BBC

ENGINEERING DIVISION

MONOGRAPH

NUMBER 13: **JULY 1957**

The BBC Riverside Television Studios:

The Architectural Aspects

by E. A. FOWLER, L.R.I.B.A.

Building Department, BBC Engineering Division

BRITISH BROADCASTING CORPORATION

PRICE FIVE SHILLINGS

BBC ENGINEERING MONOGRAPH

No. 13

THE BBC RIVERSIDE TELEVISION STUDIOS: THE ARCHITECTURAL ASPECTS

by

E. A. Fowler, L.R.I.B.A.

(BUILDING DEPARTMENT, BBC ENGINEERING DIVISION)

JULY 1957

BRITISH BROADCASTING CORPORATION

FOREWORD

THIS is one of a series of Engineering Monographs published by the British Broadcasting Corporation. About six are produced every year, each dealing with a technical subject within the field of television and sound broadcasting. Each Monograph describes work that has been done by the Engineering Division of the BBC and includes, where appropriate, a survey of earlier work on the same subject. From time to time the series may include selected reprints of articles by BBC authors that have appeared in technical journals. Papers dealing with general engineering developments in broadcasting may also be included occasionally.

This series should be of interest and value to engineers engaged in the fields of broadcasting and of telecommunications generally.

Individual copies cost 5s. post free, while the annual subscription is £1 post free. Orders can be placed with newsagents and booksellers, or BBC PUBLICATIONS, 35 MARYLEBONE HIGH STREET, LONDON, W.1.

CONTENTS

PREVIOUS ISSUES IN THIS SERIES

No.	Title	Date
1.	*The Suppressed Frame System of Telerecording*	JUNE 1955
2.	*Absolute Measurements in Magnetic Recording*	SEPTEMBER 1955
3.	*The Visibility of Noise in Television*	OCTOBER 1955
4.	*The Design of a Ribbon Type Pressure-gradient Microphone for Broadcast Transmission*	DECEMBER 1955
5.	*Reproducing Equipment for Fine-groove Records*	FEBRUARY 1956
6.	*A V.H.F./U.H.F. Field-strength Recording Receiver using Post-detector Selectivity*	APRIL 1956
7.	*The Design of a High Quality Commentators' Microphone Insensitive to Ambient Noise*	JUNE 1956
8.	*An Automatic Integrator for Determining the Mean Spherical Response of Loudspeakers and Microphones*	AUGUST 1956
9.	*The Application of Phase-coherent Detection and Correlation Methods to Room Acoustics*	NOVEMBER 1956
10.	*An Automatic System for Synchronizing Sound on Quarter-inch Magnetic Tape with Action on 35-mm Cinematograph Film*	JANUARY 1957
11.	*Engineering Training in the BBC*	MARCH 1957
12.	*An Improved 'Roving Eye'*	APRIL 1957

SUMMARY

Even before the closing down of the BBC's Television Service upon the outbreak of war in September 1939, attention had been focused on the need to provide permanent accommodation in London adequate for the requirements of a rapidly expanding service.

After the war the problem became still more acute and the Corporation acquired a site of some 13½ acres near Shepherd's Bush, which had once been part of the 1908 Franco-British Exhibition. On this site the BBC's main London Television Centre is now under construction. It was evident that the development of this site to a state in which it could play a leading part in television programme production would take a considerable time, and it was therefore necessary to provide interim studio accommodation.

Various premises have been acquired, the latest of which are the Riverside Television Studios at Hammersmith. At the time of their purchase by the BBC, these studios were being used for film production and considerable modification and adaptation were necessary to convert the premises into a self-contained television studio centre.

It is with the architectural and civil engineering aspects of the development of the Riverside premises that this Monograph will attempt to deal, although, in fact, the whole project involved the closest possible co-ordination with the technical staff responsible for the installation and operation of an immense amount of electrical apparatus.

1. Introduction

The constant need of the BBC Television Service for increased studio accommodation has resulted during the past seven years in the acquisition of a number of properties in south-west London. The natural aim has, of course, been to find buildings as closely allied in function to television premises as possible and attention has, therefore, been directed towards former film studios and theatres. Thus the Lime Grove Studios, formerly belonging to the J. Arthur Rank Organization, were acquired in 1950 as an interim measure pending the provision at White City of the new, permanent, BBC Television Centre. In due course this was followed by the purchase of the old Shepherd's Bush Empire and later of the King's Theatre, Hammersmith. Finally the Alliance Film Company's premises, Riverside Studios, were purchased in September 1954 and work was put in hand to convert them for television use.

As with most premises designed to fulfil a specific function the architectural ideal is to start with an open site and build from scratch, as was the case with the new Television Centre at White City. This state of affairs unfortunately seldom exists within the London area and it has, therefore, become necessary to develop a standard, quite apart from normal structural considerations, by which to assess the potential value of existing property for conversion to television use. Such considerations include the possibility of providing suitable access and storage for scenery, adequate soundproofing and acoustic treatment, facilities for the suspension of studio lighting and accommodation for lighting-dimmer equipment, large unobstructed control room observation windows, adequate ventilation plant space together with camera maintenance and general workshop accommodation, etc. Whilst a considerable amount of work would be required, the potential for such development existed at Riverside, and it is proposed to describe the project under the following headings:

Description of Premises Prior to Alterations.
Terms of Reference for Development.
Planning.
Building Work (Areas 1 to 6).
Requirements of Local Authority.

Two Appendices are included dealing with:

Mechanical Services.
Acoustic Treatment and Soundproofing.

2. Description of Premises as Existing Prior to Alterations

The premises, which were acquired by the Corporation in September 1954, were formerly engineering and foundry works owned by Messrs Gwynnes. The present studio areas appear to have been erected originally as open structures supported on steel stanchions and roofed with corrugated iron sheeting. At a later date the spaces between the stanchions were bricked in, windows inserted, and the whole of the area enclosed. The Crisp Road frontage to the site was, at this time, occupied by seven terrace cottages and between these and the river-bank buildings was located a three-storied warehouse type of building, used as pattern makers' shops. In 1933 the premises were acquired by the Triumph Film Company and considerable work was carried out in converting them to film use, both by this company and the Alliance Film Company, who later disposed of the premises to the BBC. The buildings directly adjacent to the river front were altered to form two studios. The buildings at present forming the large studio—which were formerly separate structures—were converted into one area by the introduc-

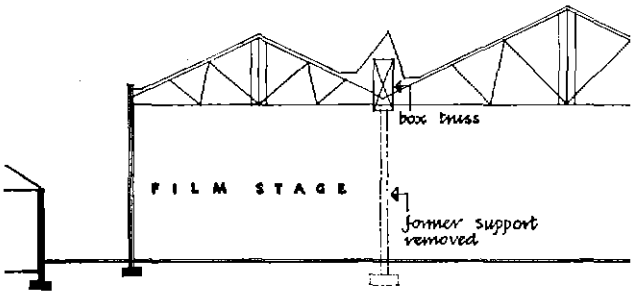


Fig. 1 — Method of supporting roofs to Studio R1

tion of a large box truss supported at each end by lattice stanchions. This structure carries the weight of the roofs formerly supported independently as shown in Fig. 1.

In addition to this work a new and very good film-recording theatre was built at first-floor level and a small review theatre formed in the former pattern makers' building. Offices, dressing-rooms, lavatories, stores, and canteen occupied the remainder of this building.

The party walls separating the Crisp Road cottages from each other were demolished and the whole area covered with a corrugated iron roof and used as a carpenters' and plasterers' workshop. Ventilation plant, property stores, motor-generator room, and switch room were located in a single-storied lean-to building adjacent to the north side of the studio area. Generally, the premises were, as far as could reasonably be ascertained, in fair condition with the exception of the roof coverings which, except that of the film-recording theatre, needed repair throughout. The course taken by some of the drainage was also particularly difficult to trace.

3. Terms of Reference for Development

The original terms of reference for the development of the property were formulated in October 1954 and were, in outline:

(i) To plan Riverside Studio premises for television production purposes on a permanent basis. The large studio (7,500 ft super) to be developed as a replacement studio for studios D, G, and H at Lime Grove whilst they were being re-equipped. The smaller studio (4,500 ft super) was to constitute an addition to the existing television studio accommodation. In neither case were the new studios to lack any facilities existing at Lime Grove and both were to be provided with a new and improved type of lighting installation.

(ii) The control areas, comprising a sound and vision control room, an apparatus room, and an advance maintenance room to each studio were to be provided adjacent to their respective studios and were to occupy approximately 1,400 ft super each.

(iii) Planning was to include for the accommodation of a telecine suite and central apparatus room, lighting-dimmer equipment, technical workshops, and stores, etc.

(iv) Additional dressing-room, quick-change, and make-up accommodation was to be provided together with a carpenters' workshop, property store, two scene transit docks, and a turntable on the river frontage approached via a covered way from Crisp Road.

(v) Restaurant accommodation for approximately 100 persons was also required.

4. Planning

Whilst the above terms of reference were an adequate guide to the general scope of the work, the early stages of planning revealed the necessity for the provision of additional facilities in order to make the premises an efficient operational unit. Sketch plans were produced by the BBC's Building Department incorporating all foreseeable requirements and a schedule of accommodation and building work was prepared by the Superintendent Engineer, Television Studios, on 15 December 1954. The preparation of the schedule was the result of close co-ordination between the Superintendent Engineer, Television Studios, Planning and Installation Department, Central Services Group, and Building Department. During this time an accurate survey was being made of the existing premises and drawings showing the proposals in outline were submitted to the London County Council for approval in principle under the Town and Country Planning Acts on 22 March 1955. This approval, subject to certain conditions relating to external appearance, etc., was received on 22 May 1955. It should perhaps be pointed out that the approval was a limited one and constituted agreement in principle only. Consent under the Building Bye-laws and Sections 20 and 35 of the London Building Acts could be obtained only upon submission of fully detailed drawings which, of course, at this time had yet to be prepared. Whilst approval in principle was being sought it was decided, in order to save time, that the preparation of final drawings and specifications should proceed. The drawings formed the subject of many unofficial discussions with L.C.C. representatives, who were most co-operative throughout. All steps necessary to the preparation of a building contract were also being taken including the transmission of details to the Quantity Surveyors for the preparation of bills of quantities, the selection of potential building contractors for tendering purposes, research on the availability and cost of materials, etc. Considerable attention was, at this stage, also given to the preparation of progress charts, these indicated, as far as could be foreseen, the times and order in which areas could be made available for the installation of various services, i.e. ventilation, heating, wiring, sprinklers, technical equipment, power supplies, etc.

The final prediction resulting from these meetings was that the building work would commence on 1 May 1955, the premises becoming fully operational by mid-July 1956. One of the results of the preliminary planning was the decision that the builders' work should be carried out in two main stages. This arrangement was dictated largely by the availability of materials and equipment and the desire to use Studio R2 in the form in which it existed for a short time for film production purposes. Stage 1, therefore, provided for the development of the large studio area (R1) complete with ancillaries including control rooms, dressing-rooms, offices, ventilation plant rooms, and associated accommodation; the provision of a self-supporting steel structure within the studio area to carry the new lighting installation; the provision of heating and ventilation where necessary throughout the whole of the premises and the execution of such works as were necessary to put the premises into a good state of repair. Stage 2 comprised the development of the smaller studio area, R2, on similar lines to that of R1 but including the provision of lighting-dimmer rooms, the demolition of the building fronting Crisp Road, and the erection on its site of a block to accommodate a scenic transit dock, additional dressing-rooms, carpenters' workshop, boiler house, ventilation plant room, etc.; the construction on the south side of the site of an engineers' workshop, stores, band room, staff rooms, lavatories, locker rooms, etc.; the conversion of the three-storied block to accommodate a telecine suite, studio control suite, restaurant, kitchen, and wash-up, together with the provision of a service hoist from the ground floor to second-floor level; and finally the construction on the river front of a scenic dock to serve studio R1.

