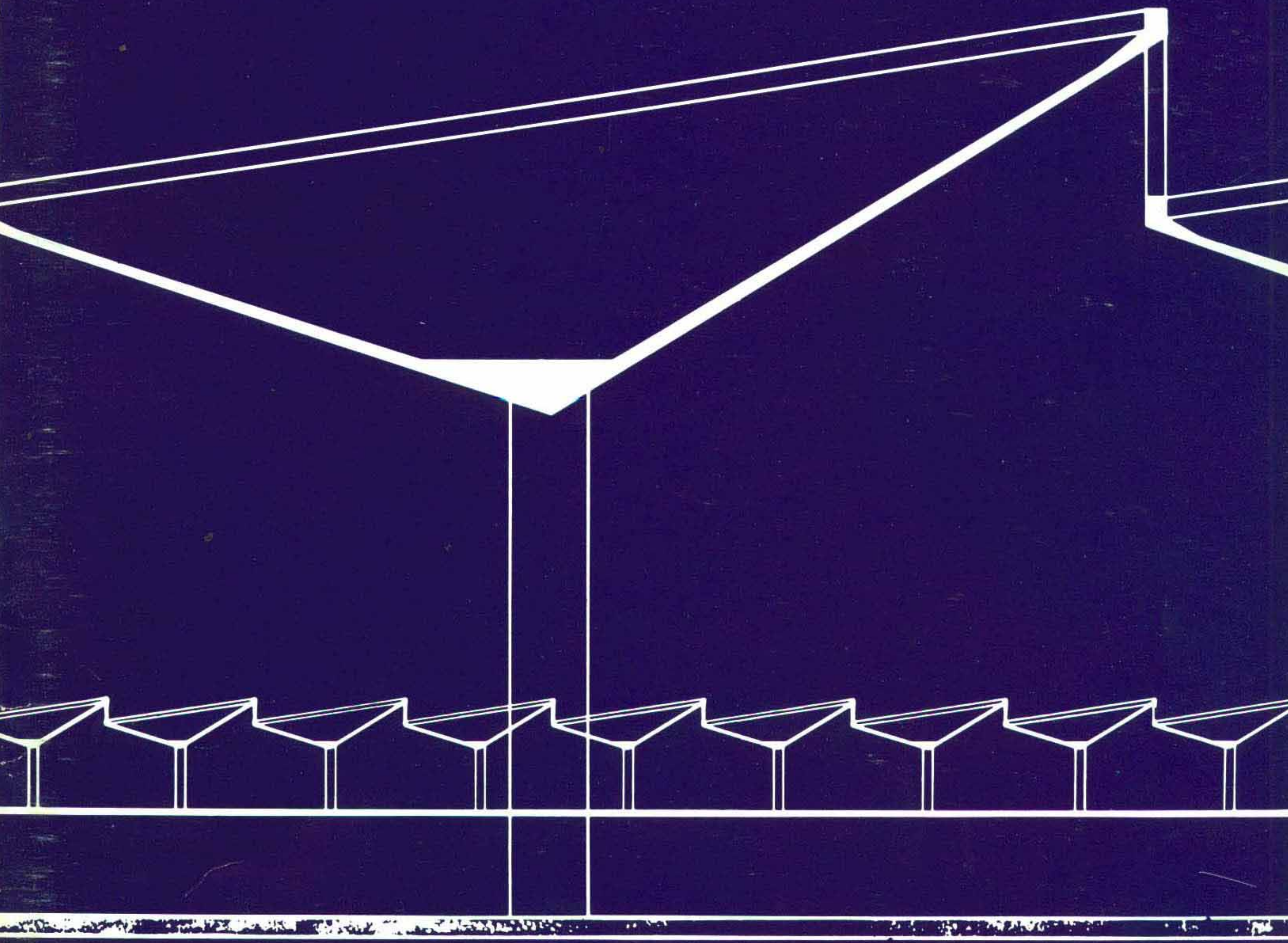
Concrete Quarterly

59



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FRONT COVER: *Transverse section through the hyperbolic paraboloid umbrellas roofing John Lewis's warehouse at Stevenage. See page 19.*

FRONTISPIECE: *Concrete facing blocks – the Congress Theatre, Eastbourne. See page 25.*

THE GOVERNMENT's recently announced plan to step up expenditure on motorways and trunk roads to some £775 million for the 5-year period ending 1968-9 will undoubtedly make a major difference to the road system of this country.

It is interesting to note that the construction of concrete roads is being stepped up at the same time. At least fifty miles of dual-carriageway concrete motorways and trunk roads have been constructed or will be under construction by the end of this year. These include the important 13-mile motorway link between the Preston and Lancaster by-passes, the 6-mile Newark By-pass on the A.1 (built to motorway standards), and, of course, the Chiswick-Langley stretch of M.4 – the London-to-South Wales motorway. The 1¾ miles of this motorway's elevated section is the longest elevated road in Europe, and a further five miles on the level – as far as London Airport and including the London Airport Spur – will be constructed in concrete. With all this work going forward, and with the excellent riding quality of the Essex roads – as, for example, Ingatestone and Harlow by-passes – to be enjoyed, interested visitors from abroad may well be coming to see our concrete roads next year, instead of our visiting theirs.

At first sight, then, this fifty miles programme seems to indicate that the advantages of concrete roads have at last been fully understood by the authorities. But is this in fact the case? Does not world-wide evidence really justify a much greater use of this form of construction?

For instance. Take the extensive use of concrete roads on the continent of Europe – for the German autobahnen, in Switzerland, in Belgium, for the new French motorways. And consider the results of the AASHO road tests in the United States (reported in *Concrete Quarterly* 54), which conclusively showed concrete's superior durability and retention of riding quality over a lengthy period of punishing use. These test results simply confirmed the wisdom of the American authorities, who have used concrete so extensively for so many years, and have built two-thirds of the already-constructed 12,500 miles of the vast new Interstate network (eventually to be 41,000 miles in all) in concrete.

There are sound reasons for their choice, based on many years of experience. The long life and negligible maintenance costs of concrete roads are well known, and in many areas concrete has the advantage in first cost as well. Its light colour and non-skid texture make it eminently safe to drive on, by night as well as by day. The absence of repairs means free-flowing traffic without hold-ups.

These advantages all apply equally to our own country – and yet, concrete for roads has not been adopted by the authorities here to anything like the extent of concrete for bridges and viaducts. Why is this? Is it perhaps that the authorities lack the courage to back the opinion of the practising engineers on a number of simplifications that have proved eminently satisfactory in practice? Or is it the tendency to give too much attention to discussion of detail? Much progress could undoubtedly be made if the engineers

[*continued on page* 33

A fine grandstand in Jamaica

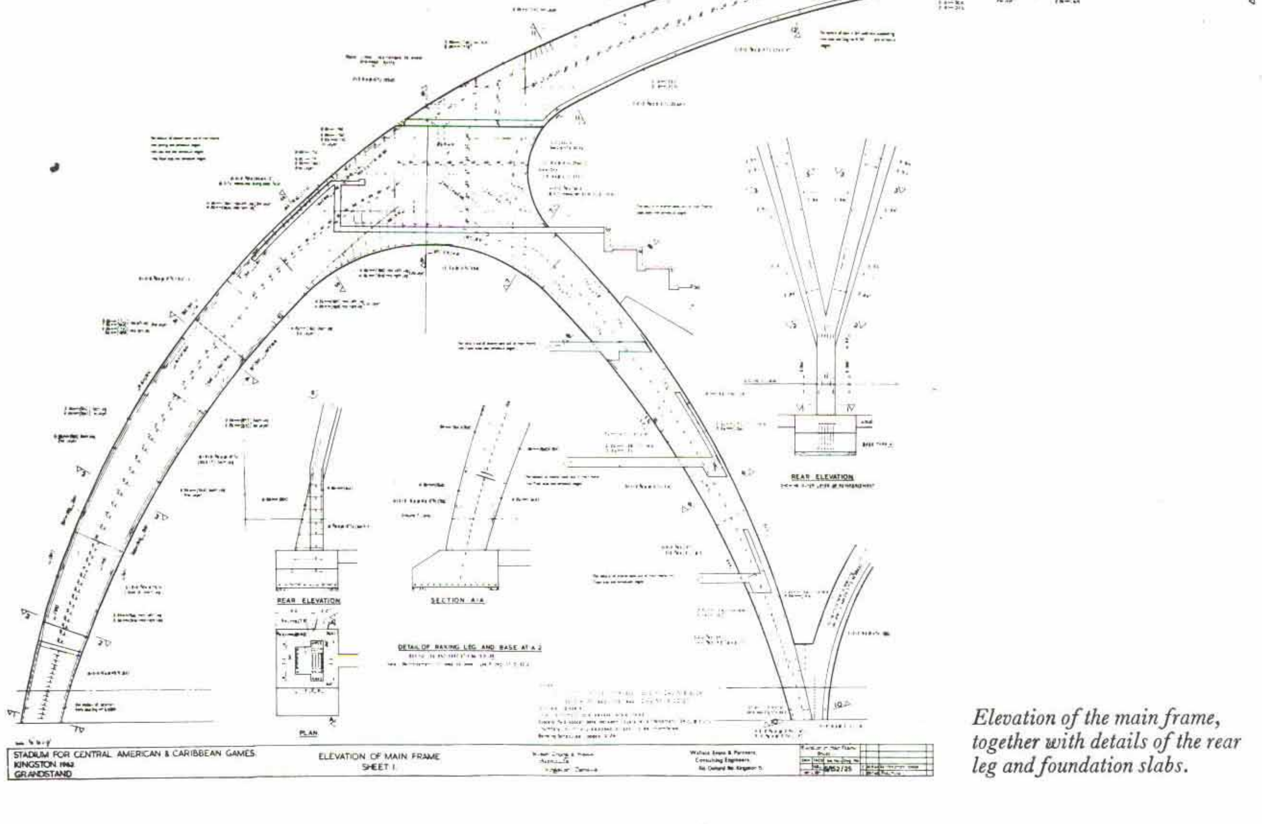
is the high-light of a new sports stadium outside Kingston

SPORTS STADIA are another field where that overworked and tiresome cliché 'the new look' is beginning to be – and justifiably – applied in this country. Sports ground and racecourse owners and managers are looking abroad and seeing, even in comparatively small and poor countries, grandstands that are things to be proud of – sites worthy of notable games – and they have been feeling that it was time we did something to bring them up to date over here. So improvements, and plans, are on foot – or at least in mind – for many of the good, solid sports grounds of Britain.

In this connection it is interesting to see a stadium overseas of which the structure was designed by a British firm of consulting engineers, Wallace Evans and Partners. This was for a country far from rich, but faced with the need – two-fold – for a prestige sports structure. The country: Jamaica; the need: the occurrence, a year ago, of the 9th Central American and Caribbean Games, coinciding with the country's achievement of independence, high-lighted by the visit of H.R.H. Princess Margaret.

Jamaica's new stadium and grandstand is something any country could well be proud of. The whole stadium covers an area of about 88 acres and provides accommodation for 30,000 spectators, 6,000 of whom have seats under the sweeping curved cantilever of the grandstand canopy.

It was fitting, of course, that Jamaica should have a fine sports stadium: it may be a small country, but it has produced some fine athletes. The present arena will provide facilities for running and cycling, football



Elevation of the main frame, together with details of the rear leg and foundation slabs.

The grandstand, with its cantilevered, doubly curved shell canopy.

and hockey, while adjacent are an Olympic swimming pool and a diving and water polo pool, tennis courts and a large cricket field with its own grandstand.

The site is a beautiful one, just outside Kingston, at the foot of the Wareika Hills and with a splendid view of the harbour on two sides. It was an excellent site also from the contracting point of view: the only hazard was a gulley which crossed it, but which was dealt with by widening and deepening it to form a huge amphitheatre, building up all the open seating, as well as the open lower tiers of the grandstand, on the earth bank, and diverting and culverting the storm water formerly carried by the gulley.

The stadium is orientated north and south, so that the athletes do not have to face the afternoon sun, and the grandstand is situated on the western side of the arena.

The grandstand is, of course, the most interesting feature of the scheme from our point of view. Three possible forms of construction were first considered by the architects: earth bank, reinforced concrete and steel. Their relative cost was in that order, and the earth bank was used as a basis for subsequent cost calculations, as well as a base for subsequent work: the lower tiers of seating are built up upon an embankment, and above that comes the fine reinforced concrete balanced cantilever structure jointly designed by the architects, Wilson Chong and Associates, of Jamaica, and the consulting engineers, Wallace Evans and Partners, of Cardiff (through their branch office in Jamaica).

The architects' reasons for the choice of reinforced concrete – apart from its lower cost than steel – are perhaps worth mentioning. We quote:

"Reinforced concrete can be formed to any size or shape. With steel work, the designer has to use standard shapes and extrusions: from the point of view of economy and speed, members are occasionally much stronger than called for by the design.

"Reinforced concrete work is usually more economical and simpler in applying the principle of continuity in structures. Because of this, in several cases steel work has to be designed to resist higher stresses. Moreover, as competent welders are not easily available in Jamaica, a welded structure was not considered feasible for the scheme.

"It would almost entirely employ local skill.

"It would require less mechanical plant."

The grandstand is 346 ft. long, formed of 21 bays at 16 ft. centres. As finally designed it consists of a series of 22 main reinforced concrete arch frames with a rise of 40 ft. and a span, from front to back, of 64 ft., from which the main curved roof members cantilever 68 ft. over the seats; curved concrete slabs form the roof covering, spanning between the cantilevered beam members.

The rear leg of the arch frame divides into two just below the crown of the arch and the adjacent branches of two adjacent arches join approximately 6 ft. from the base, giving the visual effect of Y-shaped supports. The front leg of the arch is, of course, lost behind the lower tiers of seats.

In the uncovered parts, the seating, as previously said, is built up entirely on the embankment formed by excavating the arena, which is considerably lower than the original ground level; the actual elevation was calculated to balance as closely as possible the cut and fill required for the embankments. The seats are fixed to concrete tiers and risers placed directly on the fill. The depth of each riser varies from 9 in. to 1 ft. 6 in., in order to provide maximum vision for the spectators the whole way up the slope.

Behind the seats there rises, under the arch frames, the reinforced concrete-framed 4-storey structure which houses the ancillary accommodation. On the ground floor are athletes' changing rooms and lavatories, police, first-aid and judges' rooms, caretakers' quarters and the machinery room. The first floor provides public lavatories, foyers for grandstand patrons and betting offices for cycle racing. The second floor is mainly devoted to visiting athletes and their managers: it provides sleeping cubicles and wash rooms, common rooms, canteen, kitchen, etc., to serve 64 athletes. On the third floor is the VIP lounge, the press lounge, exhibition hall, telecommunications, stores and lavatories. The fourth floor, which has a view over the entire arena, provides air-conditioned offices for the organizing body, National Sports Limited, and other local sporting bodies; here, too, are the press and radio rooms, and the photo-finish camera, which is suspended from the cantilevered roof, is reached from this floor.

The first, second and third floor slabs are designed as flat slabs, without drop panels or column heads, which gives an unobstructed ceiling throughout.

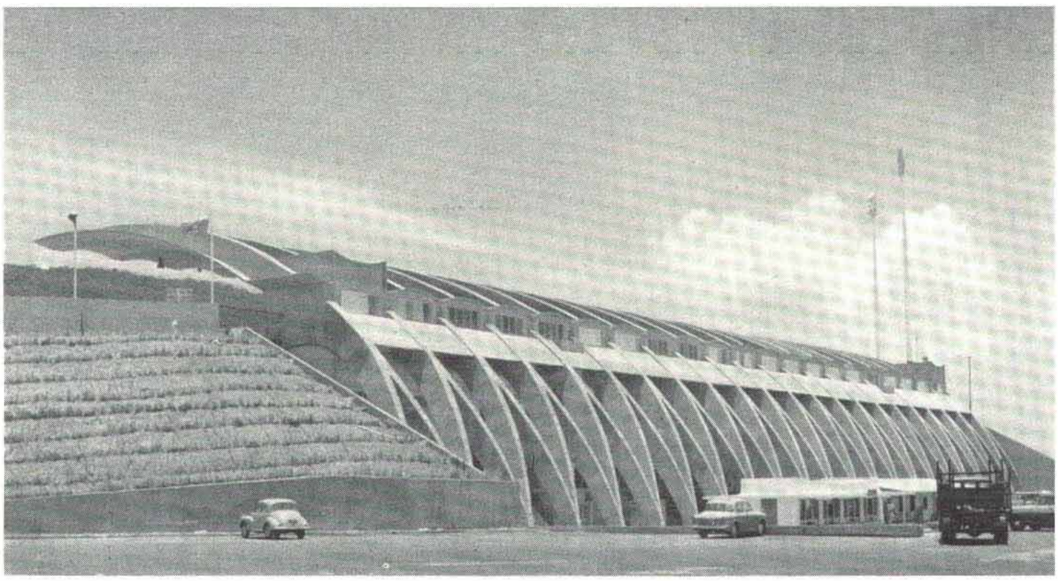
On the design of the grandstand and the main frames, the engineers have contributed the following notes.

"The main frame is designed as an arch with a moment and vertical load applied at the top of the arch where the cantilever beam springs out of the arch and with loads also applied where each floor is connected to the arch frame and also where the seating beam connects with the arch frame. Calculations were made for the arch both as a two-pinned arch and also as a fixed arch. In all probability the structure acts somewhat in between these two extreme conditions but the design was checked so that the stresses due to either a hinged or fixed arch do not exceed the safe working stresses in the concrete and the reinforcement.

"The arch frames rest on footings 7 ft. by 5 ft. below the rear legs, and 12 ft. by 7 ft. under the front leg, which carries most of the load. The central columns which support the suspended floors are founded on 6 ft. by 6 ft. footings. All the footings are connected by ground tie beams in the transverse direction, to resist the horizontal thrust of the arch, and longitudinally to resist earthquake forces.

"The roof beams are designed as simple reinforced concrete cantilever beams. At one time prestressed concrete was considered for the roof but this was rejected by the architect and the building committee on the grounds that it would not provide equal competition for all local contractors tendering. One of the problems of a cantilever roof of these dimensions is the deflections that will occur. The roof slab between the beams was originally proposed as a simple flat slab but this was later changed to the curved shape, as it was felt that undoubtedly differential deflections would occur in the beams and if the slab at the end were straight the differential deflections would be very noticeable. With the curved slab it is not possible to detect the differences in deflections of the beams. The beam itself, apart from being curved, tapers in both directions from the maximum dimensions of 5 ft. 10 in. by 2 ft. 6 in. as it leaves the arch to a section 15 in. square at the outer end."

Great care has been taken within a very limited budget to provide the arena and stands with fittingly attractive surroundings. The main entrance to all the stadium seats is on the grandstand side, from a 50 ft. wide approach road, and near this road, on the east-west axis of the grandstand, is an aluminium statue – "The Jamaican Athlete" – on a reinforced concrete arched pedestal. This sculpture stands in an ornamental pool which forms part of a paved sunken garden which takes the form of a cactus garden, planted with local types of plant set in beds or in concrete containers of varying sizes. Gravel beds of different colours, and pools of different sizes, give further variety for minimum cost.



A rear view of the grandstand frame, showing the interesting arrangement of the legs. The four-storey structure fits in within this frame.

THE RE-DESIGNED SKI-JUMP AT HOLMENKOLLEN, IN NORWAY

is built in prestressed concrete

SEEN FROM A DISTANT VIEWPOINT, above a Norwegian forest, the profile of an immense monolithic structure curves in a concave sweep from the sky. The lower end of the curve appears to rest on the tree tops, but it actually terminates at this point and is supported by a building concealed by the trees. Below the curved structure is a lower stage that slopes steeply down in a continuous snow-covered gradient to an arena below.

