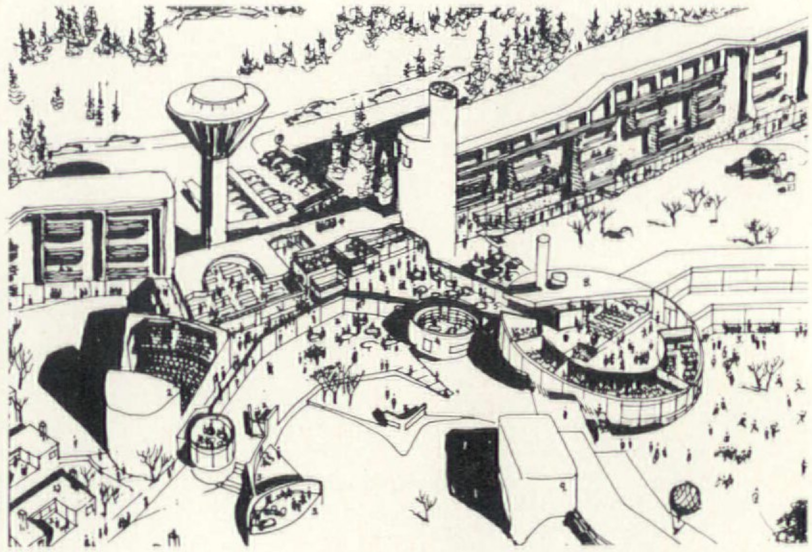

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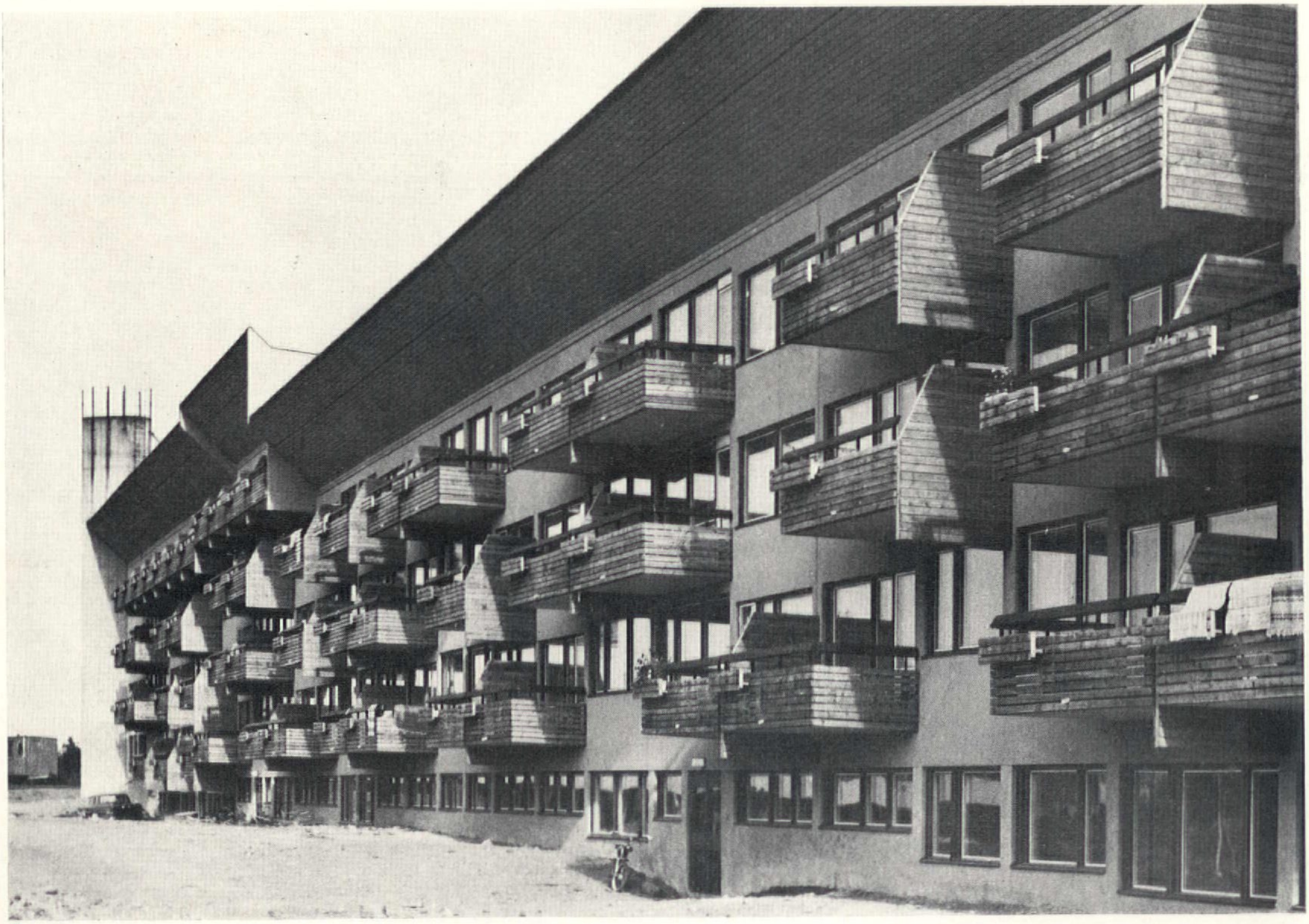
intercourse. Communal life is very important, but difficult to sustain. The community must adapt itself so that both private and communal life is richly developed. A variety of talents must be encouraged to avoid the preponderance of practical trades, common in the north.

The Kiruna development represents a less doctrinaire interpretation of these ideas than that at Svappavaara. At Kiruna there is a group of free standing buildings, some low, some high, all with magnificent views to the high Lapland mountains in the west. At Svappavaara (commissioned as the result of a competition) almost all the residential units are grouped together in one long winding block (known locally as the Big Snake), broken in the middle of its 200 metre length by a shopping centre and school, all under cover, and linked together underground. Around this as yet unfinished complex are scattered groups of single-storey houses, modelled on the traditional timber houses of the area.

1
Church in the Kiruna housing development
2, 3 & 4
Basement, ground and upper floor plans of two typical flats in the three-storey block at Kiruna
1 entrance
2 living room
3 kitchen
4 bedroom
5 dressing room
6 w.c./bathroom
7 store
8 balcony
5
View to the north between the 3- and 5-storey blocks
6 & 7
Workers' houses by Ralph Erskine at Svappavaara
7 & 8
Svappavaara civic centre and completed portion of continuous block of flats



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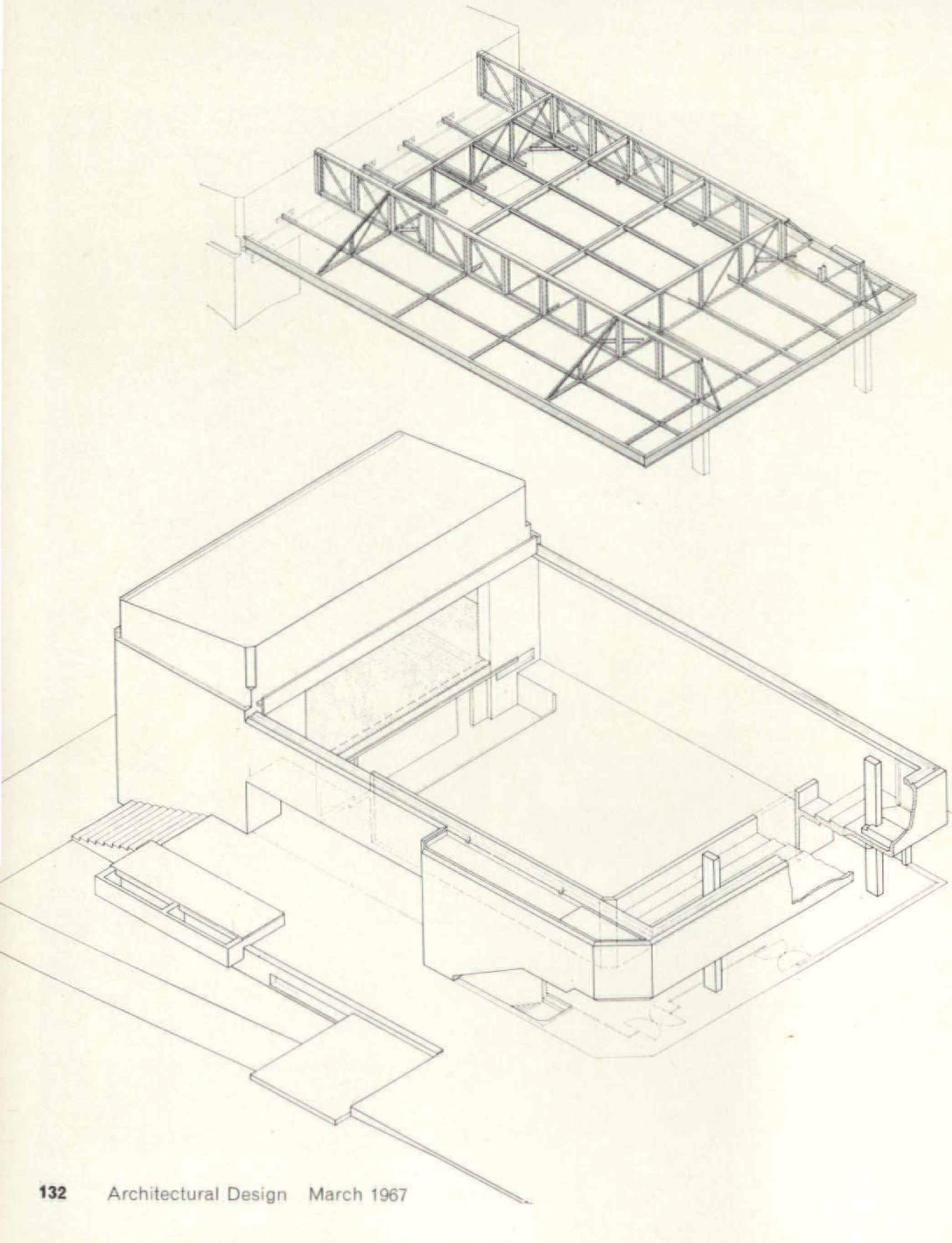


2

Bootham School hall, York

Trevor Dannatt

Assistant: Colin Dollimore
Structural consultants: Ove Arup & Partners
Acoustic consultant: Hugh Creighton

Bootham is a Society of Friends school for boys. A hall was required for assembly, meeting for worship, lectures, concerts, theatre and opera; thus freeing space in the existing building used for such functions but inadequate.

The clients laid down detailed requirements but also indicated the critical architectural problem —that of designing a building of form and atmosphere appropriate to daily assembly and Friends Weekly Meeting, yet capable of being transformed into one suitable for theatre and opera, etc.—from serenity to festivity.

The hall, for 440 people, is sited between the main school and the outlying science and music departments and the routes to these come within its aura. A wish to preserve a view of York Minster gave reason for not attaching it to the main school. However, there was a stronger reason for not doing so; from the outset, it was felt that the hall should be a freestanding building, placed pivotal to the complex of school buildings, as is appropriate to its use. It was also felt that such a cardinal building should be architecturally distinctive, fully modelled and of strong formal quality, analagous to freestanding sculpture in a courtyard.

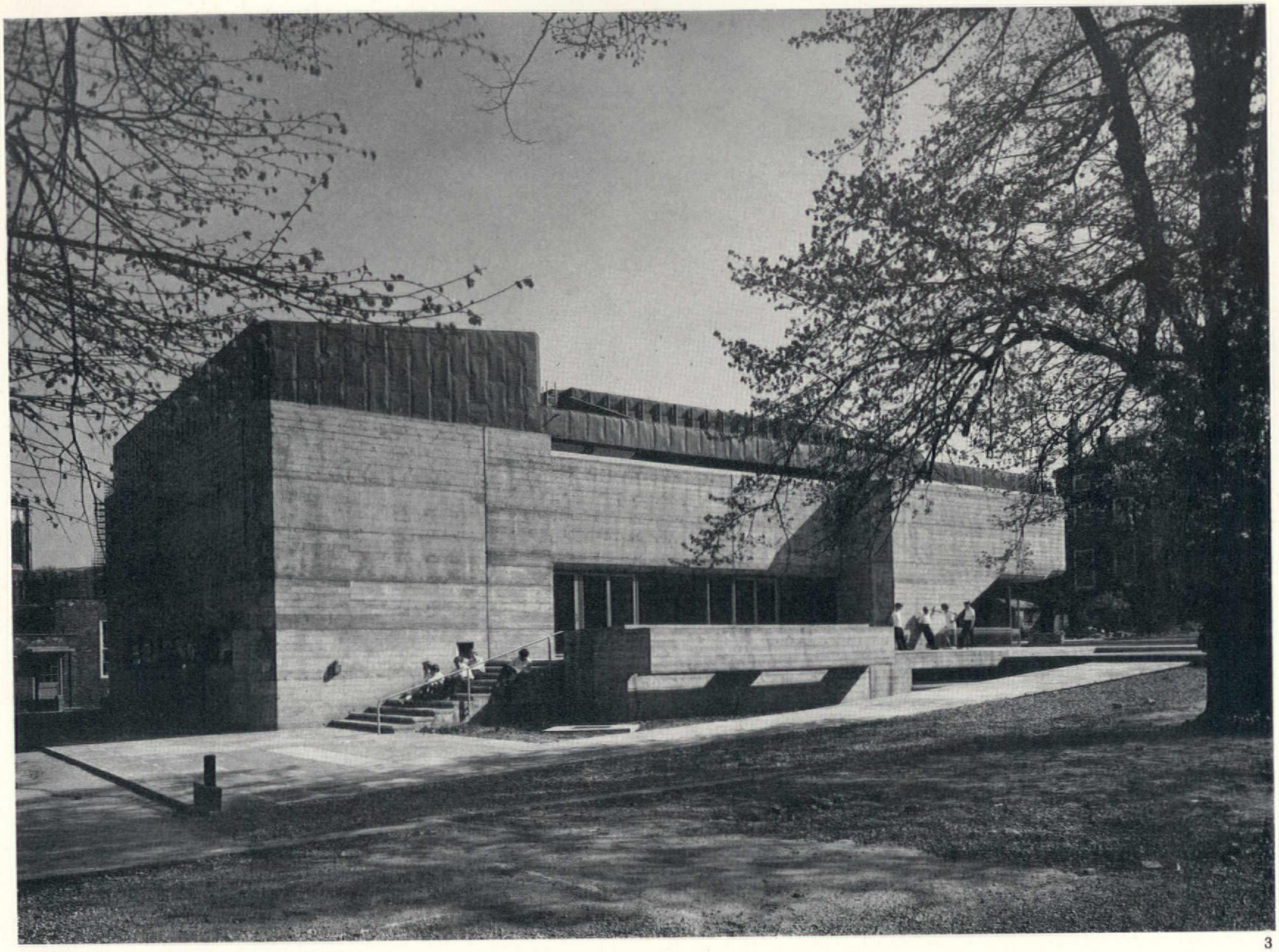
The problem of creating a dual purpose space was to reconcile centralized seating for worship with focused seating for assembly or theatre.

For central seating, space top lit from four sides of a high clerestorey is defined on two sides by the walls that separate the crush hall from the main hall, on the third side by the side wall of the building and on the fourth side by a free-standing screen wall which stands in front of the stage curtains. For focused seating this screen wall is raised out of sight and (if necessary) the clerestorey blacked out. Directional artificial lighting, related to shallow recesses in the ceiling over the stage and at the gallery end, change the whole emphasis of the interior, making it appear more elongated and bringing the stage to prominence. By means of movable sections various arrangements can be made for different types of production, e.g. conventional stage, stage with forestage, stage with orchestra pit. The hall floor can also be flat or in two steps.

The building is of reinforced concrete construction, exposed externally (sawn board shutter). The roof is steelwork and consists of two main trusses spanning from stage wall to the two columns at the rear and two cross trusses cantilevering out to carry edge beams on the long sides. These four trusses form a central 'box' carrying a high level roof, and clerestorey light enters the hall through the trusses. The lower roof, surrounding the 'box', spans off the trusses with an 18in gap between it and the lower structure, over which it hovers like a velarium. Both roofs are of edge reinforced wood wool spanning on to secondary joists. The steelwork was grit blasted and zinc silicate painted throughout to ensure good protection. Ceilings are of expanded metal and plaster. The roof finish is part proprietory sheet, part copper with copper facings and flashings.

Contract price, £62,000.

General contractors: L. H. Beal & Son Ltd.

