Complex build challenges for London PBT facility

Edward Williams, an architect who runs his own practice, Edward Williams Architects, and Sheila Carney, director of Scott Tallon Walker Architects, and a specialist in the healthcare and science and research sector, discuss the challenges of designing the NHS in England's second proton beam therapy centre, for University College London Hospitals NHS Foundation Trust, in a central London location – close to existing infrastructure such as underground 'tube' lines – and explain how the major obstacles were overcome.

Photos courtesy of Paul Raftery

The building is essentially L-shaped in plan, running the length of Grafton Way and returning down Huntley Street, flanked at one end by Tottenham Court Road, and at the other by University Street and the UCH Macmillan Cancer Centre.

Courtesy of Edward Williams Architects / Scott Tallon Walker

University College London Hospitals NHS Foundation Trust (UCLH) viewed the development of its new Proton Beam Therapy centre in the Grafton Way Building at University College Hospital as an urgent and vital milestone in the process of improving healthcare for the local community – by moving existing services to an integrated and centralised campus, and introducing a world-leading proton beam therapy unit as a significant enhancement to therapeutic cancer treatment services throughout the UK. The vision for the new hospital was to create a world-class, modern, safe, and responsive healthcare environment which would in turn will facilitate better clinical outcomes, as well as an improved environment for staff, patients, and visitors, with clinical services that reflect UCLH as a world-class centre of excellence.

Vacant cinema site

The vacant former Odeon Cinema site was located on Grafton Way / Tottenham Court Road, and formed part of the University College London Hospitals NHS Foundation Trust (UCLH) estate portfolio. The selected

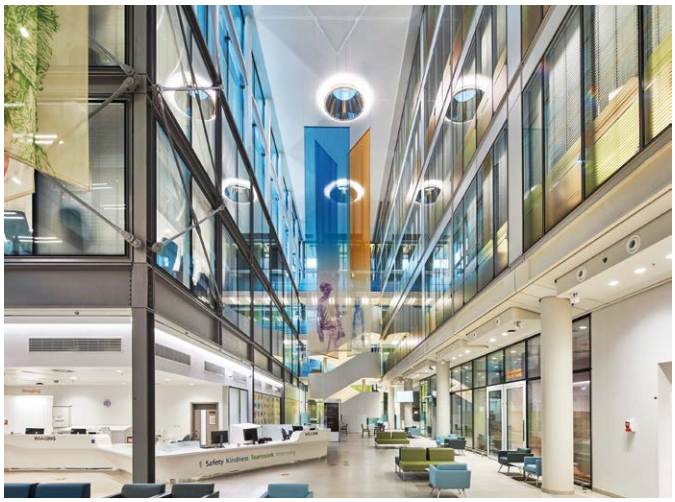
Key facts

Contract value: £217 m approx. (Construction cost, excluding equipment), funded by the NHS.
Total size: 37,000 m^2 approx.

Project team
Client: University College London Hospitals NHS Foundation Trust.
Main contractor: Bouygues UK.
Architects: Scott Tallon Walker Architects in association with Edward Williams Architects.
Structural engineer: Campbell Reith & Partners.
M&E engineer: Arup (Pre-Contract); WSP (Construction).
Fire engineer: Capita.
Landscape architect: Anna French Associates.
Client Project Manager: AECOM.
Client QS: Ridge & Partners.

Photos courtesy of Paul Raftery

There are four roof gardens – courtyard, courtyard roof, top of atrium, and roof.



Key features include generosity of space, light transparency, and 'sensory encounters to offer respite from city life'.

site sits strategically between the existing main UCL hospital to the north, and the new UCH Macmillan Cancer Centre. The Cancer Centre has been designed with spare capacity for 10 years of activity growth.

