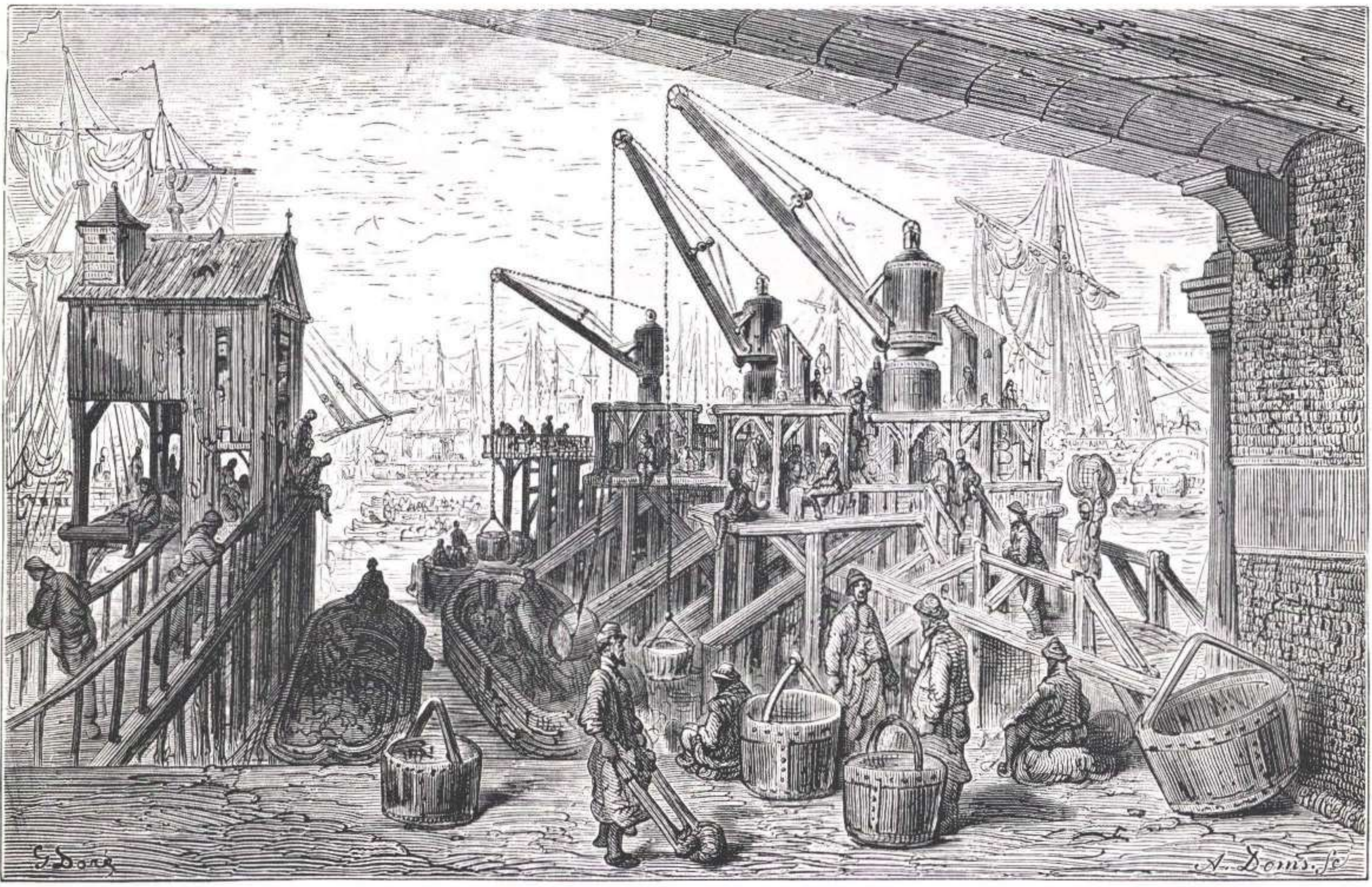
THE ARUP JOURNAL

SEPTEMBER 1977



THE ARUP JOURNAL

Vol. 12 No. 3 September 1977
Published by
Ove Arup Partnership
13 Fitzroy Street, London, W1P 6BQ

Editor: Peter Hoggett
Art Editor: Desmond Wyeth FSIAD
Editorial Assistant: David Brown

Contents

Front cover: Illustration by Gustave Doré of London Docks, *circa* 1870
Back cover: The 'Walter Press,' employed for printing *The Times*—a contemporary print of 1872
Cover illustrations reproduced by courtesy of Mary Evans Picture Library

The London Docks

Ian Mudd

Introduction

The London Docks are situated in Wapping on the north bank of the Thames some 800 m east of the Tower of London. This complex of dock basins, inter-connecting locks, quays and warehouses, nearly 42 ha in extent, straddles the Wapping peninsula and adjoins St. Katharine's Dock on the western boundary (Fig. 1). Construction of the docks began in 1801 after the granting of a royal charter. Trading opened in 1805 and finally closed in 1969. During the 168 years of its existence many notable engineers, doyens of their time, participated in its construction and modification. Its warehouses and vaults stored tobacco, brandy, tea, sugar, coffee and a host of other trade goods.

Together with architects, Shepheard, Epstein and Hunter and quantity surveyors, Burrell, Hayward and Budd, our role is to resurrect the decaying area of Wapping and the derelict London Docks (Fig. 2).

Ours was not an open brief, neither were we the first to undertake redevelopment proposals in the area. Since 1968 many schemes had been put forward and rejected from numerous architects and engineers, including ourselves, and the controversial Travers Morgan dockland study. Although we could draw on previous experience, our proposals had to conform, in general terms at least, to 'The Local Plan for Wapping' published by the London Borough of Tower Hamlets, and 'The General Dockland Strategy' published by the Docklands Joint Committee. It was also necessary to heed the requirements of statutory authorities, local action groups and developers' proposals for the north western part of the site. In other words it became necessary to please all of the people all of the time.

We recognized that our proposals should provide a desirable environment at an economic cost and decided this would best be achieved by accepting and utilizing the existing major constraints. Our philosophy was to retain the more important aspects of dockland heritage (Fig. 3), to re-use or adapt existing dock walls, locks and structures and to minimize demolition costs.

Geology and soil conditions

A good deal of geological data was available for the area of Wapping, from basic information extracted from geological survey maps, pictorial records on Port of London Authority drawings and modern boreholes undertaken in and around the area.

Alluvial deposits from years of flooding, successive reclamation and dock building have increased the fill, in places, to nearly 10 m thick. Below this can be found gravel, London Clay, Woolwich and Reading Beds and chalk.

When work commenced, the builders founded the dock walls in the flood plain gravel strata, at a level below the standing water table. As construction spread eastwards, the same flood plain gravel was used as a foundation until work commenced on the Shadwell new basin. This, the last of the major docks to be built, was situated at a point where the London Clay is higher and the north wall of this dock was founded partly in gravel and partly in clay which to some extent accounts for its magnitude and method of design.

At the time of dock construction, the standing water level was far higher than it is today and all timber piles on which the dock walls, vaults and boundary walls were constructed, were below this water table. Those still underwater owe their preservation to this fact.

Now, underdrainage of the London Clay and urbanization of the area has resulted in a gradual lowering of the water table so that today the tops of most timber piles are above the water table and, as a result, are badly decayed. It is fortuitous that the clay stratum is nearer the surface in the northern part of the site, for it holds the ground water at a higher local level which ensures that piled foundations for the original warehouses are still below water level and in a good state of repair.

History

By the middle of the 18th century, a wide band of Wapping abutting the Thames was completely built up. From this maze of alleyways and courtyards, commercial and industrial activity was carried out, causing acute problems of congestion for docks' unloading and storage facilities. Behind this band of intensive activity, the centre of Wapping peninsula, destined to become the London Docks, was still low lying in part marshy ground, covered with drainage ditches. Along the river, small docks projected into Wapping, providing some unloading facilities in addition to the river frontage. On maps of 1746, the names of three are significant in that they have remained ever since, as Hermitage, Wapping and Shadwell, and were situated at the three main entrances of London Docks, bearing the same name.

The history of dockland as we know it today began at the end of this, the 18th century, also a time of vast engineering expansion to cope with the new commercial industries of Britain started by the Industrial Revolution. With the influx of more and more raw materials to increase revenue and to prevent large scale pilferage, the first of the modern floating docks was constructed on the Thames. This, the West India Docks, was situated in the Isle of Dogs, the docks being designed by William Jessop. At the same time (1799) a company was formed by London merchants for the purpose of constructing docks as near to the Exchange as practicable and for this scheme, John Rennie the elder, was appointed


John Rennie FRS

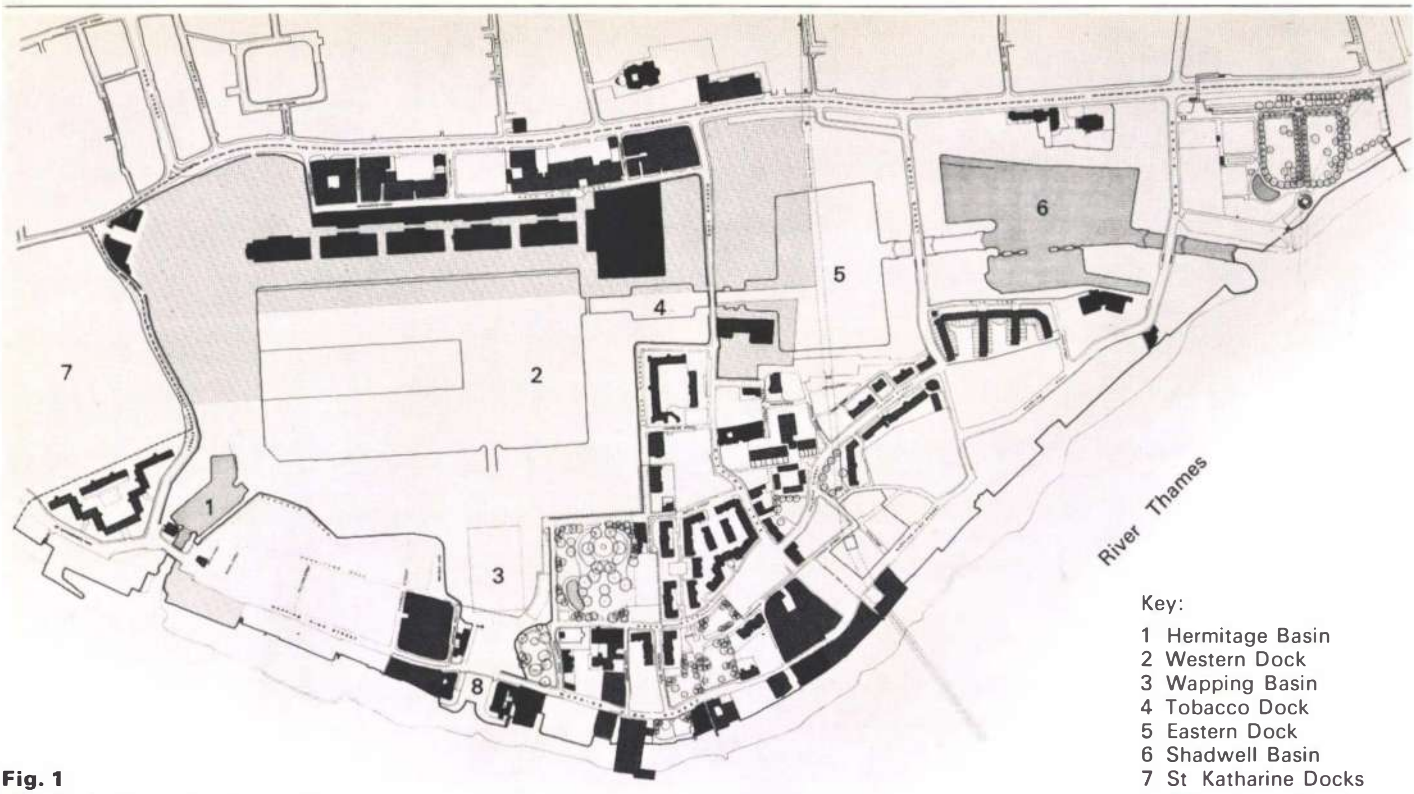


Fig. 1
Wapping and the London Docks

Key:
1 Hermitage Basin
2 Western Dock
3 Wapping Basin
4 Tobacco Dock
5 Eastern Dock
6 Shadwell Basin
7 St Katharine Docks
8 Wapping Pierhead

Fig. 2
Western Dock – an example of our decaying inner cities
(Photo: Ian Mudd)

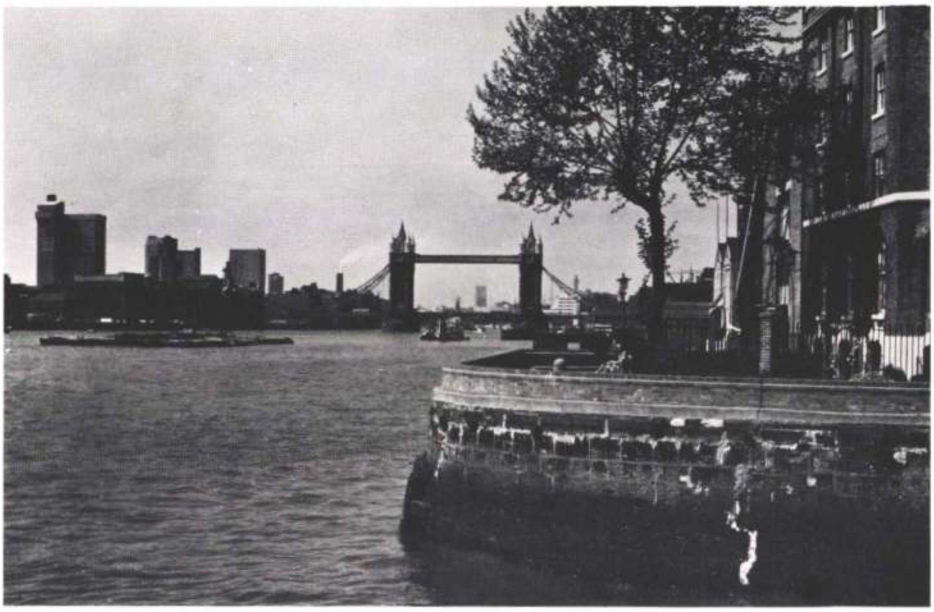


Fig. 3
Wapping Pierhead – already converted to a pleasant riverside environment
(Photo: Ian Mudd)

engineer. Several designs were submitted and, as the future trade was an unknown quantity, phased extensions were incorporated in his designs.

Although parliamentary approval was granted in 1799 and royal assent given the following year, the site of the proposed docks was to a great extent occupied by existing buildings; nearly two years elapsed before purchase and site clearance was completed to enable work to commence in 1801. As recorded in Samuel Smiles' biography 'Lives of the Engineers,' work commenced in the spring of 1801.

'When two steam engines were erected, of 50 horse power each for pumping the water, and three minor engines for other purposes, such as grinding mortar, working the pile-engine, and landing materials from the jetty – an application of steam power as an economist of labour which Mr. Rennie was among the first to introduce in the execution of such works.'

In spite of the crippling inflation caused by the war with France, this first stage was opened on 31 January, 1805, consisting of Wapping Basin and Western Dock, the lock between them and the Wapping entrance. The Western Dock was surrounded with warehouses between two and five storeys in height, the majority being constructed of timber for the floors and brick walls. An extensive system of vaults was constructed under many of the buildings, using groined brickwork roofs, carried on masonry columns. The majority of these columns was founded on timber piles although in the north west corner of the site mass foundations were provided.

Some 10 years after completion of this first phase, work commenced on the Eastern dock and the resulting link between this, and the Tobacco and Western docks was completed around 1820. The docks were generally of the same form of construction as before, work being supervised by the same two engineers.

John Rennie, dock engineer, designer of the Plymouth breakwater and the London, Waterloo and Southwark bridges, did not see the completion of this work for he died during October 1821. However, the remainder of this and his other vast undertakings were completed by his brother and his son John.

By 1828, the East and West India Docks, London and St. Katharine, were all in competition for the increasing trade from Australia, South Africa, Canada and other emerging nations. For the London Docks, further expansion was necessary. A third major stage was planned to increase docking facilities and in 1832, H. R. Palmer supervized his design for a river entrance and Basin at Shadwell in the east of Wapping. This was a smaller project than originally planned, the reason for the cutback being obscured by time. Nevertheless, history does relate that dock building had by this time outstripped shipping requirements and there was insufficient traffic to fill all the docks.

During the next 20 years, extensive modifications were carried out to improve handling and storage facilities. In 1838, a timber jetty was constructed on cast iron piles in the Western Dock. Many of the original Rennie buildings were demolished and replaced with more substantial or larger structures. Additional vaults were provided, being constructed of cast iron columns and beams supporting brick arched roofs.

Finally in 1855 the last major extension was undertaken, that of enlarging the inadequate Shadwell Basin. This phase, carried out by J. M. Rendel, represented a significant change in dock wall structures. As with the Old Shadwell Basin, ground conditions were extremely difficult; the foundations were on London clay, the gravel layer being too high, and the North wall where the clay sloped southwards, was constructed in the form of an arcade. Upon completion of this work and with the docks fully operational, the East London Railway Act of 1865 authorized the construction of an underground railway through Wapping and under the docks. The selected route was to pass under the eastern dock from north to south and continue from Wapping to New Cross Gate via Sir Marc Brunel's Thames Tunnel. The proposed route meant that work had to be carried out under the Eastern Dock at a minimum depth from the bottom of dock to arch of tunnel of 1 m.

Furthermore, as the dock company stipulated that the dock remain open at all times, this part of the work became a particularly difficult undertaking, one which even today would tax the imagination and ability of even the most experienced contractor (see Fig. 4).

Investigation

The engineering investigation formed a valuable part of our work to familiarize ourselves with the area. We were fortunate in obtaining fairly comprehensive records from the PLA, particularly drawings. Main features to be accommodated were the docks, vaults, boundary walls, road network and infrastructure.

Docks

The majority of dock walls was designed to a common form. Walls were of brick 1.8 m in thickness with counterforts on the rear face curved to a radius of 25 m and were nearly 11 m high (Fig. 5). They contained three courses of Purbeck and Kingoodie stone approximately 3 m below quay level to act as rubbing strips. Foundations were provided in the natural gravel stratum and consisted of timber piles at the toe of the wall with a flooring of 150mm thick beech and elm planking on which the dock walls were then constructed. The base of the docks was lined with clay to minimize leakage.

