The HSBC Headquarters,
Canary Wharf, London

Introduction

The new group head office building of HSBC stands proudly in the vibrant business district of Canary Wharf, East London. Some 8000 employees occupy the 210m tall tower, making full use of the building’s extensive range of facilities and services.

The decision to build a new headquarters at 8 Canada Square dates back to the mid-1990s when HSBC began a search for new premises to unite its thousands of staff in buildings across the City of London. The objective was clear: an HQ appropriate for one of the world’s largest banks and financial services organizations.

Between 1985 and 1997, various options were considered, including redeveloping the former group head office at 10 Lower Thames Street in the City of London. However, only the Canary Wharf estate could provide the standard of location and volume of space necessary. Furthermore, there was the opportunity to complete the building quickly as planning permission for the estate had already been granted. In early 1998 a heads of terms agreement was reached for a 45-storey building to occupy Canary Wharf’s DS2 plot, alongside the UK’s tallest building at 1 Canada Square. The new building has four basement levels, five levels in the 75m square podium, and 40 floors above, each 56m square.

HSBC had successfully developed its Hong Kong headquarters building at 1 Queens Road Central in the early 1980s with Arup, Foster and Partners as architect, and quantity surveyors Davis Langdon & Everest. Nearly 20 years later HSBC appointed the same team for its global headquarters, with Arup providing multidisciplinary engineering services including fire, building management controls, acoustics and security design. An HSBC in-house project team was set up to ensure that all the bank’s requirements would be met. In collaboration with Canary Wharf Ltd’s strong development team, an unusually fast-track development for a building of this size was undertaken and successfully executed. An additional challenge stemmed from the fact that shell and core work would overlap with fitout, under different management teams and conditions of contract. The shell and core was a design and build contract with Canary Wharf Contractors Ltd as contractor and the Arup/Foster design team. For the fitout Canary Wharf was the management contractor, with trade contracts being placed directly by the client. During the last year of construction, the design team co-located onto a level of the new building while the fitout works were being completed. The result reflects the enthusiastic collaboration that took place on the project, delivering a highly cost-effective design with state-of-the-art facilities and finishes.

Construction

Construction began in January 1999 with the boring of the building’s substantial deep pile foundations. During spring, the concrete core rose steadily with approximately 100 workers on site each day, increasing monthly by several hundred to over 1000 at the end of 1999. The tower began to assume its current appearance in summer 2000 when work started on installing the 4000 glass panels. As the base build continued on schedule, early 2001 saw work begin on the fitout, including installation of services to the 450 read staff restaurant and health club. In March 2001, bankers, journalists, contractors, and the design team gathered for topping out, as the final steel girder was hoisted to the top of the tower.

Within weeks another milestone arrived, as the giant hexagonal HSBC corporate signature was installed on all four sides of the building’s crown. In early 2002, with the base build completed, the project moved to the final stages of the category B fitout, installation of carpets, desks, and other furniture.

By this time, the number of workers on site had risen, with up to 1700 on duty each day. The first HSBC employees began work in the new building at 8 Canada Square on 2 September 2002, marking the culmination of seven years’ planning, teamwork, and commitment from all involved. The phased occupation of the building was completed in February 2003 when the last of over 8000 staff moved in, with HSBC Group Chairman Sir John Bond officially opening the building as the Group’s new head office on 2 April 2003.

Graham Aldwinckle
Dave Choy
Paul Cross
Barney Jordan
Faith Wainwright

The Canary Wharf location

John Brazier

Arup has been involved in Canary Wharf® in London’s Docklands from the start in 1986, when 0 Wate TradeInvest and a consortium of American banks proposed a new financial district there. Olaya & York took over the development in 1987 and this drove the originality to reality. Phase 1 was built between 1987 and 1992, with Arup providing local knowledge and input to a large American design team.

