National Graphene Institute

University of Manchester

Design & Access Statement

EC HARRIS BUILT ASSET CONSULTANCY

jestico + whiles

CH2MHILL.

RAMBOLL

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National Graphene Institute

Design & Access Statement

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1/ Project Team

Project Team

Client	The University of Manchester
Project Manager	EC Harris
Cost Manager	EC Harris
Architect	Jestico + Whiles
Technical Architect	CH2M Hill
Mechanical Engineer	CH2M Hill
Electrical Engineer	CH2M Hill
Structural & Civil Engineer Ramboll	Ramboll
Vibration Specialist	Ramboll
Fire Engineer	Ramboll
Acoustic Engineer	Ramboll
BREEAM Assessor	EC Harris
CDM Coordinator	Keelagher Okey Klein
Approved Inspector	HCD Building Control Limited
Access Consultant	AA Projects

Version History

Version	Date	Status
Revision 00	22 November 2012	Planning Application

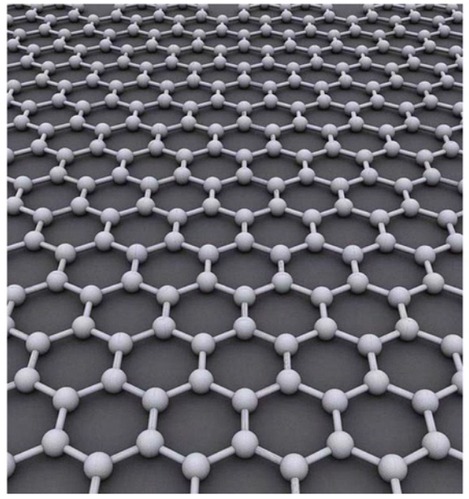
2/ Introduction

The National Graphene Institute will provide a state-of-the-art research facility which builds upon the highly acclaimed work of Nobel Prize winning Professors Andre Geim and Kostantin Novoselov of the University of Manchester. The Institute will be the focal point for both continuing academic research and commercialisation of the major past and future discoveries on graphene.

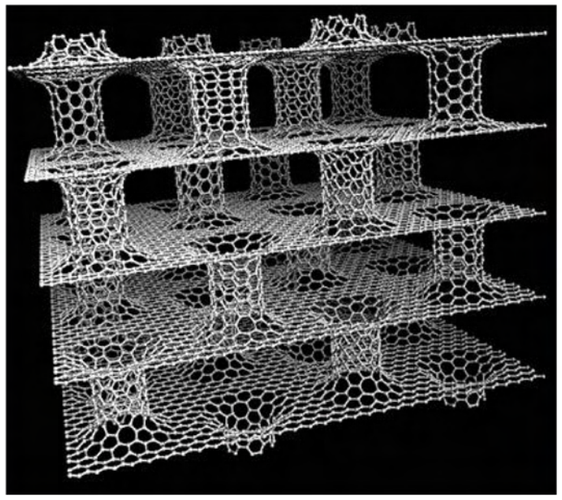
Graphene is the thinnest known material in the universe and the strongest ever measured. Its charge carriers exhibit giant intrinsic mobility, has zero effective mass, and can travel for micrometers without scattering at room temperature. Graphene can sustain current densities six orders of magnitude higher than that of copper, shows record thermal conductivity and stiffness, is impermeable to gases, and reconciles such conflicting qualities as brittleness and ductility.

Professors Geim and Novoselov managed to extract single-atom-thick crystallites (graphene) from bulk graphite in 2004. They pulled out graphene layers from graphite and transferred them onto thin SiO2 on a silicon wafer in a process sometimes called micromechanical cleavage or, simply, the Scotch tape technique.

Located on the University's South Campus, the National Graphene Institute will house state-of-the-art clean rooms and laboratories as well as offices and ancillary accommodation. The development of the facility will capitalise on the UK's international leadership in the field. It will act as a catalyst to spawn new businesses, attract global companies and translate the value of scientific discovery into wealth and job creation.



Atomic scale honeycomb lattice



Graphene pillared nanotubes



Graphene film

3/ The Brief & Project Objectives

The new Institute will provide the proper environment for the continuation of this important research in graphene, in collaboration with industry partners who will be invited to work at the Institute. The facility will provide cleanrooms and laboratories as well as academic offices to the researchers and their teams.

The design team is led by E C Harris as project manager, quantity surveyor and BREEAM consultant and comprises Jestico + Whiles Architects, CH2M Hill M+E and process engineering and specialist architect for cleanroom and labs, Ramboll civil, structural, vibration, fire and acoustic engineering. The team won the commission through competitive tendering in the OGC Buying Solutions Framework.