All docks were constructed on a 'cut and fill' basis, the original ground level being approximately the same as the impounded water level and vault floors. Excavated materials were used to bring the quays up to their present level, thus the builders were not faced with

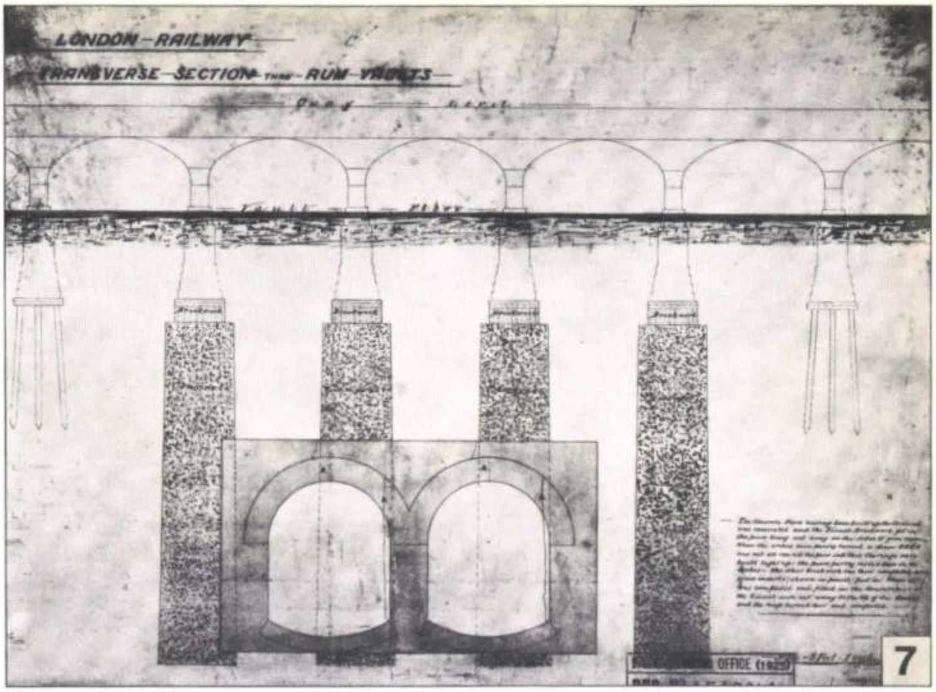


Fig. 4
Underpinning *par exellence* around which the East London Underground was constructed (*circa* 1866)

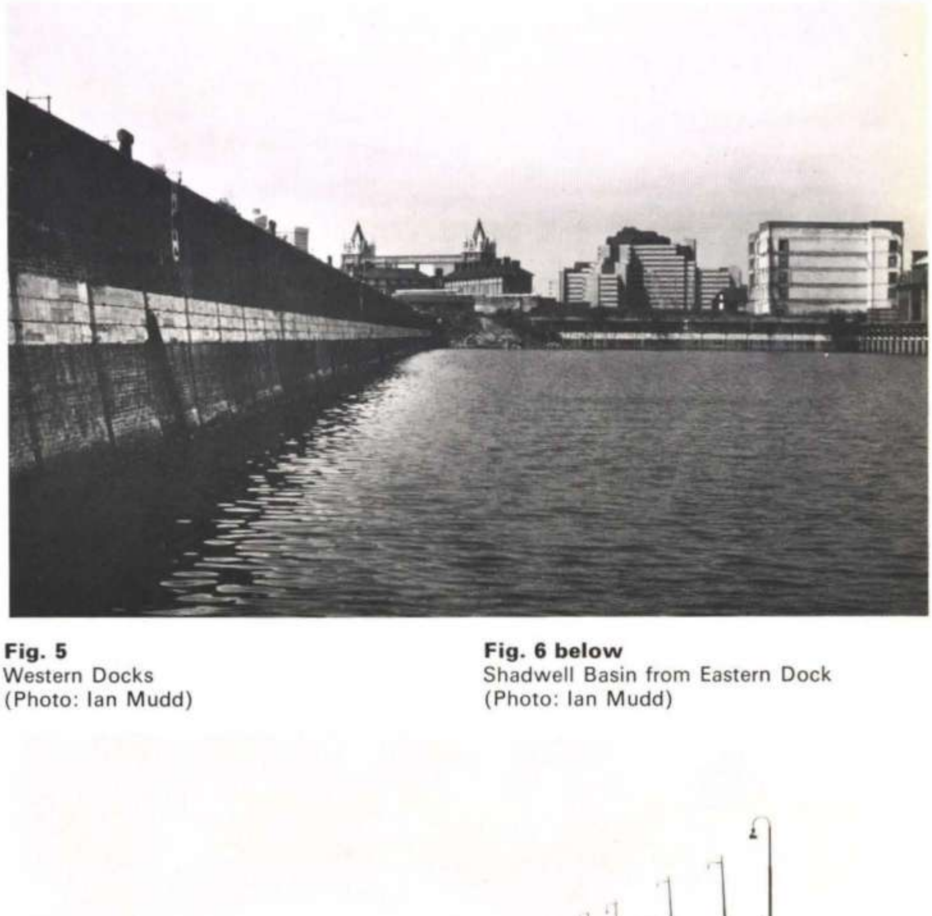


Fig. 5
Western Docks
(Photo: Ian Mudd)

Fig. 6 below
Shadwell Basin from Eastern Dock
(Photo: Ian Mudd)

the problems of wall stability when docks are partially empty, a major problem which exists today. Wapping Basin, Eastern and a portion of Tobacco Docks have since been filled under the direction of the Port of London Authority.

However, details of the method and types of fill used are not available. The problem of stability is therefore now limited to Hermitage, Western Dock and to some extent, Shadwell Basin. For the Hermitage and Western Dock walls it is calculated, assuming water at its present level of 5 m below quay level in the dock and 6 m in the surrounding ground, that the current factor of safety against overturning is only 1.20 and as periods of wet weather may increase the ground water, a constant check of relative water levels has been maintained at all times. During the first 12 months of monitoring it was noticeable that the difference in water levels inside and outside the dock maintained a 1 m difference, the water in the dock being the higher level. This meant that the walls and bottom of the dock were relatively impervious, the dock still acting as a water retaining structure.

Dock wall failures

The calculations produced and concern over the low factor of safety have been partially substantiated, for investigations show that various lengths of wall have failed in the past and the Port of London Authority has taken action to provide remedial measures. One notable failure is a length of wall in Western Dock which slipped horizontally due to excessive surcharge at quay level.

This problem of wall instability exists only where the dock water is required to be lowered or removed, therefore docks which are intended to be retained as water areas do not fall into this category. Western Dock is one in which future development must take place and the water must be lowered or removed completely. The most suitable method of providing additional wall stability is to tip fill against the water face in order to support it whilst the water is lowered. It is impossible to remove the water completely for the dock is founded on flood plain gravel and the surrounding ground water would force a path through the puddle clay in the bottom of the dock due to hydrostatic pressure.

Before this can be undertaken, some thought must be given to the sediment in the bottom of the dock. Throughout their working life regular dredging kept this problem under control except perhaps for an area under the Western Dock Jetty, an area of relative inaccessibility where a mound nearly 6 m high is trapped. This volume is estimated at 85,000 m³ and the total volume of silt in Western Dock alone may be 160,000 m³. In view of the vast quantities involved, Travers Morgan and Partners undertook sampling and testing of this silt in 1972 and published their findings in the Docklands report. More recently a paper produced by the Docklands Development Team has commented, in some detail, on the problems of dock silt and dock fill.

The Travers Morgan and Partners' report considered the silt to be toxic and unsuitable for use in its present undiluted state. Analysis taken tended to confirm the silt's toxicity, the high concentrations of heavy metals being of particular concern and the optimum solution to deal with this problem being one of removal and dumping at sea. Ultimately, mainly on the grounds of cost, we elected to leave the silt in position at the bottom of the dock and bury it beyond the reach of animal or plant life.

The Western Dock is also dominated by a large reinforced concrete jetty, built in 1912. Fortunately, it is in a good state of repair and suitable to be utilized. In a further capacity it is also economically desirable to leave it in position and build round and over it.

To the east, Shadwell Basin was constructed on London clay and the north wall of the dock constructed in the fashion of an arcade. Massive buttresses occur on this north wall and provide a measure of stability.

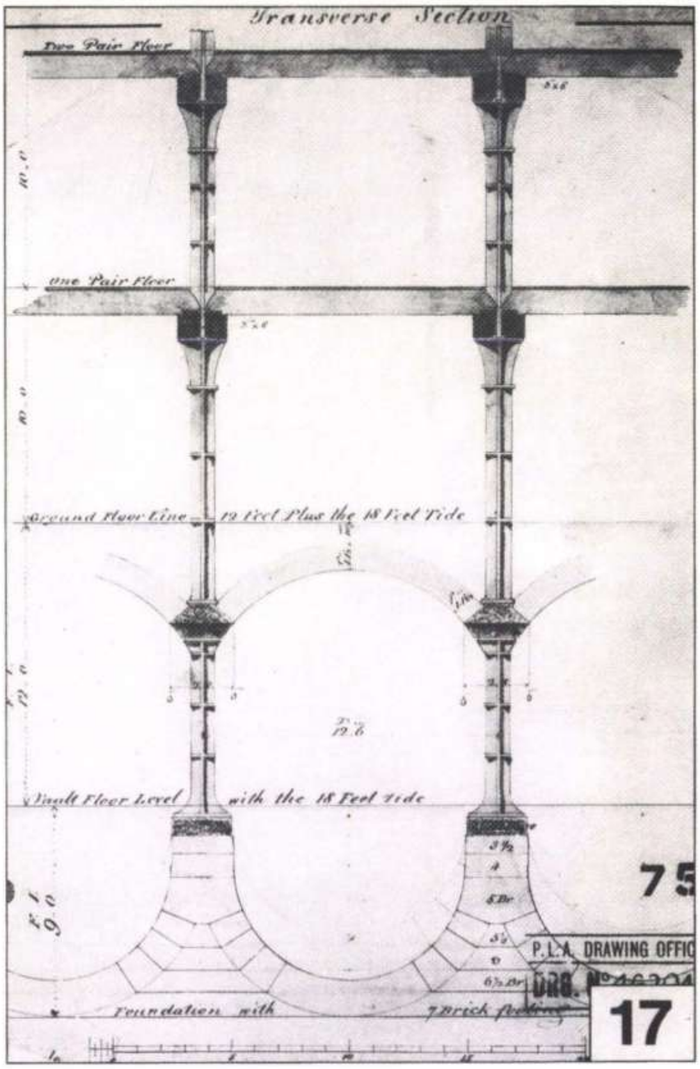


Fig. 7
Port of London Authority drawing *circa* 1860 showing vault construction

The Shadwell basins were originally constructed in two phases and later linked to form one large dock (Fig. 6). There was a duplication of locks linking the basins with the river and Eastern Dock but the earlier links were filled in some years ago by the Port of London Authority. Silt exists in these basins and seems to be heavily contoured across the width of the docks, total volume being in the order of 70,000 m³ and again suitable methods must be devised to deal with this problem.

The vaults

Existing vaults covered an area of 10.1 ha within the London Docks, stretching from Thomas More Street in the west to Shadwell Basin in the east. The majority were interconnected by tunnels running adjacent to dock areas, under Wapping Lane and Garnett Street. In the area of the south quay of Western Dock, a part of the vaults have collapsed due to overloading.

Apart from the odd basement, the vaults are of three main types, namely brick barrel arches supported on cast iron columns and beams, brick barrel arches supported on continuous brick walls and brick groined arches. Columns and wall are in turn supported below ground on brick or masonry piers resting on timber piles.

The groined vaults were constructed on grids of approximately 5 m square except for those in the south east corner of Western Dock where the module was increased to 7.6 m. Generally, the floor to ceiling heights were and still are low except for the point directly under the crown which measures between 2.1 and 2.4 m. The vaults were constructed of brickwork 450mm thick above which was laid 300mm of soil and paving slabs. Successive modifications by the Port of London Authority have added a further reinforced concrete slab to the ground floor above, improving the overall stability but increasing the self-weight carried by the foundations.

Brick-arch barrel vaults were constructed on a grid of 5.5 m centres (Fig. 7). In the other direction, supporting cast iron columns were placed at approximately 3.6 m centres. Vault floors are either earth or in some cases stone paving slabs laid directly on the ground.

The bottom of vault foundations are some 3 m below the floor level. The foundations in the northern or lease back part of the site are mainly mass concrete piers, whilst those elsewhere consist of timber piles overlaid with timber beams. These foundations have over the years been exposed to alternate wetting and drying with the serious consequences of rapid deterioration and rot. In some areas inspected the timber has already completely decayed so that it is totally inactive as a foundation.

It is fair to say that the Port of London Authority has been aware of foundation problems for some time. During the reconstruction of a large transit shed in the Eastern Dock area, trial pits exposed the original timber foundations on some vault piers and a subsequent inspection showed that the top 600mm of timber had decayed. In 1959, a test load was carried out on one vault pier in the vicinity of Eastern Dock. This did little to substantiate the ultimate capacity of the foundation, it did however, indicate that a settlement could be expected and that a settlement of 1.5mm could be expected for a load of 50 tonnes. It also indicated that a long-term creep settlement could be expected and that a settlement of 8mm was achieved for a load of 110 tonnes. Apart from the very poor state of the foundations, the condition of the vaulted roofs and

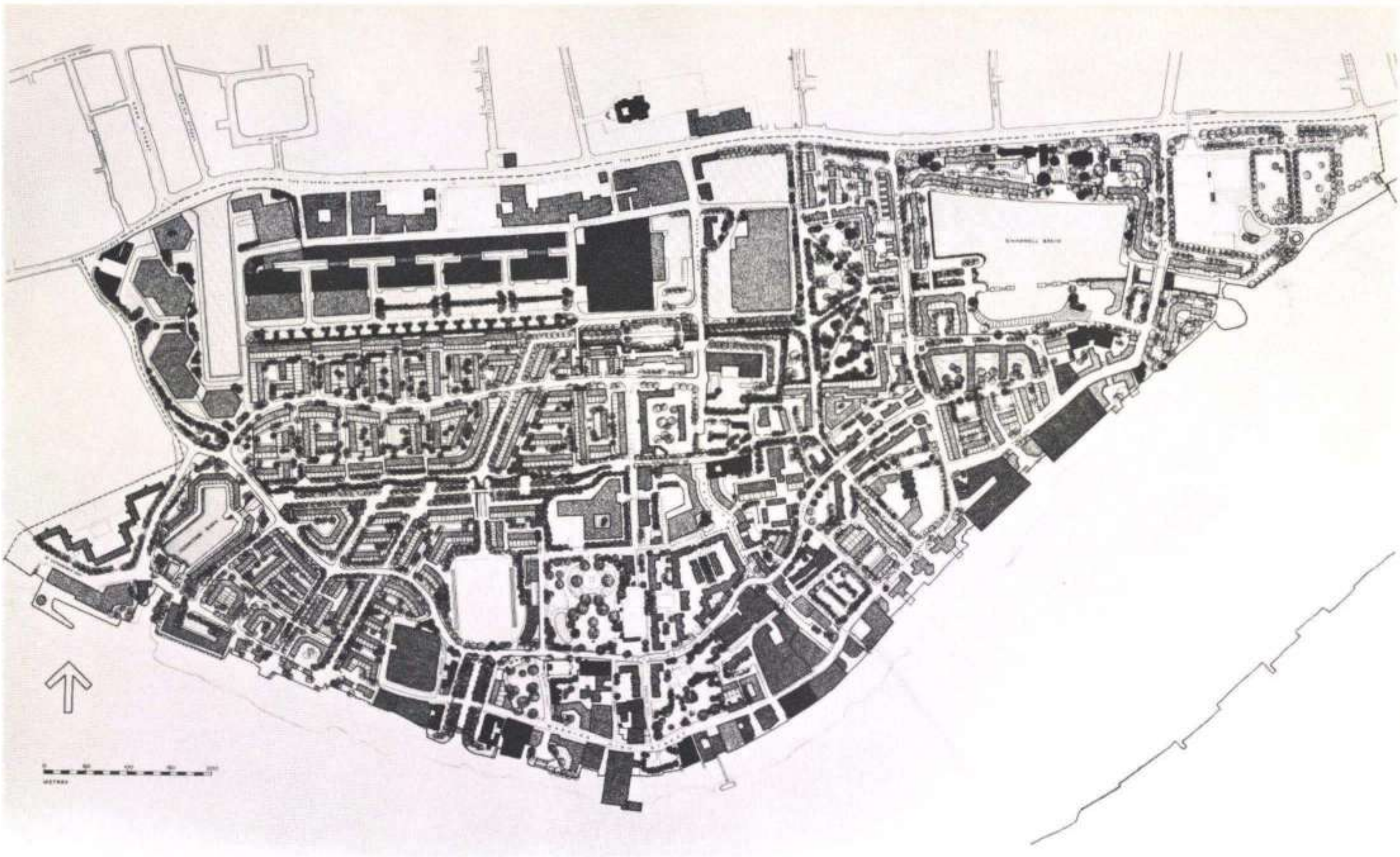


Fig. 8
The Wapping Plan (Illustration courtesy of Shepheard Epstein & Hunter)

piers is variable. The brandy vaults in the south east of Western Dock are superficially in good order although there is evidence of moisture leaching through the brickwork even during dry summer months. If any vaults are to be retained for a specific use then extreme care has to be taken due to interdependence of stability.

The boundary walls

The high boundary walls are an integral part of dockland, in the past preventing large scale pilferage of goods and retaining all dock operations behind secure boundaries. Many walls have suffered modifications and rebuilding although some fine examples of original construction still exist. In particular, the lengths along Pennington Street and Wapping Lane are examples in a good state of repair visually, except possibly for their supporting foundations. Generally, the walls forming a perimeter around the docks west of Wapping Lane are covered by a preservation order and where possible are required to be kept in any future development.

Walls were constructed from the original ground level some 3.5 m below the present, on large brick bases or timber piled foundations, and rose to a height of 10 m above the present ground level. The walls varied in thickness from 450mm at the coping to nearly 1.2 m at their base, construction being of solid brickwork. Below this formation level, the majority of foundations utilized timber piles which were driven into the firm gravel or clay and topped with a horizontal grillage of timber beams either as a continuous length or as large independent piled bases.

As with the timber piled vault foundations, severe deterioration has occurred over the years. On lengths examined, the timber grillage and pile tops immediately under the brickwork had completely rotted away, leaving the walls supported only by the alluvial fill. Although walls have not yet collapsed, signs of distress and instability are already apparent in some areas.

The services

It is true to say that the infrastructure of Wapping has been designed with and around the docks, therefore a complete re-appraisal is necessary for the development. Numerous internal services exist in the London Docks which need not be taken into account as they are unlikely to be of use in the new development and will eventually be disconnected. The only services which need to be considered are the active public services which pass through the site and are shown, by the re-appraisal of capacities and demands, to be adequate to service the proposals. These will have to remain uninterrupted during the redevelopment.

Existing buildings

During the early years of London Docks, the original multi-storey warehouses were constructed of timber floors and brick walls, many being constructed on the existing brick groined basements. Between the warehouses and docks, single-storey timber transit sheds were constructed more or less in the form of dutch barns. Changing requirements and general building decay caused many of these to be replaced while as the area of the dock property increased, further buildings were added. These were usually constructed with the fashionable materials in use at the time of building and examples of brick, timber, cast iron, reinforced concrete, structural steelwork and prestressed concrete all exist in some form or another. However, with the proposed redevelopment, most buildings will be redundant and it is a sobering thought to realize that it now costs as much to demolish these warehouses as it originally cost to build them. Today, the majority of buildings that existed within the London Docks has already been demolished. Much of this work was carried out under the direction of the Port of London Authority before Tower Hamlets acquired the site. Since that time, further buildings considered dangerous have been taken down so that the area at present is almost devoid of buildings.