Arup’s involvement in Phase 1 was:
- engineer for the enabling works, including demolition, dock wall stabilization, site investigations, and pile testing
- geotechnical consultant for most of the Phase 1 buildings
- structural engineer for the foundation platform built in the dock for four of the Phase 1 buildings
- structural engineer for one of the buildings, also in the dock, currently occupied by the Financial Services Agency
- engineering advice on the design of the temporary cervices for Phase 2 buildings
- engineering input into the masterplan for Heron Quay, now known as Canary Wharf South

Olaya & York took over administration in 1992 and Canary Wharf Ltd (CWL) took over ownership of Canary Wharf, although many of the key management people remained unchanged. Between 1992 and 1996 CWL gradually led sites and also marketed its Phase 2 sites. Arup involvement during this period comprised structural engineering advice on the fitout of Phase 3 buildings and assistance in assessing schemes for Phase 2 sites for potential tenants.

Phase 2 of Canary Wharf was unlocked when Citibank chose it as the home for its new building in 1996. Arup had been working with architect Foster and Partners to assess sites for Citibank and as part of this the consultant team was taken over by CWL to design the building to meet Citibank’s requirements. Canada Square Park to the north of Citibank Limited was redeveloped and roads and utilities, had to be built to serve the Citibank building.

The park has one level of retail and three levels of car parking beneath, and Arup was structural, geotechnical, building services, infrastructure, fire and security engineer for this development.

In 1998 the HSBC took the DS2 tower site for its new headquarters, a deal closely followed by others with major tenants, many of them financial, which has realised the original concept of Canary Wharf as a new financial centre for London.

Subsequent to HSBC, Arup has been structural and building services engineer for two major retail developments and structural engineer for three more office blocks. In addition, the firm has secured site-wide commissions for geotechnical engineering, fire engineering, and infrastructure engineering, as well as other specialist commissions for security and health.

Arup has also provided input into the design of fitouts for several tenants, the most significant being the fitout of the four buildings that Credit Suisse First Boston occupied.

From the initial provision of some structural and geotechnical engineering advice on local practice, Arup’s role has grown over the years until now the firm is one of the major consultants working on Canary Wharf, providing a wide range of services.

Sustainability aspects

The HSBC Headquarters is built on brownfield land and reclaimed land, and is served by its own dedicated Jubilee Line Underground station. This ensures that around 90% of people are served by public transport. The estate is also extremely large, around 33ha, with 1.2Mm² of lettable space already built, and a further 1.5Mm² under construction. It has copious high quality open spaces for the amenity of the users of the buildings.

For the HSBC building’s structure and services, flexibility in use was designed in, including allowance for a potential further floor in the podium. Before the first piece of earth was moved at the site, HSBC’s commitment to the environment was tested against building guidelines from the UK government-funded body BREEAM. Management of the building, energy and water use, and health and comfort issues were all assessed, as were the choice of materials, land use, and ecological issues. The assessors gave HSBC a good rating, acknowledging that harmful materials had been avoided and that many environmentally-friendly features had been incorporated.

These include energy reclaim, treatment of kitchen grease, use of copper silicate grout to prevent bacterial growth in domestic water, and highly efficient façades with internal blinds. HSBC played its part in implementing a refuse compactor installation, reducing paper storage within the building by 70%, and installing its water bottling plant.

1. View of the completed HSBC tower.
HSBC key features

Reception (ground floor)
With minimal overtones, the spacious ground floor reception area (Fig 8) combines back-sprayed black glass and grey granite flooring to create a first impression for visitors to HSBC’s new HQ. TV monitors carry rolling news feeds and a digital information board. The illuminated ceiling simulates an open natural environment which, combined with the spaciousness, feels almost like being outside. The lighting has over 3000 luminaires, suitably positioned for even light spread. The heat generated by them and the control gear necessitated a system where return air provides cooling to the light boxes to ensure that colour, temperature, and efficacy are not affected, as well as ensuring a reduction in dust settlement. Where return air-cooling could not be achieved, direct cooling is provided by recirculating chilled water tancells within the ceiling.