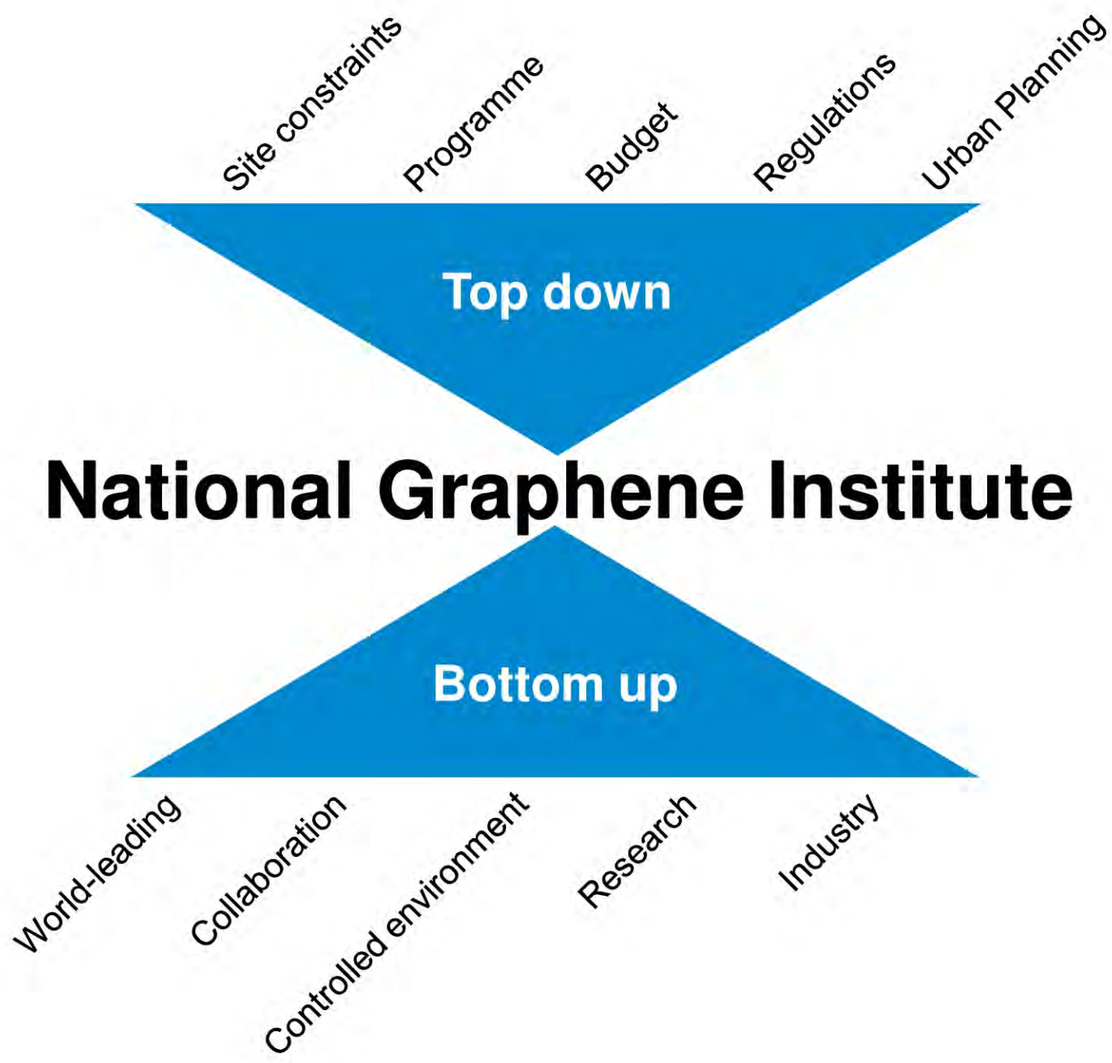
Prior to the involvement of the present team, a feasibility study was carried out by a separate consultant team who produced a Stage A/B Report which formed the preliminary project brief for the project and upon which the project cost plan and funding applications were based.

Upon appointment in early April 2012, the current design team conducted intensive briefing sessions with end users of the building, including Professor Novoselov, Dr Ernie Hill and Dr Peter Blake, MD of Graphene Limited, as well as key staff members of the University's estate, maintenance, security, IT, servicing and supply and other departments, to ascertain functional and operational requirements applicable to the new building. At the same time, the team also scrutinised the A/B report to gain a consolidated and comprehensive understanding of the project requirements to allow them to move onto Stage C design work.

This validation process necessitated in-depth investigations into detailed user requirements of each space, useable vs gross floor areas, plant spaces and capacity, redundancy requirements, construction cost rates and indices, bench marking of different elements of similar recent projects in this country and abroad, all of which are evidence-based. It was agreed by all `parties that a new definition of spatial requirement and cost plan was needed which will accurately describe the Project Brief. This resulted in a building which has an overall gross internal area of circa 7,600 m2, excluding external roof plant.

The Brief documents in detail those project requirements, available information and assumptions that have been used. This Brief has been signed off by the client and forms the basis of the design of the building. The Brief also embodies the following Project Objectives.

- Provide a technically suitable environment to carry out research in graphene
- Create a work environment which is enjoyable and inspiring for users and visitors
- Building that is robust, flexible and adaptable to future research needs
- Building that is sustainable, easy to maintain and value for money
- Building that is distinctive, reflective of the quality of research being done at the UoM, and attractive to industry partners expected to collaborate in the commercial development of Graphene
- Strive for an 'Excellent' BREEAM rating
- Firmitas utilitas venustas



4/ The Site & Context

The proposed site is located within the campus of the University of Manchester, on the south side of Booth Street East between Oxford Road to the west and Upper Brook Street to the east.

The site itself is bounded to the west by the low rise and understated Crawford House and to the east by the imposing form of the new 6 storey indoor car park building. Further to the east along the south side, the street edge of Booth Street is defined by the 4 storey red brick Crawford House. Directly across Booth Street are the narrow slab blocks of Bowden Court student residences running in the north south direction. Diagonally to the north east corner lies the University's newly completed 5 storey James Chadwick Building, home to the newly completed School of Chemical Engineering and Analytical Sciences.

To the south are a small surface car park and the L-shaped 3 storey Prospect House. Beyond them is the new University Square of alternating green and hard surface which is surrounded on all sides by recent and high quality buildings of the campus, including the Alan Turing Building, the Jean Macfarlane Building and the George Kenyon Building.

The site is effectively the northern edge of this group of academic research buildings, enclosing the new square which forms the heart of this part of the campus, to the east of the more established main thoroughfare of Oxford Road, with its historic buildings and quadrangles on the west side. The site itself is a level green plot of approximately 40m x 45m with vehicular access on all 4 sides, though two of these, to the east and south are restricted by barriers and provide access and servicing to Prospect House and the Chaplaincy further west towards Oxford Road. These access rights of way are to be maintained.