Proposals

General proposals, which formed the basis of the Master Plan, are shown in Fig. 8. The architects' drawings and model show individual buildings but stress this is purely to make clear their intentions and acknowledge that details are bound to change in execution. As the architect stated in his report:

'The aim of the plan is not to create a large housing estate, but the building of a riverside quarter which is neither a suburb nor a crowded site. It will consist of mostly two to three-storey houses, gardens, tree-lined streets and broad pedestrian avenues, opening views to the river. It deals with the creation of a pedestrian shopping street, arcaded for protection from weather, and of a varied riverside walk (Figs. 9–12). It provides for open-space and leisure areas and for the preservation of old buildings and walls where possible. Roads are arranged to exclude through traffic from many areas and to get buses within a few minutes' walk of everyone.'

One further point worth mentioning is the utilization of the existing contours formed by the docks, locks and vaults. The scope is almost infinite and the architect has elected to adopt a pleasing system of low level pedestrian ways running east/west and north/south through the existing network of docks some 3 m below the quay level.

From an engineering point of view our proposals were to tackle the main problem areas in the following manner.

Hermitage Dock

It was recognized that this dock could form the centrepiece of an attractive housing development (Fig. 13). We propose to virtually fill the dock with the surplus silt, seal it off with *Terram*, aggregate and polymer sheeting and fill with fresh water to a depth of 0.6–0.9m. The pond will then be topped up with surface water from the surrounding houses and stocked with aquatic plants and fish.

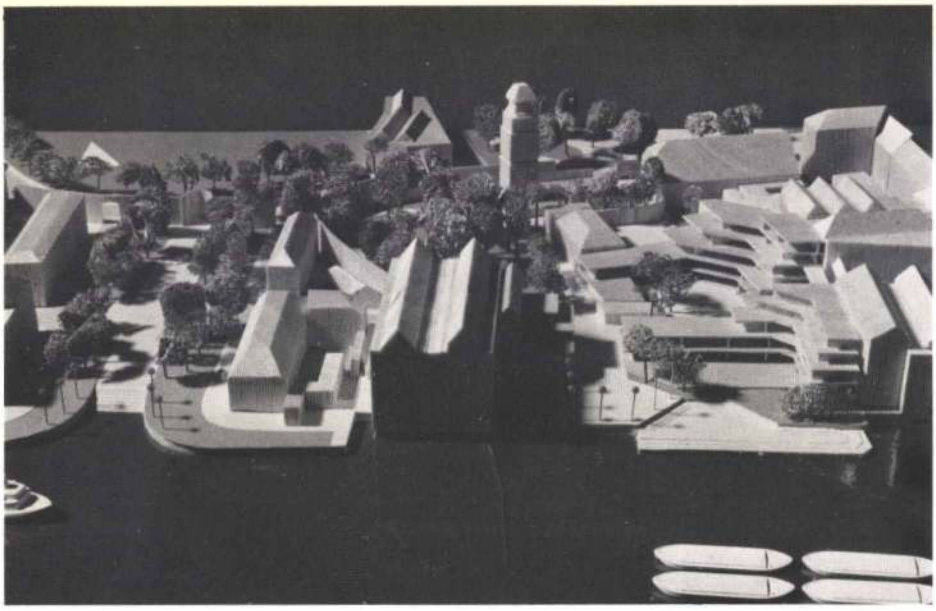


Fig. 9
Architects' model of Wapping Pierhead
(Photo: John Donat)

Fig. 10
Architects' model of Hermitage Basin from the river
(Photo: John Donat)

Fig. 11
Architects' model of the Shadwell Basin recreational area
(Photo: John Donat)

Fig. 12
The River Walk – impression of warehouses modified to create riverside access
(Illustration: Shepheard
Epstein & Hunter)

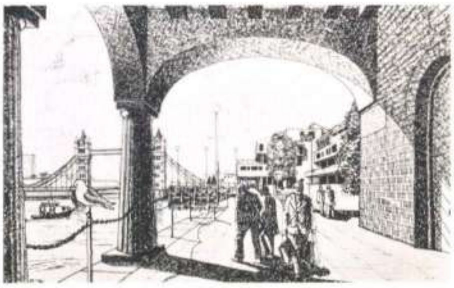


Fig. 13
Hermitage Basin
(Illustration: Shepheard
Epstein & Hunter)

Western Dock

This dock is too large to remain as a water area and, in any case, is required to support nearly 25% of the future housing. We did consider floating houses in the dock but decided that the plan form, the fact that it was landlocked, infrastructure problems and total cost were all against this being the optimum solution. It is intended that it will be filled to the minimum level required for dock wall stability, approximately 3 m below quay level, leaving the silt in position at the bottom of the dock.

To achieve this, partial filling and a system of lagooning the silt into smaller areas will be necessary, after which each area can more easily be dealt with. Due to the high cost of demolition, the jetty sub-structure will remain and the large silt deposit below should be trapped in its present position with embankments of fill around its perimeter. By undertaking the work in this manner, it will be necessary to provide special foundations in some areas. However, this approach will effectively deal with the problems associated with silt without additional overall cost.

Tobacco Dock

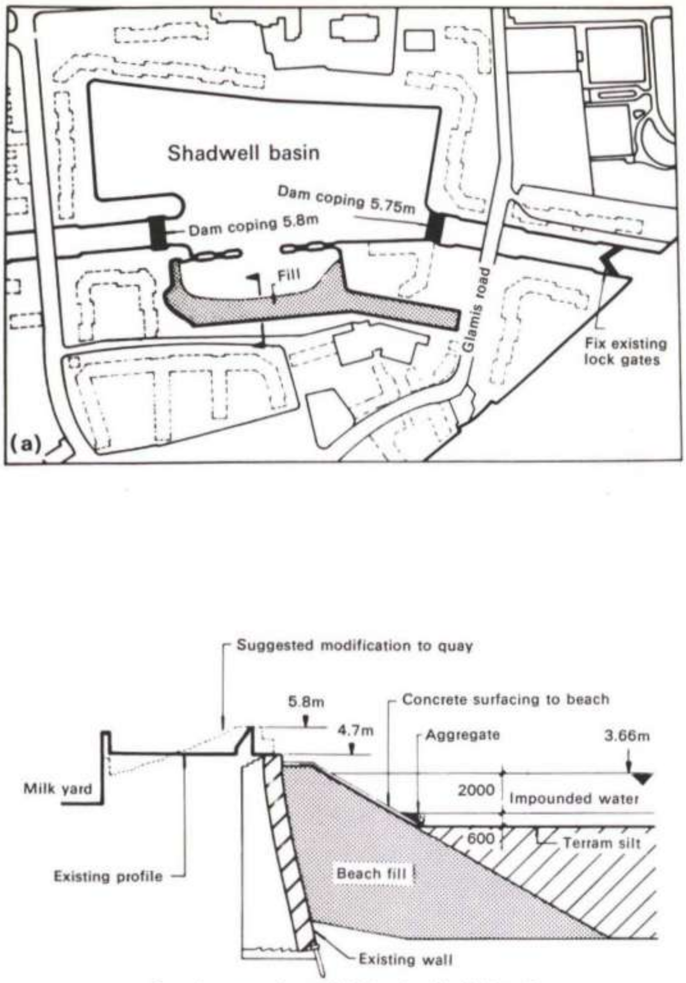
As this is designated as an open space, it is intended to utilize the area to dispose of existing material unsuitable for building on, which would otherwise need to be taken from the site and dumped elsewhere at some cost.

Eastern Dock and Wapping Basin

Both have been filled by the Port of London Authority and recommendations are to retain the former as a planted open space, whilst the latter already supports an all-weather football pitch.

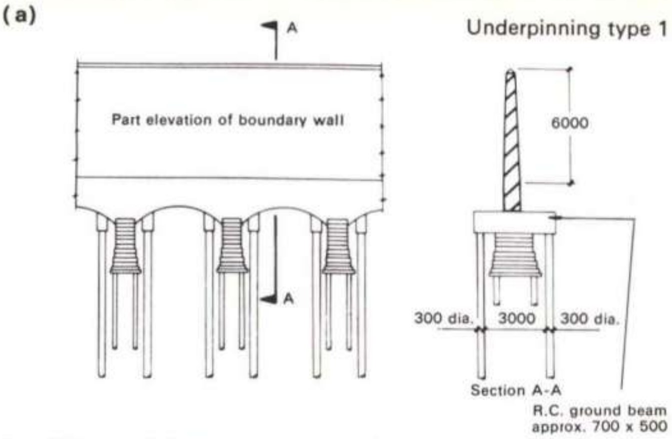
Shadwell

This has been designated as an aquatic recreational area. Phasing requirements dictate that the basin may be required to act as a settling tank when the water in Western Dock is pumped into it. The existing silt will generally remain in whatever contours exist, except for

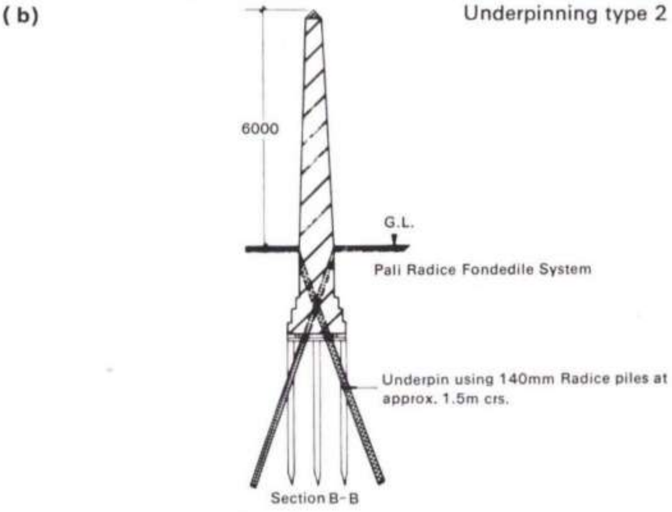


(b) Section south wall Shadwell old basin

Fig. 14
Shadwell Basin initial engineering works: (a) Plan (b) Section



Possible remedial measures to arched and pier foundations



Strip foundations

Fig. 15
Underpinning proposals (a) Type 1 (b) Type 2

Shadwell Old Basin where there is a considerable quantity. Here some action may need to be taken to lower the level by pushing silt into the new basin, thus maintaining a minimum water level of 2 m. The reshaped silt should then be covered with a polymer matting and marine dredged aggregate. It is anticipated that the final water levels will vary between 2 and 5 m in depth which seems to be in accordance with the present users' requirements. We shall introduce some degree of water circulation together with impervious dams at the entrances, beaching and a water level platform or pontoon system (Fig. 14).

Vaults

Apart from one small area in the south-east corner of Western Dock, it is unlikely that any of the vaults will remain. The main reason is that, with few exceptions, the vaults were only designed to support single-storey buildings. Furthermore, their foundations have deteriorated so they are no longer adequate for long-term stability and are unsuitable for re-use.

Boundary walls

The majority of walls, particularly those to the west of Wapping Lane, are subject to a preservation order and are constructed on badly decayed timber foundations. Each length of wall is being treated on its merits. Some lengths are being demolished whilst other lengths are being underpinned or modified and incorporated into the development plan (Fig. 15). Each length is the subject of discussions with the GLC Ancient Buildings Division, who are adopting the philosophy that it is far better to expose and retain the dock walls than to retain the boundary walls with their restrictions to planning and pedestrian movement.

Transportation

The transport policies and proposals for Wapping are based on the general land-use pattern shown on the Wapping Local Plan and in the London Docklands Strategic Plan. With the exception of the north-west industrial commercial zone, the area has been taken to be basically residential, and apart from the local centre, will have only small pockets of other uses. These remaining uses will generate only small volumes of lorry traffic and will therefore be compatible with the basic residential character of adjacent uses.

Road network

The road network is based on a hierarchy of local roads related to the highway, a primary distributor. The roads intended to provide links between residential access roads and the primary distributor are Thomas More Street, Upper Wapping Lane, Garnet Street and Glamis Road; these roads will cater for external vehicle trips. A loop road, connecting Green Bank and Thomas More Street, caters for internal east-west vehicular movements; this loop is primarily intended to provide a bus route which runs as nearly as possible along the axis of the future population and also passes close to the local centre and proposed River Line Station.

The basic form of the road network allows a number of streets to be pedestrianized and some roads closed where this is considered desirable for planning or environmental reasons. The form of the network is such that the closures would not adversely affect traffic circulation.

Public transport

London Transport have made tentative proposals to introduce a new bus service which would run between Stratford and Aldgate via Wapping. This bus route would use the loop road. The existing '67' route would enter Wapping via Garnet Street and terminate in Prusom Street near the site of the proposed River Line Station. The site for the station has not been finally decided, but it seems likely that the street exit will be on the block formed by Prusom Street and Lower Wapping Lane.

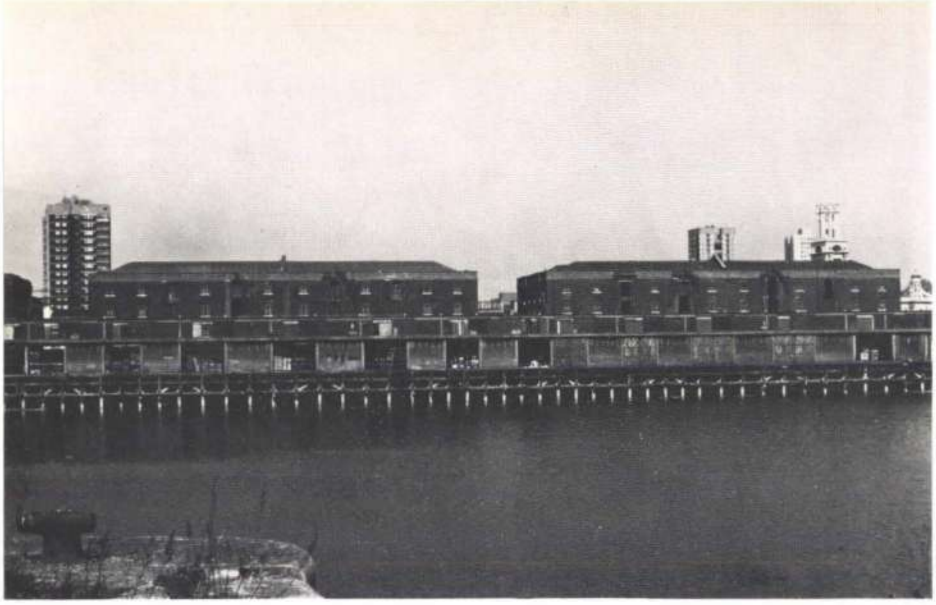
Infrastructure

Generally the area of Wapping is well served by the statutory authorities' services and foul sewerage and our proposal is merely to link up the various runs into link mains. The one shortcoming is the complete lack of a separate stormwater system which the Thames Water Authority now require to comply with their future policy.

The dock areas at present drain into the docks with some small areas drained into the combined sewers. The drainage of the proposed development will, as far as possible, be diverted to the river, via the water area of Shadwell Basin, which will act as a reservoir to store storm water for short periods of heavy rainfall when the river is in flood. One important further factor is to ensure this system and indeed our proposals provide no possible breaching of the Thames flood defences.

Industry

Together with housing proposals, there is a great need for industry to be encouraged into the area. In this respect the London Borough of Tower Hamlets have negotiated a lease with Riverside Ltd. for the north-western corner of the site. This area will ultimately contain commercial and industrial buildings and will also make use of the existing



warehouses on the north quay (Fig. 16). These warehouses, which are the subject of a preservation order, formed part of the original contract and date back to 1805. They are of brick and timber construction over well-preserved groined vaults.

These vaults contain a remarkable ventilation system which works well today even though some entrances are blocked with rubble. The roofs were constructed with large timbers and purpose-made trusses, spanning some 24 m (Fig. 17), supported the slate roof and sliding cranes.

Programme

Since the completion of the master plan we have been appointed for the Phase 1 redevelopment covering the area of Eastern Dock. We have also been appointed for the engineering reclamation work to the entire area. Both jobs are being designed at this time and work is intended to start on site at the end of this year. The completion of the redevelopment is intended to be 1985.

References

(1) SMILES, S. Lives of the engineers. John Murray, 1861.

(2) ROLT, L. T. C. Isambard Kingdom Brunel. Longmans, 1957.

(3) WALKER, T. A. The Severn Tunnel: its construction and difficulties, 1827–1887. Kingsmead Reprints, 1969.

(4) TREASE, G. London – a concise history. Thames & Hudson, 1975.

(5) PUDNEY, J. London's Docks. Thames & Hudson, 1975.

(6) RENDEL, PALMER AND TRITTON. Proposed reclamation of London Docks – An engineering appraisal. Rendel, Palmer and Tritton, 1969.

(7) DOCKLANDS JOINT COMMITTEE. *Working paper for consultation 8*. Conservation and the Role of the River. Docklands Development Team, 1975.

(8) LONDON DOCKLAND STUDY TEAM. Docklands – redevelopment proposals for East London. London Dockland Study Team, 1973.

(9) Drawing references relating to the Port of London Authority's drawings now in Tower Hamlets' possession.

(10) MUDD, I. The London Docks. A report and structural assessment for their future use. Ove Arup & Partners, 1977.

Credits

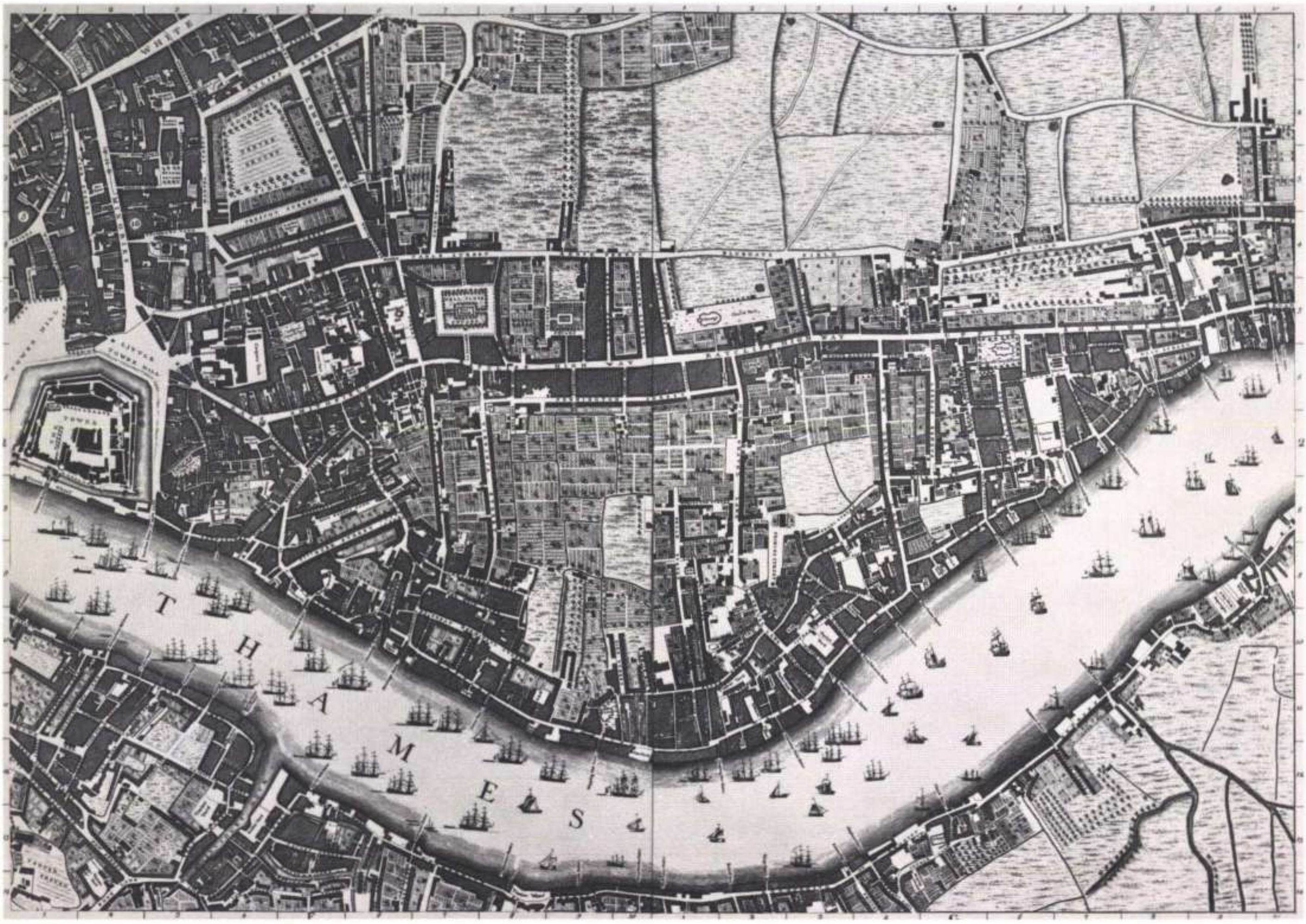
Client: London Borough of Tower Hamlets

Architects:
Shepheard, Epstein & Hunter

Quantity surveyors:
Burrell, Hayward & Budd

Consulting engineers:
Ove Arup & Partners

Fig. 18 Below Wapping *circa* 1745



'The Times' New Printing House Square

Martin Jenkins
Ken Smith

Mid-October 1971 saw the first Arup involvement with the Grays Inn Road Project. Initially work was conducted with the utmost secrecy, as it was important that we should proceed with the design whilst *The Times* and *The Sunday Times* management concluded their in-house discussions with all interested parties.