This is the famous Holmenkollen ski-jump, recently rebuilt to the design of the architect Heini Klopfer and increased in length. The previous structure was designed by Frode Rinnan for the 1952 Olympic Games.

The contestants start their run down from the top of the 200 ft. high chute and, reaching a speed of nearly sixty miles an hour, they take off at tree-top height and glide down to land on the lower slope. It is expected that the champions among the ski-jumpers will achieve prodigious leaps, covering nearly 300 feet from the take-off point.

The functional strength and beauty combined in this ski-jump have been made possible by designing it in prestressed concrete. The sides of the chute are formed with two I-section concrete girders 246 ft. long, each prestressed with BBRV cables to a force of about 500 tons; the deck of the ski-jump is of timber construction.

The lower end of the ski-jump, 360 ft. long, is supported by the structure of the Holmenkollen ski museum and restaurant building; at the centre it is carried on a gigantic bifurcated concrete trestle; the upper extremity cantilevers up and out from a massive tower pier, rectangular in section. The curved side girders vary in depth from 6 ft. 8 in. at mid-span to approximately 13 ft. 6 in. where they cross the tower pier. Air entrained concrete was specified for the structural work.

The rebuilding of the ski-jump was completed in six months and the opening ceremony took place on 17th March 1963, the 66th annual "Holmenkollen Day". The cost of the work amounted to £45,000.

More than 130,000 spectators can gather, at any one time, around the arena to watch the international and Olympic champions making their breath-taking flights from this up-to-date, prestressed concrete version of the Holmenkollen ski-jump.

The ski-jump structure rises dramatically against the sky.

A closer view of the structure, showing the restaurant and museum building fitted in beneath it.

Extensions at NEW YORK UNIVERSITY

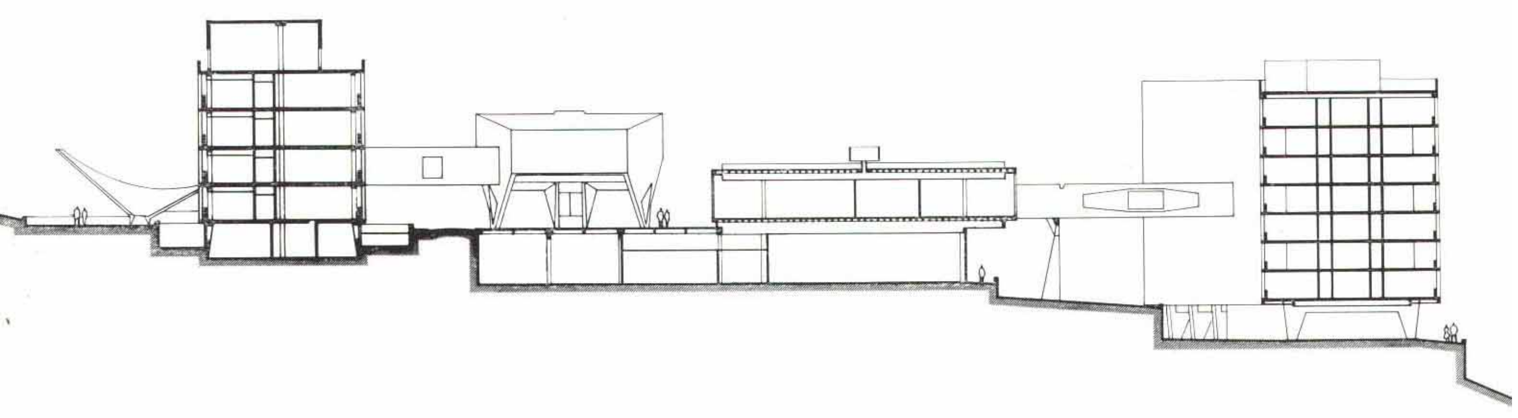
THE OLDER AMERICAN UNIVERSITIES have the same problems as those in this country over expansion, and the need for new buildings. New York University is one such case, and between 1956 and 1958 Marcel Breuer, with Hamilton Smith as associate, prepared a comprehensive redevelopment plan for the Bronx, or University Heights, campus.

The first four buildings in this scheme are now completed, namely a hall of residence linked to a community centre, and a laboratory block, with linked lecture theatre building. All make admirable use of exposed concrete, which is the structural material throughout. They form a very striking group on a tricky site – a beautiful, neglected hillside to the south of the campus centre. The site is so steep that building on it had not seemed practicable in the past, save for a scatter of temporary wooden buildings on the brow of the hill. So previously the hill had been used principally as a survey problem for the engineering students, or a place for lounging in fine weather, with a good view up and down the Harlem River – past the University's Hall of Fame, which dominates the crest of a continuation of the same hillside to the west.

The laboratory block and lecture theatre building now sit on the brow of the hill, with the community centre cut into the hillside, and the hall of residence, set on shaped supports, at the base of the hill. They present an integrated group, the splendidly thrusting hyperbolic paraboloid porch of the laboratory wing firmly proclaiming the entrance, and the V-shaped hall of residence acting as a closure, an enfolding arm.

This seven-storey hall of residence is the largest building in the group, deliberately sited low so that its 78 ft. height does not compete with the dome of the Gould Library, the sentimental landmark of the campus. The hall's width is 55 ft., and its length along the centre line approximately 288 ft., with an angle of enclosure of about 33°. It is so designed that students can walk right from the centre of the campus, through a reception lounge in the community centre, and out across connecting bridges to the middle floor of the hall of residence. So no one has to walk up, or down, more than three flights of stairs to their room. There is accommodation for 200 women in double rooms, with shared bathrooms, on the northern third of every floor and – separated by a dividing wall, like Pyramus and Thisbe – for 412 men, also in double rooms, on the remainder of each floor. Social and club rooms are also provided.

The hall is a reinforced concrete structure, supported below the first floor by a rigid concrete frame, its shaped columns carried down, below ground, to stepped concrete footings resting on rock. The floors are of flat slab construction, supported, at 24 ft. centres, by two central rows of 10 in. by 2 ft. 6 in.



The community centre on the left, linked to the seven-storey hall of residence.

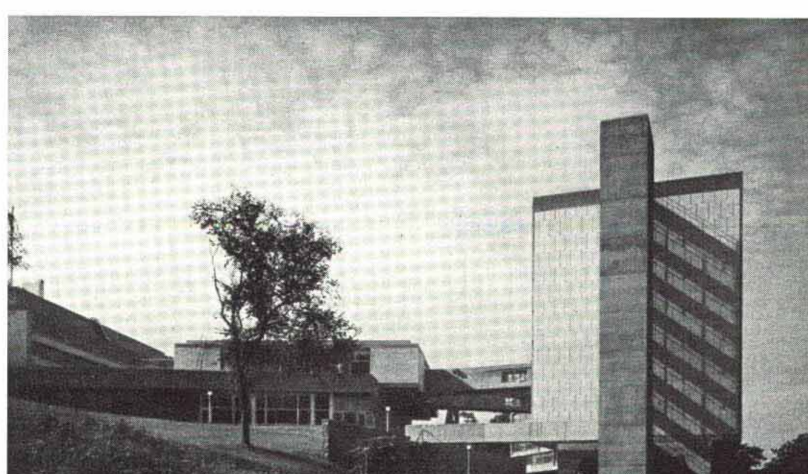
columns, and, at the sides, by 10 in. thick cantilevered concrete walls, alternately short and long, this alternation being expressed on the elevations. The floor slabs are stiffened at the long sides of the building by the spandrel panels; gable walls are infilled with brick, in small, staggered rectangles. There are no expansion joints in the whole length of the hall of residence; to minimize shrinkage stresses a 3 ft. wide 'control' strip was allowed for at the centre of the building length at each floor and also for the roof. This strip was concreted after most of the shrinkage had taken place.

The two-storey community centre is approached from the campus over a broad, trapezoidal-shaped terrace, 168 ft. by 150 ft. in area. Its entrance hall provides the only access to the bridges connecting with the dormitory floors of the hall of residence and, on this same floor, are student lounges, post room, and the private apartments of the Head of the hall of residence. The terrace also forms the roof of the lower storey – a student cafeteria, accessible by stairs, or by paths cut into the hillside, and with large windows looking out over the river. Long-span beams are used in the concrete framing, in order to provide a spacious column-free dining area.

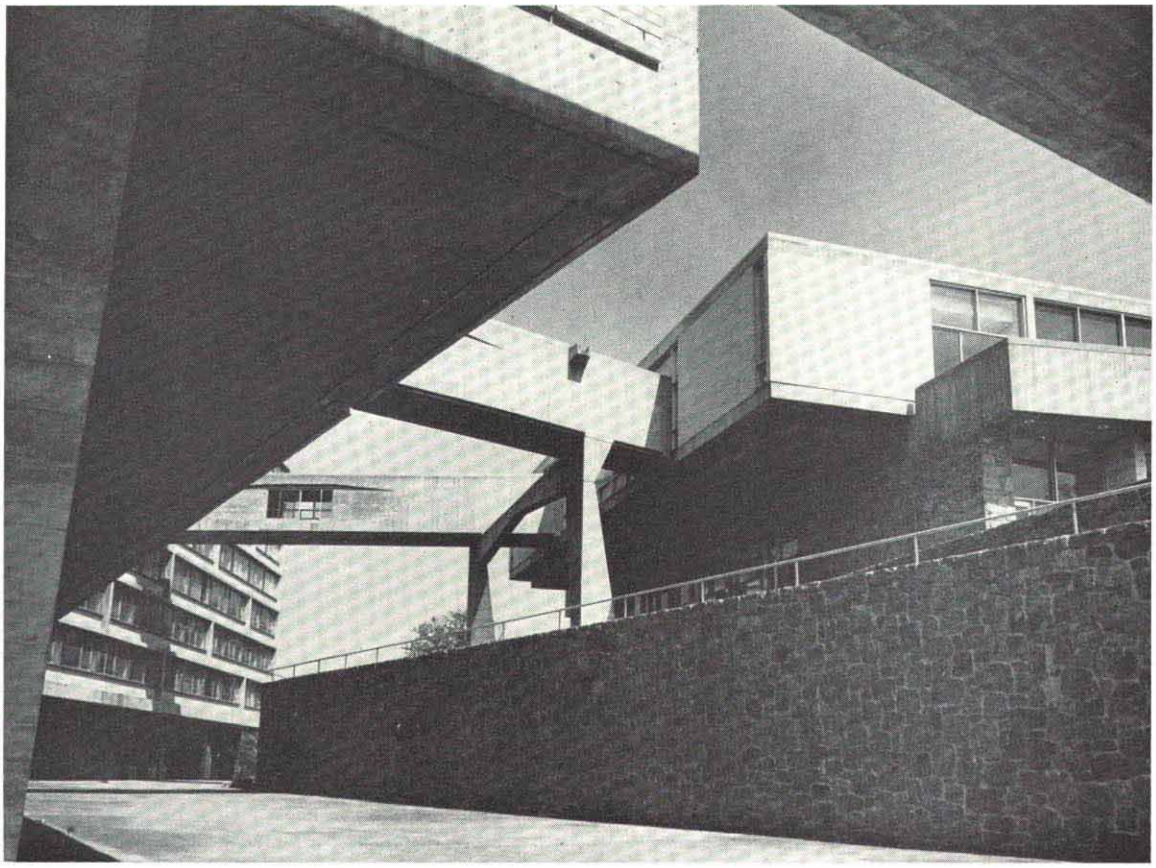
The two bridges which link these two buildings are concrete box-shaped structures with large window openings at the centre of their span, and with unusual means of support. On the residence hall side they are supported from the cantilevered walls through Vierendeel-like members. Both bridges are then supported, 71 ft. from the hall, on a distinctively shaped concrete three-hinged arch; they cantilever 16 ft. from this arch to the community centre, from which they are separated by an expansion joint. There are also two 55 ft. long open concrete bridges at second floor level, which give access to the social rooms of the residence hall.

The five-storey laboratory block – known as the

The group of new buildings descends the hillside, with the hall of residence at the foot.

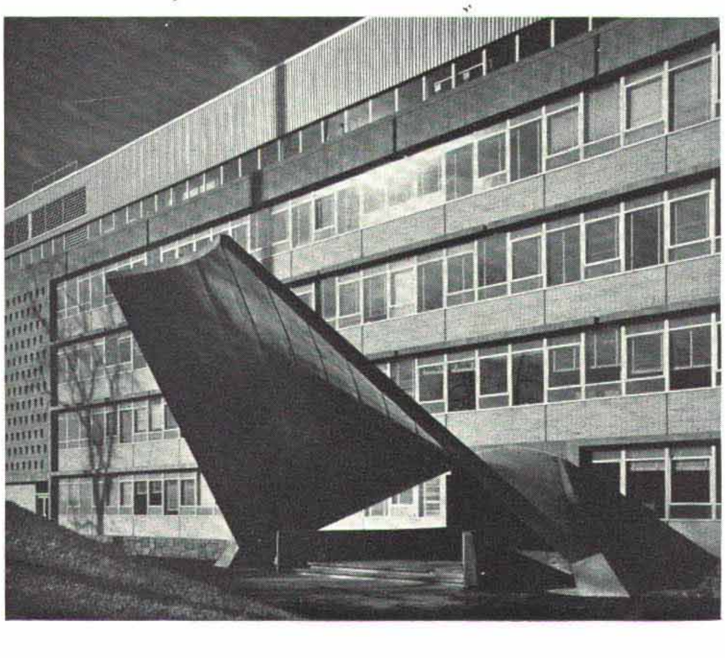


Section through the four buildings. From left to right: Laboratory block, lecture halls wing, community centre and hall of residence.



The concrete bridges linking the hall of residence and community centre are carried on a supporting frame of an interesting shape.

Gould Hall of Technology – houses the departments of Physics, Mathematics, and Electrical Engineering, and contains fifteen teaching laboratories, fifteen research laboratories, fifty-five private offices and three seminar rooms. It is a straightforward rectangular structure, 225 ft. long by 52 ft. wide, distinguished by its powerful saddle-shaped hyperbolic paraboloid entrance canopy. This exposed concrete shell, which varies in thickness from 3½ in. to 6 in., cantilevers approximately 21 ft. in front, and is connected to the building's frame at the back. It thrusts upwards to a rise of 20 ft., curving down to about 11 ft. at the supports, which are spaced 36 ft. apart. The secondary entrance, by contrast, is marked by a perforated concrete block wall. The building has 10 in. thick concrete flat slab floors, which are exposed on the exterior, and the spandrel panels are of brick.



The restraint of the laboratory block contrasts sharply with the jutting concrete shell of the entrance porch.

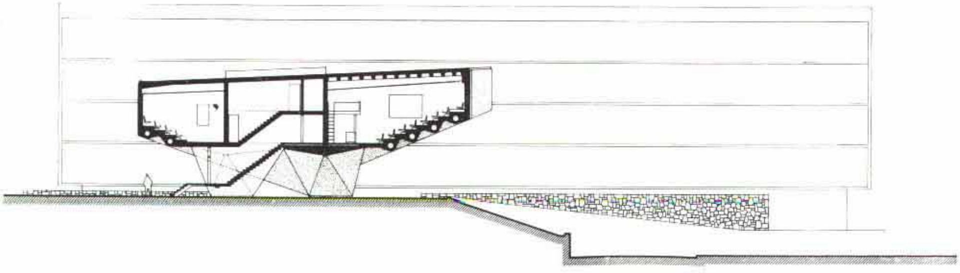
The lecture halls wing, a most striking structure, is raised above ground to the level of the first floor of the laboratory building. It contains two teaching auditoriums, seating 192 and 58 students respectively; each lecture room can be entered directly from a common lobby, which is connected by a bridge to the second floor of the laboratory building. In the architect's own words "the space of this building has been wrapped, so to speak, in a concrete enclosure which follows closely the contours of the interior functions with none of the wasted space commonly associated with the sloping walls and floors of lecture room shapes". It is, in fact, a trapezoid, standing on three piers of unusual shape, the structure cantilevering about 40 ft. on the south side and about 25 ft. on the north side. Its floor rises gradually about 21 ft. on the north and 16½ ft. on the south side, above the finished ground level. The in situ 1 ft. thick concrete walls were designed as wall beams, with openings for windows, and the roof is in part a two-way grid slab of concrete beams 14 in. by 4 in., and in part a 9 in. thick one-way in situ concrete slab. Each of the four walls and the roof has a controlled expansion joint, that of the roof being placed simultaneously with those of the north and south walls.

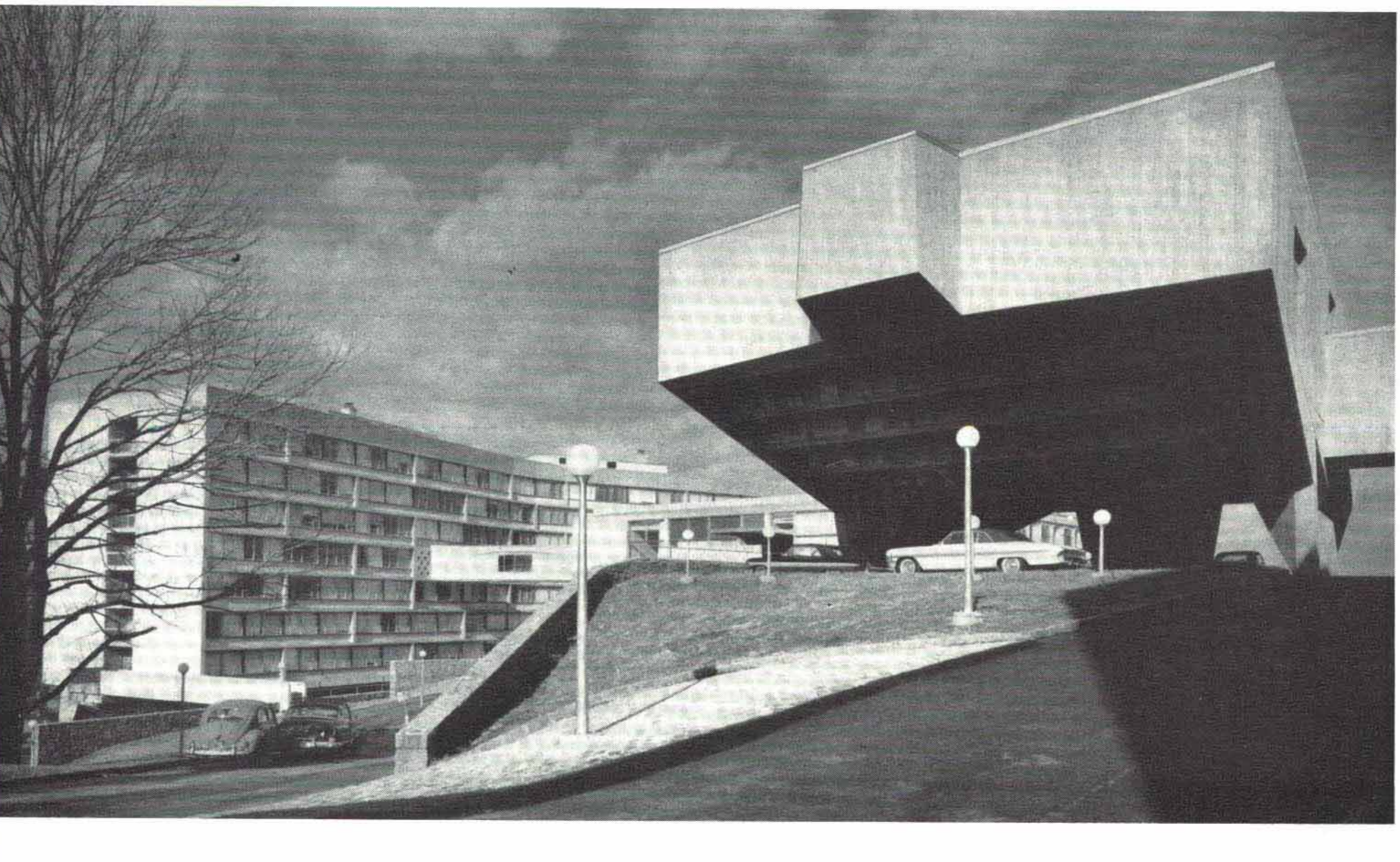
The lecture hall building is an outstanding example of a wholly concrete exterior, in a group where exposed concrete has been extensively used. The architect's aim throughout has been to use materials in harmony with the Hall of Fame and the Gould Library, and the buff bricks which are combined with the concrete closely match those used on the original buildings, while the warm grey colour of the natural concrete is quite similar to that of the limestone used on the older buildings to trim brick panels. Extensive concrete retaining walls, required in terracing the hillside for roads, have been faced with natural stone which echoes the heavy rusticated stone walls at the base of the Hall of Fame.