In 2010 the UK Treasury committed funding to provide a new National Centre for Proton Beam Therapy for NHS Patients in the UK. Scott Tallon Walker Architects (STW) was appointed to develop outline proposals for both University College London Hospital (UCLH) and The Christie Hospital in Manchester, as part of a national bid process by major NHS Trusts. Both schemes were successful, and each is able to treat up to 750 patients per year.

Scott Tallon Walker Architects, in association with Edward Williams Architects, were appointed by UCLH as architects for the London PBT project, and took the design through a successful town planning application with the London Borough of Camden, and then on to tender stage. Scott Tallon Walker Architects was then contracted as lead designer and architect for the construction stage by main contractor, Bouygues, UK.

An 'L'-shaped building

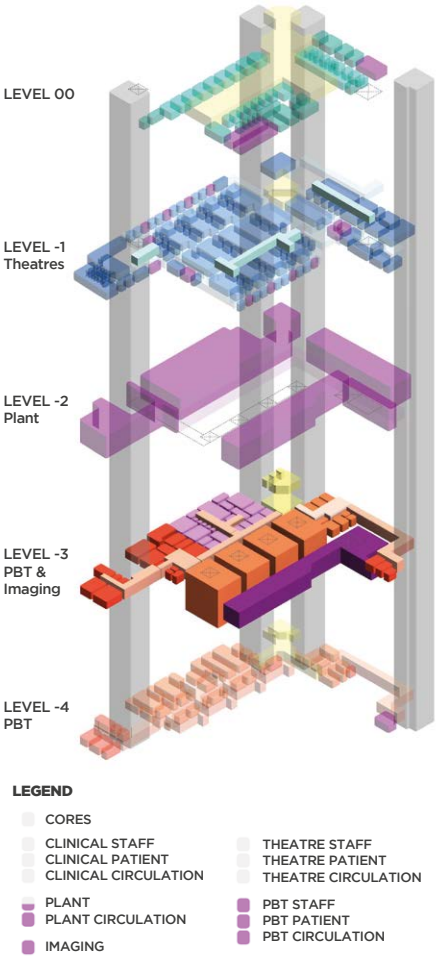
The building is essentially an 'L'-shaped building in plan, running the length of Grafton Way and returning down Huntley Street, flanked at one end by Tottenham Court Road, and at the other by University Street and the UCH Macmillan Cancer Centre. It features a central atrium running through the axis of the building that separates the Main building from the lower internal Courtyard building.

The Main building consists of seven above-ground levels and four below-ground basement levels. Proton beam therapy (PBT) and plant consume the majority of the basement levels, the remaining areas being given over to operating theatres and imaging. Above ground are clinical spaces, including bedrooms and consultation rooms.

The Courtyard building consists of three above-ground storeys housing predominantly support spaces, with two roof gardens on top.

PBT's benefits

Proton beam therapy is a type of radiotherapy that uses a beam of high-energy protons, which are small parts of atoms, rather than high-energy X-rays (called 'photons'), to treat specific types of cancer. Proton beam therapy enables a dose of high-energy protons to be precisely targeted at a tumour, reducing the damage to surrounding healthy tissues and vital organs – an advantage in certain groups of patients, or where the cancer is close to a critical part of the body such as the spinal cord. PBT is only suitable for certain types of cancer, such as highly complex brain, head, and neck cancers, and sarcomas, as it doesn't lead to better outcomes for many cancer cases than using high-energy X-rays, which are still considered the most appropriate and effective treatment for most cancers. Like high-energy X-ray radiotherapy, proton beam therapy is painless, but patients may experience side effects similar to those experienced from other forms of radiotherapy.



Courtesy of Edward Williams Architects / Scott Tallon Walker

An axonometric drawing of the PBT access hatches.