The situation was that in 1966 *The Times* had sold their office and production facilities to *The Observer*. The former had contracted to vacate Printing House Square, a previous Arup job, for new premises by the end of April 1974. This meant that there were 2½ years left from the time the final design team was appointed, with R. Seifert and Partners as the architects, to when *The Times* had to move or go out of print.

The implications were very serious. All we knew at that time was that the building would be up to 20 storeys high with a 12 m deep industrial basement. We understood that it would be impossible for the newspaper to find alternative accommodation as both editorial and production facilities are specialized and require purpose-built accommodation.

This was daunting enough, but we were unaware of the problems which were to follow:

(1) Planning restrictions which increasingly lowered the height of the building and enlarged and changed its plan and shape

(2) The increase in the size of basement from one or possibly two tunnels linking the adjacent Thomson House, to ultimately opening up the full width of the basement under Coley Street, thus making one large integral industrial basement

(3) Increase in the size of the car park basement to support the additional north east wing, which became necessary when the height of the building had to be reduced

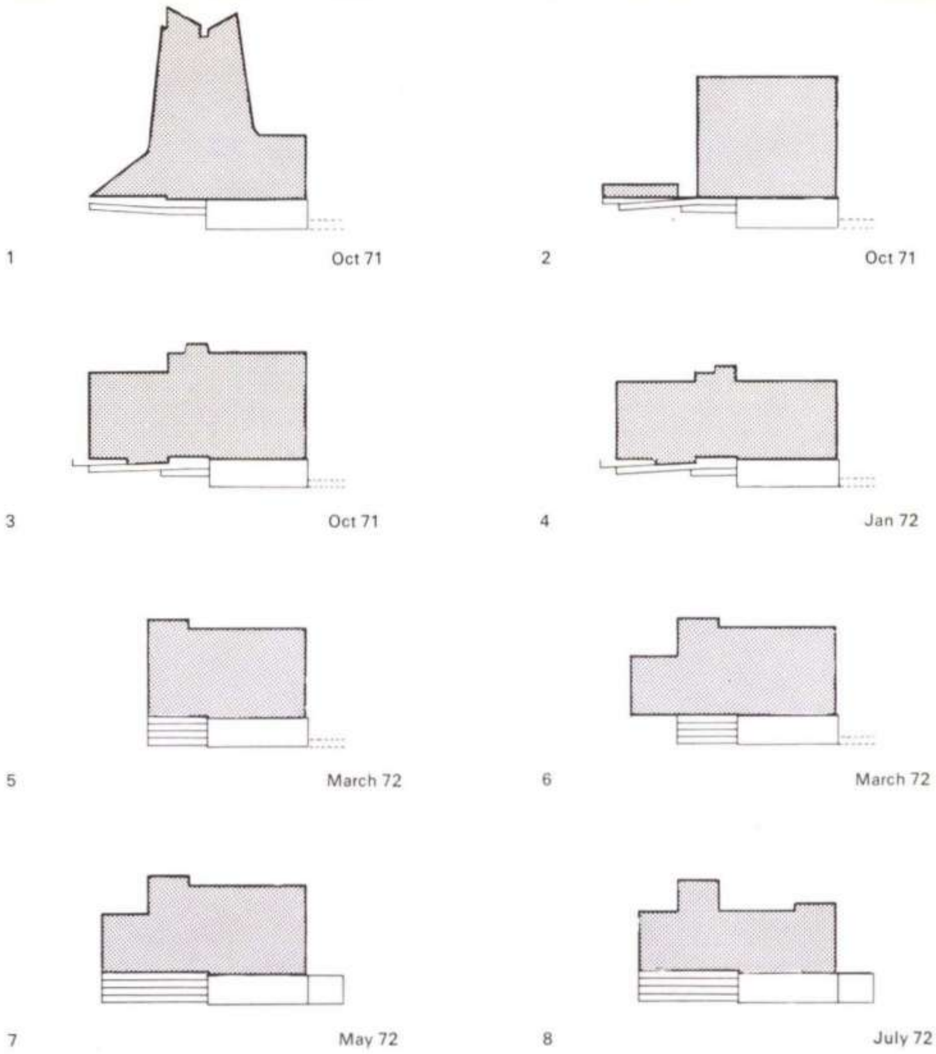


Fig. 1
Development proposals

(4) The shortage of materials which often led to sections of the building being redesigned in order to use materials which were available

(5) Additional problems which arose with the advent of the three-day week.

As it was a requirement that construction should in no way affect the production of *The Guardian* and *The Sunday Times* in the adjacent Thomson House – the loss of one night's production could cost up to £100,000 – traffic movements to and from the site had to be carefully monitored and restricted.

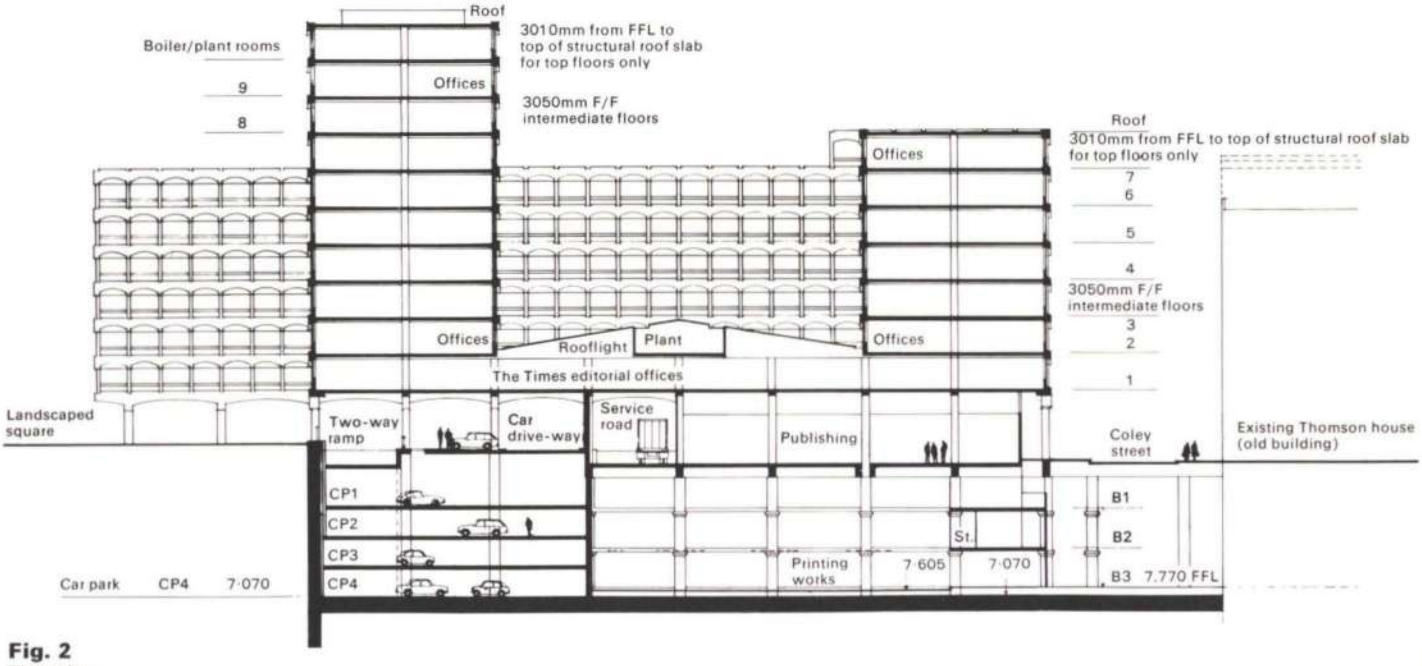
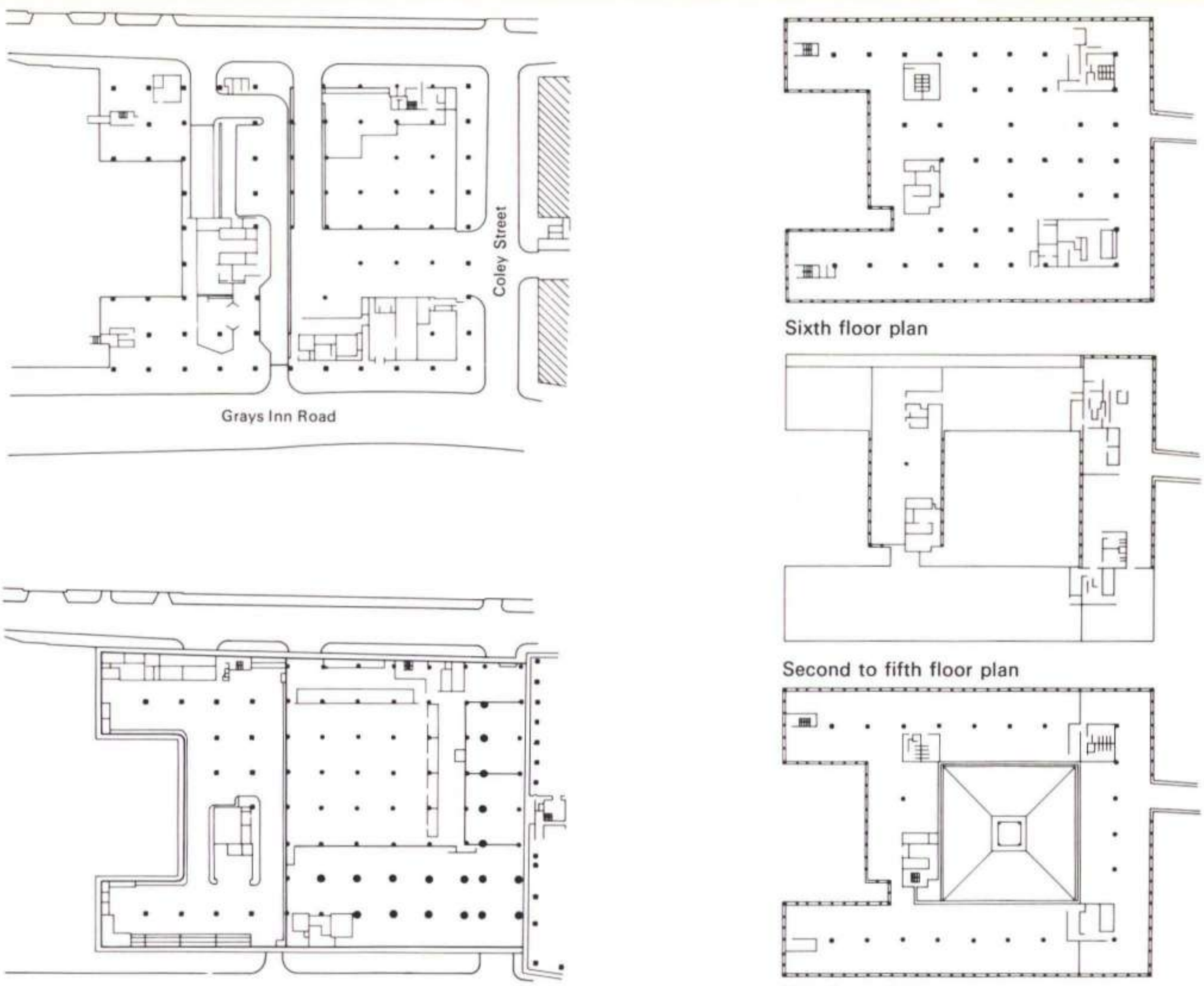


Fig. 2
Elevation



Ground floor plan

Basement plan

Sixth floor plan

Second to fifth floor plan

First floor plan

Fig. 3
Plans

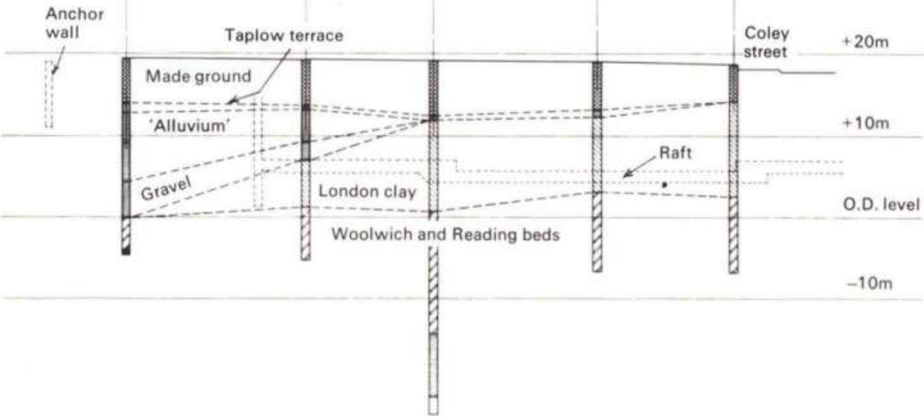


Fig. 4
North-south section through site

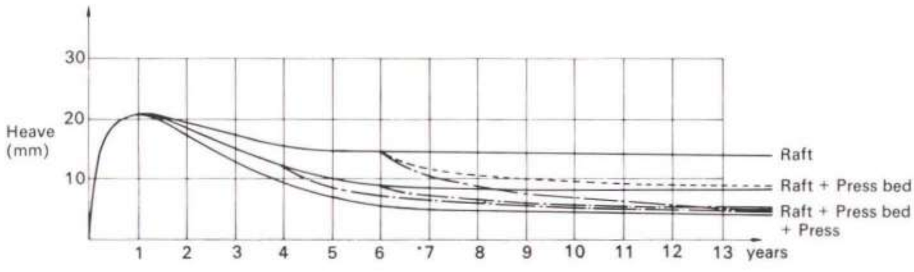


Fig. 5
Typical time-deflection curve at middle of raft

Although similar to normal speculative office building, the editorial offices required a much higher level of communication. In addition to telephone, telex and possibly computers, Lamson Paragon, with its system of vacuum tubes, is used and library storage for newspaper cuttings, photographic plates, etc., were needed. *The Times* would have liked complete flexibility on the location of the areas requiring abnormal floor loading, but this would have meant designing the whole building for a minimum of 10kN/m^3.

Although the Thomson Organization, proprietors of *The Times*, owned the site, they did not wish to finance the development completely. Through a complex financial arrangement the building was eventually financed, mostly by Westmoreland Properties Ltd. They also provided the expertise to develop the site on the lines of a speculative office development. This situation gave rise to a conflict of interests between a commercial office development on the one hand and an industrial printing complex on the other. For example, the centres of columns, the ground to first floor headroom and access to the basement from the ground floor, would affect the economic return on the offices by adding to the building costs without increasing the rent return.

All nine presses in the basement of Thomson House were only used on Saturday nights for the production of *The Sunday Times*. For the remainder of the week the majority of the presses were idle, except for two which produced *The Guardian*, and one which produced *The Times Educational Supplement* during the day. The production side was therefore very much under-utilized. With *The Times* being produced on the spare presses,