NGI Site



Prospect House



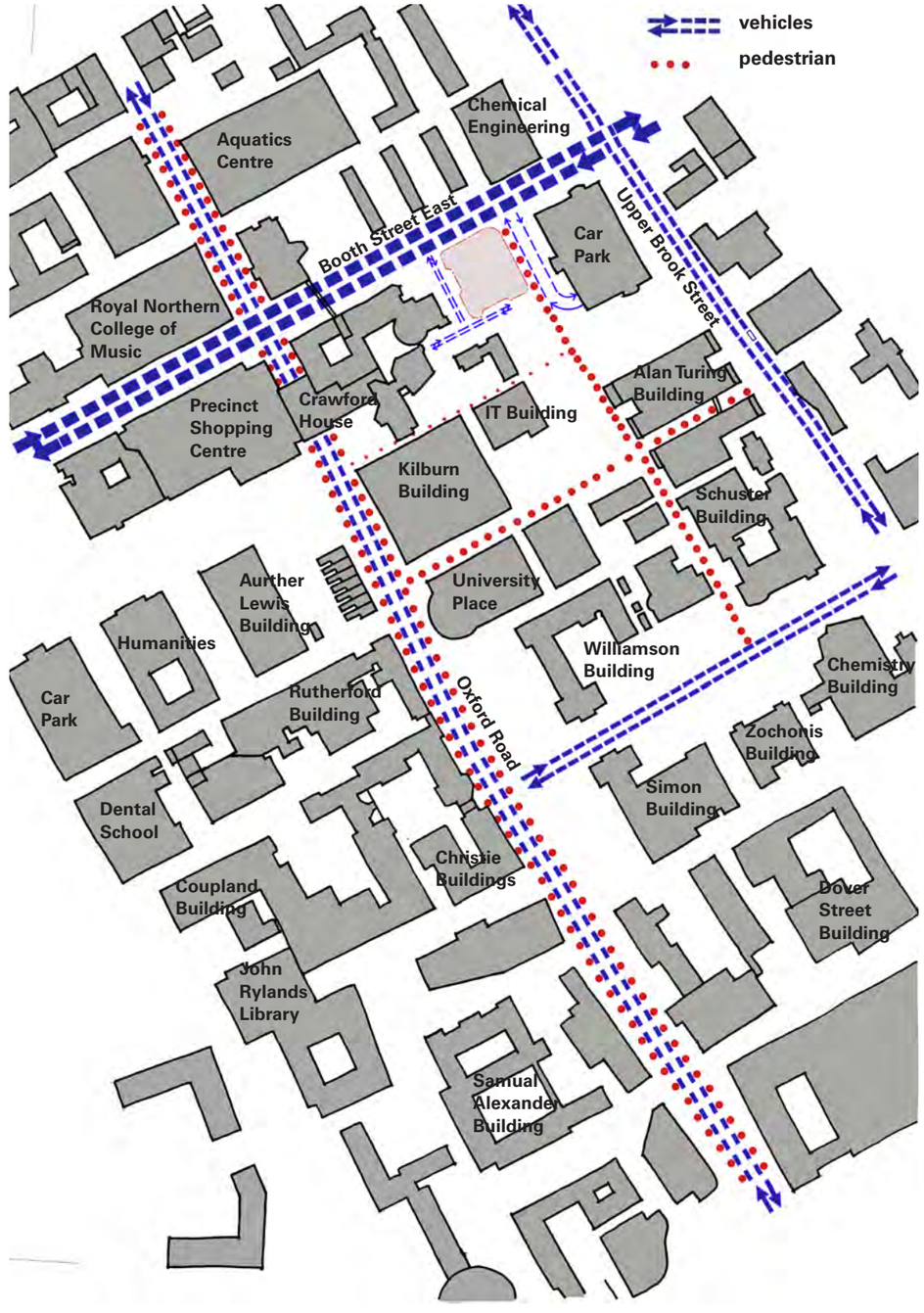
James Chadwick Building



Alan Turing Building



Jean McFarlane Building



Campus Plan

4/ The Site & Context

Two parallel rows of poplars line the Booth Street edge, further cluster of trees are found at the south east corner. A arboricultural survey has been commissioned which indicates a mixture of status and conditions for the existing trees (refer to Appendix L for more details). An agreement has been made in principle with Manchester City Council planners to provide a contribution for trees to be planted elsewhere. The details are expected to be finalised in the course of the planning approval process.

The adjacent land uses are all passive/non-sensitive and compatible with a new academic research facility. There are no heritage or conservation area issues. Likewise no change of use is required. Pre-application discussions with MCC were positive, the planners indicated that they see no design issues with the scheme presented. They had stated that they expected to see a building of high architectural qualities that would reflect well on the City of Manchester and its links to the discovery of graphene.