5. Building Work—Areas 1 to 6

Pre-contract work having been completed, bills of quantities prepared, and competitive tenders invited, the contract was awarded to Messrs Robert Hart on 5 May 1955. For ease of reference the premises are here shown divided into six main areas (see Fig. 2). All the work will be described in the order shown although, in fact, much of it was carried out simultaneously.

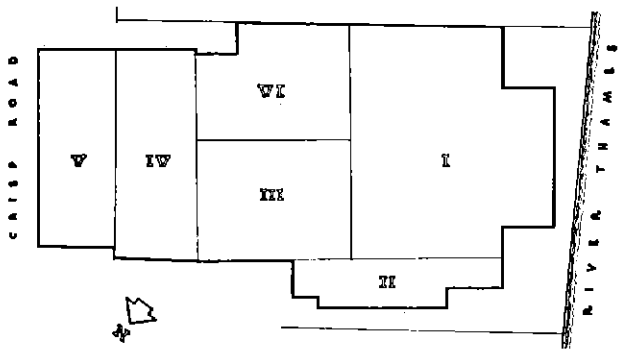


Fig. 2 — Key plan

5.1 *Area 1, Studio R1*

In the final planning of Studio R1, it had been found necessary, in order to achieve maximum floor space within the studio, to extend the control areas beyond the existing south perimeter wall of the main building out to the adjacent boundary wall separating the premises from the Hammersmith Borough Council Depot, thus the technical areas, ventilation plant rooms, and dressing-rooms were to be built partly within and partly outside the main building as shown in Fig. 3. The clear floor space in the studio resulting from this arrangement was approximately 6,000 ft super, providing the working area for four image orthicon cameras. The original flooring of $1\frac{3}{4}$-in. tongued and grooved boarding laid on battens was to be taken up and replaced by a reinforced-concrete floor and covered with $\frac{1}{4}$-in. Korkoid linoleum or a composition floor finish in order to provide a good surface for tracking cameras. Threaded eye-bolt sockets were to be grouted into the floor at 8-ft centres to give a maximum flexibility for the fixing of acrobatic or similar equipment. Large inlet ventilating ducts were to be excavated in the floor around the internal perimeter of the studio with sheet-metal extensions projecting up the wall faces and terminating in grilles just below the existing lighting galleries (see Plate A). All concrete duct covers were designed to carry 200 lb. per ft super. Ducts for supply cables and other technical wiring were to be similarly formed. Extract ventilation was to be provided via high-level metal ducts in the roof space above. In view of the fact that the existing roof steelwork was not designed to carry additional loading, the major operation in the studio area was to be the erection of the self-supporting steel structure previously mentioned which was designed to carry remotely con-

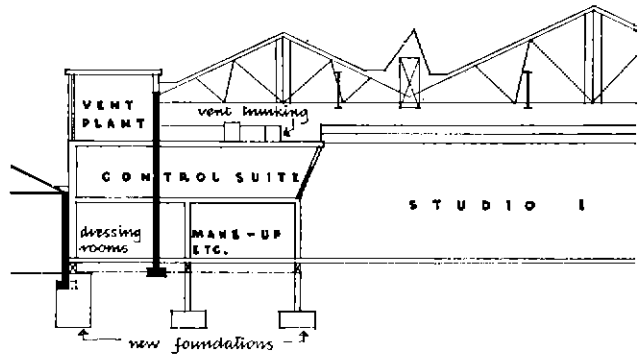


Fig. 3 — Diagrammatic section through new control suite to Studio R1 showing deep foundations

Plate A — Progress photograph showing underground vent ducts and vertical metal risers in Studio 1

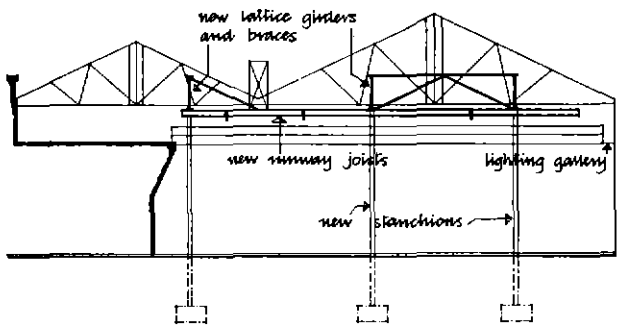


Fig. 4 — Diagrammatic section showing method of supporting runway joists and motorized lighting equipment

trolled motors operating lighting and scenery battens together with their power supply cables. In addition, the structure was to incorporate runway joists for the transit and support of scenery, cyclorama, etc., within the studio. In order to avoid undue delay the steelwork for the lighting structure had been ordered in advance of the placing of the main contract; the design basically comprising a six-legged table framework with the ends cantilevered as shown in Fig. 4.

The steel trusses supporting this structure were to be built up on site and 'threaded' between the members and braces of the existing roof trusses without in any way taking support from them. A new soundproof door 10-ft wide and 12-ft high was to be formed in the existing wall dividing Studio R1 from R2. The existing acoustic treatment of 2-in. rockwool throughout was to be modified to suit television requirements and additional soundproofing material applied to the roof. The lighting gallery was to be retained on three sides of the studio, part of the projecting roof of the control area at the south end of the building being used to complete the fourth side of the gallery. The

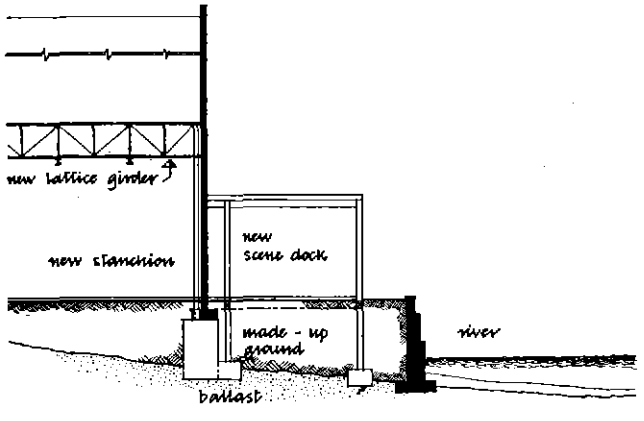


Fig. 5 — Diagram showing foundations adjacent to river wall

work within this area commenced with the removal of all extraneous material, the existing wooden floor was taken up and excavation of concrete bases for structural steel and the formation of underground ventilating ducts put in hand. It was found that the foundations to the existing building extended approximately 4 ft below ground level and it was assumed that the new bases would be approved by the District Surveyor at about 6 ft below ground. Unfortunately, this was not the case and the Surveyor insisted that the bases be taken down to a level at which river ballast would be encountered. At this level a loading of two tons per ft super was permitted. In view of the target date for completion it was deemed inadvisable to lose time in appealing to the L.C.C. against this ruling and it eventually resulted in the excavation of six 6-ft by 5-ft holes each approximately 15-ft deep (see Fig. 5). To fill these excavations with concrete would in itself have created a fresh problem because the proportionate increase in the weight of the concrete over a given base area would have led to the necessity for increasing the surface area at the bottom of the excavation.

The avoidance of this vicious circle resulted in the employment of short lengths of steel stanchions bolted to a 3-ft thick concrete base at the bottom of each excavation in order to lighten the loading. The excavated earth was then back filled, the steel having first received a 2-in. casing of concrete. Whilst the delay resulting from this extra work was most unwelcome, every effort was made to recover lost time and the steelwork for the lighting gantries was erected very quickly once the bases were in. The main gantry having been erected, it was necessary to fabricate light subsidiary steelwork resting upon the gantry in order to support the cable trays carrying the power supply to the independently motorized lighting battens. This light steelwork was pre-drilled and bolted together on site in 'Meccano' fashion in order to give maximum adaptability in a roof space which was, by now, a complexity of struts, braces, ties, members, and ducting—very difficult to visualize clearly in a three-dimensional manner from the drawings available. Fig. 6 gives a diagrammatic view of the steelwork relating to a typical motorized lighting batten (see also Plates B, C, and D). Work in the roof space being completed, the floor ducts were formed in waterproofed concrete, the new reinforced concrete floor slab being laid over them, access panels were provided at strategic points. It had originally been envisaged that a 2-in. sand and cement screed should be put down over the whole of the floor prior to laying the final floor coverings. But time being short and the weather being extremely cold it was decided to substitute asphalt for the cement screed, the advantage being that it could be walked upon almost as soon as it was laid and that the operation would not, as in the case of concrete, be held up owing to the low temperatures prevailing at the time. Some research was necessary to find an asphalt which would suitably meet the conditions of heat normally associated with a television studio and also to be unaffected by heavy rolling

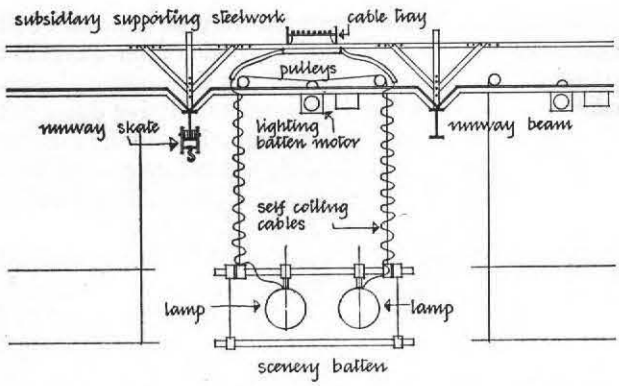


Fig. 6 — Diagram of typical lighting batten arrangement

loads as well as providing a suitable base for a floor covering. The required conditions were successfully met and similar treatment has now become standard practice in BBC television studios. Prior to the laying of the asphalt screed the eye-bolt sockets had been grouted into the floor at 8-ft centres and fitted with threaded caps to prevent the ingress of dust and dirt.

In the later stages of the contract the floor was covered with $\frac{1}{4}$-in. Korkoid linoleum laid on patent adhesive with a $\frac{1}{4}$-in. joint between sheets to allow for spreading. The floor to date has given every satisfaction under operational conditions. The existing 12-in. wall dividing the two studio areas consisted of two 4-in. skins of breeze block with a 4-in. cavity between them. In this wall was formed a door opening 12-ft high by 10-ft wide to allow of the transit of scenery and equipment from one studio to the other. Double soundproof doors were provided and constructed to detail shown in Fig. 9.

The existing acoustic treatment in the studio area was in the main composed of 2-in. rockwool slabs contained in chicken wire netting spiked to 2-in. by 1-in. wooden battens fixed to the walls. The roof treatment being similar but with a layer of $\frac{1}{2}$-in. soft-board fixed to battens between the rockwool and the asbestos roof covering. This treatment was largely retained except in areas directly affected by building work where it was taken off and not compensated for to any degree elsewhere. The new metal inlet-duct risers above floor level were found to be excessively reverberant and were treated with a thick coating of Bostick adhesive and faced with scrim. The roof was far from soundproof and it was originally decided that additional measures should be taken to improve it. Ultimately this proposal was dropped, in view of cost, and to date no undue sound interference has been experienced either from aircraft or shipping. (See Appendix II, Acoustic Treatment and Soundproofing.)