Lifts
From the entrance, four banks of lifts are accessible, serving levels 1-15, 15-25, 25-34, and 34 to the roof. Levels 15, 25, and 34 are therefore known as ‘transfer floors’, as to access levels 1-15, 15-25, 25-34, and 34 to the roof. This is a reception area as well as a café, shop, first aid area, cash machines, and meeting rooms. Level 15 houses medical and dental suites.

The ‘History Wall’ (ground floor)
Unveiled in September 2002, HSBC’s 6.6m high ‘History Wall’ (Fig 15 in Fire Safety panel on p18) marks the history, achievements, and values of the Group from the 18th to 21st centuries. Located in the ground floor lobby and designed by the Thomas Heatherwick Studio, it boasts 3743 captioned illustrations of staff, buildings, businesses, and events. They are arranged so that when viewed from farther away a ‘magic eye’ effect becomes apparent, revealing the letters ‘H-BBC’.

Staff restaurant (level 1)
The 800-seat staff restaurant (Fig 6) is possibly the largest of its kind in Europe, serving some 2500 meals daily. A 450m long continuous marble counter top. Light refreshments and tea/ coffee are served here with a seating area that overlooks the main ground floor reception.

Trading floors (levels 2-4)
The building includes a treasury, capital markets, and equities trading operation, all served by giant screens displaying order boards and pricing information. The treasury and capital markets operation over the whole of level 4 forms one of the world’s largest trading floors, accommodating nearly 600 dealing staff and 1750 full panel screens across 4500m² (Fig 5). HSBC is a leading player on international foreign exchange markets, offering a 24-hour capability with London connecting to the Group’s other key trading locations in the Americas, Asia, and Europe.

Central and satellite equipment rooms (level 8)
The central equipment room (CER) is the building’s nerve centre. Occupying all of level 8, it contains the complete IT equipment required to run the building, as well as the main local computers and networking equipment that support data, voice, and video services. The two exchanges that operate the building’s 10 000 telephone extensions are also here. Each floor also has pairs of satellite equipment rooms (SER), from which communications and IT wiring emanate to serve all the floor’s desktops. Each SER has its own standby electrical supply as well as its own dedicated class control air-conditioning unit. Over 700 IT cabinets housed equipment that require the laying of some 200 000m of cable.

Main plant floors (levels 7 and 43)
Central and satellite equipment rooms (level 8)

Air-handling plant is divided between these two floors. The AHUs supply treated air into a structural shaft that runs the height of the building. Level 7 also houses the plant that generates domestic hot water from gas-fired boilers to serve the level 5 gym changing facilities and the level 6 and level 1 kitchens. Also at level 7 is the uninterrupted power supply (UPS) system, which provides an instant standby electrical supply to serve the level 8 CER and the SERs throughout the building.

At level 43, access for the external ‘Halo’ specialist lighting for the crown of the building also acts as the air intake/exhaust for the level 43 AHUs. The crown lighting also incorporates HSBC’s hexagon symbols on the four sides of the building just below the roof, with powerful backlights (Fig 7) to illuminate the brand at night.