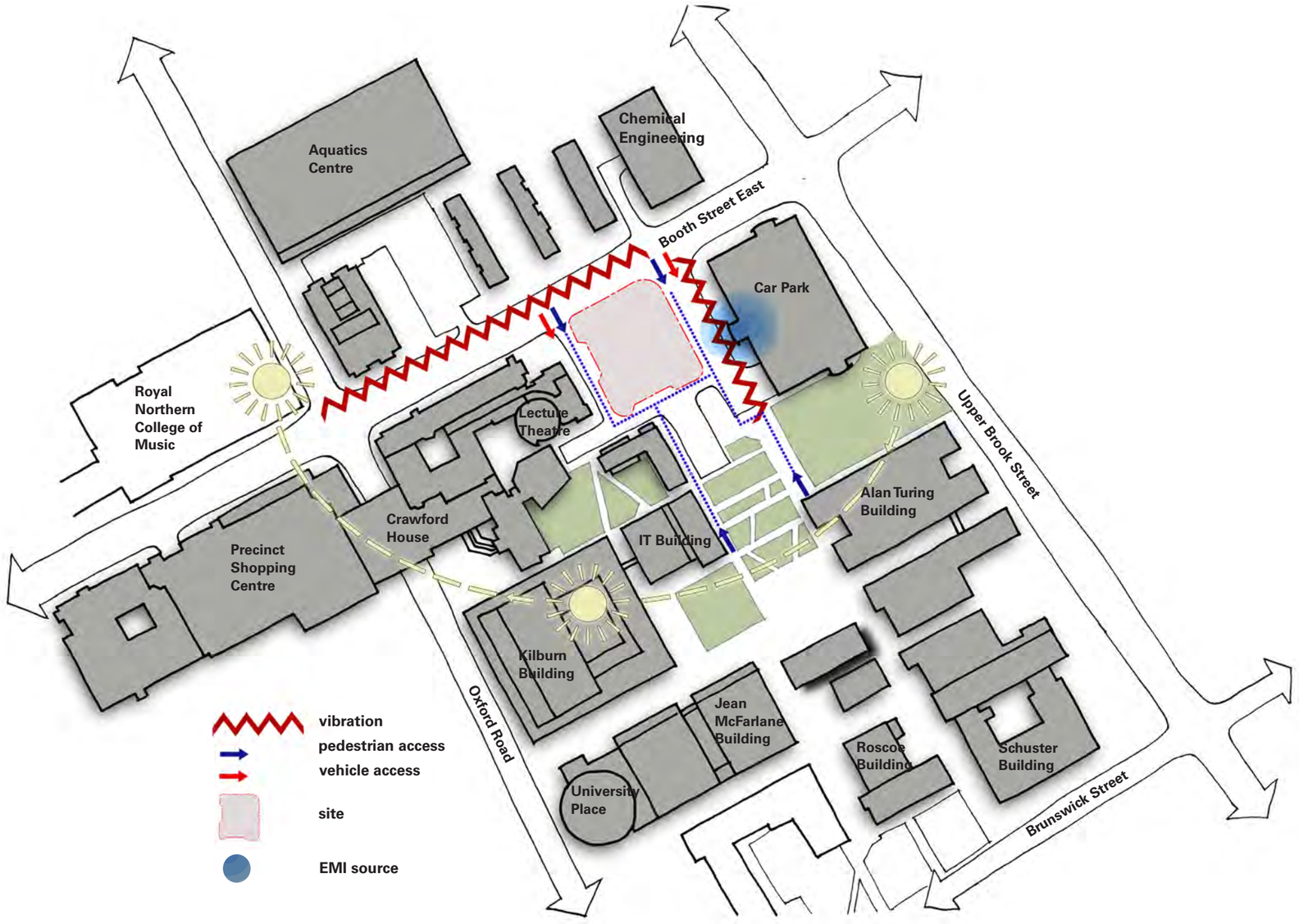
There are two principal approaches for pedestrians to the site, from the Booth St East frontage on the north or from the other campus buildings to the south. Visitors will probably come from the northern direction whilst users of the facility, academics, researchers and students are more likely to come from the south where they may have other offices or places of work or need to visit other university buildings.



Campus Square



Multi-storey carpark



Site analysis

5/ Design Principles & Spatial Organisation

The primary function of the new facility is for the research of graphene and the key performance criterion is the minimisation of vibration of the structure which can compromise research activities carried out in the cleanrooms at nanoscales. Vibration Criterion D has been established as the standard required for the main cleanroom and the laser laboratory. This requirement has been the principal driving force underpinning the various design concept options.

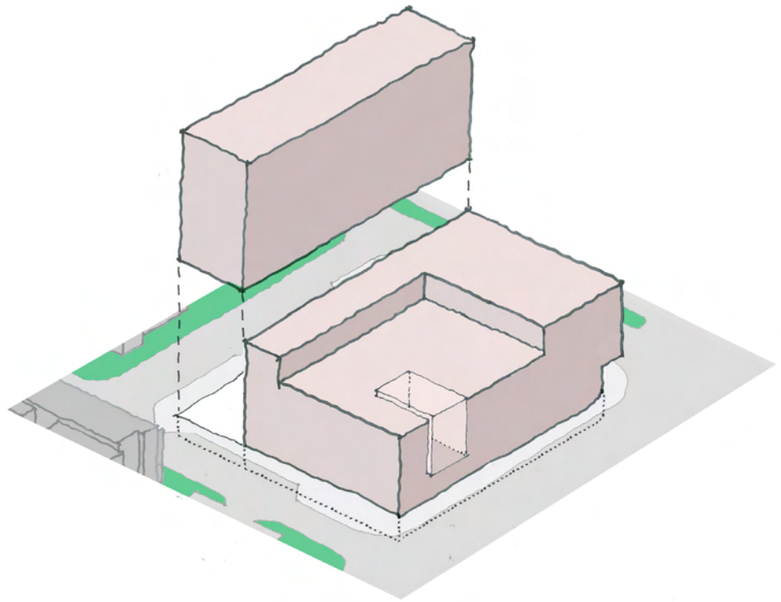
After numerous explorations, the design team concluded that the most practical and efficient means of achieving the vibration requirements would be to locate the main cleanroom directly or as close to the bedrock as possible, having removed the top layer of made up ground which is unstable. This approach resulted in the main cleanroom working level being located about 3m below ground.