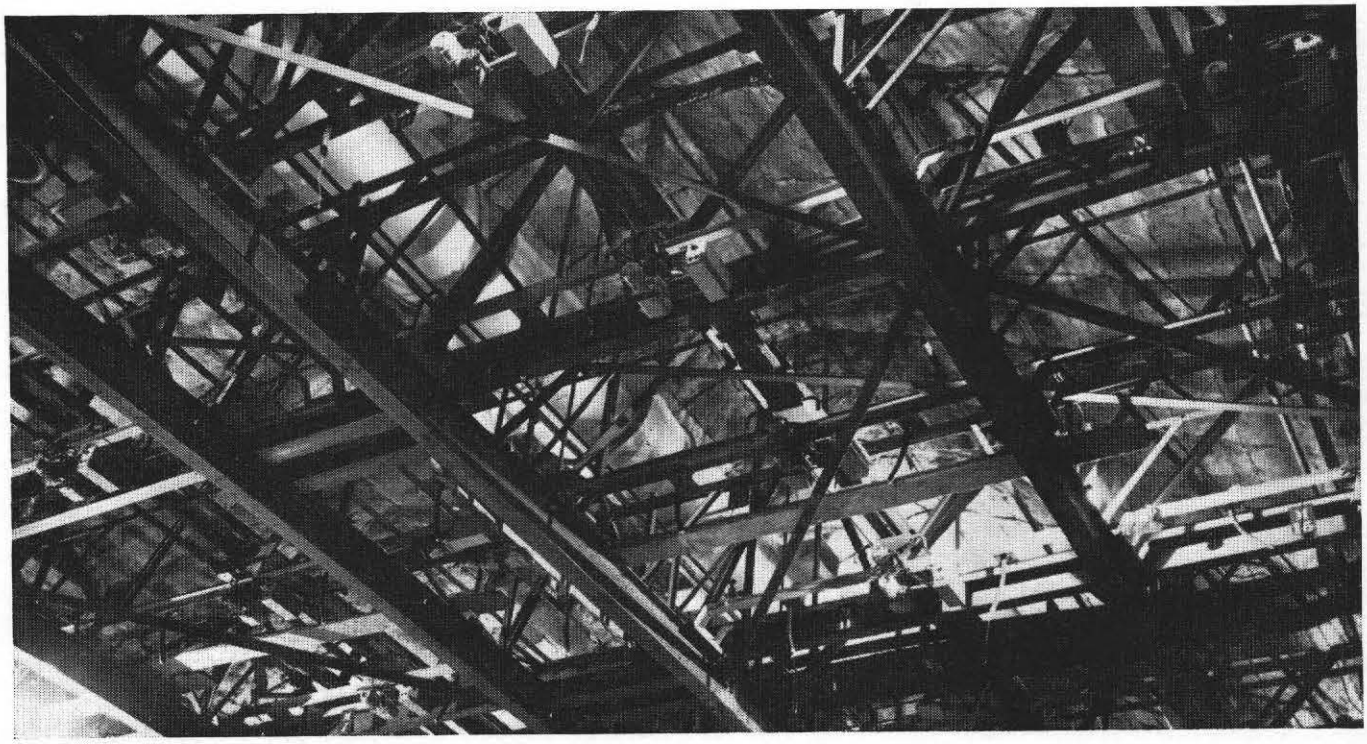


Plate B — Studio 1. Independently supported steelwork incorporating runway beams, motorized lighting batteries, and cable tray supports

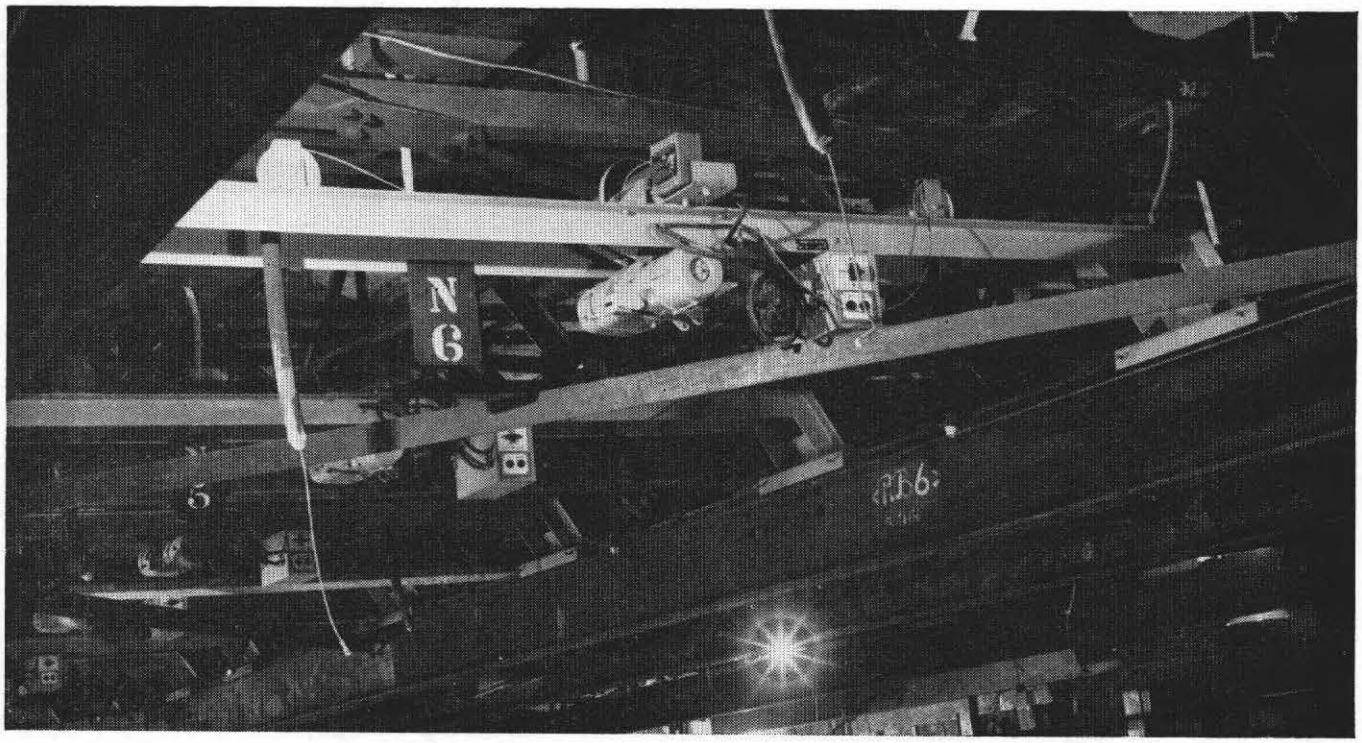


Plate C — Detail of typical motorized lighting batten

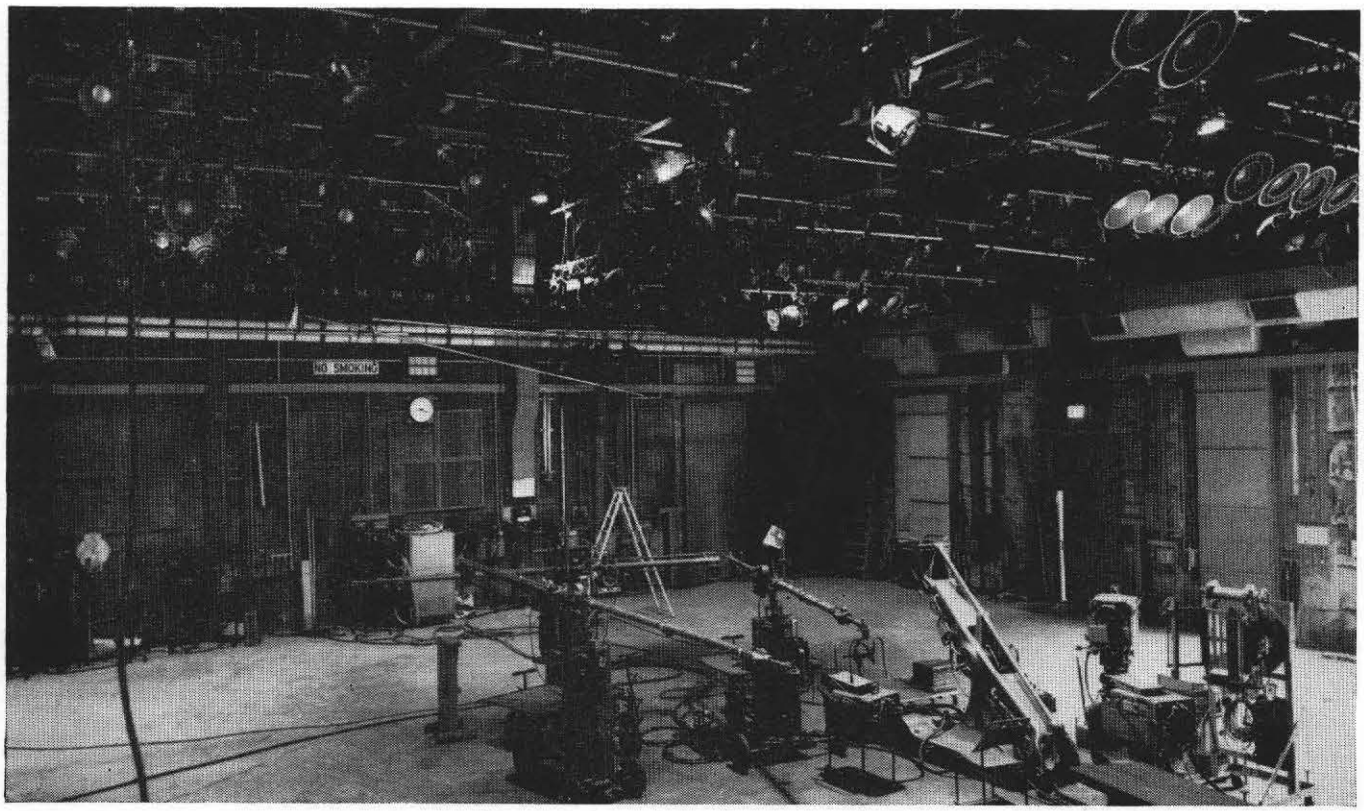
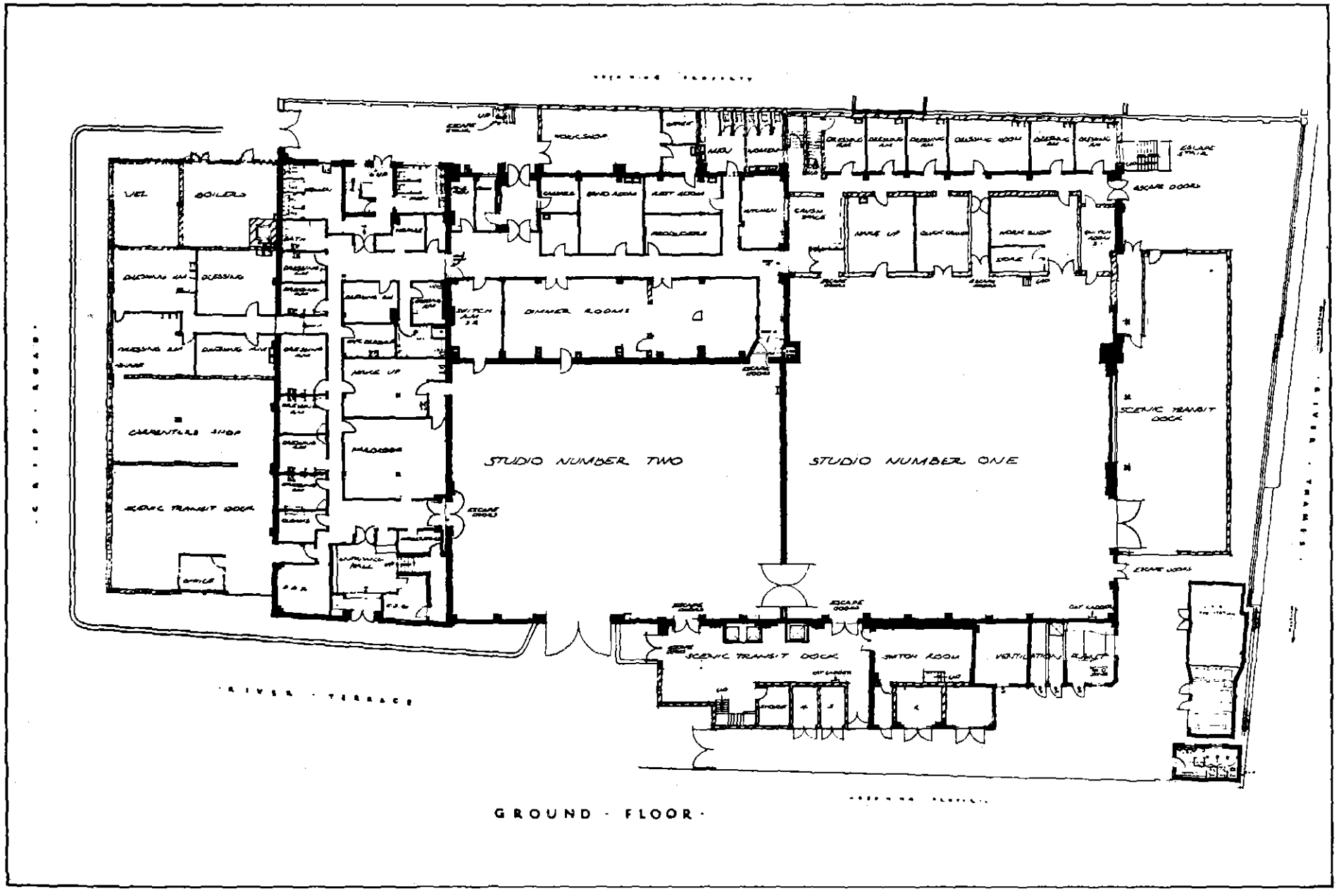
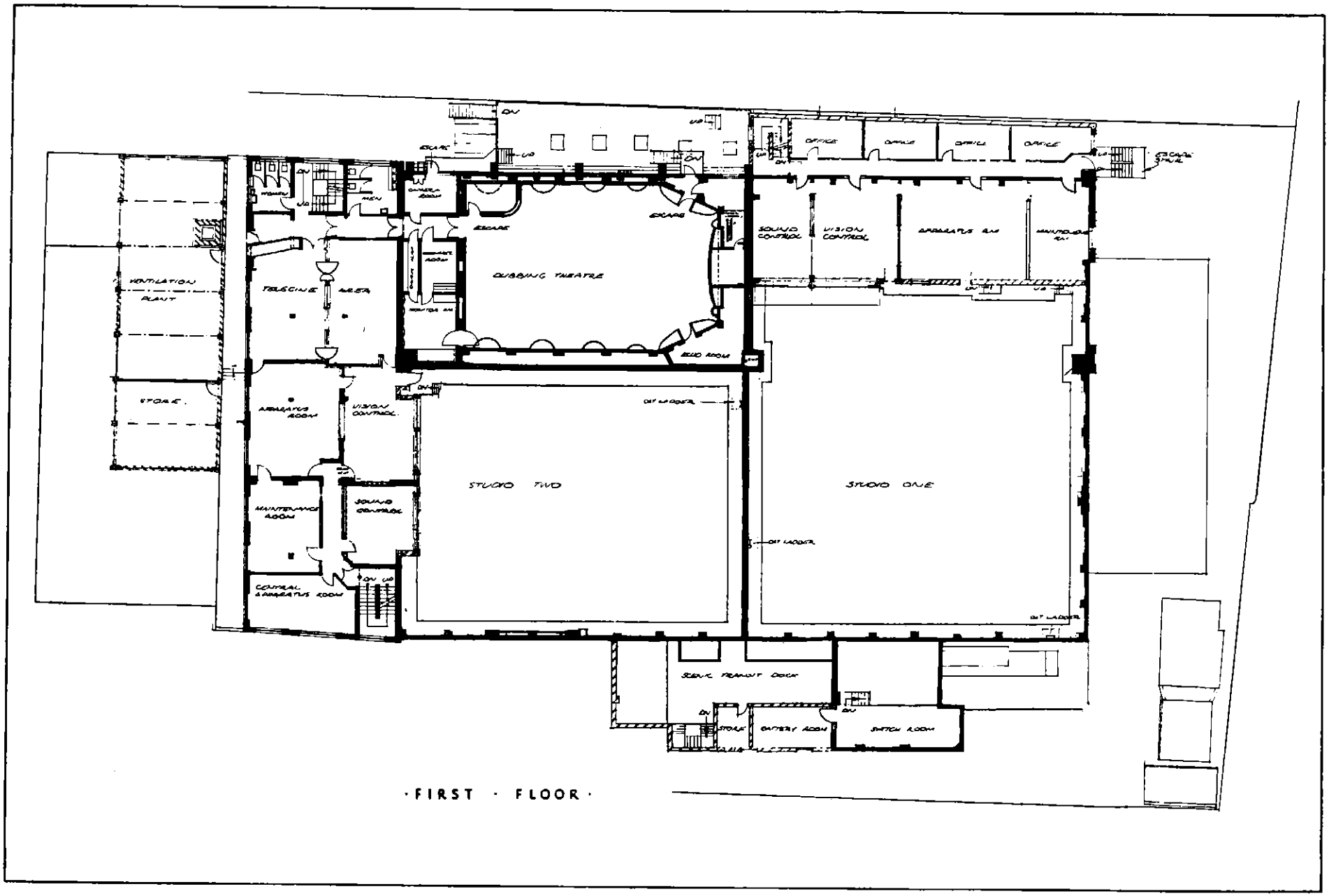