The fine quality of the exposed concrete in all the buildings can be attributed to the great care with which the finishes were obtained, the architect giving extremely detailed specifications for the pattern and direction of the grain on the 6 in. boards used, for the joints of the boards, for the spacing of form ties and for the sharpness of the arrises, etc. For the all-concrete lecture hall building specially prepared forms were used, the architect making a particular feature of the alternating directions of the grain in the boards. The areas of different grain direction break up the solidity of the massive concrete walls, the individual areas being separated by deep grooved joints in the concrete. In casting the hyperbolic paraboloid canopy of the laboratory block the plywood sheets of the formwork were laid with a minimum distance of ½ in. widening to 5 in. This splay in the formwork was incorporated as a decorative feature in the finished surface of the underside of the canopy; looking like the ribs of an open fan, this consisted of a number of ½ in. thick raised strips below the soffit, varying in width according to the gaps in the formwork. These two specific instances show how the exposed concrete was treated as a major architectural feature throughout the scheme.

For the hall of residence and community centre Marcel Breuer had Robert F. Gatje, F.A.I.A., as associate architect, and Wiesenfeld and Leon were the consulting engineers. The associate architect for the laboratories and lecture halls was Hamilton Smith, A.I.A., with Farkas and Barron as consulting engineers.

Below: The uncompromising strength of the lecture halls wing dominates the hilltop. Right: Section through the lecture halls wing.





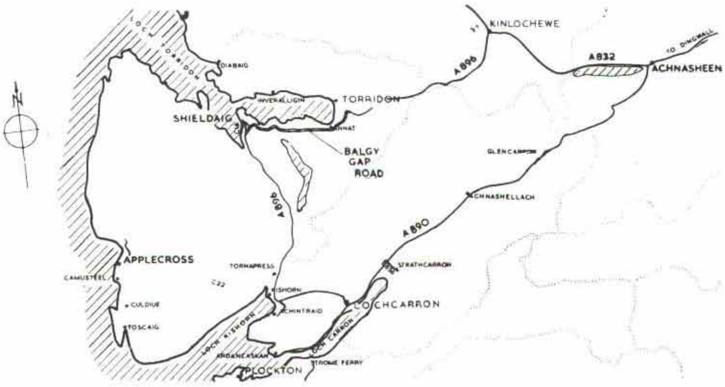
THE CLOSING OF THE BALGY GAP

opens up a new tract of the Highlands

THE LACK OF ADEQUATE ROADS in the crofter counties of Scotland has long been a source of despondency to those who live and try to make a living there, and also to those tourists who wish to enjoy the lesser-known parts of the country without having to make enormously long detours or to risk life and car on wholly unsuitable roads.

Latterly, however, improvements have been stepped up to some extent; road and bridge works are being authorized and put in hand in the more out of the way parts of the north-west, and notable gaps in the system gradually being closed.

One of these 'gaps' was the stretch from Shieldaig to Torridon, on the south side of upper Loch Torridon in Wester Ross, known, from the Balgy river which runs through the area, as the 'Balgy Gap'. This is a stretch of magnificent scenery, which has been inaccessible to the motorist simply because there was no road at all; the hamlets lying between Shieldaig and Torridon had still only footpath connection with the outside world.



The new road on the west coast of Scotland closes the gap between Shieldaig and Torridon. The whole road, from Lochcarron to Kinlochewe, is now reclassified as A.896.

Until the new road was put in hand, the A.896 northwards from Lochcarron stopped at Shieldaig, and B.858 south-west from Kinlochewe stopped at Torridon. The new road closes the gap, linking Shieldaig with Torridon, passing through the intermediate village of Annat, and crossing three rivers on three reinforced concrete bridges. It provides views over beautiful scenery: to the west over outer Loch Torridon and Shieldaig to the Outer Hebrides; eastward, to the majestic Torridon mountains, and the river Balgy with the Balgy Falls under Ben Damph in the distance.

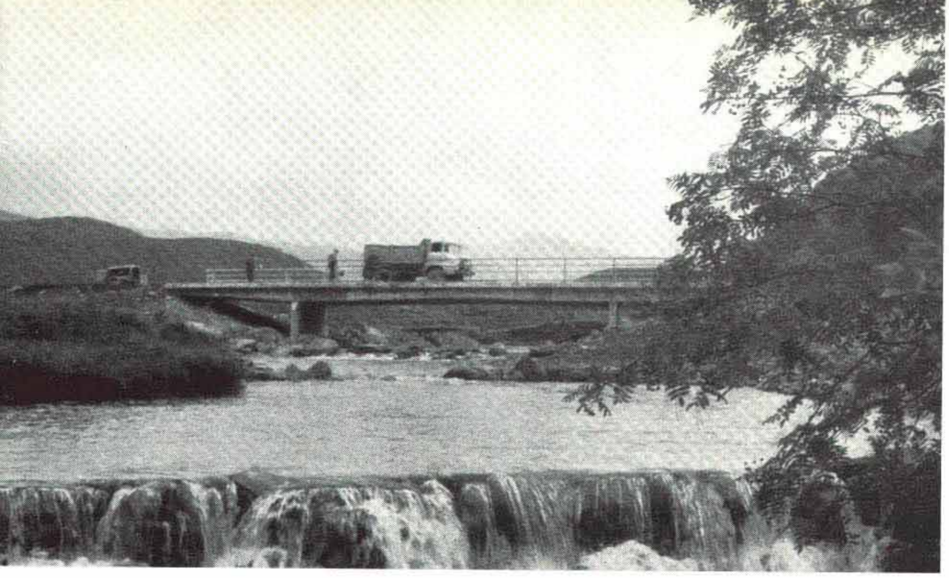
One curious feature of the initial planning of this road was that although it was from the start reclassified as a Class I road, it was still to be built to only 11 ft. width with passing bays; to criticism of this plan in the House of Commons, the Secretary of State for Scotland replied that "earthworks required to enable this to be widened to 18 ft. when the traffic justifies it are being done at the same time". Further Parliamentary criticism of this "false economy" was brushed aside at the time, but the Ross and Cromarty County Council wisely decided that the road should be built, from the start, to the 18 ft. width, with 4 ft. 6 in. verges, which is now constant throughout its length.

The three reinforced concrete bridges by which the road crosses the three rivers in its $7\frac{1}{2}$ mile path are Balgy bridge, the longest, at the Shieldaig end; Allt Coire Roill bridge over a smaller stream, and Torridon bridge, which replaces an old iron bridge over the river Torridon.

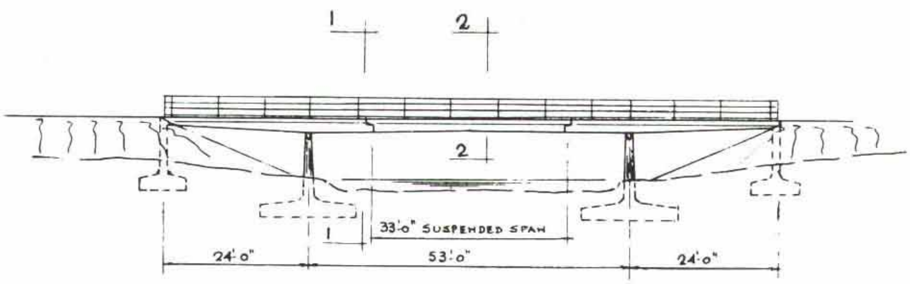
Balgy bridge has a total length of 101 ft., made up of two 24 ft. end spans and a central span of 53 ft. including a suspended section 33 ft. long. End piers of the bridge are almost entirely buried in the sloping embankments. At the edge of the water stand the two main piers, over which the end spans cantilever a distance of 10 ft. to carry the central suspended slab. The bridge has a total width of 24 ft. 6 in., giving an 18 ft. carriageway, a 5 ft. footpath on one side and a 1 ft. 6 in. guard kerb on the other. (This arrangement is standard for all three bridges.) The deck is a solid reinforced concrete slab varying in thickness from 27 in. over the main piers to 12 in. at both ends.

Allt Coire Roill bridge is a two-pin portal frame structure spanning 36 ft. over the stream. The sloping abutments here are continued to the line of the portal frame supports by reinforced concrete wing walls, faced with Torridonian sandstone (which, together with the other local stone, gneiss, is one of the oldest rocks on earth). The deck slab is 18 in. thick.

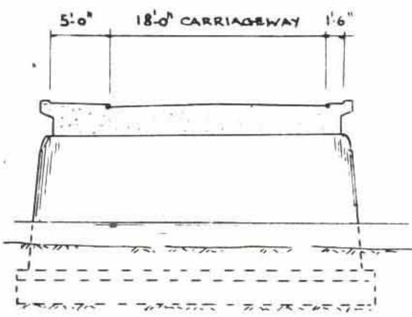
Torridon bridge is built on a marked skew. It has a total length of 123 ft. with a central span of 80 ft. between raking main supports. End support columns are buried in the sloping embankment; they have an



BRIDGE OVER RIVER BALGY



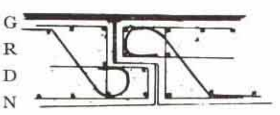
ELEVATION



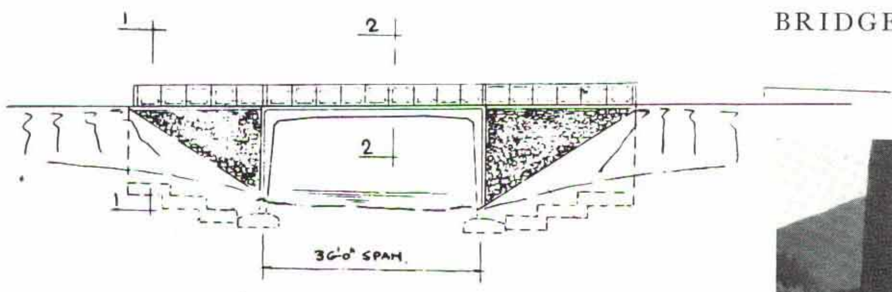
SECTION 1-1

SECTION 2-2

SEATING FOR SUSPENDED SPAN

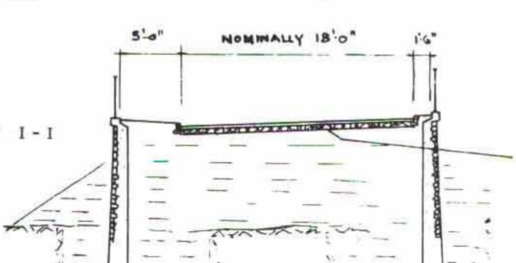


BRIDGE OVER ALLT COIRE ROILL

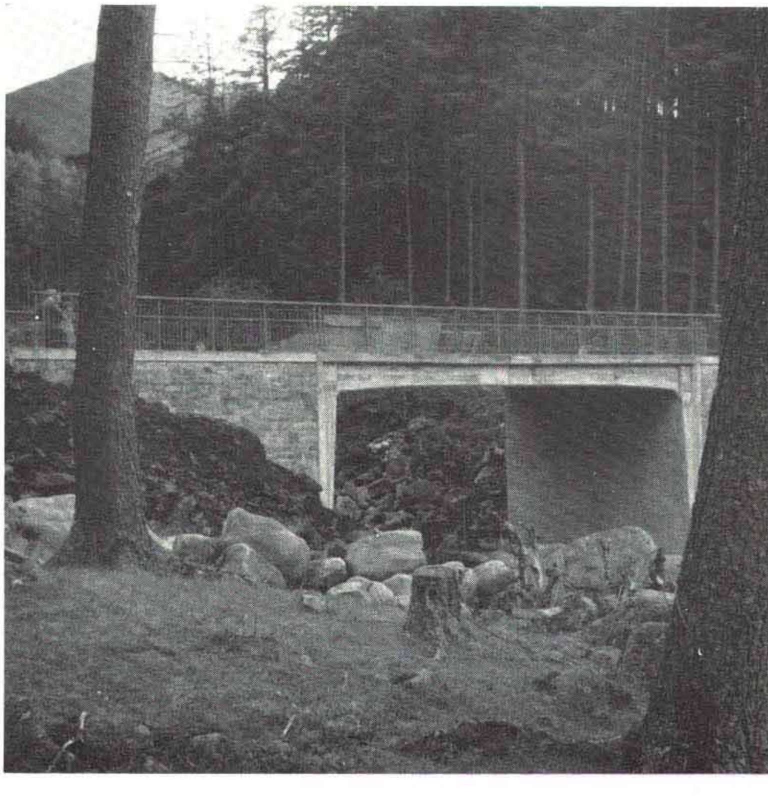


ELEVATION

SECTION 1-1



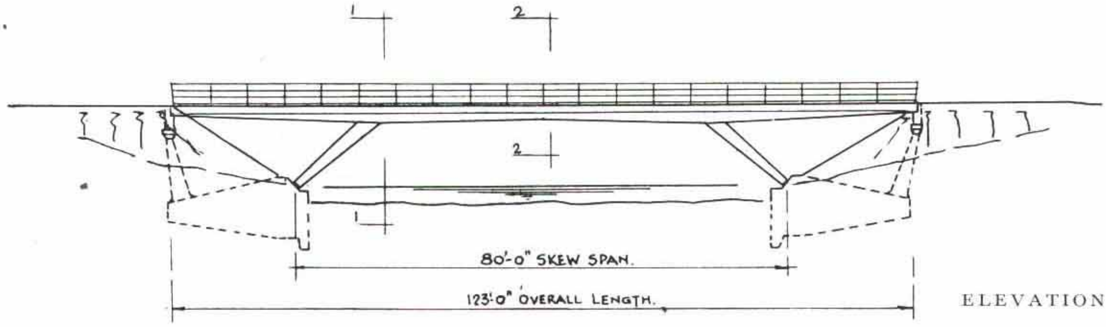
SECTION 2-2



outward rake from the foot, and are founded on the same large reinforced concrete thrust block as the main supports, which are hinged at the base and have a rake towards the centre. These main supports are two separate legs; the deck slab which they carry has a maximum depth, over the legs, of 33 in., cut away to 15 in. between them, and tapering to the same depth at mid-span – a treatment which gives a very agreeable line to the bridge. The line of this bridge made the construction of the formwork a fairly complicated matter; it was carried out, most successfully, by a local boat builder.

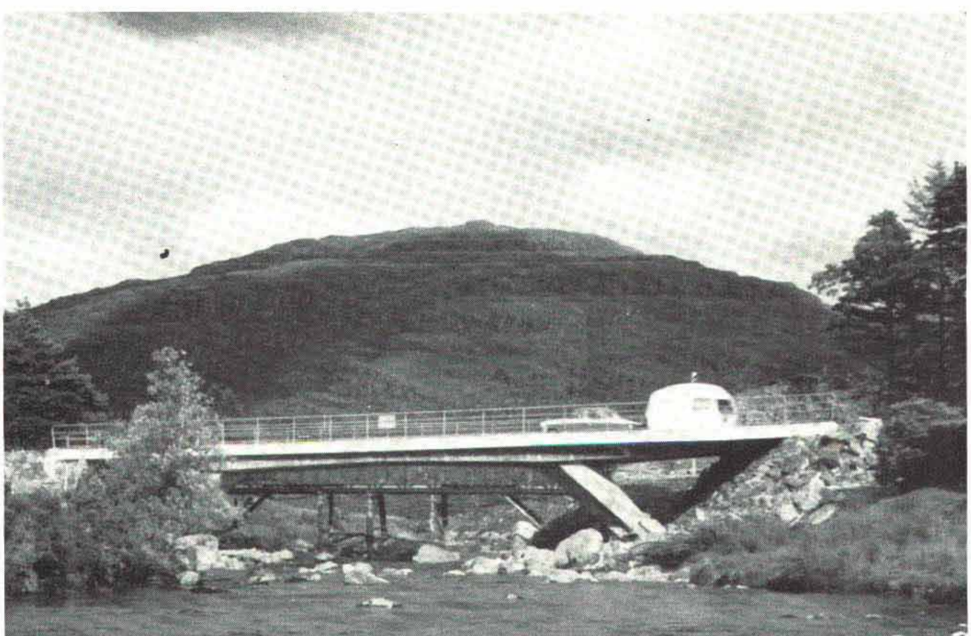
The consulting engineers for these three bridges – so simple and appropriate in their setting – were Babtie, Shaw and Morton. The Ross and Cromarty County Surveyor is James Arrol, A.M.I.C.E., M.I.Mun.E.

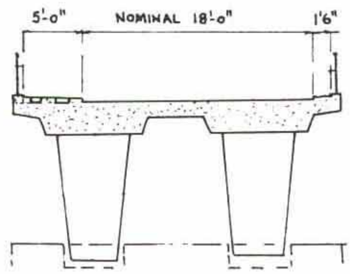
The Shieldaig-Torridon road was opened on 9th September 1963, by the Rt. Hon. Michael Noble, M.P., Secretary of State for Scotland. It is the first of three outstanding 'gaps' to be completed. Now in hand is the second – on the shores of Loch Moidart, between Kinlochmoidart and Lochailort – another area of outstanding tourist attraction, with lovely scenery, and historical links with Prince Charlie, which had previously been accessible only by footpath or by sea.



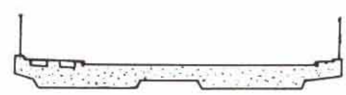
ELEVATION

BRIDGE OVER RIVER TORRIDON





SECTION 1-1



SECTION 2-2

HINGE DETAIL

A new department store at Southend-on-Sea

THE OLD-FASHIONED STORE – grandiose, dignified and vast – is rapidly disappearing. Of course, in London there is still Selfridges. And Harrods. Although one wonders how long these great monuments can survive, with half Oxford Street rebuilt, Victoria Street and the Army and Navy Stores in a state of flux, and even Gorringes – which disappeared almost overnight – brought up to date. As is well known, the shop that made architectural history in Britain was Peter Jones in Sloane Square – a store that could have been built yesterday or even tomorrow, and about a quarter of a century ahead of its time. After that, nothing much happened in this particular field until Denys Lasdun's shop for Peter Robinson's in the Strand a few years ago, which heralded a fresh approach to the subject. Now another landmark in department store design has appeared at Southend-on-Sea for G. J. Keddie and Sons Limited. Like Peter Robinson's, the building makes much of the blank wall on its lower façades, with a minimum of natural lighting. This is a refreshingly 'direct' building, the greater part of its sales floors encased in solid walls relieved only by narrow slits of windows. The store, with its crisp white tile facings, forms a sharply-incised base from which rises an eight-storey office block of equal simplicity. The whole adds up to one of the most self-assured pieces of architecture that we have seen in the home counties for some time. The architects were Yorke, Rosenberg and Mardall.