On the super structure, the frame will be reinforced concrete flat slab construction with columns at 6.6 metre centres.

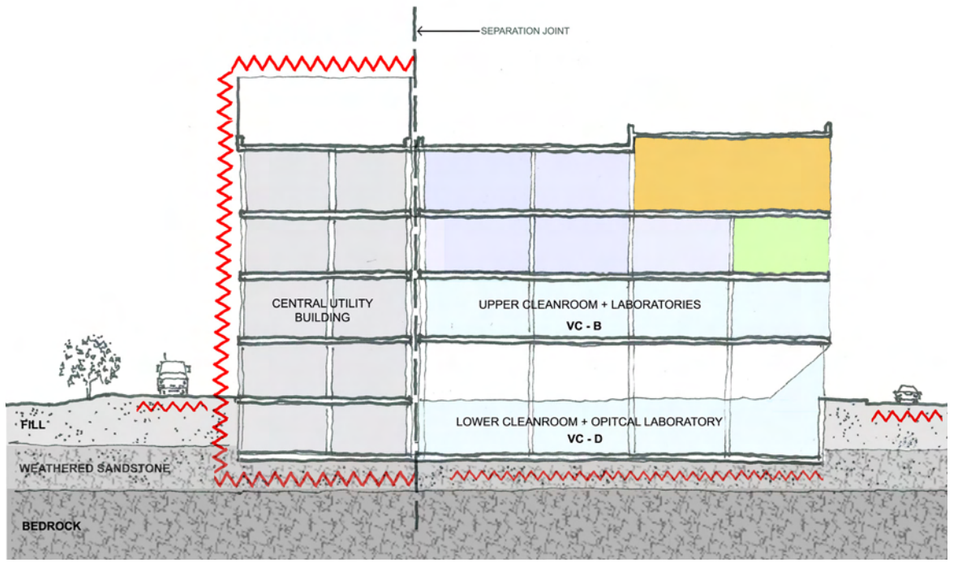
Another key design principle is the grouping of all major plant equipment that serves the research space into a structurally and spatially separate Central Utility Building (CUB). This has the advantage of isolating all heavy, noisy and vibrating equipment into one structural zone and away from the sensitive research environment; the two structures will be separated by a construction joint running the full height of the building. Being a multi storey compartment, the CUB facilitates efficient distribution of services into the areas that they serve from a space directly adjacent, usually on the same floor. Further advantages are that access to outside for fresh air or exhaust is easily available for any equipment on an external wall or from the roof of the CUB, and deliveries and loading area are also located in this wing which feeds directly to the research areas using a goods lift.

Early on in the design process, it was agreed that the preferred location for the CUB was on the west side of the building, this street being a narrow semi-controlled service access presently serving Crawford House, Prospect House and the Chaplaincy, with the least significant elevation and public access impact. The longer north south dimension of the site facilitates a more useable foot print for the CUB. This also avoids the troublesome western sun heat gain and glare into offices or laboratories.

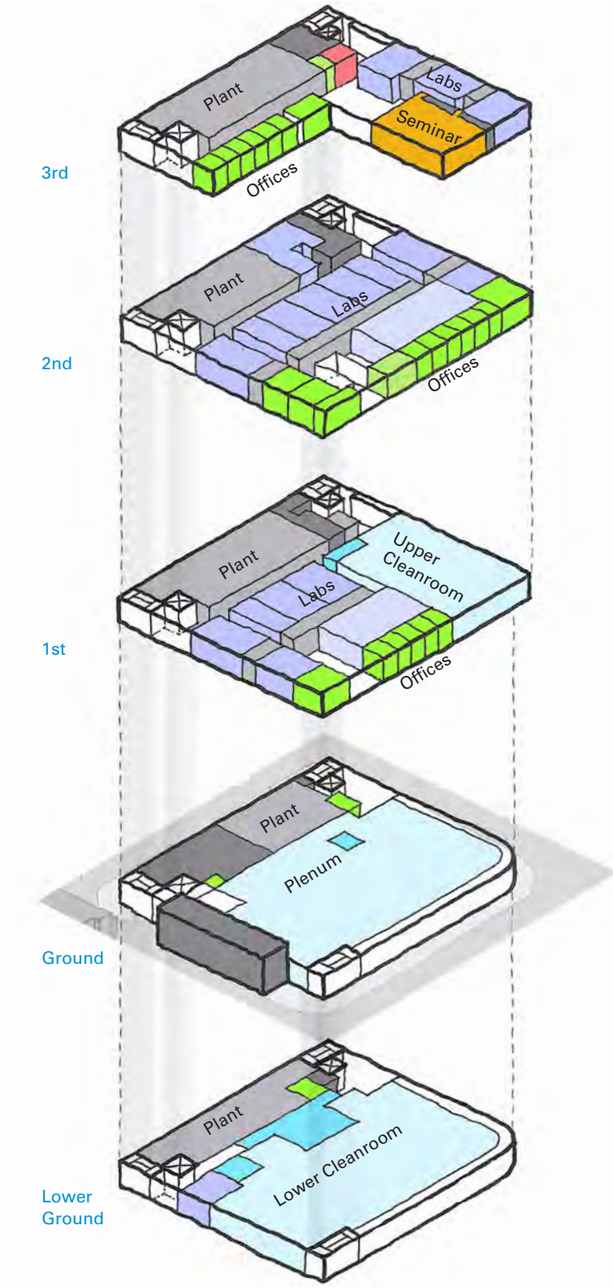
The location of the main and secondary entrances into the facilities took some exploration and discussion with the client and end users. Eventually it was agreed that for urban planning, identity and public access reasons, the most appropriate place for the main entrance of the facility is on Booth Street East. An additional entrance is provided at the opposite end of the CUB to cater for regular university users who will need convenient connections to other buildings on campus. This will be a secured entrance with card access only.



