



Buro Happold
Aviation Capability Statement
The engineering of excellence



BURO HAPPOLD AVIATION

a·vi·a·tion

ORIGIN mid 19th century: from French, formed irregularly from Latin *avis* 'bird'

Buro Happold understands both the complex demands and commercial realities of the air transport sector. We have the global experience and knowledge to take any airport project from its initial masterplanning and forecasting phases, through passenger terminal design or expansion, baggage handling systems and air traffic control centres, to its internal transport links and car parks, offices and retail areas.


With a focus on enhancing passenger experience, our designs will always put the passenger first, whether in terms of optimising people flow through the buildings and reducing queuing times, creating a comfortable internal environment, or safety and security.

For passengers, time spent in the terminal building is an important part of the journey, so we strive to create inspirational spaces which are also functional and navigable. Offering light and airy column-free designs, our new terminals often achieve iconic status while our expansions involve truly creative solutions to minimise disruption. We will always seek to add value for our clients, ensuring minimal operational impact during expansions or upgrades by offering fast and flexible solutions, and helping airports to exceed their carbon reduction targets while saving on both operational and energy costs.

We combine simplicity and innovation in our pier design, confronting logistical and security complexities while making extensive use of pre-manufacture and assembly techniques to ensure quality, meet deadlines and avoid risk. Our extensive experience of hangar and cargo handling design leads to functional facilities which cater for every contingency, enabling quick aircraft turnaround to minimise the airline's costs and maximise airport efficiency.

Security is paramount to all airport processes, and we can recommend the most appropriate measures, taking into account both passenger comfort and ease of movement and the need for rigorous security control. Equally, our bespoke baggage handling modelling technology guarantees fast and secure processing, for the benefit of passengers, airlines and the airport itself.

Our specialist multi-disciplinary aviation teams will work closely with both client and architect to make sure we understand their priorities, and ultimately provide design solutions which not only meet client's needs but are carbon-efficient, easily constructed and with built-in flexibility to allow for future expansions and modifications.



Translucent ETFE cushioned canopy shelters passengers outside while improving light capacity inside

T3, Heathrow: transforming passenger experience at one of world's busiest airports

Over 450 semi-mature trees planted on T3 site during expansion process

40m wide pedestrian forecourt maintains reduced security threat to terminal

Terminal 3 Heathrow Airport, London, UK
Architect: Foster + Partners | Image: Buro Happold / David Hatfull

Buro Happold

OUR EXPERIENCE

Buro Happold's work in the aviation sector can be seen at every stage of the air travel experience. From the approach roads and car park to the first class traveller's lounge and control tower, our engineers have designed the airport buildings that can make flying a straightforward and comfortable process.

Our experience in the sector means we have expert knowledge of how airports operate and meeting the goals set by clients. From work on large international airports such as Heathrow and Gibraltar, to private, exclusive facilities such as TAG Aviation, our priority is to help clients improve their business. This expertise extends to scheduling construction so as to minimise

disruption for travellers, maintaining business continuity throughout.

From creating distinctive landmark structures or extending existing facilities, our engineers apply the same level of skill and care to deliver airport facilities that are functional, sustainable and efficient.

| | | | | |
|---|---|---|--|---|
| 2005 | 2006 Ongoing | 2007 | 2007 Ongoing | 2007 |
|  |  |  |  |  |
| Jinan Airport Jinan, China | Gibraltar Airport Gibraltar | Dublin Airport Check-in Facility Dublin, Ireland | New Doha International Airport Doha, Qatar | Tomorrow's T4 Heathrow Airport, London, UK |
| 2009 | 2009 | 2009 | 2010 | 2011 |
|  |  |  |  |  |
| T3 MSC West Heathrow Airport, London, UK | New International Pier Birmingham Airport, UK | London City Airport London, UK | Mauka Concourse Honolulu Airport, HI, USA | Air Traffic Control Tower Indra Gandhi International Airport, New Delhi |

A snapshot of our work in aviation

Fixed rails for cleaning gantries integrated into the design to provide safe maintenance access.

A unique passenger experience. Pier 6 is accessed via a pedestrian bridge spanning across a taxiway

