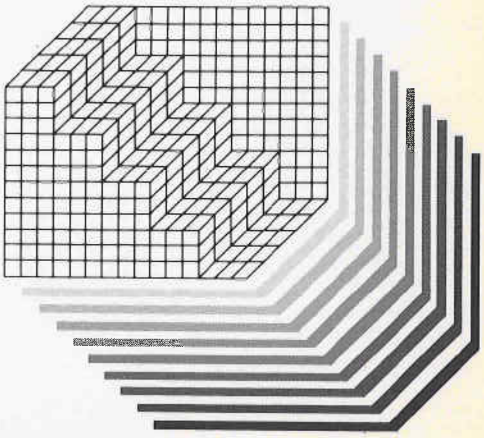
Patterns 4



Patterns 4

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Building Services Ten Years On

The fourth issue of "Patterns" celebrates Buro Happold's tenth anniversary as consultant building services engineers. During these ten years the building services group has grown steadily and can now look back on a diverse array of successfully completed projects, some of which have been described in previous issues of Patterns.

The practice entered into the field of building services engineering because it was believed that for many projects there would be a gain in the quality of engineering achieved from the presentation of a total engineering service. The design of most building projects is led by architects, and engineering follows architecture. However, engineering considerations influence architecture, and good buildings result from a design which coordinates and optimises the requirements of form, function and planning with structural effectiveness and economy, environmental comfort and control, efficient energy use of building fabric, and durability and maintainability. The architecture should respect engineering efficiency and economy, and the engineering should be appropriate to the architectural solution selected to fulfill the client's aspirations. We hoped therefore that the bringing together of all the principle engineering disciplines under one umbrella would enable a more effective and less fragmented engineering response to be made at the important early stages of a design when principles are being established, and that this would lead to better coordination throughout each project.

Early days in building services

Buro Happold's first full UK project as building services engineers was the competition winning scheme for the new Sainsbury Hall of Residence at Worcester College, Oxford (Ref 1.1). However, early projects in the UK were relatively small. We began working for Bath City Council on a variety of small refurbishment and reservicing commissions. One such early commission was the control of condensation in the East Roman Bath, where dripping of condensation water from the roof on to the floor was creating both a hazard and a nuisance to visitors to the Roman Baths. After environmental and fabric study, a scheme was chosen combining ceiling insulation with enhanced ventilation, which resulted in both removal of the hazard and improvement in air quality.

The building services group has since worked regularly for Bath City Council on housing, it's civic buildings and historic monuments. Among recent projects, the new visitor flow and refurbishment scheme at the Roman Baths was completed earlier this year (Ref 1.2), the new 42 unit sheltered accommodation at Durley Park is now on site (Fig 1.1), the refurbishment of council flats at Kingsmead has just been tendered, and the refurbishment of the Assembly Rooms will be tendered later in 1988.

The impetus to the early growth of the building services group was largely provided by overseas projects, initially that of the National Museum of Archaeology, Amman (Ref 1.3), and widening to include the Diplomatic Club, Riyadh in 1981. A competition was held by the Riyadh Development Authority for the design of the Diplomatic Club, and Buro Happold were the structural and building services engineering members to the winning team (Ref 1.4). The success of this project led to a number of further commissions as structural and building services engineers by the Riyadh Development Authority, the most notable being the Riyadh City Centre redevelopment, and the new Riyadh City Mosque and Justice Palace which are at present on site. In Kuwait, the first phase of the Fintas residential development has recently been completed (Ref 1.5).

Diversity of Involvement

In the last seven years the balance of workload has shifted gradually to a predominance of commissions at home in the UK. The range of work currently being undertaken in Britain by the building services group is wide, ranging from

Fig 1.1 Sheltered accommodation at Durley Park, Bath

Fig 1.2 Fleet Velmead Infants School, Hampshire

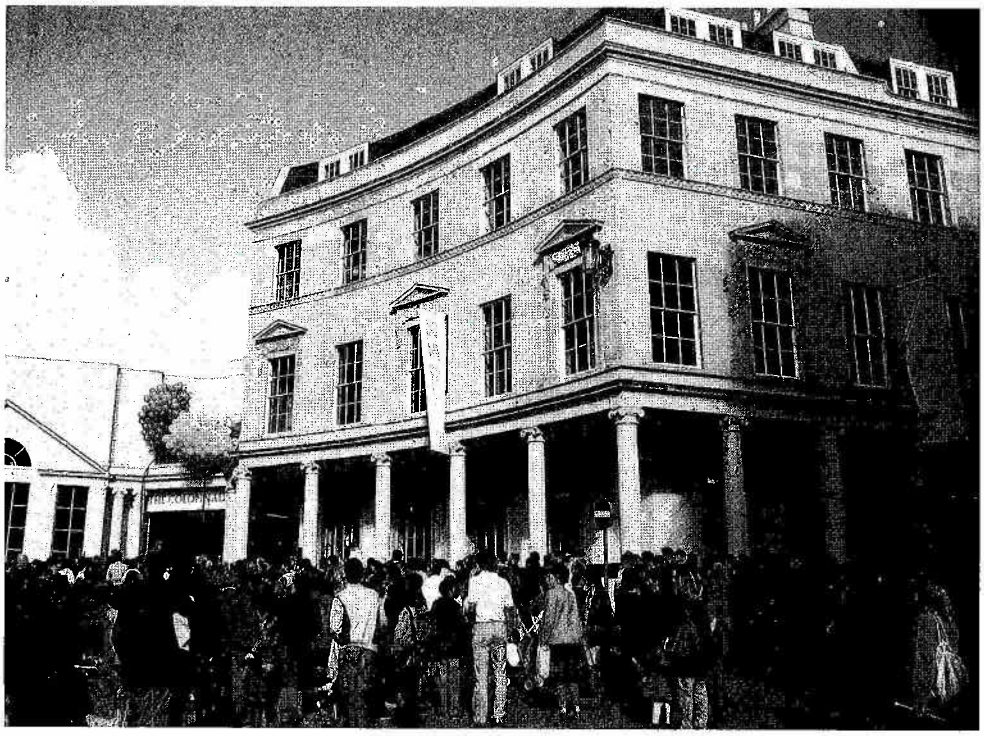

Fig 1.3 Bath Street "Colonnades" shopping development, Bath

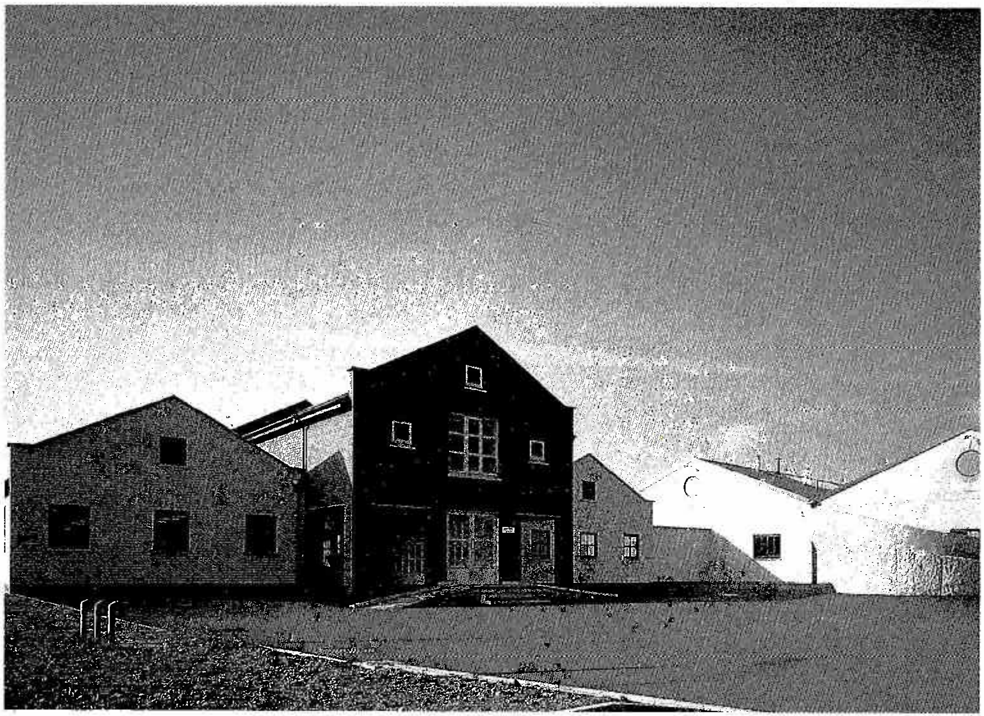

Fig 1.5 Offices and workshop for Radiodetection, Bristol

Fig 1.4 Canutes Pavilion, Ocean Village, Southampton

shopping and offices, housing and education, to leisure and tourism, refurbishment and industrial, and spans both public and private sectors. In the field of education one of the early commissions was that of the nine class infant school at Fleet Velmead for Hampshire County Council (Fig 1.2). The shopping centre redevelopment at Horsham is now on site, and the Bath Street "Colonnades" shopping development in Bath city centre (Fig 1.3) has just opened. The redevelopment of the ferry dock at Southampton, now called Ocean Village, with mixed use of retail, commercial, residential, marine and leisure, has been progressing steadily in phases for nearly four years now, and continues (Ref 1.6) (Fig 1.4). On the leisure front, in London, the new Greenwich Cinema complex is now on site, the Royal Britain Exhibition has been recently opened at the Barbican and the new Kensington Odeon mixed cinema, residential and office development is at the design stage. The Shakespeare Globe Theatre at Bankside is due to be tendered early next year, as is Buckingham Hotel in Kensington and Chelsea (Ref 1.7). On the industrial side, the research and laboratory facilities for Radiodetection in Bristol were opened this year (Fig 1.5), the new assembly facility for Solid State Logic has just been completed (Ref 1.8), as has the new warehousing facility for Schwarzkopf.

Development of specialist skills

During the past ten years the group has developed additional specialist skills to meet project needs. These include such skills as lift engineering, fire engineering, acoustics, lighting and building physics. It would be wrong to state a priority of importance of these skills, because specific projects have their own priorities. Building physics is important in establishing the overall concept of a building design by looking at the way a building envelope and its fabric does, or can be made to, respond to the external environment and to its mode of use. Notable applications of building physics by the group have been the study for a covered township in Alberta, Canada, the Diplomatic Club, Riyadh, the Archaeological Museum, Amman and the atrium of Buckingham Gate, London.

Lighting work has included the Grand Mosque, Riyadh, the lighting design brief for the National Gallery, London, the Islamic Medical Centre, Kuwait (Ref 1.9) (Fig 1.6), the Archaeological Museum, Amman and the Katharine Hamnett retail outlet in London (Fig 1.7).

Acoustic work has included the proposal for the new base of the Halle Orchestra in the Manchester Refuge Building, the Leeds Playhouse competition (Ref 1.10), the Islamic Medical Centre, Kuwait, the Grand Mosque, Riyadh and the Assembly Rooms in Bath.

To complement the structural fire engineering service developed under Mick Green, the building services group has developed skills in fire engineering systems to cope with the complex problems associated with atria, covered town centres, hotels and buildings with significant public risk.

For the future the aim of the building services group is very much the same as it's initial aim — good engineering contributing to good buildings, except that it now has a past on which to build.

Terry Ealey

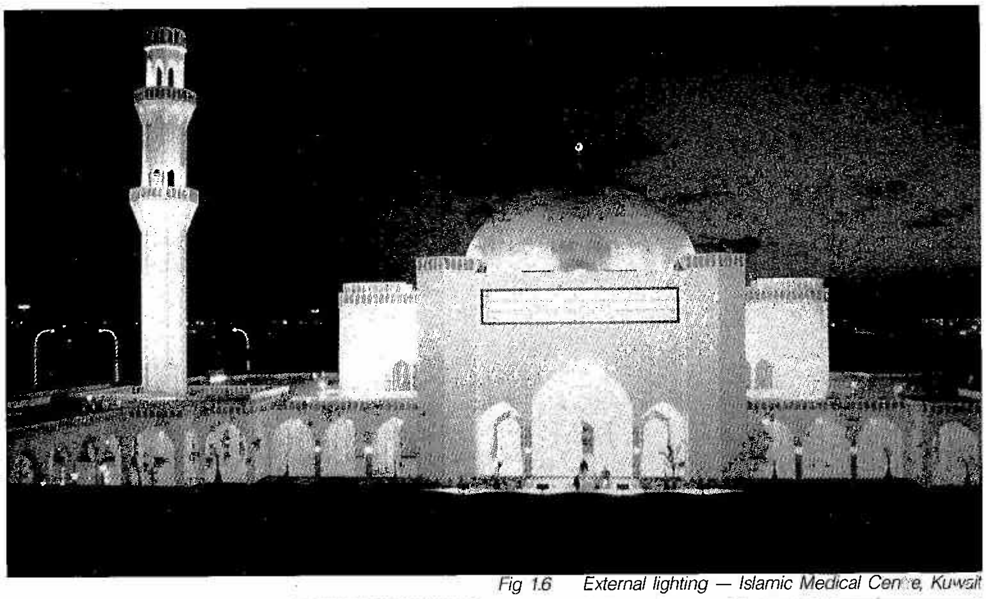

Fig 1.6 External lighting — Islamic Medical Centre, Kuwait

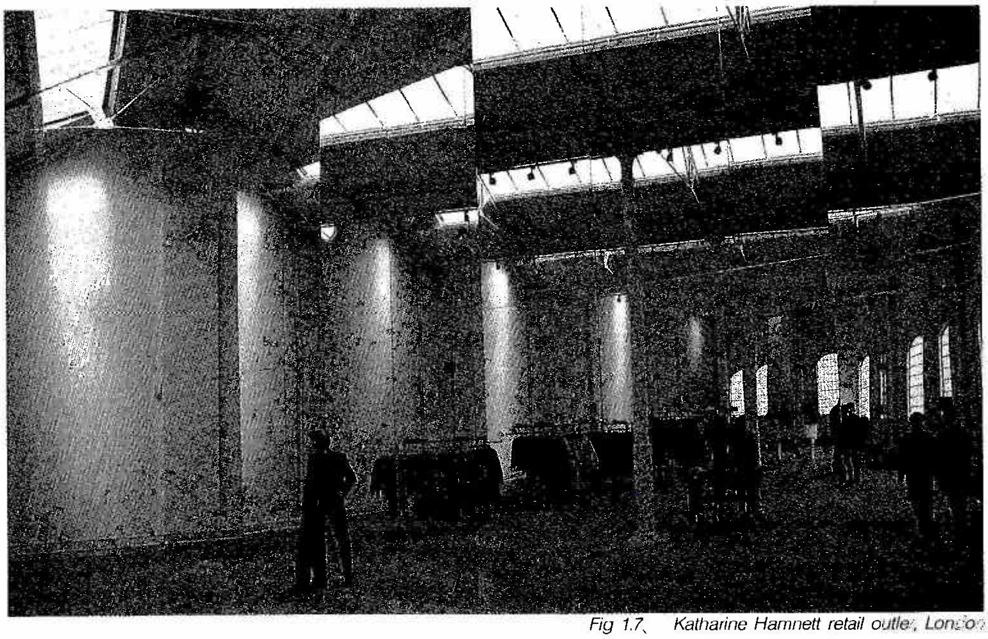

Fig 1.7 Katharine Hamnett retail outlet, London

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1.1 Macdonald R. "An extension to Worcester College, Oxford" Patterns 2 pp 4–7

1.2 McLaughlin A. "Improvements to visitors' facilities for Pump Room and Roman Baths Museum, Bath" Patterns 4 pp 5–7

1.3 Dickson M. and Shaw M. "National Museum of Archaeology, Amman" Patterns 1 pp 13–14

1.4 Ealey T. et al "Diplomatic Club, Riyadh" Patterns 1 pp 20–24

1.5 Corbett M. "Residential Complex in Fintas, Kuwait" Patterns 4 pp 15–17

1.6 Macdonald R. et al "Ocean Village — Regeneration of Princess Alexandra Dock, Southampton" Patterns 3 pp 15–19

1.7 Brooke P. "Buckingham Hotel — Renovation in Kensington, London" Patterns 4 pp 23–28

1.8 Moseley P. "Solid State Logic — new facilities at Begbroke, Oxford" Patterns 4 pp 10–14

1.9 Morrison J. and Ealey T. "The Al Marzook Centre for Islamic Medicine, Kuwait" Patterns 1 pp 8–9

1.10 Dickson M. and Moseley P. "The Theatre as a Built Form" Patterns 3 pp 20–24

Improvements to Visitors' Facilities for Pump Room and Roman Baths Museum, Bath

Project Data

Client	Bath City Council (Estates Department)
Architects	Feilden Clegg Design
Feasibility Study and Design Consultants	Robin Wade Design Associates
Services Engineers	Buro Happold
Structural Engineers	Buro Happold
Quantity Surveyors	Bare, Leaning and Bare
General Contractor	J Long & Sons Ltd
Cost	£1m
Completion Date	June 1988

The Roman Baths Museum and Pump Room complex in the centre of Bath provide a unique tourist attraction receiving 900,000 visitors per year — the country's second biggest historic attraction after the Tower of London (Fig 2.1). Over the last twenty years the Museum has seen a 400% increase in the number of visitors, and statistics tend to indicate that the increase will continue. The Museum and its activities are therefore the focus for Bath's vitally important tourist industry. This dramatic increase in visitor numbers, although welcomed, had put a heavy strain on the management of the complex. The diversity of activities taking place in the complex, and the restricted space available in the building, had steadily given rise to problems defined in the client design brief. These included the clashing of activities due to physical limitations of the building; the inadequacy of visitor services in meeting current requirements, giving rise to congestion and justifiable complaints; and the confusing routeing of visitors through the Pump Rooms and Museum facilities.