Separation of Central Utility Building (CUB)



Vibration control strategy



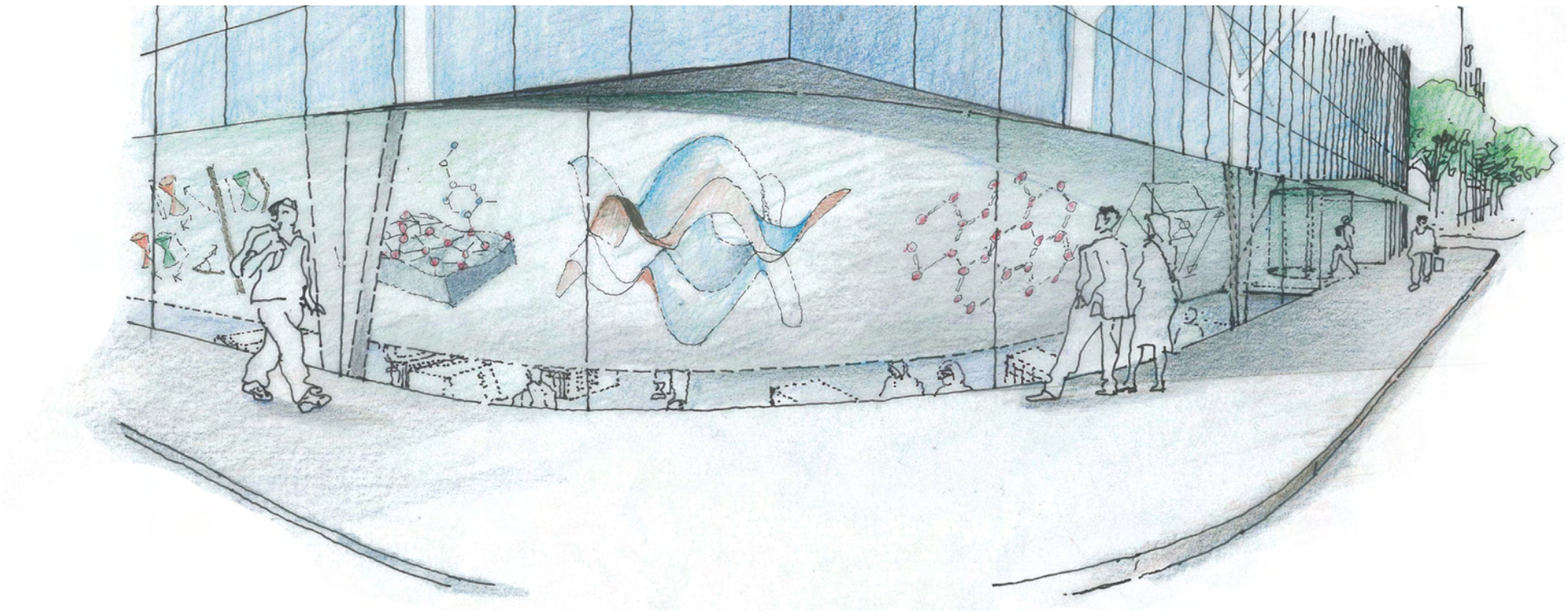
Exploded Axonometric

5/ Design Principles & Spatial Organisation

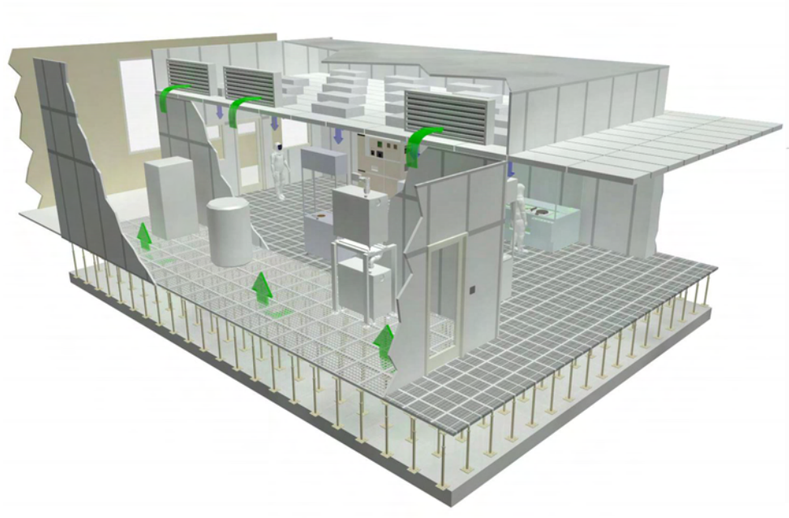
Internally, the facility is organised with the main cleanroom taking up the entire lower ground floor, together with a laser lab which also requires VC - D stability. The lower cleanroom layout consists of a centrally located gowning room which is accessible from both the stair and lift cores at either end of the building. Dedicated access is provided directly from the gowning area into the flake preparation area. From the gowning area users also have direct access to either the clean stair leading to the upper cleanroom or directly onto the clean circulation corridor of the lower cleanroom which serves a traditional 'bay & chase' arrangement. A dumbwaiter is also provided at the vertical core to allow for transportation of clean materials between the cleanrooms. A secure perimeter access corridor provides direct viewing into the Cleanroom and also allows for escape from the clean bays and chases.