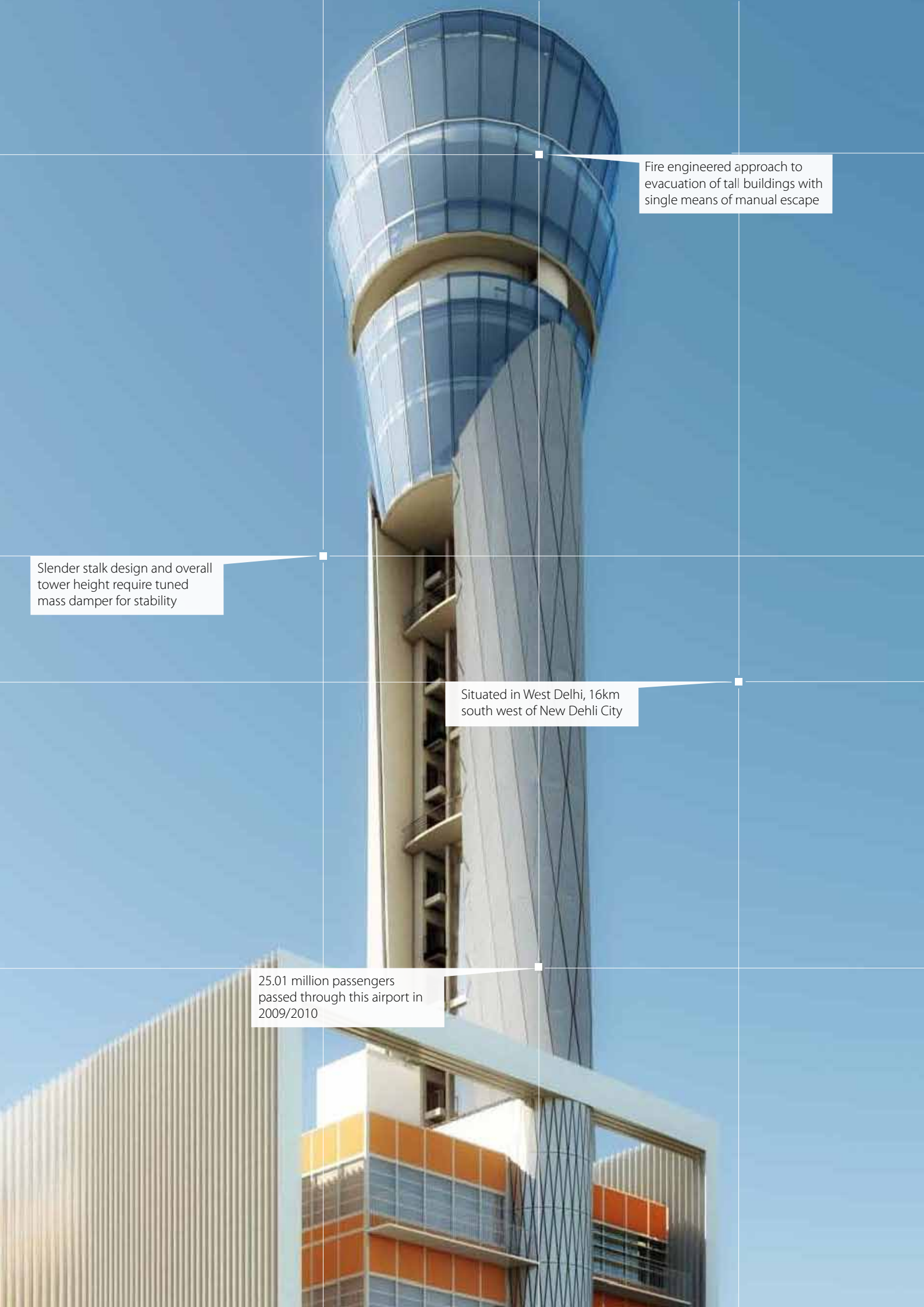
Segregation screen with minimalist structural support separates arriving and departing passengers

Escalators descend to bring passengers down from the bridge to the pier building

Pier 6, Gatwick Airport, London, UK

Architect: GHW Architects Images: Buro Happold / David Hatfull

Buro Happold



Fire engineered approach to evacuation of tall buildings with single means of manual escape

Slender stalk design and overall tower height require tuned mass damper for stability

Situated in West Delhi, 16km south west of New Dehli City

25.01 million passengers passed through this airport in 2009/2010

Delhi Air Traffic Control Tower

India

Indira Gandhi International Airport is currently investing in a 20+ year masterplan development, to service the ever increasing travelling needs of the residents and visitors of New Delhi. As a key component of the expanding development, a new air traffic control tower (ATCT) is to be built at the airport, in order to meet the challenges of the air and ground traffic operations posed by such intense development.

As well as providing for the operational requirements of the air traffic controllers for the future, IGIA aspired to construct an ATCT that is internationally recognised, contemporary and that provides an architectural landmark to the airport. In order to maintain visual connection to the ground traffic and to meet such aspirations, the proposed 105m tall tower will be one of the tallest ATCT in the world. Given the height of the tower, the required 24 hour operations and the architectural aspirations of a slender aesthetically pleasing form, it required the design team to come up with many innovative engineering solutions, and to constantly challenge the design in order to further refine the scheme.

The structural design of the IGIA tower was developed to complement the architectural form of the tower stalk, making use of core walls wherever possible. However, due to the slender form, height and small tower footprint, the design employed tuned mass dampers (TMD) positioned near the top of the tower, to reduce the acceleration of movement under wind loads. This is an ever increasing trend in ATCT design. The structural design also had to incorporate requirements of seismic movement due to the geographic zone, as well as allowing for a complex sequence of construction in a region where perhaps the latest construction techniques are not financially viable.

The design of the Cab at the top of the tower poses some difficult challenges for the environmental design. Delhi is located in an area that experiences high temperatures, high humidity and monsoon rains, as well as wide variations in conditions from summer to winter. Conditioning the 5m high, near fully-glazed visual control room to very stringent internal conditions without detriment to the thermal comfort, room acoustics or limited maintenance requirements was a challenge met through dedicated plant spaces on the

lower floors of the Cab, where all plant was provided with duplicated elements to reduce downtime for maintenance or failure.

Innovative strategies were employed by the specialist Buro Happold team for facade design and maintenance, security, fire engineering, acoustics and specialist lighting to assist the architectural team in delivering a cutting-edge facility worthy of the Client's highly challenging aspirations.

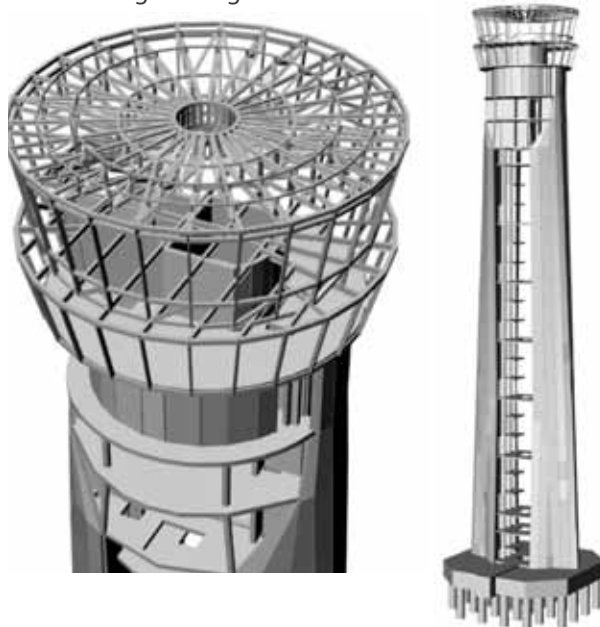
Buro Happold took this project to Tender information then handed the design over to local consultants to complete production design during April 2011.