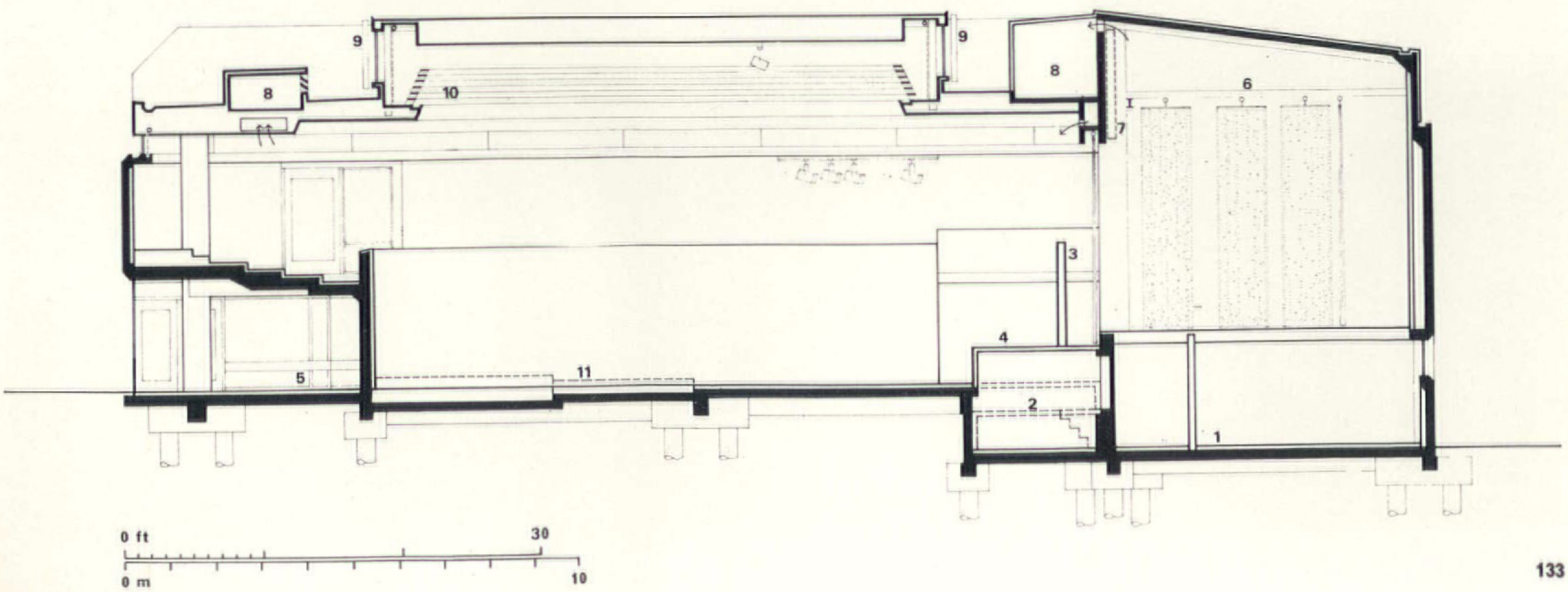


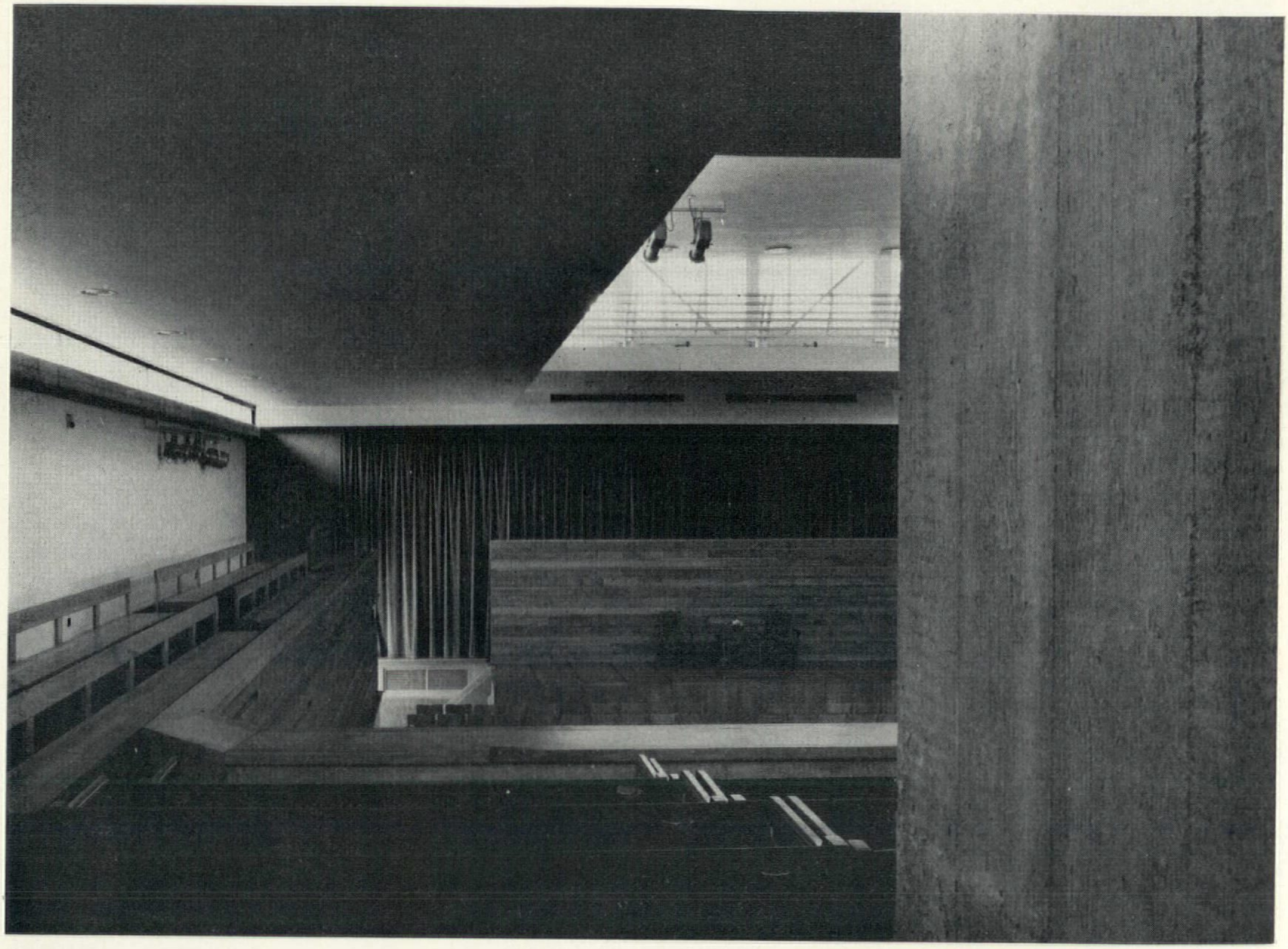
3

1
South-west view of hall as approached from school
2
Isometric showing the planning arrangement and the structural schema; a steel roof truss and a concrete box
3
West side and stage end with dressing rooms. The concrete feature conceals lower level lavatory windows

4
Long section
1 dressing room
2 orchestra pit
3 raisable screen
4 forestage
5 crush hall
6 stage grid
7 screen in raised position
8 vent plant
9 clerestorey
10 louvres
11 adjustable floor
Photos: 1 & 3, Frank Donaldson

4



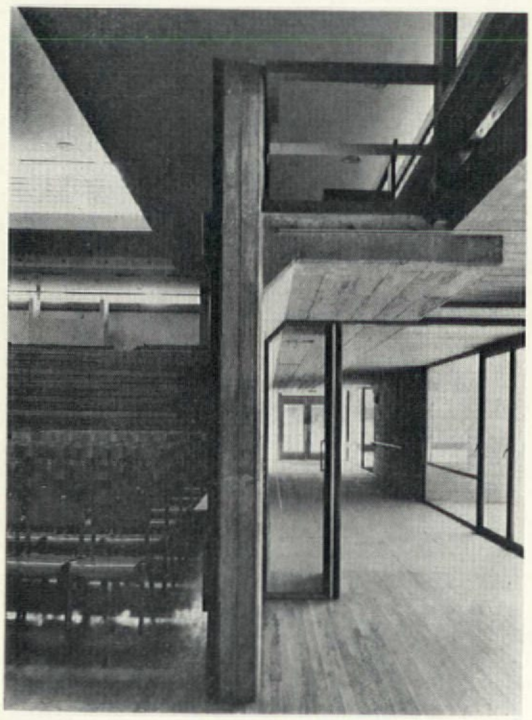


1
General view of hall from rear of balcony arranged for assembly, screen wall in position in front of stage curtains and opening

2
Front entrance to hall from foyer

3
West arm of crush hall

Photos: Colin Westwood



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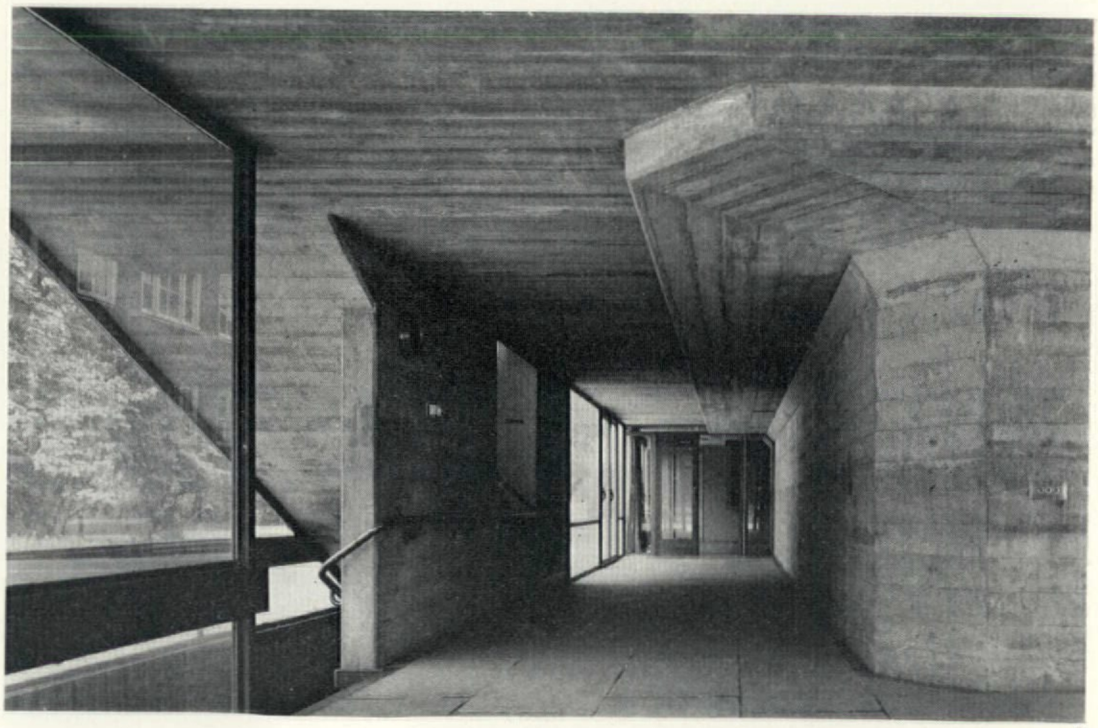

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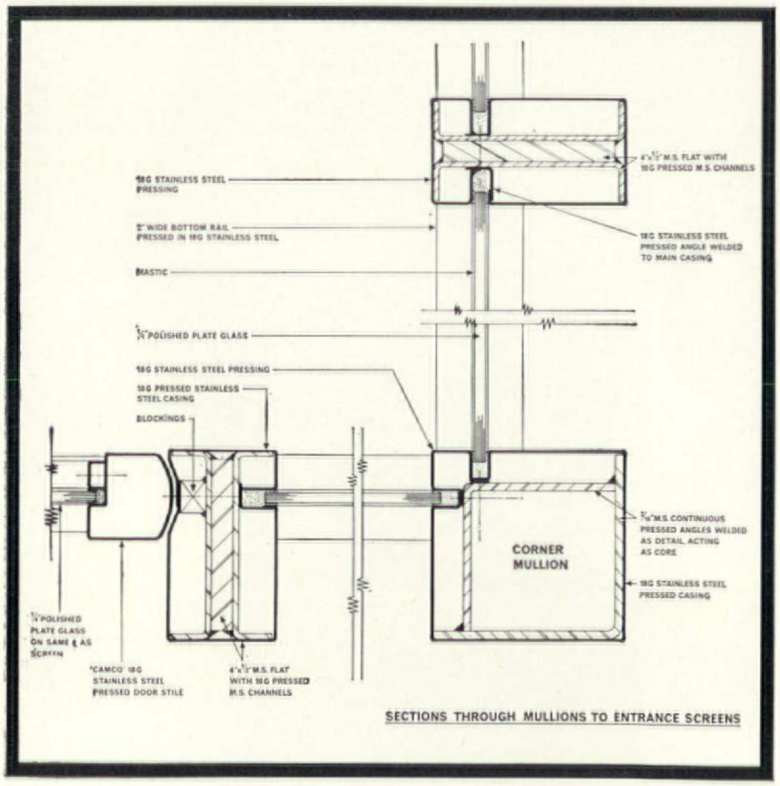
The Centre, Feltham. Architects: R. Seifert & Partners. Contractors: R. Costain Ltd.
Stainless Steel fabrication: Culford Art Metal Ltd.



Stainless Steel

Slender 'Silver Fox' stainless steel-clad mullions have lasting elegance

The Centre at Feltham, built by Hallmark Securities and leased as shops and offices, makes admirable use of the effects which only stainless steel can create. Here, slender mullions of Silver Fox Stainless Steel are contrasted cleverly with the deep-section canopy. Consequently, the building conveys an impression of airiness and light combined with strength and structural efficiency. The main mullions to the screenwork are formed of pressed box stainless steel sections, and the doors are pressed hollow stainless steel sections. The canopy is constructed of rolled steel joists, encased in stainless steel.

SEPARATE GLAZING BEADS AND CILLS ELIMINATED

If glass has to be replaced in the screen, the stainless steel centre pad rails and head sections can be removed to allow the glass to be placed in the open rebates, and slid behind the vertical sections. This eliminates the use of separate glazing beads and cills.

If you'd like to know more about Silver Fox stainless steel, write now for the recently published book 'Stainless Steel in Architectural Design'.

samuel fox & company limited

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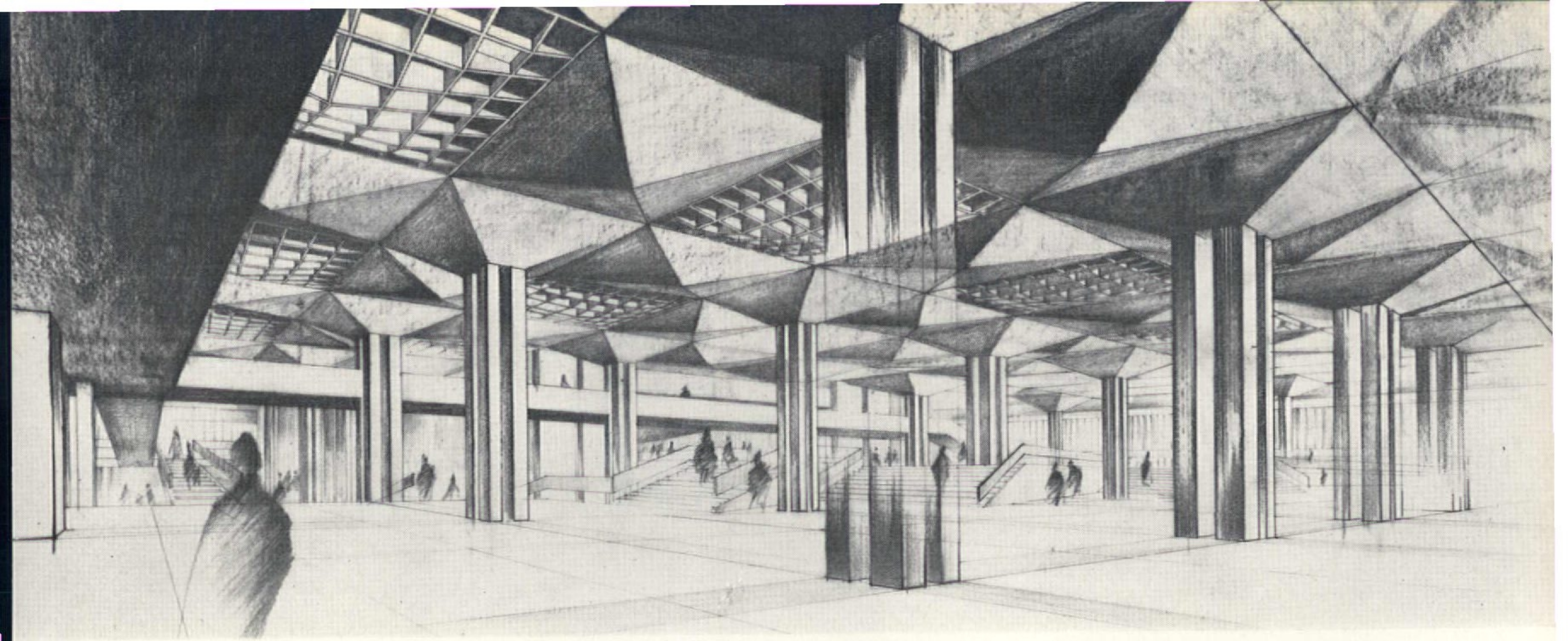
The makers of Silver Fox Stainless Steel

A subsidiary of The **united steel** Companies Limited



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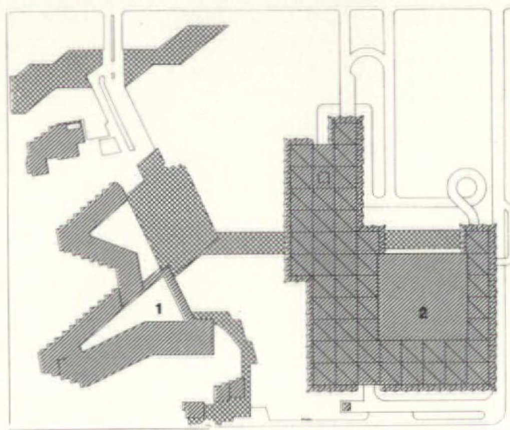

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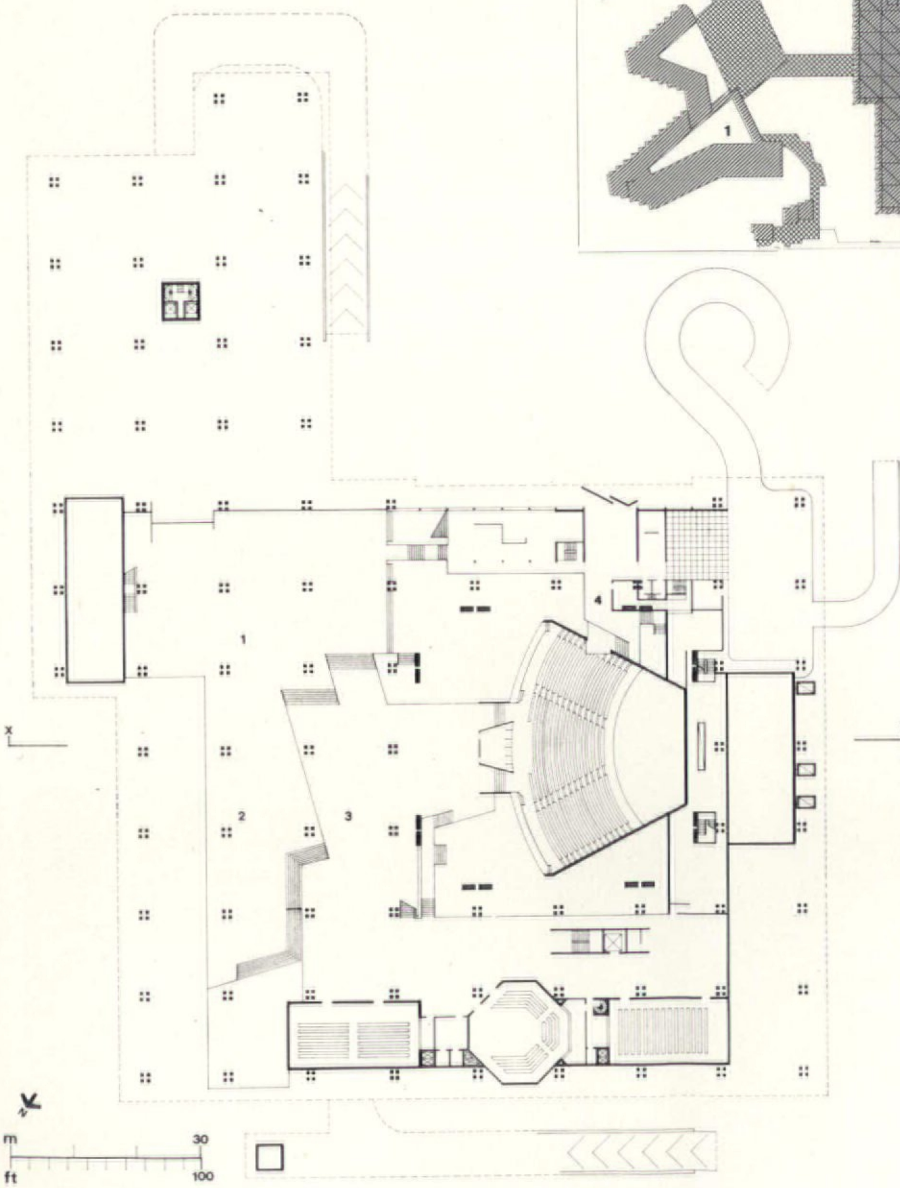

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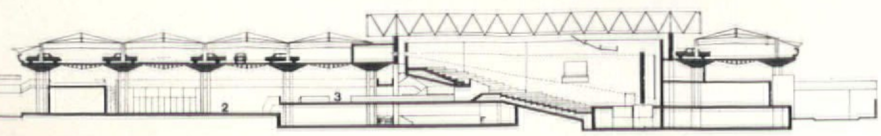

4

Conference centre Riyadh, Saudi Arabia

Trevor Dannatt

Structural consultants: Ove Arup and Partners

As the result of the international competition organized by the IUA (International Union of Architects)*, limited to six architects, Trevor Dannatt, the British participant, has been invited by the Government of Saudi Arabia to develop his winning design†.

This consists of two closely related units. A conference centre comprising a hall with 1200 seats, three small meeting halls for 200 each, generous foyer, exhibition and refreshment areas, administrative and service accommodation, etc. A luxury hotel with 200 bedrooms, residents' reception areas and lounges, dining room for 300, private dining rooms, kitchens and all necessary service areas.

The design of the hall, strongly influenced by given criteria, aims to create the right environment for conferences (rather than an auditorium atmosphere). Movement from foyer to hall happens in the centre of both spaces, bringing and keeping delegates together (either way). The foyer, technically less critical, is regarded as major architectural/social space.