The responsibility for managing and maintaining the Museum lies with Bath City Council and its Department of Leisure and Tourism. In early 1986 Robin Wade Design Associates (RWDA) were appointed to investigate and prepare a report on how the complex could be reorganised to clear these problems. Initial considerations were given to additional buildings at first floor level in the SW corner, but although presenting a much improved situation, this proved too costly to implement. The decision was therefore taken that all reorganisation had to be within the limits of the existing spaces.

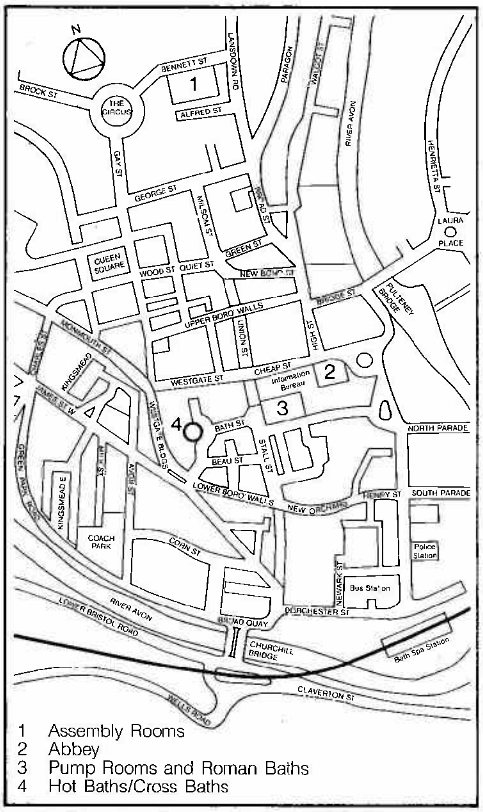


Fig 2.1 Location plan of Roman Baths/Pump Rooms complex within historic centre of Bath

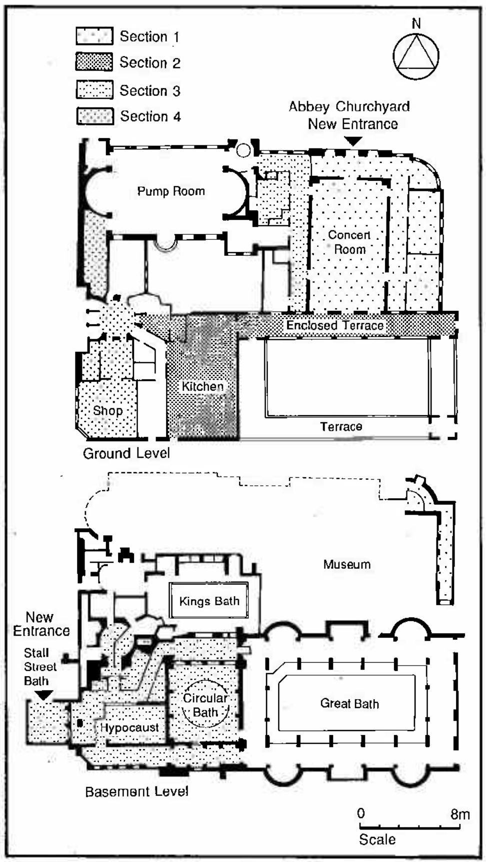


Fig 2.2 Plan of the complex showing final work phases

Feasibility Study and Design Proposals

It was at this point that Buro Happold were invited to meet RWDA to discuss the services and structural engineering implications of the proposals. It was evident from this initial meeting that the proposed brief was fraught with complexities. One particularly onerous condition of the contract was that the work was to be carried out whilst the Pump Room and Museum remained open, at least in part, to the public. This was an especially exacting requirement as these rooms are open 364 days a year from 9am to 7pm, with functions often taking place in the Pump Room till late.

The RWDA/BH report was completed in July 1986 and costed at just under £1 million. It was presented to and accepted by the City Council with the instruction to proceed to tender as soon as possible. The Bath architectural practice, Feilden Clegg Design, were appointed to progress the architectural design work, with RWDA remaining as consultants.

Survey and programming of works

The design team's first objective was to programme the work into sections which would allow the contractor to work in cordoned off areas, whilst the remainder of the complex remained open to the public. This programming ran in parallel with a services and structural survey of the building. The amount of detail which could be obtained from the survey was limited. Record drawings were non existent and access to the majority of voids and shafts could only be achieved by 'breaking out' the finishes which, pre-contract, was unacceptable to the management of the complex. It later became obvious that the success of such a refurbishment contract lies in the depth of detail recorded in the preliminary survey. In this case, at the risk of being unpopular during the pre-contractual stage, more emphasis should have been put on tracing the routes of services even if it had involved limited disruption. Programming and surveying were then combined to define the four work sections of the contract (Fig 2.2).

In May 1987 the contract was awarded to the contracting firm, J Long & Sons Ltd, the mechanical and electrical sub-contract going to Multiheat (Bristol) and J Long & Sons Ltd Electrical respectively.

Alterations to Concert Room

Work started in June 1987, the first section being the formation of a new entrance off Abbey Churchyard into the Concert Room. This Concert Room, which had previously been the Four Seasons restaurant, was to become the new visitors' reception and ticket sales area (Fig 2.3). The room was cleaned and painted, the floor repaired and a grid of floor outlet boxes installed which contained outlets for power, 'clean earth' circuits for computerised tills, data and telephone lines. These outlets would supply sales kiosks, specially designed by RWDA, which could be unplugged and pushed back to clear the floor when necessary, for functions and parties.

Lighting of the room was designed to emphasise the highly ornate, vaulted ceiling, whilst at floor level concealed low voltage spots on track were used to focus attention on the main ticket counter at the southern end of the room. The existing chandeliers were rewired and cleaned. The movable kiosks were lit by small integral low voltage spots adding sparkle to the room. The use of dimmer control on certain circuits

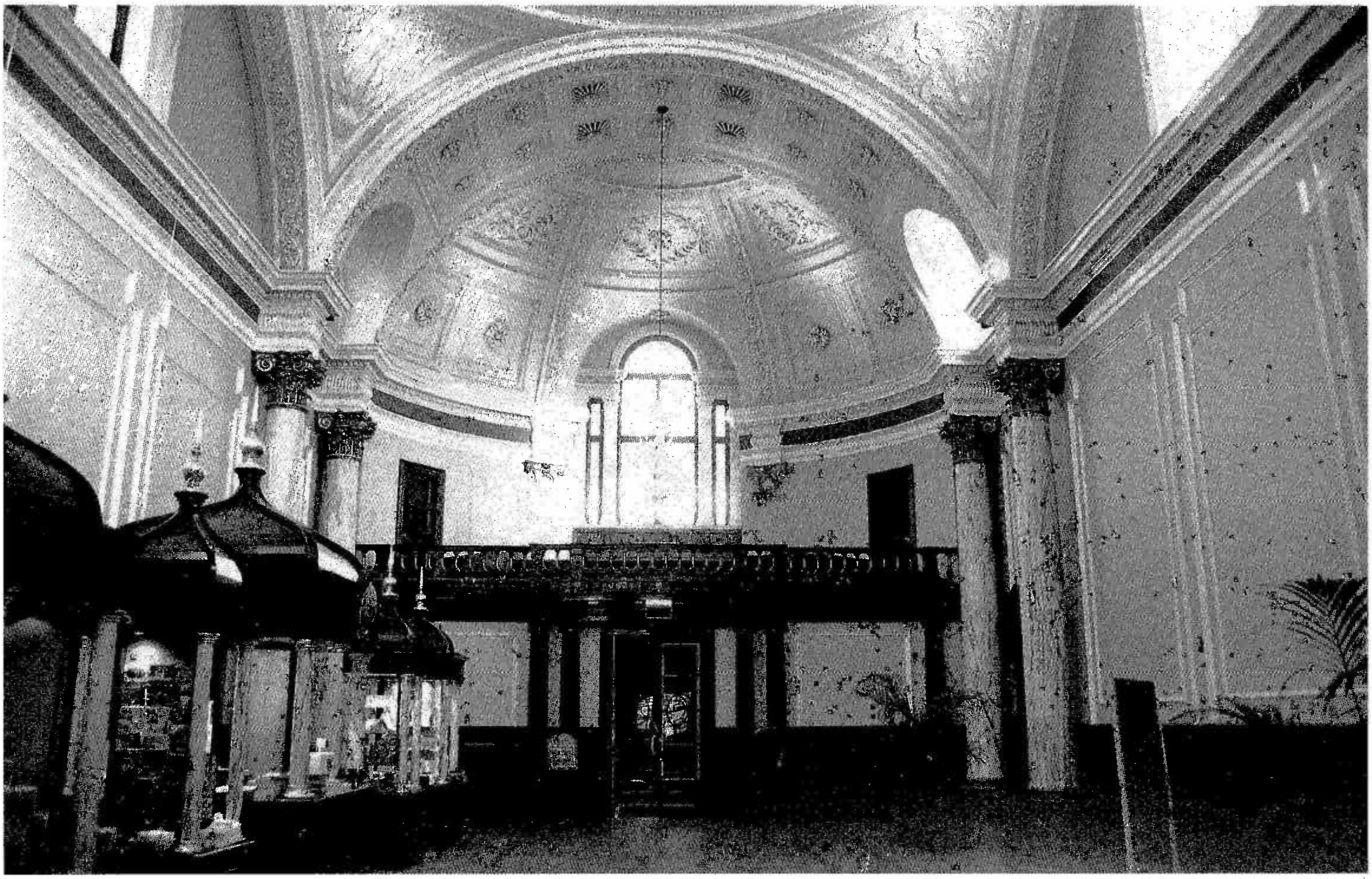


Fig 2.3 Interior view of refurbished Concert Room

allowed variation to the lighting theme, so catering for the various functions which the room hosted.

In the north corridor structural repairs were carried out to strengthen the floor.
A grillage of beams was inserted under the slab, but was complicated by the fact that below lay the complex's main boiler room — fully fitted with pipes and ductwork.

It was in this first phase of work that all the forward planning and programming fell foul of the hidden secrets of the buildings. Asbestos lagging was found on an extensive network of old heating pipes in the voids under the Concert Room and directly over the Museum. In consultation with the City's Environmental Health Officer, a contract was immediately drawn up for the removal of the lagging by a specialist company. In order to accomplish this the main body of the Museum had to be closed to the public for six weeks, visitors being restricted to the lower ground level Baths at that time.

In parallel with the Concert Room works, the adjacent male toilets were refurbished at basement level.

Provision of Improved Catering Facilities

The second phase of work involved refurbishment of the main kitchen and enclosed Terrace overlooking the Great Bath, and the provision of new booking and management offices. Catering in the building is geared to both the servicing of visitors to the Museum and to functions in the Pump Room. The kitchen refurbishment was extensive and involved major structural alterations and a complete rewiring and piping of services.

For economical reasons the only equipment retained was the hot water plant serving the kitchen, and the main extract canopy which could be incorporated in the new kitchen scheme. New drainage lines were run under the kitchen slab, and over the Roman Circular Bath below. The kitchen was fully fitted, and all equipment and services installed. The drain pipes however just protruded through the slab to the area below which lay within the third phase of work. Literally overnight the contractor moved down, erected scaffold over the Circular Bath, and installed the remainder of the drainage. The kitchen was then handed over for operation.

Refurbishment of Roman Remains

Section three of the work had moved the contractor to basement, or Roman level, where the Cold Circular Bath was no longer to remain open to the Great Bath, but be restored to its original enclosed form (Fig 2.4). Natural light was excluded, with artificial lighting provided from lamps in each

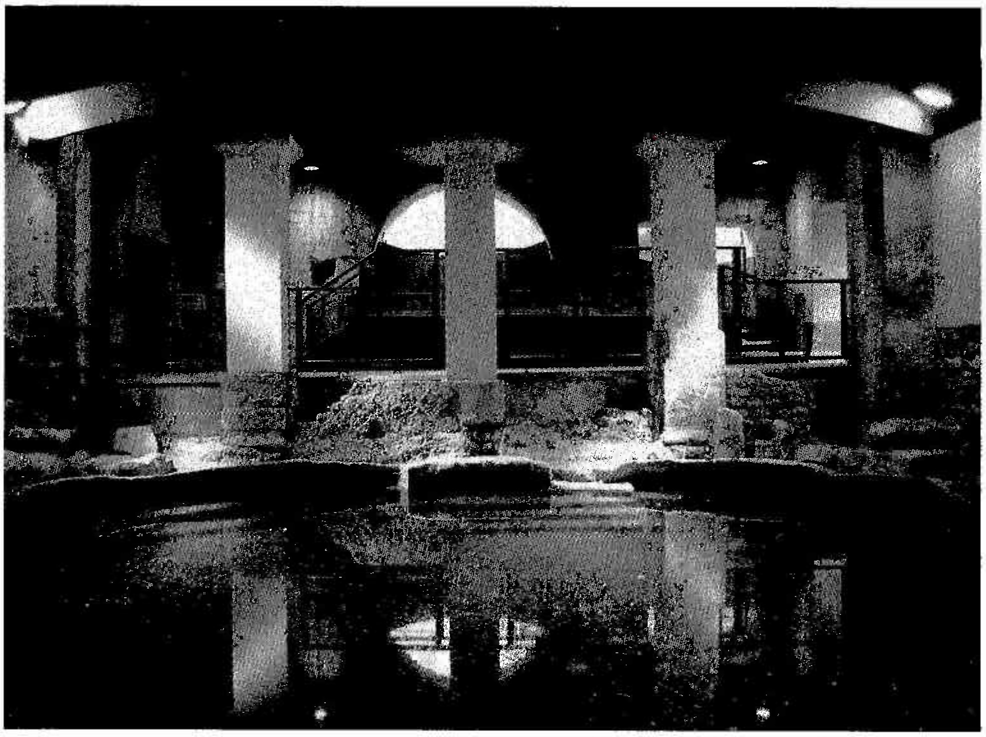


Fig 2.4 Newly enclosed Roman Circular Bath

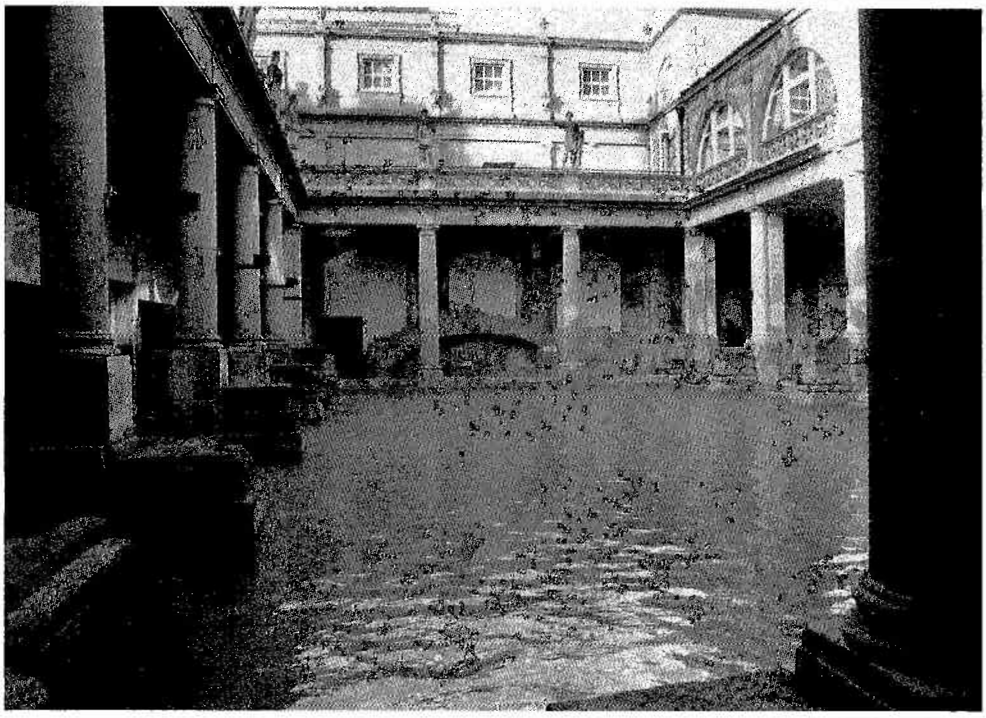


Fig 2.5 Great Bath, surrounded by high level Victorian terrace

corner of the room, hidden behind the new vaulted curved baffles. Metal halide lamps were chosen to create the appropriate cool atmosphere. Viewing to the Hypocaust adjacent to the Circular Bath was reorganised, this area being re-wired and relit using low voltage narrow beam spots at high level. The Museum Directors were keen that the lighting should not distract the attention of visitors from the remains, and that the lighting effect would not be theatrical.

New female and male toilets were provided at mezzanine level together with female, disabled and VIP toilets close the the Concert Room.

For the Museum Directors and their staff one of the highlights of the refurbishment was the opening to the public of a 'new' Roman swimming pool under Stall Street. The viewing gallery around the hypocaust was extended to take the public up to the edge of the pool. The opening of this bath marked the end of the great process of discovery and exposure which had begun in the City more than 100 years ago. However, the displaying of the pool to public view necessarily broke the boundary of the heated building which was then resealed with full height viewing windows, heated at the base to keep the glass clear of condensation.

The final section of the work included refurbishment of Mementos, the complex's shop, provision of a new servery adjacent to the Pump Room, and the opening of the high level terrace around the Great Bath so that, for the first time, visitors could walk around the four sides of the Victorian terrace to view the Great Bath below (Fig 2.5). The Great Bath itself required no alterations apart from the ceiling under the terrace which was strengthened and 're-roofed' to conceal the array of services which had previously been run on the surface.