Key project information

| | |
|----------------------|--|
| Client | Delhi International Airport Limited (DIAL) |
| Architect | HOK international |
| Project value | Circa £35m |
| Dates | Completed 2011 |

Services provided by Buro Happold

Structural engineering, building services engineering, facade engineering, civil engineering, ground engineering, fire engineering and design risk assessment, security strategy, specialist lighting advice, acoustic engineering





Innovative system developed to reinforce beam connections allowing transfer of forecourt onto car park's top deck

Close collaboration with all parties throughout construction process saved client 10% of total costs

Regulatory minimum width of a Zebra pedestrian crossing = 2.4m

£60m upgrade to Heathrow's Terminal 4, London, UK

Heathrow Terminal 4

London, UK

The £60m upgrade to Heathrow's Terminal 4 has created a modern, bright and expansive column free space to handle the 45 airlines including the Skyteam Alliance. The previous facilities were claustrophobic and outdated, and only served a handful of airlines.

Buro Happold's structural, civil, geotechnical, fire and acoustic teams worked closely with both client and subcontractors to deliver an extended check-in hall, a transparent ETFE canopy and a full-height frameless glazed facade, offering a vastly improved experience to travellers and an infinitely better workplace for staff. The check-in hall offers twice as much space as before, making circulation easier and greatly increasing capacity, while the canopy and glazing allow in plenty of natural light.

One of the key requirements of the project was to enhance the passenger experience by creating more space and improving connectivity to the terminal building. Our engineers had to think innovatively to achieve this – our solution was to move the forecourt onto the existing multi-storey car park. This posed a tough challenge, as to accommodate the extra weight, the whole structure needed to be strengthened, so we developed an innovative system for reinforcing the beam connections as well as the top deck. The final extension to the building was a new airside three-storey lounge for first and business class passengers.

Buro Happold's close cooperation with BAA, the contractor, stakeholders and suppliers, as well as effective liaison across our own teams, ensured that buildability and security issues were addressed early. This was especially important on a large-scale airport project such as T4, where the terminal needed to remain fully operational during the works, with security and access implications as passengers had to be diverted under the construction site and back up to the existing check-in hall during building.

Our expertise in collaborating with all parties throughout the construction process directly saved the client 10% off the total budget, as mock-ups of various components were pre-fabricated and tested – including 'bomb blast' specifications for the facade – and learning was captured through a 'One Point Lesson' plan.

Furthermore, 91% of project waste was successfully recycled.

Our multi-disciplinary input on this prestigious project has helped create a world class facility, greatly enhancing the passenger experience while offering the client massive cost savings and enabling a complex development to be delivered on time and with minimum disruption to passengers.

Key project information

| | |
|-----------------------------|-------------------------------|
| Client | BAA (Business Support Centre) |
| Architect | 3D Reid |
| Construction Manager | Taylor Woodrow |
| Project value | £60m |
| Dates | Completed 2010 |

Services provided by Buro Happold

Structural engineering, civil engineering, geotechnical engineering, fire engineering and acoustics



Images: BAA



Landmark facility at Heathrow housing Virgin Atlantic's Upper Class check-in service

90m long glazed facade creates airy environment and reduces artificial lighting costs

Next departure:
Flight no. VS039 to Boston

People flow modelling techniques informed design by identifying key touch points for passengers

Terminal 3 (A landmark for Virgin Atlantic) Heathrow Airport, London, UK

Heathrow Airport is one of the world's busiest international airports, our role working collaboratively with the client BAA Ltd, was to create a new landmark facility to house Virgin Atlantic's Upper Class "check-in" service, to insert an elegant high tech glazed facade extension and to expand the existing forecourt to terminal 3 within a "live" environment.

For BAA, we were able to deliver an end result which surpassed expectations for such a complicated brief, whilst ensuring minimum disruption during the works.

The state of the art Southwing Annex provides Virgin with a comparable business platform to that which has been achieved in T5, keeping the passenger experience at the very heart of their offering. In delivering efficient passenger processes along with a sophisticated and high quality environment passengers are able to relax before embarking on their journey. Through careful consideration and future proofing the "check-in" functionality can ebb and flow to reflect the passenger peaks and troughs, delivering a comfortable and efficient environment to suit Virgin's diverse customer base.

Virgin and BAA sought an internally sustainable environment for passengers that delivered an abundance of natural light and airy spacious architectural feel without compromising the function of the activities contained within.

Arriving passengers were to benefit from a clear and uncluttered sightline, delivering transparency so that they could see the Virgin branded space and intuitively flow towards the main entrance doors. Our team designed an elegant high quality 90m long, fully glazed facade, subsequently reducing the cost of artificial lighting. The extension creates 900m² extra "check-in" space and room to circulate freely in anticipation of the 35% increase in passenger numbers which Heathrow expects in the run up to 2012.

Keen to make the most of the new forecourt and capitalise on the revenue opportunities, BAA benefited greatly from our predicative passenger flow modelling tool. This highlighted the key touch points for passengers, informing our design and placement of retail units to optimise income yields.

This methodology also supported the way finding strategy with a "less is more" solution. To enhance the passenger facing terminal 3 front elevations, we engineered a translucent yet durable ETFE canopy which brings a sense of welcome and reinforces the entrance threshold whilst protecting passengers from the elements. In addition we improved vehicular access routed to the forecourt by realigning the roads around it, with the insertion of a four drop off lane and subway extension. The 40m wide pedestrian forecourt also acts as a means of mitigating against potential security threats.