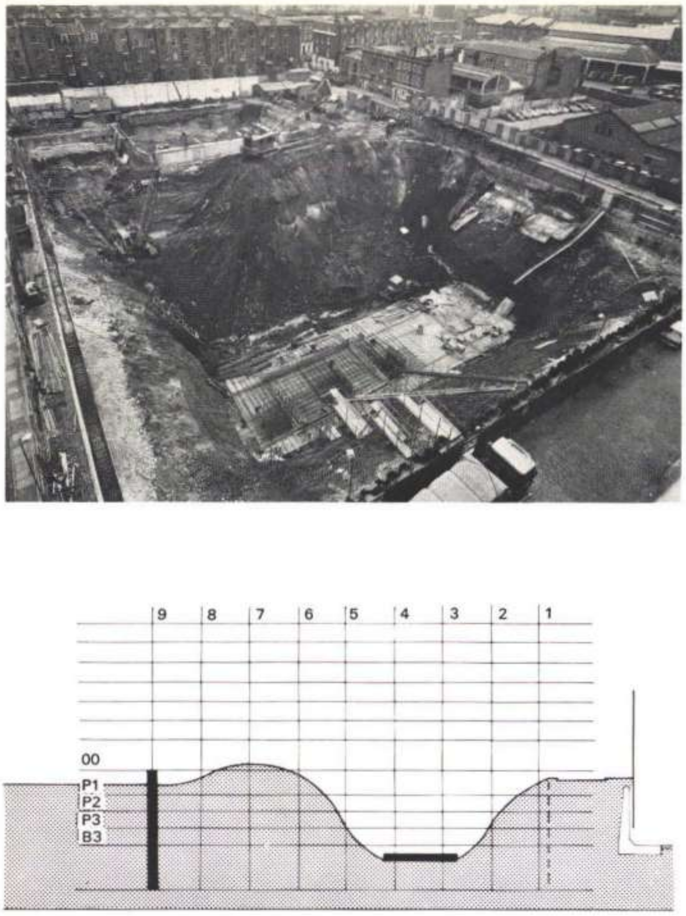


Fig. 6
Construction at 9 January 1973

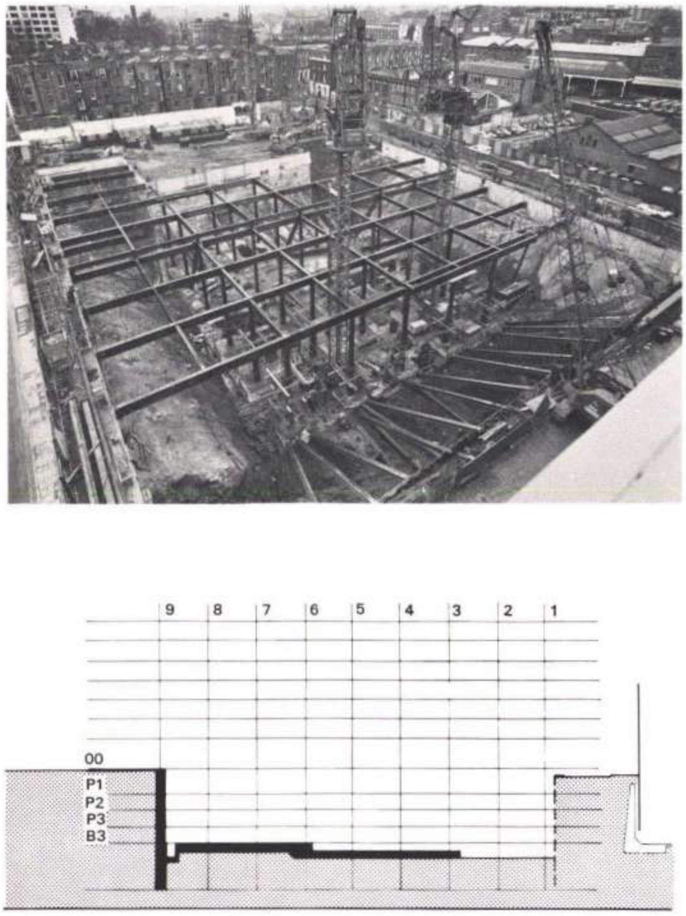


Fig. 7
Construction at 4 April 1973

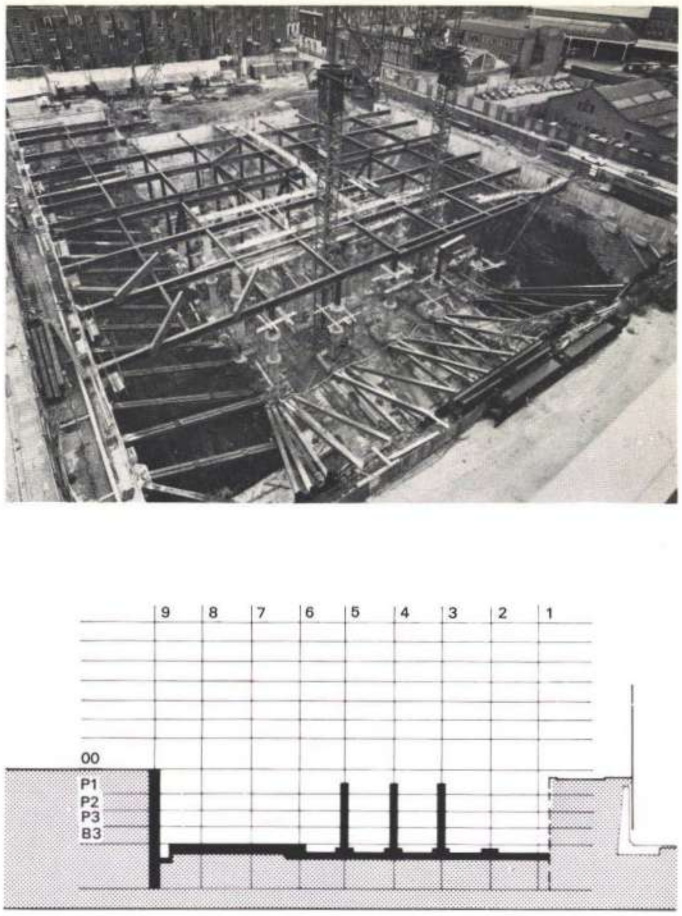


Fig. 8
Construction at 1 May 1973

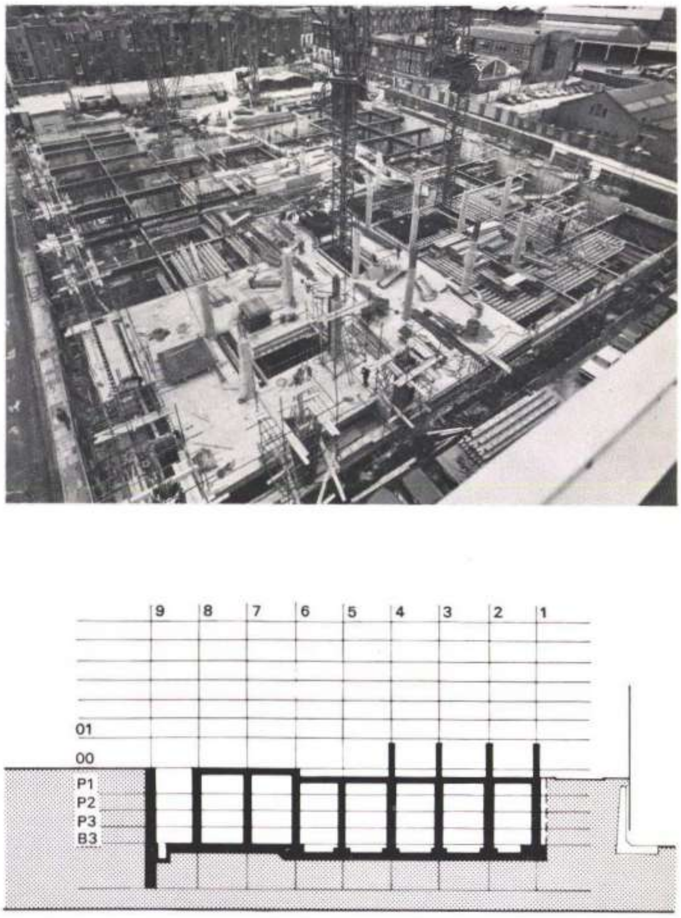


Fig. 9
Construction at 23 July 1973

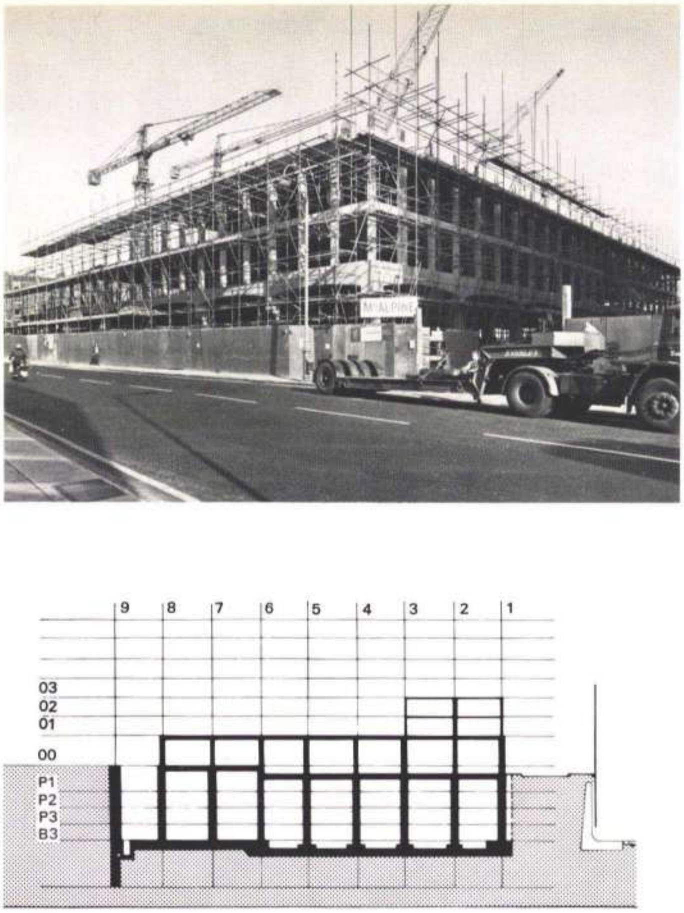


Fig. 10
Construction at 24 October 1973

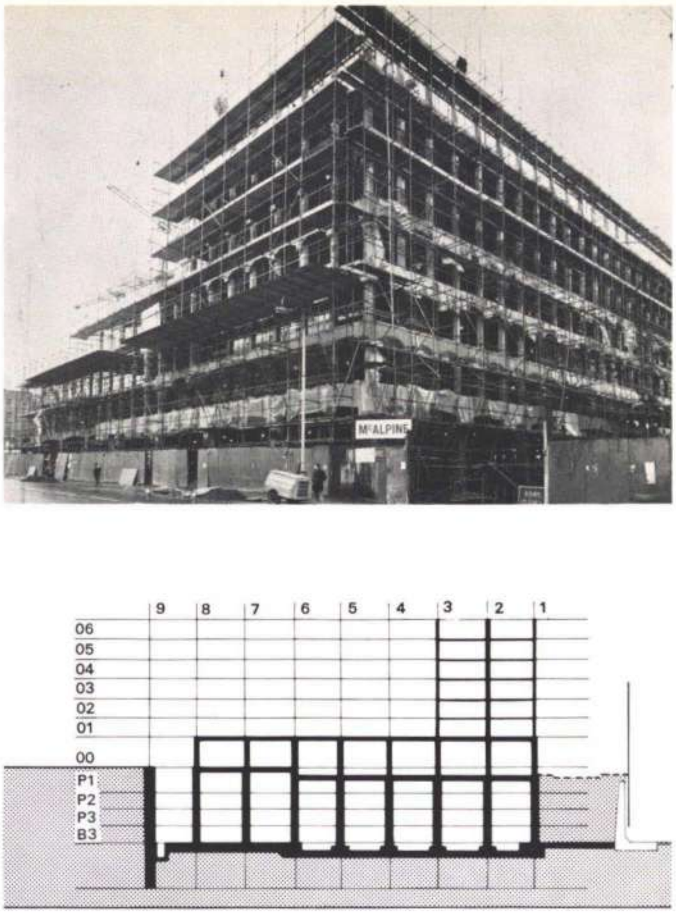


Fig. 11
Construction at 11 December 1973

there would then be little reserve capacity in the event of overhauling or possibly changing the presses in the future. Hence the need for provision for expansion, even if not immediately used.

1500 tonnes of newsprint is used each week to produce *The Times*, *The Sunday Times* and *The Guardian*. The total storage capacity of the existing basement was about 1,000 tonnes. As 800 tonnes of this was being used to produce *The Sunday Times*, there was inadequate spare capacity in the event of a disruption of supply. A much greater storage capacity was required immediately.

Final scheme

It took nine months from the appointment of the design team, before a final scheme in principle was reached. The diaphragm wall contract was then awarded prior to the final scheme being agreed and planning approval obtained, the diaphragm wall contractor being the main contractor until approval was obtained. The 20-storey scheme with a 12 m deep basement was too complex and unlikely to be ready for occupation within $2\frac{1}{2}$ years. For a long time schemes were being produced almost daily as planning requirements reduced the building in height. The basement and the brief however increased. An extra basement wing was added and the link bridge between the new building and Thomson House was extended from the original one or two storeys to five.

To achieve the occupation date it was essential to construct up to and including the ground floor as soon as possible. The diaphragm wall was designed to span from foundation to ground floor, whilst the columns were designed to be unrestrained between foundation and ground floor. Construction could then take place from the foundation and the ground floor simultaneously.

The site is located on the west side of the Fleet Valley. From a preliminary site investigation it was known that there were unusual geological formations, so a more comprehensive site investigation was carried out. The geological section through the site in a north/south direction showed that below the 5 m of made ground there was approximately 3 m of Taplow Terrace. Below this the alluvium tapered out over the London Clay in the middle of the site. At the north end below the Taplow beds there was alluvium, at the south, London Clay. Allowing for foundation construction this would leave approximately 3 m of London Clay between the foundation and the Woolwich and Reading beds. The site investigation showed that each stratum had its own water table. Various foundation solutions were investigated. Piling would either have to be with 20 m casings, which would be rather impractical, or drilled through bentonite slurry. As a diaphragm wall was envisaged around the basement, consideration was given, particularly when considering the 20-storey solution, to using lengths of diaphragm wall as barrettes (pier foundations).

Had the building remained 20 storeys high this would probably have been the only possible solution. However one of the requirements of Jack Stragg, the chief engineering consultant to *The Times*, was that the distortions which could take place under the press runs should not exceed 1 in 40,000. If this figure is exceeded then the presses do not run true, resulting in the newsprint running incorrectly over the press rollers, causing the paper to jam or break, with substantial loss of production. It was therefore necessary to carefully assess the effects of heave and settlement during the excavation and construction sequence, not only for the new building but also in respect of the existing presses in the adjacent Thomson House.

Very careful analysis was therefore made of the heave and settlement that was likely to occur. The construction time for these assessments was very critical. It was fortunate in this respect that the building had to be built by a certain time. At a very early stage it was necessary for Arup's Project Planning Group to prepare a construction programme to see if the building could possibly be built within the time available. The result of this programme proved to be a very useful input, in assessing the loading at any time during construction and hence aiding the assessment of heave and settlement.

The result of this investigation concluded that due to the fact that we were constructing a deep basement, the final loads from the building were approaching what had been removed during excavation. Also because of the depth of the basement we were very close to the Woolwich and Reading beds. Normally the London Clay gives rise to the majority of heave and settlement. As this was thin the settlement was found to be of an acceptable order. In fact it transpired that the presses would require realignment approximately every six months, which is the usual frequency for this operation anyway.

Raft

For speed of construction a raft seemed to be the quickest solution. It was fortunate that the results of the analysis also indicated a raft as being the preferred solution.

In its temporary condition the east and west retaining walls were required to cantilever from the perimeter berm until the raft, central columns and ground floor steelwork, which braces the top of the wall, were complete. In its final condition the wall spans the 13 m from the raft to the ground floor; it also supports the perimeter columns of the building. As it was not possible to prop the walls in a north-south direction it was necessary to anchor the retaining wall back. To achieve this an additional diaphragm wall was constructed to the north and anchored to the north retaining wall by means of McAlloy bars. The stability is provided by the mass of material between the two walls. At the southern end of the site, Coley Street was temporarily supported by sheet piling until it was excavated.

It was possible to make very economical use of the ground floor steelwork and the columns supporting it. In its temporary condition the ground floor steelwork props the top of the retaining wall.

Jacking the ground floor steelwork

To ensure that the elastic shortening had taken place in the ground floor steelwork bracing, before constructing the superstructure, the ground floor steelwork was jacked to the equivalent of the active reaction at the top of the retaining wall. The jacking force was 300 tonnes using Freyssinet flat jacks with a resin jacking fluid. Once this was completed the berm could then be removed in sections, the perimeter raft constructed, and the remaining columns in the berm section inserted so that the casing to the basement columns and ground floor could proceed. Both the columns and the ground floor beams were designed as composite sections. The columns were provided with corbels for future intermediate floors, in the industrial area, connections being provided for the car park slabs.

In its final position the majority of the ground floor is designed as a composite bridge deck, using prestressed concrete inverted T highway bridge beams. *The Times* required that the ground floor should be designed for 42 tonne continental lorries and *not* for the lower 32 tonne Ministry of Transport loading. Although it was understood that it is illegal in this country to exceed the MOT requirements, it was thought prudent to design for the heavier lorries, so that if, due to paper shortages or for any other reason, continental lorries did enter the building, it would be capable of carrying the heavier load.

Coley Street was to be removed to enlarge the industrial basement under New Printing House Square and also to provide a direct link with the Thomson House basement. It was therefore found necessary firstly to remove, by blasting, areas of the walls adjacent to Thomson House and then to diamond stitch drill through the 1.4 m thick reinforced concrete retaining walls.

Concrete clad portal frames

While Coley Street was being removed and reinstated, a Bailey Bridge was provided between Thomson House and the site to enable a free flow of reel lorries. The new structure for Coley Street was of steel portal frames clad in concrete with corbels provided for two additional basement floor levels. Several of the portal frame members were salvaged from the temporary steel props used during the diaphragm wall construction. The deck was of composite construction and was cast at a lower level to enable statutory services to be replaced and added. Approximately $\frac{1}{2}$ m of fill was placed over to make up levels.

Planning constraints increased the complexity of the design of the superstructure. Planning consent was granted on the condition that the parapet to the Grays Inn Road elevation should not exceed the height of the handrail on the roof of the existing adjacent Thomson House. The height between ground and underside of the first floor beams was fixed by the height required to obtain 5 m headroom for lorries entering and leaving the building. The typical floors were designed to a minimum height with provision for services to run within the false ceiling. The facade is clad with precast arched soffit panels with mosaic facing. Above first floor the facade has mullions at 2.5 m centres with the 1st floor beams spanning 7.5 m in a flat arch form.

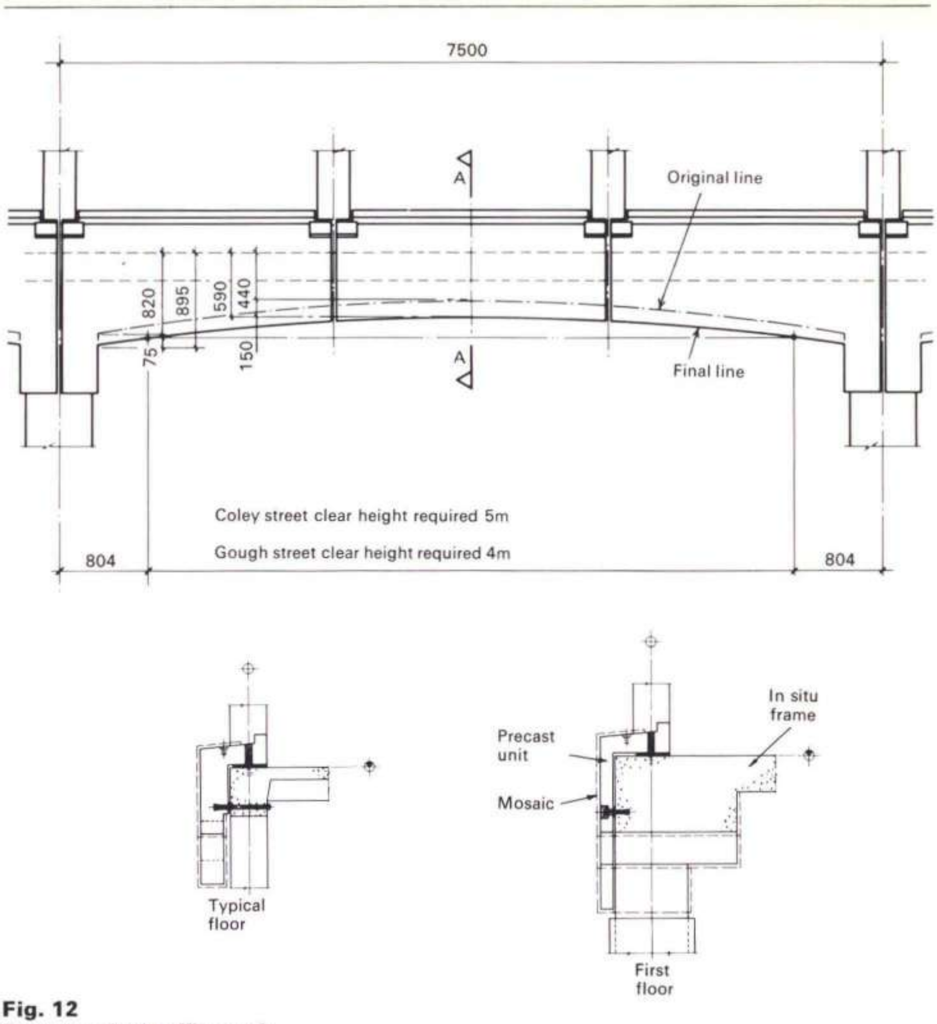


Fig. 12
Precast arched soffit panels

Fig. 13
(Photo: Sydney Newbery)

The first floor beam section was not capable of carrying the full facade loading from these mullions, and the mullions on the column centres were not capable of carrying the load from the full 7.5 m span. To minimize the depth of the first floor beams and avoid losing a complete storey height, the whole facade was designed as a frame, thus sharing the load between the typical and first floor beams. In view of the industrial use of the ground floor and basement, the first floor level had an upper slab floating on a cork granule layer. The slabs above this level were normally of inverted trough section with coffers or plain slabs in areas of specialized usage. The superstructure plan forms a quadrangle with the middle space roofed at second floor level with a steel beam pitched structure falling in four directions. The secondary plant room was positioned at the centre of this area with its height varying with the roof pitch. The soffit of the plant room is at first floor roof level, i.e. directly above *The Times* main editorial area, the sound proofing, therefore, being critical.