The solution proposed is to form a generous load-bearing structure over all the accommodation except the hall, extended as necessary to provide entrance and loggia spaces, and to use this upper floor as car parking deck under its own lightly constructed sun reflecting roof, giving double protection to lower spaces.

Thus the car is accepted as the normal way of arriving and its convenience exploited. At the same time arrival is an architectural experience and parking is made easy.

The design of the hotel involved a deliberate intention to avoid the faceless pattern of an 'International Hotel' and to design a building of a character arising from its special problems.

For sun protection, private rooms are arranged to open onto patios, which either face northwards or are protected by overhangs.

1
General view of foyer looking towards the upper foyer

2
Site plan
1 hotel 2 conference centre

3 & 4
Plan and cross section of conference centre
1 general foyer 3 upper foyer
2 exhibition area 4 VIP suite

* *Announced* AD *January 1967*

† *Design by the runners-up, Gutbrod and Frei, on page 104*

Rusting steel

General use of structural steel in building has been inhibited by two major factors. Firstly the quick loss in strength and shape of steel structures subjected to fire and secondly rapid weather-corrosion.

Everybody knows that the latter can be restrained by painting the steelwork, but it requires periodic re-painting—an expensive and often difficult operation. No architect would dream of covering a roof with steel plates, though copper and aluminium are often used. The two non-ferrous metals do corrode, but the oxidized metal forms a protective skin which so retards the corrosive action that it can be regarded as negligible. What most people in the building industry do not know is that there have been steels with similar oxidizing properties available for about 25 years. During the 30s, chromium and nickel low alloy steels were developed which had a higher strength than mild steel but similar manufacturing qualities, and they became popular in America for railway wagons and heavy construction equipment. Some interest was aroused by these steels appearing to have an improved paint life over mild steel, and corrosion tests were begun.

Shortages during the war led to further developments using manganese and vanadium in combination with carbon steel to produce a similar high strength steel at reduced cost. Interest in the original low alloy steels did not revive after the war. But the corrosion tests continued. As they continued a rather remarkable feature became apparent. Corrosion rates of unpainted steel exposed to typical industrial conditions declined to insignificance in about two years.

At first this steel was used only on railway wagons, heavy containers, mixer drums and construction equipment. Then, in 1961, Eero Saarinen used rusting steel for the structure of his Deere & Company building at Moline in Illinois (see *AD*, August 1965). Since then several buildings and bridges of this material have been built. The most notable have been the Chicago Civic Centre (see *AD*, November 1966) and, in Britain, the Cummings Engine Company at Darlington **1** by Kevin Roche, now chief designer of the old Saarinen office.

When these steels begin to rust they look just like ordinary rusting steel. Slowly this rust darkens to provide a dense tough coat which does not flake or crack. The colour depends on the atmosphere—in an industrial climate it turns dark brown with a good uniformity of character and colour. The speed of the change also depends on the atmosphere; normally it will take one and a half to three years, but there is some variation in speed of attack depending on the locations of the members of a structure. This can be reduced by grit blasting exposed members to ensure that they have a uniform surface to start with, but the heat of the sun evaporating moisture on surfaces will still accelerate the formation of the film.

Considerable testing has been done on the corrosion characteristics. Obviously the rate depends on the atmosphere, but continuing the curve of reduction in thickness of a plate (exposed both sides) against time we would expect to lose about $\frac{1}{100}$in. in one hundred years. In some atmospheres the attack is accelerated; near the sea it is about six times as fast; by the sea it is much greater. Constant immersion is dangerous, the protective coat is continuously leached away as it forms; thus detailing, so that no water is entrapped in the structure, is of vital importance. The problem is eased by the fact that the material is easy to weld.

Rusting steels in plate and sections suitable for use in building structures, are produced and rolled by three firms in this country. Colville's, Appleby-Frodingham and Dorman Long all make *Cor-Ten* and *T-I* steels under licence from United States Steel. Both of these steels are high strength, which means reduced section areas compared with mild steel, but the elasticity is the same so that the depth of sections is not reduced.

No British Standard exists yet: it can be specified to conform to ASTM specification A441. *Cor-Ten* is the trade name of the steel produced by USS, and *Mayari R* is the steel produced by Bethlehem Steel Corporation. Cost comparisons are difficult. It is possible that the cost of a rusting steel building would be cheaper than a mild steel one; almost certainly the first maintenance painting would pay any premium. *Edmund Happold*

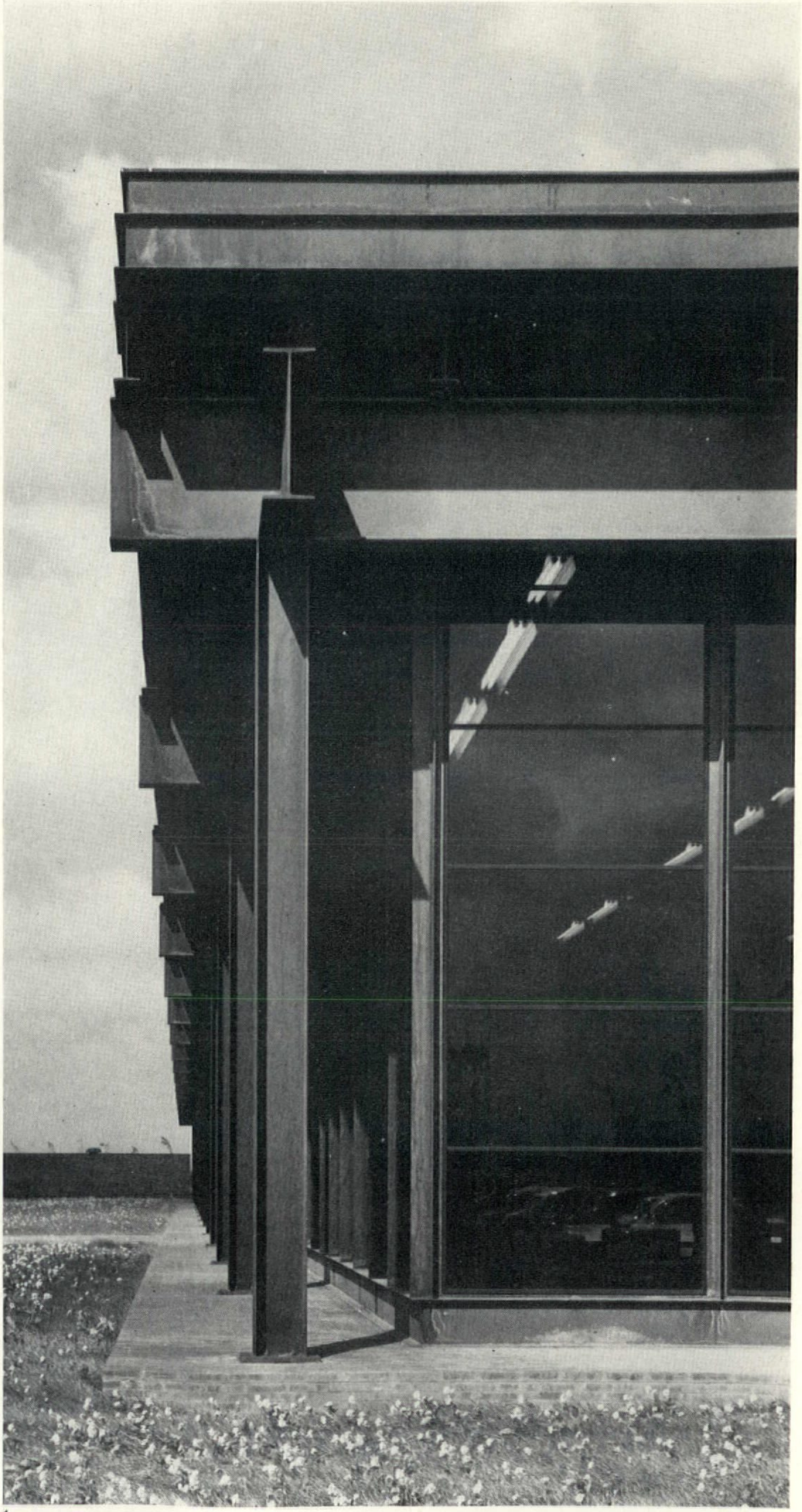

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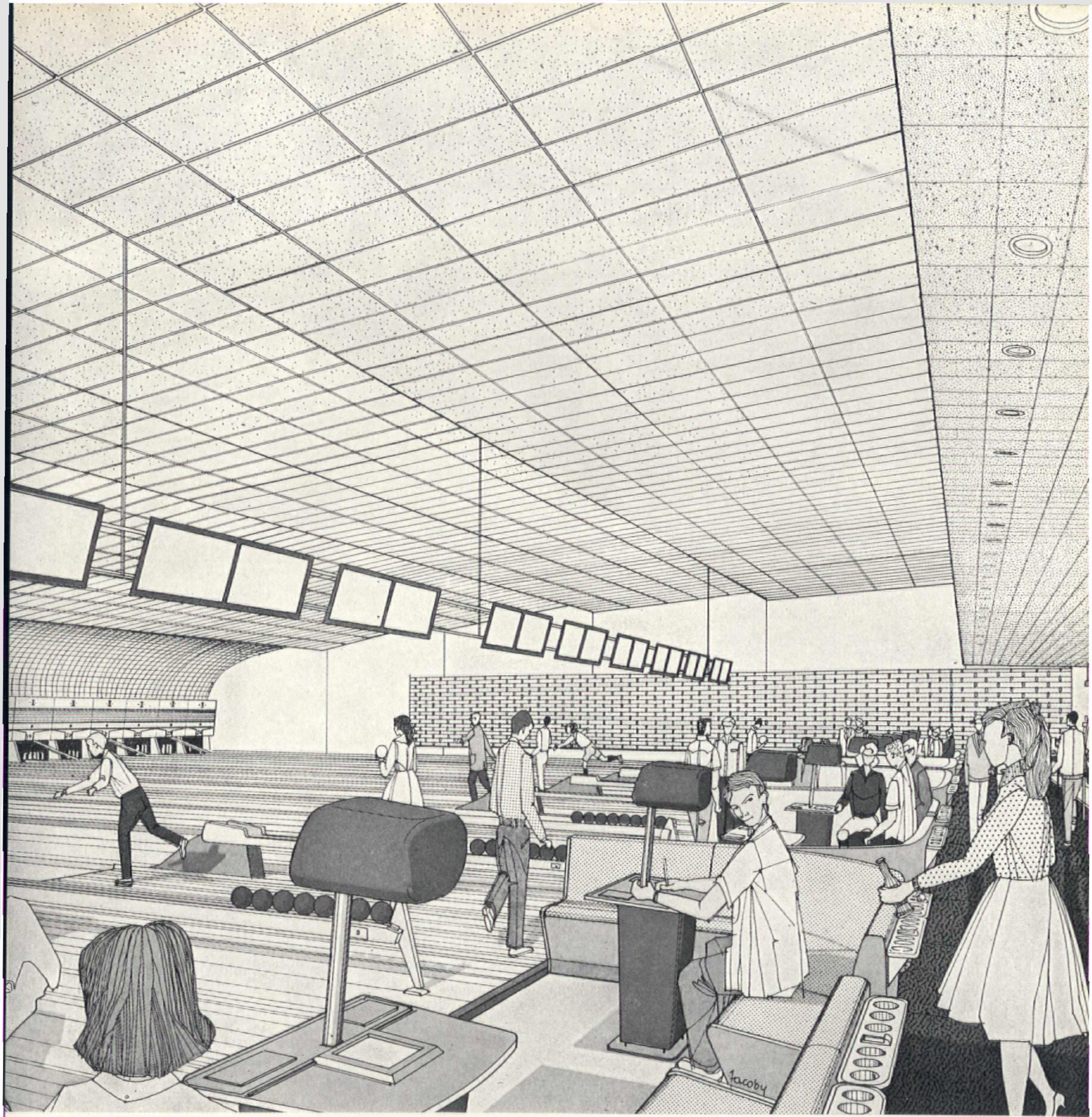
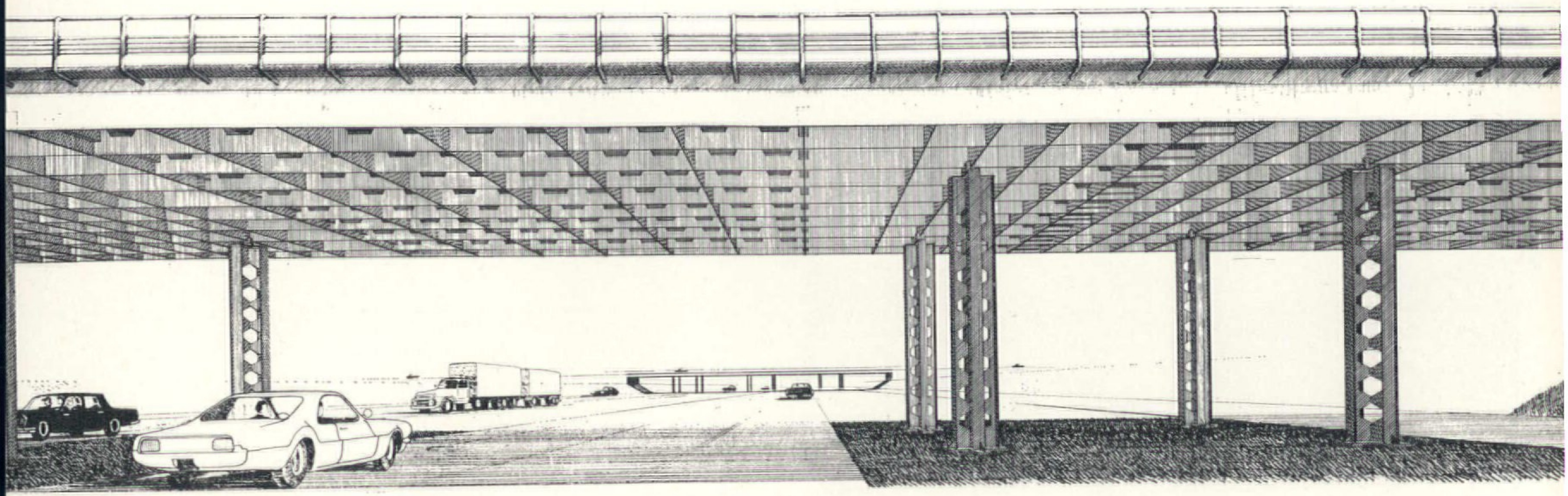
Photo: Forum



Jacoby



1

Bridge design

D. Griffin, E. Happold, O. Vanggaard, J. Wood (all from Ove Arup and Partners)

Architect: Trevor Dannatt

In October 1965, the United States Steel Corporation announced an International Bridge Competition to design an overpass structure. This would carry a two-lane highway over a four-lane interstate highway with frontage roads. Judges were to give equal value to originality of design; degree to which steel was used; economy in design, fabrication, construction and maintenance; and finally, appearance.

Fascinated mainly by the challenge of reflecting the characteristics of the new Cor-Ten and T-1 steels and the problem of the relationship of a bridge structure to its environment, the group entered a design. They felt that a motorway overpass bridge is usually only seen by road users and must have the minimum disruptive effect on their concentration. The weight of the carriageway above must not cause the driver to slow down and the appearance must not distract his attention from consistent driving. Any design must be relevant to trends in the construction industry. With rising labour costs and people's unwillingness to work outside, the more that can be carried out in the factory and the less on the site the better.

The engineering form of the bridge is three double cantilever deck units, each sitting on four columns, with suspended spanning deck units between. As two-way spanning is necessary for distributing bridge loads, this decking is designed to deal with it in the most efficient manner—orthotropic grid plates of constant depth with the variation in bending moment expressed by the spacing, sizing and fabrication of the vertical members. Thus, in the suspended deck unit, the load distribution is primarily longitudinal, and the transverse members are spaced well apart as their major function is only one of transverse distribution. The T beam action in these suspended units enables the vertical members to be castellated, thereby saving steel and welding. The voids in the lateral members occur where the longitudinal members are full depth enabling the important horizontal welds to be taken through uninterrupted and giving maximum support for the deck plates.

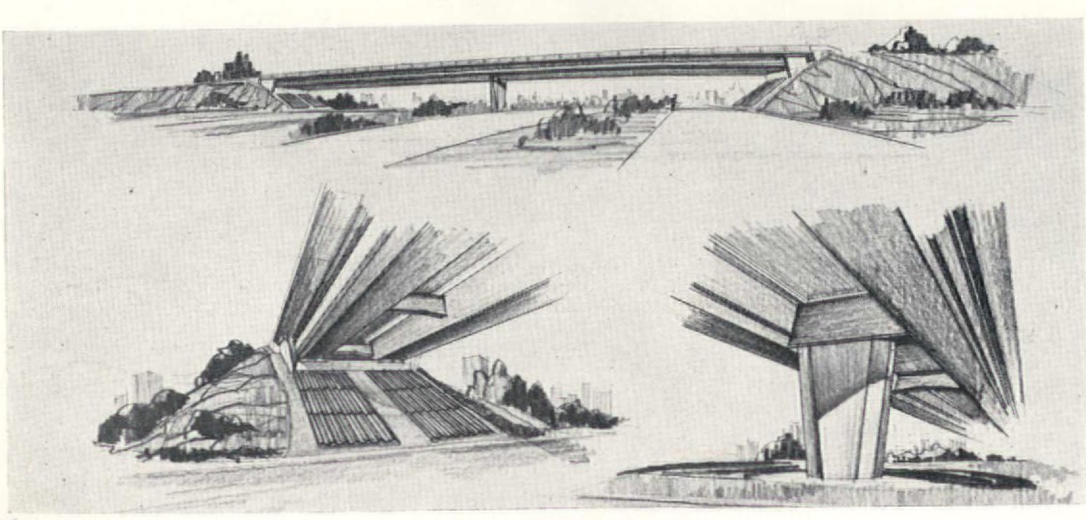
The action in the cantilever deck units is almost entirely two-way, as the loading of the suspended units is carried into the columns by the vertical members running in both directions. The negative bending moment in these units is dealt with by stopping the castellations, increasing the vertical member thickness and decreasing the unbraced lengths of the vertical members. As the vertical members are fixed on three sides, buckling is not a major problem and shear is the major sizing force.

All units have been designed to be fabricated, using a welding bar jig, face down, in the works. The width of the units is the maximum which can be handled on the road and the maximum unit weight is $9\frac{1}{2}$ tons—easily handled by a mobile crane.

Wind and braking forces are taken out on the columns and expansion is relieved at each suspended span. These columns are cantilevers, pruned at the tops and, in order to take the bending without too great an increase in steel area, are fabricated from standard I beams, cut castellated and welded. For simpler welding and to stiffen the column webs, the joint down the column centre is overlapped.

Steel has the best strength/weight ratio of any common material. Full utilization of this means fabricating in a factory the largest possible units transportable by road. Yet the units are relatively light and site work is a minimum. The use of Cor-Ten and T-1 steels means no repainting costs. This is a major breakthrough in the development of steel utilization. Protection of steel is no longer a design consideration and need not dictate the form of the bridge. No longer is it necessary to have box girders, with their exposed areas reduced by the boxing. An entirely new aesthetic for steel bridge design can be developed.

The group felt strongly that they wished to express the two-way structure, quantity production techniques and the characteristics of 'rusting steel'. But they felt that the beauty of an individual bridge was not enough. Many such bridges cross the road and it is the form of the many within the total environment of the road which matters. An overpass bridge should not be a restless arch jumping across the driver's vision. It should be a quiet, well designed and static piece of road furniture, causing no distraction by its scale or appearance.