Our work on Heathrow's Terminal 3 has seen the passenger experience transformed. From the outdated facilities to an iconic landmark, the expansion creates an oasis of calm while maximising the commercial value of the building.

Key project information

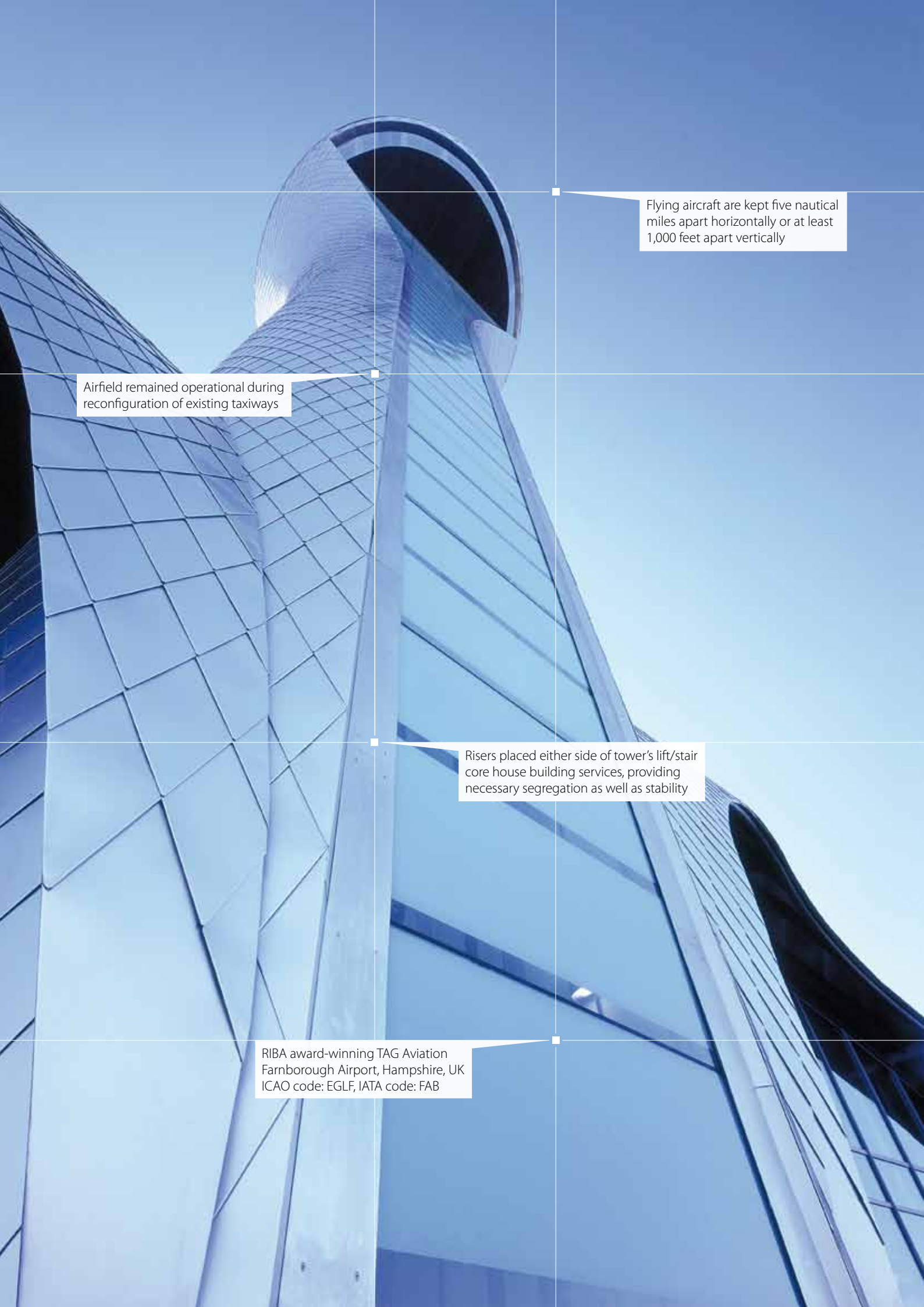
| | |
|----------------------|-------------------|
| Client | BAA |
| Architect | Foster + Partners |
| Project value | £43m |
| Dates | Completed 2008 |

Services provided by Buro Happold

Structural engineering, geotechnical engineering, civil engineering, wind engineering, site supervision and people flow modelling



Images: Buro Happold / David Hatfull



Flying aircraft are kept five nautical miles apart horizontally or at least 1,000 feet apart vertically

Airfield remained operational during reconfiguration of existing taxiways

Risers placed either side of tower's lift/stair core house building services, providing necessary segregation as well as stability

RIBA award-winning TAG Aviation
Farnborough Airport, Hampshire, UK
ICAO code: EGLF, IATA code: FAB

TAG Aviation

Farnborough, UK

When TAG Aviation took over Farnborough Airport in Hampshire from the MoD in 2001, their goal was to win executive business and private flights. Following the transformation of the RIBA award-winning ex-military base, the development is now considered the most modern and efficient private airport of its kind in Europe. With a brief to provide an eye-catching new air traffic control tower, terminal building and hangar, the airport provides a convenient gateway to London and also hosts the prestigious Farnborough International Air Show.

The striking futuristic design of the 33m high air traffic control tower immediately captures the attention of visitors. There were a number of challenges during the design of the tower to accommodate both the aesthetic vision of the architect and the safety regulations set by National Air Traffic Services (NATS). The client's requirements for duplicate, separate and fully independent systems meant that the building services would take up considerably more space than usual, while being restricted to the tower's slimline design. Our engineers solved the problem by placing risers that housed the services on either side of the lift/stair core, which conveniently provided the necessary segregation and also stability.