The complex was officially re-opened in July 1988 by John Lee MP, Minister of Tourism. Improvements had been successfully carried out in phases permitting rapid occupation by the client on the completion of each phase. The complex consequently remained available to the public throughout the duration of the project, albeit to the background chorus of contractors' hammers and drills.

Tony McLaughlin

New Office Development at Focal Point, Swindon

Project Data

Client	London & Manchester Insurance Company Limited in association with Peter Long
Architects	Architect Drew in association with Wyvern Partnership
Services Engineers	Buro Happold
Structural Engineers	Buro Happold
Quantity Surveyors	Scott and Partners
Main Contractor	Espley—Tyas Construction Limited
Building Area	4400m²
Cost	£2,000,000
Completion Date	1985

In recent years Swindon has maintained an aggressive policy of expansion, attracting new business to provide increased employment opportunity. The policy has been very successful in the development of business parks and industrial units on the outskirts of the town, leading in turn to the regeneration of much of the central town. Among many new office developments is Focal Point, located close to the town's central railway station (Fig 3.1).

The developers' intention for the site had originally been to redevelop the tired area of housing in Fleet Street. However, lengthy legal proceedings with such a fragmented area of land eventually led this to be abandoned. An office/shopping complex, Focal Point, was proposed as the alternative.

The brief was simple, requiring a speculative office development of 4200m² with 200m² of shopping at ground level, but limited to five storeys in height, and to be completed within the client's budget of £2m. The commission was therefore not one that needed to extend the boundaries of technology but one that needed competent and considered design to produce a building that would appeal to potential tenants and be readily let. Many buildings are of this type and are nonetheless a challenge to the skills of the designer, and particularly the engineer.

Environmental Appraisal

The initial concept for this compact site was that of a square, air conditioned, framed building. The first reaction was to question the reasons for air conditioning and the assumed massing of the building. Consequently alternative building forms were considered with the architects, the objective of the exercise being to provide an energy efficient building of simple yet rational form, keeping systems and maintenance to a minimum. Firstly a study of the optimum plan form and orientation was undertaken, to achieve good daylight quality throughout the office spaces. The alternatives of a square building with a central light shaft, a linear building, an 'L' shaped building and a 'U' shaped building were considered. The most effective was that of a 'U' shape which, when orientated to the sun path, provided maximum, sunlight and daylight throughout the year to the whole of the floor area (Fig 3.2).

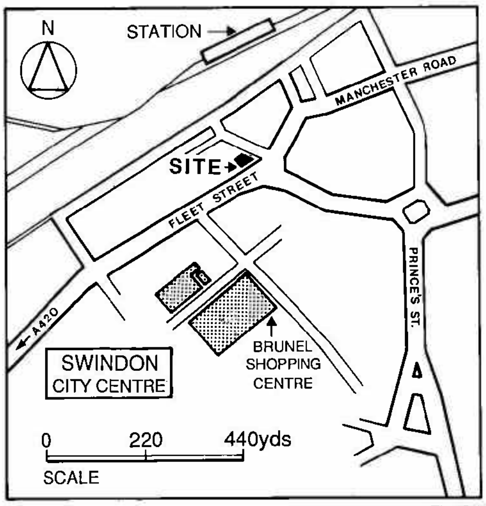


Fig 3.1
Location of Focal Point site within Swindon city centre

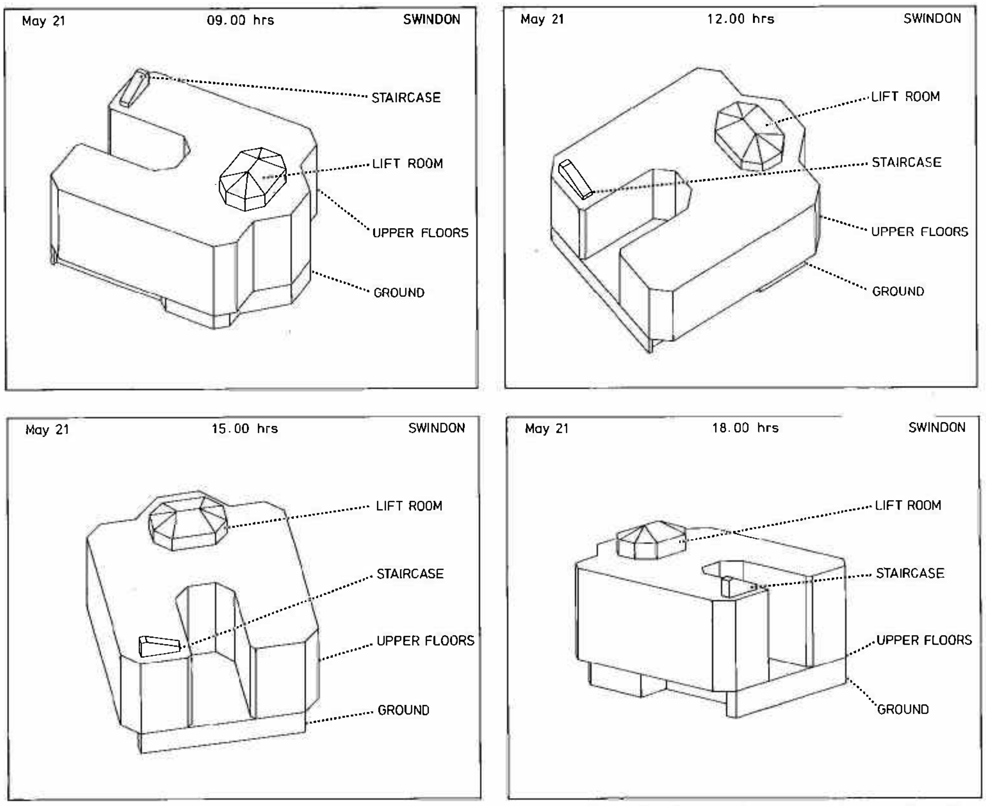


Fig 3.2 "Sun's eye" diagrams during month of May

Measured values in the completed building later demonstrated that daylight figures in excess of 4% were achieved in all office areas. Air conditioning was eliminated on the grounds of a potentially increased building cost, together with high operational running costs, the need to use valuable floor area for plant rooms, and the additional height requirements necessary for distribution. There were no external noise or pollution problems and the client had not requested high heat producing equipment within the offices.

Heating would be by natural convector perimeter system, and ventilation was to be natural with opening windows for cross flow. All plant was located at ground level for easy maintenance. The space occupied by plant represented approximately 0.5% of the total lettable area. Had air conditioning been installed this demand for plant space would have increased to around 5% and added height on the building. Following a favourable response from the client, detail design proceeded on the basis of the report.

Design of Building Services

To permit maximum flexibility in the letting of the office space, control systems and metering were based on a minimum sublet of one half of a floor. Heating was to be communal with a standard charge being made to tenants on an area basis, whilst electrical supplies were to be sub-metered. Zone heating control was achieved by thermostatically controlled diverting valves for each half floor. Total installed boiler capacity was 250KW, equivalent to 60W/m², using 50KW gas fired modular boilers supplying a low temperature perimeter system. System control has optimum start and zone over-ride controls to allow extension times for each half floor beyond the normal shut down time (Fig 3.3). Hot water for WC areas is generated locally by electric water heaters.

Office lighting is arranged to suit the planning grid

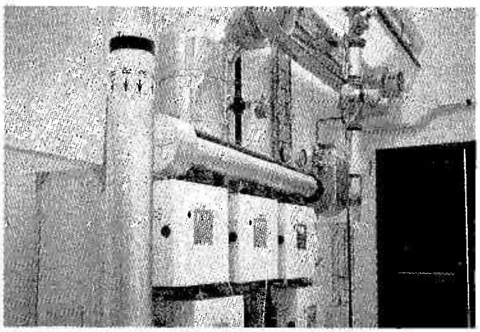


Fig 3.3 Plant in ground floor boiler room

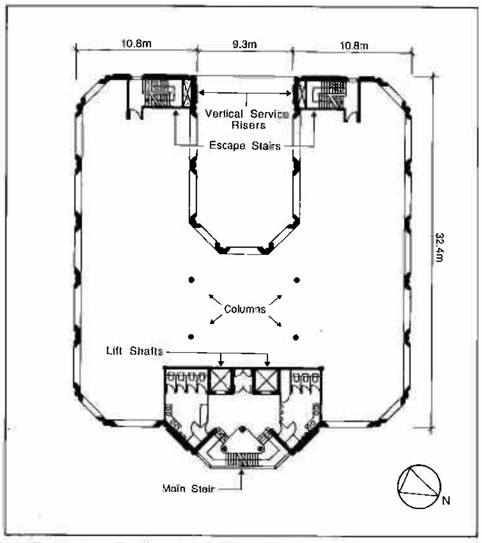


Fig 3.4 Typical floor plan showing column free space

using 600 × 600mm recessed modules with two 40W 'U' tubes per fitting. A lighting level of 500 Lux was obtained with fittings on a 1.8 × 1.8m grid. For the main entrance and impressive glazed staircase a fluorescent tube system, following the profile of the rising staircase, was selected.

A raised floor system with cable trunking beneath was installed to provide power, data and telephone outlets on a regular 2.7 × 2.7m grid over all office spaces. Each box provided 50% excess on cable length between trunking and box to allow for flexibility in future planning.

Structural Design

The preconception of a column free office space was not difficult to achieve using a traditional concrete framed structure. Columns were located around the periphery of the 'U' with main beams spanning from one side of the office to the other (Figs 3.4, 3.5). They in turn supported secondary beams at third points to enable the floor slab thickness to be reduced. Stair and lift shaft cores provided overall stability and foundations were piled. Whilst pad footings were equally viable, piling was selected to control the possible differential settlement that could occur with pad footings, and being an open framed building with precast cladding, a limitation on differential movement was considered desirable. One corner of the building was also traversed by an optic fibre cable, and piling enabled foundations to be installed well away from the cable.

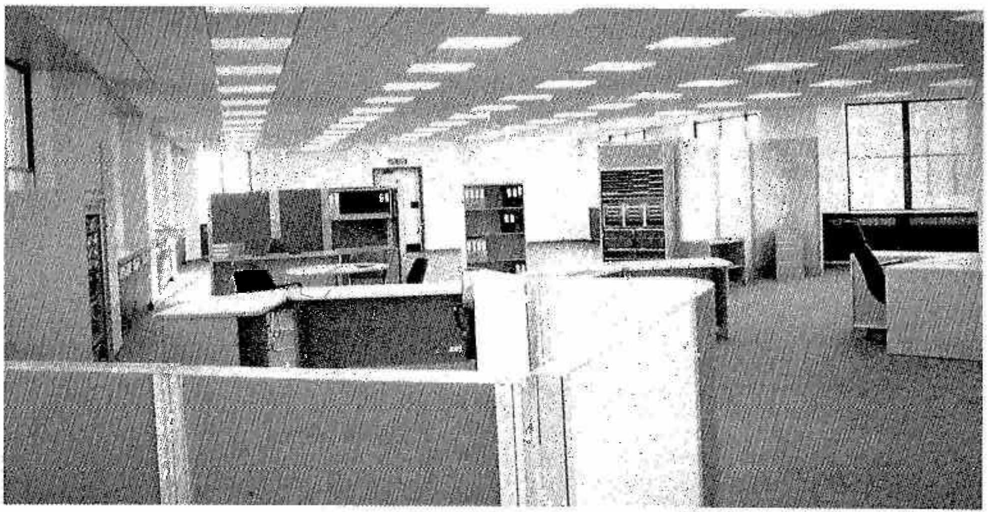


Fig 3.5 Interior view of office space


Fig 3.6 Elevation of completed building

The building when tendered was contracted marginally under the £2,000,000 target price and successfully constructed to programme, although regrettably the contractor went into liquidation only a few weeks before handover. Final completion was delayed as a result (Fig 3.6), and the completed building was fully let to Allied Dunbar. Whilst remaining a standard development of its type, engineering design of the plan form, energy efficiency, and maximisation of lettable area of the building have contributed to the overall success of the development.

Tony McLaughlin and Peter Buckthorp

Solid State Logic — New Facilities at Begbroke, Oxford

Project Data

Client	Colin Saunders (Chairman SSL)
Architects	Michael Hopkins and Partners
Services Engineers	Buro Happold
Structural Engineers	Buro Happold
Quantity Surveyors	Davis Langdon & Everest
Management Contractor	Walter Lawrence Project Management
Concrete Works Contractor	Talon Construction
Steelworks (Roof) Contractor	Space Deck Ltd
Mechanical Contractor	Alden Heating
Electrical Contractor	Drake & Scull
Building Area	3500m²
Date	September 1988

Solid State Logic are a 'high technology' company who, under the leadership of their chairman Colin Saunders, now hold a major share of the world's market for design and construction of recording studio consoles. Indeed, they received a Queen's Award for Export Achievement in the same year (1987) as we ourselves did. The company now employs in excess of 250 people throughout management, design, research and development, production, manufacturing and testing, together with sales, commissioning and after-sales service.

In 1986, just prior to the purchase of the company by the electronics group UEI, SSL had decided to concentrate their entire design, manufacturing and marketing operation at Begbroke Convent just outside Oxford, on the A34 to Stratford. The convent is a converted Victorian country house with substantial, if run down, orchards and grounds. The brief called for the design of an elegant modern pavilion as befitting a "brain firm" — neither office block nor factory — into which the total process of design and production of the consoles could be concentrated. In this way the existing stores, assembly and testing facilities at Witney could be brought together on one site with other departments while reception, sales, marketing and administration were to remain housed nearby in the old convent.

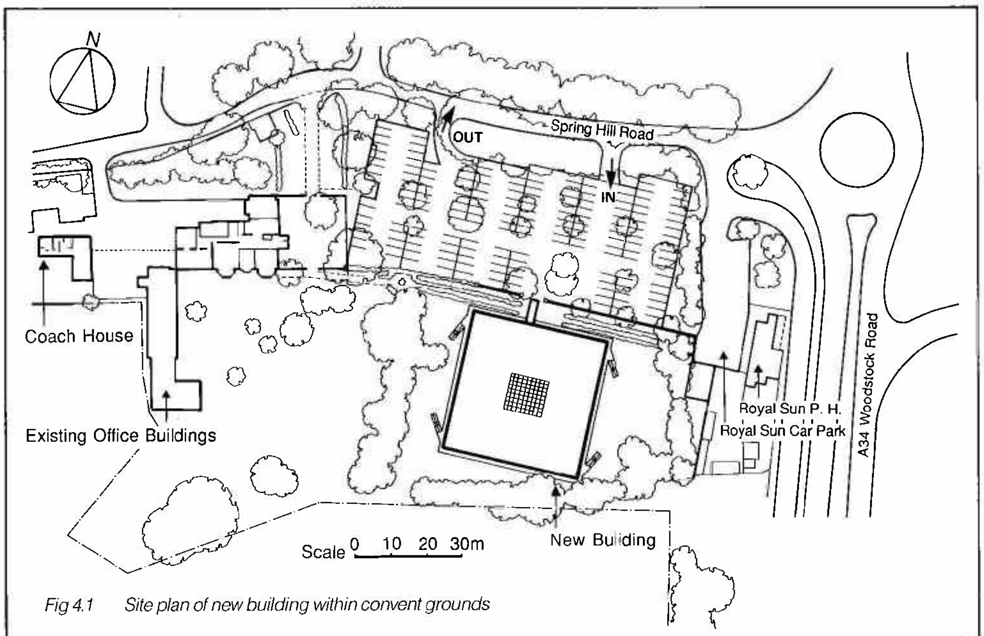


Fig 4.1 Site plan of new building within convent grounds

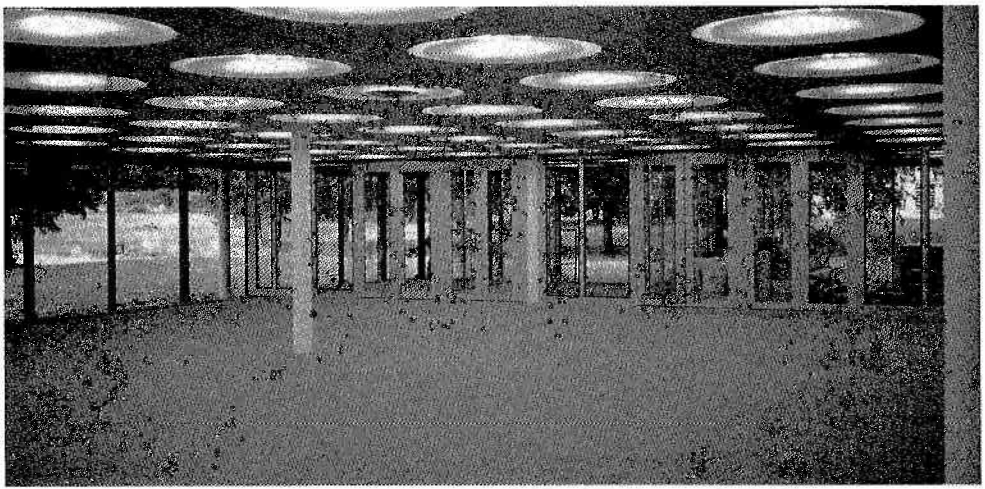


Fig 4.2 Coffer lighting and full height glazing on ground floor

Early Considerations

Essential to planning requirements was that the new building, while modern, should make minimum impact on the predominantly stone constructions of Begbroke village. It had to merge into the landscape, even though its aspirations were certainly modern.

The first designs in 1986 were for a series of linear buildings placed behind the landscaped car park and existing garden wall. However, with the consequently high wall-to-floor ratio of this design it would have been difficult to achieve a high standard of external construction within the project budget.