3. Elevation showing the 44 levels.

4. The gymnasium (level 5).

5. Staff restaurant (level 1).

7. Crown lighting at roof levels 43/44 for the HSBC symbol.

8. The spacious reception area (ground floor).


10. Central plant floor (level 7).

11. Typical office floor (level 2).

12. Typical office floor (levels 14 and 34).

13. Typical office floor (level 25).


15. Typical office floor (levels 26-34).

16. Roof plant floor (level 44).

17. Typical office floor (level 42).

18. Boardroom (level 42).

19. Typical office floor (level 43).

20. Typical office floor (level 34).

21. Typical office floor (level 24).

22. Typical office floor (level 14).

23. Typical office floor (levels 2-4).

24. Typical office floor (levels G-2).

25. Boardroom (level 42).

26. Typical office floor (level 1).
**Foundation design**

Tim Chapman
Duncan Nicholson

Arup Geotechnics had been very involved in Phase 1 at Canary Wharf, so when Arup was appointed as structural consultant for the Citibank and DS2 buildings in Phase 2, there was a useful database of experience from which to draw. Piled DS2 for HSBC was the largest of the buildings and the first to be constructed in the north cofferdam. It was therefore an important test piece for the team. The foundations for Citibank in the south cofferdam were built in 1997 when the adjacent Jubilee Line station was nearing completion in its deep excavation. The project team decided to continue dewatering of the Thanet sand and chalk aquifer, and the Citibank piling contractor was able to take advantage of this. The pile depth was much more quickly than expected. Canary Wharf and Arup Geotechnics gained much more than conventional design approaches would allow. Accordingly, the project team rapidly geared up to full-strength construction information as quickly as possible.

388 permanent piles were installed by Keller Ground Engineering between January and July 1999 for DS2, including two to resolve the south abutment for the Great Wharf Road Bridge planned for installation once the building was complete. These piles were generally 1.5m in diameter. The first pile cap was浇筑 an hour after the concrete reached the specified strength. This reduction in pile depth below the level of the water table in the deep aquifer was very helpful as it took the toe level above the level of the water table in the deep aquifer. This reduction in depth below the site was very helpful. The HSBC tower proved very effective on subsequent buildings.

**Programme and planning**

For its magnitude, the project was designed and constructed remarkably quickly. The Canary Wharf team was geared to delivering buildings rapidly; with no planning permission stage in the process and the cofferdam already in place, there were no barriers to teams delivering construction information as quickly as possible.

Also, the previous involvement of Arup and Partners in the nearby Citibank building, as well as the overall site development, meant that the team could hit the ground running.

The planning had to fit with established cost benchmarks and meet market expectations for high quality, flexible office space with a high degree of user comfort. This constrained the project team to provide an air-conditioned office space with a high degree of user comfort. The structural package confirmed on the basis of a set of multidisciplinary scheme design was produced by the end working after appointment in October 1998, and a detailed construction information as quickly as possible.

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Resilience in the cooling and electrical systems is a theme throughout the building. At the lowest basement level are two separate and fire-compartmented chiller plant rooms, and whilst two of 450mm diameter chilled water and two pairs of 450mm diameter condenser water (heat rejection) pipes rise through the building; two separate cooling tower heat rejection circuits are housed on the roof. Two AHUs on each floor (each an 75% of the total) provide chilled air to the FAT/W terminal boxes. Similarly, dual generator and UPS-backed busbars rise through the building to feed essential IT services throughout the structure. A triplicated generator control system was specified. Although well known in aviation, these do not usually feature in commercial buildings. The system triplicates all signalling between controlling devices using different cabinet and route, so if one of the two systems remains operative on the remaining two. The generators have five days’ supply of oil, with the storage tank located in the basement. An electrical network management system (ENMS) monitors the condition of the business-critical protective devices throughout the building. It receives power quality harmonics and records disruptions, minimizing future malfunctions by preventative maintenance.

The CEP provided with the fire扑灭 units. These have dual coils, each fed with chilled water from different chilled water systems, thereby ensuring that cooling is maintained at all times should one chilled water system fail. Having dual coils simplifies the controls and changeover valving arrangements, again enhancing the robustness of the system.

13. Skeletal 3D GSA model.

14. Detailed finite element model.

Load spectra from the wind tunnel testing were combined with modal properties extracted from the 3D analysis and processed by BWTL to give predictions of pseudo-static peak wind forces on the building and accelerations experienced by the occupants. The maximum predicted wind displacements were building height/2000 for overall displacement and storey height/2000 for inter-storey drift. These were well within the normal limits for tall buildings (h/500 and h/300 respectively), as the core size was determined by space planning rather than structural requirements.