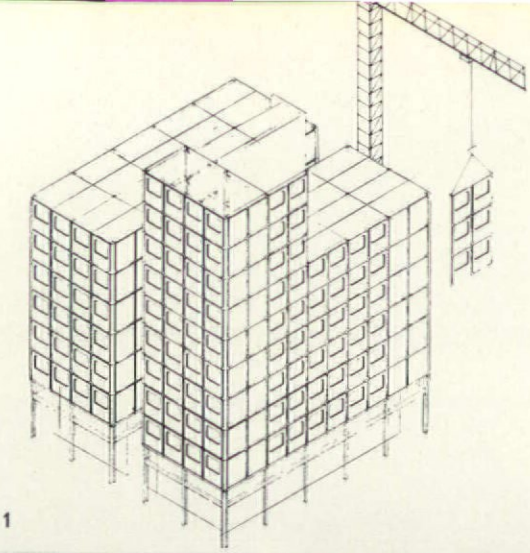


2

Comment on the Arup-Design by Edgar Kaufman

The technologies involved are quite outside my scope. As to appearance the entry was one of few that had dignity and decency. On the other hand it also lacked something, namely the feeling of participation in the smooth speed of highway travel. This was not because it was so reticent, so modest in the landscape; rather, it had a good, crisp, outspoken style of its own. But this style is one that offered no handhold to the traveller's desire to experience a well composed, serial, eventful trip. Those entries that succeeded in providing this coddling did so in the trite and tired terms, so that there was opportunity for a new, perhaps better founded, way to provide these obbligati en route.

1
Arup group-Dannatt competition design
2
Winning entry by William J. Jurkovich



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2 | 3
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6 | 7
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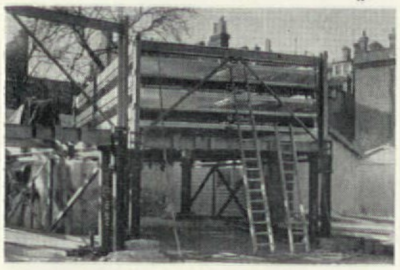
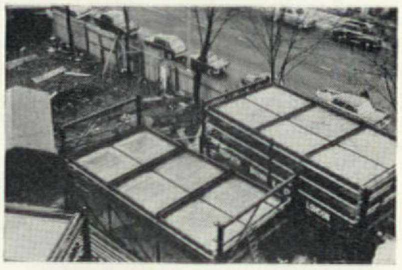
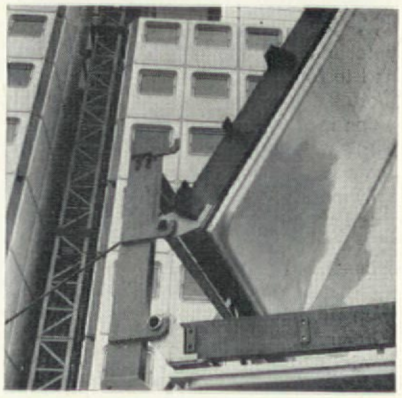
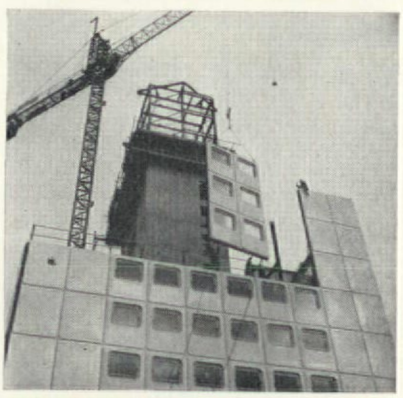
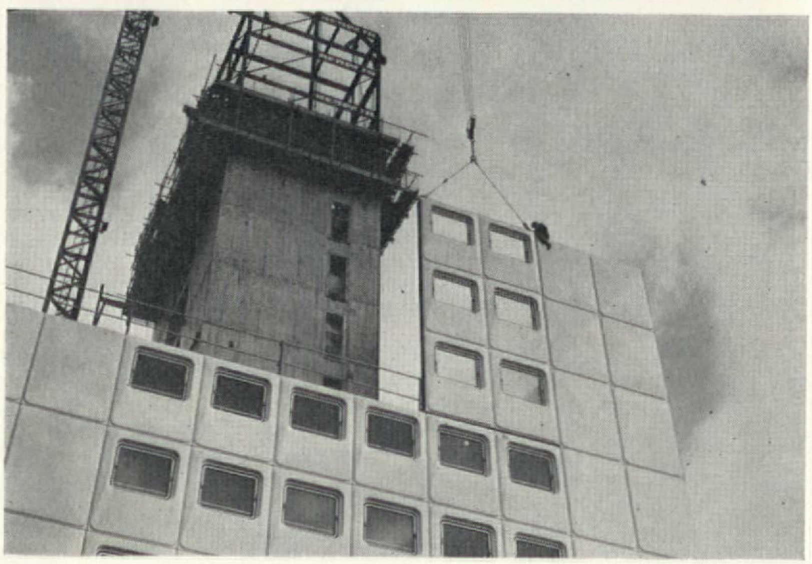










SF1

J. W. Davidson*

The SF1 system was designed in the Department of Architecture and Civic Design of the GLC (formerly LCC), and it is being used for the first multi-sotrey blocks to be constructed with a steel frame clad entirely in glass fibre reinforced plastics. The system is the result of close collaboration between the Council's architect and the construction industry and represents an industrialized system in which the obvious advantages of steel in terms of accuracy and speed of erection have been related to similar advantages in cladding panels in material essentially factory produced but with no prior history in such conditions.

Development of the external cladding for the SF1 system was evolved from the need to provide a solution suitable for use on the steel structural frame. The wall panel was initially specified as one which would have a high strength/weight ratio, would be factory produced and would be precise enough to relate to the accuracy possible in the steel frame. Further, it was defined that the wall unit would be of storey height and room sized, be easily transportable, be complete with a maintenance-free external surface, have an insulative quality better than 0·2 U value and an inner surface suitable for decoration. It was also required that a window aperture be incorporated and that there be a maximum of three alternative panel types to aid standardization. The cost factor was also taken into account and limited in the case of wall units to the equivalent costs in traditional construction.

From this initial design exercise it became clear that there was no ready-made panel available that would meet all the standards required. Many alternative materials were considered and in the case of sheet steel, only at that time available in a maximum width of 4ft 0in, a number of unnecessary joints would have been required. This applied to many other materials under consideration.

The only material available suitable for the 'one piece' application desired appeared to be glass reinforced plastic, and this had been well tested by the familiar LCC ambulances, the bodies of which are of this material. Through the

9

cooperation of the Council's Supplies Officer's Mechanical Works Division, where many of the techniques of plastic bodywork had been pioneered, a series of developments of plastic wall units was put in hand. Early prototypes consisted of shallow trays made by the hand-lay-up process which were then filled with various insulative materials. The panels were stiffened by a light metal frame to which fixing bolts were attached through weld nuts positioned at top and bottom edges. At this time panels also incorporated peripheral endless gaskets of tubular shape. This feature was provided so that when panels were fixed on the steel-framed structure a 'compression' weather seal would be obtained from the location of one panel against its neighbour.

Prototype panels were subjected to structural tests by the Council's Structural Engineer. Tests on the panels, 9ft wide by 8ft 7½in high, were required to check deflection characteristics and the suitability of the bolt fixings to the steel frame. A deflection of 0·24in at the working load of 19lb/ft² was considered satisfactory, as were the recovery characteristics.

Before the panels could be used in multi-storey blocks of flats in London, it was necessary to test the reaction of these plastic-faced, steel-framed panels to ensure that they would meet the fire requirements of the Building Regulations. Following three years of exhaustive research by the Indulex Engineering Company, appointed by the Council, and with the collaboration of the Council's Scientific Adviser a suitable formulation for the plastic skin was arrived at and a technique of manufacture was evolved.

The design for 21- to 25-storey flats is conditioned by a module of 6ft 8in, this being the final modular size of the cladding panels based on the smallest compartment of accommodation.

The structural steel frame, organized round the module of 6ft 8in, provides a basic structural grid at 13ft 4in centres. Precast prescreeded concrete floor slabs also of 6ft 8in width and 13ft 4in long, take bearing directly on the steel beams. Alternative floor constructions were considered for this element, but it was felt that these factory produced concrete slabs were the most suitable, as placing on the steel bearing surfaces would allow a direct and quick application. Pre-packaged flaxboard partitions with balancing asbestos wood facings form the main compartment separation, normally in single leaf but double-banked on grid lines. The structure is designed to limit deflection to 1:1000 of the height. This is achieved by the central core of *in situ* concrete, encasing the steelwork in that area and, incidentally, providing both the requisite fire protection and an effective barrier to noise transmission. The central core steelwork comprising welded braced framing, supplies the necessary stability during the construction period. It also ensures the accurate location of the exterior cladding through the connections of the steel floor beams and serves as a support and guide for the repetitive formwork for the concrete core.

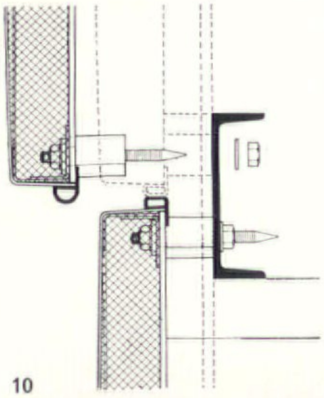
Structural techniques were developed in collaboration with the general contractor F. G. Minter, Ltd, and the steelwork specialist, Redpath Brown & Co. Ltd. This was an essential exercise because of the particular nature of the constructional elements. A sequence of site operations was evolved by critical path analysis, based on the use of a K/60 tower crane taking advantage of the high strength/weight ratio of the cladding and the structural steelwork.

In preference to lifting individual panels which would be uneconomic in the use

▷140

1
Isometric showing erection
2–8
Erection sequence of a six-panel assembly, from the stacks on the site to its final position on the building
9
LCC ambulance with a GRP body
10
Vertical section showing the junction of panels and fixing to the steel frame
11
Vertical section showing junction of panels and floor slab
12
Horizontal section through window jambs showing meeting of two panels
13
A six-panel assembly being hoisted upright, ready for erection
Photos: 2, 4–8 & 13 Sam Lambert

* *This article is the substance of a paper prepared for the British Constructional Steelwork Association conference in 1966, and revised for the 23rd International Congress of Steel Information Centres at Essex, June 1967.*



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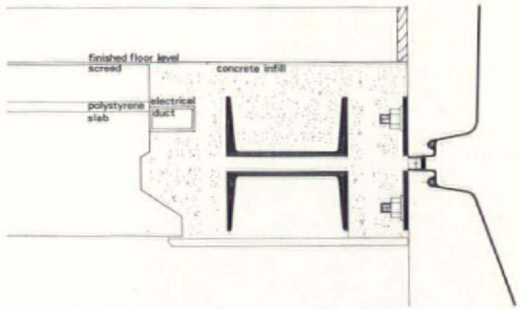
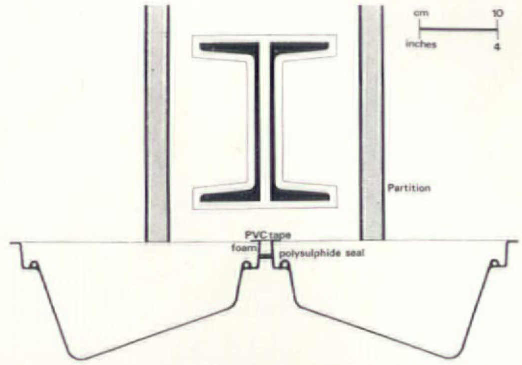

finished floor level
screed
concrete infill
polystyrene slab
electrical duct

11


cm
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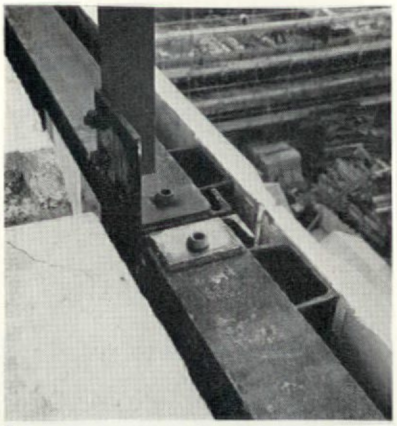
inches
4
Partition
PVC tape
foam
polysulphide seal

12

13

1



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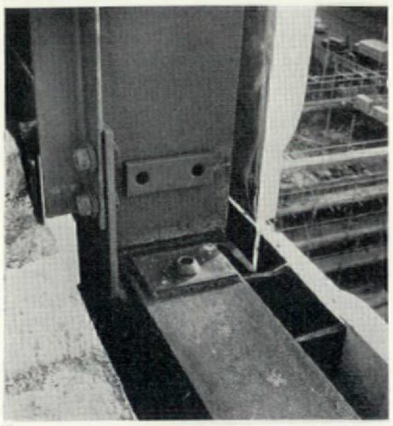

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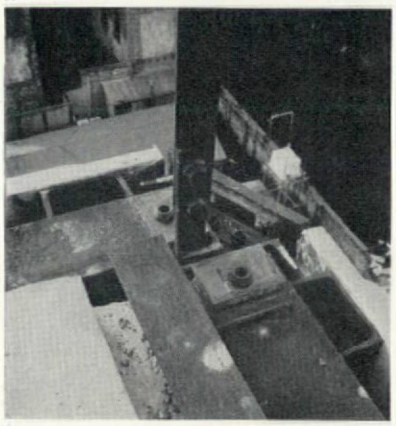

◁138

of the crane, it was decided to pre-assemble the peripheral steelwork in three-storey welded frames onto which plastic panels could be bolted in the factory. Field tests were carried out on this principle and it was necessary to design the steelwork not only for the loads it would carry as part of the structure but also for the additional stresses incurred in handling and transportation and to limit deflection in this condition to avoid damage to the cladding panels. The panels themselves had to be considered in the same way. Early prototypes indicated the potential of the idea in providing an economic and rapid construction of the building with all the advantages of immediate weather exclusion.

These early tests were based on a 9ft wide assembly, but when the layout plan was revised to meet new standards, the panels were redesigned on a 6ft 8in module. It then became clear that the most economic frame-and-cladding unit would be a six-panel assembly. Apart from being the largest unit capable of being transported by road (27ft × 13ft 4in), this represented an area of 360sq. ft. of combined walling and structure and a load of about three tons for each crane lift.

The accuracy of the factory-produced panels located on a steel frame has made it possible, through simulated tests, to define the joint dimension between panels with tolerance for expected movement which is accommodated by the gun-applied polysulphide sealant for which the edge detail of the panels has been designed. An initial plastic adhesive strip, employed during construction, keeps the building weathertight for finishing trades.

Precision is achieved in the following manner. Each steel component for the six-panel assembly is first individually jigged and drilled as required for fixing the plastic panels. Following this, the individual members are placed in another jig and welded together to give a frame three storeys (26ft 2¼in) high and two modules (13ft 4in) wide.

The edge member of each three-storey assembly is an inward facing 8in × 3in channel section. In their location on the building these assemblies are bolted together so that adjacent channels are united back-to-back. Steel packing plates ¼in thick are used between the channels to ensure accurate spacing of the assemblies. Spliced connections, using friction grip bolts, unite the tiers vertically. At corner conditions, diaphragm gusset plates provide the continuity in the peripheral steelwork and act as anchorages for the corner cover units.

The sequence of operations for the erection of frame and floors is as follows:

Erect three-storey-high central core welded steel bracing frames.

Erect three-storey-high welded steel peripheral frames with plastic wall panels attached, in conjunction with inner frame steelwork.

Apply repetitive shuttering and pour concrete around central steel core.

Place pre-screeded precast floor panels in position.

The above sequence is operated on a 15-day cycle, including 11 days for the erection of the steel frame and cladding frames and four days for the precast floor slabs.

The steel-framed structure is being fabricated and erected by Redpath Brown & Co. Ltd, who have been responsible for the design and development of the prefabricated structural frames. The steelwork is designed to BS 449 and welding will be to the appropriate specification, BS 1856 or BS 2642. Ultrasonic inspections of the welding will be carried out on a number of frames during fabrication. 'High yield stress (welding quality) structural steel' to BS 968:1962 became available during the development period and advantage has been taken of this. Columns up to the tenth floor are designed in this steel which proved more economical than mild steel to BS 15 for these compression members. The use of high tensile steel for these heavier loaded columns, with mild steel for the upper lengths, also permitted a continuity in the column dimensions throughout the height of the structure, thus limiting the jig patterns to standard sizes.

Foundations for the first two 22-storey blocks at the Walterton Road site, consist of large diameter (2ft 6in and 3ft 6in) under-reamed bored piles to a depth of 40ft with a main-beam grillage with stub columns to receive steel bearing plates at stanchion positions. Piling was completed in two weeks for each block.

It had been assumed that there would be savings in foundation costs for a building using a steel frame and lightweight cladding units and this assumption has been shown to be correct in the case of Walterton Road where, in comparison with the estimated cost of foundations for a similar height block in traditional construction, a saving of over 50 per cent was affected. It is appreciated, however, that the actual costs will vary for different sites and subsoil conditions.

The plastic panel skins are pressure moulded in the United States from British materials in a process similar to that used for glass fibre motor car bodies. The panels are shipped to the United Kingdom where they are further processed, provided with reinforcing frames and bolt fixings, gasketed aluminium windows and insulative filling. Panels are then individually crated and despatched to the steel fabrication shop where they join in the final stages of the steel assembly line. Here they are lifted by gantry crane and bolted to the three-storey steel frames. Three of these assemblies now combining framework and panels are then loaded on to specially designed stillages for low-loader transport. The final stage involves transport to the building site where the stillages are rolled from the loaders on to site cradles from which the assemblies are subsequently lifted into position on the building. It is interesting to note that the plastic panels are untouched by hand from the time they leave the plastics factory.

The first steel/plastic assemblies were erected on November 24th, 1966. Experience gained in actual site operations has indicated that the 15-day cycle for the three-storey constructional sequence may be improved upon.