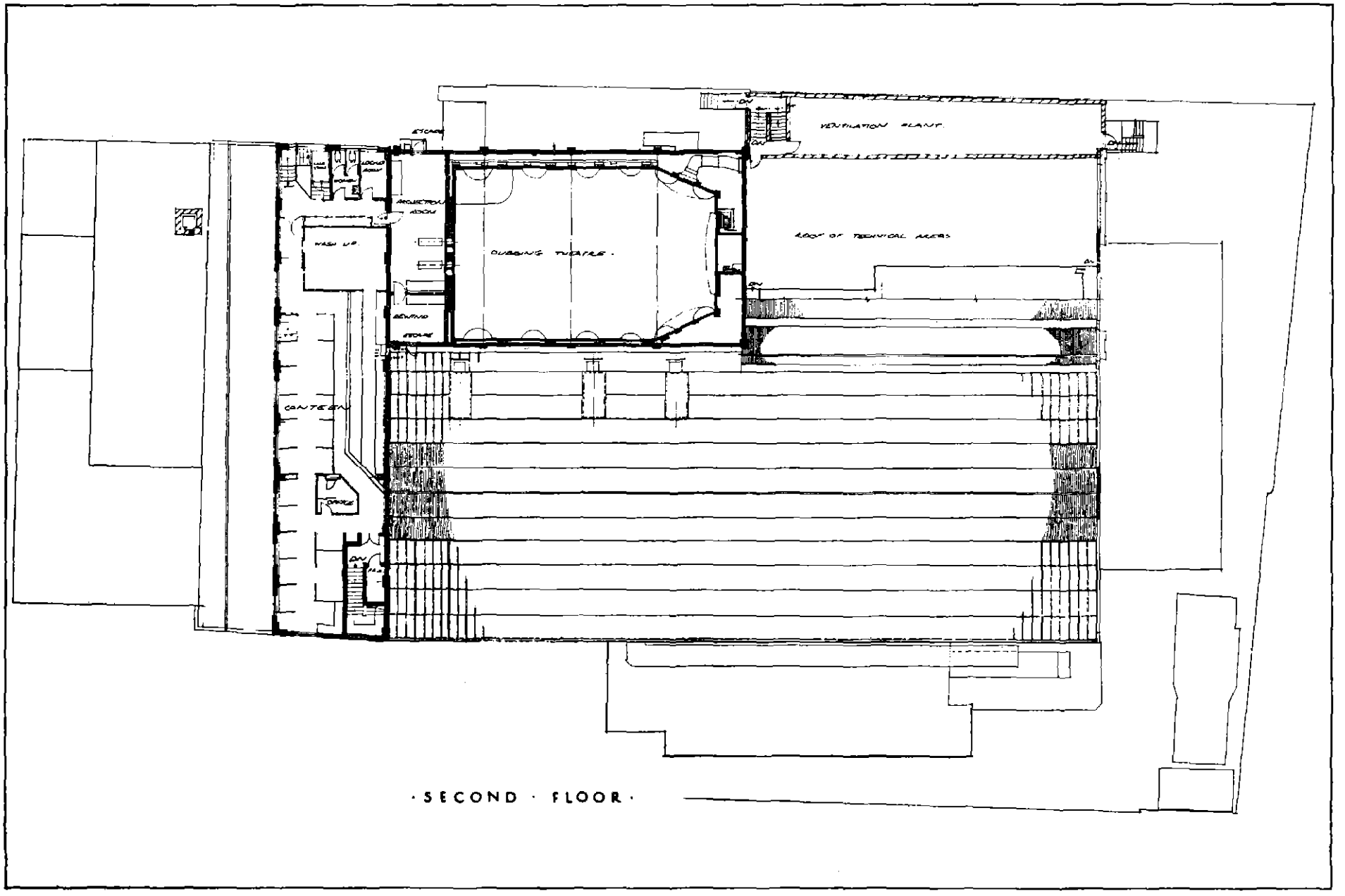
Plate D — View of ceiling of Studio 2 with lighting in position



Ground Floor Plan



First Floor Plan



Second Floor Plan

5.2 *Studio R*1, *Control Room and Dressing-room Block*

Shortly after the commencement of work in the studio, excavation was commenced for the foundations to the above building. Here again it became apparent that special measures would be required satisfactorily to spread the load of the new building, but in this case, in addition to deep foundations, it was necessary to employ ground beams as indicated in Fig. 7. This form of foundation leaves no part of the structure unsupported by steelwork, all weight being transferred to the stanchion bases. Numerous obstacles were encountered during the excavation including culverts, which had to be diverted, masses of heavy iron from the former foundry which had to be removed; the discovery of a large testing tank full of rubbish and the constant presence of water with its attendant pumping operations also added to the difficulty of the work. Apart from this the construction of this block was of a type conventional in sound-insulated structures, except for the double-glazed observation windows to the first-floor sound and vision control rooms which were exceptionally wide (11 ft and 14 ft respectively) and were tilted outward at an angle of 25 deg. to the vertical in order to give better control room viewing, reduce light reflection, and, most important, to provide a recess in a convenient position above the windows for the location of picture monitors, thus allowing producers and technicians to view the action on the studio floor and in the monitors simultaneously (see Plates E, F, and G). The equipment in these control areas was arranged to allow of 'front viewing' and power-operated windows were provided between the control rooms and apparatus room. The internal partition walling to the technical areas was formed with Camden partitioning. See Fig. 8 for detail.