The stylish new terminal building, which mimics a section of an aircraft wing, provides a safe and relaxing environment for passengers and crew. Our structural engineers employed specialist computer modelling to realise the curvature of the architect's design, while 25,000 recyclable aluminium shingles were used on the terminal building's facade. The two new hangars follow the curved shape of the terminal building, with office and plant spaces cleverly incorporated in areas between the three separate hangar spaces.

Rising to considerable design challenges, Buro Happold collaborated closely with the design team and NATS to deliver a striking airport building, under budget and with minimum disruption to customers.

"The most modern and efficient business aviation airport in Europe, and a magnificent gateway to London."

Key project information

| | |
|----------------------|-------------------|
| Client | TAG Aviation |
| Architect | Reid Architecture |
| Project value | £26m |
| Dates | Completed 2006 |

Services provided by Buro Happold

Structural engineering, building services engineering, ground engineering, facade engineering, fire engineering, site supervision



Images: Buro Happold / Adam Wilson (left, top) and Hufton + Crow (bottom)

Gardermoen Terminal 2 and Pier Extension Oslo

A major expansion at Oslo's Gardermoen Airport will include a terminal extension, a new pier, and extensive remodelling of both airside and landside infrastructure.

One of the key goals for the project is to cut energy demand by 50% against the existing terminal - which is already among the most energy-efficient in the world.

Buro Happold was heavily involved in developing the environmental and sustainability concepts for the scheme - working to the 'lean' 'mean' 'green' principle - advising on the performance of the building envelope and helping to optimise the building form for passive solar design and maximum daylight penetration.

Another key concept is that of the 'dynamic building envelope' to respond to changing external conditions both throughout the day, and across the year. Low carbon technologies such as snow cooling and tapping into the natural thermal energy from the aquifer were also key elements of sustainability strategy.

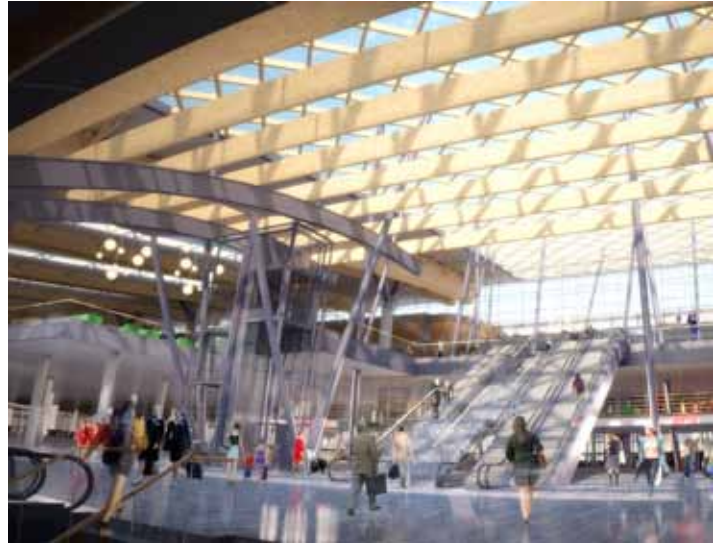
Our sustainability engineers also considered the design in a much wider holistic sense, ranging from material selection, construction practices, transport and waste management as well as the proposal to use a sustainability management system to measure and monitor performance.

Key project information

| | |
|----------------------|-------------------------|
| Client | Oslo Gardermoen Airport |
| Architect | NSW |
| Project value | £250m |
| Dates | Start on site 2010 |

Services provided by Buro Happold

Environmental and sustainability, infrastructure engineering, ground engineering, building services engineering, transport, climate (COSA).



Images copyright NSW



External shadowcasting analysis

Bergen Airport Master Plan Norway

This existing capacity constrained airport is a gateway to the tourist destination of the Norwegian Fjords and also for helicopter operations to the North Sea oil-rigs. The project included developing a 20-year airport masterplan to increase capacity in line with growing tourism demand while making best possible use of existing assets and also to resolve some legacy operational challenges.

A number of new facilities included a second runway, enhancing the capacity of the taxiway networks, a new terminal building complex including aprons, taxiways and a landside forecourt and car-park, accommodating a new rail-link to Bergen centre and re-developing the existing facilities for re-use.

Buro Happold took on this project with HOK architects by providing airport master-planning and terminal planning expertise including air-traffic analysis, forecasting and scheduling, review of existing facilities and operations, airfield planning, landside transportation assessment, baggage handling systems selection and reconfiguration, structural engineering and phased implementation planning.

Key Project Information

| | |
|----------------------|----------------|
| Client | Vinor |
| Architect | HOK |
| Project value | £50m |
| Dates | Completed 2009 |

Services Provided by Buro Happold

Airport master-planning, airfield and apron planning, landside transport planning, baggage handling, structural engineering and sustainability consultancy.



Images copyright HOK

Gibraltar New Airport

Gibraltar

The project involves the complete redevelopment of the existing airport facilities following an agreement between Gibraltar and Spain to derestrict aircraft movements. Once completed the new 20,000m² terminal will provide new check in facilities, baggage systems, retail lounge, gate rooms etc., to deal with the significant increase in passenger numbers.

The terminal will be positioned in Gibraltar but passengers will have direct access from Spain. This makes the project relatively unique as the terminal has increased passenger segregation issues due to border controls between the two countries.

In addition to the new terminal, Buro Happold is also providing new multi-storey car parks and business aviation facilities adjacent to the proposed terminal.

Key project information

| | |
|----------------------|-------------------------|
| Client | Government of Gibraltar |
| Architect | 3DReid Architecture |
| Project Value | £35m |
| Dates | Ongoing |

Services provided by Buro Happold

Building services, structural engineering, fire safety, geotechnical engineering, facade engineering, acoustic engineering and security consultancy services.