Inside, the layout of the sales floors is modelled – as is common nowadays – on the American pattern. This recommends that as much merchandise as possible should be visible at the same time, with as little as possible in the stock room. Customers should be able to wander through a 'market place' with everything as near at hand and as irresistible as possible, and without ever having to go up or down more than one floor. The sales floors at Keddies provide all this quite neatly, considering the quantity of goods on display; units are colourful, attractive and incorporate well-designed lettering.

The lower sales floors of Keddies store are lit by narrow strips of windows. Offices are housed in the eight floors above.

A NEW DEPARTMENT STORE AT SOUTHEND-ON-SEA: *continued*

The new building marks the first stage in the expansion of Keddies existing store in the High Street of Southend, and is linked to it by a tunnel in the basement and two bridges at first floor level over a narrow roadway. These are designed to link the sales areas of the old and new buildings visually, in as close a way as possible. There are three sales floors – basement, ground and first floors – with a total area of about 35,000 sq. ft. The second and third floors, which complete the 'base' of the building, are taken up with parking space for 160 cars – an unusual arrangement. The cars are raised to parking level by two lifts, from which they are removed manually by trolleys to the parking bays. The second floor will be used for sales when the next stage of the store is built. The fourth to eleventh floors form an office block of some 44,000 sq. ft. with an executive suite and roof garden for Keddies on the top floor.

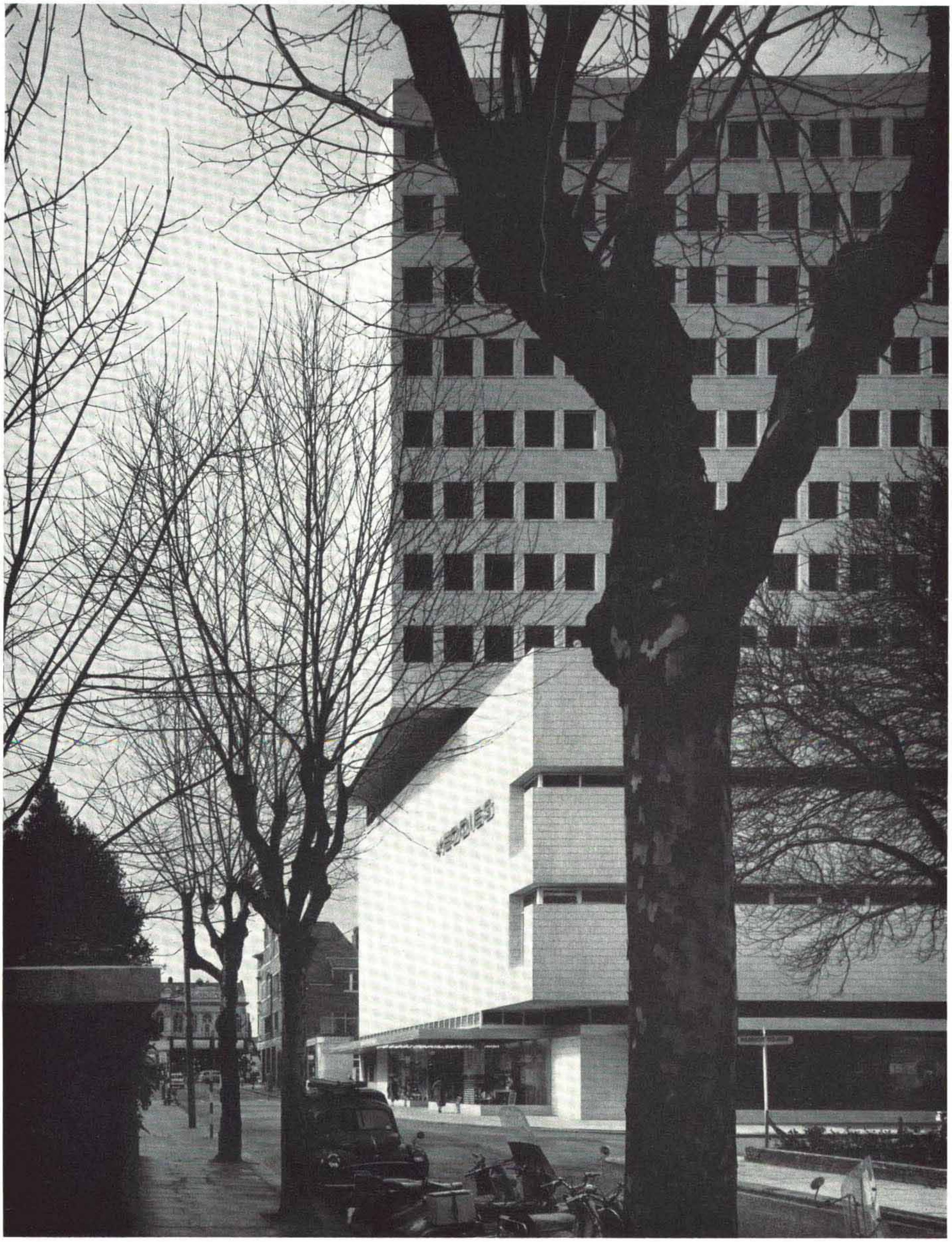
The solidity and chunkiness of the store façades are an indication of the concrete structure behind. This is an in situ reinforced concrete-framed building, with a considerable amount of solid reinforced concrete walling externally, as well as round the service cores and stairways in one corner. The solid external walling, in which the window strips are set, is of 7 in. thick concrete. These – and most of the external walls – are faced with white glazed ceramic tiles; the structure is, in fact, designed to a module corresponding to the size of the tiles, in order to avoid cutting and to preserve the crispness of the elevations. Inside, the store is divided into large bays – 22 ft. 4 in. in one direction and sometimes as much as 29 ft. in the other. The reinforced concrete columns are elongated on plan, and measure 1 ft. 3 in. by 4 ft. 3 in. The frames support light slab floors of reinforced concrete and wood wool, designed to reduce the weight of the structure. On the north face of the building, the frame is exposed externally, with a fair-faced concrete finish and infilling panels of buff bricks. A point of particular interest is the treatment of the office block elevations, with a series of squareish windows separated by closely-spaced mullions – a change from the curtain wall and infilling panel approach.

The design of the interior fittings has been carefully considered: display fittings are all of modular dimensions, so that it becomes an easy matter to ring the changes with display panels of different materials and colours. The decoration of walls and floors is uniform and muted to set off the merchandise. The strips of natural lighting, provided in the upper parts of the walls, are enough to enable customers to see the proper colours of the goods, and at the same time do away with the feeling of claustrophobia which is common in stores piled to the ceilings with carpets and furniture. At the same time, the size and placing of the windows still leaves a good deal of wall space free for display units and fittings.

The associate partner in charge of the building was John Vulliamy, with Freida Olsen as job architect. Clarke, Nicholls and Marcel were the structural engineers. Tersons Limited were the general contractors.

Left: Display fittings are all of modular dimensions and are easily interchangeable.

Right: The extreme simplicity o[f] form and finishes result in [a] powerful elevational treatment.



Temple Israel synagogue and school –

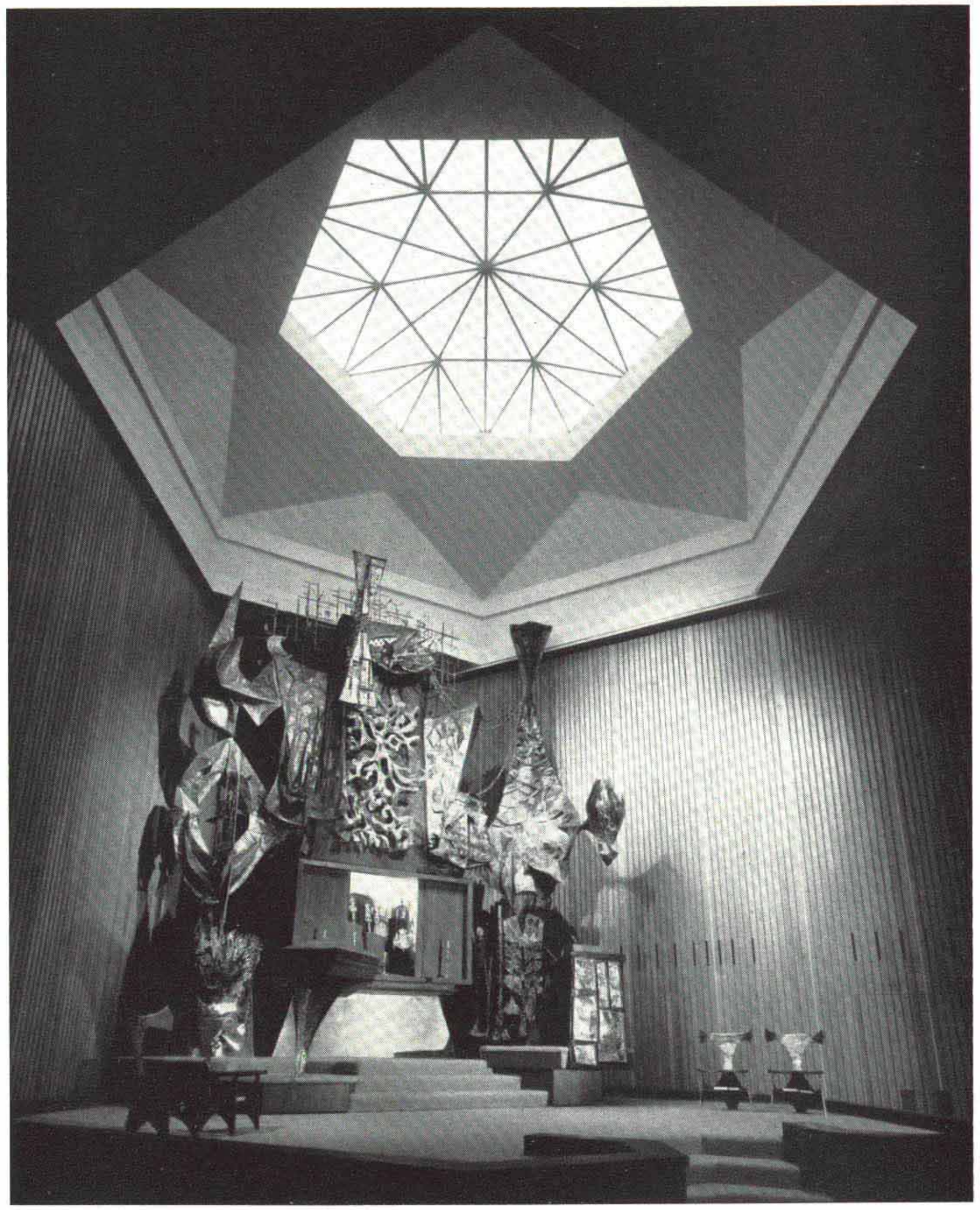
an unusual and striking scheme in the United States

THERE ARE CERTAIN ASPECTS of the synagogue and school at Crève Coeur, Missouri, which it would be a pity to miss. Primarily, these are the complex faceted roof of reinforced concrete which covers the main sanctuary, and the three-storey school block – a simple framed building which shows an unusual purity of design.

The architects are Hellmuth, Obata and Kassabaum, who are already noted for their concrete shell work in the United States. The Saint Louis priory chapel in Missouri, for which Nervi was the consulting engineer, is an earlier example of their work and consists of a circular church composed entirely of three tiers of concrete parabolic arches in three concentric circles. The synagogue at Crève Coeur, by contrast, has not a curve in it. The plan is for the most part made up of hexagons, broken down into smaller hexagons and triangles. This seems to evolve naturally from the six-pointed Star of David – a motif which recurs frequently in the structural elements.

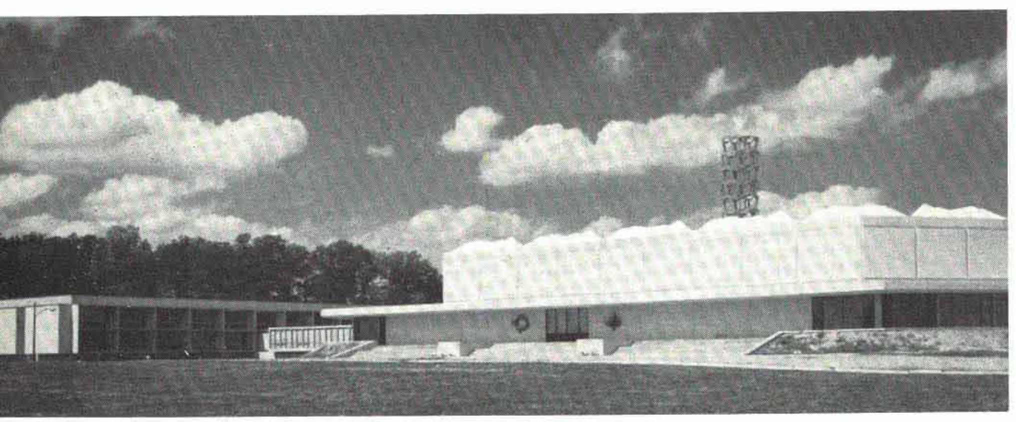
The plan consists of an elongated hexagonal temple, linked with a small hexagonal chapel on the north side, and a rectangular school block on the west. At the centre of the temple is the sanctuary made up of two adjacent hexagons, about 210 ft. long by 90 ft. wide overall, planned to give a flexible seating area, and without internal columns. This space is roofed over by reinforced concrete diagonal beams, forming hexagonal and triangular spaces between. The hexagons are filled with precast folded plate sections of reinforced concrete, faceted to form Star of David motifs; the triangular spaces are filled with skylights of dark stained glass. This geometric roof silhouette is crowned by a lattice tower of aluminium tubes covered with gold leaf.

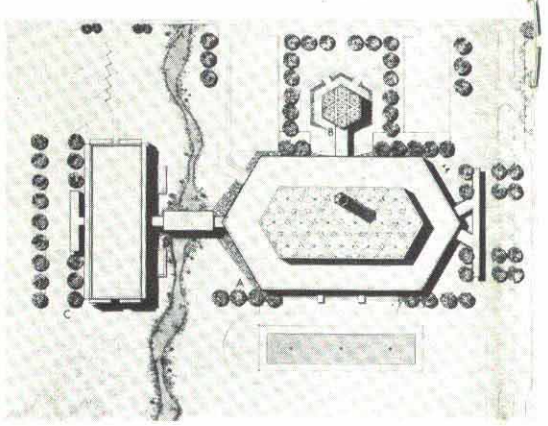
The temple is placed on a podium to give it height, and is linked by a bridge over a stream with the three-storey school block; this is located in a beautifully wooded part of the site. The bridge is in the form of a single-storey block which contains a well-furnished lounge, and has a reinforced concrete frame supported on four tapered columns. The school has classrooms for five hundred children and is a rectangular structure divided by cross walls which project beyond the glazing on the two long elevations to form thin concrete sun-breakers, together with projecting slabs at floor level. This block has an elegance and simplicity about it which is immediately appealing.



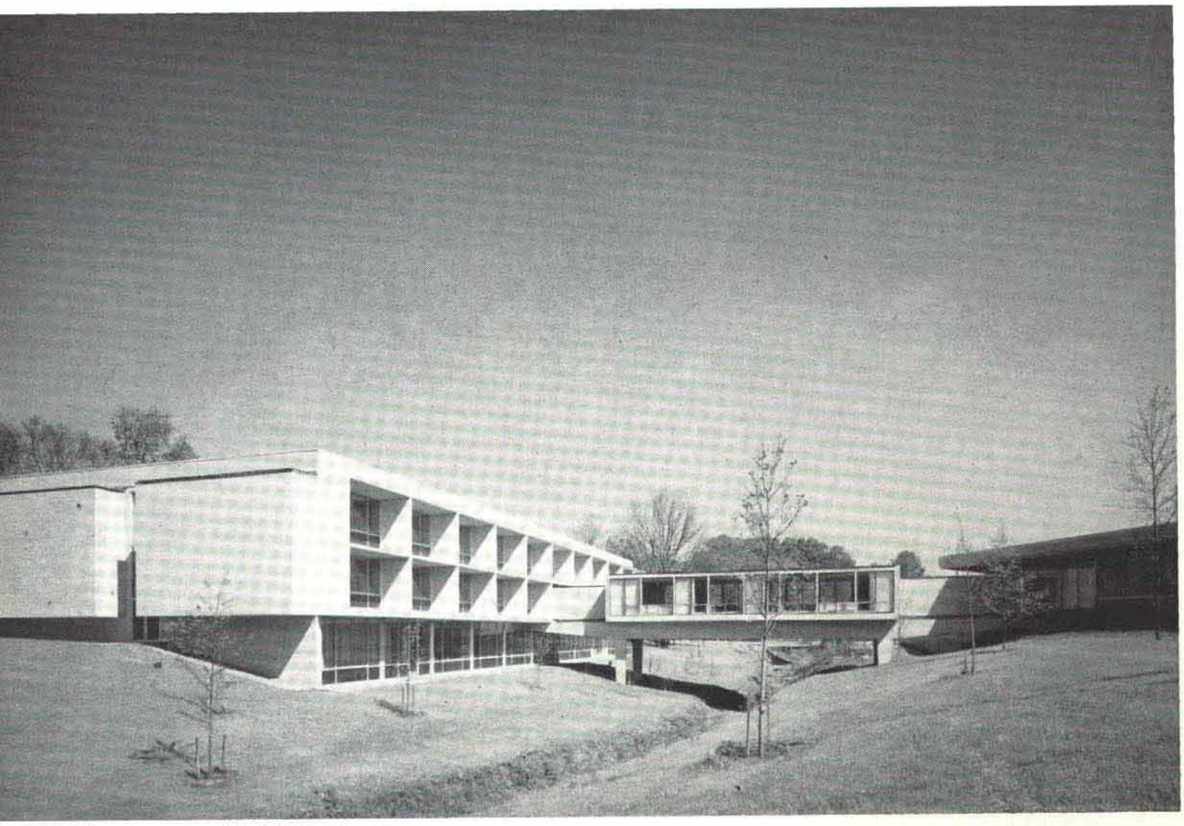
Hexagonal roof light over the altar, set in a six-pointed star formed of precast concrete units.

Diagonal reinforced concrete beams over the sanctuary divide the roof into hexagons and triangles, filled in with precast concrete folded plate sections.