The main plant room was at 10th floor level in the north block. This also had a double sound proofed slab with cork granule infill.

Fig. 14
Elevation from Grays Inn Road
(Photo: Sydney Newbery)

Fig. 18
Directors'suite
(Photo: Sydney Newbery)

Fig. 19
Executive suite entrance area
(Photo: Sydney Newbery)

Fig. 15
Editorial office
(Photo: Sydney Newbery)

Fig. 16
North elevation
(Photo: Sydney Newbery)

Fig. 17
B3 basement reel store
(Photo: Sydney Newbery)

Access was also required between New Printing House Square and Thomson House at upper levels. This led to the requirement for a single width, two-storey link bridge with lightweight cladding which subsequently increased to a double width, five-storey link bridge with steel structure and concrete cladding and containing stairs to enable random access between New Printing House Square and Thomson House. Due to the cladding fixing and architectural requirements, it was decided to use storey-height vierendeel members for the main frames. However, as Coley Street was being removed at the time the link bridge structure was erected, each vierendeel member had to be split into two longitudinally to get within the weight restriction imposed by the lifting capacities of the tower cranes. At the New Printing House Square end the structure had been redesigned to carry the additional loading but, upon checking the existing Thomson House, this was found not to be possible. Columns were placed, therefore, between the Thomson House facade and the inner face of the retaining wall.

Despite all the problems, setbacks and the complexities of the building, the move to New Printing House Square took place in June 1974 and the production continuity of *The Times* was maintained.

Credits

Architects:
Richard Seifert & Partners

Main contractor:
Sir Robert McAlpine & Sons

Structural consultants:
Ove Arup & Partners

Mechanical and electrical consultants:
Hayden Young Ltd.

Quantity surveyors:
G. D. Watford & Partners

Competition for township at Sulaibikhat, Kuwait

Svend Jensen

A new era in the history of Kuwait began in 1946 when oil gushed from the desert of what is now known as the Burgan oil field. Up until then outsiders had mainly known the City of Kuwait as a junction of caravan routes and as a home port for deep-water sailing dhows where the Sheikdom's inhabitants quietly occupied themselves with the time-honoured pursuits of pearling, fishing, seafaring and ship building.

The oil brought sudden economic prosperity which led to radical changes in mental attitude, in culture and in society. This was reflected, not least, by physical changes to the townscape; the urban growth that has taken place in Kuwait over the last 30 years is unequalled by any development elsewhere.

The old city of Kuwait, shaped like a rugby ball, occupied the end of a blunt promontory in the Gulf. To the north was the sea and the southern side was protected by an 8 km long, 4m high mud wall hurriedly built during Ramadan, 1920, in defence against invading tribes.

The early buildings

Inside the wall was a compact, cellular town with an intricate network of roadways and alleyways (Fig. 1). Most of the houses were built with an inner courtyard on one level, with perhaps a single room upstairs. Around the roof was a parapet wall, up to a couple of metres high, to give privacy and in the summer everyone slept up there. The walls were made with coral rock from the bay and sun-baked mud, and the flat roofs were formed by circular poles covered with mats of woven reed, topped by a thick layer of mud mixed with straw. This heavy, solid structure with its thermal time lag was ideal in the hot, dry climate and the houses being built against, or close to each other, gave shadow and protection against sand storms. The buildings were simple and dignified with no pretension about their design but an expression of a very coherent and ordered way of life.

All this came to an end when the oil revenues started an urban expansion and redevelopment which grew with mushroom-like speed. The first in a long series of master plans was prepared in great haste in 1951 and a decision was made to rebuild the existing city. The Government launched a scheme where, to cope with the Country's increased trade and importance, it bought the old houses from the Kuwaitis to redevelop the centre to provide public buildings and commercial areas. A road network was ruthlessly cut through the closely packed city and the organic housing of the old inner town was replaced with wide, busy highways, new large buildings, modern bazaars and open semi-derelict spaces were left to be filled in later. This was a massive city building operation with demolition, building work and highway construction all going on at the same time at a speed which sometimes outstripped the planning.

The old inhabitants were paid a very generous compensation which allowed them to buy land and put up new modern houses outside the original limits of the town. This was a way of distributing the oil income to the citizens and as such was very successful, but the new developments, which were built on the neighbourhood unit concept, were not so satisfactory.

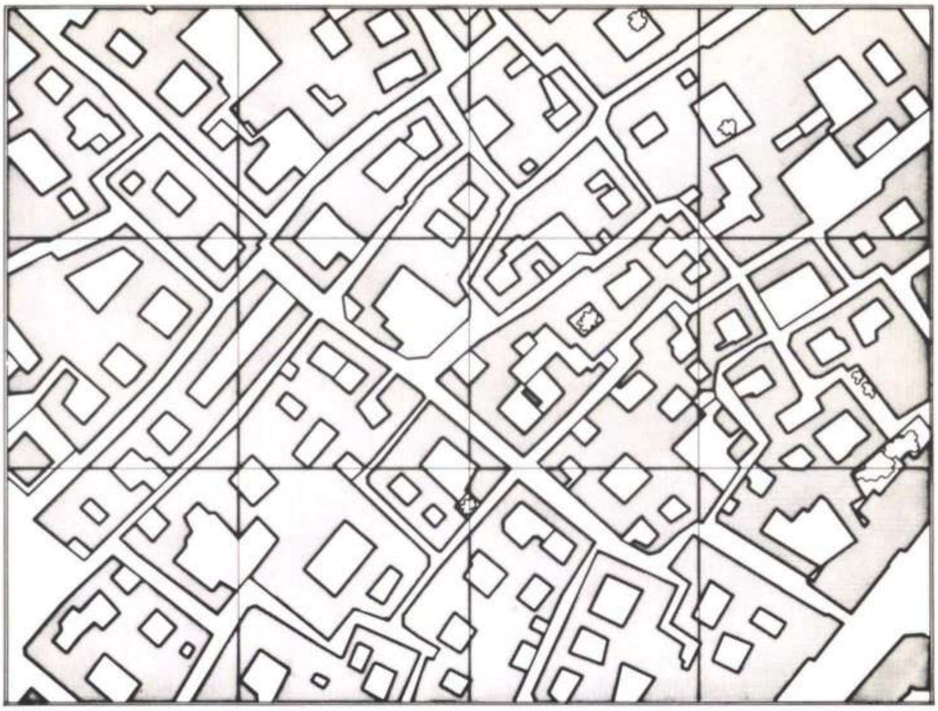


Fig. 1
The anatomy of Old Kuwait

Fig. 2
Site plan (1:1000 model) (Photo: Dissing & Weitling)

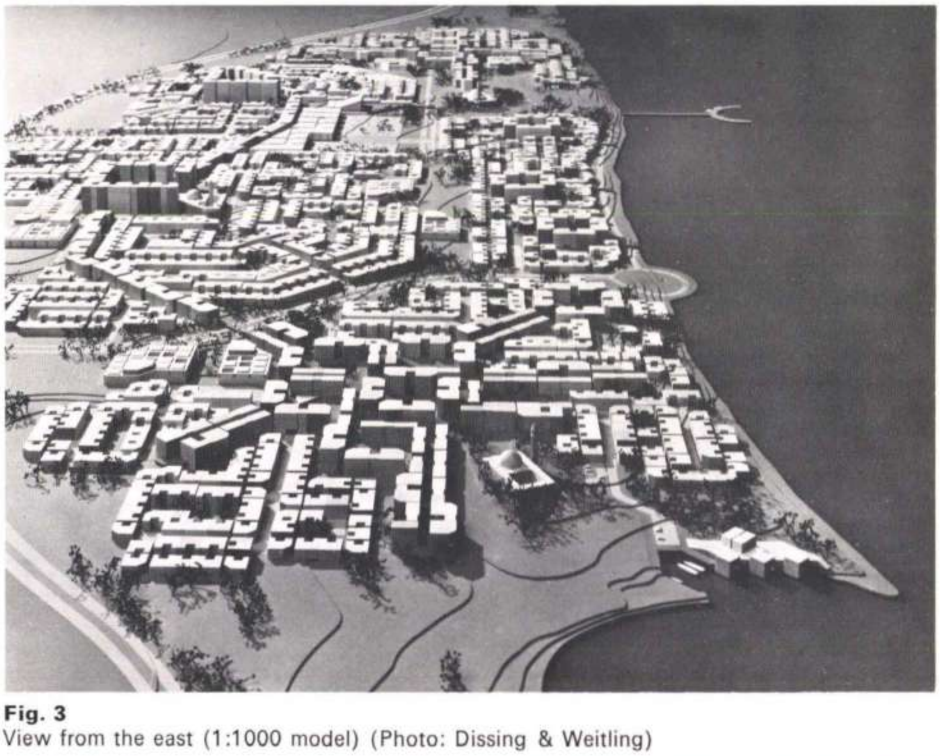


Fig. 3
View from the east (1:1000 model) (Photo: Dissing & Weitling)

The courtyard houses were abandoned and bungalows were built instead, each on its own plot, with vehicular access everywhere. The new 'western-style' houses did, in a number of ways, represent an improvement, but at the same time they were a complete break from the traditional buildings which had evolved around the local culture and climate. Nowadays more Kuwaitis are becoming disillusioned with the form of some of the new developments; there is a feeling that something has been lost and a hankering to go back to the old roots.

It is Government policy that each Kuwaiti should have his own home and, in spite of all the building works which have taken place, there is still a great need for housing. The original inhabitants of the city have been rehoused and there is now a programme for settling the Bedouin. Another growing demand is for middle income housing for the young, newly married graduates and professional people, known as 'the second generation Kuwaitis'.

Invitation and brief

It was against this background that Dissing + Weitling and Ove Arup & Partners were invited in 1975 to enter a limited competition for a new township on a 108 ha site at Sulaibikhat, 15 km west of Kuwait City.

Arne Jacobsen had designed the Central Bank in Kuwait and the National Housing Authority asked Dissing+Weitling, who are carrying on his practice, to submit a prequalification entry for the new township. We were working closely with Dissing+Weitling on the design of the Danish Embassy in London and they suggested that we should make a combined submission as joint principal consultants. Northcroft Neighbour and Nicholson came in as Quantity Surveyors and John Allpass of The Institut for Center Planlaegning in Copenhagen acted as consultant on planning. The submission was successful and we were one of six firms asked to enter a paid competition.

The brief was to provide middle income housing together with all associated community facilities and infrastructure on a site approximately 2 km long and 0.5 km wide. The township was intended to be for the younger generation and the size of all dwellings had to be based on a five person family with a net area of 230 to 250 m² together with car parking for two cars. A high density was required and it was envisaged in the brief that the housing would be in the form of medium to high rise buildings.

It was a condition that the firm who submitted the successful entry should work with a local consultant and we formed an association with Pan Arab and drew on their local knowledge and expertise. In particular one of their partners, Sabah Al-Rayes, was very much involved and came to London and Copenhagen to advise on the proposals.

Even with Pan Arab's involvement there was some concern as to how well we, as foreigners, could put forward solutions within a very short time-scale which were right for Kuwait. This was stressed by John Allpass in the section of our report dealing with planning, where he said, '... urban and building development is not only a technical and economic question but just as much an expression of culture, social values and climatic conditions'. It went on to say that there should be further consultations, studies and pilot schemes before any proposals were implemented.

Densities and land use

One of the points we queried with the National Housing Authority was the specified density of 250 persons per ha. We got the impression that they saw this as a gross density and they were really looking for ways of putting 25,000 people on to the site. In the architects' and planners' opinion this was unrealistic, particularly with the given space requirement of 50 m² per person, and we got the client's agreement to put forward our own suggestions.

In our proposals, housing occupies 68 ha with an average plot ratio of 0.79 giving a total population of approximately 11,500. The detailed breakdown of the land use is:

	Number of units	Total land required
Dwellings	2265	68.0 ha
Children's playgrounds	28	2.8
Green areas/parks	23	2.3
Mosques	2	1.0
Kindergartens	3	3.0
Elementary schools	3	4.5
Intermediate schools	2	3.5
Secondary schools	1	2.5
Commercial neighbourhood centre	1	3.0
Town park	1	4.4
Roads, car parks, walkways		13.0
		108.0 ha

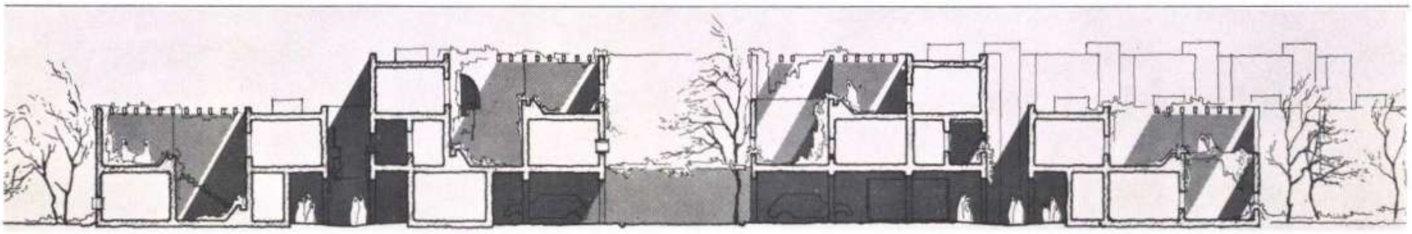


Fig. 4
Sections through A-Type dwelling

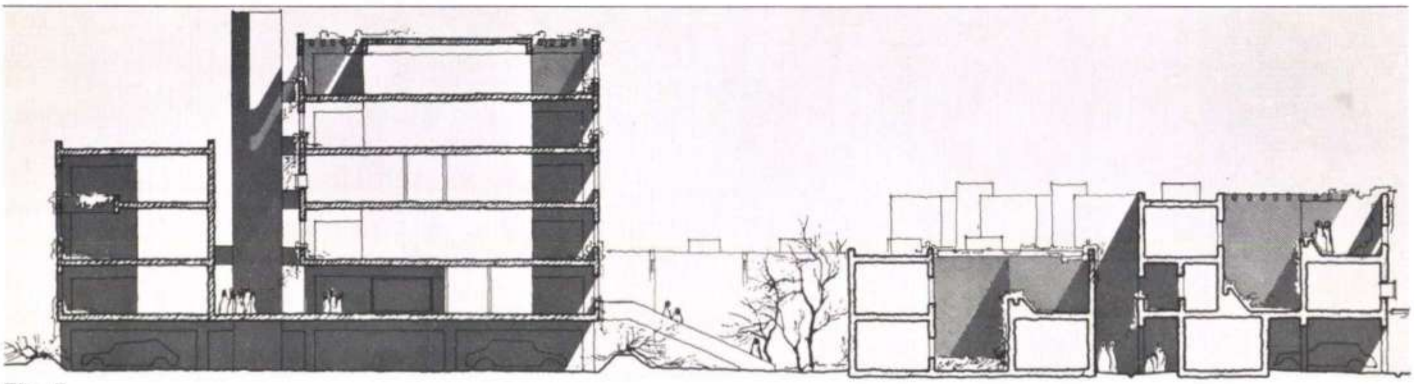


Fig. 5
Section through apartment buildings and A-Type houses

Planning

The brief appeared to have been written around a scheme characterized by wide roads and tower blocks with large open landscaped areas in between. A solution on those lines, which at one time was thought to be the answer for sun-starved, northern climates, was totally rejected by the architects. They saw a scheme based on the traditional Arab township in a form which would give natural protection and shadow and the key phrase for the project became, *The Architecture of the Shadow*.

We argued that low rise housing is not synonymous with low density and the planning ended up being based on two basic types of dwellings. The first type, representing approximately half the total number of units, was a two or three storey courtyard house which could be used isolated, semi-detached or as a town house to give a high density. The second type was apartment buildings. Generally these were four to five storey blocks but in two cases, on the high points of the site, they were taken up to 10 storeys to reinforce and strengthen the urban environment, creating a vertical structure which is necessary to experience and measure the horizontal scale.

The buildings were designed with an inbuilt privacy so they could be placed very close together and access roads were kept as narrow as possible. There is vehicle access to all the dwellings, but frequently one road serves two rows of houses on either side (Fig. 4) and in other cases the roads have been placed under the buildings (Fig. 5).

The pedestrian system, segregated from the roads, was given a lot of thought. A community feeling is more easily fostered if people meet, walk and sit together, so in the design an attempt has been made to create conditions that will encourage people to become pedestrians again. The shaded walkways have been used as a structuring element in the planning with all the principal points of attraction—shopping centres, schools and recreational areas—placed along them.

There is always the likelihood that a large scale development, combined with modern building methods, may produce a dull monotonous layout because the standardization, which is necessary for production purposes, starts influencing the planning. Both the architect and planners took great pains to try to avoid this, and to create tension, contrast and diversity within an overall framework of order and homogeneity. The repetition of a single unit could be devastating and although the number of different units in this project is limited they can be varied and put together in an infinite number of ways.

Housing units

The two principal units, the house and the apartment, are both planned to satisfy the Kuwaitis' need for privacy with separation between the public and private parts of the dwelling. The custom of segregating the sexes is not practised as strongly by the young generation as it was in their parents' time, but it is still very common for the husband to entertain friends without his wife being present. To allow for this there is, in addition to the normal reception rooms, a separate family room. Courtyards and balconies, shaded by sunsails and pergolas, are designed so that they cannot be overlooked by neighbours.

The A type house (Fig. 8) is based on a square plan so it can be used in free orientation related to the pedestrian street. The accommodation is on two floors and approximately half the houses are raised on pilotis so the space underneath can be used for car parking, hobby rooms and storage.

The apartments come in four versions, either on two floors as the B type dwelling or on one level as the C type. The façades are made up of U-shaped elements with the windows set in between, recessed from the front to give shade and protection. Stairs and lifts are placed in 'towers' free of the buildings, but linked to them by bridges over the pedestrian walkways (Fig. 9). The arrangement of all the apartment buildings employs the same idea of raising the pedestrian level to the first floor and reserving the lowest level for vehicle access and parking.

Community facilities

For the competition the community facilities had to be considered only in planning terms.

The Commercial Neighbourhood Centre with supermarket, shops, mosque, library, assembly hall and local offices was located centrally on the site and planned as a spine development along the main pedestrian route. This gives a more attractive solution than the common 'point centres' which easily end up as an island in a sea of parking. In the project the car parks were behind the centre and the delivery of goods also took place from the rear. In addition to the main centre it was proposed that there should be smaller shops, kiosks and coffee houses along the principal pedestrian routes.