How the site was chosen

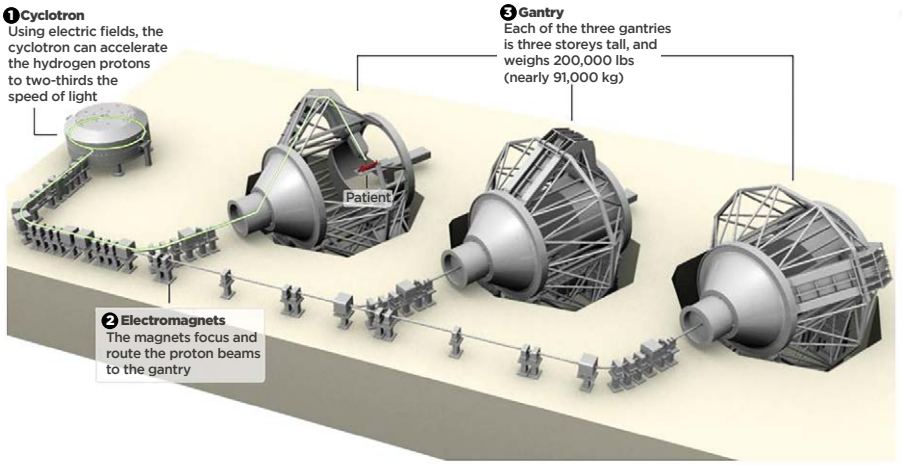
The site was one of several identified in the UCLH masterplan, and sits within the central London Bloomsbury Conservation Area on the existing UCLH campus, close to the main UCL hospital and several listed buildings, most notably the Grade II-listed UCL Cruciform Building and UCL Medical School. The site was owned by UCLH, and had been empty for many years. This location proved particularly suited to this development, as it is next door to both the main UCLH hospital and the Macmillan Cancer Centre for co-located clinical services, and there was also the ability to connect physically to the network of underground tunnels that runs across the UCLH Campus. This building is connected at Level -1 (Theatre Floor) directly to the tunnel network, providing direct connection back to the main hospital if required, without the need for transport outside across public highways. The site also sits within the designated Mayor of London's View Corridor, which runs from Parliament Hill to Westminster Palace, and which limits the height of development.

Extensive public consultations

Extensive public consultations were carried out with all immediate neighbours, particularly the Paramount Court Residents Association and Charlotte Street Association, local resident groups, London Borough of Camden councillors, Westminster Council, and the Greater London Authority. A Planning submission was made in December 2013, and granted in Spring 2014. Despite the impact of COVID-19, the project was delivered in February 2021.

The old UCLH Rosenheim building (along Huntley St.) was not fit for purpose, and was demolished as part of the overall redevelopment. Its functions had already been transferred to the new Macmillan Cancer Centre next door. The existing UCLH tunnel system is utilised for transferring patients, staff, and FM, between UCLH buildings.

In order to create the necessary clinical space, while respecting the Mayor of London's View Corridor height limits and surrounding heritage, the building consists of seven storeys above ground, and four storeys plus a mezzanine below ground. Construction of the building, which is 57 m high in total, included excavation to a maximum depth of 28.5 m, with occupied buildings on the same urban block and near an underground line making it one of the most complex building projects to be undertaken recently in the UK.



Courtesy of Edward Williams Architects / Scott Talon Walker

This image shows the configuration of the PBT system – from the Cyclotron to the massive gantries.

Essentially a concrete structure

The building is essentially a concrete structure throughout the main blocks and basement. The main structural grid is 9 m, with typical floor-to-floor heights on upper floors of 4080 mm, providing resilience and flexibility in terms of a future change of use. There is also provision for all major equipment replacement and removal designed into the structure, including that in the Basement area.

This building's section is particularly complex, so as to overcome the structural and servicing challenges for the very large-scale PBT gantries, which are positioned beneath a double-height plantroom sitting beneath an eight-theatre day surgery facility, which is itself beneath a seven-storey hospital, split into two blocks and connected via the atrium. The key challenges in designing the Proton Beam Therapy Centre were the size and weight of equipment, radiation shielding requirements, and the installation of the equipment itself. The system comprises of a Cyclotron (a particle accelerator)

Courtesy of Edward Williams Architects / Scott Tallon Walker

An aerial rendered view of the new PBT facility in its central London setting.