Copyright 3DReid Architecture



King Abdullah International Airport, Hajj Terminal Saudi Arabia

This major redevelopment work at the King Abdulaziz International Airport involved modernisation and capacity expansion of the Hajj Terminal, the world's fourth largest air terminal. Buro Happold provided a full suite of privatisation transaction related due diligence services on this build, transfer and operate (BTO) scheme which is at the forefront of Saudi Arabia's private sector participation programme for its civil aviation sector.

Passenger flow modelling at transport terminals such as Airports and Rail Interchanges enables design and management teams to assess the suitability of design proposals and space/management provisions in relation to crowd congestion, safety, security, comfort, and footfalls.

The work went hand-in-hand with the design development process, advising and optimising on space and resource provisions within the terminal. It was carried out in two parts. The first step was to do a desk study to analyse the space and resource provisions within the IATA guidelines and minimum technical requirements, and substantiating it by using simple flow models and spreadsheet based analyses. This stage also focused on identifying the key realistic scenarios for detailed dynamic simulation. During the second stage detailed agent based simulations were carried out on these key scenarios to test the design against passenger waiting times and densities.

Key project information

| | |
|------------------|-----------------------------|
| Client | El Seif Al Aziza Consortium |
| Architect | GMW |
| Dates | Completed 2008 |

Services provided by Buro Happold

Structural engineering, building services engineering, civil engineering, acoustic consultancy, security consultancy, bomb blast analysis, fire engineering consultancy, IT consultancy, media production, computational and simulation analysis and management consultancy.



Overview of the terminal



Internal view



SMART Move simulation of people movement within the terminal

King Abdulaziz International Airport

Jeddah, Kingdom of Saudi Arabia

The King Abdulaziz International Airport (KAIA) is approximately four kilometres to the east of the Red Sea and 15 km north of the city of Jeddah in the Kingdom of Saudi Arabia, and is the main gateway to the holy cities of Makkah and Madinah. Commercial operations at KAIA began in May 1981 and by 2004 approximately 14.2 million passengers per annum passed through the airport. This is 70% more than the original design handling capacity of 8.5 million passengers per annum

To relieve congestion and accommodate future growth, the General Authority of Civil Aviation (GACA) which is responsible for the construction, management and operation of the Kingdom's civil airports, commissioned a masterplan for the major expansion and upgrading of KAIA's existing infrastructure and facilities. The KAIA development is intended to take place in three development phases: the first phase for 30 million passengers capacity is scheduled to be completed by 2013, the second phase for 43 million passengers by 2020 and the final phase for 80 million passengers capacity by 2035.

Main components of the Phase One development include, construction of a new passenger terminal and passenger processing facility, upgrading of airport facilities including aeronautical and utilities, upgrading of access facilities and rehabilitation of existing aprons, runways and taxiways.

Key environmental challenges for the works include contamination risk during decommissioning and demolition of existing buildings and structures, noise and air quality due to an increased air traffic during operation and temporary and permanent dewatering of fluctuating levels of groundwater to a sensitive saline creek environment.



Key Project Information

| | |
|------------------|---|
| Client | General Authority of Civil Aviation (GACA). We are appointed with Huta-Hegerfeld Environmental Works Ltd as consultants to Saudi Binladen Group, the main contractor. |
| Architect | Atkins |
| Dates | January 2011 – Ongoing |

Key Services provided by Buro Happold

Environmental risk assessment and contamination advice, EIA management including air quality and water quality, construction and operational environmental management plans, solid waste management plans and design input and a sustainability review of the design and utilities.



Harbin International Airport

Harbin, China

We were invited to join RMJM as the engineering consultant in the shortlisted competition to develop the Extended Preliminary Design for Harbin Airport to the planning horizon of 2050. This required the design of all airside facilities as well as new terminals and associated facilities, transportation and the proposal for the refurbishment of the existing terminal.

Our approach to the design was to make the new airport as efficient as possible in terms of use of available space, movement of aircraft and passengers, resource and energy use and water consumption. The climate in Harbin is very cold in winter and hot in summer so we developed a sustainable design for the terminal buildings to ensure that it was both low energy whilst providing a comfortable interior climate all year round for the passengers and staff.

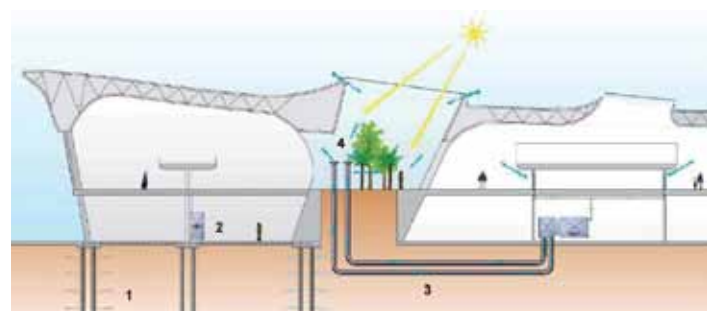
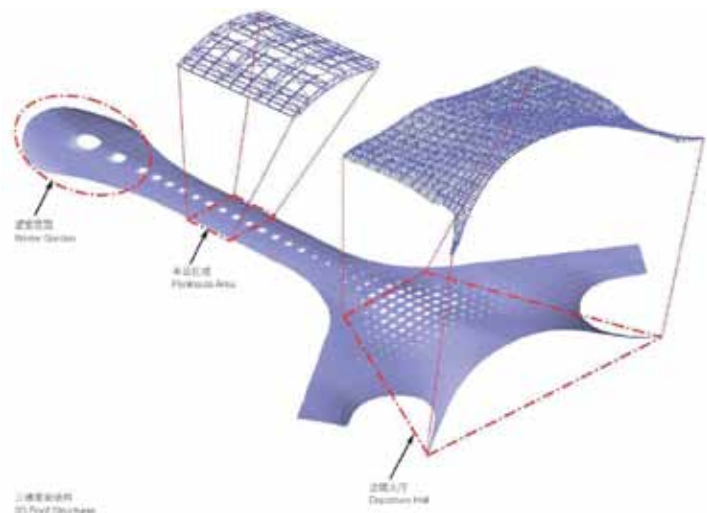
Key outcomes of the design are: maximising the number of aproned gates at the terminals, reducing walking distance for all passenger movements, a winter garden that provided warmth and light in the winter and coolth in the summer, and efficient structural design for the elegant terminal building, an integrated transport interchange and a water strategy that reduced the airports need to draw on the rapidly depleting ground water resource.