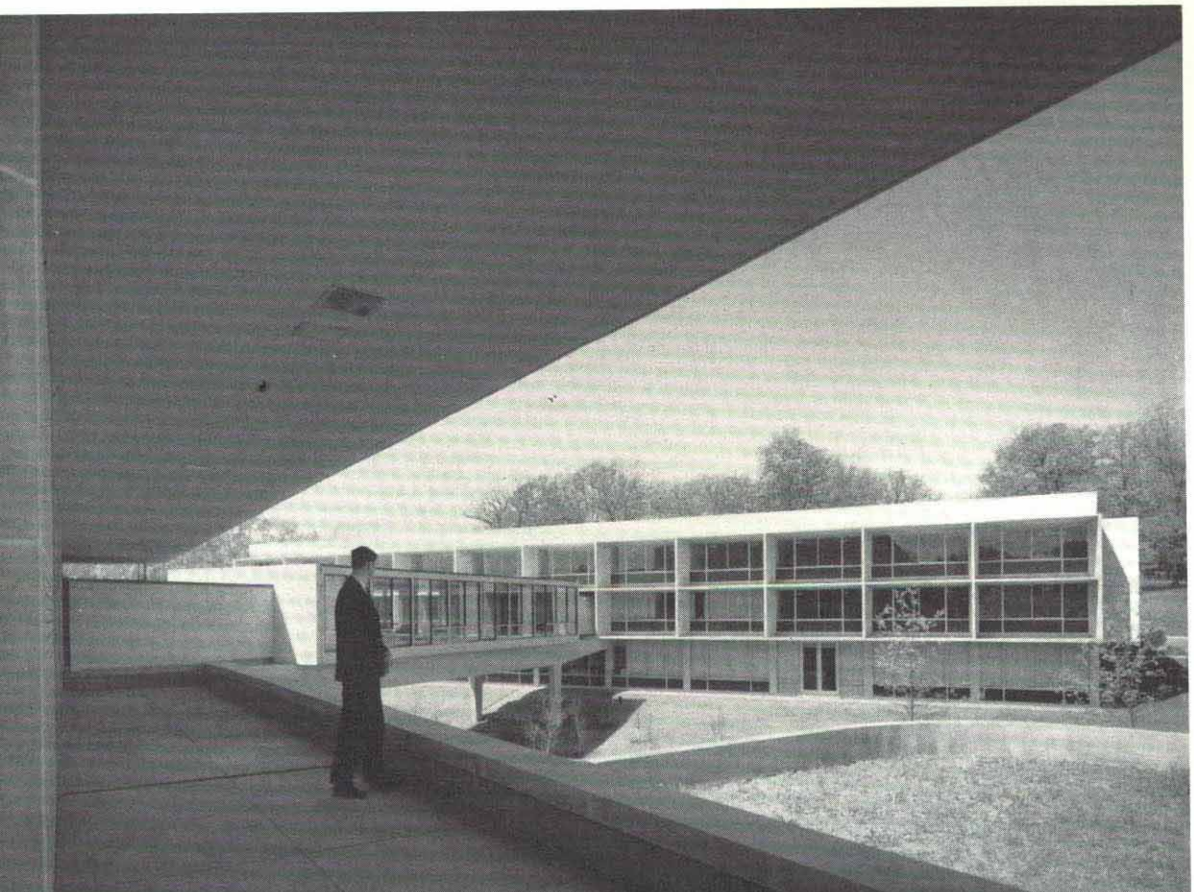




Opposite
Far left: The precast concrete roof treatment is visible from ground level. Left: Plan of the synagogue and school.



The three-storey school block, linked with the synagogue by a bridge over a stream.



Concrete sun-breakers divide up the elegant façade of the school block.

Elegant hyperbolic paraboloids roof

a warehouse at Stevenage

IN THE INDUSTRIAL AREA of Stevenage new town a new warehouse has recently been put into use for the John Lewis Partnership – a clearing house from which stock is sent out to all their different branches.

The complex occupies a 9 acre site, with the large rectangular warehouse building, covering 145,000 sq. ft., and a small adjoining office block of 16,000 sq. ft. area.

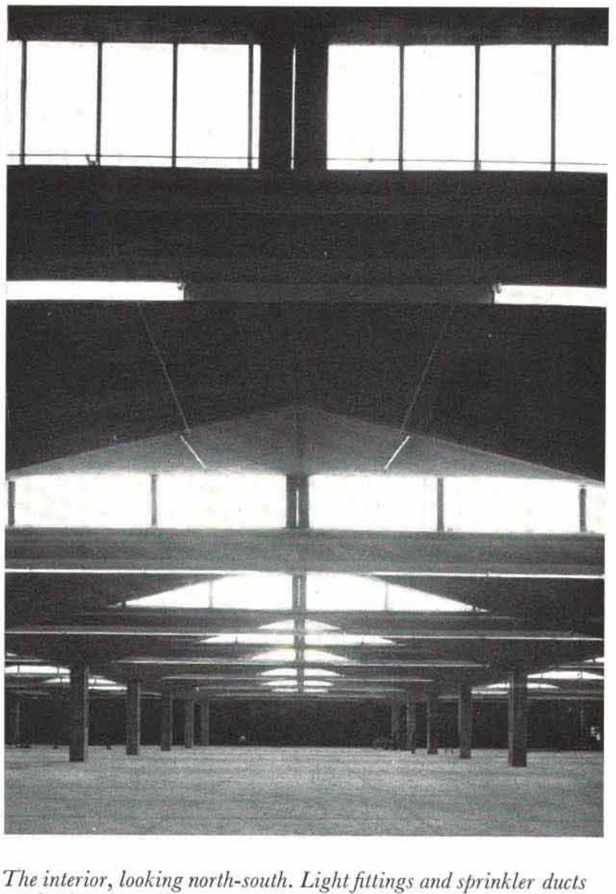
The warehouse is entirely roofed with hyperbolic paraboloid umbrellas of reinforced concrete, and has the distinction of having Felix Candela, the world-famous expert on this form of construction, as its co-designer.

The building is 465 ft. long by 330 ft. wide, divided into five bays transversely and 15 longitudinally. Individual umbrellas measure 60 ft. by 31 ft. and are only 2 in. thick. They are supported centrally on square section reinforced concrete columns and are tilted to provide north lighting: the higher edge is at 23 ft. 4½ in. from the ground and the lower 18 ft. 7½ in.; supporting columns are 13 ft. high. Fifteen half-shells, which are believed to be unique, complete the building along one side. At the receiving dock end, three shells are extra high, to accommodate a gantry for high loads.

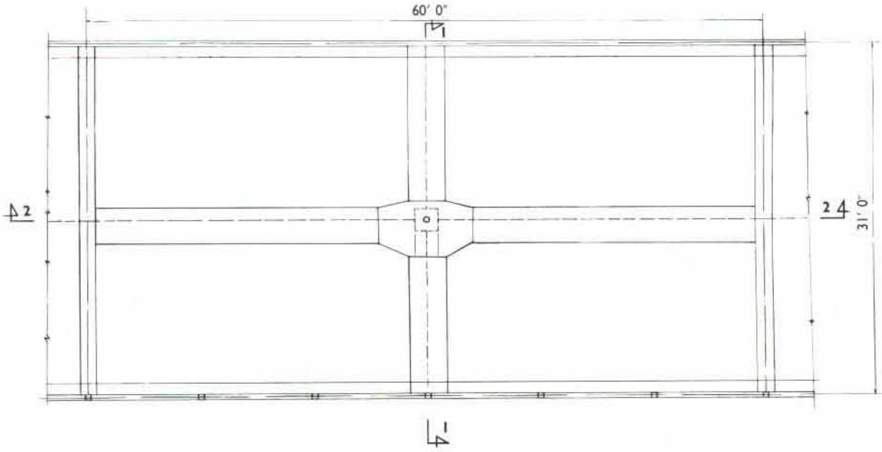
Externally, the roof is insulated with cork covered with a lightweight screed and finished with roofing felt. The high and low edges of adjacent shells are linked by precast concrete mullions, between the northlight glazing. One end of the building is entirely infilled, above a certain level, with greenish glass; below it, and elsewhere, wall infilling is smooth grey flint-lime brick.

The effect is superb: the whole building is magnificently light and airy; the subtle curves, which are barely curves, of the hyperbolic paraboloids, are most pleasing to the eye, the pale grey of the concrete has an unexpected warmth in its tones and the effect of the narrow board-marking is to give an almost 'quilted' effect to the soffit.

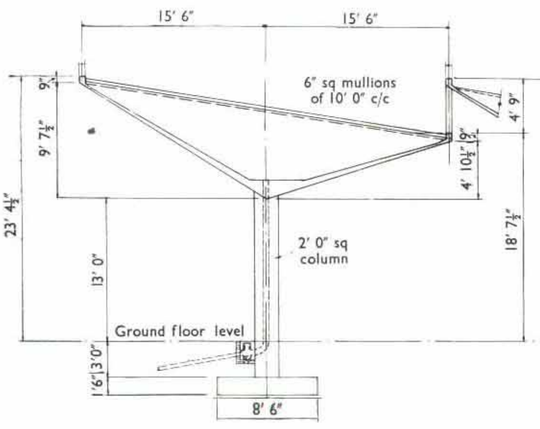
The whole roof structure was cast with formwork for 5½ shells only. Timber forms were used, with 4 in. planed boards. The boardmarkings, which are so attractively designed, were, of course, entirely functional, not to say inevitable. The horizontally-boarded strip at right angles to the valley was included to provide a section for propping after striking. A Duck-



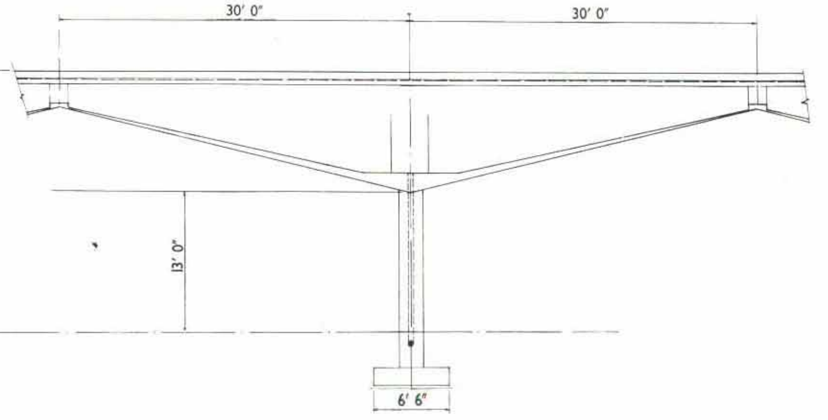
The interior, looking north-south. Light fittings and sprinkler ducts are fixed to the roof.



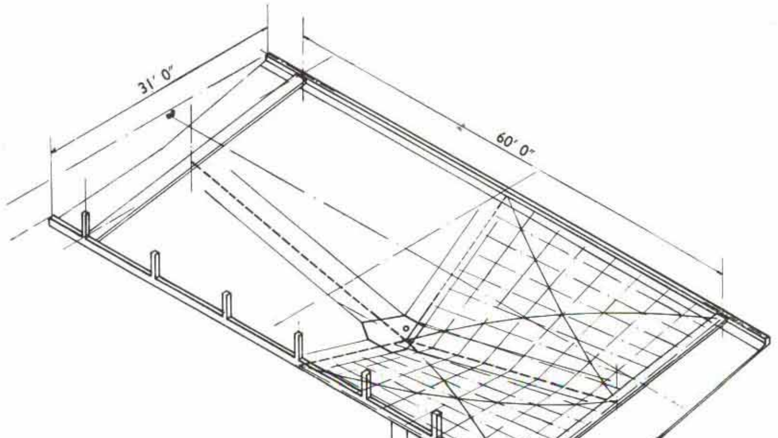
Plan of a single umbrella.



Transverse section, 1-1.

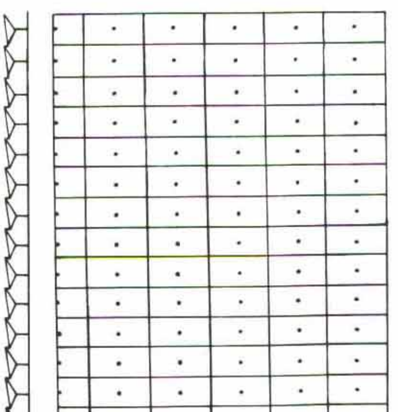


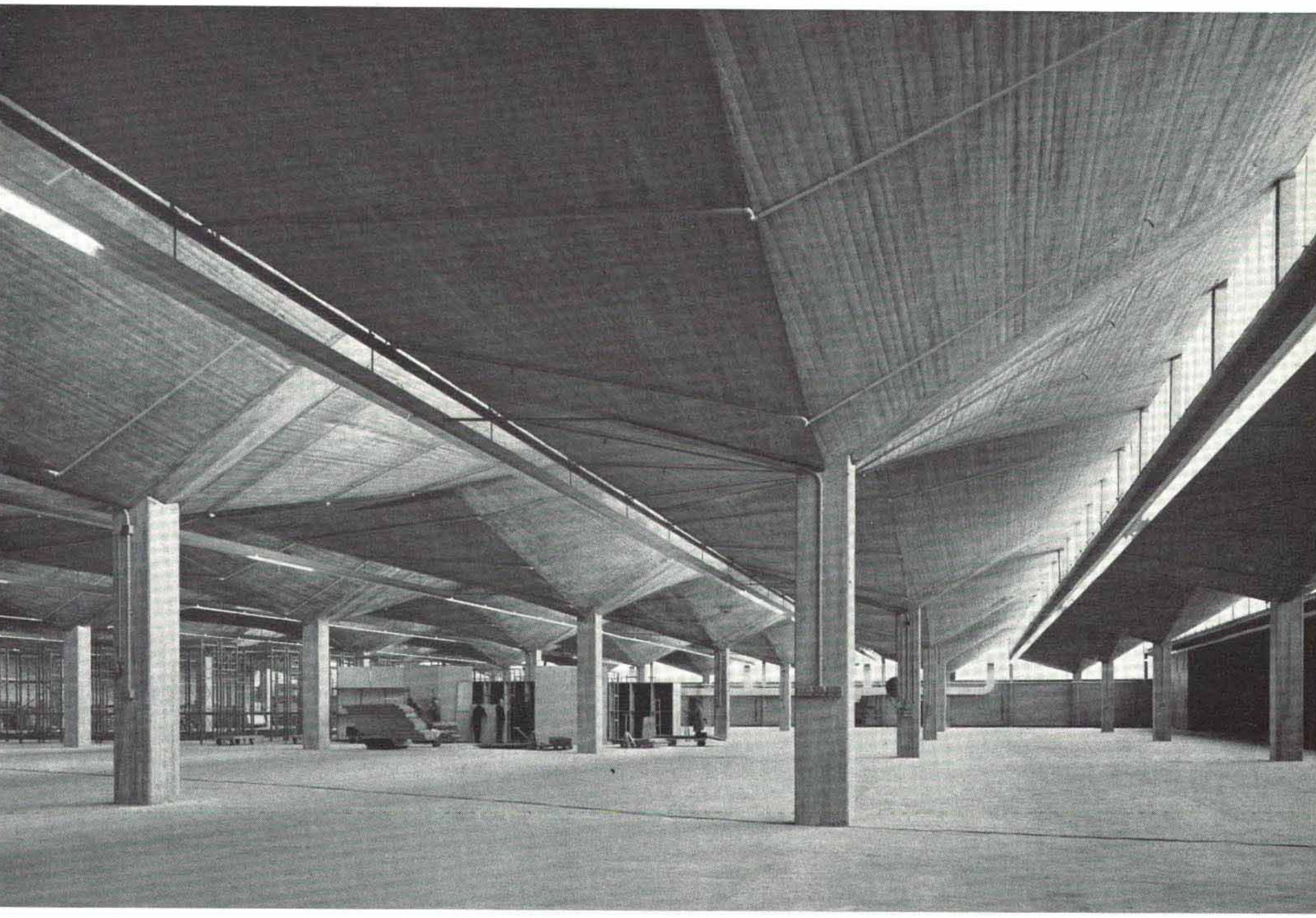
Longitudinal section, 2-2.



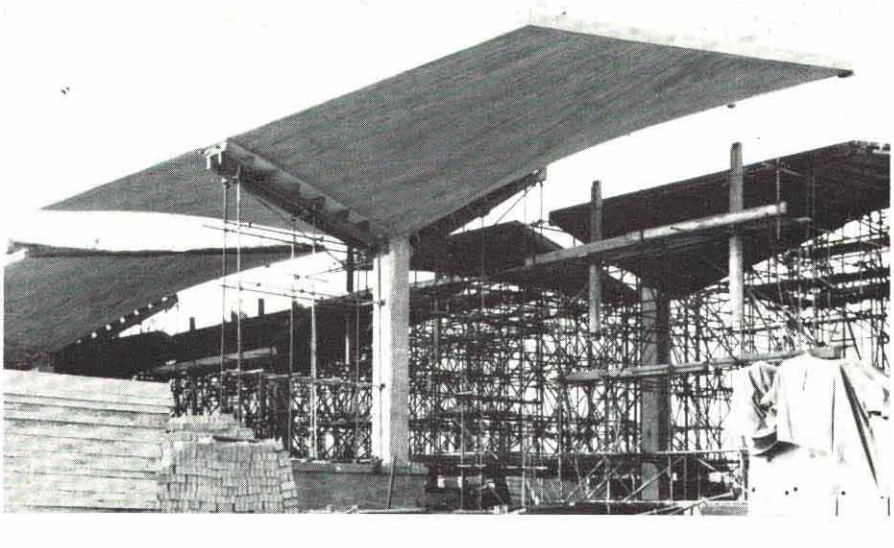
Isometric view of a hyperbolic paraboloid umbrella.

Plan and section of the warehouse.





Looking west down the light, open aisles. The tilt of the umbrellas provides north lighting. Drain pipes run down inside the columns.



Individual umbrellas under construction, with the formwork in position.

ham's mould oil was used; it has given a surface absolutely free from staining, and excellent in texture.

A very good cycle of production was maintained – approximately three shells per week. Formwork was made up in half-shells, and as each row of $5\frac{1}{2}$ shells (using 11 sets of formwork) was completed, that range of formwork was moved on into the next position, giving fifteen re-uses in all.

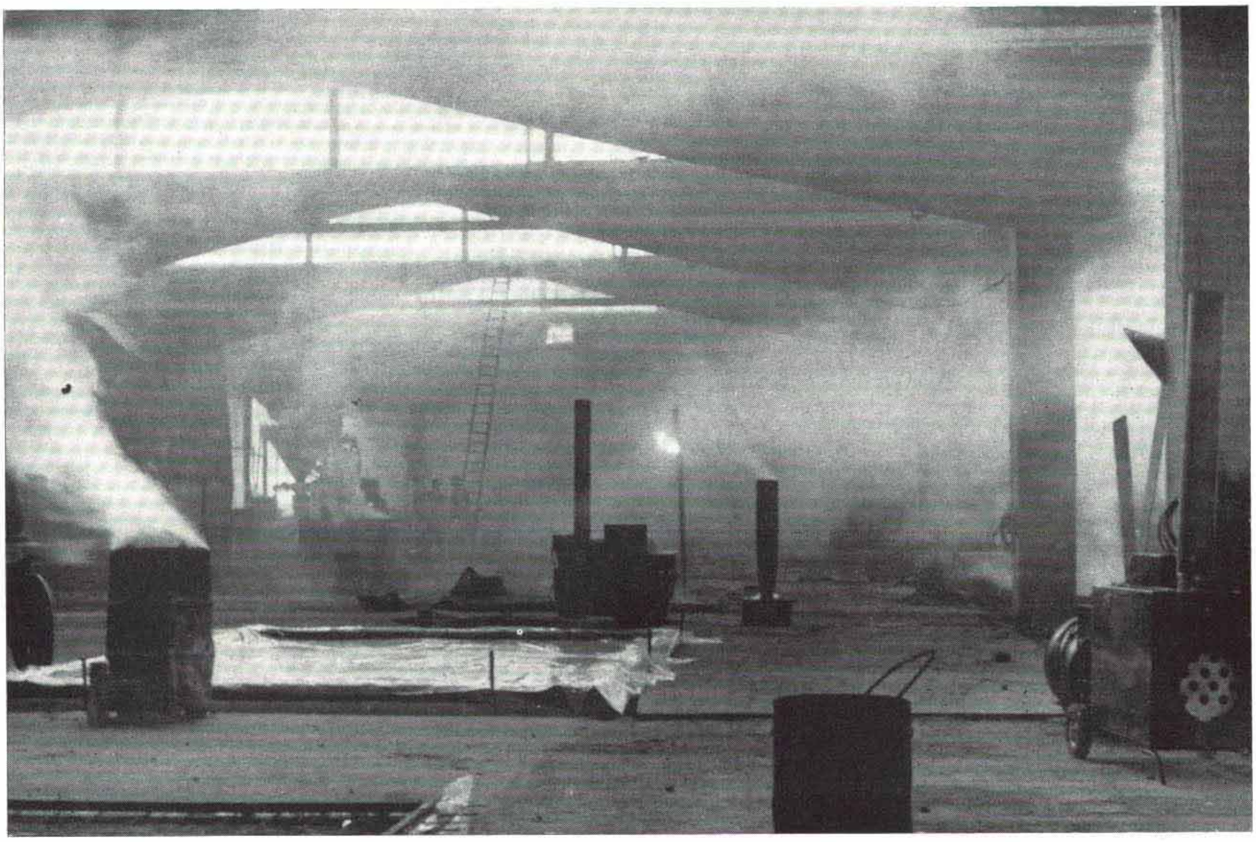
The difference in height between edge and valley made for certain complications in lowering the forms for moving on to the next row, but this was overcome by hinging the form to the shallower wing and dropping it down at the time of moving. By this means it was only necessary to lower the whole formwork a very little – just enough to release the higher wing and move it on to its next position; the form for the lower wing was then flapped down on its hinge into the horizontal position and so passed easily underneath the newly cast concrete wing. The whole arrangement of hinged formwork and winches was mounted on a scaffolding frame carried on bogies. After release, props were left in position for two weeks. The whole operation of lowering the formwork was carried out by only two men.