1
View of meeting of two assemblies, showing steel framework. The upright on the top left is part of a temporary handrail

2
Junction of three assemblies bolted to steel framing

3
Junction of two assemblies and a steel corner panel set at an angle of 45°. The upright is part of a temporary handrail

4
A steel corner panel being fitted to an assembly prior to hoisting

5
Internal steel joists being erected after positioning of the six panel assemblies

Photos: 1–5 Sam Lambert

4

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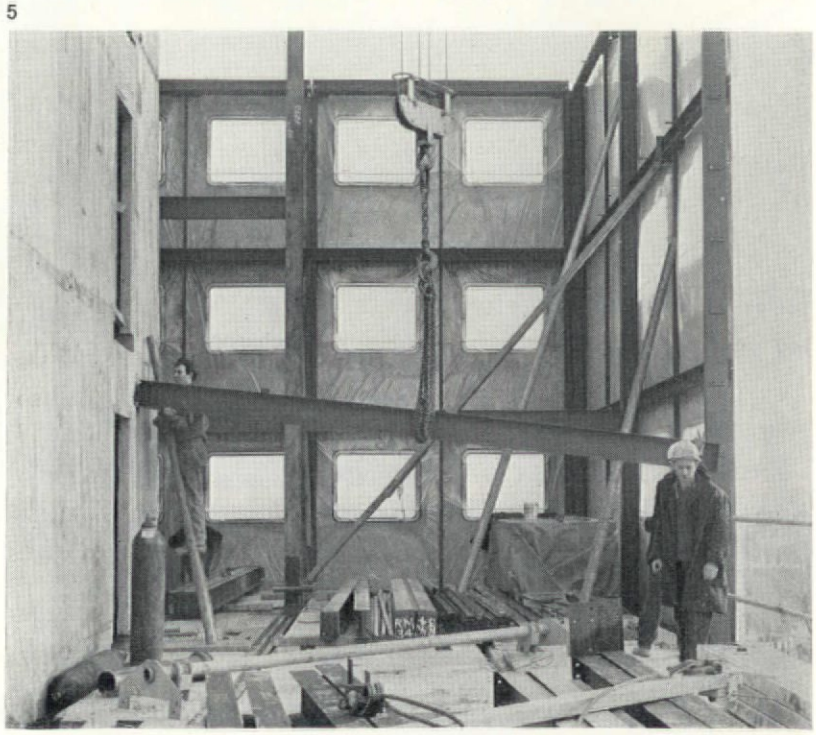
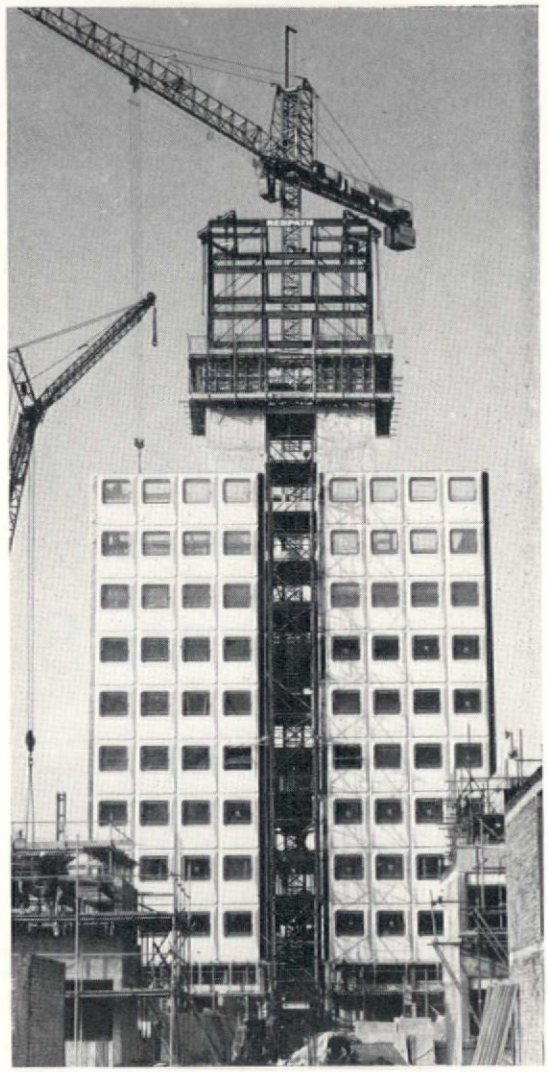
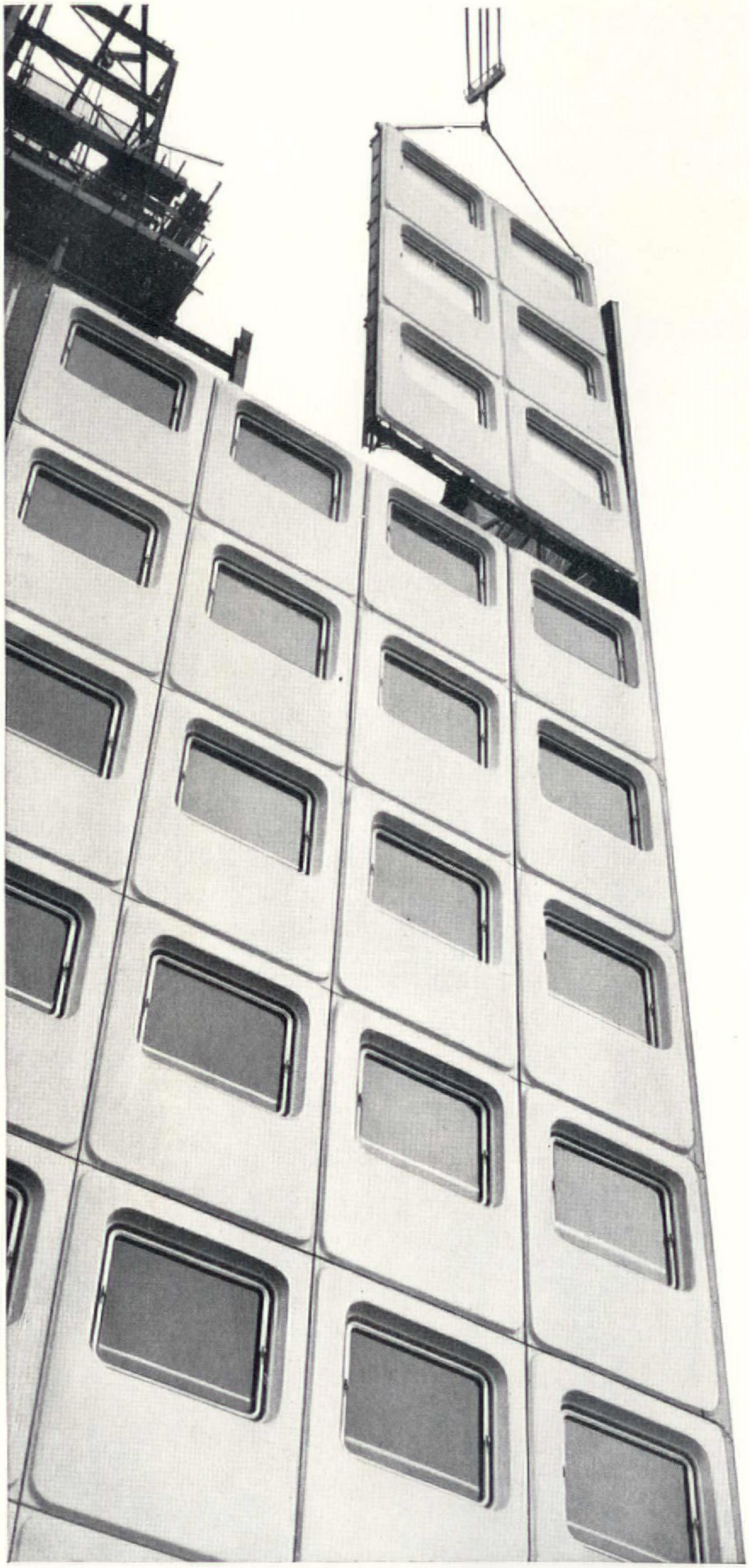






FORMULA FOR RAPID CONSTRUCTION

Steel + R.G.F = S.F.1

The S.F.I. system—comprising a steel frame and reinforced glass fibre cladding panels—is ideal for the industrialised building of multi-storey flats. Steel has the advantages needed for industrialisation—high strength/weight ratio, structural economy, precision production and high-speed erection.

The G.L.C. flats, now under construction at Westminster and Tower Hamlets, have a steel frame designed, fabricated and erected, complete with wall units, by Redpath Brown in collaboration with F. G. Minter Ltd. and Indulex Limited.

Designers: Department of Architecture and Civic Design of the Greater London Council.
Architect: Hubert Bennett, F.R.I.B.A, Architect to the G.L.C.

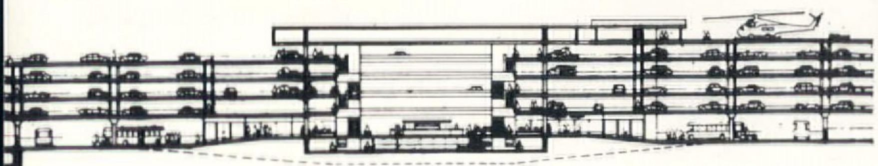
REDPATH BROWN

EDINBURGH · GLASGOW · LONDON · MANCHESTER

Recently, the city of Venice organized an international competition for the design of the development of the new island of Tronchetto (AD, *Dec.* 1964, *p.* 593). *The island had been created by reclaiming part of the lagoon near the approach causeway to the city from Mestre. The programme contained a number of separate elements, one of which, the parking terminal, clearly constituted the major item in the competition.*
Illustrated below is the design of the parking terminal of the prize-winning scheme by Manfredi Nicoletti (architect), Riccardo Morandi (engineer) and John Peverley (planner)

Car parking terminal

John Peverley



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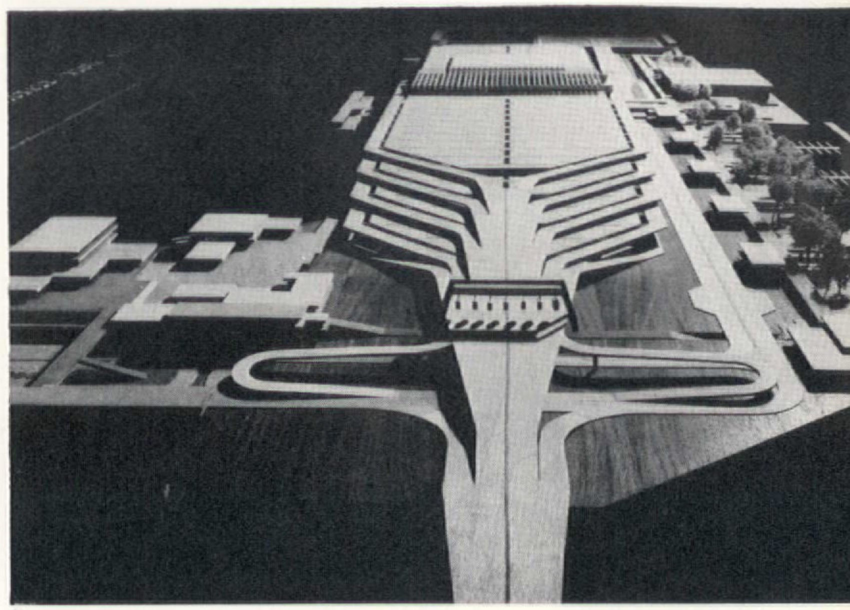

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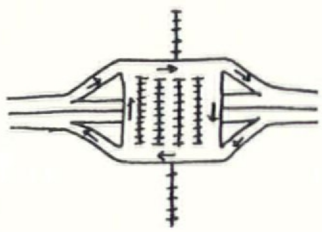
The problems raised by the Venice parking terminal are not primarily peculiar to that city, but have a particular relevance to the design of parking garages as a new element in city form making for the immediate future.
Fundamental research into the functional design of parking garages, not only in terms of circulation of cars and pedestrians, but in terms of the garage as a transition point between one form of movement and another, is currently totally lacking. Similarly lacking is research into the parking garage as a physical and possibly standard symbolic locational element in city design.
Garages designed for commuters and located as a matter of standard planning policy on the radial roads of an existing city, around the periphery of the central area, might take the form of enlarged bridges over the radials as suggested in the sketch in the Leicester Traffic Plan (*AD*, Dec. 1964, p. 586) **2**.
Alternatively, a garage designed in a shopping centre might take a linear form, with a car access edge on one side and a pedestrian access edge on the other, on to which are latched a number of department stores or the pedestrian system of the centre **3**.
It would also seem that the days of the multi-layer centre with the parking garage conceived as an uninterrupted subterranean level throughout the central area may be numbered; as experience at Cumbernauld and other similar shopping centres is demonstrating the very real problems of coordinating the designing, construction, financing, renting, administration and legal rights of a community garage overbuilt with a collection of small retail properties **4**.
These difficulties may result in a decreasing acceptance of overall parking layers in favour of multi-storey parks concentrated at stategic locations throughout the central area, in accordance with a standard planning policy **5**. A parking garage will aggravate congestion unless the capacity of the surrounding streets is sufficient to accept the extra traffic volumes generated by the garage.
Whatever the outcome, some research is needed immediately into the designing and operating of garages in the future as physical extensions of the city road system and as physical extensions of the functional organization of the buildings and patterns of movement within the central area (what is referred to in the Buchanan Report as 'traffic architecture' —paragraphs 80 and 118).
It is this functional aspect of the design solution for the Venice parking terminal that is of continuing interest in the design of garages in other urban contexts.



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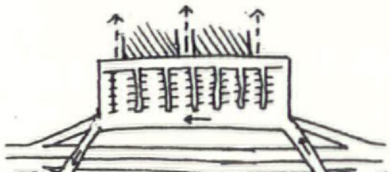

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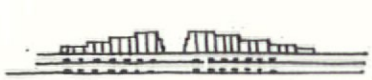

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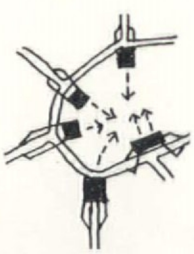

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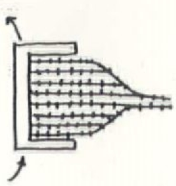

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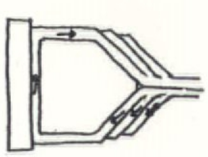

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A solution was found that caters functionally for the mass arrival of large numbers of people and the long-term storage of their cars, while at the same time providing the full range of reception facilities necessary in any major transportation terminal.
To some extent a parallel precedent already existed in the organization and functioning of a large terminal railway station **6**.
In a broadly similar way, but for different functional reasons, the parking garage proposed for Tronchetto also fans the traffic out and brings it to a common unloading edge where all the public facilities are located in the form of a concourse or galleria **7, 8**.
It was decided that the parking garage would be designed as a physical termination of the autostrada with the two-dimensional road evolving to become a 3-dimensional multi-storey structure **1**.
In a garage of this size the functioning and organization of the terminal building should be visually expressive and understandable to the approaching motorist, and that for clarity of entrance and exit circulation, a simple one-way cyclical system should be used.
These last two functional criteria were essential to the successful operation of the parking garage. The terminal accommodates 6500 cars and 600 buses and will be the largest garage in the world. Because of its low overall height, great size and intermittent seasonal use, a mechanical or attendant system of parking would not be economically viable. This means that the driver of a a car has to take an active part in all the operations involved in the termination of his journey, including unloading of passengers and baggage and the parking of his car.
It was decided that it could not be left to the individual driver to find one empty space out of 6500 spaces distributed over four parking levels. A numbered ticket or token for a parking space would have to be issued to the car at the time of arrival by a simple electronic computer located at the 'toll' station at the entrance to the garage. At the time of departure the numbered parking ticket would be handed in at the exit toll station and fed back into the computer which would simultaneously register the parking charge incurred and release the parking space for a new arrival.
In addition, at the entrance toll station, cars are segregated on to the four upper levels of the garage, and buses are directed to the ground level.
The approaching car driver selects that level corresponding with the colour or number of his ticket. The access roads are segregated from the parking areas and are designed on a one-way cyclical system leading first to a centrally located arrival and unloading concourse and then to the parking areas.
To avoid making the passengers walk long distances with their baggage through the garage from the parking place to the embarkation point for the boats into the city, each parking deck is provided with its own loading and unloading area for passengers and baggage.
These unloading areas form 'edges' which are grouped around a great covered central space or galleria, the equivalent of the concourse area in any major railway terminal. Here are located the travel agencies, tourist information kiosks, banks, post office, toilets and wash rooms, shops, tobacconists, newsagents, bars, restaurants, baggage depository, etc., etc. This is the first point of physical arrival in Venice, and it is from the various levels surrounding the concourse that first impressions and first glimpses of the city and its water way of life will be obtained, and an understanding of the organization of the terminal facilities and the impending change to water transport will be comprehended.
After the discharge of passengers and baggage, the vehicle proceeds along an internal distribution road directly to its reserved numbered place. After parking, the driver can then return along a segregated pedestrian way to rejoin his passengers in the concourse. The pedestrian way is also designed as a structural spine to the building, permitting ventilation to be effected in the centre of the parking areas, and natural light to be admitted to the pedestrian ways.
The various unloading edges around the concourse area are connected to the ground level by escalators and baggage lifts. One end of the central concourse connects to a protected floating platform for embarkation on to the water buses and ferries operated by the city of Venice. The other end of the concourse connects to the local buses and to the buildings of a cultural and recreational centre. There is also a vertical connection from the concourse level to a helicopter station located on the roof of the terminal. The procedure involved for departing is the reverse of that for arriving.

Design

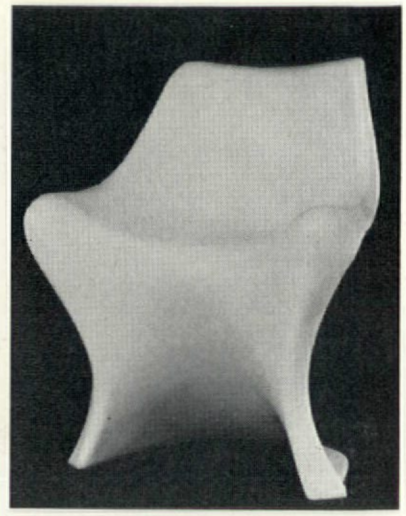
Prototypes seeking manufacturers

Photos by the Council of Industrial Design who exhibited the furniture at the Design Centre in January

Fibreboard chair
D. David Bartlett
Cut from two sheets of fibreboard (60in × 40in) laminated with thin polythene film. The board is then scored lightly, folded into shape and held together simply by interlocking the seams. It is intended by the designer (shown here) to use gay coloured designs on a white board.

Cardboard chair
D. Peter Murdoch
Originally designed in polypropylene, plastic coated cardboard—folded and riveted—has been substituted to reduce manufacturing costs.

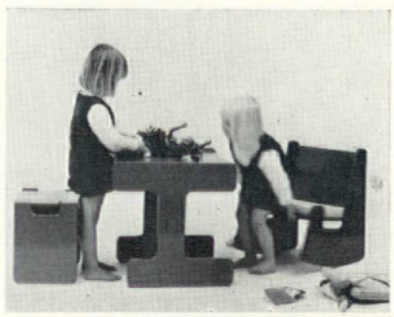
Polypropylene chair
D. Peter Murdoch
Flat sheets of polypropylene, folded and riveted together, are supported on a tubular steel leg structure.



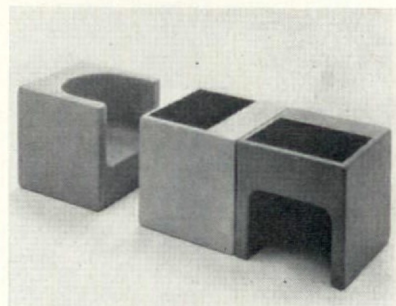
Monoform chair
Nigel Walters
Of glass fibre, this cantilevered stacking chair relies on its curved surfaces for rigidity and strength.

Prestfibre chair
D. Gerald Tyler
The fibreglass prototype is intended for production in Prestfibre (a moulded wood pulp made by British Moulded Fibre Ltd, with whom the designer is associated), and upholstered in moulded polyether foam covered in stretch PVC. Seat and base shells stack and are screwed together.

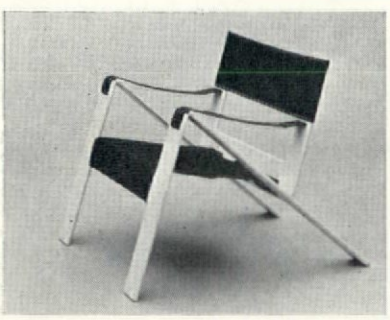
Double rocker
D. David Goodship
The ply sides of the prototype are each constructed from three separate pieces: the end and centre tubes are of reinforced cardboard faced with ply and upholstered with polyether chip foam. Glass fibre and PVC would be used in future versions.



Ply nursery units
D. Susan Ekins
Birch ply and a nylon joint are used for the knockdown units. Without the polyether foam cushions, the chair can be used as a desk and the stool as a table.



Polythene nursery units
D. Noel Fleury
These are two basic units, both one-piece mouldings in a combination of high and low-density polythene. The rotational casting process used entails very low tooling costs.



Folding chair
D. Alex Roberts
In birch ply finished with polyurethane paint, plus canvas seat, back rest and arm straps, the chair has brass butts hinging the side frames which allow it to fold completely flat, the back rest being hinged to the seat by the canvas which is secured throughout by rustproof staples driven in pneumatically.

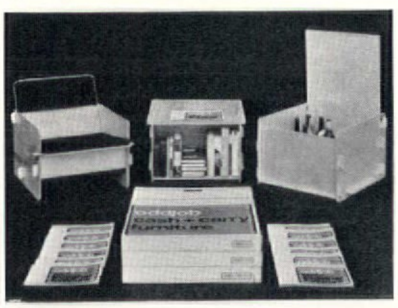
Polythene stool
Graham Fairfax-Jones
Made from a single piece of pressed polythene scored with a thin line and folded into shape, the form is achieved partly through the natural resistance of the material.