The cleanroom air system utilises a clean plenum approach, with fan filter units within the ceiling grid and sensible cooling coils located within the return-air path. This allows for flexibility and efficiency. The cleanroom tools require a precisely controlled internal environment to be maintained on a 24/7 basis. Makeup and pressurisation air to the cleanroom is provided via central air handling provision located adjacent to and distributing within plenum void space. The volume of makeup air provision exceeds that required for general occupancy for the space and is driven by the technical requirements of the exhaust provision. The full height of the cleanroom is thus over 7m and occupies in effect the lower ground and ground floor levels of the building.

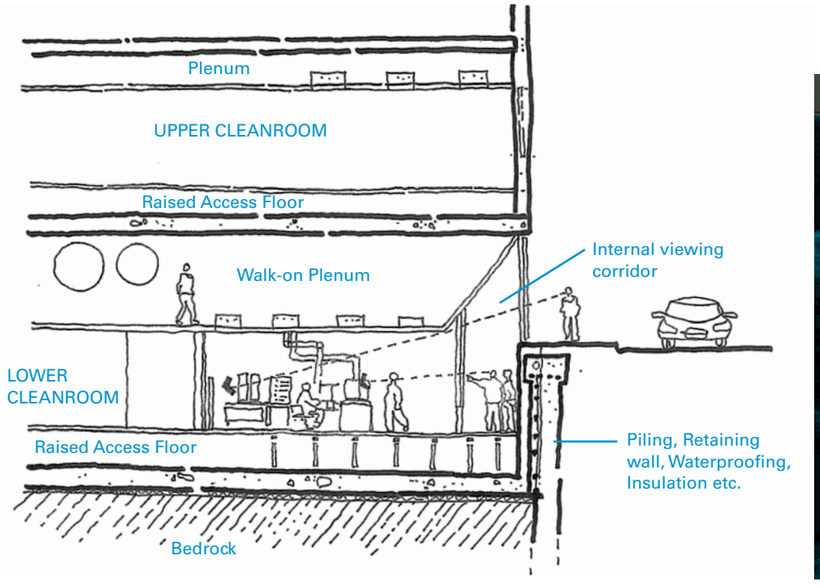
On the north and east sides of the building, a continuous glazed viewing window runs along the length of the pavement outside which corresponds to the internal viewing corridor. The sides of the 3m high walk-on plenum at this level is chamfered back at an angle along the perimeter, permitting views into the cleanroom from the pavement. Internal blinds at the cleanroom level will allow researchers to control the degree of visibility of their work space and activities to outside. The continuous angled side of the plenum enclosure along the length of the viewing window can also serve as an excellent display surface, as suggested by Professor Novoselov, leader of the user groups. Efforts are underway to investigate various options of projecting still or moving images onto this continuous 'display board'.



Perspective view to north east corner showing continuous viewing window down to cleanroom below and projected images on inclined "display board"



Cleanroom ventilation diagram



Sketch section showing cleanroom viewing



Exemplar cleanroom

5/ Design Principles & Spatial Organisation

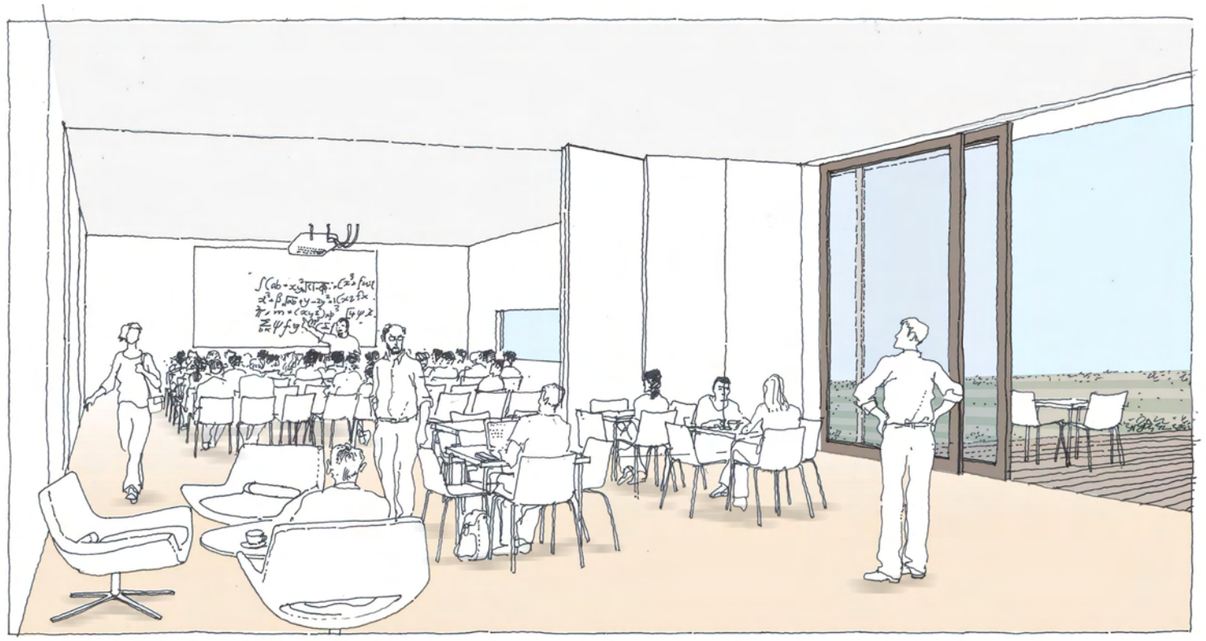
Moving up, part of the first floor will house the secondary cleanroom, access to which is via the clean support/gowning room on the lower ground floor, as mentioned earlier. The rest of the first floor is taken up by laboratories and offices. A double height breakout area is provided near the south east corner which links to a similar space on the second floor. This area is lit by a roof light and a double height window that provides natural ventilation.