The quality of the concrete is extremely good; in the columns it is smooth faced and the transition from column to umbrella is admirably designed. Altogether the detail is excellent and the overall effect completely satisfying. Great care was taken to obtain a concrete absolutely right from the appearance point of view and from the point of view of consistence for use on the steep slope of the wings. The visible face of the soffits was, of course, a leading consideration; in addition came workability and speed of placing, a 3-day strength of 3,000 lb. per sq. in., and the need for the plastic concrete to stay in place on the 33° slope. It was essential to provide for full compaction without too much vibration, and the mix was specially designed with this in view: the sand, finer than usual, was specially chosen and a plasticiser was included in the mix, which had a low water content. After experiment a special vibrator was evolved for compacting the concrete – an external clamp-on type which produced the desired finish with a minimum of vibrating. The top surface of the shells was finished with a wood float to give a smooth face to take the cork insulation layer. Reinforcement consists of $\frac{3}{8}$ in. square twisted bar at 6 in. centres in both directions.

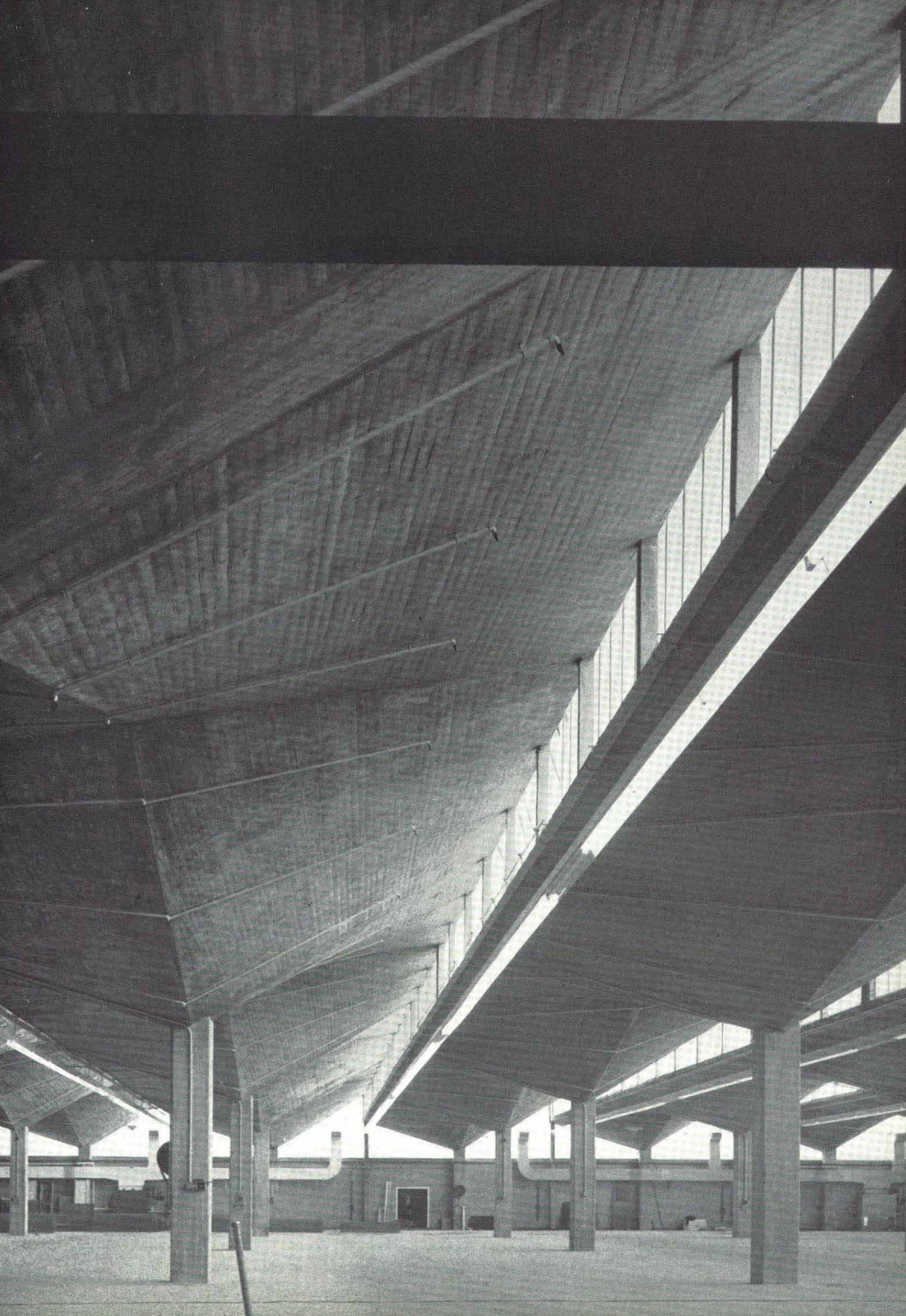
Strip lighting hangs from the edges of the shells, and sprinklers are fixed to them over the whole roof area. Drain pipes run down inside the columns.

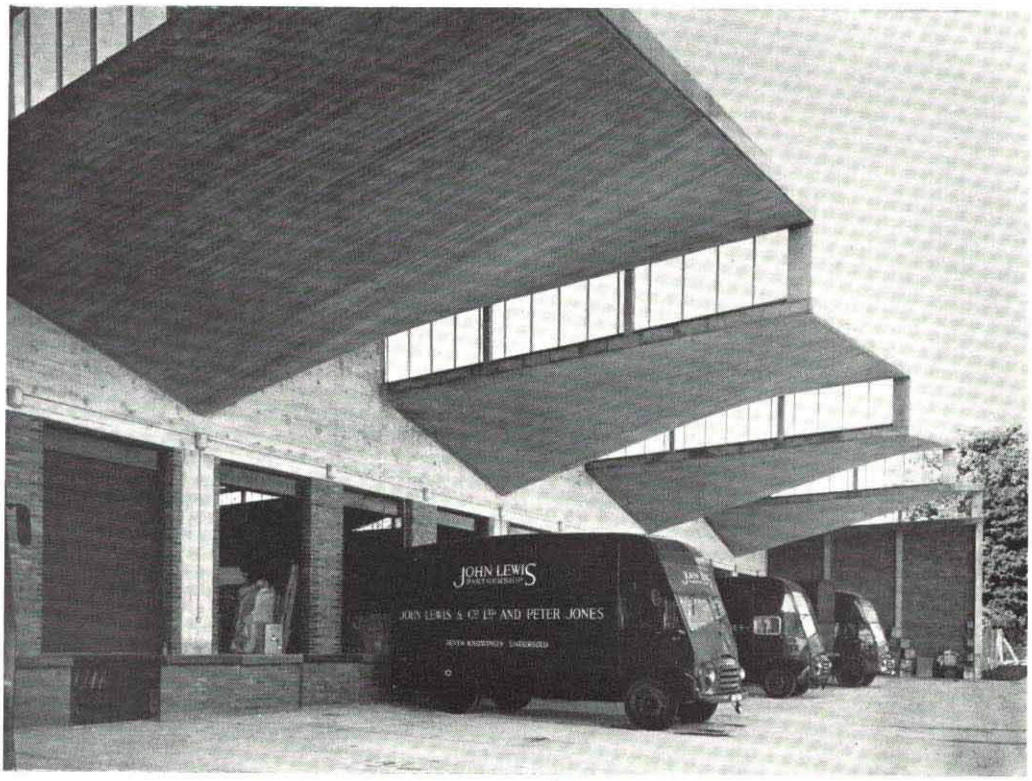
The floor is granolithic concrete, with an excellent

Special heating arrangements were made to enable concreting to be continued through the intense cold of the 1962-3 winter.

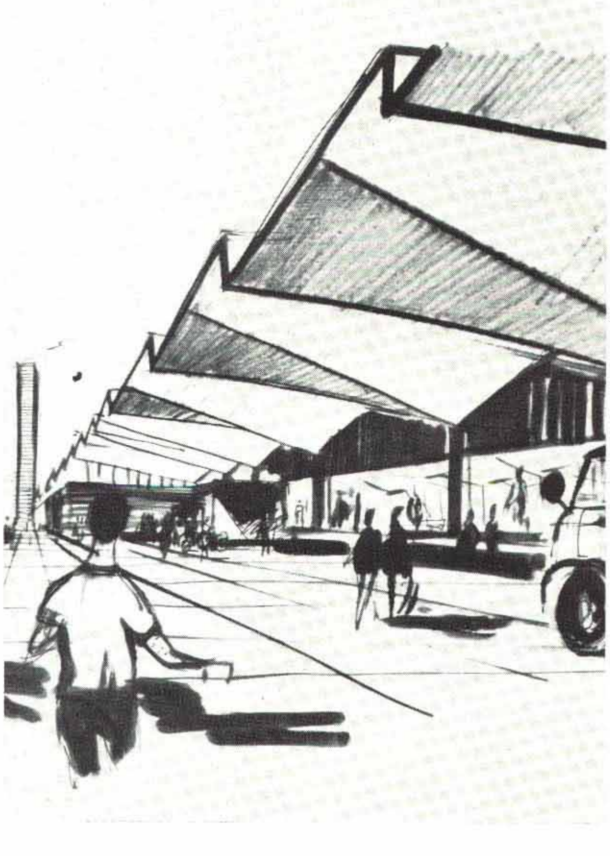


*Opposite:
The interior, looking west; the regular narrow boardmarking and excellent concrete gives the structure great distinction.*





Boldly jutting wings spread over the loading dock.



smooth, even finish. It incorporates special cables, which guide the 'Robotugs' – small, quietly running automatic conveyors which follow a set course round the warehouse aisles, delivering supplies from place to place without human intervention.

The equipment of the warehouse is altogether of the most progressive; there are automatic doors, levellers in the loading bays to make for easy loading and unloading, conveyors and lifting gantries, and, in the office block a computer keeps track of the complicated stock supplies constantly moving in and out.

Stevenage new town's industrial area has some good things in it, among others more prosaic. This new warehouse, with its little single-storey office attachment (later to be given extra floors) is definitely one of the best for sheer structural interest. The flaring wings over the loading bay catch the eye with a sudden lift of excitement, and inside, there is no doubt of the visual satisfaction of the whole. Ally this to speedy construction, economy and high functional efficiency, and it was clearly worth the extra preliminary thought that went into its design.

The architects for the warehouse were Yorke, Rosenberg and Mardall; the consulting engineers, in association with Felix Candela, were Clarke, Nicholls and Marcel. The contractors were Trollope and Colls Limited.

Original drawing for the cantilever shells.

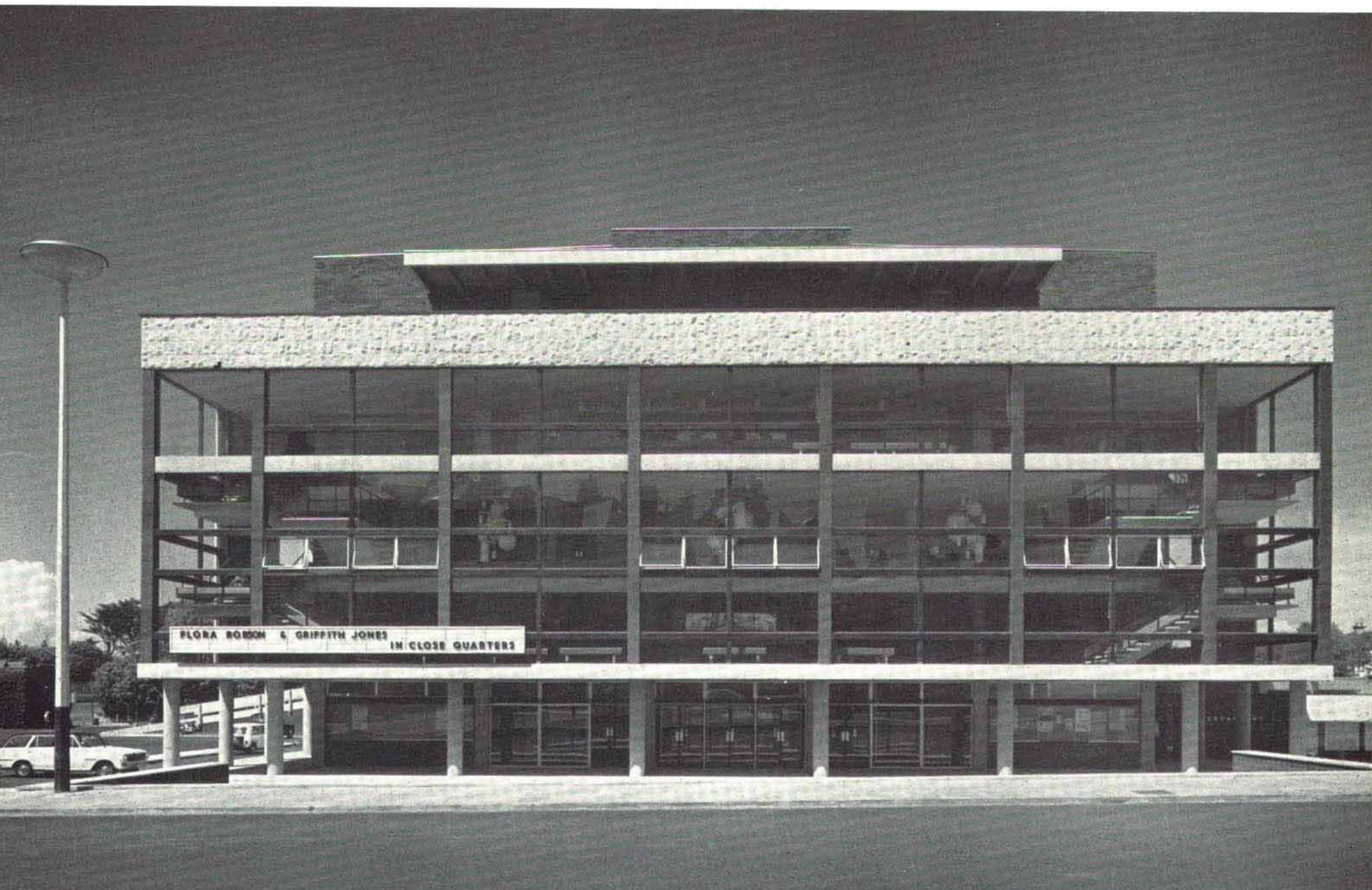
Eastbourne's new

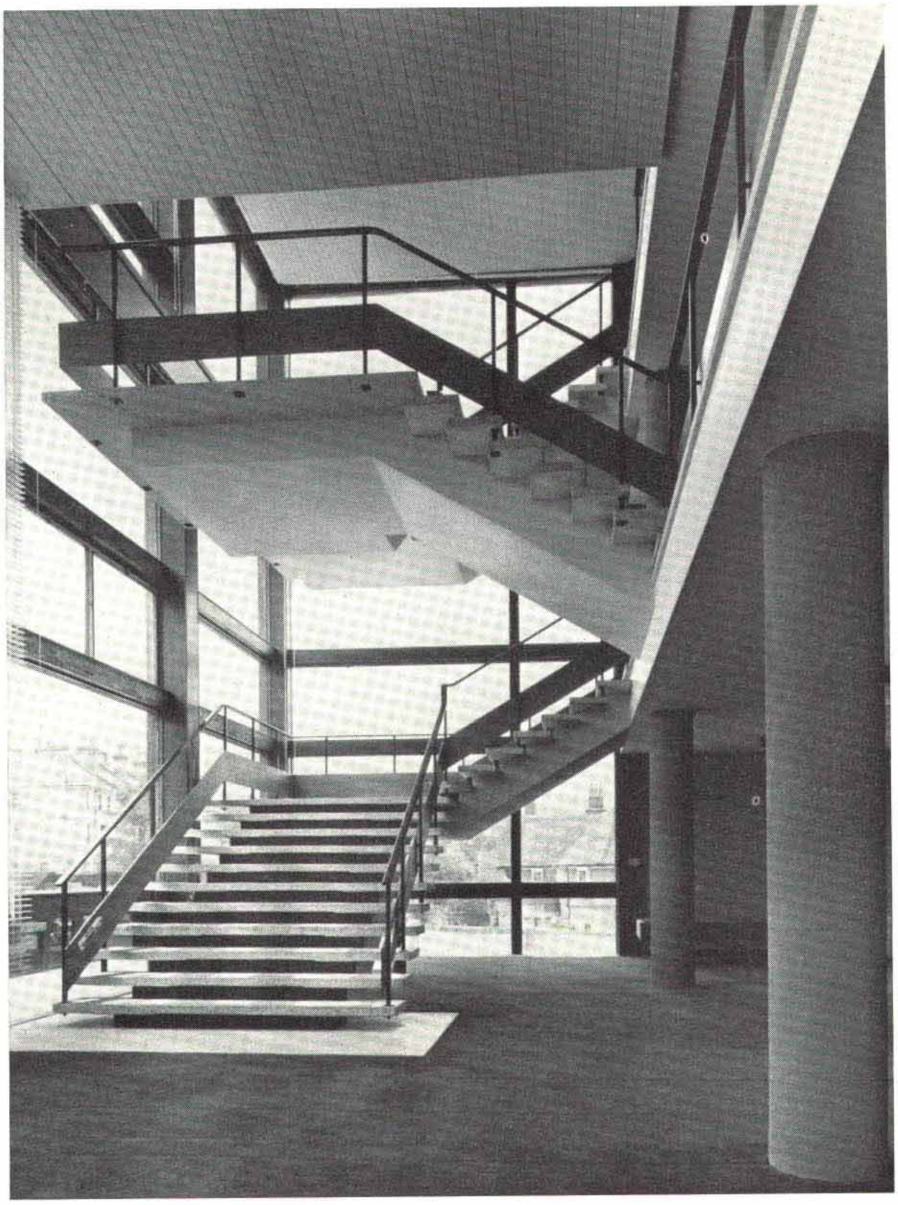
CONGRESS THEATRE

shows a varied use of concrete finishes

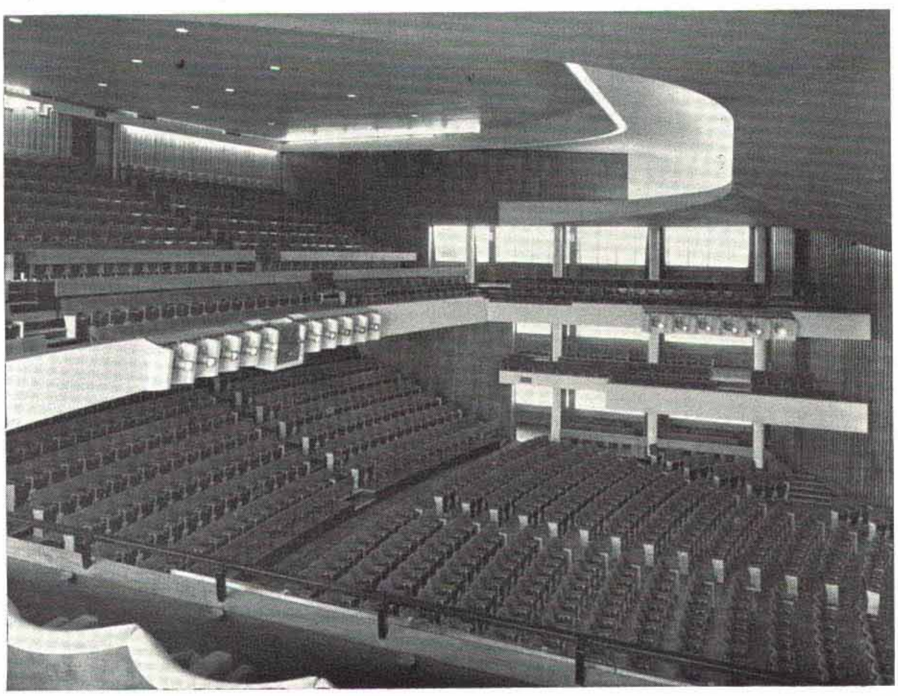
EASTBOURNE – judging from recent buildings – is at last bursting out of its Victorian reserve. New flats, shops and restaurants, put up in the last few years, have livened the town up. The latest addition to the amenities is the Congress Theatre, commissioned by the Corporation as a building for conference and entertainment purposes. It has an auditorium with 1,640 standard seats, extendable by removable seats to 2,000, and a stage suitable for plays, ballet, opera, and concerts. For conferences, it will offer – politically speaking – an alternative to Brighton, Scarborough and Blackpool, and so bring revenue to the town. Architecturally, it is a fine multi-purpose hall, certainly unique along the south coast.