Key project information

| | |
|----------------------|-----------------------------------|
| Client | Harbin Airport Planning Authority |
| Architect | RMJM |
| Project value | Confidential |
| Dates | Completed 2010 |

Services provided by Buro Happold

Airport planning and design , transport planning and design, structural engineering , sustainability strategies , building services engineering , civil engineering



MSCP East, Heathrow Airport

London, UK

This project is a key element of the redevelopment of the Eastern Campus of Heathrow Airport, one of the principal gateways to the UK. It will provide the link between the new Terminal 2 building and the landside infrastructure and includes; 1350 space multi-storey car park, Arrivals and departures forecourts, The Covered Court providing pedestrian routes between the forecourt and the terminal building, 1.6km of highway, including 500m of elevated highway and two complex traffic intersections, Connection to underground railway system.

Buro Happold lead the design team, pursuing an agenda to maximise off site manufacture. The project includes extensive use of precast concrete combined with post-tensioned concrete. This significantly speeds up the build process whilst maintaining a robust design. The project makes extensive use of BIM to integrate the design, as well as for visualisations and as a tool to inform construction methodology. Design integration is a key success criterion, particularly with respect to the underground works, where live utilities must be maintained throughout.

Other aspects of the project of particular note:-

- meeting security requirements
- achieving targets for sustainable design and construction
- complex phasing and partial site handover
- wind study to assess pedestrian comfort

The contract is Design & Build, picking up from Stage C+. Operational constraints from the ongoing airport



operation and the adjacent Terminal 2 building sites will be major considerations in the design and construction process. The Design and Construction Team will work in close collaboration, to ensure the smooth delivery of the project.

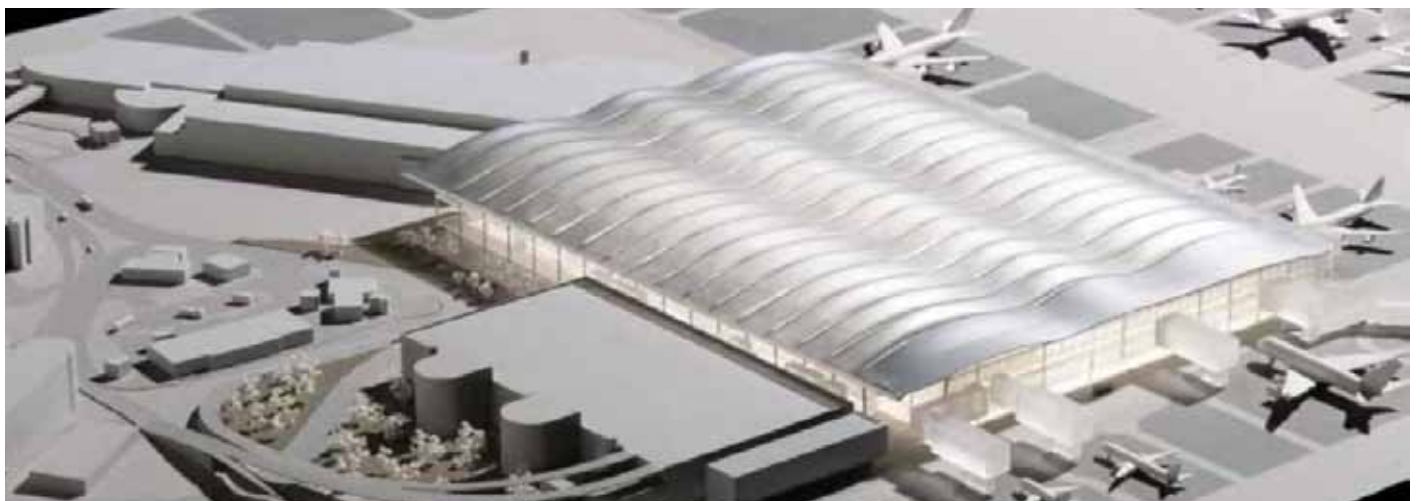
Future expansion of the car park to 2400 spaces, with associated infrastructure changes, may follow.

Key project information

| | |
|----------------------|-------------|
| Client | BAA |
| Project value | £77m |
| Dates | 2011 - 2013 |

Services provided by Buro Happold

Design Team Leader, civil engineering, structural engineering, geotechnical engineering, transportation, fire engineering, bridge engineering, MEP, acoustics and security.



RAF Museum, Hendon

London, UK

The brief called for a new exhibition hall to be built at the RAF Museum Hendon, in addition to a new shop, cafe and car park areas. The project also involved the refurbishment of existing buildings on site.

The additional gallery space is central to the museum's vision to display the most important aircraft in the history of aviation. Their collection includes over 200 aircraft from all over the world, from the first gliders to the fighter planes of today. It also includes the legendary Spitfire and Lancaster bomber. There is also an interactive timeline that engages the visitor in a journey through the historical landmarks of aviation.