An adjustable venetian blind system is incorporated as a non-integral part of the curtain wall system.

weighing 100 tonnes, four treatment gantries each weighing 200 tonnes, and a beam line made up of individual magnets of varying weights. (The volume of concrete alone in the PBT area is approximately 28,000 m^3 – enough to fill the dome of St Paul's Cathedral 1.5 times).

Radiation shielding

Dense concrete walls (in some areas up to 2 m thick) provide the necessary radiation shielding and structural support for the building above. There is also a provision of demountable blockwork in some areas to provide future flexibility, and removal / access pathways to the PBT beam line and back-of-house areas. The use of BIM during both the detailed design and construction stages was paramount, but especially beneficial in the coordination of services within the PBT areas. A highly complex web of embedded ductwork, pipes, and wires, within the poured mass concrete had to be co-ordinated with reinforcement steelwork, while allowing for the requisite bends and spacings to comply with Radiation Shielding regulations.

Above ground, the building is characterised by generosity of space, light transparency, and sensory encounters to offer respite from city life, and the busy Tottenham Court Road area where it is based. To align with adjacent buildings and protect light and sight lines, the building itself is stepped back across its section, and split into two corresponding blocks – the 'L'-shaped main block, and the smaller 'Courtyard' block, connected by a spacious, light-filled atrium.

Light 'filters' into all inpatient rooms

The atrium brings natural daylight down through the building, through a deep plan and six floor levels, to filter into all inpatient rooms. This is particularly important for the wellbeing of long-term cancer patients, many of whom are likely to be immunocompromised and confined to their room for long periods. The building's external 'veiled' façade provides solar shading and layers of privacy to patient rooms from the outside, while allowing a larger degree of openness, connectivity, and visibility, to the outside world for the patient, to counter the sense of isolation that can accompany extended hospital stays. The fixed veil system wraps around the perimeter building, providing permanent privacy screening from the street. The veil can be safely cleaned and maintained from the permanent external walkway system, and sections dismounted and replaced separately if needed in future. As a secondary level of privacy to the street façades, as well as providing privacy for the atrium-facing patient bedrooms, an adjustable venetian blind system is incorporated as a non-integral part of the curtain wall system. These blinds can be controlled by the patient or staff to achieve the desired level of privacy and incoming light. The blinds have been incorporated into an openable glass screen ventilated cavity which allows easy access for cleaning and maintenance, and can easily be removed and replaced, if necessary from the outside, without affecting the permanent hermetic seal of the bedroom. This means that the bedrooms can stay fully operational while the blinds are being cleaned or replaced externally. The cavity incorporating the blinds also includes a ventilation filter which excludes dust from

Courtesy of Edward Williams Architects / Scott Tallon Walker

The atrium brings natural daylight down through the building, through a deep plan and six floor levels.

A planning study sectional perspective view of the new PBT facility.

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the cavity, and reduces the need to clean the blinds. Manifestation / screening to the glazed atrium and bridges provides colour hints in line with the interior design strategy, adding to the overall calming aesthetic internally.

Fitting into its surroundings

Extensive consideration was given to making sure the new building would sit comfortably within its surroundings, and would be a welcome new addition to the high-profile Bloomsbury Conservation Area. The new facility is contemporary and innovative, and sensitive to the local vernacular and the existing Portland stone cladding of neighbouring buildings. The project is designed to have a positive impact on the urban block where it is sited, that was in part previously derelict for many decades, with a scale, massing, and façade alignment, that respects and restores the well-established city grid. The façade system itself reduces the apparent bulk of the building, and allows it to sit comfortably with adjacent listed buildings. While the muted colour choices for the high performance aluminium, the veiled façade sits well with the stone and brick buildings nearby.