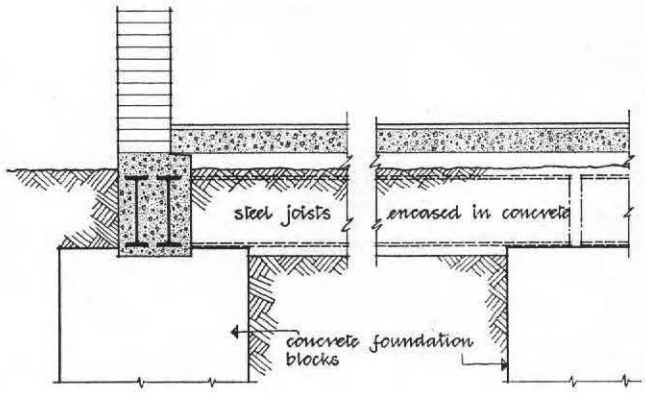


Fig. 7 — Detail of typical ground-beam foundation

Plate E — View of Studio 1. *Control suite windows from studio*

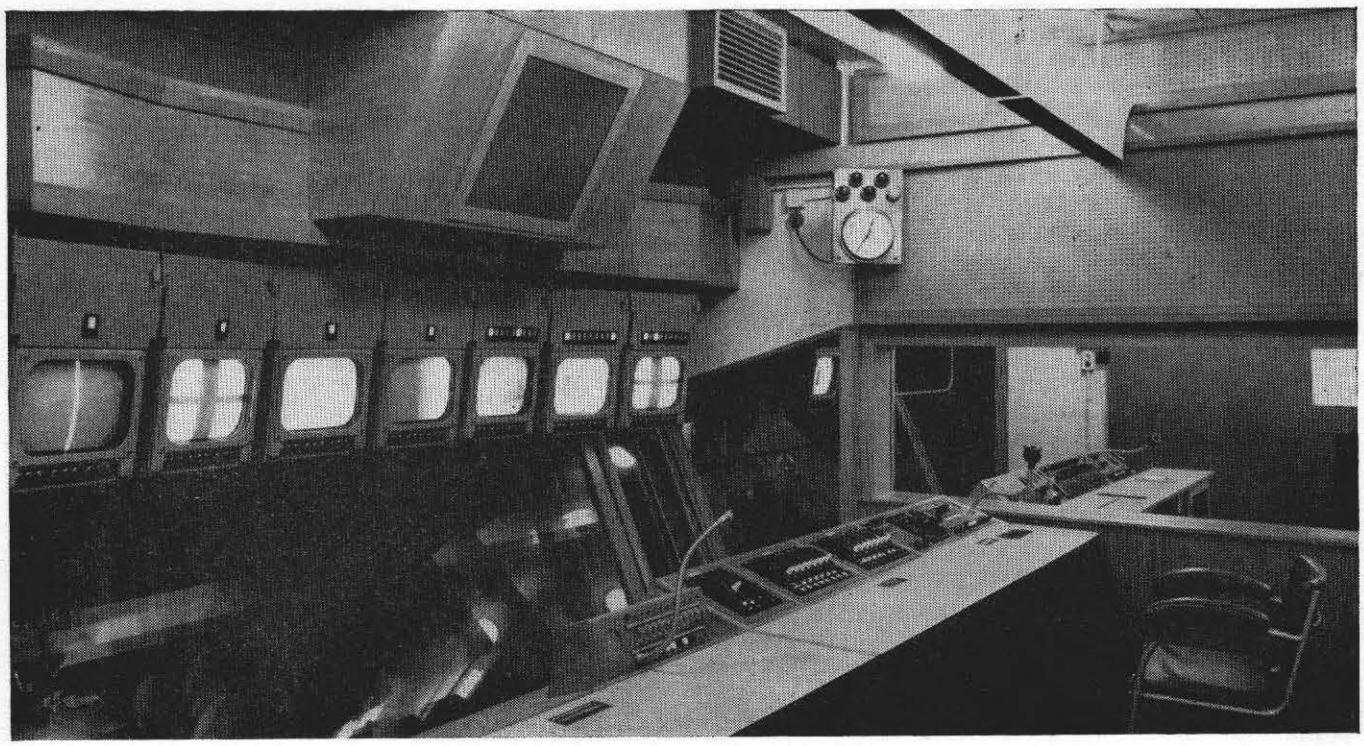


Plate F — View of Studio 1. *Control suite windows from within*

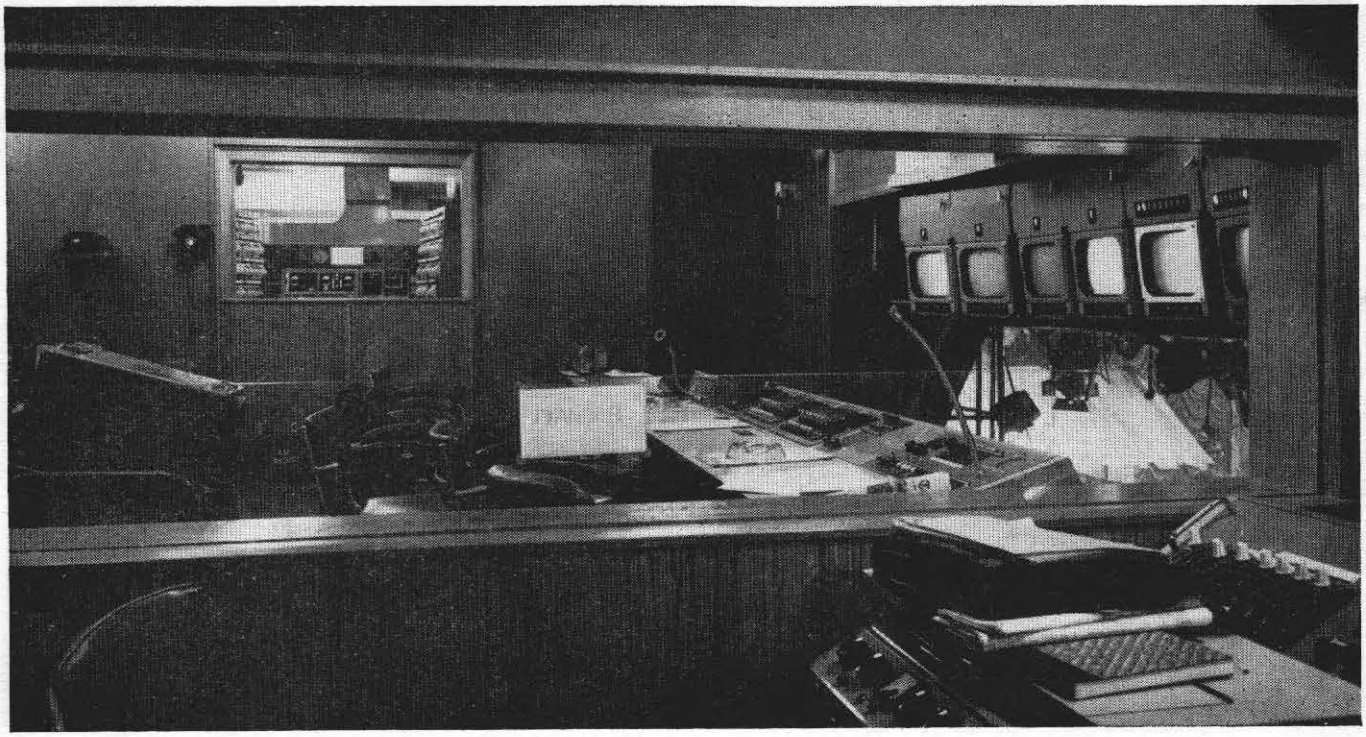


Plate G — View of Studio 1. *Control suite power-operated window*

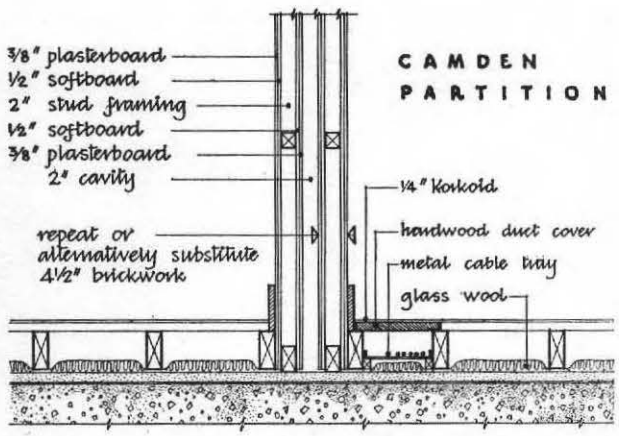


Fig. 8 — Typical detail of control room partitioning and floor

The floors were of hollow-block construction finished on the top side with 1-in. bitumen-bonded glass-wool upon which floor joists were laid and boarded over. Ducts for cables were formed in this false floor, the final finish being $\frac{3}{16}$-in. Korkoid linoleum. The remaining non-technical accommodation in this block comprised dressing-rooms, make-up room, quick-change room, studio equipment store, and switch room, together with a small self-service tea-bar and preparation room at ground-floor level (see Plate H), producers' offices at first-floor, and ventilation plant rooms at second-floor level.

5.3 *Scenic Transit Dock*

The construction of this building was subject to similar conditions regarding foundations to those already described; a further consideration being the proximity of the existing river wall and the danger of surcharging it with the additional loading resulting from the new building. It was decided that even the construction of a reinforced-concrete raft would not adequately counteract this danger and again deep excavations had to be sunk before ballast was reached (see Plate J). Ground beams were again employed and the structure erected as a steel-frame building. 70-ft long by 25-ft wide by 18-ft high, entirely independent of the existing building. An 11-in. cavity wall infilling was employed between the concrete encased steel stanchions and the roof was of hollow-block construction without a screed and finished with asphalt. In view of the restricted space at this end of the site it had originally been intended to install a turntable for scenery transport vehicles. This proposal was, however, dropped in the planning stage as it was considered that such a facility would be of limited value owing to the size of vehicles employed.