The theatre is built on to one end of the existing Winter Garden and is linked with it by a restaurant, so that the whole can be used as a single unit if necessary. Approached from the front, the building





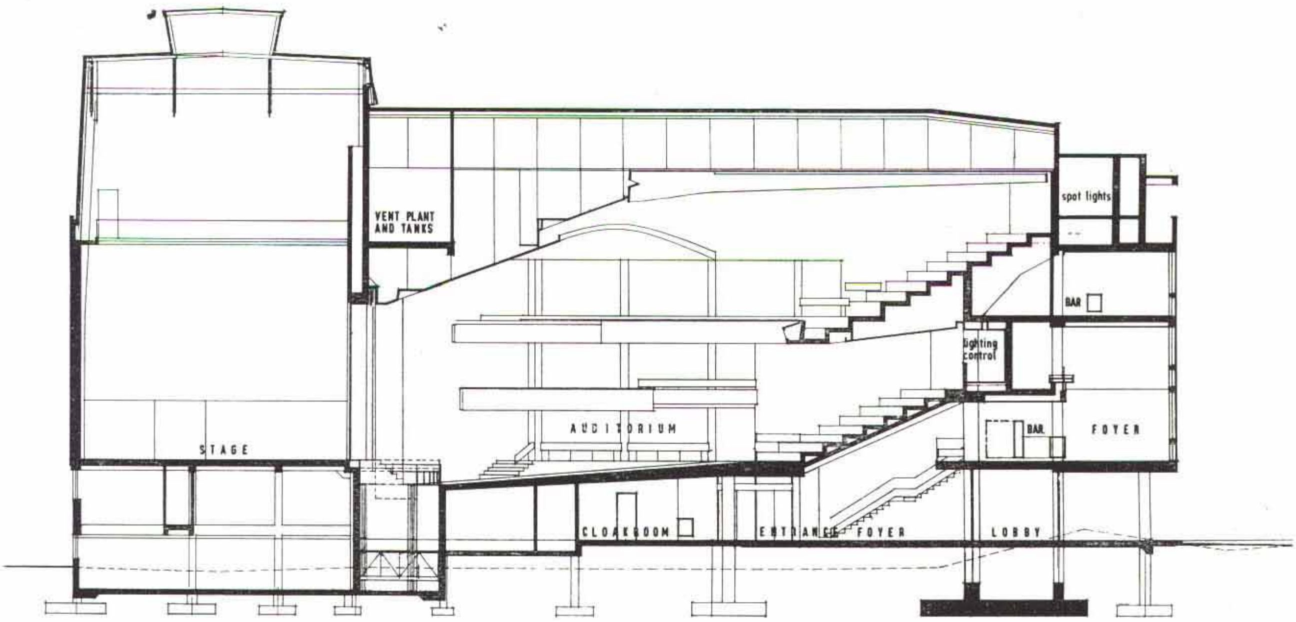
The foyers are linked by broad stairs of terrazzo treads cantilevered from reinforced concrete spine beams.

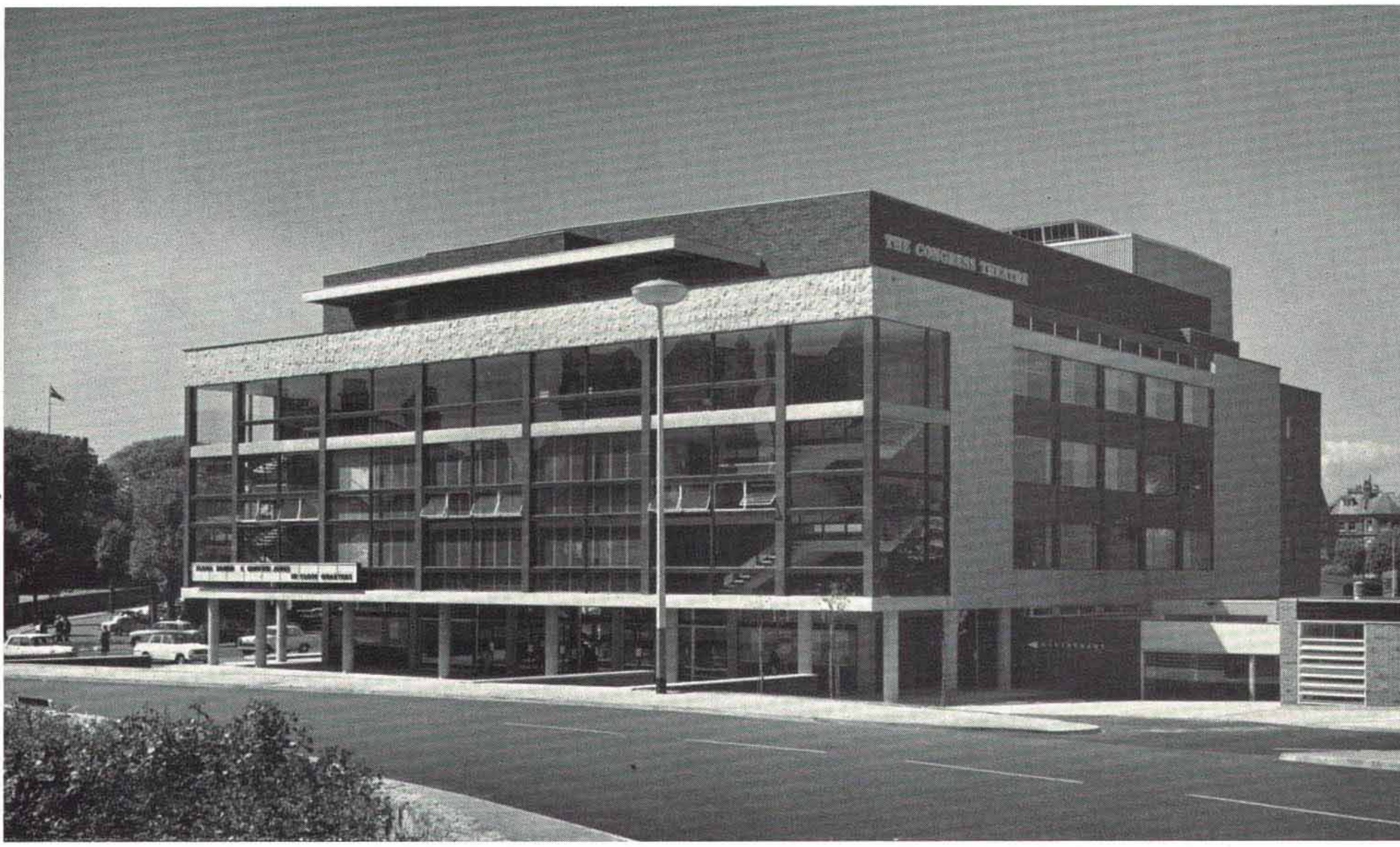


The auditorium from one of the side galleries.

Above: The entrance foyer, paved with standard precast concrete flags.

Below: Longitudinal section.





White riven 'Maclit' blocks form a continuous band along the front and sides of the theatre.

has a definite kinship with the Festival Hall, with a fully glazed front elevation through which the various foyers, levels and open stairways can be glimpsed. Basically, it comprises a central auditorium, 88 ft. wide and 98 ft. long, with access from foyers on three levels, and a five-storey stage block at the back.

Inside, the two levels of upper foyers, with their external glass walls, are wrapped round the back of the auditorium. They are thick-carpeted, open spaces, equipped with two bars, each with 30 to 40 ft. of counter. The levels are linked on each side of the building by wide stairs constructed of precast terrazzo treads cantilevered from in situ reinforced concrete spine beams. These are fully expressed and structurally are very interesting to look at. The auditorium itself, with its stalls, circle and side galleries, is a spacious airy place with uncluttered ceilings, plain finishes and red upholstered seating. It is lit by large double-glazed windows at each side, which can be blacked out if required, and it is hoped that this natural lighting will help to do away with 'conference fatigue'. A point worth mentioning – usually non-existent in old theatres – is the access for wheeled chairs by way of a scenery ramp, or by a lift serving all the main levels. Another interesting point is the orchestra lift in front of the stage, which can be raised to increase the size of the stage for concerts, or else sunk below auditorium floor level to form an orchestra pit.

The main frame of the auditorium and stage block is of in situ reinforced concrete. The stepping of the stalls, however, is built up of precast reinforced concrete units. Over the entrance foyer, at ground level, the bones of the structure can be seen in the soffit to the rear stalls where the stepping is supported on radial beams linked by transverse members. This produces a coffered ceiling, painted in white and lime green as a decorative canopy to the entrance hall and first floor foyer. The columns of the frame are free-standing at the front and sides of the building; they are circular on plan. The tall fly tower, over the stage, juts up some 28 ft. above the main roof level, and has three walls of reinforced concrete. The erection of the frame was carried out by the general contractors very economically indeed.

From the concrete point of view, the highlight of the building is undoubtedly the varied use of concrete finishes on the main elevations and in the paving. At the front and sides of the building, concrete facing blocks provide depth and texture as a foil to the large glazed areas and smoother surfaces. They are white riven 'Maclit' blocks, made by Kendell's Stone and

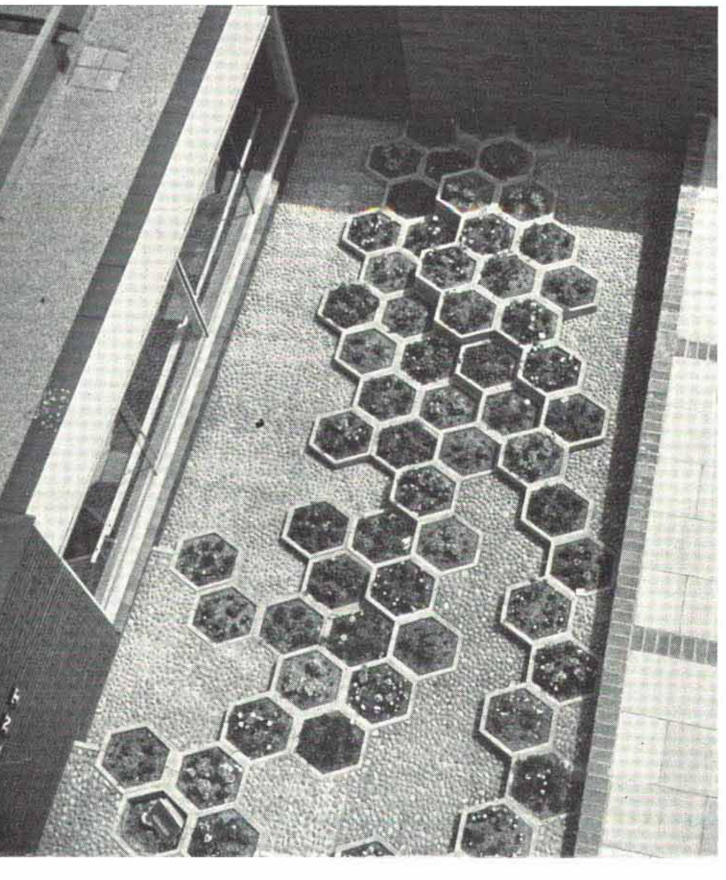
Paving Company Limited. The blocks have a pronounced rugged texture which shows up well in the sunshine, and measure 15 in. by 6 in. by 3 in. thick. They are, in this instance, used vertically and laid in a stacked bond, forming a broad capping to the glazed front façade, which is continued round on the side elevations. Also made by this company are the thin horizontal units of black concrete which form glazing bars round the foyers. A tribute to the precision of construction and manufacture of the main concrete elements is the fact that the whole of the glazing at the front is fixed direct to the concrete and housed only in butyl gaskets; tolerances of $\frac{3}{8}$ in. were worked to.

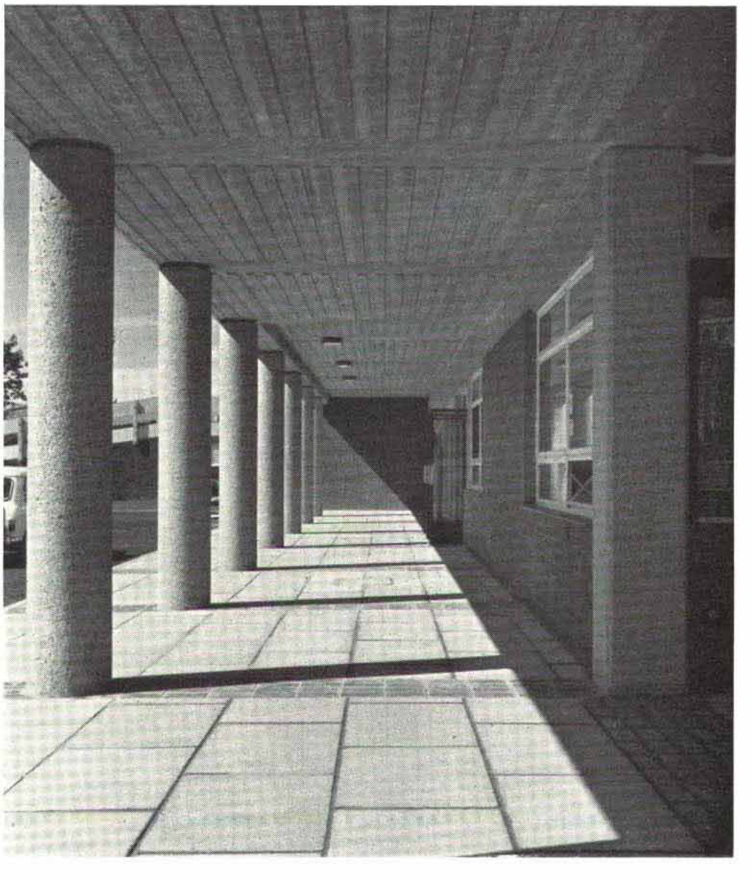
Also of special interest is the finish on the circular columns which form a colonnade at the front and sides. These are of natural in situ concrete cast in cardboard tubes, with a beautifully even exposed aggregate finish, achieved by the 'Jason' pistol method of tooling the surface (the instrument is also used for de-scaling ships). This is a rather more delicate method of treating the concrete – particularly the matrix round the coarse aggregate – than ordinary bush-hammering. The texture of these columns is most effectively thrown up at night by small lights set flush with the paving at the base of the columns. This represents an outstanding example of exposed aggregate carried out in situ. The same surface treatment has also been applied to the facing slabs which form bands of concrete at the base of the foyer glazing, and again at a point two-thirds of the way up. Another point of interest in this area is the ribbed concrete soffit to the first floor slab, achieved by casting against plywood formwork fitted with battens.

The paving in the entrance to this building particularly deserves attention. Essentially it is very simple, and by nature of its simplicity, all the more impressive. The entrance foyer and approaches are paved with standard precast flags of a slightly pinkish colour, ground smooth, laid with wide joints and interspersed with strips of blue paving bricks to take up the curve of the foyer. Internally, the flags have been rubbed down to give a slight polish. They were made by the Atlas Stone Company Limited. Nearby, flanking one side of the restaurant, there is an eye-catching sunken garden, paved with cobble and scattered with a random pattern of 'Monohex' flower containers of various heights, made by the Mono Concrete Company Limited. These make an effective honeycomb pattern when viewed from the main pavement level above.

The architects for the theatre were Bryan and Norman Westwood and Partners. The structural engineers were Ove Arup and Partners. Walter Llewellyn and Sons Limited were the general contractors.

Below, left: The sunken garden flanking the restaurant, paved with cobble and patterned with 'Monohex' flower containers. Below, right: In situ concrete external columns have a uniform exposed aggregate finish.





New offices for Birds Eye Foods Limited

– elegance for a move "out-of-London"

HOW MANY OF US, as we commute to work in London each day, would like to avoid the struggle and congestion, and to go quietly "out-of-London"! The 600 employees of Birds Eye Foods Limited's London office can now do just that. Their elegant new offices lie in handsomely landscaped grounds surrounded by natural woodland, seventeen miles out of London, at Walton-on-Thames. This example of compliance with the Government's plea for London companies to move out of the Metropolitan area, has resulted in delightful new working conditions for the firm's staff.

The major part of the five-acre wooded site has been left undisturbed, the main building at present occupying 110,000 sq. ft., though additions may be made at a later date. There is also a service building for car maintenance, and a gate lodge for the engineer in charge of the premises. The main block is three-storeys high, 318 ft. long and 170 ft. wide, and has two internal garden courts. The basement provides space for plant and storage, and there are three further plant rooms on the roof, giving the effect of three small penthouses. These have been deliberately designed high enough to permit a further storey of office accommodation to be added, if required.