When work recommenced in 1987 after takeover by UEI, the building developed its final square plan form on two storeys. Discreetly surrounded on three sides by existing mature trees, it is approached via a rustic car park through a gap in the 4m high stone garden wall (Fig 4.1).

The new building is separated from the old house by the "country park" style gravel and landscaped car park accommodating 150 cars, and houses the manufacturing part of the operation on the ground floor with the related design, research and development functions being carried out at first floor level. Ground and first floors are linked visually by the central naturally light atrium.

Full height glazing to the perimeter of both floors enables views, albeit through 'moderating' blinds, of the surrounding Oxfordshire countryside from everywhere in the complex (Fig 4.2).

Within the client's fixed building budget, 3500m² of usable space is provided in the two-storey building. At it's centre is a naturally light atrium, 11.6m square, linking the 40.8m square ground floor by means of a diagonally placed metal and glass stairway to the larger first floor. This first floor overhangs the ground floor on the outside by 1.8m and with the central atrium forms a 17.6m wide square 'doughnut', supported on simple 219mm diameter fire-protected steel columns on a 7.2m × 7.2m grid. A fairfaced off-white in-situ moulded concrete slab 375mm thick provides a permanent lightly sandblasted gridded soffit on a 1.8m module, for the ceiling to the ground floor and also supports the raised service floor. The heavily insulated flat roof to the first floor, and over the atrium, is provided by an elegant modification to the standard Space Deck roof, supported off 192mm diameter steel columns on a 14.4m grid. Cantilevering of this structure from the first floor achieves lateral stability.

Reflecting the close co-operation necessary

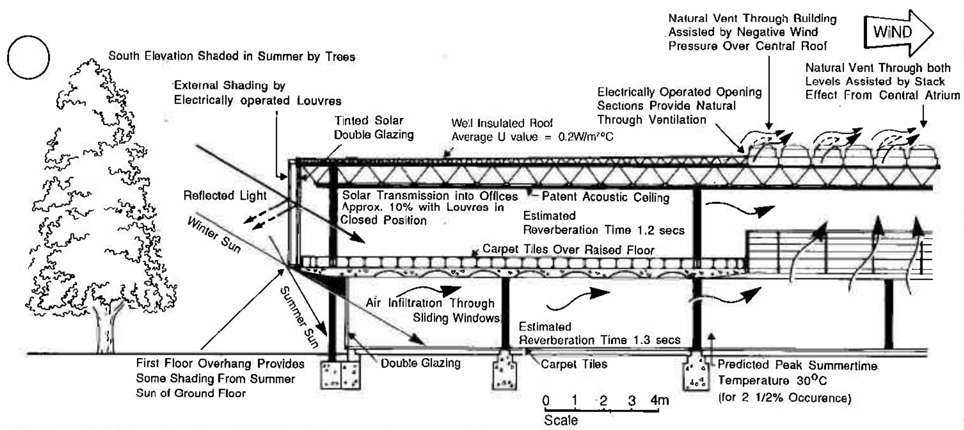


Fig 4.3 Solid State Logic — section displaying building physics

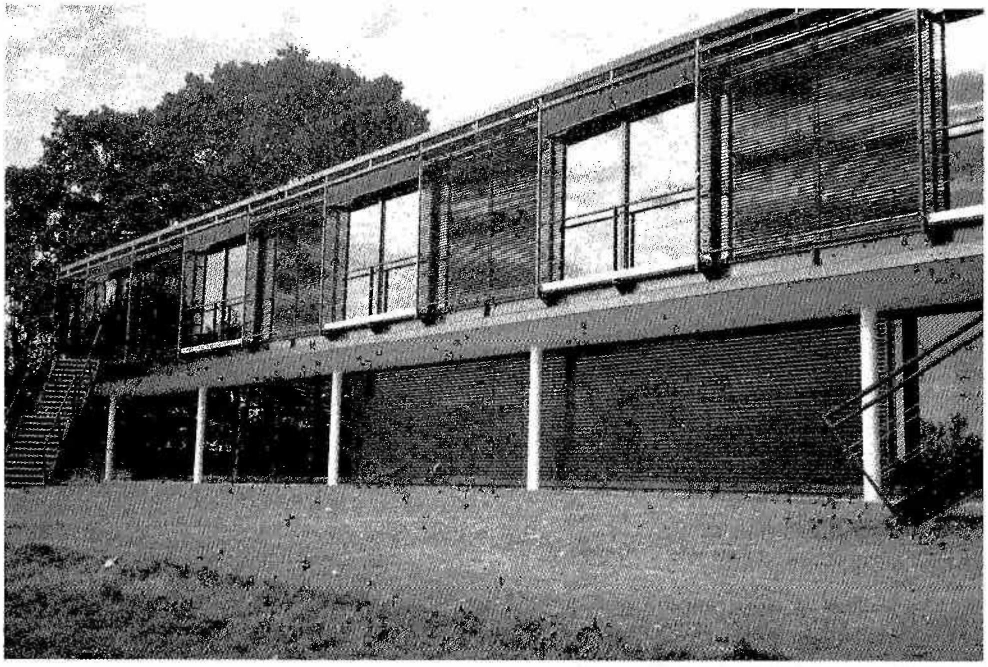


Fig 4.4 Alternate banks of external blinds to first floor

throughout the project, the structural engineers strove to keep the structural concepts simple but elegant in order to concentrate on co-ordination of service holes and routes. An example of such collaboration across disciplines is displayed in the use of the solid partitions, which provided the necessary sound insulation to the two plantrooms, as reinforced cores in order to produce lateral stability and stiffness to the first floor. Similar levels of enthusiasm and collaboration were also necessary between the design team, the managing contractors and their works contractors to sustain the contract programme with elegance.

A Study of Building Physics

The overall square plan of the building produces the most thermally efficient shape for any given external envelope (Fig 4.3). The extensive use of full-height glazing to the elevations and transparent central rooflight accounts in part for the requirement of a highly insulated roof. The mean roof U-value of 0.2W/m^{2}K was achieved by laying tapered insulation to form the required drainage fall. The building meets the thermal requirements of Part L of the Building Regulations by use of Method 3 of the procedures (Ref 4.1). This allows trade-off in terms of heat loss between building components, unlike the traditional percentage glazing allowance of Methods 1 and 2.

The choice of tinted double glazing to the complete elevation of the building is determined by both visual and thermal parameters and the need to maintain a level of comfort appropriate to the usage of the building. In the visual sense the resulting direct communication with the rural environment is desirable, whilst the high illuminances from natural light (both sunlight and daylight) and radiant heat from solar radiation will offset heating and lighting costs at certain times of the year. These features maintain the sense of well-being and communication with the outside and together with good ventilation from the sliding windows helps occupants to feel comfortable at higher internal temperatures. Tinted glazing also provides a measure of confidentiality to the building.

Computer predictions of summertime temperatures were made with various configurations of glazing and shading. Recommendations based on the CIBSE Method (Ref 4.2) were that a tinted glazing and an external blind were required. The architect was keen to see an external blind system for aesthetic reasons. The outcome is a system of retractable and adjustable blinds to all elevations on the first floor, arranged in two alternate banks over fixed and sliding glazing (Fig 4.4). An internal horizontal blind with perforated louvres was selected below the rooflight to shade the central atrium (Fig 4.5). The ground floor was effectively shaded by the 1.2m overhang of the first floor, supplemented by further shading from the adjacent trees (Fig 4.6). The result is that mean summertime temperatures are estimated at 25–27°C with peak temperatures of 29–30°C according to extent of ventilation.

Control of the external louvres is automatic according to solar intensity with full manual override of each bank. A seven-day programmer is included to allow a regular schedule to be followed and all blinds are automatically retracted at 8.00am each day to avoid that 'morning after' look!

Natural ventilation is well catered for by means of sliding glazing to approximately 50% of the elevations. Furthermore, one third of the 1.2 × 1.2m transparent rooflights are openable either manually or automatically in two banks in response to two internal temperture sensors at pre-set levels, and a rain sensor override. Battery operation allows an element of safety should a power failure and rain coincide.

Due to the depth of the building, central areas could potentially be devoid of daylight. A central void, formed by the omission of the first floor slab, links ground and first floors, and is covered by a system of transparent rooflights and blinds (Fig 4.7). The atrium and transparent rooflights allow light to penetrate the core of the building correcting any daylight imbalance reducing the contrast with the bright perimeter areas.

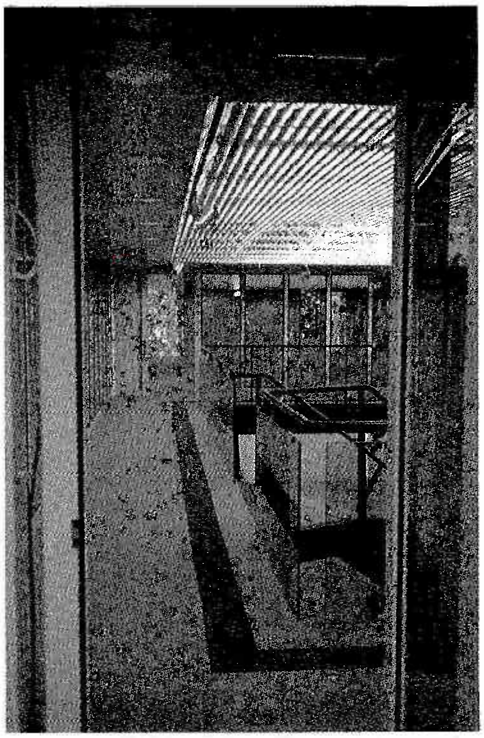


Fig 4.5 Perforated louvres over central atrium

Infrastructure Development

The early stages of the design included the provision of new utility services onto the site. Water, gas and telecom were already connected to the existing building with additional capacity available from the adjacent Woodstock Road. However, the 415V 3-phase overhead electricity supply from a distant pole-mounted transformer was operating at capacity and was unreliable. The large voltage fluctuations experienced caused problems with existing computer equipment. Power supply was improved by the provision of a new 11KV sub-station adjacent to the new building, supplying the whole site with an available capacity of 300KVA.

Furthermore, rainwater drainage in the area discharged into an overloaded culvert which often led to flooding of the area intended to be the new car park. The rainwater drainage culvert was upgraded, whilst a new foul drainage connection was taken through to the Woodstock Road sewer.

Design of Building Services

Both the nature of the company's operations and the architect's concept scheme required the design of building services within certain parameters. The relative heat losses between building components were at great variance, requiring heat input to be

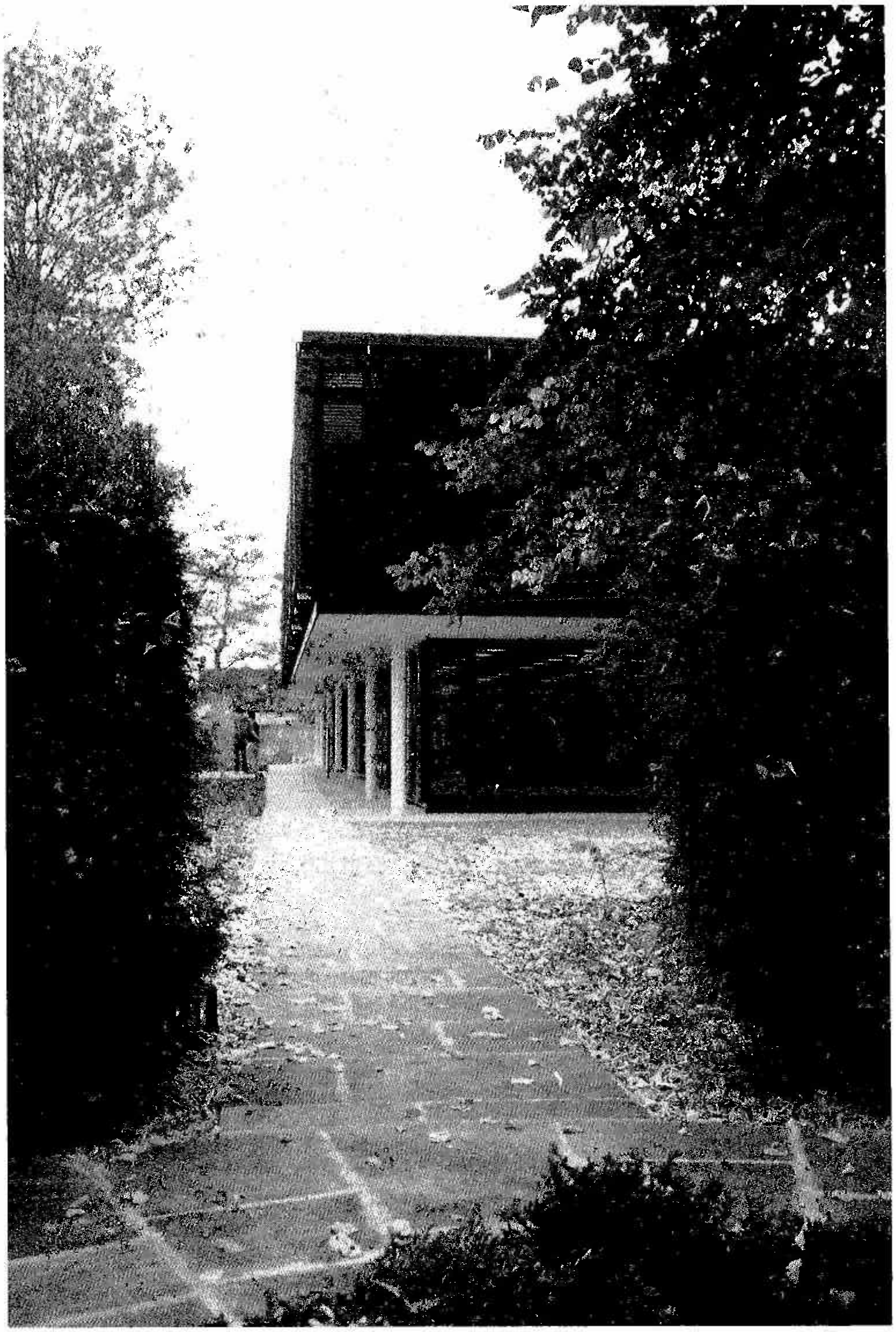


Fig 4.6 Overhanging first floor viewed from car park entrance

Fig 4.7 Naturally light central atrium, with diagonal metal stairway (M Charles)

biased towards those with the high rates, whilst a high mass element was desirable to dampen temperature swings. With such a deep plan building mechanical ventilation was necessary to maintain a good air change rate throughout. A good standard of artificial lighting was also required throughout, while local task lighting was to be provided by the client as part of the workstation furniture. Finally, surface treatments should, where possible, be acoustically absorptive to offset the reflective glazing element.

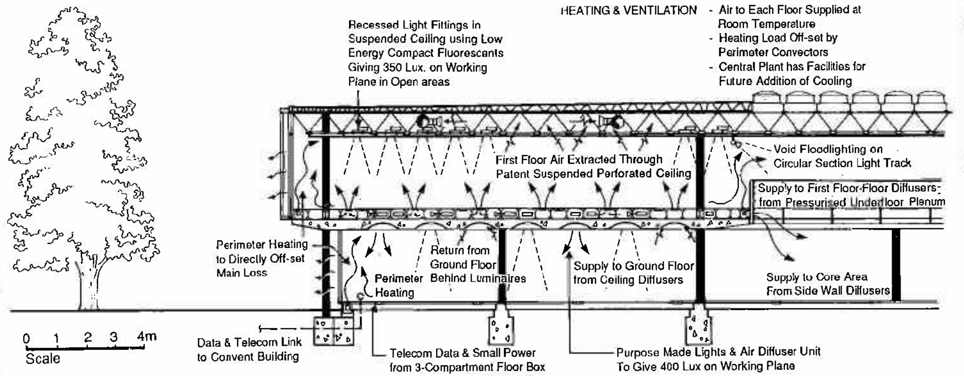


Fig 4.8 Solid State Logic — Servicing principles

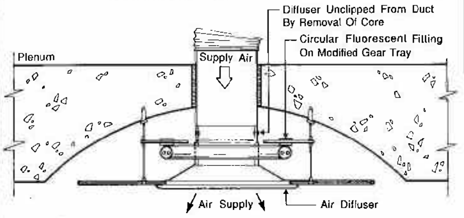


Fig 4.9a
Section through combined supply air diffuser and light fitting

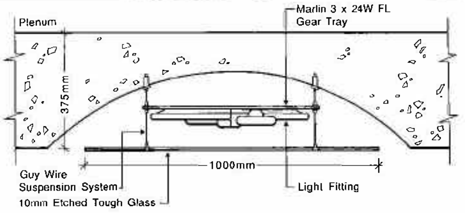


Fig 4.9b
Section through light fitting

The solution to several of these parameters is found in one major component — the first floor slab. This consists of an exposed white-concrete coffered slab with a full access raised floor above; no suspended ceiling is provided (Fig 4.8).

As well as providing a high quality architectural feature, the concrete slab serves as a heat sink whilst the 1.2m diameter coffers are the location for the purpose designed luminaires. The latter design, after site testing on a sample coffer slab, settled on a 1m diameter toughened glass disc, etched on one side, suspended by guy wires from anchors in the slab above. Fixed above the disc is a Marlin compact fluorescent gear tray with three 24W PL lamps, with emergency conversion packs where necessary. Illuminance levels from the completed installation measured on site gave an average of 600 Lux on the working plane. A variation on this luminaire occurs where air supply diffusers are required (Fig 4.9a,b). The latter are recessed into the glass disc and connected via clips to ductwork above, allowing a circular fluorescent fitting to be used around the ductwork connection.