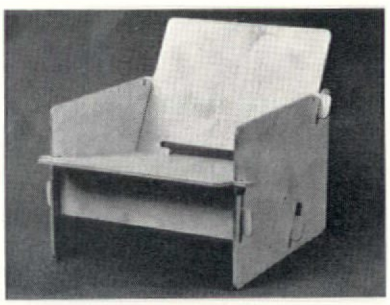
Polythene chair
D. Ronald H. Flood
Made from a single pressed polythene sheet, scored lightly, folded into shape and welded on three seams; then riveted to a base ring of aluminium tube.

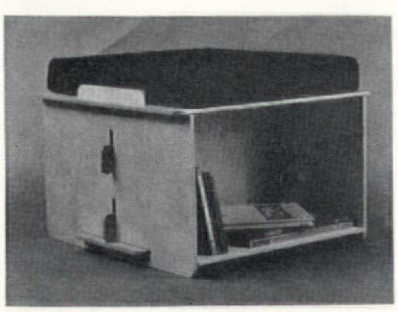
Additive knockdown chest of drawers
D. Trystram Mylius
The drawers and framework, all in birch ply, slot together without any mechanical fixings.

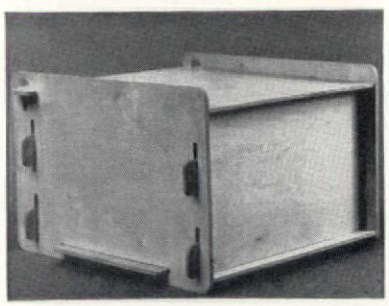
Fibreboard nursery furniture

Designed and made by Reed Corrugated Cases Ltd, the corrugated fibreboard nursery units are intended for assembly on delivery, the desks stapled, the chairs folded and tacked. The furniture is currently being tested in a Bucks nursery school and standing up well to it.







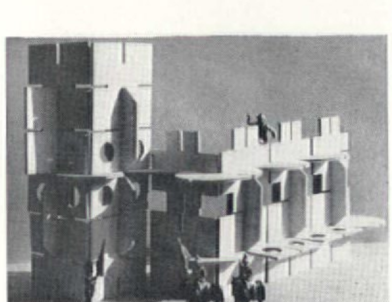


Odd-job slot-together furniture

Designed by Liz Goldfinger and made by Studio G (Hutton Rudby, Yorks), the knock down units are in birch, ply-lacquered or painted bright red. Their price, including postage, is £7 3*s* 6*d* each (cushions extra).

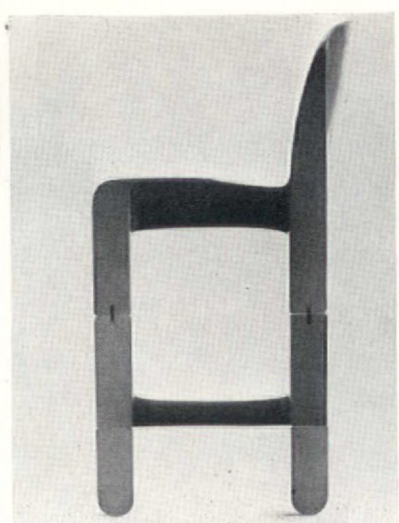
Interslot toy

Roger Limbrick Associates (Belmont Terrace, London W4) are the designers and producers of sets of 34 pieces of slotted coloured ply of different shapes, which could be useful for subliminal design-conditioning of the young. Price 38*s* 6*d* the set. (Shown here with tin soldiers.)



Joe Colombo

Prof Joe Colombo, after much research, reckons to have solved *all* the problems of chair design with his latest stacking model for Kartell of Milan, which is just coming onto the market—a one-piece injection moulding in polypropylene, with added feet of the same material equipped with shock absorbers. These feet are of several heights to cater for varying needs. The technological characteristics of the material are such that the chair will be low cost and can be made in an infinite range of colours (also chrome or metal finish). Clip-on cushions will be available. Finmar will be importing the chair into Britain (see also p.145).



◁143

The International Furniture Show, London

This year's exhibition—despite credit squeeze doldrums—began to live up to its claim of being international, with representation from Italy, Denmark, Belgium, Switzerland, Germany, Holland, Norway and Sweden; coming from more than 70 firms grouped according to their country. Prof. Colombo's chairs for Kartell & Comfort (p. 145) were on show; also a clever mobile revolving storage unit, 'Combi-Center' he has designed for Bernini (via Cefalonia 9, Milan; UK agent, Conran) which consists of varying stacked units pivoting on a central metal column and capped by a translucent lighting unit **1, 2**.

Also on the revolving storage theme from Bernini was a mobile bar designed by the architect G. Frattini. Here, however, the centre stays still and the bar turns round it. Again varying height **4**.

Casaluci showed rosewood and walnut storage units 4D by Angelo Mangiarotti—varying heights, tambour shutters, felt or leather tops, very elegant. (Via Piave 59, Rovellasca, Como.)

From among the Danish exhibits we show a fibreglass chair **3**, model No. 10, by Sven Ellekaer for Relax Furniture (Bøstrup, Laurbjerg) which costs about £20 in Denmark (not available yet in UK), and can be had in black or white, with or without castors. Scandia Furniture Group, (6 Dryden Court, Ham Common, Surrey), showed a gay, bright orange, wooden armchair **5** designed by Alring & Thygesen, for A/S Mogenskold, Kerteminde, with striped loose cushions, and large disc bolt covers. Nanna Ditzel's shaped floor cushions (*AD* 4/66, p. 200) were being displayed by Mines & West (Downley, High Wycombe, Bucks.)

Returning to the British exhibitors: the main impression was that repro-modern has 'arrived' and that bright shiny colour is OK. Stag (neat bedroom units), Conran ('Package deal' storage wall), Kandya (metricized kitchen units), and Meredew (white cubic storage units perched on bright yellow cylindrical recessed plinths, with matching giant-sized disc handles), were among the exceptional. While Arkana (Falkirk, Scotland), a two-year-old firm, all of whose products are designed by Maurice Burke, caught the eye with their elegant, plastically eclectic (Eames, Nelson, Saarinen derived) *Star*, *Lundquist*, *McKenzie* & *Bjorgensen* chair ranges. All of these have moulded fibre glass shell seats. Mr Burke has designed a sprung, automatic return swivel for optional use with some of the models, concealed in the shell support. The latter, together with the cast aluminium base, is colour-finished in fluidized butyrate to match the shell, though the base can also be polished aluminium.

A variety of combinations of bases and shells (with or without cushions or upholstery) is possible within the range of six colours allowed (black, white, beige, mustard, turquoise and coral). There are also matching tables in a choice of three heights of pedestal base with eight sizes of circular top, six oval, and eight square or rectangular. Even nine sizes of boat-shaped conference table. (Tops and bases are available separately). To give an idea of price, the *Star* armchair shown here **8** costs about £25, and the table about £35. The side chair **7** costs £15 to £18.

Arkana's *Chelsea* chair **6** will probably be a winner as it is both cheap and comfortable, costing just under £17. It is of structurally-supported foam upholstery covered in Cirrus (backed PVC) in the firm's colour range, with a self adjusting back, solid afrormosia legs and matt black stretcher rails. Large chromed bolt heads become a feature. The matching stool costs £9 18s.

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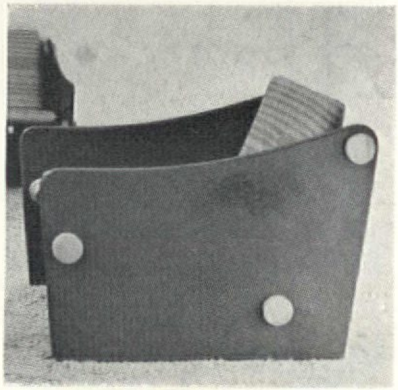

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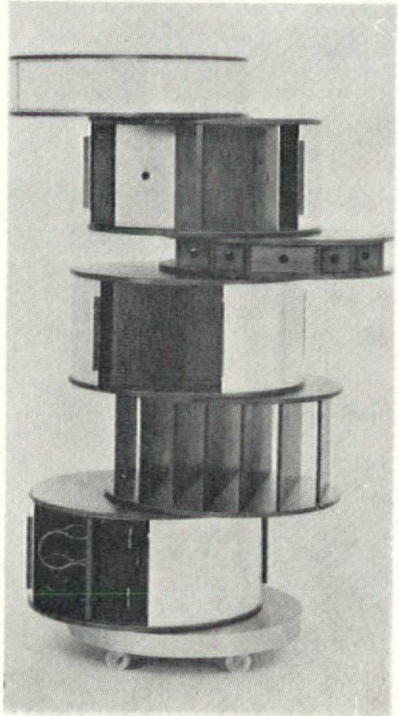

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A colour brochure giving full details together with a DECLAM sample can be supplied on request. Our area representatives will be pleased to make their services available and subsequently submit layout suggestions and quotations for the supply of kitchen units.

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Lea Valley 'Continental' kitchen to be installed in Stevenage New Town Development, Silam Road, Stevenage.
Architects: Leonard Vincent, Raymond Gorbing & Ptnrs., Architects & Planning Consultants, Southgate House, Town Centre, Stevenage, Hertfordshire.
General Contractor: Gilbert-Ash (Southern) Ltd., 17 Park Place, Stevenage.

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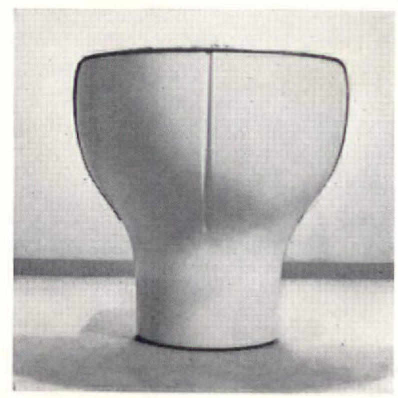
◁143

Joe Colombo (continued)

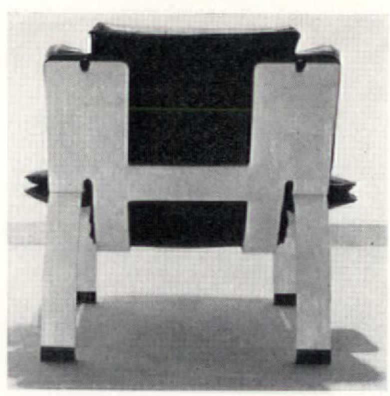
Thanks to the enterprise of Finmar Ltd, (32 and 34 Avon Trading Estate, London, W14) we can now see, touch and buy the luxurious white and black confections designed by Prof Joe Colombo for Comfort-Milano.
(The prices given are those quoted by VASA Ltd, 31 Lowndes Street, London, SW1).

Golf Club 1002, matching sofa, chair, stool and table, consisting of lacquered wooden boxes with separate cushions. All the units move on castors. Sofa, £196 (cloth) or £284 (leather); chair, £103 or £142; stool £54 or £59; table £46.

Elda 1005, a monolithic reinforced plastic shell frame with seven separate down-filled cushions clipped onto the upholstery lining the shell. Available all in red as well as in white with black cushions with leather upholstery, £201; cloth £150 10s.

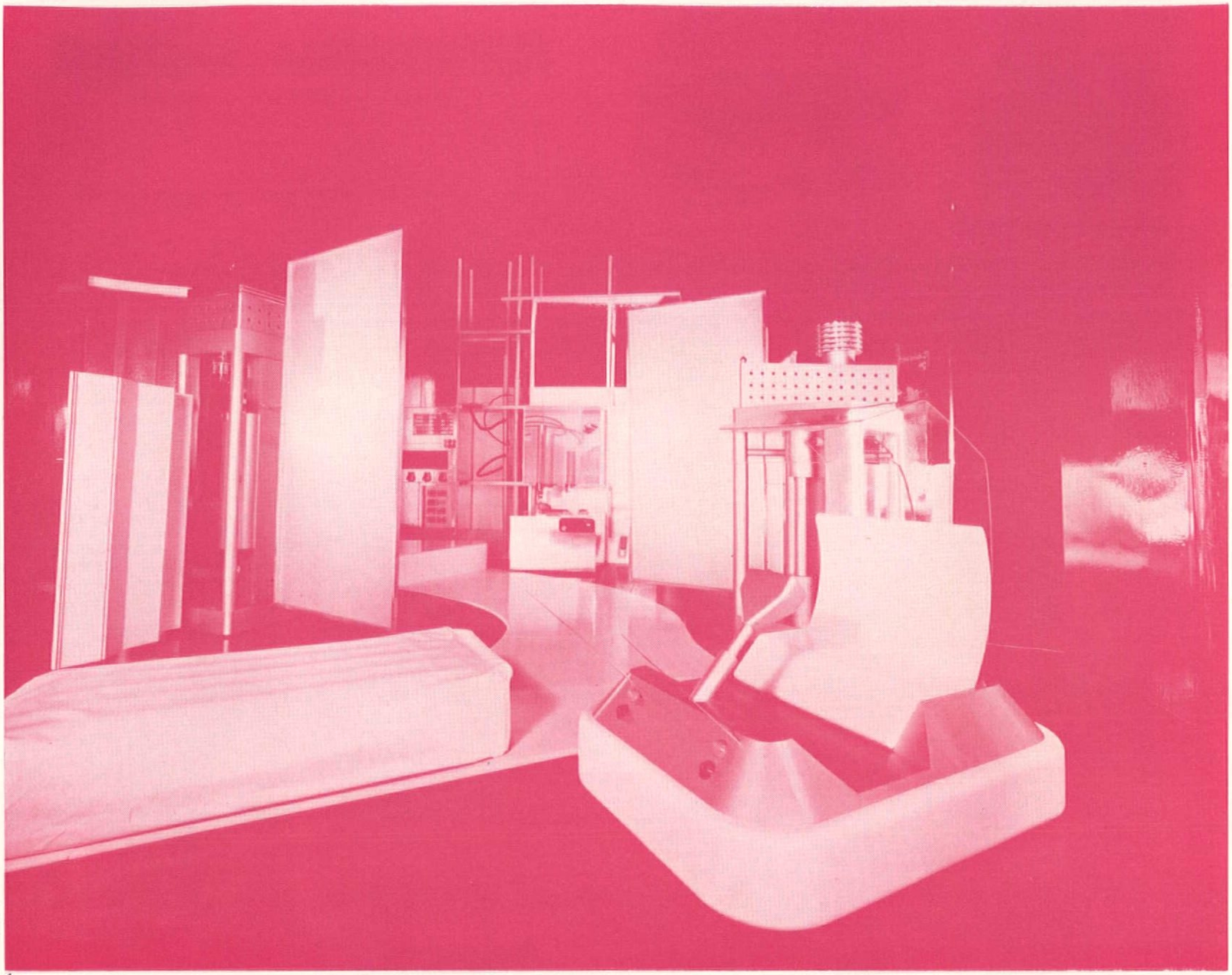




Sella 1001, in moulded ply with steel spring and leather upholstery, £65 10s.

Supercomfort 1000, with a lacquered bent ply frame with removable leather cushions, leather upholstery and inner plastic springs, £88 or £102, depending on the height of the back. Matching stool, £25 10s.





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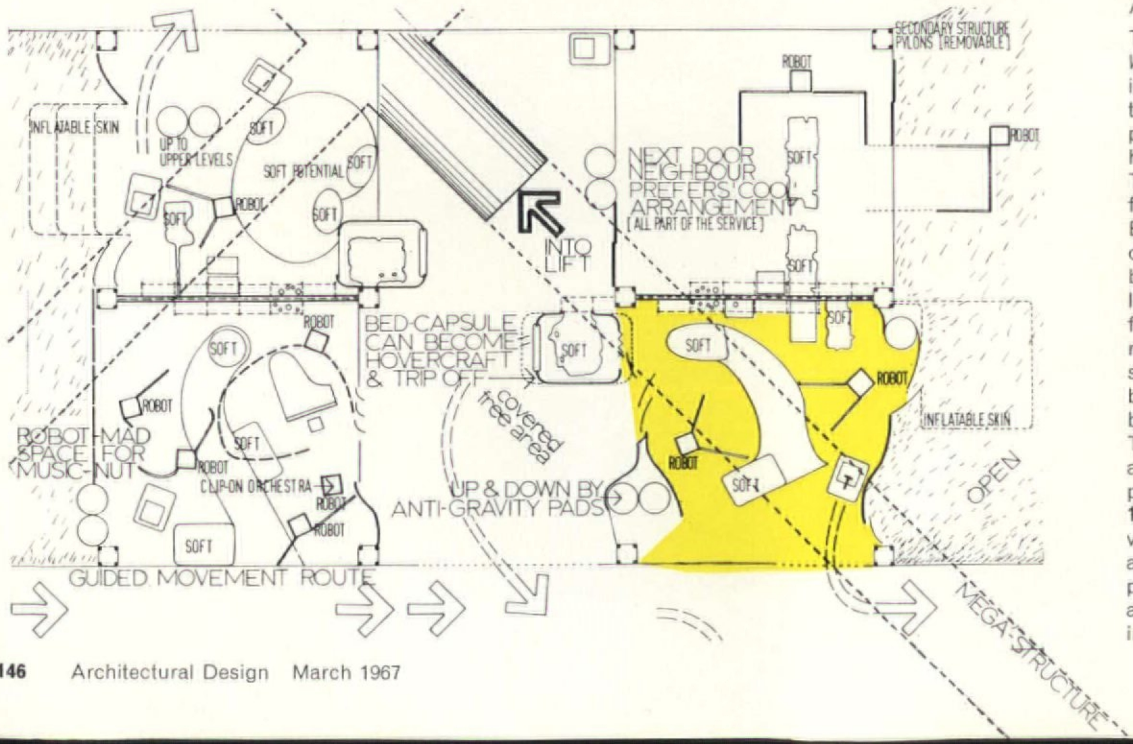
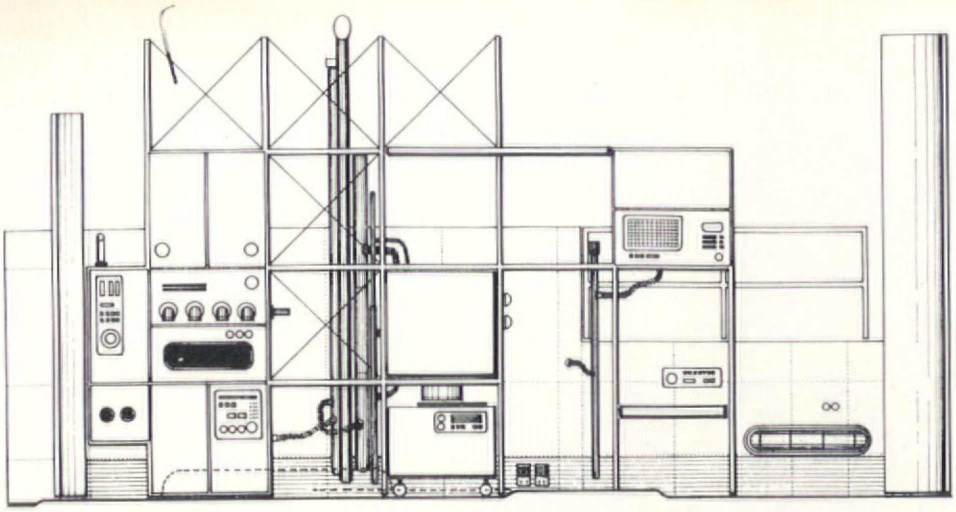


Living, 1990

Archigram Group

The intention of this exhibit, sponsored by the *Weekend Telegraph* on show this month at Harrods in Knightsbridge, is to demonstrate how computer technology and concepts of expendability and personal leisure might influence the form of future homes.