The new exhibition hall had to be large enough to enable the display of full-size aircraft, but consideration also had to be given to the environmental conditions to ensure better and longer conservation of these artefacts.

Overall objective

The team worked together from the outset to effectively develop the RAF's brief and to help devise an innovative yet elegant response to it. The aim was to provide a practical design that balanced cost with value and performance in use, by applying sound principles of engineering and appraising systems over their full life cycle.

Key project information

| | |
|----------------------|------------------------------|
| Client | RAF Museum Hendon |
| Architect | Feilden Clegg Bradley Studio |
| Project value | £7.5m |
| Dates | 1999 - 2003 |

Services provided by Buro Happold

Structural engineering, building services engineering, fire engineering design & risk assessment (FEDRA), lighting consultancy, ground and site infrastructure engineering, acoustics consultancy



Images copyright: Buro Happold/Adam Wilson

ENGINEERING EXCELLENCE

Addressing the complex challenges presented by airports in both their urban and regional context requires a holistic approach and we respond to that challenge by integrating creativity and innovation within an evidence-based way of working.

We have the ability to assemble a custom-designed and world-wide experienced project team, bringing together the best skills and talent from inside our company and trusted project partners to deliver the level of Aviation expertise required to deliver successfully.

Our team have experience of Airport planning from regional airport refurbishments & extensions to the delivery of major new gateway airports. With our strong knowledge of aviation policy, licensing issues Worldwide, including the requirements and best practice recommendations of ICAO, IATA, CAA, FAA and GACA.

We bring lessons learnt from our diverse range of experience working with Airport owners, operators, airlines, baggage handling groups and end users from logistics and management of cargo to defining passenger requirements, passenger modelling.

Our worldwide experienced sustainability team contribute to the long term planning of providing sustainable solutions. Supporting airport owners and operators in achieving internationally recognised awards in sustainability, reducing energy consumption and therefore OPEX, seeking innovate means of reducing the carbon impact, providing alternative renewables energies where desirable. We are at the forefront of low energy design: we strive to deliver airports that have less carbon emissions and are more sustainable, we deliver projects that do not cost the earth.

Our experience

Airport Masterplanning

- Airport Buildings
- Terminals
- Piers
- Air Traffic Control Towers
- Hangars, Maintenance & Cargo Facilities

Airport Processes

- Passenger Flow Modelling
- Baggage Handling
- Security

Landside

- Terminal Forecourts
- Car Parks Public Transport/Railway Stations

Airside Planning

Trusted partners with:

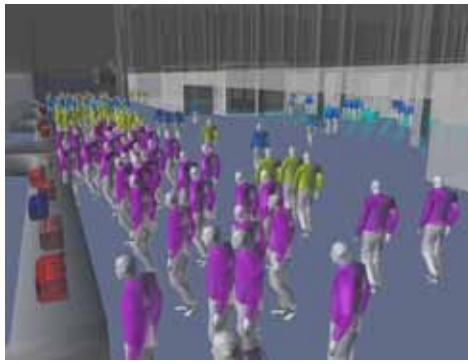
- Runway Systems
- Taxiway Networks
- Aprons

Our services

- Structural engineering
- Building services engineering
- Civil engineering
- Ground engineering
- Airfield design
- Masterplanning
- Bridge engineering
- Roads and highways
- Transport planning
- Facade engineering
- Passenger flow modelling
- Security consulting
- Fire engineering
- Acoustic consulting
- Inclusive design
- Project management
- Environmental services
- Terminal planning and operations



New Doha International Airport, Qatar Ongoing



London City Airport Crowd Flow Analysis 2009



Heathrow Terminal 3, New Air Bridges 2010



New Hajj Terminal, King Abdullah Airport 2008



Dublin Airport, New Check In Facility 2007



Heathrow Terminal 3, New Pier 5 2003



Heathrow Terminal 3, International Departures Lounge Extension and Refurbishment 2002



Fedex New Warehouse, Stansted Airport 2000



Bergen Airport Development Master Plan 2009



Gatwick Airport, New Pier 6 2005



Cork Airport, New Terminal Roof 2005



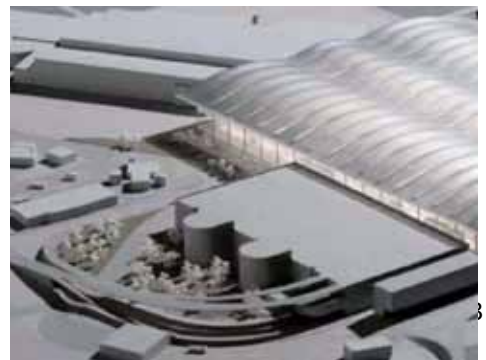
Birmingham Airport, New Terminal and Pier 2009



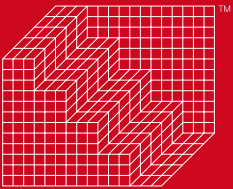
Heathrow Terminal 3, New Pier 6 2005



New Lisbon Airport Master Plan 2008



Heathrow New Multi Storey Car Park East Ongoing



Buro Happold

Neil Squibbs
Global Sector Director

Buro Happold
Camden Mill
Lower Bristol Road
Bath BA2 3DQ
UK

Telephone: +44 (0)1225 320 600
Email: Neil.Squibbs@burohappold.com

Buildings Environment and Infrastructure Consulting

www.burohappold.com

Abu Dhabi
Bath
Beijing
Belfast
Berlin
Birmingham
Boston
Cairo
Chicago
Copenhagen
Dubai
Edinburgh
Glasgow
Hong Kong
Jeddah
Kuwait
Leeds
London
Los Angeles
Manchester
Milan
Moscow
Mumbai
Munich
New York
Pune
Riyadh
San Francisco
Warsaw