First floor lighting is provided by efficient double Concorde 11W Pl downlighters recessed into the perforated metal ceiling tiles. Installed wattages are approximately 9W/m^2 for a measured working plane illuminance of 450 Lux. The perforated ceiling tiles allow air to be drawn into the ceiling plenum to the return ductwork within the spaceframe structure, whilst also providing acoustic absorption.

This access floor above the slab contains not only the lay-in 3-compartment electrical trunking but all supply and return ventilation ductwork to the ground floor, and supply ductwork to the first floor. The final height of the raised floor resulted from an exercise to determine the most economic use of this void in terms of mechanical and electrical systems distribution. This led to symmetrical ductwork layouts in plant rooms on opposite sides of the ground floor. Ground floor supply and return ductwork is connected directly to diffusers within luminaires and return bellmouths above the luminaires, located within the coffers. First floor supply air is discharged into the raised floor void as a plenum with Trox 'twist' floor grilles discharging air into the space.

Heating to the building is provided by convectors located within channels in the raised floor at the perimeter of the building and beneath the rooflights at first floor level, and in a concrete edge beam channel at ground floor level. In this way potential downdraughts, cold radiant effects and condensation problems have been directly offset. The heat source is provided by gas-fired low temperature hot water modular boilers serving two compensated heating circuits (with optimised start) to the north and south halves of the building, and the constant temperature circuits for air handling units.

Air handling plant supplies air at room temperature in the heating season, with a minimum of 15% fresh air. An enthalpy detector and modulating dampers allow use of free cooling as available in the warmer months. Facilities have been allowed for addition of comfort cooling to the building at a later date, with the lower limit on supply temperatures of 18°C being set by the nature of the first floor supply diffusers.

Electrical outlets on the first floor consist of Van Geel circular 3-compartment floor boxes connected to the in-floor trunking by means of flexible conduits, allowing easy repositioning of terminals. Ground floor outlets are located in a flush-floor trunking system within the screed. All data and telecom trunking systems are fed from a central incoming position which connects via a network of underground ducts to the existing hardware in the administration building. An existing standby generator was retained to provide emergency back-up.

Fire alarm equipment consists of smoke detectors in ceilings, return ductwork and plant rooms together with manual call points. In addition to normal plant shut-down, any alarm automatically opens all rooflights to safely vent the central atrium, a feature required by a cautious Fire Brigade.

Needless to say, the achievement of the desired standards of servicing, fittings and finishes within the client's fixed project budget required both intense but rewarding collaboration between the services and structural engineers and the architects.

Peter Moseley

References

4.1 DOE/Welsh Office
"Building Regulations 1985 — Approved Document L — Conservation of Fuel and Power L2/3 Procedure 3" 1985

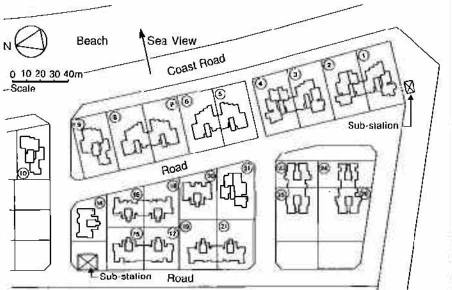
4.2 CIBSE
"CIBSE Guide Vol A Section A5 Thermal Response of Buildings — Summertime temperatures" 1979

4.3 Architects Journal "Pavilion in the Park — Solid State Logic HQ" AJ 26 October 1988 pp 37–63

Residential Complex in Fintas, Kuwait

Project Data

Client	Kuwait Real Estate Company
Architects (Kuwait)	Christopher Castelino Consultant
Services and Structural Engineers	Buro Happold
Local Engineering Office	OHA Consultant/MESC
Quantity Surveyors	Middle East Quantity Surveyors
Gross Building Area	46 800m²
Completion Date	Studio apartments completed June 1988, duplex and single level apartments on hold



Apartment Data

Type	Plots	No. Apartments	Area (m²)	Block
Duplex	1-10, 22	135	27000	A (Plots 1-4, B (Plots 5-10), C (Plot 22)
Single	14-21	78	14300	C
Studio	23-26	108	5500	D

Fig 5.1 Site plan of Fintas residential complex

In 1983, Kuwait Real Estate Company organised a concept study assessing potential for residential development of a package of land in the Fintas area of Kuwait. The study investigated possible apartment combinations with the aim of providing maximum rentable area balanced against adequate recreational facilities, offering a sea view to as many apartments as possible (Fig 5.1).

The layout chosen by the client divided the 23 buildings on the site into four blocks made up of a number of basic apartment types, including studio, single level and duplex apartments, repeated in various combinations. Block D, consisting of studio apartments, was completed in June 1988 (Fig 5.2).

Environmental Constraints on Design

Kuwait experiences severe summer climatic conditions. The average peak summer design conditions are 46°C dry bulb and 28°C wet bulb. In the late summer the air has a high moisture content and this necessitates a high degree of latent cooling. The daily temperature swing is 12°C. With this type of climate up to 70% of the energy consumption can be due to the air conditioning. These factors coupled with the economic boom of the early seventies in Kuwait, have led to the development by the Ministry of Electricity and Water (MEW) of an "Energy Conservation Programme". This requires the formal submission by building designers of data, calculations and drawings for proposed air conditioning, lighting, and electrical systems, as outlined in Table 5.1. Further criteria selected for water services in this particular residential development are given in Table 5.2.

Further submissions of drainage and structural drawings were also required, and a detailed design programme was developed to ensure submission dates to the relevant authorities were met. In this case the drawing production evolved around drawing submissions in preference to working drawings.

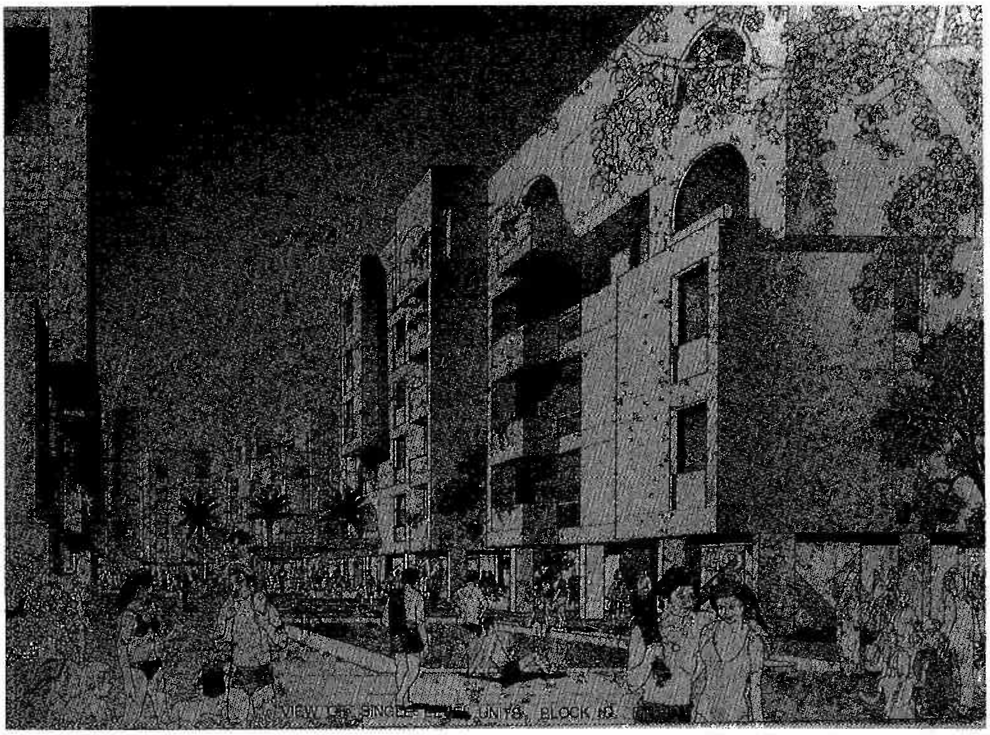


Fig 5.2 Model of Fintas development

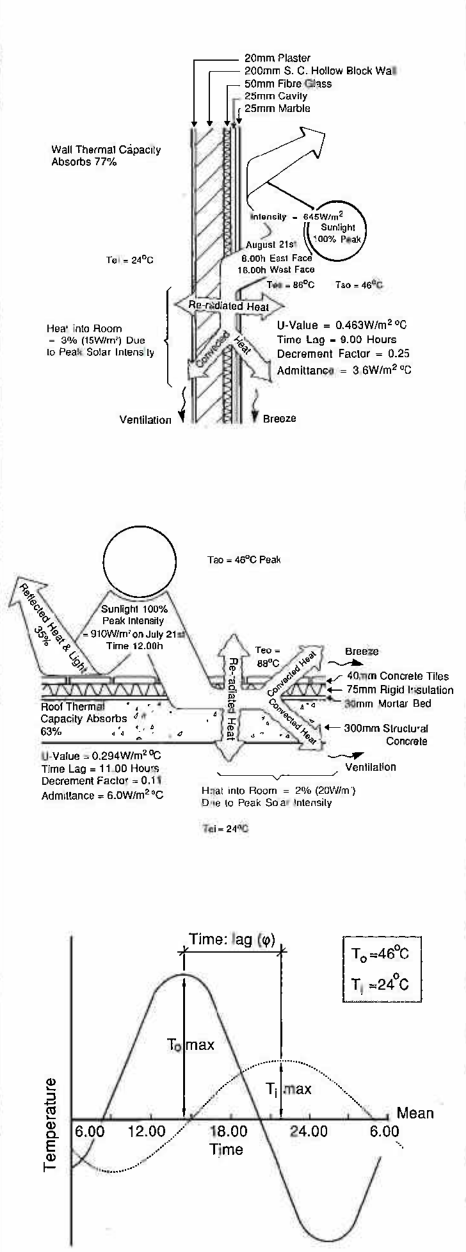
Table 5.1 **MEW Requirements for Residential Buildings (1985)**

Peak electrical load for A/C	—	65 watts/m² for air cooled systems
Peak electrical load for internal lighting	—	15 watts/m²
Maximum infiltration rate	—	1.0 change per hour
Maximum power utilisation factor for air cooled systems	—	2.0kW/ton of refrigeration
Maximum U values Wall	—	0.57W/m²°C
Roof	—	0.40W/m²°C
Glazing — 10% of the total wall area (colour and type to be specified)	—	Double glazing to be used

Minimum power factors are also specificed for various electrical appliances.

Table 5.2 **Water Services Design Criteria for Fintas Development**

Underground Cold Water Storage	—	870 US gallons per apartment
Roof mounted day tank Storage	—	150 US gallons per apartment
Hot Water Storage	—	20–30 US gallons per apartment (2 hours recovery period)



$$\text{Decrement factor : } \mu = \frac{T_i \text{ max}}{T_o \text{ max}}$$

Note ; a) Length of time lag depends on thermal capacity
b) Amount of heat flow depends on insulation

Fig 5.3 Heat flow and thermal data for construction

Design of Building Services

The harsh Kuwaiti climate necessitates the use of the fabric of the building to passively control the heat gains. The constructions used for the apartments are illustrated in Fig 5.3, an inverted construction being chosen for the roof. The concrete used produces a time lag delaying the heat reaching the inner surface, while the insulation produces a decrement factor reducing the intensity of the heat reaching the inner surface. The high thermal capacity of the walls and roof produce a heat sink to reduce the fluctuations in internal temperature. Light coloured pavers were laid on the roof top to reflect the solar radiation while the wall construction was chosen on similar principles. Cooling loads were calculated using the Ashrae method for residential buildings (Ref 5.1).

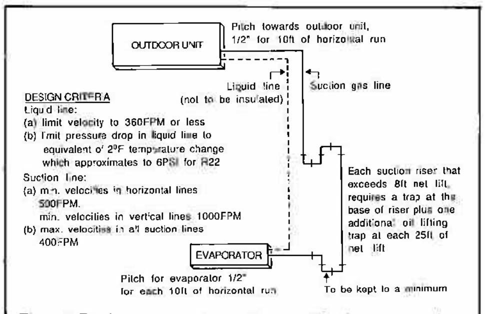


Fig 5.4 Design parameters – Air conditioning split systems

The initial proposal for the scheme design was to use roof mounted air cooled chillers on each block to serve fan coil units within the apartments, but this was rejected due to the high capital outlay and running costs for this type of installation. Instead a number of direct expansion systems are used to

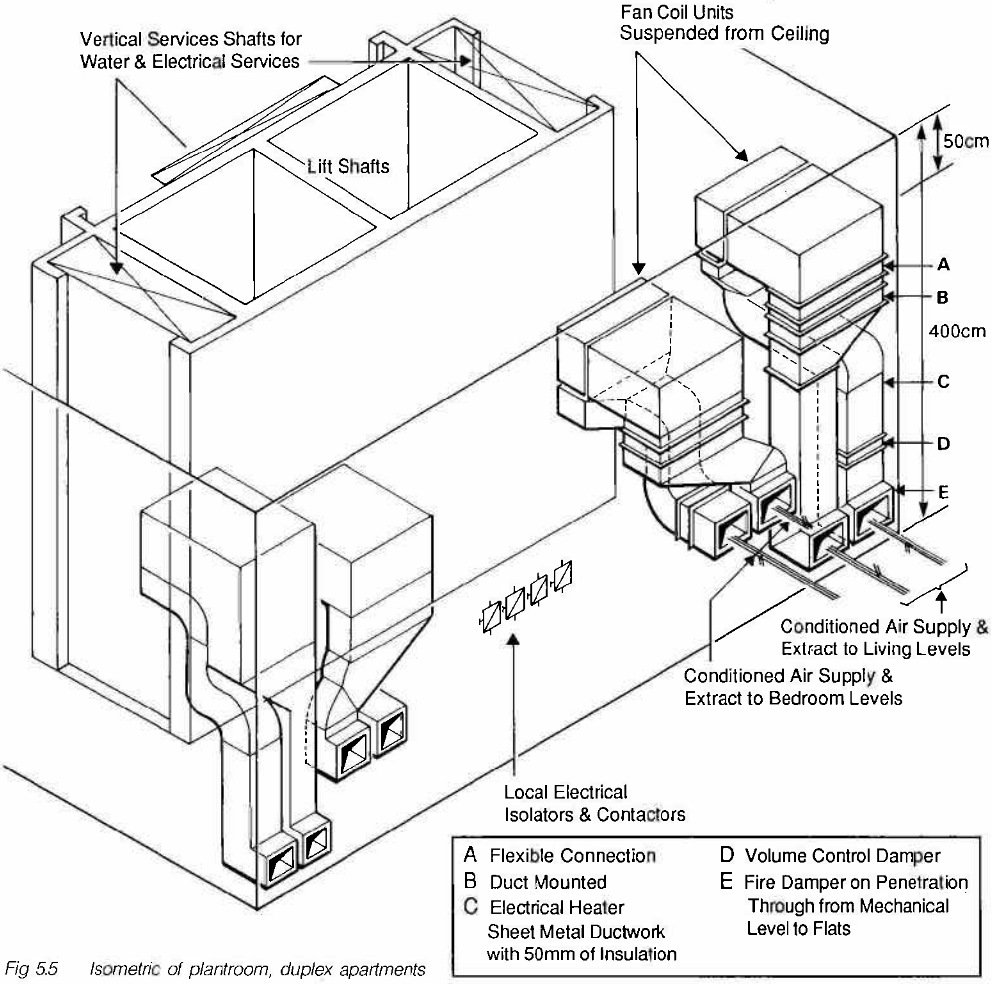


Fig 5.5 Isometric of plantroom, duplex apartments

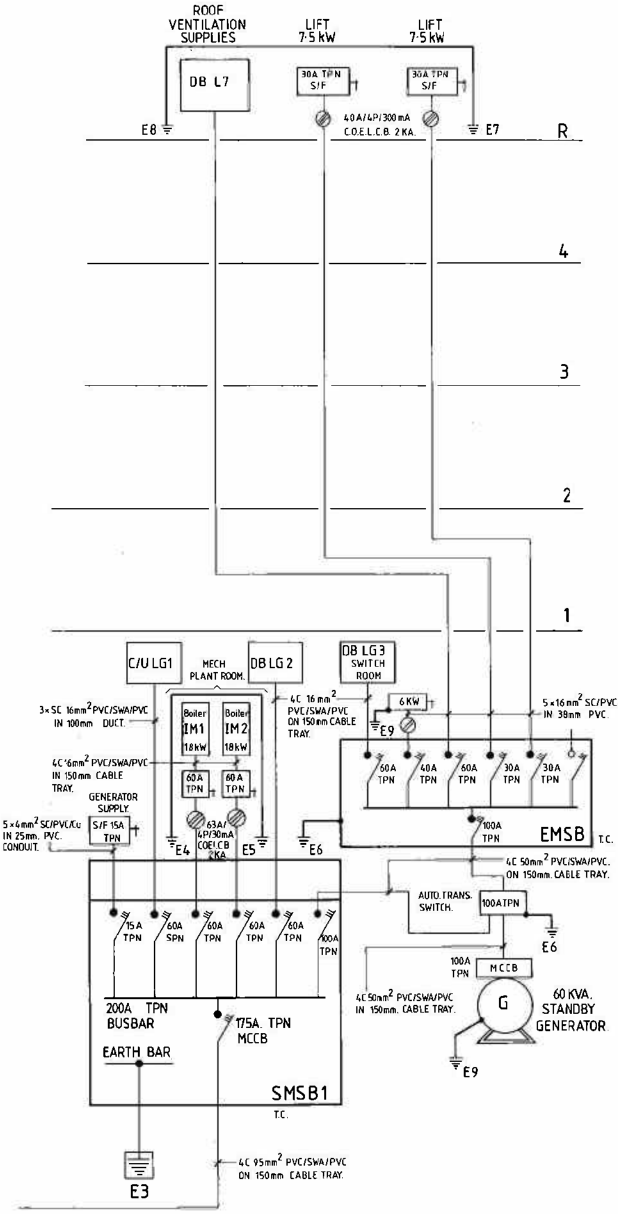


Fig 5.6 Electrical schematic, studio apartments

provide the cooling. These consist of condensing units located either on the balcony or on the roof, linked with refrigerant piping to single or multiple evaporators located within the apartments or plantrooms. Because the systems used are up to six storeys in height (at the limitations of vertical lift for such systems) careful attention to detail was necessary in the design of the pipework (Fig 5.4) (Ref 5.2).