The living space **1, 4**, is intended to be in a space frame **2** or suspended within a tensegrity structure. Enclosure is created by skins which close together or separate electronically. The floor and ceiling can be transformed from hard to soft as acoustic/space/light regulators or inflated in certain areas as required for reclining and sleeping. The adjustable screens of the robot towers (robots Fred and James) **8**, define smaller areas within the main volume where one can be totally enclosed—enveloped in an event generated by the projection of films, light, sound and smellies. The push of a button or a spoken command, a bat of an eyelid will set these transformations in motion—providing what you want where and when you need it **10–16**. Each member of a family will choose what they want—the shape and layout of their spaces, their activities or what have you. The hover chairs **1, 9**, will provide an instant link-up with local amenities or access to the nearest transit interchange. A fully integrated systems approach to domestic bliss.



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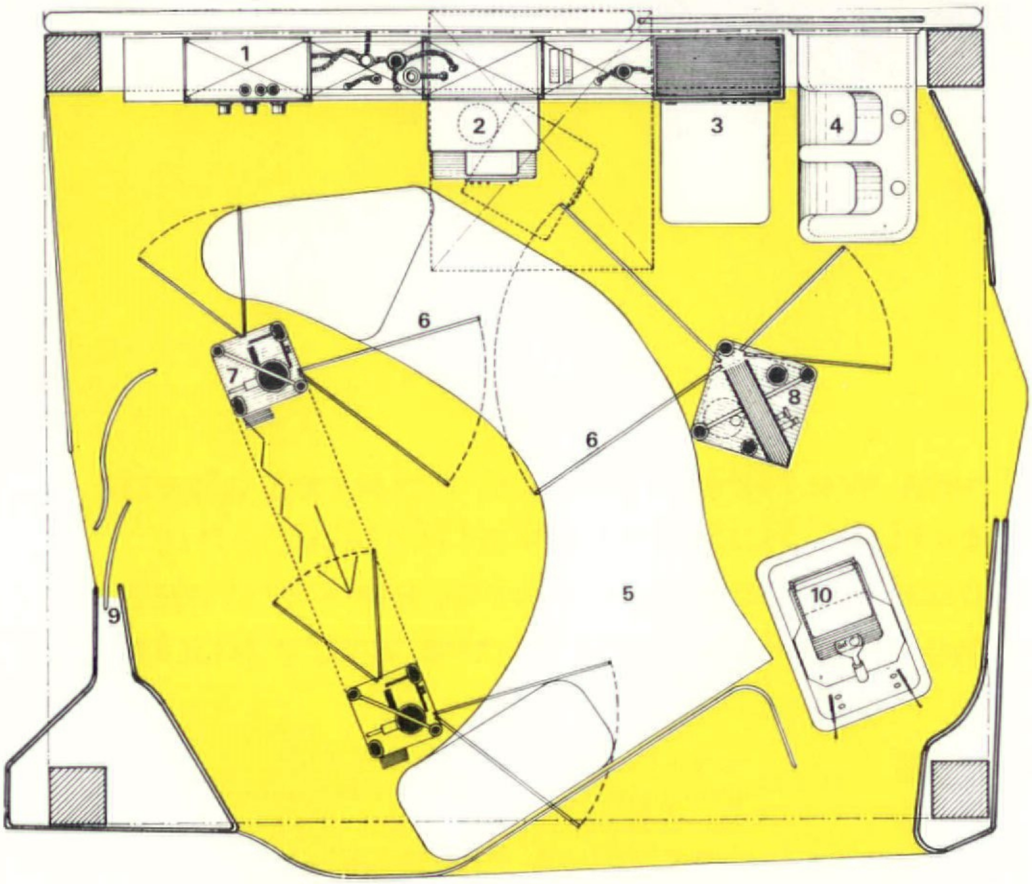

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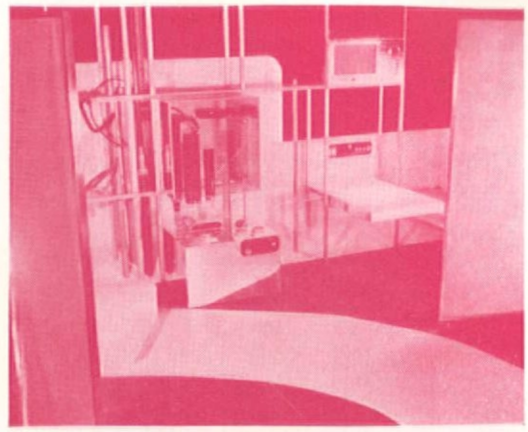

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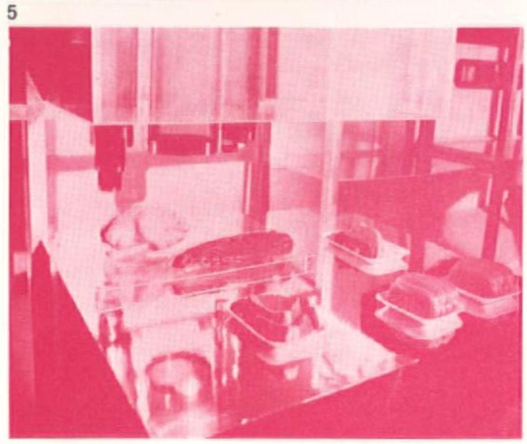

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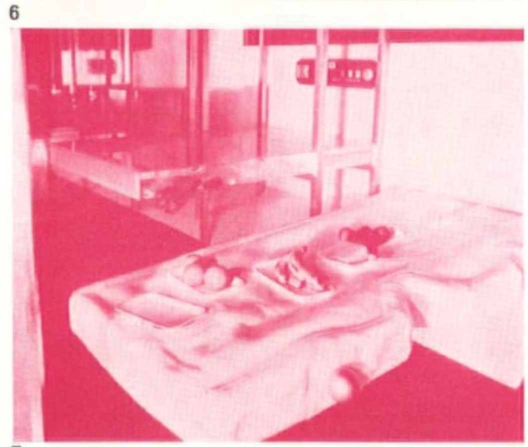

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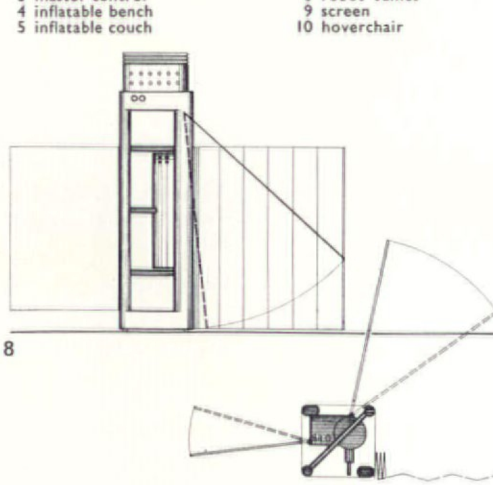
The importance we attach to the new technology is quite clear. To say that electronics is important to the future of architecture is a truism—something to talk about and discuss, yet feel unable to produce constructive and significant propositions about. This vision of the dwelling of the future takes an elementary and popularized form, but it is not a compromise. It makes clear, without any falsification of our beliefs, ideas that are otherwise difficult to grasp. Participation in an event such as this helps to redefine the problems we recognize to be important; clarifies our position before another step is taken. It might enable all of us to endure better the crisis we live in. Architecture remains well outside the orbit of technological forecasting—the ability to look ahead further than you can see—but inevitably and eventually it will be pressurized into a more receptive position. The public is not interested in the current betrayal of the Bauhaus achievement; it is equally, reluctant to suffer the inefficiencies of Welfare State housing. The only way to involve the public in architecture is to give them what they want. We see self-selection as the obvious solution.

Warren Chalk

key
1 hardware dispenser
2 food dispenser
3 master control
4 inflatable bench
5 inflatable couch
6 3D TV screens
7 robot 'Fred'
8 robot 'James'
9 screen
10 hoverchair

Photos: 1, 6, & 7 Terence Donovan courtesy Weekend Telegraph; *5 Archigram Group*



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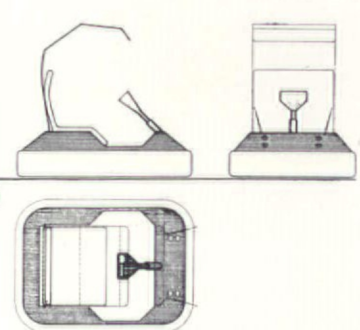

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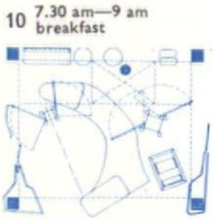
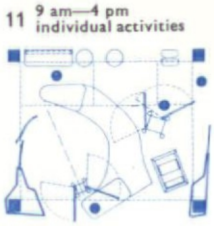
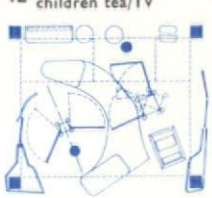
10 7.30 am—9 am breakfast



11 9 am—4 pm individual activities



12 4 pm—6.30 pm children tea/TV



13 6.30 pm—8 pm teens/adults activities

14 8 pm—10 pm dinner

15 10 pm—3 am party

16 3 am—7.30 am sleep

Metrology and the module*

J. F. Eden

The author is indebted to colleagues at the Building Research Station in the preparation of this note, and in particular to Dr F. H. Rolt, erstwhile head of the Division of Metrology at the National Physical Laboratory.

The problems of dimensional coordination are of two main kinds. The first emanates from the design office and concerns the restriction by designers—for reasons that are basically economic—of the free range of dimensions from which they might select, and the substitution of a limited range of standard dimensions. The second emanates from the site, and is the problem of making things fit in an acceptable manner when assembled.

Neither of these problems is of much concern to architects or contractors so long as it is permissible to allow time and labour for making components fit together on site. It is only when attempts are made to avoid fitting operations on site by the extensive use of standard interchangeable mass-produced components that problems of dimensional coordination became acute.

They occurred in the mechanical engineering industry during the industrial revolution in the nineteenth century. Prior to this time, as in building today, extremely accurate and beautifully finished work was produced with great skill by fitting part to part, but there was no universal control of dimensions to a common standard. The need for this became acute only when machines were produced in numbers, and the advantages of having parts which were *interchangeable* became apparent.

The solution of this problem in mechanical engineering, which took about 100 years to complete, has revolutionized engineering production and brought with it incalculable benefits to mankind.

One of the earliest theorists of dimensional coordination and interchangeability was Lieutenant-General Gribeauval (1715–89), first inspector-general of French artillery from 1776[1]. Gribeauval is credited with laying down the principles of the techniques for interchangeable manufacture, including the choice of standard sizes for guns and ammunition, the fixing of limiting sizes for components and the verification of those limits by the use of 'go' and 'not go' gauges†. It is said that the resulting advantages to the French armies contributed greatly to Napoleon's early successes.

The pioneer of interchangeable mass production in the USA was Eli Whitney, who began to manufacture cotton gins in large numbers in the late 1790s. He followed this by applying similar methods to the manufacture of rifles for the US Government around 1800. Whitney's work may have been influenced by contact with French émigrés to America.

In Britain, some dimensional coordination problems were tackled in naval dockyards in the late eighteenth and early nineteenth centuries. General Sir Samuel Bentham (brother of Jeremy), was an early exponent of standardization, and coined the word *interconvertibility* in describing the property that an article may have in replacing a range of others. Thus many of the sails, and parts of the masts and rigging of Bentham's experimental vessel *The Arrow*, were alike, with consequent saving of stocks of spares[2]. Bentham extended his ideas on interconvertibility to naval stores in general, to materials and to buildings.

Marc Isambard Brunel, father of Isambard Kingdom, and a French émigré to America, at one time Chief Engineer to the city of New York, came to England and worked under Bentham, devoting much time with Maudslay to the development of a machine for making standard pulley-blocks in large numbers (about 1400 pulley blocks were required in a man-of-war).

Problems of dimensional coordination were accentuated as manufacturing methods improved in the first half of the nineteenth century. The work of men like Henry Maudslay (1771–1851)[3], who invented the automatic screw cutting lathe, opened new frontiers of repetitive manufacture. His concern with accuracy (he invented the method of making plane surfaces three at a time, and could make a 'wring fit‡, established very early the essential relationship between mensuration and standardization. But it was left to Joseph Whitworth[4], working between 1840 and 1880, to establish the four fundamental requirements for the manufacture of interchangeable products in quantity.

Dimensional standards

Whitworth recognized the fundamental need for common dimensional standards with a real meaning. He made standard length gauges and strongly urged the need for governmental standards of dimension.

Use of plane surfaces

Whitworth recognized with Maudslay the need for plane surfaces as aids to measurement. 'I cannot impress too strongly . . . the vast importance of possessing a true plane as a standard of reference. All excellence in workmanship depends on it.' Without an accurate plane surface, many dimensions of components are extremely difficult to measure and there can be no control of warping and other forms of distortion.

Control of dimensions—use of gauges

Whitworth stressed the fundamental need to control the dimensions of interchangeable manufactured items and recognized that the ability to measure was the key to progress in this field. He spoke of *the power of measurement*. He made standard plug and ring gauges and advocated their use. In 1841 he said in discussing screw gauges:

'To maintain uniformity, provision must be made for multiplying standards of the diameter and threads. This may be easily done and will prevent screwing tackle from degenerating by use and propagation.

'This part of the case is connected with a subject of great extent, which, in every aspect, lays claim to the attention of practical engineers. We allude to the general use of standard gauges to a final scale as constant measures of size. It is quite practical by such means to work to a common measure with a degree of accuracy sufficient to all ordinary purposes. Corresponding parts, instead of being got up one to another, might be prepared separately. The indefinite multiplication of sizes would then be prevented and the economy of the workshop simplified to an extent beyond calculation.'

Standardization

Whitworth's work on screw thread standardization, for which he is best known, would have been meaningless without his metrological advances. Had he advocated standard sizes and shapes without being able to show how they could be achieved and without being able to

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† A satisfactory component will pass the 'go' gauge and not pass the 'not go' gauge.

‡ When two surfaces are made to a sufficient degree of accuracy, and are clean and dry they will stick together if pressed in contact with a twisting motion known as 'wringing'.

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distinguish between the achievement of others, his ideas would have remained philosophies. The fact that he was able to *measure* enabled him to analyse current performance and advocate compromise thread forms which could be widely made. There is no logical basis for the shape of the Whitworth threads. This is a compromise derived from the various shapes which were found in use at that time. These threads are still in use. Whitworth's attempts to realize other standards on the bases of logic—such as his passionately advocated bolt diameter series in tenths of an inch instead of sixteenths—made no headway. Similarly, his ideas about standardization of building components lay dormant for sixty years.

In spite of Whitworth's considerable efforts and their implications for our civilization, their application to repetitive manufacture was confined until the turn of the century, to a few firms making such things as bolts and nuts, bicycles and sewing machines. Then the Newall Engineering Company introduced their system of limits and fits and first offered standard 'go' and 'not go' limit gauges for sale.

The enormous increase in interchangeable mass production during the first world war occasioned the final stage of the development of methods in this country. At the beginning of the war the few master gauges sent in for checking at the National Physical Laboratory were measured by time-consuming methods—some using machines to Whitworth's original designs. A period followed in which it was found that the master gauges and check gauges needed to control the dimensions of the greatly increased number of interchangeable mass produced components, could not be produced with sufficient accuracy by industry, and could not be checked sufficiently quickly at the NPL for correction. For a period, dimensional control of gun parts and ammunition was in danger of being lost, and a national crisis ensued. The classic work carried out in the ensuing few years by a small team at the NPL completely revolutionized engineering metrology and has become the basis of modern methods of interchangeable mass production. The tools of civilized life—motor cars, trains, farm tractors, telephones, razor blades, electric motors—now depend on the control of dimensions by methods evolved over the past hundred years, using an international system of limits and fits, determined with the active collaboration of the British Standards Institution, in which dimensions are controlled by gauges which are related to ultimate dimensional standards defined in terms of the wave length of cadmium light.

This system was determined by the International Organization for Standardization (ISO) and is fully set out in BS 1916, Limits and fits for engineering. Part 3 of this Standard covers a size range up to 124 inches and gives recommended tolerances for eleven different grades or fit, the coarser of which might well be considered suitable for some aspects of building*. Part 2 of the Standard is a guide to the selection of the grade of fit which is suitable for any particular purpose.

The system of dimensional control described in this standard is fully backed up by an internationally agreed system of expressing limits and tolerances on production drawings (BS 308 Engineering drawing practice) and by a similarly agreed system of gauging, measuring, and inspection (BS 969 Plain limit gauges, limits and tolerances). Together these three complementary systems control not only the individual dimensions of components, but also their shapes (e.g. squareness) and the relative position of components as a whole. The gauging system as set out in BS 969 depends upon 'go' and 'not go' gauges, used to indicate whether a component is too big or too small. Besides workshop gauges of these types, which are used directly for controlling dimensions during manufacture, gauges to slightly wider limits are used for inspection purposes, and reference gauges are kept aside to control gauge wear. Gauges of these three types would be used nowadays in repetitive production of interchangeable fitting parts *however coarse the tolerance allowed*. To check dimensions and shapes not convieniently measured by gauges, modern workshops rely on accurate plane tables which can be made to very high standards, and upon the use of standard gauges of nominal dimensions made to very close limits. These standard gauges, and the highly accurate 'go' and 'not go' check and master gauges used by gauge manufacturers, have their dimensions controlled by reference to the wavelength of cadmium light.

The building industry

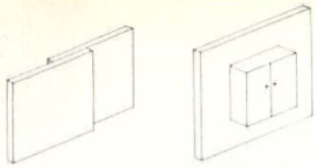
There are two inter-related aspects of dimensional coordination; the one concerned with making interchangeable things fit, the other with the choice of size ranges from the point of view of economy. The main mechanical engineering experience lies in the theory and practice of interchangeablity, where very great advances have been made. There has been no correspondingly great engineering advance in the theory or practice of economic size ranging; in this respect such practical advances as have been achieved have been as a result of attempts to combat waste by agreed discontinuation of unused or little used sizes. Only recently has interest developed in the theory of the subject† and as yet there has been little practical achievement in the field. This lack, however, does not seem to have inhibited progress, and engineering experience must suggest that in mass production economic size ranging is of secondary importance to interchangeability problems.

On the other hand, in the building industry, though the work of the Building Research Station and the British Standards Institution has lead to the use of many standard components, the history of dimensional coordination, which dates back to the 1930s, is almost entirely theoretical, and concerned primarily with size and ranging in its mathematical and planning aspects.

Since the aims of prefabricated building are to achieve the benefits of mass production it is somewhat astonishing to find so different an emphasis being given to dimensional problems in the two industries. A consideration of the history of the subject in both industries suggests that a further interchange of experience might be beneficial. While it is not within the scope of this note to attempt any historical review of dimensional coordination in building[5], it is worth pointing out that it displays little authentic contact with engineering. Indeed, some of the references to engineering matters in Bemis[6] are nonsensical, although he himself claimed to be an engineer. Engineering experience strongly suggests that modular theory and practice in building will be advanced only by a marriage with metrology. ▷150

* Architects and builders reading this Standard need not be confused by references to 'shaft' and 'hole' dimensions for which they can substitute 'component' and 'gap'.

† Largely as a result of the ISO, see BS 2045.



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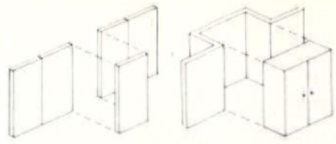

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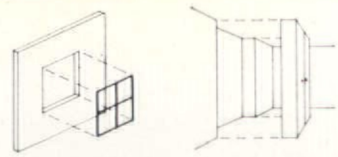

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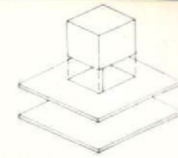

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Before embarking on a discussion of this connection, it is of interest to consider the various types of operation which might be encountered in the assembly of prefabricated components which vary in size. Assembly difficulties can be rated in order of the 'degree of restraint' provided. Thus, if we assume that we are dealing with flat rectangular panels, **1** shows that no restraint is provided in certain simple assembly operations such as fitting cupboards to walls, the assembly of panels with lapped joints, etc. For such types of assembly no dimensional control is necessary.