An engaging backdrop

The building facade is articulated to provide an interesting, engaging, and suitable backdrop to the listed buildings, and to contribute positively to the Conservation Area and the activity on Tottenham Court Road. Its mass is 'pushed' back at ground floor level to activate the street frontage. The veil is pulled forward to provide privacy screening and façade maintenance access. The roof steps back discreetly at Level 5 to minimise perceived mass. The building is broken up in elevation with the expression of stair towers, entrances, bays, and sub-division of bays. The façade articulation reflects the nearby Rosenheim Building's bay.

The requirements for external facade treatment for the 'body' include the provision of natural daylight and controlled views in and out, while being easy to clean, for infection control, with minimal invasion and disturbance of bedroom operation for maintenance and replacement.

A 'natural garden' theme

The choices of material, colour palette, motifs, and artwork, are guided by a 'natural garden' theme, designed to complement the complex therapeutic facilities and aid wellbeing and recovery by creating a calming and uplifting environment. The design embraces the principles of direct visual access to natural daylight, natural materials, and natural landscapes, through a series of planted terraces intended to flower year-round to provide peaceful settings for recuperation.

There are four roof gardens – courtyard, courtyard roof, top of atrium, and roof, some of which have controlled access for hospital amenity space, with some landscaped, but not accessible. These gardens aim to be visually pleasing to patients, visitors, and staff, as well as neighbours.

The 'controlled access' Courtyard roof garden is accessible to visitors, patients, and staff, while the Atrium roof is accessible for fifth floor patients. As well as providing visually pleasing outlooks, these planted areas help the biodiversity, combat the urban heat island effect, and reduce the problem and rate of surface rainwater run-off.

The building was a winner in the BALI (the British Association of Landscape Industries) National Landscape Awards 2021. The PBT equipment provider was Varian, with the chosen system a Varian ProBeam.

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Edward Williams

Edward Williams is an architect, and runs his own practice, Edward Williams Architects, with his partner Laura Carrara-Cagni, in West London. He established the studio in 2011, after nearly 20 years at Hopkins Architects, where he was an equity partner and involved in key projects including Glyndebourne Opera House, Ickworth House Refurbishment for the National Trust, Goodwood Racecourse, Wellcome Trust Offices, Library and Exhibitions, the Princeton University Chemistry Faculty Building in the US, and the Macmillan Cancer Centre at University College London Hospitals. The studio specialises in high-profile, complex, sustainable projects for leading clients both in the UK and internationally, and is currently working on major healthcare, residential, and mixed use projects and masterplans in the UK and abroad. Edward Williams has also served as the RIBA's Honorary Librarian (2012-2016), and Chair of the RIBA Library Committee, which has responsibility for the oversight of the British Architectural Library, the leading architectural library in the world. He sat on the main Board of the RIBA, and the Institute's British Architectural Trust Board, and was a trustee and Council Member from 2012-2018. From 2002 to 2010 he was a board director and trustee of Bedales Schools, where he chaired the Buildings Sub Committee, and oversaw a major architectural competition and successful, award-winning, development for the school.

Sheila Carney

Sheila Carney is a director of Scott Tallon Walker Architects specialising in the Healthcare and Science & Research sector. She has over 34 years' experience with the practice, successfully leading the full range of multidisciplinary services, and now leads its UK office. With 'a distinct focus on delivery of innovative and complex healthcare and science-research projects', her experience of working collaboratively, in framework partnerships, gives her 'an invaluable understanding of the strategic issues facing leading healthcare clients'. The practice said: "Her depth of experience brings added value in dealing with multiple personalities and managing the interactions of our large project teams, including at Trust management level, in Estates teams, with clinical leads, patient user groups, operational and support teams, infection control and FM staff, and external stakeholders such as regulatory bodies and research and education partners. She has presented at the Healthcare Estates Building Forum, the International Proton Therapy Congress, and the UK-China Oncology Congress, and plays an active role at Architects for Health.