The apartments are designed to be efficient in terms of the ratio of rentable space to gross development area, in this case achieving 80–85%. The plantroom and riser duct sizes are therefore economically designed to ensure optimum usage of space. A plantroom on the ground floor in each building is used for the hot water storage, cold water booster pumps, standby generator and the main electrical switchrooms. Plantrooms are provided on the upper levels of the duplex apartments only for packaged air conditioning units, providing ducted treated air to and from the apartment (Fig 5.5).

Toilet ventilation is via shunt duct systems to reduce noise transfer between apartments. These discharge at roof level via auto changeover twin extract fan units extracting more than 6 air changes per hour.

Water supplies to each apartment block are from a tanker at the site boundary. This fills underground cold water storage tanks while ground level booster pumps transfer water to roof mounted concrete day tanks. A separate feed is run to a central hot water storage cylinder, for distribution of hot water to the apartments, while an individual booster pump is provided on the top floor apartment for showers. A dry riser system is provided with landing valves on all levels. In order to accommodate the above ground branch drainage runs in bathrooms, the floor slab is dropped by 160mm within each toilet. This allows the drainage to be run within a lightweight screed avoiding horizontal drainage running in the apartment below.

The Ministry of Electricity and Water were responsible for distribution of low voltage supply cables to each apartment block, terminating at the ground level switchroom. Each apartment was then provided with separate metering at ground level and a landlord's supply ran from this point to serve the core areas and common services (Fig 5.6). A standby diesel generator was provided for emergency services to stair and lobby lighting, portable water pumps, and to enable the lifts to return to ground level.

The design of so many different apartment permutations required detailed organisation, with submission and tender dates only being met through a high degree of co-operation and co-ordination, and a systematic approach from all members of the design team.

Martin Corbett

References

5.1 Ashrae Handbook 1981 Fundamentals Chapter 26 "Air Conditioning cooling load"

5.2 Trane, "Reciprocating Refrigeration" 1978

Real World Studios, Box Mill

Project Data

Client	Real World Studios Ltd	
Architects	Feilden Clegg Design	
Building Services	Buro Happold	
Structural Engineering	Buro Happold	
Acoustic Consultants	Harris Grant Association	
Quantity Surveyors	BHQS	
Cost	Phase 1	£635,000
	Phase 2	£550,000
Completion Date	Phase 1	September 1987
	Phase 2	November 1988

Building Services Technical Data	Phase 1	Phase 2
Gross Area (approx)	700m²	300m²
Heating Load	60 KW	30 KW
Air Conditioning Load	50 KW	35 KW
Supply air volumes (total)	2.14m³/sec	1.87m³/sec
Maximum electrical demand	50 KVA	50 KVA

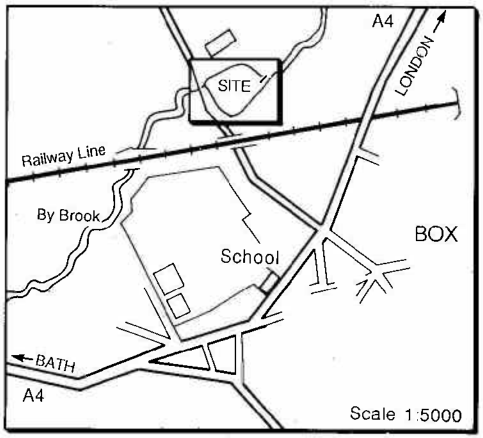


Fig 6.1a *Site location, Box, Wilts*

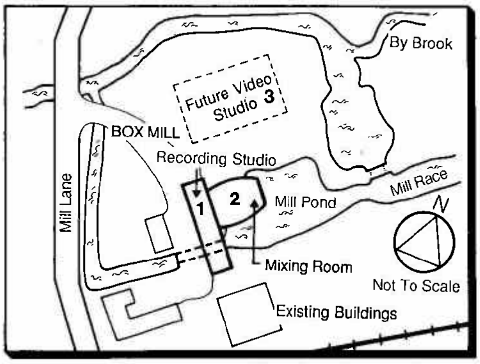


Fig 6.1b *Box Mill, Site Plan*

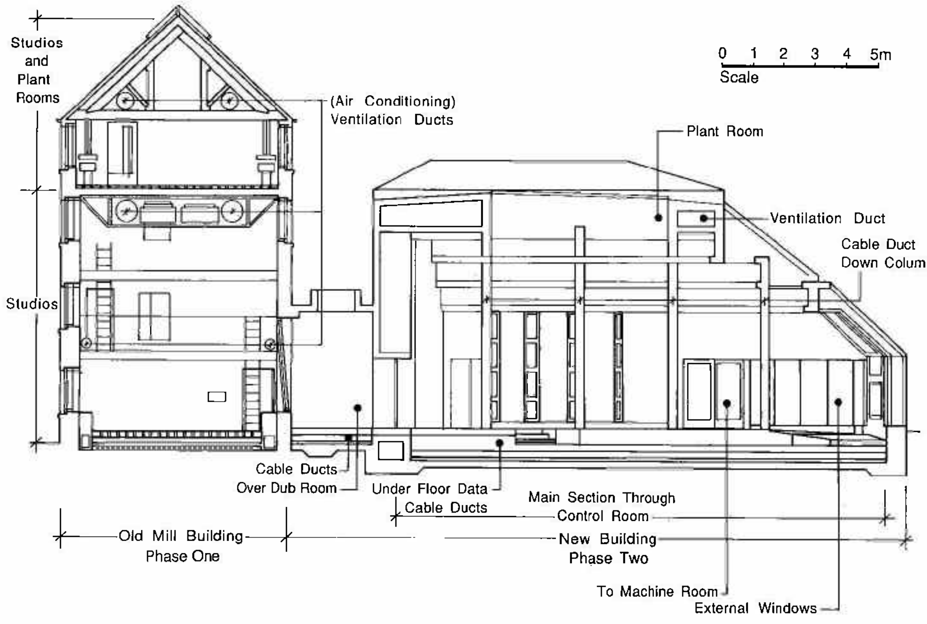


Fig 6.3 Section through Phases 1 and 2

Box Mill, an old mill building located on the By Brook in West Wiltshire, lies some 5 miles to the east of the city of Bath, within 250 metres of the high speed British Rail Intercity London to West Country network (Fig 6.1a). Throughout its life the mill has been adapted to meet varying needs and in latter years has been used as office accommodation.

The concept was to provide a recording studio complex consisting of the redeveloped mill building (phase 1), a new control room complex (phase 2) and a new video studio (phase 3) — a concept in which the water would once again become central to the functioning of the building in a spiritual, if not a technical, manner (Fig 6.1b).

The redevelopment of the existing mill building has provided sound studios and workroom spaces, with the newly built control room complex abutting the mill building. The mill pond has been increased in size and extended around the control room complex, the water being taken down through a weir under the mill building, now visible through a glass floor. The control room location with large windows at the mill pond end provides attractive and peaceful views up the river valley (Fig 6.2).

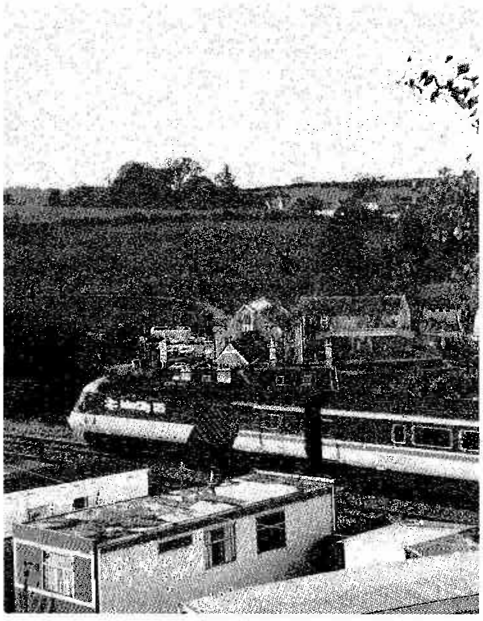


Fig 6.2 *View of studios from east*

High peaks in external ambient noise and ground transmitted vibration from the nearby railway line have, however, caused great concern to the design team and required detailed investigations to overcome acoustic problems.

Phases 1 and 2 are now completed leaving phase 3, the video studio, to be commenced in the future.

Assessment of Building Fabric Requirements

The initial briefing stage with the client occurred over a three month period in parallel with start on phase 1 detail design. The aim was to achieve a studio complex of extremely high acoustic performance without detracting from the aesthetics of the traditional stone mill building. Within this old building the client wished to accommodate a studio, mixing room, stone (hard surfaced studio) room, workroom (where experimental music could be developed) as well as associated store rooms and toilet facilities (Fig 6.3).

The design of the second phase of the development commenced in October 1987 and consisted of the construction of a control room/studio, over-dub room, tape store, machine room and other ancillary

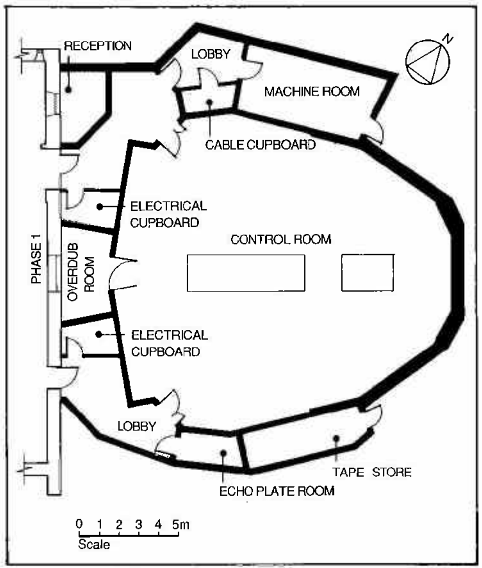


Fig 6.4 Plan of control room complex, Phase 2

Table 6.1 **Services Design Criteria**

Mechanical

External temp = 28°C wb (summer)
−1.5°C db (winter)

Internal temp = 20°C wb (summer)
21°C db (winter)

Fresh air = 8 litres/person

Electrical

Lighting — no plasma arcs within sound studio.
— provision of effect and task lighting
— no electronic transformers to be used so avoiding interference on sound system.

Power — 110V and 240V for technical outlets.

Earths — clean and quiet earths to be arranged to avoid impedance coupling.

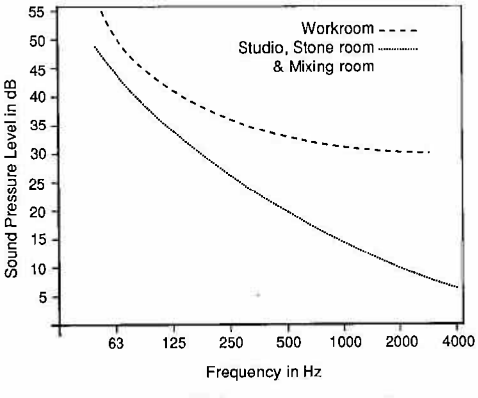


Fig 6.5 Design noise criteria curves.

accommodation (Fig 6.4). This phase abuts the existing mill building and the design process examined a number of construction options. The final solution was that of a lead clad dense concrete shell incorporating all the studio accommodation as well as the plant room.

Extensive sound and vibration tests were carried out on site by Harris Grant Associates, from which a number of proposals were formulated for the control of airborne and structure borne sound both from within the complex to the outside and also from the outside to within the studio complex. These proposals included the use of acoustically suspended floors and walls, triple glazing and the silencing of all air inlet and exhaust ducts.

It was decided that the floor of the main studio and mixing room in Phase 1 would consist of a secondary floor isolated from the main structure. This consisted of a 200mm reinforced concrete slab suspended on a large number of rubber anti vibration mountings and designed to deflect a maximum of 9mm, such that the resonance of the slab and supports would occur two octave bands below that frequency shown by field tests to potentially cause problems. The design sound reduction index for walls and windows was in the order of 55–65 dB. Existing walls were of sufficient mass to meet the requirement. Windows however required triple glazing to meet this design sound reduction index.

Following further deliberation it was agreed that the studio, stone room, workroom and mixing room would be air conditioned to achieve the building service design criteria outlined in Table 6.1 and the acoustic criteria of Figs 6.5, 6.6. Other non acoustically critical areas would be naturally ventilated and heated.

Building Services Design — Phase 1

Each air conditioned space was provided with a single zone, all air, system comprising supply plant (filter, supply fan, heating coil, cooling coil) with associated air supply and exhaust ductwork, attenuators and exhaust plant (Fig 6.7). Cooling was provided by a direct expansion air cooled refrigeration plant. Humidity control was not provided.

The resulting noise levels in the spaces are a function of duct air velocities and plant noise, both that transmitted through the air ducts and that transmitted from plant to the space through the structure. Duct velocities were limited to a maximum of 2 m/sec and plant was carefully selected for low noise criteria. All plant was suspended on spring vibration isolation

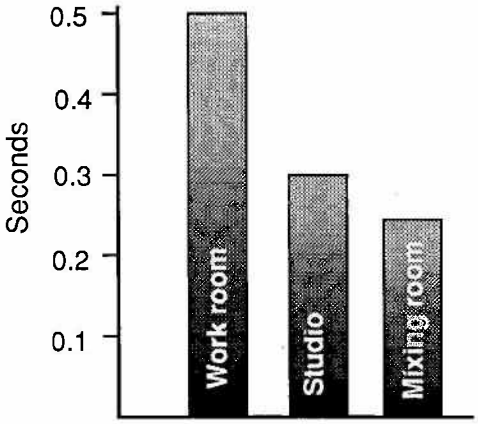


Fig 6.6 Design reverberation times

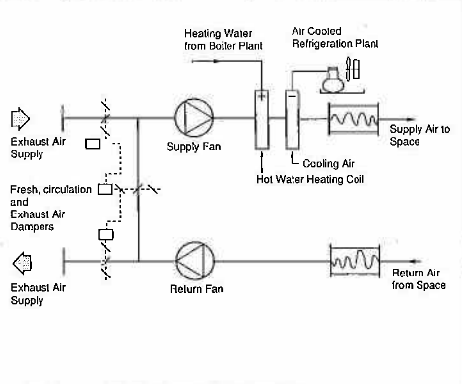


Fig 6.7 Typical air conditioning plant

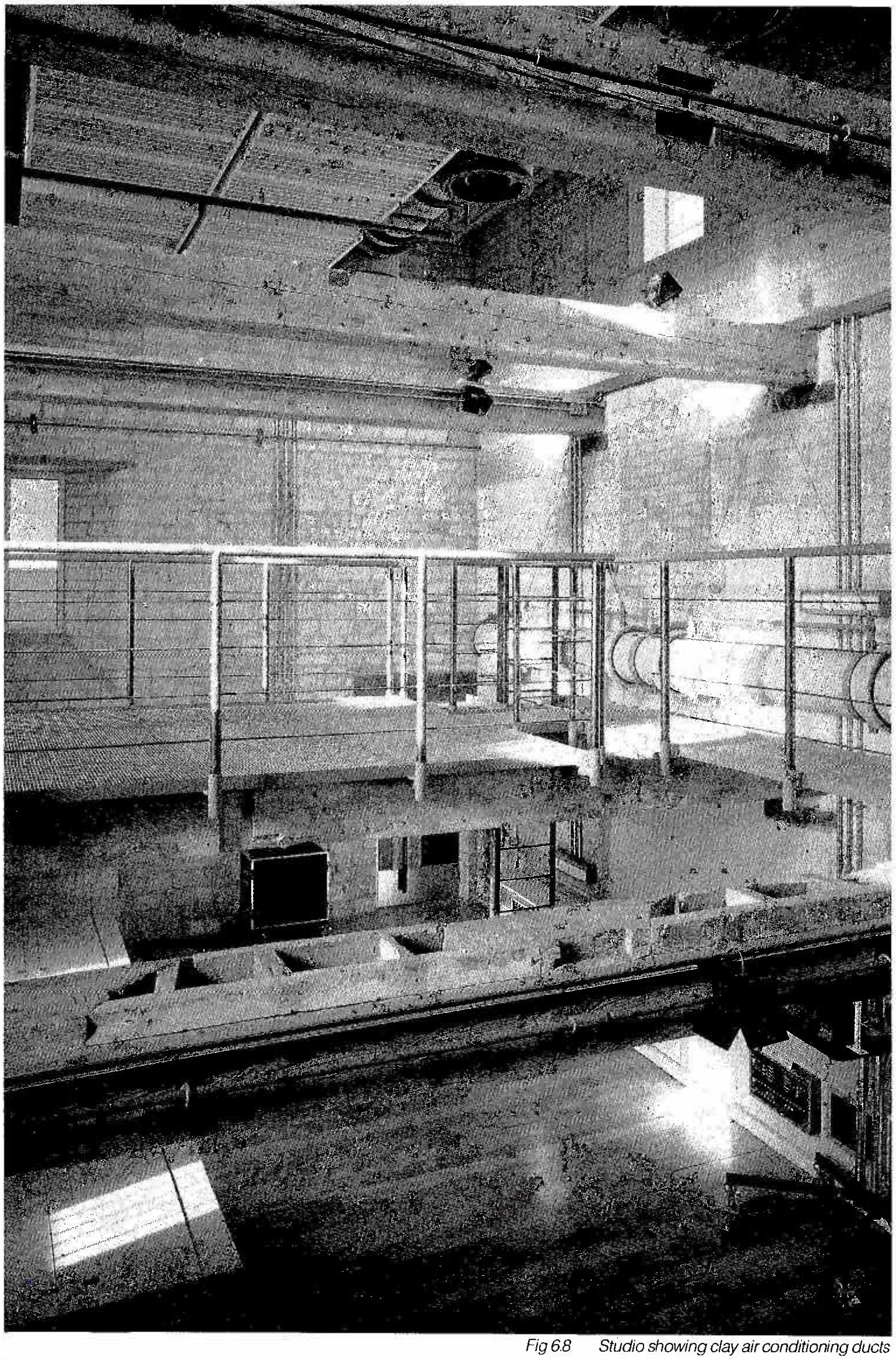


Fig 6.8 *Studio showing clay air conditioning ducts*

mountings with static deflections of up to 65mm. Specially designed attenuators were provided to achieve the required noise levels in the spaces, and to ensure insertion losses of up to 40 db in the 500 Hz frequency band. These attenuators were selected to provide high broad band attenuation at medium frequencies and very good attenuation at low frequencies.