Building services
Planning permission for the site had been based on the then standard Canary Wharf specification of an all-electric building with fan-assisted terminal variable air volume (FAT/W) air-conditioning. Arup looked at several alternative systems for HSBC during the concept stages, including two and four pipe systems, gas-fired heating, and district water heating. The Canary Wharf standard specification was adopted by HSBC, but several innovations new to Canary Wharf were carried out a detailed single point of failure (SPOF) analysis. The appointment was extended to cover full acoustic design. This involved partition design and privacy issues, although services noise and room acoustic control were also to a very high standard in many areas. The client wanted the flexibility for future ‘churn’, so for-cooling reboiler reboilable partitions were the intended option. Higher performing slab-to-slab partitions only in a few critical areas. For relocatable partitions to be useable, noise transfer via the common ceiling sound insulation was upgraded. For relocatable partitions to be useable, noise transfer via the common ceiling sound insulation was upgraded. Initial sound insulation results were lower than anticipated. Significant improvements were made by modifying the partitions, but the resulting privacy was still inadequate, due to the unforeseen low background sound from the services in some of the internal spaces. Levels in the affected rooms were therefore artificially raised by installing a low-cost sound masking system in the ceiling void. The sound generated was derived from recordings of real ventilation services, optimised to give the most appropriate sound-masking spectrum. The resulting sound is natural for an office building and therefore unobtrusive to the users, and tests after the masking system was installed showed it target privacy standards to be achieved.

A combination of sound absorbing ceilings and absorbant wall linings built into the partitions contribute the most to the good acoustic performance for the various partitioned spaces. The double-height boardroom, however, presented an interesting acoustic design challenge. To work effectively for video conferencing and recording, the room needed a very high acoustic performance. The wall paneling throughout the room, the boardroom had fabric-faced acoustic lining, but the floor-to-ceiling glass partitioning did not go down to the floor, and the room was intended to be used in pairs, normally opposite each other. It is covered in a large world map made from extruded aluminium sections, and these sections are fitted with LED lighting. This lighting system is concealed in the sections, and the entire system is controlled by a central control panel.

‘The challenge on this job was always going to be whether everyone could pull together to proactively solve problems on an extremely tight programme.

Arup and Cleveland Bridge worked closely together on the structural steelwork design to anticipate just about every potential construction issue, and the tower went up very smoothly.’

Winston Huth Walls, Construction Manager, Canary Wharf Contractors Ltd

Economizing space
Space efficiency for the building services was also a prime concern. Numerous plant arrangements were tested to ensure separate and fire-compartmented plant containment, and that maintenance and replacement was also possible. Arup provided a replacement strategy report, which detailed the maintenance/replacement frequencies of the major components and the physical routes by which this could happen. Specialist contractors and the design team collaborated on the report, which was well received.

The layouts of the various engineering systems were also designed to maximize the net lettable floor space. Again with the architect and the client’s agreement, the chiller plantroom room was designed without tube withdrawal space, but with knock-out wall panels instead to allow chillers to be removed for maintenance. The cooling water system was meticulously designed and tested as a single pressure zone system (buildings of this height are normally divided into two or three), saving plant space normally needed for pressure break heat exchangers, secondary circulating pumps, and auxiliary equipment and controls. To achieve this servicing strategy, the team analyzed the stresses in the piping system at the base of the building, and reviewed and checked in detail manufacturers’ pressure ratings for coils. Having a single pressure zone ensured that chilled water at EC could be delivered to the entire building, ensuring that all cooling coils in the building are efficiently sized.

Another space-efficient design was the provision of a fresh air riser running through the building’s concrete structure. Detailed analysis ensured that the structure’s inherent thermal inertia did not adversely affect the treated fresh air supply. The shaft was subsequently suitably finished to prevent migration into the structure. The fresh air shaft can also be used as smoke extract in a fire.

Movement differentiation
As a result of the single pressure zone design, Arup devised a way to allow for thermal movement based on anchoring the two pairs of pipes risers at the base of the building, and the two pairs of condenser water risers at the top of the building. This ensured that the mechanical services acted in sympathy to avoid any need for hazardous chemical storage and handling up against a normal chemical treatment system; this overcame any need for hazardous chemical storage and handling up against a normal chemical treatment system; this overcame
Security
Simon Brimble

Arup Security Consulting was involved in designing the security installation from almost the inception of the project. The initial study was to develop a strategy for providing the building fabric, based on a threat model.