With one degree of restraint **2**, such as arises when a panel is inserted into a critical gap, there is a problem of fit, and, in interchangeable assembly, it is necessary for the designer to control the dimensions of both component and gap. With two degrees of restraint **3** there are very considerable additional problems, of which an example will be that of fitting a rectangular plug into a rectangular hole. Both plug and hole will vary in size if panels are manufactured in numbers, and if fitting operations are to be avoided, gaps are inevitable, their size depending on the degree of control excercised in the manufacture of the panels. The problems of fitting plugs into holes can often be avoided. Traditional practices such as fitting door and window frames into walls, or cupboards into recesses, need to be reconsidered when there is a change from traditional construction to methods using the assembly of interchangeable mass-produced components. An engineering answer would be to bolt the door or window frame to the face of the wall.

The solution of a fitting problem with three degrees of restraint **4** is extremely difficult and can be exemplified by a requirement that a prefabricated staircase should be fitted into a well in such a way that it fits all round in plan and at the same time that top and bottom levels match with floor levels.

The above examples will be sufficient to illustrate that building in interchangeable prefabricated components raises fitting problems which do not arise in normal building methods and require new thought from the designer about many traditional architectural details.

Modular theory and practice

In considering the connection between the theoretical aspects of modular coordination, its practical implications on site, and the science of metrology, some attention must be given to the declared aims of modular coordination. While most definitions[7] stress the purely practical aspects of making mass-produced components fit, there is also an assumption, either declared or underlying, that this is not possible without standardization involving a drastic limitation of sizes, and hence a strict design discipline in this respect. Engineering history seems to indicate, however, that while design for interchangeability does necessitate a design discipline (of dimensional control), it is not essential to achieve a standard range of sizes, however desirable this may be. Interchangeability has been achieved in mechanical engineering without the module.

The first step in architecture is to consider the meaning of the module. Is it a dimensional standard of reference like the foot or the yard, or is it a dimension? In design for interchangeability a fundamental clarity on the distinction between these two concepts is essential. The former is a fixed entity, related numerically to the wavelength of cadmium light. The latter, in the context of interchangeability, is a dimension of a large number of interchangeable components or measurements, and hence must vary within imposed limits. We must therefore distinguish carefully between the module—a unit of length—and the modular dimension, which is a range of repetitive measurements.

If we accept that modular theory postulates the module as a unit of length, what of the modular grid? This is quite clearly a series of dimensions having a fixed meaning only in relation to a single imaginary grid. If the grid dimensions are to be repeated, as would be necessary for real building with interchangeable components, they will vary as well as the components. Imaginary components can be fitted into imaginary holes, real components will fit or not fit into real holes, but fitting real components into imaginary holes may be a mental exercise but is metrological nonsense. In interchangeable design, planning grids have no place on working drawings unless their dimensions are given limits. The misconception that they can be reproduced without variation seems to be inherent in current architectural detail for industrialized building and is implied both in BS 3626 *Recommendations for a system of tolerance and fits for buildings*, 1963, and in the recent RIBA publication *Co-ordination of Dimensions in Building*—**5** is a typical detail. Examining the corrected diagram **6**, it will be seen that maximum gap between panels is really greater than is evident from **5**, due to the inevitable variation in setting out the modular grid which was not previously taken into account. The discrepency resultant upon this misconception is a cause of a good deal of the erection difficulties at present being experienced in industrialized building where variations up to one inch have been observed in setting out a 5M grid on site.

The concept of a 'grid' to which all other dimensions are referred, probably stems from the practice, in traditional building, of 'setting out' the outline of a building on the site before starting erection. Such a practice is of course necessary while the dimensions of components are uncontrolled, and parts have to be fitted on site or otherwise made to conform to specified dimensions. If, however, building consists of the assembly of interchangeable components of controlled and related dimensions, setting out can be greatly simplified, because the shape and dimensions of the components will then determine the shape and size of the building. All that will be necessary in most cases will be a single point from which to start building and a line (or perhaps two lines at right angles) to determine its orientation. An alternative to the details **5**, **6**, which would be closer to engineering methods (see BS 308) would be as shown in **7**. This detail assumes that both gap size and overall dimensions need to be controlled. If, on the one hand, there was no functional need for the gap, the panels would be shown butted together with a toleranced overall dimension and a maximum gap size. If, on the other hand, there were no need to control the overall dimension but a functional gap were needed, it would merely be necessary to indicate the maximum and minimum permissible dimensions.

The realization that the insistence upon a modular grid will lead to an increase in joint gaps, variability, and site problems, leads inevitably to the question as to whether it is a useful concept. There are further difficulties when applying a modular grid in a vertical plane, or to structural components both horizontally and vertically because of the need to transmit loads through the joints. An advantage that is claimed for the modular grid is that it imposes a building discipline that ensures that joints are aligned on the façades in an acceptable manner. This however only holds true if the modular grid can be set out more accurately than components can be fitted together, and, in the present state of the art at least, this is not the case. If the modular grid is an ecumbrance on site are there reasons for retaining it on the drawing board? The author would argue against this on the grounds that it is dangerous to deal with imaginary concepts when depicting real things. Its use (if it is at all useful) should be strictly confined to diagrams used for the selection of components.

Freed from the grid, there is nothing to prevent the effective development of modular building based on sound metrological, building, and mathematical lines. Some courses of action which engineering experience suggests might lead to further advances in dimensional co-ordination and design for interchangeability in industrialized building are:

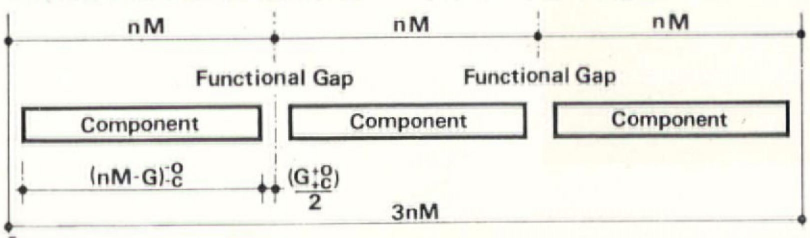
International standardization of the module as a unit of length in real terms.

Education in science of metrology and limit fit design.

Joint architect/engineering/metrologist action to develop building metrology, and provide a gauging system for dimensional control.

The development of modular theory to take account of metrological aspects.

Dropping the modular grid (as distinct from the module) as a concept.



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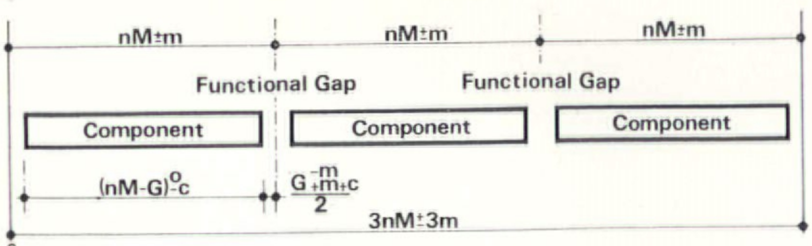

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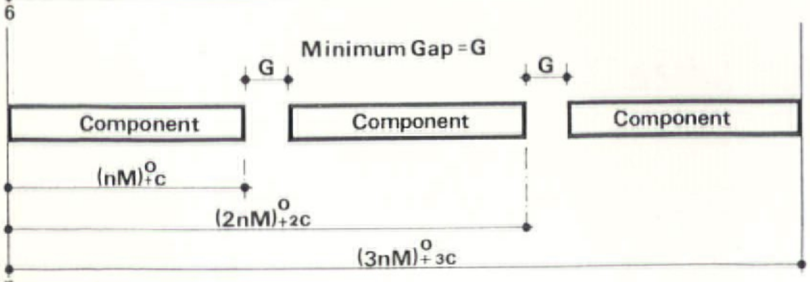

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1 This reference was obtained verbally from Dr F. H. Rolt and the author has not been able to trace its source. A possible reference is Hennébert—*Gribeauval, lieutenant-général des armées du roy*, 1896.

2 Bentham, Sir Samuel. *Papers and practical illustrations of Public Works*. London, John Weal, 1856. Inst.Mech.E. Library.

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4 *The Whitworth miscellaneous papers*, Institution of Mechanical Engineers (most of the quotations in this note are from his address to the Institution in 1856).

5 Letostaw Piotun-Noyszewski, *Zasady Koordynacji Modularnej w Budownictwie*, Warsaw, 1961.

6 A. F. Bemis, *The Evolving House*, 3, Rational Design. MIT University Press, 1936.

7 For example, BS 2900 and the EPA project report No 2 on modular co-ordination (OEEC, July 1961), but not Corker and Diprose 'Modular Primer', *Architects Journal* August 1st, 1962, in which other aspects are stressed.

1–4
Fitting problems in interchangeable design

5
Assembly method in which the architectural detail determines the component and the joint but does not control the modular dimension nM. This detail cannot be reproduced on site

6
Assembly method based on the preceding example, but revised to take into account variations in dimensions when marked out on site*

7
Engineering method of assembly, without a grid, all dimensions being controlled from a single datum line*

* With a large number of panels, N, the cumulative tolerance could be reduced to $\sqrt{N}$ times the tolerance of a single panel, because of the improbability of all panels being of maximum size.

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T17 Fluorescent light fitting 4, 5

Allom Heffer & Co. Ltd., 17 Montpelier Street, Knightsbridge, London, SW7

The 707 Frameless Series of modular light fittings is available in recessed and surface mounted versions in standard sizes 1ft × 1ft, 4ft and 5ft, 2ft × 2ft, 4ft and 6ft, but can also be made in 1ft × 2ft, and 8ft and 2ft × 5ft and 8ft. Prismatic diffusers are standard alternatives to opal diffusers. Price for recessed 4ft × 2ft fitting £22 12s 10d, plus surcharge.

T18 Constructional system

I. Warshaw & SonLtd., Netil House, 89–115 Mare Street, London, E8. AMHerst 0541

A new contructional system for assembly of space frames, racking, furniture, partitions, exhibition stands, etc., utilizes fine basic connectors on a $1\frac{1}{4}$in square module which are tightened by means of an Allen key inside $1\frac{1}{4}$n square 16g steel or aluminium tubing.

T19 Outdoor lantern

Falks Ltd., 91 Farringdon Rd., London, EC1

The Centurion lantern is 5in high, $10\frac{1}{4}$in long, and 5 in deep, and has a stove enamelled aluminium body and hood with a perspex visor. In grey or dark green, the unit takes a 40w or 60w lamp. Price £3 18s 0d.

T20 Unit bathroom in GFP

Rollosrank Ltd., 3 Church Row, Wandsworth Plain, London, SW18. VANdyke 9151

Manufactured in two halves in glass-fibre polyester and factory assembled to form a unit 5ft 8 in × 6ft 4in in plan with a ceiling height of 7ft 4in the complete bathroom with ceramic w.c. weighs 233lb. Intended for industrialized buildings and hotels, all connections are made from outside the unit. Prices vary from £170 to £250 according to quality.

T21 Obscured double glazing

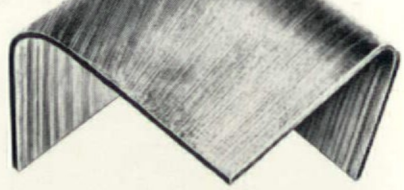
Pilkington Bros. Ltd., St Helens, Lancashire. St Helens 28882

Four versions of obscured Glastoglas are now being manufactured and can be obtained in sizes ranging from 18in × 39in to 50in × 70in with a maximum ratio of $3\frac{1}{2}$: 1. Each of the four designs provides a different degree of obscuration and the patterned surfaces are inward facing for ease of cleaning.

T22 Pre-finish chipboard for roofing

Formica Ltd., De La Rue House, Regent Street, London W1. REGent 8020

Formica wood chipboard can now be supplied surfaced and with Farosheet, a neoprene/butyl rubber laminate, providing a prefabricating roof decking. Joints are sealed on site by Farostrip. Three different densities of board are available, either planed or with an interleaving layer of polystyrene.



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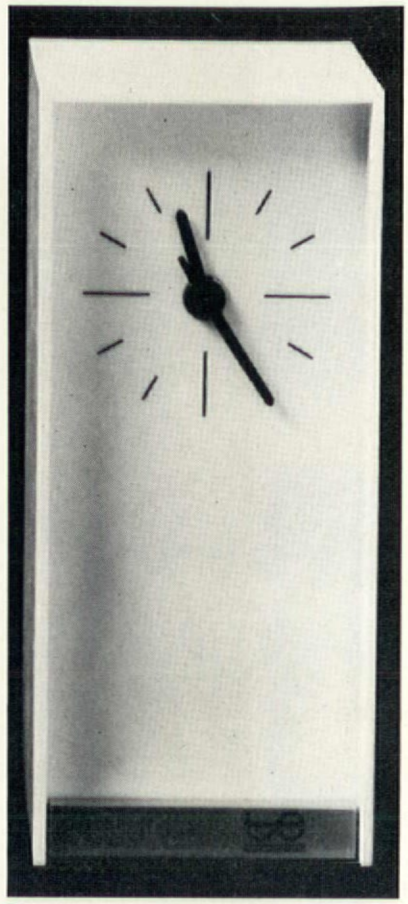

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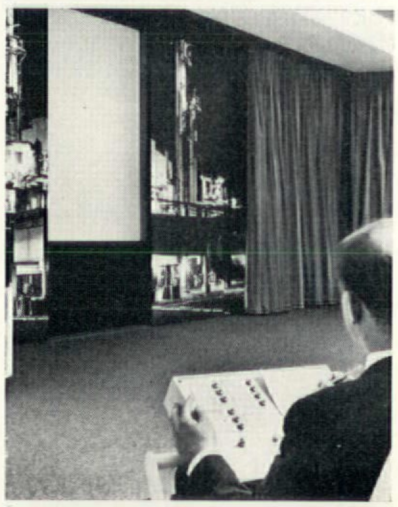

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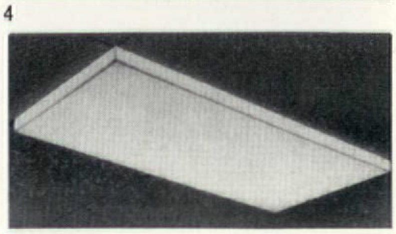

5


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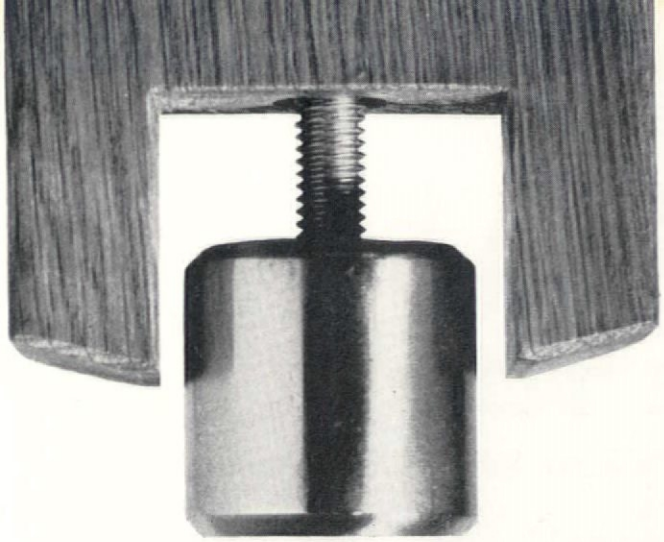
In strong vitreous glazed fireclay, shaped to protect the jet, the fountain projects 11" from screw-to-wall fixings
Details from ADAMSEZ Ltd.75 Victoria Street London SW1 (Abbey 5846) or Fireclay Works Scotswood-on-Tyne
DMA



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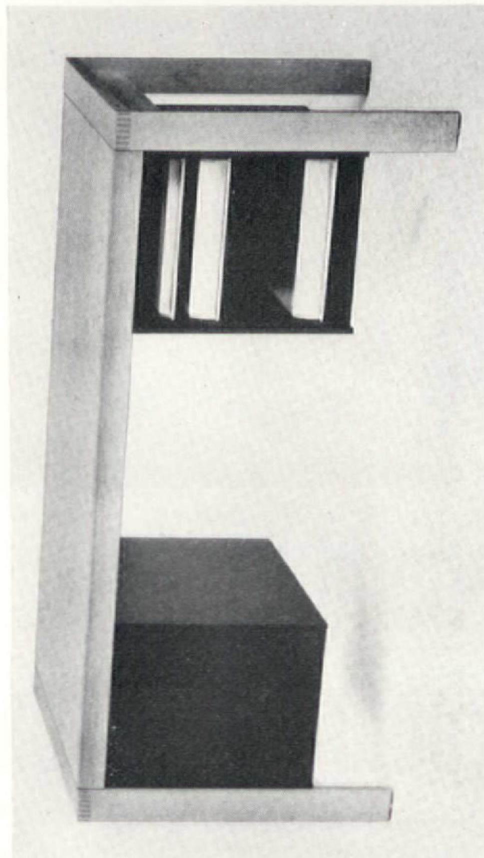
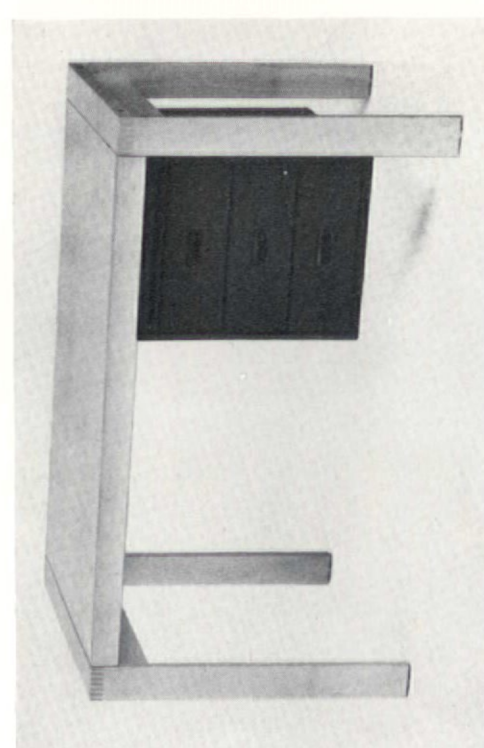
Designed by Martin Grierson MSIA FRSA

Left: single pedestal desk 24U/203 in beech 4′ 4″ x 2′ 8″ x 2′ 4″ high Price £27 12s 9d

Right: double pedestal desk 24U/311B in beech 5′ 4″ x 2′ 8″ x 2′ 4″ high Price £37 12s 3d





Ken Garland and Associates

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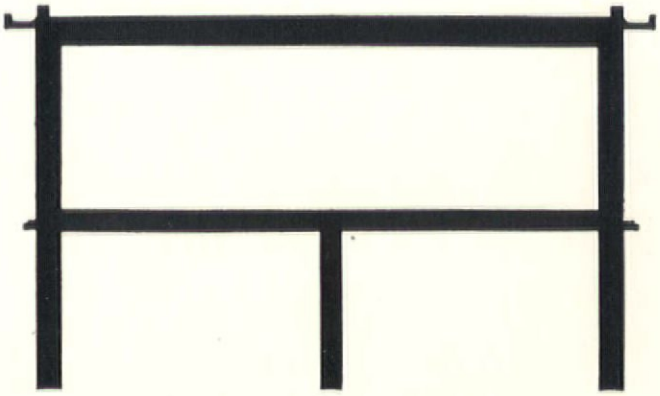
Printed in Great Britain for the Proprietors of " Architectural Design " (The Standard Catalogue Co. Ltd.), 26 Bloomsbury Way, London, W.C.1, by The Whitefriars Press Ltd., London and Tonbridge (Kent)



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