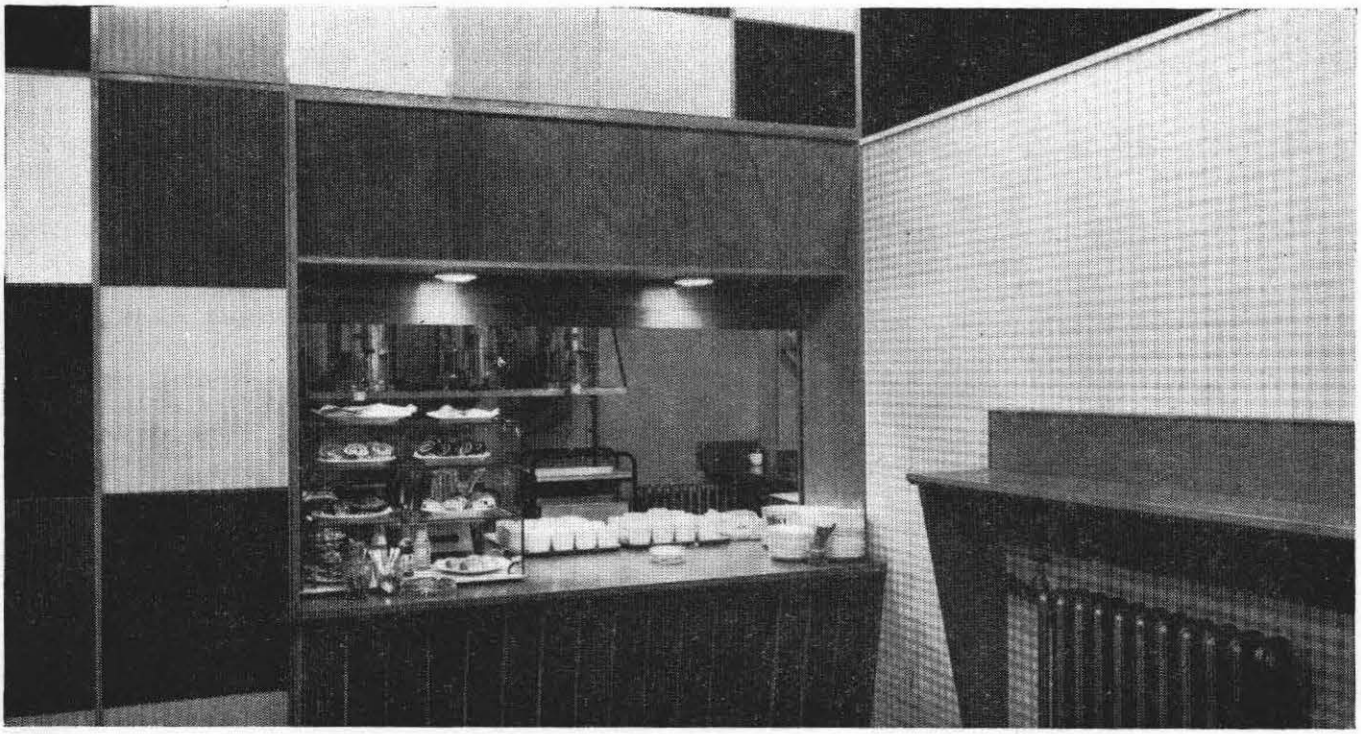


Plate H — View of ground floor tea bar

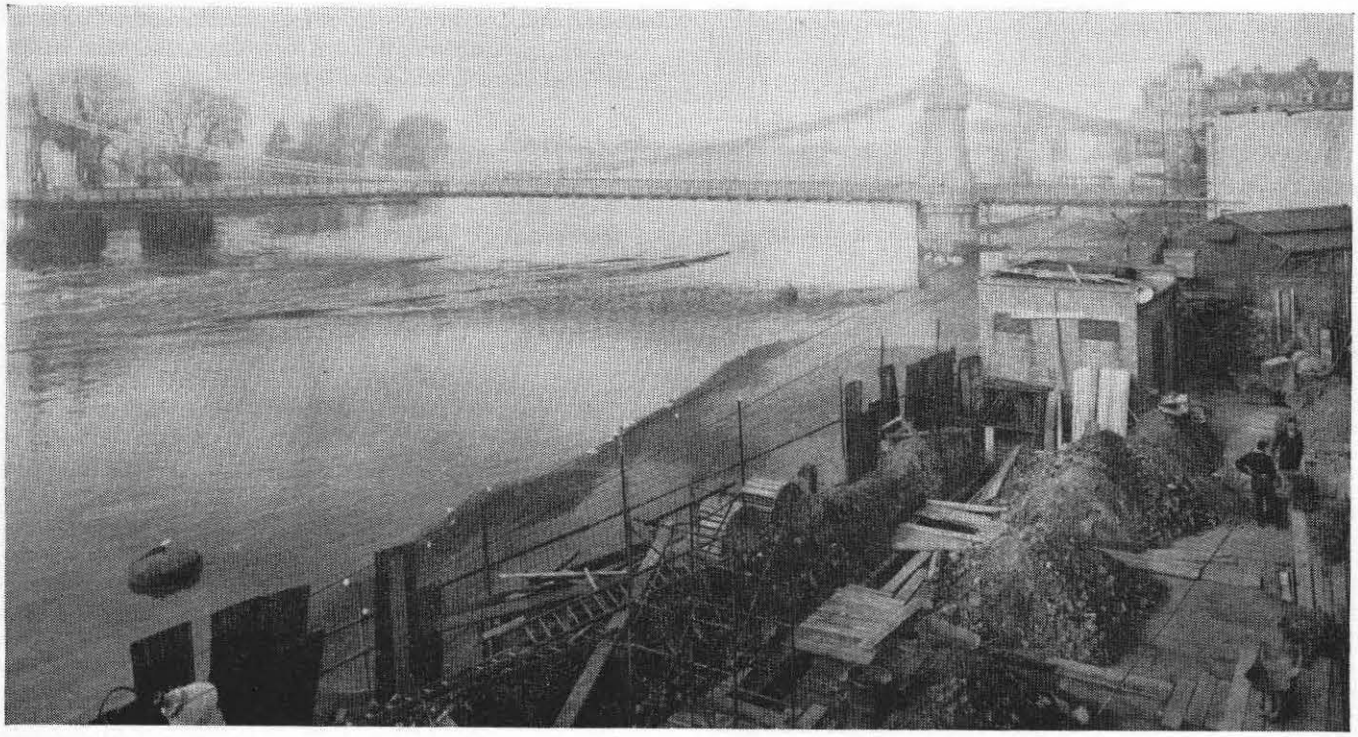


Plate J — Excavation work for Scene Dock in progress

5.4 *Area* 2, *Power Intake and Property Store Block*

This block, which formerly comprised a single-storied lean-to structure for film properties and a lofty brick and concrete building accommodating a large motor generator together with ventilating plant, was partly demolished and converted into a two-storey building housing four transformer rooms, switch room, a large property dock with store and office and a battery room at first-floor level. An emergency escape corridor communicating with Studio R1 was also incorporated. In view of the proximity of this part of the premises to those of the adjoining owners (Messrs Rosser & Russell) the L.C.C. insisted that special fire precautions be taken in the transformer room area and heavy steel doors incorporating shutters operated by fusible links were designed, approved, and fitted. Artificial ventilation of the transformers, therefore, became essential and a separate system had to be installed to cope with this requirement. It had originally been proposed that the road running between this block and the adjoining property be protected from weather by a covered way in order to safeguard scenery in transit. But here again the L.C.C. would not permit such a structure to be erected owing to the necessity for the preservation of a fire break between the premises.

5.5 *Area* 3, *Studio R2*

The conversion of this studio to television purposes closely followed the lines employed in the case of Studio R1. Certain inherent advantages, however, existed in this area which reduced the amount of work which had to be carried out. Whereas in the planning stages it had been decided that priority should be given to the completion of Studio R1, the difficulties which have been outlined had retarded progress to such a degree that it was agreed that priority should now be switched to R2 as it was apparent that this studio could be made operational in a comparatively short time. The existence of non-load-bearing bowstring trusses between the roof trusses was one of its chief advantages as their presence obviated the necessity for providing a self-supporting lighting gantry. Whilst certain strengthening measures were required to the trusses, once this work was carried out, the runway beams and superimposed subsidiary steelwork and lighting equipment could be erected without further support and costly excavation and steel erection avoided. The floor was treated in an exactly similar manner to that of R1 including the formation of underground ventilation and cable ducts, etc. Additional excavation was necessary, however, in the formation of stanchion bases for the steelwork required to support part of the vision control rooms which were built to project into the east end of the studio at first-floor level although the main control suite areas were accommodated within Area 4. The space beneath the bays thus formed was utilized as a store for back-projection screens. Acoustic treatment for this studio was as described for Studio R1 and, of course, the new 10-ft wide soundproof doors were common to both studios.

5.6 *Area* 4, *Three-storied Block*

The development of this block entailed an almost complete internal gutting of the building, although it was found possible to retain elements of the existing dressing-room accommodation. The final layout of this area was largely governed by the planning of the new accommodation in Area 5. The existing main entrance was extremely cramped and was consequently redesigned to create a greater impression of spaciousness and light. A contemporary style of decoration was employed. The first floor, which was to accommodate Studio R2 control suite, a telecine suite, and central apparatus room, was planned as indicated, the majority of the internal partitioning being of Camden construction. The formation of the projecting bay into the studio area was, in view of its length, a rather difficult operation as it was necessary to carry the weight of a large section of gable-end wall upon which was supported the floor of the restaurant above and entailed manœuvring the supporting steelwork within a very limited space. Certain L.C.C. requirements regarding the fire protection of buildings under Section 20 of the London Building Acts (Amendment) Act also influenced its construction (see Requirements of Local Authority). The soundproofing and acoustic treatment in these areas followed closely that employed in Studio R1 control suite. (See Appendix II, Acoustic Treatment and Soundproofing.) The formation on the second floor of a restaurant area was regarded as an opportunity for introducing a type of layout not hitherto employed in Corporation premises. The extreme length of the available area compared with its width was utilized to give a dining-car effect with fixed seating running parallel to the service counter, but separated from it by a glazed screen. This arrangement allows of good circulation and adequate access to the escape stairs at either end. The existing open roof space was closed by a false ceiling constructed with $\frac{1}{2}$-in. slotted asbestos panels on light metal angles and covered on the top side by bitumen-bonded glass-wool for the dual purpose of sound deadening and thermal insulation. A small service hoist was installed within the existing south stair well to serve the kitchen. This unit operates within a self-supporting metal framework and was constructed in this manner to avoid the necessity of transferring any additional load to the existing light roof steel.

5.7 *Area* 5, *Crisp Road Block*

This building, which was entirely new, was designed to accommodate the boiler house and oil storage, carpenters' workshop, scenery transit dock, and four 'crowd' dressing-rooms at ground-floor level with a ventilation plant room and technical equipment store at first-floor level. Both the boiler house and the scenic transit dock were double-height areas; the dressing-rooms being located between them. The building is of steel-frame construction with 11-in. cavity walls and hollow-block floor slabs (see Plate N). The foundations in this instance were also con-