The security elements that most staff and visitors encounter are the pedestrian gates to control access. These were specially developed to maintain the visual objectives of the lobby design and provide an installation that would handle the total building population.

Through much discussion a sophisticated vehicle management control system was introduced to prevent vehicle tailgating. The installation comprises ‘vehicle articles’ formed by impact rated roadblocks, raising arm barriers, and fast-acting speedgates. Throughout the development and implementation of the vehicle-management scheme, Arup strove for a balance between the building security objectives and personal safety, and the scheme was implemented for all vehicles including goods deliveries and private cars.

Close attention was given to integration with the building and its systems, including the use of the structural cable system to transmit video signals, use of a common building LAN for IT, and access control through to custom-designed access controlled gateways, camera housings and brackets.

The successful realisation of the security design was a co-ordinated effort between Arup, HSBC’s security, facilities and project team, Foster and Partners, and not least the construction team of Bell Security and Canary Wharf Contractors.

Fire safety
Andrew Gardiner

Arup Fire was responsible for Category A and Category B strategies and also participated, as part of the design development process, in HSBC’s monthly security working parties, the fire, safety and security working party meetings, where security was considered in the most holistic of ways.

The scheme comprised CCTV, access control, intruder detection, vehicle management, turnstiles, and control room systems.

Building controls
HSBC is the first large-scale installation of Inversys Building Controls’ new Sigma control system, specifically selected to complement the resilient mechanical and electrical design.

HSBC’s BMS installation not only uses Arup standard controls but also implements a distributed starter approach. Instead of relatively few large centralised motor control centres, specialists, there are many individual starter enclosures provided by the associated mechanical equipment suppliers.

Each incorporates all hardwire interlocks required for the safe stand-alone operation of the plant, including all fire interfaces, allowing the doors to be commissioned before the building is occupied.

This effectively provided a plug-and-play approach for the equipment to be controlled. To complement this philosophy, Arup designed the building controlling many small controllers distributed adjacent to each starter enclosure.

As the mechanical systems were generally designed with dual duty/duty plant configurations, it was necessary for the controls to be able to control both systems and controllers for each item of plant. This modularity needed far more co-operation between contractors than under a normal contract, with Arup successfully providing much of this co-operation.

The FAT/UV box and fan coil unit controllers are driven by an ECO-ELON (Open protocol) data network, but communications between the main plant controllers utilize a proprietary dual redundant twisted pair network, linked to an ethernet backbone. Failure of the primary network causes an automatic changeover to the secondary standby network, creating a high-integrity, resilient data network.

Similarly innovative dual flash allows firmware upgrades to the controllers to be carried out without the usual downtime ensuring continuous service while maintaining the flexibility of using different building system by interfacing with the lifts and escalators, lighting, and energy metering. To achieve this Arup has developed an open system to provide a recording information to become the main portal for the building facilities management.

Providing for the client
For a building of its size, the design and construction of the new HSBC building was a balanced design and construction. HSBC wanted spaces to generate synergies among the staff, to reduce facilities management costs, to improve communications and to promote efficiency in central functions such as HR, Finance and IT. The design was key to improving business and providing an enriched working environment for the staff.

This approach to the building design and client requirements and the challenges of efficiency in this country to the scale of the building by applying appropriate and innovative design.

15. The History Wall in the ground floor entrance lobby.

References

16. Symbolic HSBC Lion brought to the new headquarters from the Hong Kong building.

‘The very demanding fast track programme was only achievable because of the first rate personnel from the designers, contractors and clients who were highly committed to the project and maintained the confidence of the Bank throughout. HSBC are delighted with the completed building.’

Mike Smith, Project Manager, HSBC