The client had a strong desire that sheet metal ductwork would not be used external to the plant room — alternatives including glass, plastic, timber and vitrified clay were examined. The final solution was to use exposed vitrified clay ducts of either 300mm or 600mm diameter in the studio (Fig 6.8), timber glulam ducts in the workroom (Fig 6.9) and, where ducting was concealed from view, sheet metal was used. The choice of uninsulated vitrified clay ducts has resulted in slow warm up due to the high thermal capacity of the clay ware when the plant is in heating mode. No problems have been experienced with condensation. Detailed installation proposals formed part of the design to ensure that noise from the plantroom did not penetrate the walls between the occupied spaces and plantroom. Normal building procedures needed to be greatly improved to achieve satisfactory end results and close supervision was required to ensure that installations met the design criteria.

All spaces were provided with heating from a gas fired low temperature hot water heating system utilising radiators. Air conditioning system heating coils were also supplied with heating water from this system. Hot and cold water services were provided to all sinks and sanitary fittings.

Electrical supply to the mill building originates from a 300KVA substation on the perimeter of the site. From the substation a 150mm² cable supplies a main distribution board, from which supplies are run to serve lighting, small power and the mechanical services control panel (Fig 6.10). This main distribution

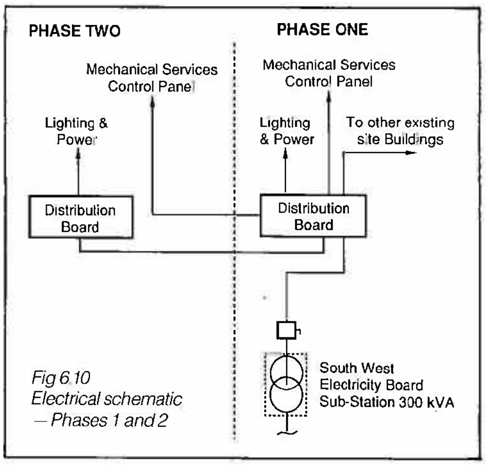


Fig 6.10 Electrical schematic — Phases 1 and 2

board also serves other buildings on the site, offices, accommodation unit and store buildings. Lighting in the studio spaces is by tungsten luminaires, combinations of tungsten and fluorescent being used elsewhere. Power supplies for studio equipment is provided at 110V and 240V to "technical outlet points". These points also include clean earthing for functional currents and quiet earthing for sound equipment.

The main plant installation was confined to a somewhat restricted roof void with limited facilities for services distribution throughout the building. Careful selection of plant and distribution ductwork and pipework allowed all the services plant required to be integrated into this limited space.

Phase 2 Design Solutions

Air conditioning to the control room/studio and over-dub room was provided in a manner similar to that of phase 1 air conditioned spaces. Air distribution in the control room/studio was achieved using builders' work ducts while in the over-dub room vitrified clay ducts were preferred. Both the tape store and machine room were air conditioned using self contained fan coil units interconnected to air cooled direct expansion refrigeration plants. All plant was located in a roof plant room above the studio (Fig 6.11).

Difficulties in providing gas supplies and discharge of combustion products precluded the use of gas fired heating plant. All heating in the building is electrical but, with the high lighting and sound equipment loads in the studio and associated rooms, the heating energy requirement is low.

Electrical services to the control room/studio complex are also similar to those of phase 1, with the main supply to the complex originating from the phase 1 distribution board. An additional separate supply is run from this board to the mechanical services control panel. As before, 110V and 240V supplies are available to technical points, and clean and quiet earthing facilities are provided.

Work on phase 1 was completed in the latter part of 1987 while phase 2 reached completion in November 1988.

Howard Bays

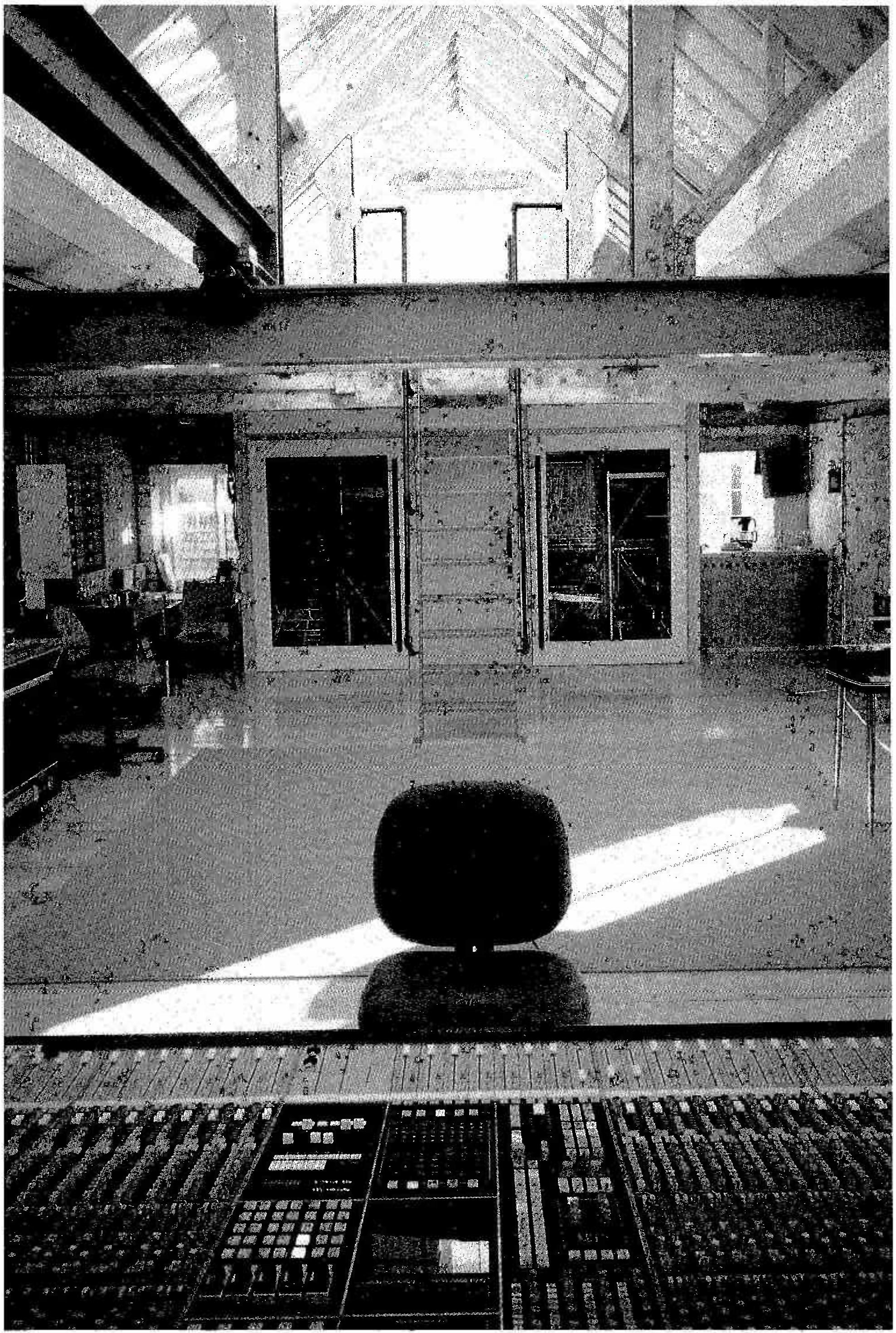
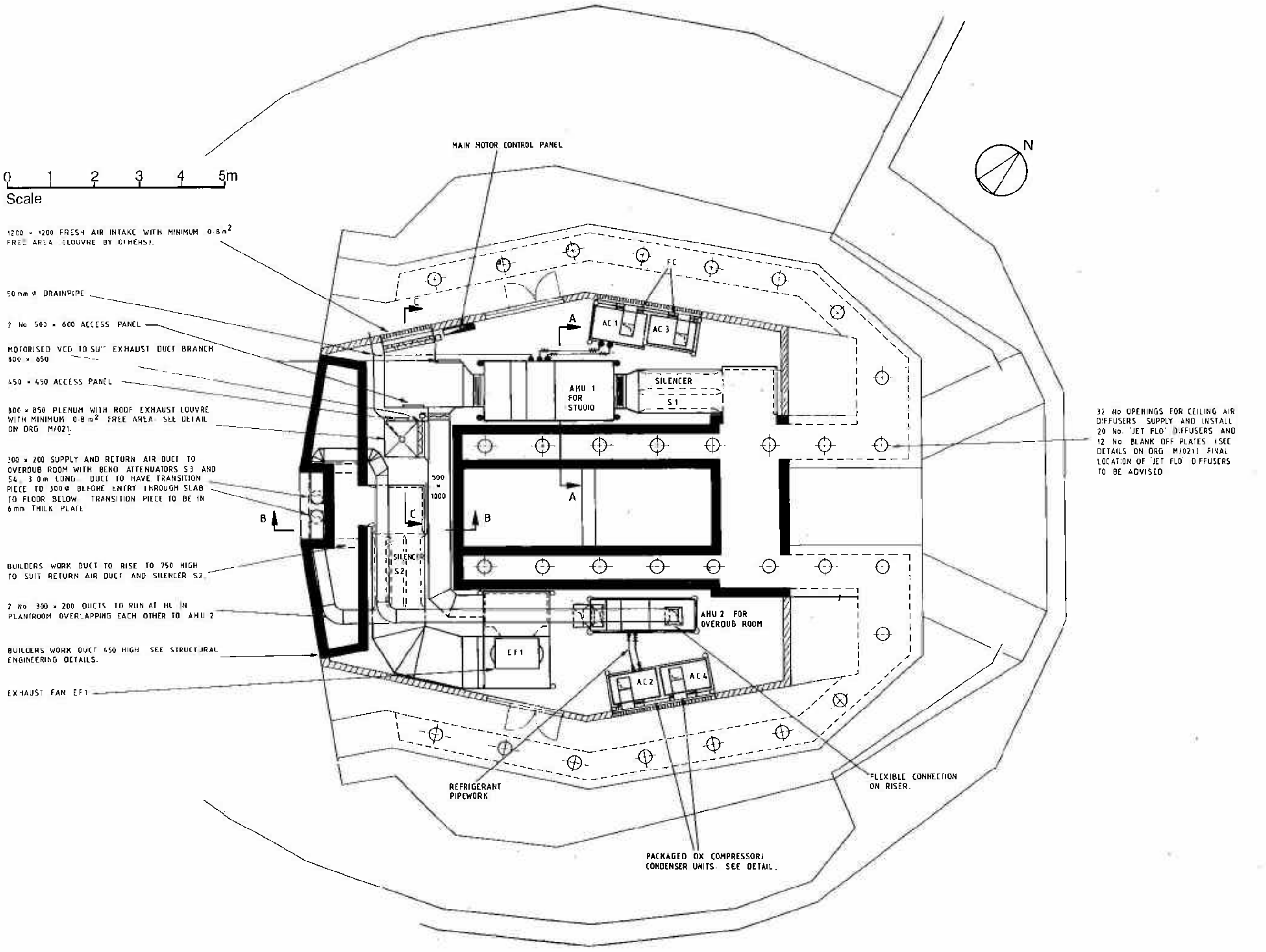


Fig 6.9 Timber air conditioning ducts in workroom

Fig 6.11 *Roof plantroom, Phase 2*



Buckingham Hotel — Renovation in Kensington, London

Project Data

Client	Naaz Investments
Architects and Interior Designer	Iain Pattie Associates
Service and Structural Engineers	Buro Happold
Quantity Surveyors	BHQS
Cost	£11.5m (Mechanical/Electrical £3.1m)
Completion Date	1988

Fig 7.1 Cromwell Road facade, prior to refurbishment

The development lies on the north side of Cromwell Road in Kensington, between Gloucester Road and Greenville Place. At the commencement of the project the site was comprised of seven Victorian 5-storey houses with basements (Fig 7.1), five of which had at one time been combined into a hotel. These had subsequently become dilapidated and work had been started, but not completed, to convert them into flats. The other two houses had been gutted by fire and only the shells remained. As a result, the seven houses together offered an ideal opportunity for redevelopment over a site area of 1540m^2.

In common with a lot of inner city developments, the financial viability of the scheme depended on the provision of a high percentage of money earning floor area. In this case 159 bedrooms and suites with a total floor area of 6200m^2, and restaurant, conference and leisure facilities over 2800m^2 were planned. Again in common with similar developments, the physical planning constraints were very tight — the main criteria being that the site was part of a terrace, and the building could not be increased in height beyond the existing roof line 25m above road level. Furthermore the Cromwell Road facade was to be retained (Fig 7.2)

Design Solutions and Services Brief

The existing floor area would not have provided an adequate number of bedrooms for the project to achieve viability, so demolition and reconstruction with the addition of extra floors, in a building of the same height, was obviously necessary. The architects incorporated two further floors by introducing a new floor in the roof space and by ingeniously inserting a mezzanine level between the ground and first floors, in the form of split level suites. A reduction in original storey heights was proposed, providing a challenge to both the services and structural engineers.

Structural engineers played their part by designing a rigid steel frame and precast concrete plank construction, within a general structure depth of only 152mm in critical areas such as the guest floor corridors (Fig 7.3). Careful co-ordination took place between the structural and services disciplines to ensure that deeper beams and main services routes did not coincide.

Services design was developed to overcome the problem of very shallow false ceilings in a variety of ways. The overriding principles included careful selection of systems, analysis of optimum services routes and of course co-ordination with both structural engineers and architects.

The brief was to design services to a standard commensurate with a 3 or 4 star hotel and within performance guidelines provided by Holiday Inn. Most significantly the hotel was to be fully air conditioned and a standby generator was to be provided.

The mechanical services element of the building includes heating, ventilation, cooling, relative humidity control, water services, natural gas service, drainage and fire fighting systems.

HVAC Systems

The primary heat source, four gas fired boilers providing 1400kw of heat, is located in a basement plantroom with a combined flue discharging above the main roof. The boilers supply conventional low temperature hot water to air conditioning plant and equipment, and hot water service calorifiers.

Approximately 550kw of cooling is provided by a water chiller in the basement plantroom in conjunction with two air cooled condensers on the roof (Fig 7.4). The chiller supplies chilled water to air conditioning

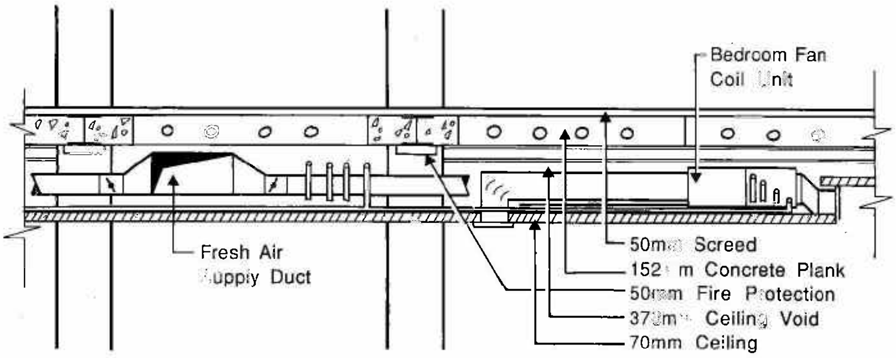


Fig 7.3 Services ducts within corridor floor


1
2
3
4
5
6
7
8
8x
120.80 FFL ROOF MEZZ
117·85 FFL 5th
115·00 FFL 4th
112·15 FFL 3rd
109·30 FFL 2nd
106·45 FFL MEZZ
107·449
103·60 FFL 1st
100·00 FFL Ground
99·133
99·858
99·072
97·676
96·969
96·52 FFL Base.