Plate K — Service counter to restaurant

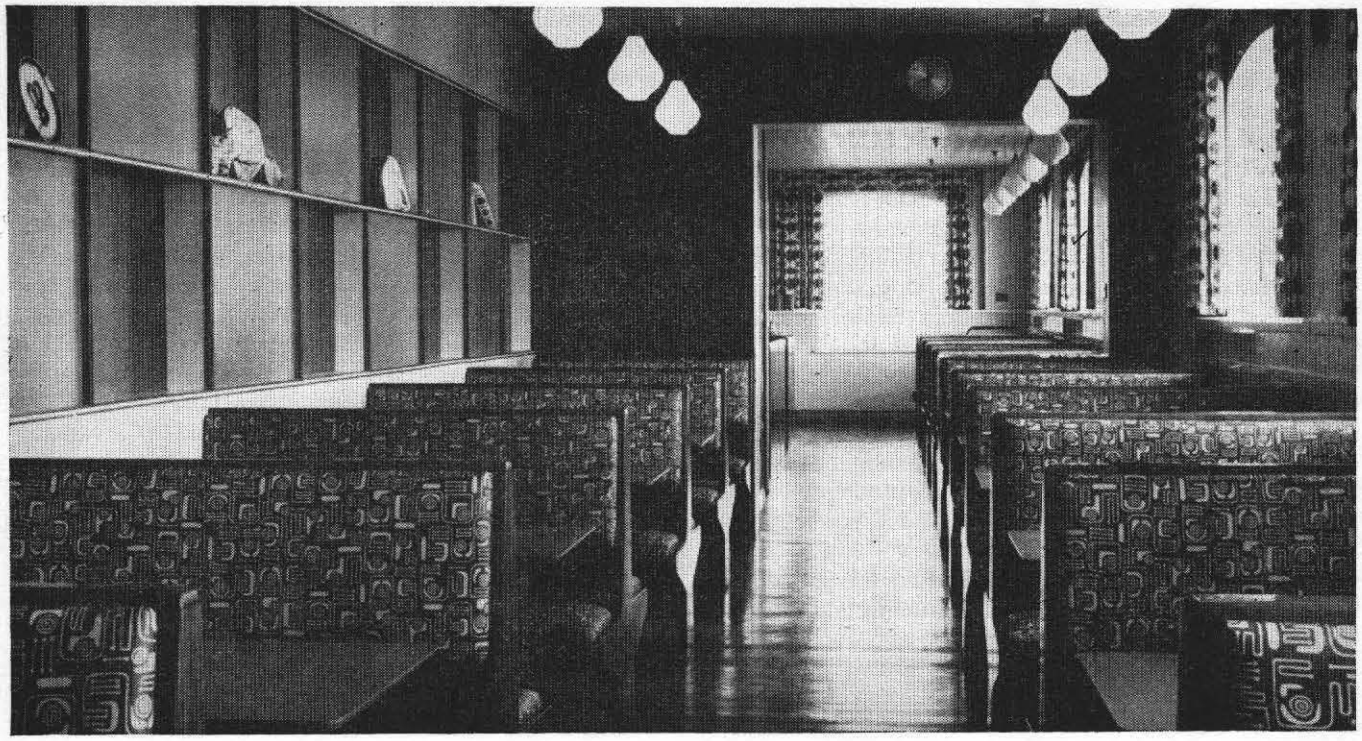


Plate L — View of restaurant seating area from east end

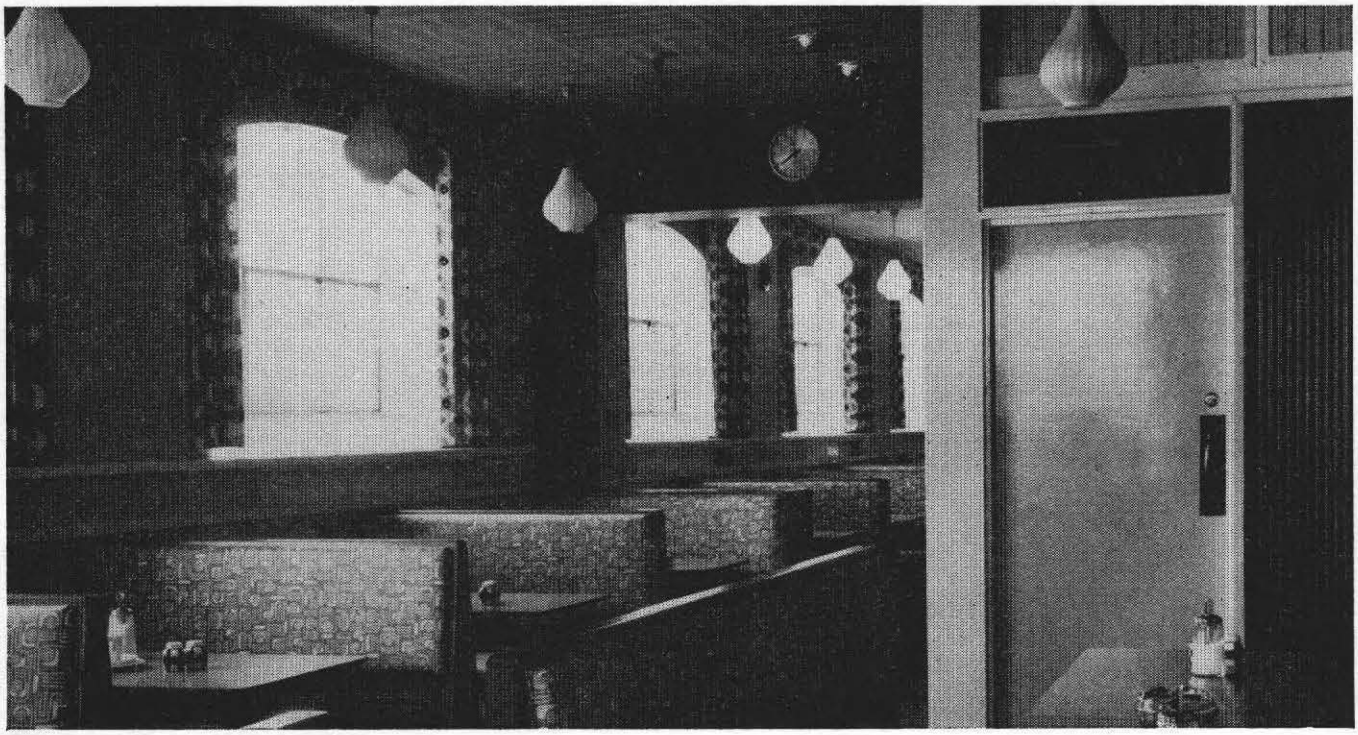


Plate M — View of restaurant seating area from west end

ventional, the bearing capacity of the ground being considerably better than that adjacent to the river. The main difficulty in construction was occasioned by the necessity to underpin the existing high and rather bulging wall which separated the new block from the old building. The new stanchions along this boundary were inserted in the thickness of the existing wall in order to save space and thus it had, in effect, to be cut into independent sections to allow of the steel being positioned. The new stanchion bases were, of course, considerably below the existing wall foundations. With the exception of the dressing-rooms the internal finish in this building is fair-faced brickwork painted two coats emulsion paint, the dressing-rooms being plastered.

5.8 *Area 6*

This portion of the premises is again a mixture of old and new construction. The ground floor of the existing part of the building was completely replanned to house two lighting-dimmer rooms, a switch room, a new rear entrance, with accommodation for commissionaire, firemen, and telephone booth, whilst the provision of a band room, producers' room, manual-staff room, and cashier's room completed the layout. Workshop accommodation for house engineer and staff electricians was formed between the old building and the existing south boundary wall and lavatory accommodation provided to serve Studio R2 and its ancillary areas. The first floor of this part of the building, which comprised the old recording theatre, was left virtually untouched although it was necessary to construct a soundproof room within the theatre for commentary dubbing purposes and this was used during the noisier stages of the building operations. The formation of the dimmer rooms necessitated a considerable amount of work to the floors in order to form cable ducts and bases for equipment. This area was separated from Studio R2 by an existing cavity wall of similar construction to that dividing the two studios. The house engineer's workshop building was subject to conditions imposed by the adjoining owner regarding disturbance likely to result from noisy operations within the workshop and in consequence the walls and ceiling were lined with 2-in. Stramit before being plastered. The building was constructed with 9-in. brick walls, one side being erected on the existing party fence wall. The roof is of hollow-block construction trimmed to accommodate domed roof-lights.

6. Requirements of Local Authority

The influence of L.C.C. requirements and Conditions of Consent on the building work at Riverside was considerable although, in view of the rather piecemeal way in which our proposals had, of necessity, to be presented, it

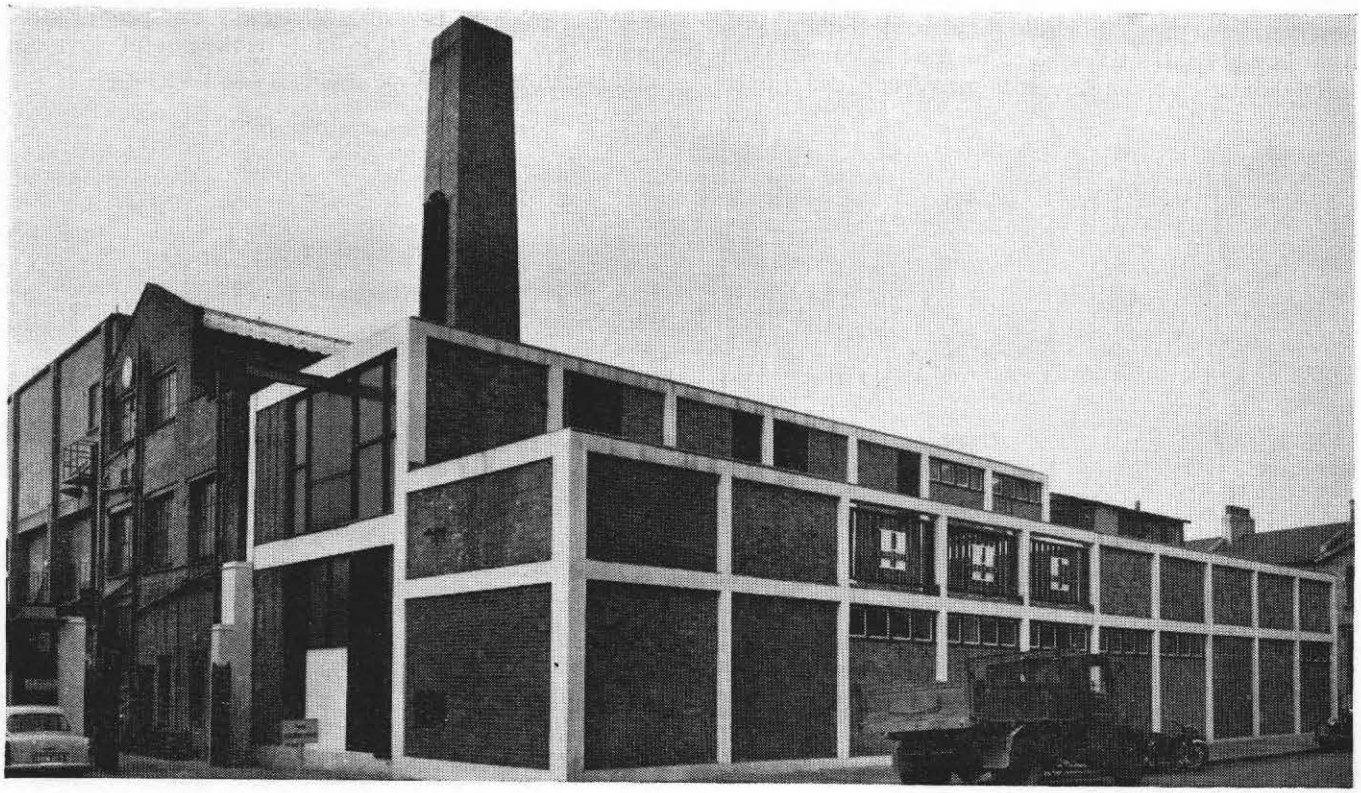


Plate N — Frontage to Crisp Road

was not possible accurately to assess in advance the manner in which they would be applied. As previously mentioned, application for approval was made under three main headings: Town and Country Planning, Bye-laws, and Sections 20 and 35 of the London Building Act. Whilst approval under Town and Country Planning was essential before the work could commence, consents under the other headings were, to a great extent, dependent on the evolution of the project, certain aspects of which became apparent only as the work proceeded. The implementation on site of the Bye-laws is primarily the responsibility of the District Surveyor, to whom considerable discretionary powers are delegated. Whilst the alterations were planned to conform with ascertainable requirements, in the case of the foundation works the final decision as to what constituted a satisfactory load-bearing surface rested with the District Surveyor. Similarly the decision partly to demolish and rebuild the property store block was largely the result of his condemnation of the existing building, in view of the proposed alterations. The interpretation on site of the Conditions of Consent under Sections 20 and 35 relating to the excess cubical extent of the premises and Means of Escape respectively also rested with the District Surveyor. It should, perhaps, be mentioned that where, as in this case, a building falls into the category of excess cubical extent (i.e. over 250,000 cubic feet content) the regulations relating to the prevention of fire become very stringent, an example being the necessity for providing automatically operated steel shutters on both sides of the observation windows to Studio R2 control suite. In addition the materials permitted to be used in construction throughout the building are, to a great extent, determined by their fire-resistant qualities. The ventilation system also is closely scrutinized to ensure that all risk of fire spreading through ducting is avoided. The regulations applying under Means of Escape are similarly very comprehensive and relate, among other things, to the adequate positioning and sign-posting of emergency exits, types of door fastenings to be used, protection of staircases and corridors, details relating to secondary means of illumination, etc.

It should, perhaps, be noted that the methods employed in obtaining L.C.C. Consents in connection with this project were not those to be recommended, and had time permitted it would have been very much more satisfactory and economical to have prepared the scheme in its entirety and obtained all consents prior to the actual commencement of the work.

7. Conclusion

Riverside Studios represent the latest and most modern practice in the equipment of television studios in the country. The layout and facilities which have been provided depend in no small measure upon the work described in the foregoing sections of this Monograph and the studios have proved adequate for the purposes for which they were intended. Some very ambitious productions have been staged at Riverside with the maximum efficiency.

The incorporation of many new features on the engineering side of television production, particularly in the fields of lighting control and co-ordination of the production and engineering staff involved in the staging of programmes, has been made possible by the careful planning and layout of the studios and their auxiliary areas.

APPENDIX I

Contributed by L. NORTON, B.Sc.(Eng.), M.I.H.V.E.
Building Department, BBC Engineering Division

Riverside Studios, Mechanical Services

The mechanical services associated with these Studios include ventilation of studios, technical areas, office accommodation, dressing-rooms, dubbing theatre, and restaurant; heating, hot-water service throughout, and compressed-air, gas, and fire-prevention arrangements.

Ventilation

The intensity of lighting in television studios is high and also variable in location and power so that large air quantities are involved and the distribution internally has to be as flexible as possible. At Riverside the air is brought in through fabric-type filters and delivered to the studios through sound- and heat-insulated external ducts thence into underground brick and concrete floor ducts to rise at selected points in the studio itself. The rising ducts feed into horizontal distributing ducts under the lighting gallery arranged to give proper distribution over the entire floor area and also to 'blow' into the sets; the supply grilles are above backcloth level and each grille can be individually closed and its supply air directed elsewhere.

The supply air enters below lighting level and the exhaust is arranged in the higher part of the studio to exhaust the warmest air and cut down the effect of a roof space at a high temperature. The return air can be recirculated or thrown to waste automatically depending on weather conditions.