Altogether, including the kindergartens, there are nine schools. Those for the younger children were located evenly throughout the development, whereas the schools for the older children were placed along the southern boundary of the site with the playing grounds and sports fields forming a buffer zone to the main road.

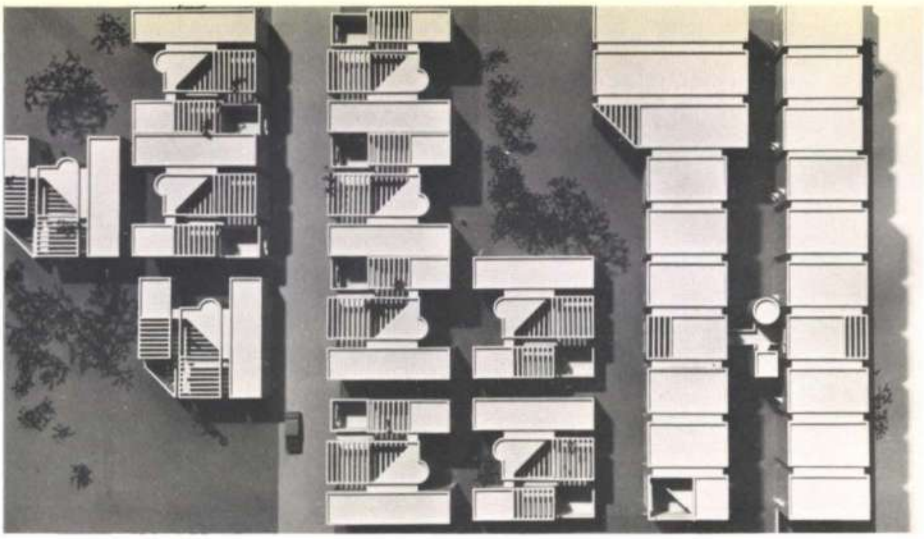


Fig. 6
Plan of dwelling (1:200 model) (Photo: Dissing & Weitling)

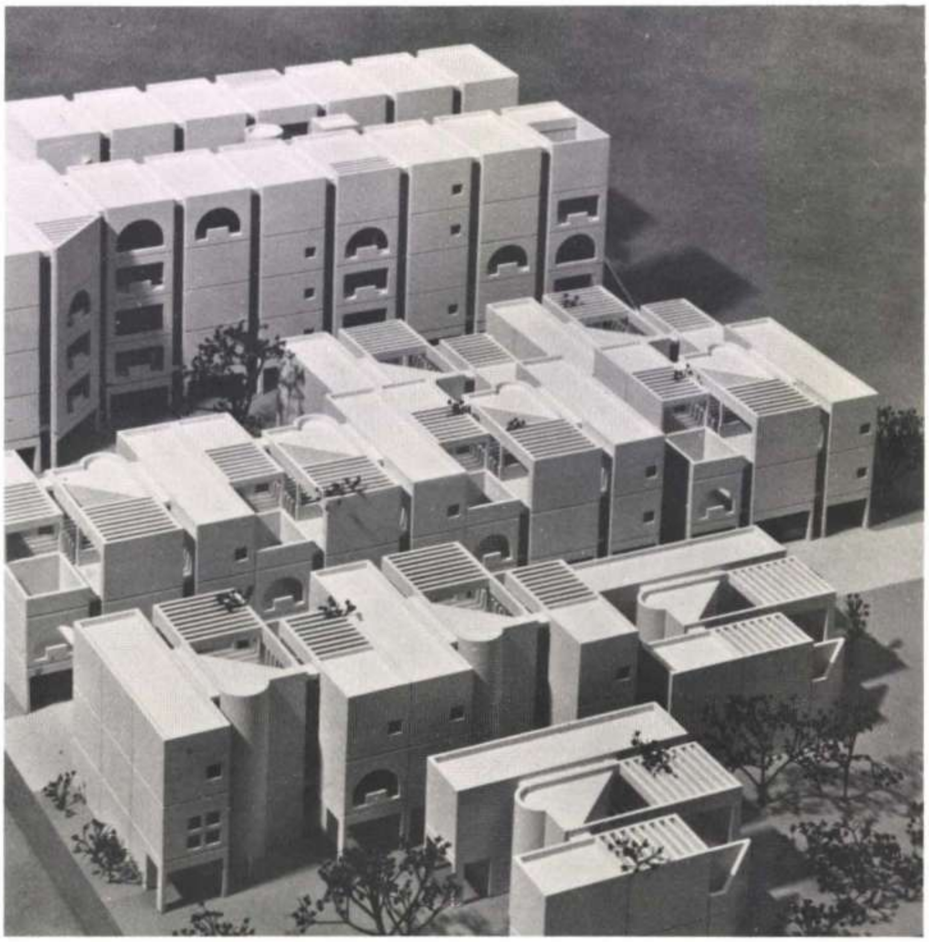


Fig. 7
Perspective view of model (Photo: Dissing & Weitling)

The two mosques were sited some distance apart from other buildings so they stood as monuments clearly seen from any viewpoint.

The minarets will act as vertical elements, in the same way as the two high-rise blocks, giving emphasis to the horizontal scale.

Parks, open spaces and playgrounds were distributed evenly throughout the development. The dimensions of these spaces were purposely kept small to maintain the urban character and to ensure the up-keep of cultivated areas under the extreme climatic conditions.

One of the most attractive things about the site is its location on the shore of the bay and the value of the waterfront as a recreational area is immense. The proposals included a circular marina at the end of a pier, a 'scenic drive' and a club at the eastern end of the site.

Building systems and structures

The programme called for the construction of more than 550,000 m² of floor area in a relatively short time, so clearly some form of rationalized or industrialized construction would be required. However, the requirement in the brief for the proposals to be compatible with five industrialized international building systems was not considered realistic and the client agreed that we could interpret this freely.

In the report we outlined the merits and disadvantages of fully industrialized, semi-industrial and rationalized traditional systems.

A fully industrialized system imposes limitations on freedom of planning and architectural expression. With large markets they can have economic advantages and, if the system is readily available, speed of construction can be increased. The trouble is that most of the systems have been developed for low to middle income housing in Europe and they would not be appropriate in Kuwait where the climatic conditions are so different and the space standards are larger than those the systems can accommodate.

Going to the other end of the scale it was obvious that the necessary rate of construction could not be achieved by conventional methods, so the scheme we put forward was a semi-industrialized system based on setting up a precasting yard on the site. The proposal was to use combined precast and in situ concrete construction which has an inherent structural stability and allows more freedom in planning than an all precast solution.

For industrialized construction to be a valid proposition it is a prerequisite that there is a high degree of standardization and repetition and the basis for that is dimensional co-ordination. A planning grid of 1.2 m was adopted and a lot of effort went into finding rational and economic standard solutions to integrate the services and structure within the modular systems. Air-conditioning ducts were carried in trough-shaped floor units or within double spine beams and precast elements were provided with standard holes and openings for service runs.

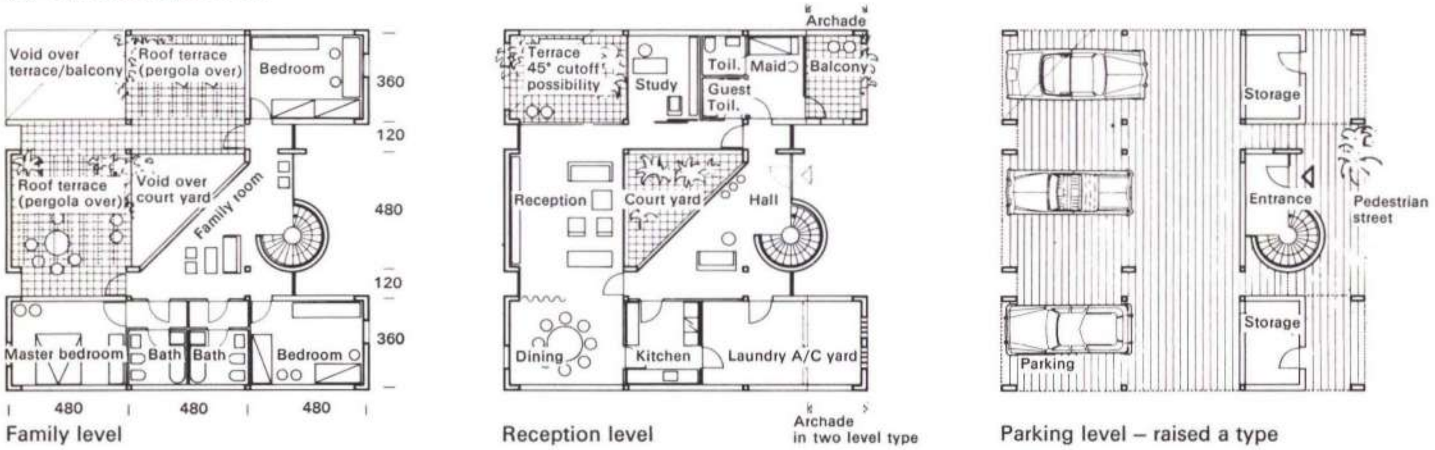
Although there are fundamental differences between the courtyard houses and the four to 10 storey high apartment buildings, common solutions were adopted as far as possible and structural elements were standardized to gain maximum advantage in production.

Apart from oil, Kuwait has few natural resources and sand-lime bricks are the only building product wholly made from local materials. In the past, surface deposits were used as coarse aggregate for making concrete, but the desert has now been 'swept clean' and there is a real shortage of aggregate; this, together with a large increase in cement prices, is reflected in the cost of concrete. One of the objectives in the design was, therefore, to employ sections with a high strength in relation to the amount of material used. For instance, the precast floor units which are common to all the dwellings and constitute a large part of the structure, were made as thin, trough-shaped elements.

Generally, framed construction was used for all buildings but shear walls were introduced in the 10 storey blocks to give lateral stability.

The span of most beams was 4.8 m but 8.4 m long beams were also used in the apartment buildings to give space for roads and car parking underneath. For the longer spans double spine beams were used to keep the size down and allow room for air-conditioning ducts in between.

(a) Apartment area 244m²



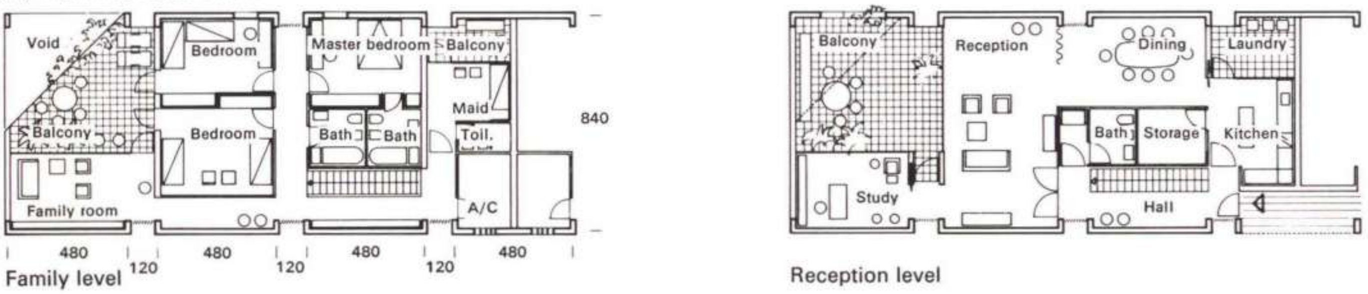
Family level

Reception level

Parking level – raised a type

Fig. 8a
Plans of A-Type dwelling

(b) Apartment area 276m²

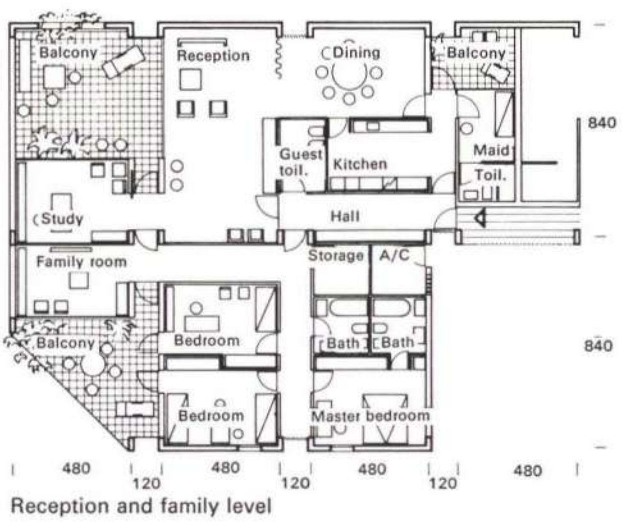


Family level

Reception level

Fig. 8b
Plans of B-Type dwelling

(c) Apartment area 246m²



Reception and family level

Fig. 8c
Plan of C-Type dwelling

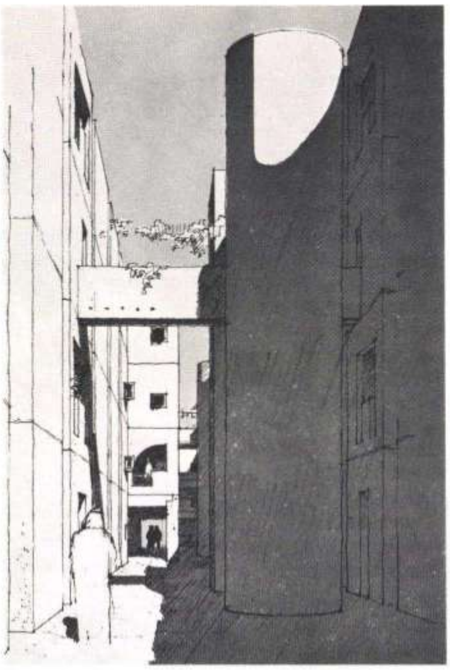


Fig. 9
Pedestrian street
between apartment buildings

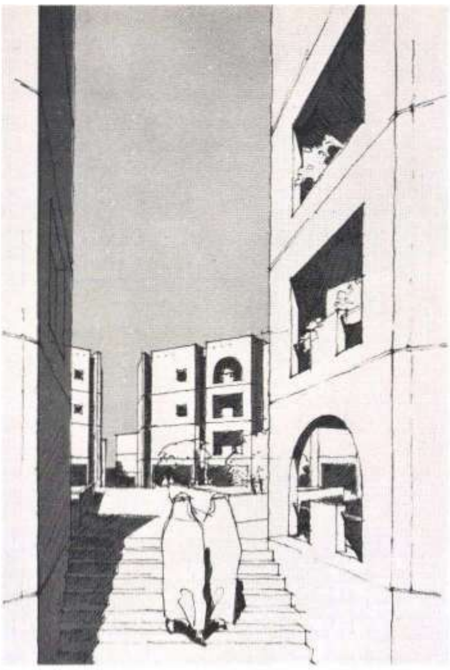


Fig. 10
Street leading to
pedestrian square

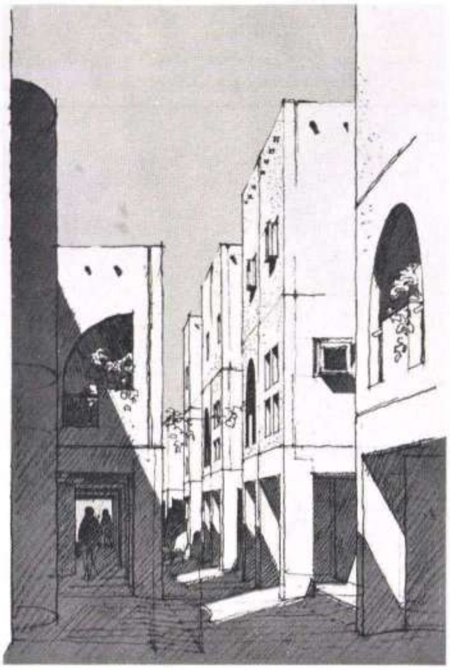


Fig. 11
Pedestrian street
between A-type houses

Services

Main services would be provided up to the site boundary but distribution within the site was included in our brief. The construction of a new infrastructure gave the opportunity to arrange the services in an orderly layout, mainly under footpaths and verges and where possible in a common trench, to economize on installation and maintenance costs.

The incoming electrical supply was taken from the 33 kV national grid, and extended underground to a bulk supply sub-station housing 33/11 kV transformers. From these an 11 kV primary distribution system supplied 500 kVA sub-stations, which were located throughout the development, each serving a group of residential units or community facilities. The secondary distribution was via a 415 volt, three phase system

Fresh water is a precious commodity, and we therefore suggested a dual system to supply both potable and brackish water. Brackish water would be used for fire fighting, irrigation, pools, fountains and also in the dwellings in those instances where the quality of water is unimportant.

Using the same principle the sewage and surface water drainage were kept separate and as far as possible the rainwater falling onto paved areas and roofs would be retained on site, collected in reservoirs and used for irrigating the landscaped areas.

It is claimed that for its size Kuwait has more air-conditioning than any other country in the world and this is perhaps not surprising with the hot dry climate, the large diurnal temperature variations and the absence of cloud cover to reduce solar radiation. The summer season has a shade temperature that can actually reach 50°C at noon and the black bulb temperature can soar as high as 80°C with the total incident solar radiation amounting to 1.2 kW/m².

The climatic conditions will place a constant demand on the cooling system for most parts of the day and lack of skilled personnel creates a maintenance and service problem. This called for selection of equipment which would provide the most dependable service possible.

The system adopted was to provide each dwelling with its own air handling unit located in a plant room accessible from the service areas. The individually controlled units were supplied with chilled water from a packaged, air-cooled, liquid chiller. These chiller units were placed on top of the roofs and each served about eight dwellings.

The air handling units drew fresh air through louvres in the exterior walls and the distribution through the dwellings was by ducts, integrated with the structure, at ceiling level. Exterior rooms were pressurized to minimize infiltration.

Phasing and costs

The development was planned to be built in three phases, making certain that the first phase was a viable community on its own and that later stages could be constructed with minimum disturbance to the residents.

Based on rates which applied in April 1975 the estimated cost of Phase 1 was about £80 m. and the estimated cost of the total development was approximately £270 m.

Competition entry and result

The other firms who were invited to enter the competition came from the USA, Canada, France, Holland and Sweden.

Apart from the drawings the National Housing Authority required a report describing the design, a cost estimate, details of the consultants' manpower forecasts, design programme and fee, proposals for supervision including an estimate of the cost and finally a 1:1000 model of the project.

The time allowed for preparing the entry was 12 weeks and as usual things went fairly slowly to start with, mainly because we were uncertain how to interpret the specified densities. As could be expected this meant working round the clock in the end, but this in itself was exhilarating. Late night meals in Dissing and Weitling's canteen were commonplace and Hans Dissing knew a friendly baker where he could get hot rolls early in the morning.

After all the material had been submitted it took some time before we heard anything officially. Nick Madina, who was looking after things in Kuwait and had been a tremendous help throughout, told us that our proposals had created a lot of interest and from other bits of information filtering back we felt hopeful. Carl Mogensen, Dissing and Weitling's job architect, went to Kuwait in connection with the Central Bank and came back feeling very optimistic. Knowing we were in the running right up to the end it was disappointing when we were finally told that we had lost out to the French. Their scheme was for clusters of high rise blocks with a high density and a cost per dwelling which was lower than ours.

The latest feed-back we have is that the French scheme has been reduced and undergone major changes so that it now is likely to be a low rise development with one or two 12 storey blocks.