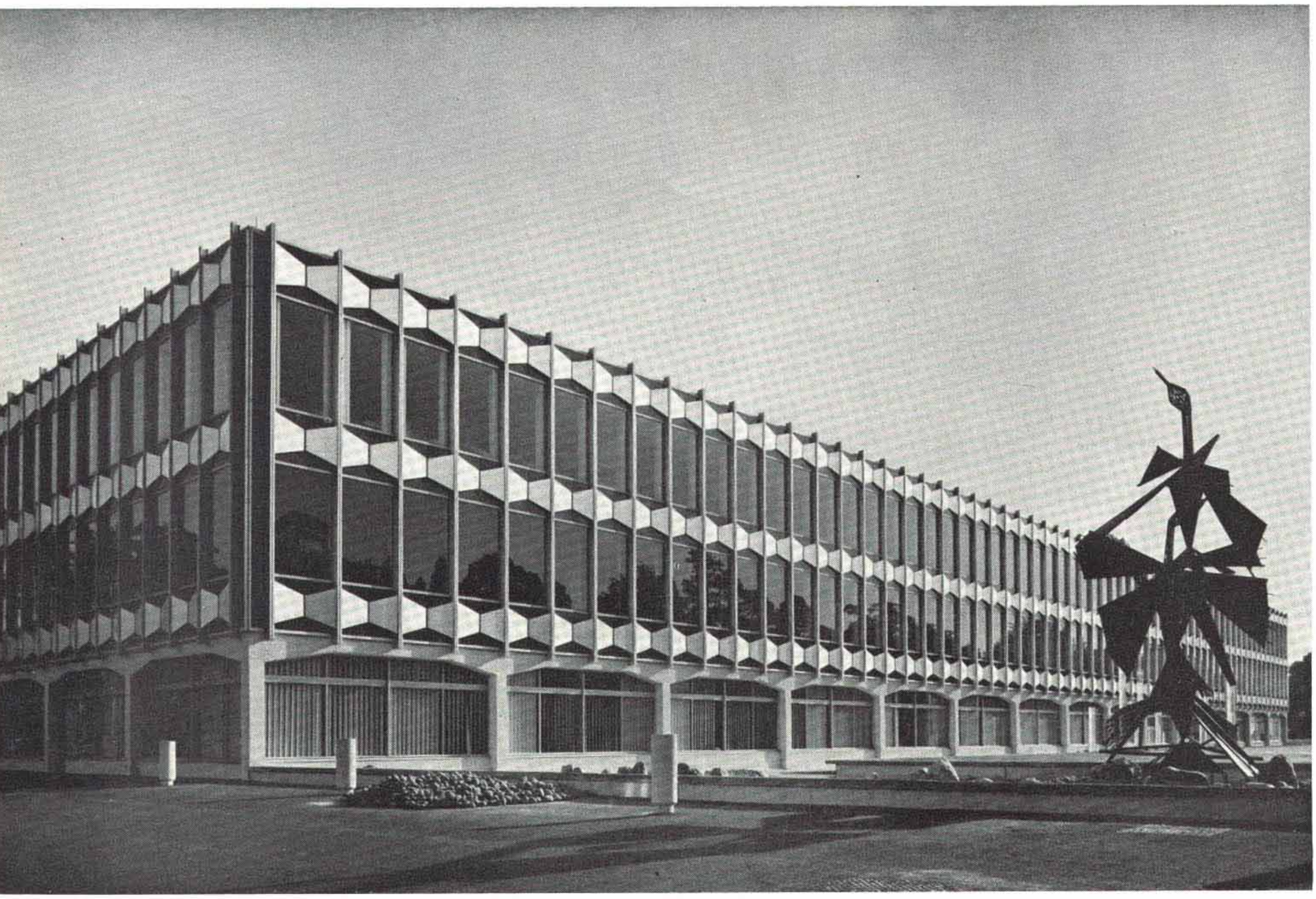
The structure, planned on a 5 ft. 3 in. module, is wholly concrete, made up mainly of precast, prestressed units and clad, on the upper floors, with aluminium and glass curtain walling. Flexibility was the planning keynote, with the largest possible unobstructed floor area a main requirement. To meet this, and other requirements, the structural engineers considered several solutions – structural steel framing, all in situ reinforced concrete construction, flat slab construction, and composite concrete construction. The first three were all rejected for a variety of reasons – the structural steel was considered uneconomic for this project and difficult to provide with satisfactory fire protection, all in situ concrete would have restricted the space available for services, flat slab construction would have necessitated a line of internal columns. So composite concrete construction was found to be the best solution, using precast, prestressed floor beams with external columns only, and leaving the interior free for flexible re-arrangement by the use of demountable partitions.

The high water table of the site made construction below ground costly, and a basement was only provided under one-fifth of the building. The building was therefore founded at two levels, 7 ft. and 18 ft. below ground, with its two parts divided by a settlement joint. All the foundations were constructed in mass and reinforced concrete. Quality controlled concrete was used for the basement and service tunnels to ensure watertightness against the full water pressure for which they are designed.

The ground floor external concrete columns and the haunched, first floor, perimeter beam carrying the concrete mullions, form an interesting contrast to the aluminium facings of the upper floors, as they are cast in white concrete. White cement and calcined aggregates were used in the mix, and the concrete was left exposed, after bush-hammering. The concrete mullions from the first to the third floors were precast full length, with a gap at the second floor, into which the second floor perimeter beam was cast in situ.

The precast, prestressed I-beams used for the floors give a clear span of 42 ft. They are 15 in. by 9 in. in section, spaced two to a 5 ft. 3 in. module, and are given a 3 in. in situ concrete topping. The beams are of smaller span round the three in situ reinforced concrete service cores, which lie in the transverse sections of the building. These cores both house lavatory accommodation and services and also act as stiffeners to the building. Ceiling heights are 10 ft. on the ground floor and 9 ft. on the upper floors, giving 3 ft. between as housing for services.

The glass and natural anodised aluminium curtain walling of the upper floors combines with the white concrete to give the building an appearance of extreme lightness, the slender mullion facings breaking up admirably the length of the façades. Horizontal contrast is provided by the three panels running round

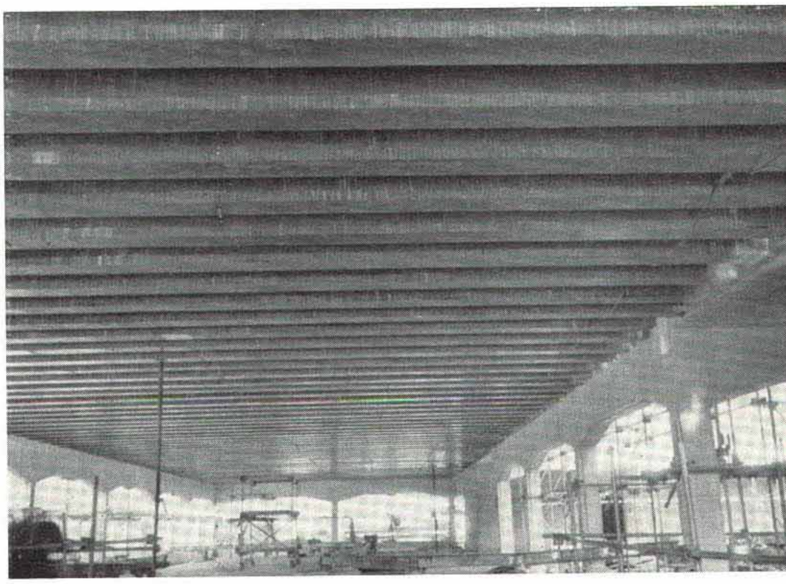


The elevation to Station Avenue, with a sculpture by John McCarthy in the foreground.

the building at roof and floor levels. They consist of lozenge-shaped profiled sections in aluminium against a dark blue vitreous enamel background. The white pierced ceramic screens which surround the three plant rooms on the roof of the main buildings enhance the effect of lightness, and this effect is further developed in the white brick of the ancillary buildings and of the boundary walls.

Lightness is again a keynote of the interior. The entrance hall on the ground floor is largely of marble and glass, giving views on to the gardens and inner courts; the board room and Directors' offices also look out through walls of glass on to the garden, over the long narrow pool which runs the length of the building. Offices occupy the remainder of this floor, likewise the greater part of both upper floors. There is, however, a small cinema on the first floor, and a special kitchen where samples of frozen food are examined and cooked. The food is tested in two adjoining rooms, equipped with special lights which make the food appear monotone in colour – so that colour cannot affect judgment. The staff and management dining rooms are on the second floor, and both use a cafeteria system based on quick-frozen prepared meals, in disposable foil trays – a system which requires a minimum of staff. This service is supplemented by a 'Grill and

Precast prestressed beam units form the upper floors; in all, 800 of these units were used in the offices.



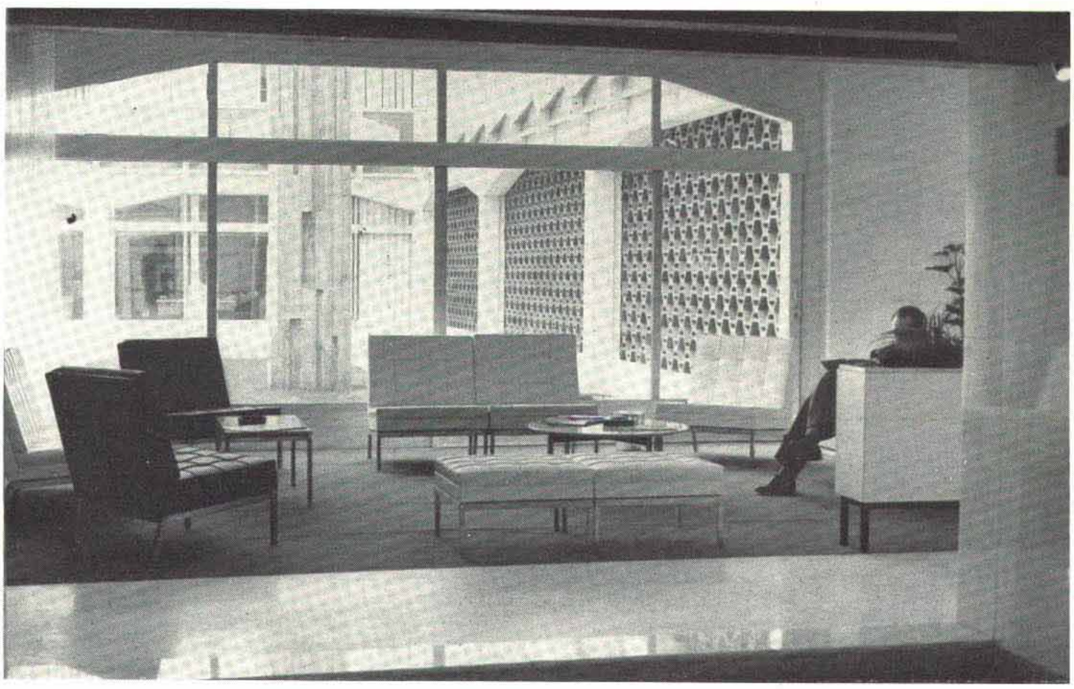
Griddle' which seats 36 and provides a variety of grills.

Internal finishes and fittings throughout the fully air-conditioned building are all of the most up-to-date. The offices' suspended ceilings take fluorescent lighting in continuous flush troughs at 5 ft. 3 in. centres. The windows all have 'Louvredrape' vertical louvre blinds – one of the first installations in the country of these blinds, which rotate through 180 degrees, giving ample light control, or draw back leaving the window unobstructed.

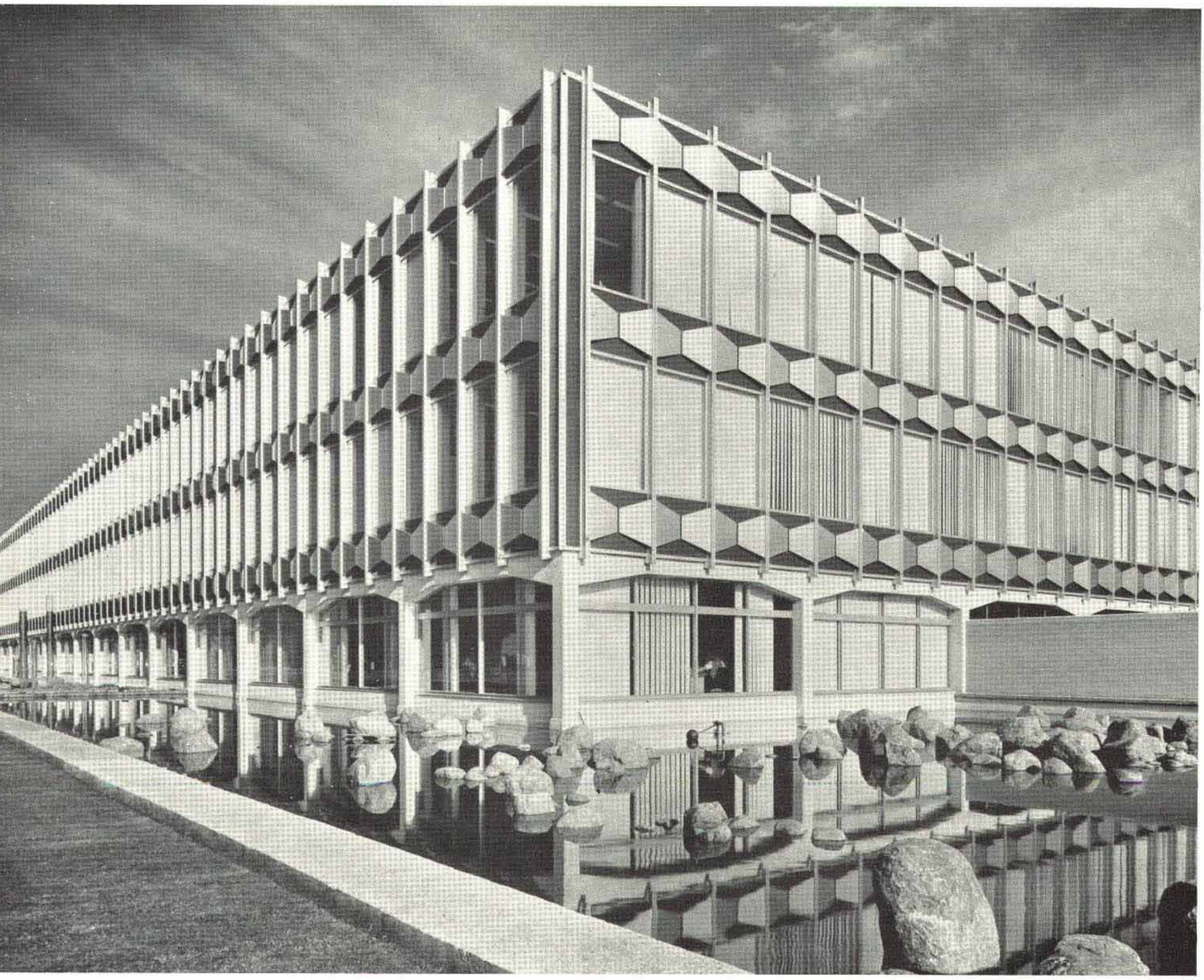
The landscaping of the grounds has added further to the offices' attractions. They have been embellished with pools, fountains, sculpture, and trees specially imported to the site, and the main entrance has been deliberately sited to the rear of the building, primarily so as to cause the minimum of disturbance to the residents in Station Avenue, but also so as not to break up the effect on the Station Avenue side, where a reflecting pool, with concealed flood-lighting, runs the full 370 ft. length of the building. This pool is constructed in reinforced concrete, with expansion joints and with an in situ reinforced concrete coping. The pool's exposed concrete surfaces make an interesting contrast with the groups of boulders scattered in its length, and with the fifteen bubble fountains, their narrow plastic cylinders, of various sizes, again scattered in the pool like groups of gleaming thermometers. Fountains at the entrance end feed water to the pool, and it is overlooked by a metal sculpture of three birds poised on a shallow boulder-strewn plinth. This sculpture was designed by John McCarthy.

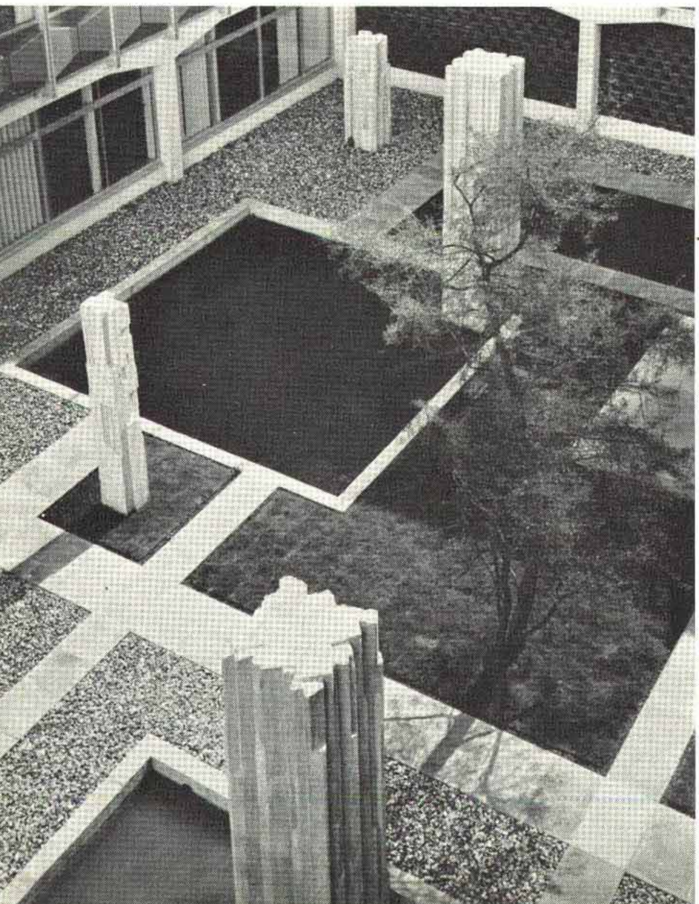
The two internal courtyards again make liberal use of concrete in their unusual and striking landscaping. The one combines, in a formal arrangement, shallow square pools, grass, edged with ordinary hydraulically pressed concrete slabs, and areas of interspersed flints. Out of the pools, the grass, and the flints, rise six dissimilar natural reinforced concrete monoliths, the interesting differences of their ruggedly fluted surfaces created by fixing timbers of different shapes and sizes to the inside of the formwork. The one tree in its grass plot stands out most distinctively by contrast. All the concrete here is natural, while, among the flints, white stones are in a majority, in order to pick up the white concrete of the building's ground floor columns. The other courtyard also makes white concrete a keynote. Here three white concrete platforms rise out of a shallow concrete pool, which is surrounded by boulders and planting. These formal elements of the landscape design – the long pool and the courtyards – are set off by the lawns, trees and shrubs which complete the landscaping.

The architects for the office block were Sir John Burnet, Tait and Partners. Bylander, Waddell and Partners were the structural engineers, and Matthew Hall and Company Limited designed and carried out the large service installation required in a building of this type. Higgs and Hill Limited were the main contractors, and the precast units were supplied by the Fram Reinforced Concrete Company Limited. Philip Hicks, A.A.(Dip.), A.R.I.B.A., Dip.L.D., did the landscaping.



A waiting lounge looks out on to one of the landscaped courtyards.





The boulder-strewn long pool contrasts effectively with the smooth curtain-walled façades.

Concrete monoliths form a striking feature in a landscaped courtyard.

EDITORIAL: *continued*

were left free to build an extensive, and continuous, programme of concrete roads; they would, of course, be backed by the help and advice of the research laboratories, but the tendency for the trees to obscure the wood should be eliminated. Fifty miles will add notably to our experience of concrete roads, but fifty – or a hundred and fifty – continuous miles would be better still.

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