The technical areas consist of the sound control room, vision control room, apparatus room, and maintenance areas associated with each studio, also telecine areas, dimmer rooms, transformer rooms, and central apparatus room. In all these areas electronic equipment has to be cooled and the technical areas kept at a comfortable working temperature. Care has to be exercised in distributing large volumes of air without draughts in restricted areas full of equipment, all with reasonable sound levels. The passage of sound between the various areas is taken care of by the positioning of grilles and the layout and lining of the service air ducts with acoustic material.

The offices, restaurant, and dressing-rooms are dealt with in a conventional manner, care being taken to prevent the spread of odours in the last two cases.

Generally five ventilation plant rooms are in service, one for each of the large studios, two serving the technical areas associated with the studios, and the fifth serving the dubbing theatre. This was done to economize ductwork and to enable stable conditions to be maintained in the various areas, each having diverse ventilating loads. This results in studios and technical areas being separately ventilated and the normal working areas also are subdivided as mentioned above.

In densely populated areas a high proportion of recirculated air is undesirable, due mainly to the evaporation of moisture from the human body and the possibility of spreading infection and odours.

In the case of the studios and technical areas, the air volume for cooling, due to the heavy technical heat emission and lighting loads, is greatly in excess of normal standards and thus a high degree of recirculation can be used still maintaining a very good quantity of fresh air per hour for the occupants. This high degree of recirculation enables the scale of the air-heating plant to be reduced, as the electric power dissipated as heat is used to temper the incoming fresh air when required.

Arrangements have been made to make the operation of these systems as automatic as possible and compressed-air controls are used throughout. Indicating thermometers are fitted in the plant rooms to enable the attendant to read air temperatures at various points in the system and in the occupied areas. Static pressure controls governing the studio air supplies are also provided.

Heating and Hot-water Services

The boiler plant is centralized in one boiler house and consists of two cast-iron sectional boilers each rated at 1,982,000 B.Th.U.s per hour, with fully automatic oil-burning equipment for use with 200-seconds oil.

These boilers deal with all the heating and hot-water service requirements in the winter, and in the summer there is a small gas boiler to take over the summer load for domestic hot water. The duplicate calorifiers providing the hot-water storage for domestic purposes are housed in the ventilating plant room immediately over the boiler house, forming a compact unit. This also permits a gravity circulation without using the pumps in the summer. The heating installation served from the boilers consists mainly of cast-iron radiators except in the canteen, where specially designed convector units incorporated with the seating arrangements were used.

The distribution mains were run at high level in corridors to avoid the construction of expensive floor ducts and every effort has been made to eliminate pipework from studio and technical areas. Thermostatic control in the form of motorized valves and room thermostats has been provided to control the room temperature in selected areas, viz. technical areas and dressing-rooms, which are also ventilated.

Compressed-air Services

A twin-cylinder compressor electrically driven and water-cooled, capable of 100 c.f.m. at 70 lb. per square inch, is sited in an out-building remote from the studio and

serves a general-purpose compressed-air distribution system. Special care was taken to ensure the removal of moisture and foreign matter from the air supply and instantaneous-type couplings were fitted at the supply points.

Gas Services

Gas services are also provided for the studio 'effects' purposes. Special precautions were taken in the form of armoured flexible hoses for studio use to guard against mechanical damage which could easily occur in a television studio during a production.

Fire Prevention

Fire prevention installations are normal CO_2 equipment in technical areas on account of the electrical equipment and the normal sprinkler system in studios and elsewhere.

Fire-warning devices are also incorporated in air ductwork to give warning of local temperature rise and fire-dampers to L.C.C. approval have also been fitted. The exhaust air from the telecine area has been separately dealt with as a precaution to avoid the possible spread of fire through the main ventilation ducts throughout this portion of the building.

APPENDIX II

Contributed by
ALEXANDER BROWN, D.A.(Edin.), A.R.I.B.A.,
Building Department, BBC Engineering Division

Riverside Studios, Acoustic Treatment and Soundproofing

At the outset it was obvious that the sound insulation value of the roofs of Studio R1 would be very low, and some investigation was, therefore, made into this and into the type of ambient noise level to be expected over the site. British European Airways had intended to make the proposed helicopter service between Waterloo and the London Air Terminal follow a route along the river. This would have been likely to produce high noise levels in the studios, as measurements of helicopter noise made by the BBC's Research Department showed. Fortunately, however, the river route was replanned by B.E.A. to by-pass the large bend at Hammersmith and the problem resolved itself. Aircraft and river traffic, nevertheless, still presented a problem. It was not practicable to suspend a ceiling inside the studios because of the vast amount of unrelated steelwork, and measures to improve the sound insulation were, therefore, designed as an external treatment to the roof. These were subsequently abandoned on grounds of cost. This decision could be termed a 'calculated risk', which, so far, has been justified in practice, as no serious complaints have been received from the users. The sound insulation of the studios to the outside must nevertheless be classed as sub-standard.

The two studios are divided by an original party wall consisting of two leaves of 4-in. clinker blocks with a cavity of 4 in. The insulation of this wall was measured and found to be 59 dB average. This is an unusually high value for this form of construction, probably owing to the large cavity, the acoustic deadness of the two adjoining studios, the large area of the walls, and the absence of connecting ties between them.

It was required to form a new opening in this wall between the two studios without reducing the insulation. Two pairs of doors were fitted giving a 10-ft by 12-ft opening. Each of these doors is 5-in. thick and weighs 11 lb. per sq. ft. The construction is shown in the attached sketch, Fig. 9. Special care was taken to secure a good seal at all edges of the doors.

Acoustically the studios were typical of those used for filming. Applied treatment to the walls and ceilings consisted of 2-in. thick rockwool mats fixed to battens covering almost all of the available area. The result of this type of treatment is usually a very dead acoustic condition with a downward slope at high frequencies and a steep rise in the bass. The measured curves for both studios (see Fig. 10) were as expected except that, probably due to the poor insulation of the roof, the rise in reverberation at bass frequencies was not very pronounced. The volumes of Studios R1 and R2 are 214,000 ft³ and 146,000 ft³ respectively. From experience at Lime Grove and elsewhere optimum reverberation times for various enclosures have been plotted for television purposes. The optimum reverberation time for Studio R1 is 0·80 secs. and for Studio R2 is 0·70 secs. In Studio R2 it was decided to introduce some further absorption at bass frequencies by means of membrane absorbers. These consist of a bitumen-felt membrane over an air space damped with rockwool, their absorption characteristic being very much higher than rockwool at low frequencies. At the same time these units have little absorption value at high frequencies and this would tend to level the curve. The measured values after treatment are shown in Fig. 10. This curve is very slightly higher than the optimum, and this is borne out

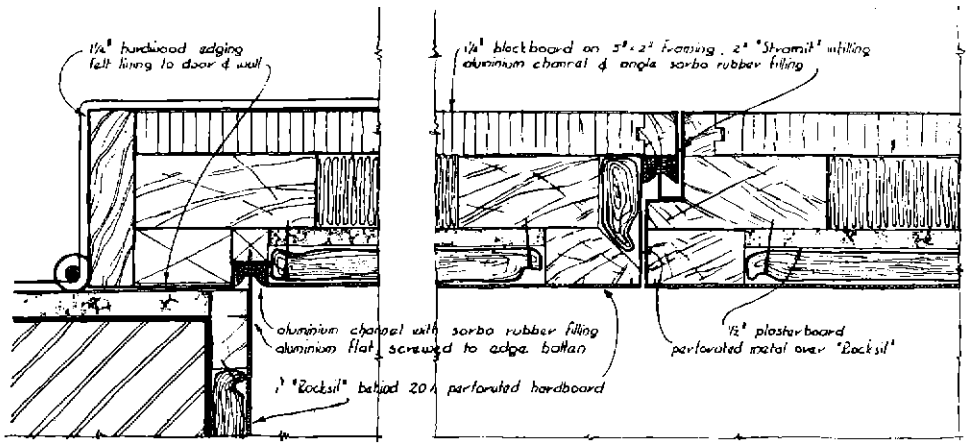


Fig. 9 — Detail of soundproof door between studios R1 and R2

by the experience of the users since the studio was put into service. Measures are being considered to effect this slight reduction. It is intended to introduce some further bass absorption in Studio R1. This will be in the form of double-sided membrane absorbers, and will be hung, as all the available wall space has been used. Bearing in mind the foregoing slight reservations regarding the acoustics of the studios, it should be said that both have been used for very ambitious productions, and have been found eminently satisfactory. The small modifications which have been proposed are in the nature of 'final tuning'.

The original 'sound-stage' in the premises is at present in use as a dubbing theatre. The existing acoustic treatment is flamboyant in the extreme, consisting of 'poly-cylindrical diffusers' fixed irregularly on the walls. There is no applied porous material and the result is the curious curve shown in Fig. 10. In order to satisfy the needs of the Television Service it will be necessary to add some bass absorption, and a considerable amount of absorption tuned to 3,000 c/s. The studio control rooms have been treated with perforated-metal tray-tiles on the ceilings, and porous and membrane type absorbents on the walls covered with slotted hardboard. All these areas have been designed for a flat curve, and the average measured reverberation time of the sound control room to Studio R2, which is typical, is 0·43 secs.

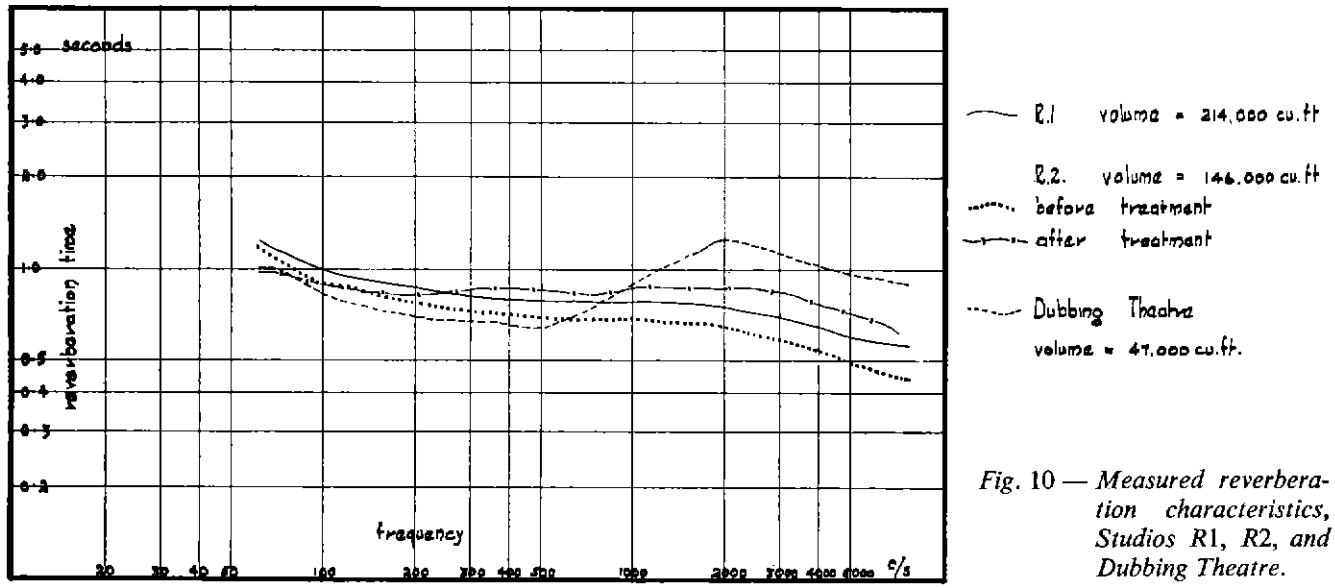


Fig. 10 — Measured reverberation characteristics, Studios R1, R2, and Dubbing Theatre.

Published by the British Broadcasting Corporation, 35 Marylebone High Street, London, W.1
Printed on Basingwerk Parchment in Times New Roman by The Broadwater Press Ltd, Welwyn Garden City, Herts. *No. 3628*