Credits

Client:
National Housing Authority, Kuwait
Architect:
Dissing & Weitling

Management-type contracts: an introduction

Raymond Payne

Introduction

Management-type contracts have been in use for nearly 10 years with varying degrees of success. This paper sets out to provide an introduction to this type of contract. Other objectives are to indicate the situations in which they may prove useful, what services a management contractor can be expected to provide, and the contract arrangements under which this type of contract can be administered. A large body of knowledge and experience exists as a result of the management-type contracts which have been completed. This, coupled with the large range of alternatives available and resulting personal preferences, has generated a variety of opinions as to what is right and wrong. It is not the intention of this paper to arbitrate on these issues, but to show why, when and how a management-type contract could be applied. Part of the answer to the question 'Why'? is historical, and one point of view which could be adopted is that management-type contracts are rationalizing what has been going on in the industry for some time.

The construction industry has been in a state of change for the last 10 or 20 years. During this time three types of change have been prominent. These may be ascribed to organization, technique and administration. The organization of work has changed with the growing importance of the sub-contractor, the changing pattern of labour relations and a shift of responsibility amongst the design/construction team. The diversity of materials available and complexity of erection methods have contributed towards major changes in construction technique. These changes in construction organization and technique, when coupled with the commercial demands of low cost, short time and increased size of projects, has led to changes in management and administration in the industry. The scale and direction of administration must grow and change in the future if supply is to keep pace with potential future demand.

These changes often throw considerable stress on the conventional solutions to the demand/supply problem. For example the difference between the actual role of the nominated sub-contractor and his role as illustrated in the *Standard Form of Building Contract* is becoming increasingly large. It is probably true to say that the contractual relationships and administration in the Standard Form (and many other forms of contract) were brought into being for a demand and supply situation which is gradually disappearing, particularly on large jobs. Management-type contracts have, therefore, been developed to satisfy the conditions surrounding the administration of contracts which are either of very short duration or of great complexity, either technically or by virtue of the need to employ a large number of sub-contractors. Often both speed and complexity may occur on the same job, a situation which throws considerable stress on conventional organization and administration arrangements.

Basic principles

The most critical problem which the design and procurement side of the construction industry often has to face is how to place orders and start on site before the design for the whole project is completed, and, at the same time, keep the options open for as long as possible so that alternatives for following parts of the project can be properly considered without unreasonable pressures from cost and time factors. The difficulties in solving this problem increase as projects, particularly industrial ones, become more complex, and with the demand for faster construction programmes, the need for alternative contract arrangements becomes more critical, particularly in what is generally known as the process industry. The management-type contract is one way in which these alternative arrangements can be implemented.

The broad objectives of the management-type contract will obviously be as for any other arrangement, that is, to produce a situation that will assist in achieving better quality of design, equipment and construction within the time allowed and to achieve the best value for money. These obvious and apparently simple ideals are, however, often not fully achieved even on relatively straightforward projects which allow ample time for design, procurement and construction. Given a fixed time for the completion of a project the form of contract likely to satisfy most of the ideals will be that which allows maximum time: (1) For design so that problems are solved, specified, cost proved, and the alternatives fully considered (2) For procurement so that purchasing, expediting, works testing, manufacture and installation of equipment may be properly carried out. (3) For construction organization so that the design is accomplished to a sequence and gives a solution that is related to the materials, method and time for construction and procurement. (4) For commissioning so that the equipment can be used efficiently and the client is trained in its use.

Obviously all these times cannot be maximized simultaneously.

Where a client places priority on speed, and as a result of this places priority on advance procurement, it is advantageous to overlap the design and construction phases as much as possible in order to give the maximum time for design and construction organization. This however requires care if the initiative in cost control and design are to be maintained. It is difficult to hold a contractor to a tender based upon approximate information, irresponsible to insist on firm prices on such a basis, and not making the best use of the construction industry's resources. A contract arranged on the principle that costs will be negotiated for work subsequently to be designed and the construction time adjusted accordingly, inevitably passes the initiative and choice of alternatives in these matters to the contractor.

A management-type contract allows the design and construction phases to be extensively overlapped and at the same time permits competitive tenders to be obtained for a large part of the project. The management contractor is often, although not always, appointed on a fee basis which in theory allows him to align his attitude with that of the design team. Because he will not have a direct profit motive or other commercial interest in value of the project works, he is able to complete the client/designer/contractor team and has the common aim to achieve the ideals mentioned above.

The appointment of a contractor to work on this type of contract is done generally to satisfy a number of objectives. These are to:

(1) Draw upon the contractor's construction, procurement and management skills

(2) Enable the client to order in advance of construction items of material or equipment which are on long delivery

(3) Obtain competitive bids for the majority of the work

(4) Extend the time available to formulate a real construction programme so that the design can be sensibly organized and programmed without increasing the total project time

(5) Enable work to start on site well in advance of the completion of design.

The scale of the contractor's involvement in each of the above will of course depend on the size and type of project and on the type of contract which the management contractor has with the client to carry out the work. Clearly the management contractor can be appointed at any time. The main advantages of making his appointment early in the project's development, are that full use can be made of his resources and an early start be made on site.

Circumstances suitable for the employment of a management-type contract

There is a growing awareness in the construction industry of the need for more integration between design and construction, and if not integration, then at least positive steps to find out what the other part of the industry does and can do. In fact some would argue that it is difficult to design anything without it. This has led to the proliferation of methods of crossing this barrier, ranging from dimensional co-ordination and information systems on the one hand to package deals on the other. Whilst these ideas really only lightly touch upon the problem, it must be remembered that the same is true in a sense of management-type contracts. The application of this form of contract is largely dependent on the type of construction as well as the constraints imposed on the administration of the work by commercial needs. The type of construction will be dealt with first.

(a) Buildings generally

The use of management-type contracts on this type of construction is confined almost exclusively to major redevelopment projects, the leisure industry and the recurrent-type contracts of large retail groups. It is unlikely that management-type contracts would be suitable for the remainder of the building work where the various existing traditional systems are eminently suitable. However special consideration may need to be given in situations where a very large number of specialist sub-contractors are to be employed, or work is being built in conjunction with the process industry.

(b) Civil engineering

The existing methods of administering of civil engineering contracts, whilst needing a certain amount of overhaul, are not likely to be improved upon by the use of management-type contracts. The administrative methods for the small and middle range civil engineering works are very similar to the majority of building works. The large and very large works necessitate a particular methodology for each individual job, within the framework laid down in the administering contract. Even on large civil engineering work complicated by stage and/or serial construction, the number of sub-contractors is likely to be relatively small and well within the scope of current administrative techniques. However, the use of a management-type contract on civil engineering work where it is undertaken in conjunction with large mechanical and electrical contracts might be appropriate.

(c) Industrial complexes

The use of a management-type contract on large or small industrial complexes where a large procurement, expediting and free issue service is required, can prove beneficial, and in certain instances may be the only way in which a particular design and construction problem may be solved; even more so if there is also a building and civil engineering involvement. However, it may not prove to be a worthwhile method if the job simply involves straightforward mechanical and electrical supply and erection for a single or easily identifiable group or groups of process or utility services.

It has already been mentioned that the second category of application to which management-type contracts may be applied is to solve the problem imposed by a variety of constraints which may be imposed either deliberately or by commercial or administrative pressures on the design and construction team. These are summarized below.

(a) Short design and/or construction period
This is a situation which is becoming increasingly common with changing money values and the consequent need for projects to be either revenue-earning or replacing obsolete processes at an early date. It is aggravated by the increasing size and complexity of buildings and plant installations, and often the time period, in the case of chemical installations, is so short as to produce a crash cost situation. Many buildings and industrial works with short design and construction periods can be designed and built either within the framework of traditional systems or on a 'package deal' basis quite satisfactorily. However, if into this situation is injected a multiplicity of sub-contractors and some kind of advance ordering or free issue arrangement, then the only satisfactory solution is a management-type contract.

(b) Progressive expansion of large industrial complexes

This is a particular problem facing the petrochemical and allied industries. The problem here, in addition to the various points mentioned above, is one of keeping adequate labour resources over a relatively long period of time and arranging the contracts in such a way that the labour forces are compatible. The management-type contract may go a long way towards solving these problems, together with obtaining and/or training the permanent employees who will eventually operate the plant.

(c) Closely-related design and construction
When the construction method and the equipment is sufficiently unusual that it materially affects the method of design, then a management contract can possibly be used to advantage. In this way the contractor's construction skills can be linked to that of the design team and best use made of the resources available.

(d) Finance required and/or term maintenance
Satisfactory term maintenance arrangements can often be successfully arranged, sometimes in conjunction with plant leasing finance or project funding, by some form of management-type contract.

The use of a management-type contract can therefore probably be used to advantage on the following types of work:

(i) Major redevelopment projects and work undertaken for retail and leisure industry.

(ii) Civil engineering works forming part of larger contracts.

(iii) Industrial complexes with many sub-contractors and large purchasing involvement. In addition a management-type contract may be effectively employed where a very short time scale is involved, finance or maintenance is necessary, there are particular labour and related problems or the method of design is very closely linked to construction.

Administration

The broad objectives of the administration of management-type contracts are to satisfy the demands of the trinity of quality, time and cost. With this type of contract, however, it will be within the framework of the commercial and administrative pressures surrounding the project. The standard forms of contract without modification are often unsuitable for complex projects which have to be designed and built in a short space of time, or with untraditional constraints. Standard forms are often adapted and used in conjunction with approximate bills, negotiated rates, two-stage tendering techniques and so on in their various forms. The most critical problem often is how to place orders, obtain information from vendors and start on site before the design for the whole project is completed and at the same time keep the options open for as long as possible so that alternatives can be properly considered. The difficulty in solving this problem increases as projects become more complex and, with the demand for faster construction programmes the need for alternative contract arrangements becomes greater.

A hierarchy of inter-related contracts must therefore be developed to deal with the contractual issues involved in the administration of management-type contracts, together with the management contractor's responsibilities. A common form of such contracts is shown below.

(a) Between employer and management contractor

This contract defines the responsibilities and duties of the management contractor, the employer and often the engineer, architect and other relevant party. It is the employer's basic control document, which control he may exercise on the advice of his professional advisers or unilaterally.

(b) Between management contractor (or employer) and sub-contractor or supplier

(i) This contract will exist where the management contractor elects to enter into a contract direct with the sub-contractors. often referred to as construction contractors, or suppliers. The management contractor may operate this contract under a specific agency condition written in either his contract with the employer or a condition in the sub-contract agreement.

(ii) It may be desirable in certain circumstances for the employer to enter into the sub-contracts direct, in which case the agreement between the employer and management contractor would be worded accordingly.

(c) Between sub-contractor or supplier and nominated or domestic sub-contractor

These agreements would be written and administered in the usual way, based on one of the standard forms of contract if appropriate.

(d) Between employer and professional advisers

The service agreements between the employer and engineer, architect, quantity surveyor, planner, etc., would be written to incorporate the activities of the management contractor and complementary duties and responsibilities in this respect would be included.

The management contractor's responsibilities

The type of contract between the management contractor and client falls between two extremes. This contract, which defines the management contractor's liability for time cost and quality, may be either 'hard' or 'soft' or somewhere between the two. The hard and soft contracts may be defined as follows:

(a) The hard contract
An extreme example of a hard contract is when a management contractor bears all the duties, liabilities and responsibilities of a normal conventional contract but is not allowed to carry out any of the work himself. This arrangement is hardly a management-type contract at all, but serves to indicate what is meant by the term 'hard'.

(b) The soft contract
The soft contract is a more liberal contract. The client relies only on his common law rights if the management contractor fails to exercise all proper care and skill in the performance of his duties. In other words he is relied upon to act in a quasi-professional capacity. Again it is unlikely that he would be called upon to carry out any of the work, other than to step in when sub-contractors default.

Between the hard and soft contracts there is obviously a vast range of contract types which places a variety of obligations on the management contractor, including the right to build part of the project if necessary, and complementary conditions on the members of the design team. The basic principles can be adapted as the job demands which of course means that each job must be considered on its own merits. Unless one is dealing with serial contracts, it is unlikely that previous or standard agreements can be adapted to suit other circumstances and each project must be considered afresh. A significant feature of this is the consideration of the services which the management contractor is required to provide.

Outline of management contractor services

The following are brief details of the sort of service which a management contractor can be called upon to provide. Obviously each project will dictate the extent to which these services are used and some, all or more can be used as required. There is a further point to consider apart from which of these services are used. It is that they are defined very carefully in the agreement between the client and the management contractor.

Programming and construction planning
Programming could commence immediately after appointment and be a continuous activity throughout the contract. The management contractor could be required to produce jointly with the design team and regularly update a programme. One or more of the management contractor's programmers or planners could work in the design team's office. Later this activity could be transferred to site. The management contractor could also advise on possible methods of construction and on the selection of building materials and specialist building components.

Joint selection of sub-contractors and placing of sub-contracts
The design team jointly with the management contractor draws up tender lists for all sub-contracts. In this selection process it is usual that the management contractor be responsible for investigating performance and the financial soundness of prospective tenderers. He could advise the design team on the sub-contract conditions of contract, and ultimately these could be compiled and agreed jointly. The management contractor is often responsible for placing the sub-contracts upon the instructions of the design team.

Ordering long delivery plant
Upon the instructions of the design team the management contractor could place orders as applicable for the manufacture, delivery and erection of items of process and other plant. This process and other plant is that which, because of long delivery times, must be ordered in advance of the work on site. It is also considered desirable that the management contractor could be responsible for checking the progress which the sub-contractor is making in the design, manufacture, delivery and erection. He could then take such corrective action as is necessary, and inform the design team accordingly.

Cost control
The management contractor could assist in the pre-construction period with this work by advising on specific elements involving alternative materials and methods of construction. He could also assist in the pro-

duction of cash flow forecasts. During the construction period the management contractor could assist the design team with the preparation of accurate cost statements and forecasts, the forecasting of the effects of variations and generally to control costs during the progress of the works.

Project management
The management contractor could be responsible for the quality, coordination and progress of sub-contractors' works using delegated powers from the design team. He could ensure that the design team's production information and the construction and commissioning programme are properly integrated.

Site organization and facilities
The management contractor could be responsible for the provision and maintenance of the site organization and facilities. These generally comprise the following:

Site security

Temporary site access roads and hardstandings

Temporary lighting and electric power

Lighting and electric power for pre-commissioning tests

Temporary drainage, sewage and effluent disposal

Water for the works

Water for pre-commissioning tests

All fuel and chemical supplies for pre-commissioning tests

Temporary gas main and supplies

Storage facilities for materials and plant

Allocation of space within the site to sub-contractors

Welfare and messing facilities

Sanitary accommodation

Telephones

Offices

Site testing laboratory, etc.

Setting out and temporary works
The management contractor could be responsible for setting out the whole of the works including the establishment, maintenance and checking of subsequent datum marks. He could also be responsible for determining all temporary works requirements and for their design construction and maintenance.

Attendance upon sub-contractors
Certain general facilities such as scaffolding, hoists and ramps required by the sub-contractors could generally be provided by the management contractor.

Indemnities and insurances
The management contractor could be responsible for all the insurances required by the contract and ensure that the appropriate measures are taken by the sub-contractors in this respect.

Measurement and agreement of sub-contractors' accounts
In connection with his responsibilities under cost control the management contractor could provide staff to deal with day-to-day measuring for the purposes of preparing all interim valuations and accounts. He could also liaise closely with the design team in the collection, processing and reporting on this data, and the settlement of all sub-contractors' accounts.

Industrial relations
The management contractor could be responsible for fostering good labour relations with the unions and men for all the various trades employed on the site. This is applicable to the pre-contract period and throughout the construction of the works.

Inspection and testing
The management contractor could coordinate the activities of the inspection and testing consultants and be responsible for their appointment on the instructions of the design team. He could regularly inform the design team of the inspection and testing consultants' findings and take such action as necessary in conjunction with his expediting function.

Maintenance manuals
The management contractor could be required to assist the design team in the preparation of the client's maintenance manuals and record drawings, and in the training of the client's operating and production personnel.

It can be seen from the above that whilst all these activities supplement that of the design team, they are an integral part of the management of design, procurement and construction. They have been drawn out of the normal contractual situation, given a professional status, and integrated into the management structure. However, it is important for the design team to realise that the appointment of a management contractor does not in any way allow them to avoid their responsibilities. In practice it has been found that working on a management-type contract imposes a very strong discipline on both the client and the design team, and may require staff over and above that normally required.

Selection and remuneration

Selection
The selection of a management contractor is not usually based on cost: His appointment is made in a similar way to the design team's in that it is based upon interviews of desirable firms and the final choice made in favour of the firm which the design team and client judge will give the best service and is most sympathetic to the philosophy upon which this form of arrangement is based. The short list of desirable firms may be given an explanation of the philosophy together with a notional copy of the appointment contract, typical preferred sub-contract conditions, an outline of his responsibilities and a cost plan, if available, setting out the overall notional prime cost items of the works. From this information and discussions at interviews they are able to judge the nature of the works and to assess the resources which must be provided. The cost plan should indicate the order of the expected fee and require the firms interviewed to state their willingness to undertake the appointment and to make recommendations for any improvement they feel can be made to the proposals. It will in most cases be necessary and fair for the client to guarantee and pay monthly the management contractor's direct and indirect costs for his involvement before acceptance of scheme design, in case the project should be cancelled at any time up to that stage. Any such costs would subsequently be covered by the overall fee paid for the management service when the project goes ahead.

Remuneration
The prospective management contractor's views on the method of payment (i.e. lump sum or percentage) and the basis on which it is to be calculated should be investigated. The cost of the services to be provided by the management contractor falls into two categories:

(a) Direct costs

(b) Overhead costs.

The extent of the services comprising direct costs, which include items such as those mentioned under the earlier outline of management contractor services may not be known in sufficient detail to price at the time of appointment of the management contractor. An accurate estimate should be made by the management contractor for the purpose of cost control as soon as possible. The overhead costs comprise head office services and are related to the project size, content and the duration of the contract. The overhead costs will include for the management contractor's profit. Payment for these services may be as follows:

(a) Direct costs—
Probably on a net cost basis check from receipts, invoices, vouchers, salary records, etc.

(b) Overhead costs—
Probably on an agreed percentage of the contract sum.

Conclusion

The management-type contract has often been regarded, and perhaps still is, as the salvation of all the construction industry's problems, particularly those relating to construction management. This is not the case. Many people who have worked on such contracts, both for designers and contractors, say that they cause more problems than they are worth. In the same way, some contractors who have been employed as sub-contractors (or construction contractors) to a management contractor are sure that they would not do it again. So what are the advantages? Speed is perhaps one because management-type contracts achieve a speed for design and construction which is perhaps only bettered by cost reimbursement. Diversity of types of contract is another. This is because each sub-contract with a management contractor could be on the basis of different forms of contract, in other words, the best form of contract to suit the work. A third might be that a large number of different contractors could be used, each best suited to the work they do; a slight advantage because of the labour problems this sometimes generates. Another slight advantage might be cost control, but apart from providing man power to do the task there is little more advantage to be gained, other than perhaps one contractor dealing with another contractor's claims. This conclusion has taken a deliberately pessimistic view of management-type contracts, partly to counter any misinformed enthusiasm this paper may have provoked, and partly as a result of having coped with some of the problems this type of contract generates. Whatever one's perception of management-type contracts, they are difficult to administer, require a level of staffing in excess of that normally provided and should only be used in exceptional circumstances.

Printed by Thompson & Tompkins Mitcham England 32661