Fig 7.2 Elevation of terrace, showing new floor levels

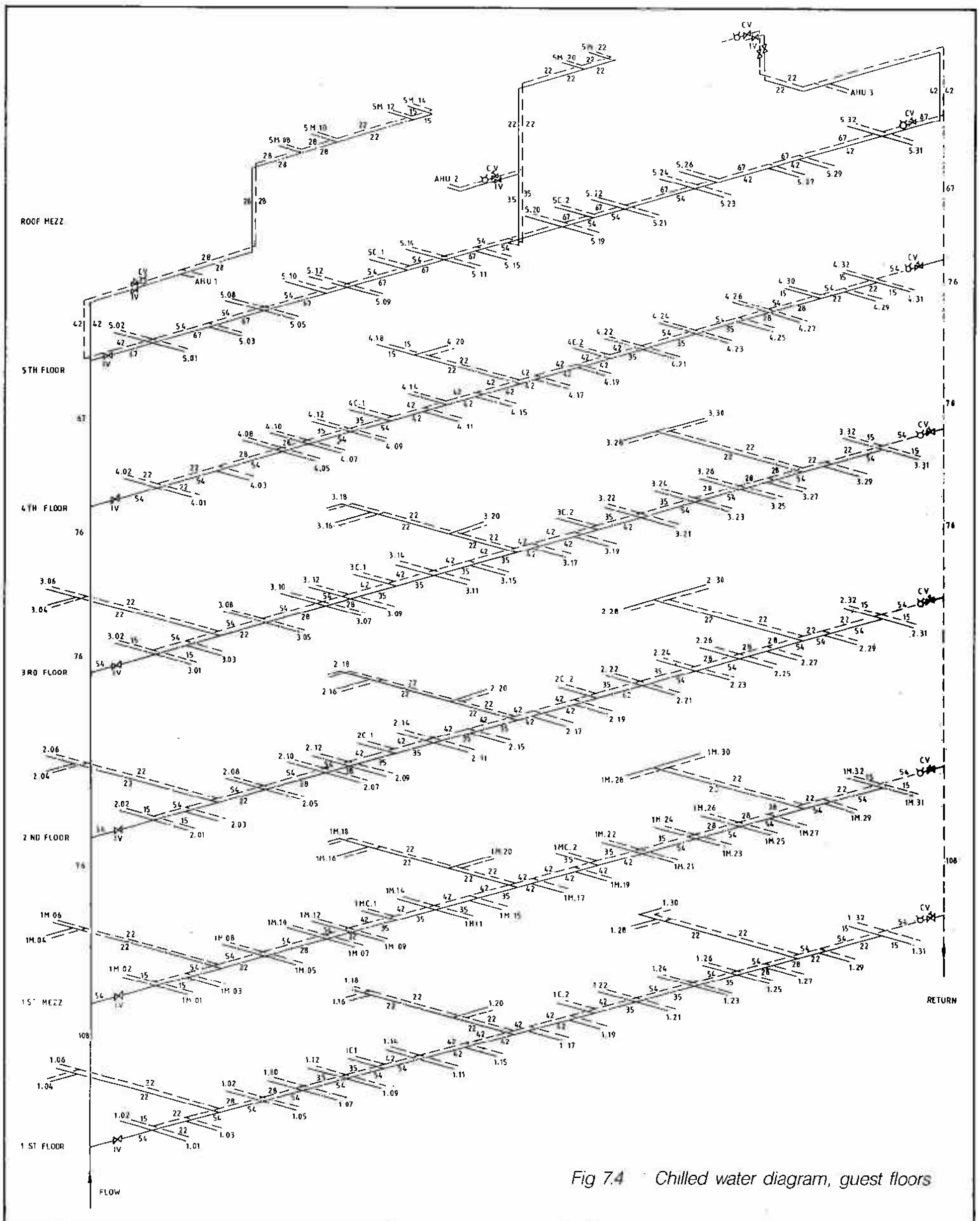


Fig 7.4 Chilled water diagram, guest floors

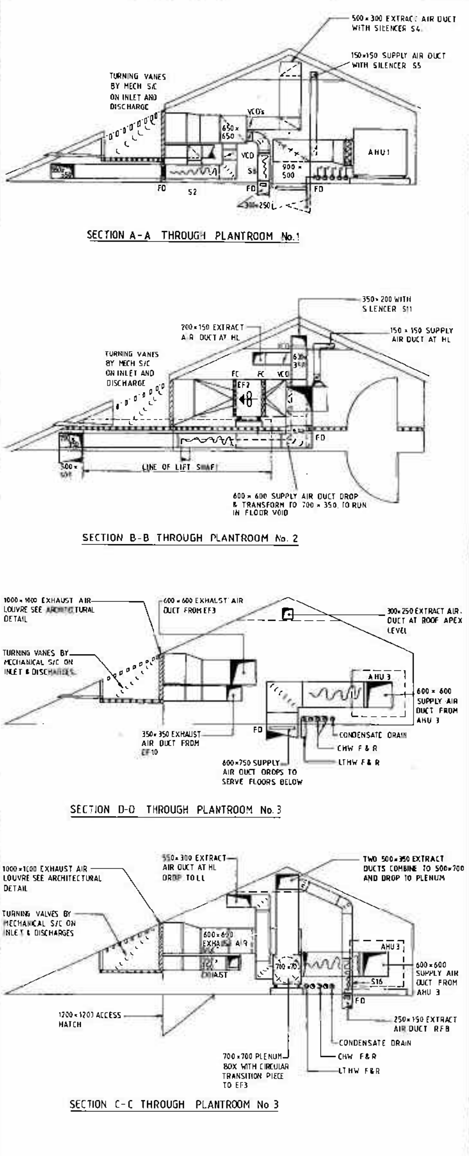


Fig 7.5 Sections through roof plantrooms

plant and equipment. Siting of the condensers was difficult, the only flat roof areas being overlooked by bedrooms. Further, due to a planning requirement, the parapet walls were only 1200mm high. A condenser was found which did not project above the parapet and, by selection of 12 pole motors, the relatively low noise rating necessary was achieved.

Fresh air supply and extract air systems are provided by plant which is sited within the building's main pitched roof (Fig 7.5). The fresh air is supplied through ductwork in the central corridor to fan coil units in a bulkhead at the entrance to each guest room, the largest ductwork within the corridor ceiling void measuring 350mm × 250mm. A slightly greater volume of air to that being supplied is extracted from bathrooms. Two measures were taken to reduce the depth of ceiling to 378mm clear. Firstly, the fresh air is distributed from three risers, one near each end of the building and one in the centre, requiring small horizontal ducts at each floor (Fig 7.6). The second measure completely avoids any supply and extract duct crossovers by locating extract ductwork within the vertical plumbing ducts associated with each bathroom. Fan coiled units are supplied with chilled and low temperature hot water from the central plant. Individual fan coil unit controllers in each guest room

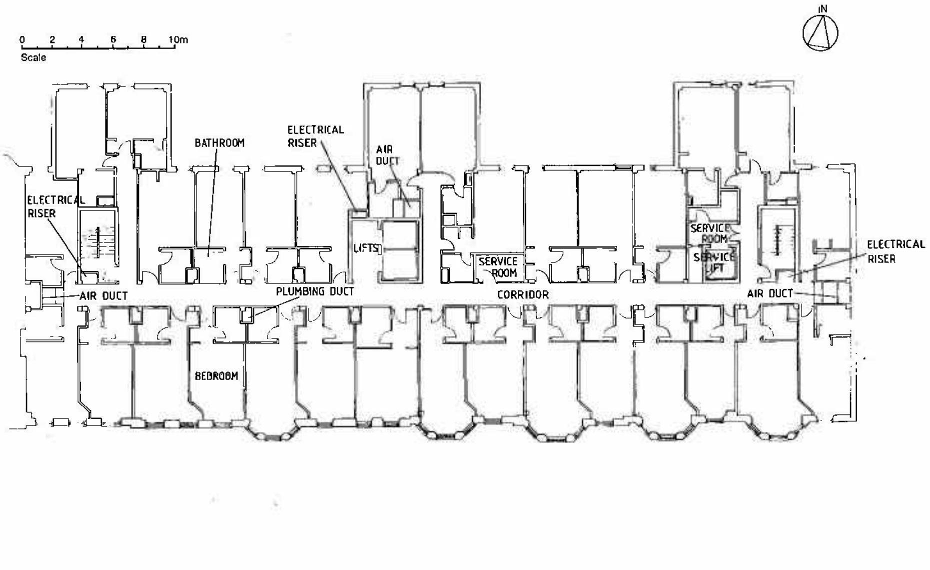


Fig 7.6 Typical floor plan showing bedroom suites

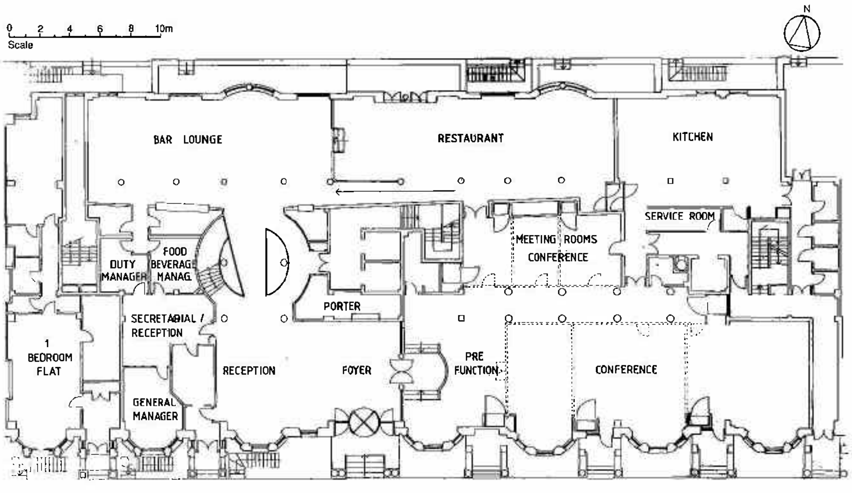


Fig 7.7 Ground floor plan of public areas

allow the occupants to control the heating and comfort cooling provided.

There are a variety of high occupancy areas at ground floor and basement levels. These include a bar/lounge, dining room, wine bar, entrance foyer, and a conference area which is provided with folding screens allowing it to be divided up into separate rooms (Fig 7.7). The potentially high occupancies of these nine different areas meant that large volumes of fresh air had to be introduced, necessitating the installation of an "all air" air conditioning system. Furthermore the low storey height could not readily accommodate large low velocity ductwork (of the order of 1700 × 1000mm at 6 m/s in the worst case) for both supply and extract systems. A high velocity supply system was therefore adopted reducing the largest supply duct to 1543 × 510mm flat oval. A variable air volume air conditioning system was chosen, with 100% shut off being incorporated at each terminal box in the interests of energy conservation. A perimeter heating system, compensated to outside conditions, was provided, to ensure comfort at room boundaries and the matching of air volume supplied to the load requirements.

Close co-operation was required between engineers and architects to incorporate even the high velocity ductwork, and particularly the VAV terminal boxes, into the ground floor ceiling. The architects favoured the provision of modelled ceilings with a variety of levels in each space, so it was necessary for the main duct runs and terminal boxes to be located between the higher "feature ceilings".

A sophisticated control system with air quality sensors was adopted, to ensure that adequate fresh air was provided. This minimised the treatment of outside air and hence reduced potential running costs.

Other public and staff areas of the building were conditioned using a fresh air supply and extract system in conjunction with fan coil units. Fresh air supply rates varied between 8 l/s/person and 18 l/s/person depending upon the activities to be carried out within each area. Toilets were provided with their own supply and extract systems utilising low temperature hot water reheating coils for local control.

The kitchen also had its own supply and extract plant, the extract system being connected to a conventional hood with grease filters above the main cooking equipment. However, a discharge of kitchen air at ground floor level, where the kitchen is located, would have caused a nuisance to occupants of both the hotel and neighbouring properties. Alternatively, taking the kitchen extract exhaust to roof level would have used valuable floor area at each floor above ground level and would have caused severe planning problems. It was therefore decided to take the discharge to basement level, and combine it with other extract air discharges, filtering the kitchen air with charcoal filters to remove cooking odours. The ventilation rate of the kitchen was determined by the area of cooking range, and hence by the extract hood — a hood face velocity of 0.35m/s giving rise to a ventilation rate of over 50 airchanges per hour.

Water Services

Hotels are notoriously large consumers of water, customers using up to an average of 200 litres per day. Therefore a large quantity of water had to be stored on site to maintain a supply in the event of mains failure. An area of approximately 120m² of valuable floor area would have been required to accommodate conventional plantroom tanks. This was avoided by storing 55m³ of water in concrete underground storage tanks, provided with water boosting pumps. Two calorifiers capable of holding a total of 8m³ of hot water, were provided in the basement plantroom. On the guest floors the hot and cold water services pipes were located in the plumbing ducts, so avoiding the use of corridor ceilings where chilled and heating water pipes and supply ductwork were located.

Drainage

At basement level, the very low storey height characteristic of Victorian buildings posed further problems. With the ground floor level fixed by the entrance doors in the existing facade, and an increased storey height necessary for the new air conditioned basement, there was no alternative to setting the new basement floor level lower than the old. This not only meant that the facade and party walls would have to be underpinned, but raised doubts concerning the relationship between the new building level and the Borough sewer in Cromwell Road. Investigations showed that the Victorian developers had located the Cromwell Road sewer just below the old basement level. The problem was overcome by pumping the basement drainage system, a peak flow of 15 l/s, to just below ground level, combining it there with the remaining building drainage system, and discharging by gravity into the sewer.

Main and Emergency Power Supplies

The electrical requirements of the modern air conditioned hotel are much greater than those of the buildings formerly on the site. The increased demand meant that, in common with many larger developments in London, space had to be found within the site to accommodate two London Electricity Board transformers.

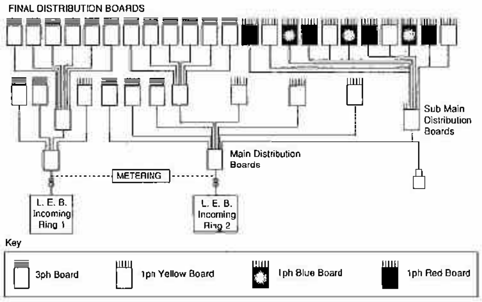


Fig 7.8 Electrical schematic, Buckingham Hotel

Although the development required approx 900 KVA of supply, 800 KVA was the nearest suitable size of transformer available (Fig 7.8). Spare capacity from the two LEB 800 KVA transformers installed would then be available to neighbouring properties when required. For access reasons the transformer room had to be located at the front of the building, unfortunately occupying prime floor space at the Cromwell Road side of the building.

A standby diesel generator is provided to supply both essential plant and emergency lighting. The most important items of plant supplied in this way are the sewage pumps and water booster pumps, without which the hotel could not function in the event of a mains failure. Lifts are also supplied from the standby generator under power failure conditions, the control system being arranged so that either of the passenger lifts may then be operated, but only one at a time.

The switching of the mains and standby power supply is arranged so that in the event of failure of either of the LEB transformers, the essential loads supplied from that transformer can be taken over by the generator, leaving the other transformer supply operating normally and feeding its usual loads. Further, by load shedding non essential supplies through the energy management system, all the essential supplies can be supplied by one transformer. Thus full advantage is taken of the provision of two LEB transformers.

Lighting and Lift Facilities

Hotel lighting is more to do with providing the right ambience rather than fixed lighting levels. Because such lighting is very much a part of the interior design, close co-operation was essential between engineers and the interior designers.

A wide variety of other electrical services are also necessary for a modern hotel. These include telecommunications, fire alarm, public address, staff location, security and electronic door locking systems. The telecommunications systems was to provide radio, television, video film, telephone and computer installations.

Lift studies indicated that two 13 person passenger lifts operating at a speed of 1.6 m/s were required. A goods lift capable of transporting furniture, rubbish, and linen etc was also necessary. However, as the top floor of the hotel incorporates the sleeping quarters to suites accessed from the floor below, it was not necessary for lifts to travel to the top of the building. With plantrooms at basement level, it was therefore possible to contain the lift shaft below the Victorian roof line.

Kitchen Refurbishment and Energy Management

The brief included the design of the kitchen, production layouts and selection of equipment. As well as catering for the hotel dining room, the kitchen had to be designed to provide banquets for the conference facility. A separate, small kitchen is provided for preparation of room service snacks when the main kitchen is not in use. The room service kitchen is located and accessed in such a way that it can also be used for preparation of beverages for the conference rooms.

A computerised energy management system is provided to integrate the engineering services controls associated with the various engineering systems. This system allows monitoring and control of plant and equipment throughout the building from one central location.

The challenge of the project to provide luxurious hotel accommodation of adequate floor area, within a structure meeting modern stability and fire safety requirements, and utilising sophisticated and extensive building services, has been strongly influenced by the constraints of financial viability.

Communication, understanding and a common aim, in short very close co-operation, were the essence of achieving the design objective. Whether or not five separate consulting practices could ever have co-operated in the way that the two practices involved did, is an interesting question.

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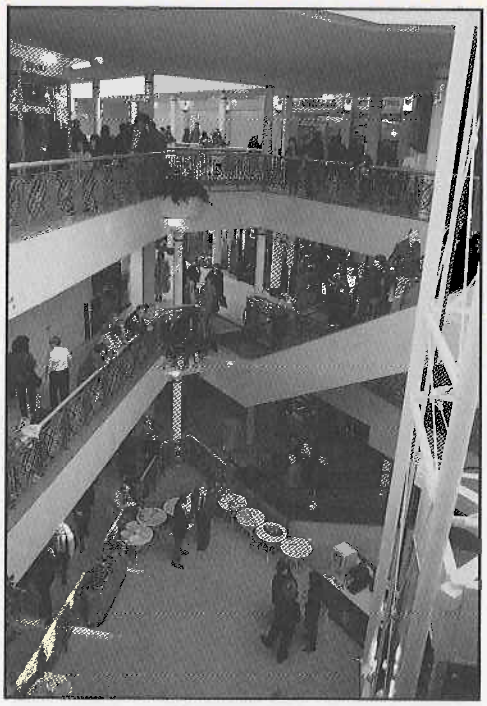

Interior of "Colonnades" shopping complex, Bath