A number of laboratories are also located on the external perimeter of the building allowing natural light to penetrate the space, offering an alternative environment where such research allows. However, more demanding laboratories in terms of services requirements such as the Chemistry Laboratories are located on the Third floor of the building below the roof level, reducing the run of services and therefore cost.

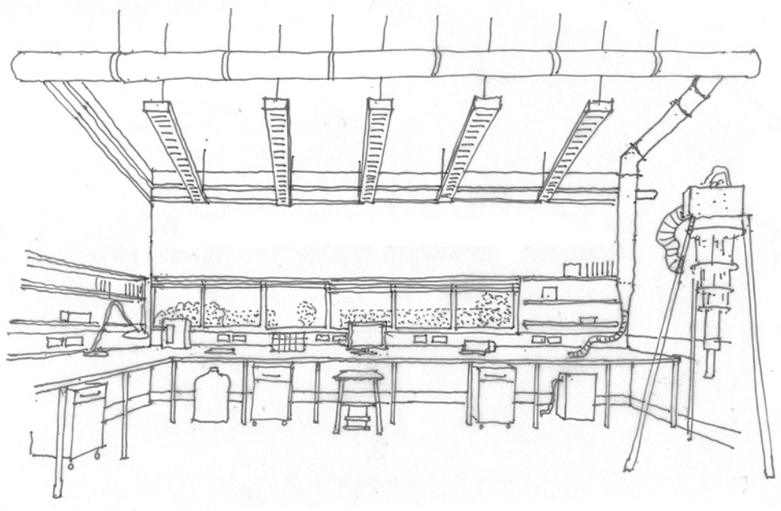
The second floor accommodation resembles the first except that there is no cleanroom. Like the first floor, it is populated with a mix of labs and offices, providing close proximity between the two uses, an adjacency requirement stipulated by the end users. The internal modular laboratories within each floor level are primarily located within the centre/ core of the building and are positioned back to back with a central shared grey space running the full vertical length. This allows increased flexibility for the services and pumps etc to be located within the grey space for the full length of each lab, reducing service runs and connection points. Likewise the breakout space on the second floor overlooks that below which together share the roof light and large glazed window on the east elevation that provide daylight and view into the heart of the two laboratory storeys.

Each Modular Laboratory will also have a double door entry for equipment move in and user access. The lab itself will measure approximately 6 x 7m and provide a clear floor to soffit height of minimum 4m. Modular freestanding benching with integrated shelving will be located around the perimeter of the room with clear height zones for larger pieces of equipment. Within the exposed concrete soffit will be recessed Halfen channels to facilitate the hanging of exposed services, lighting and laboratory equipment/ furniture. Gas distribution and sink locations will be dependent on lab user preferences.

The third floor contains the remainder of the labs and offices and the multi-purpose seminar room and its generous foyer. This room itself can accommodate up to 120 people for seminars, as well as being divisible for smaller gatherings. If the entire space - seminar and foyer, is opened up as one single large area, then up to 200 people can take part in a seminar. It is envisaged that the public may be invited from time to time. At the same time, this area also serves as the principle social space of the facility, with an adjoining kitchenette. It is south facing and has an outdoor roof space adjacent.



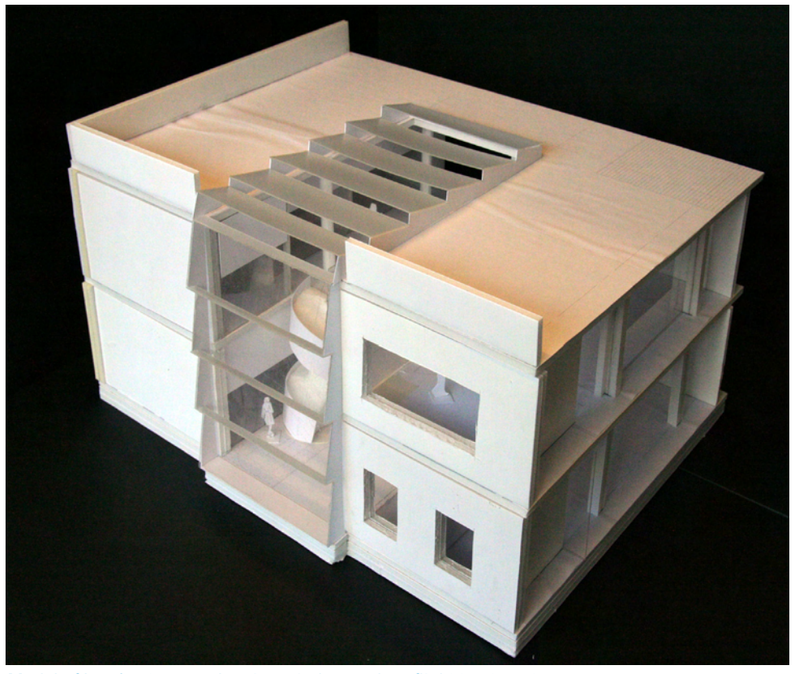
3rd floor seminar room with roof terrace beyond



Interior sketch of typical laboratory



Interior view of breakout model



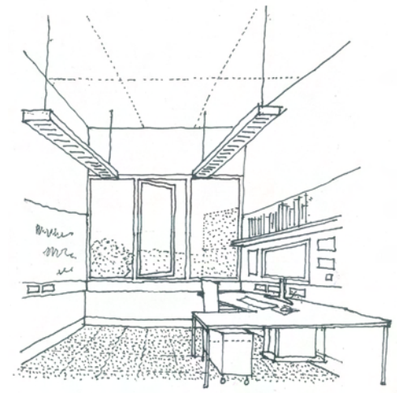
Model of breakout space showing window and rooflight treatment

5/ Design Principles & Spatial Organisation

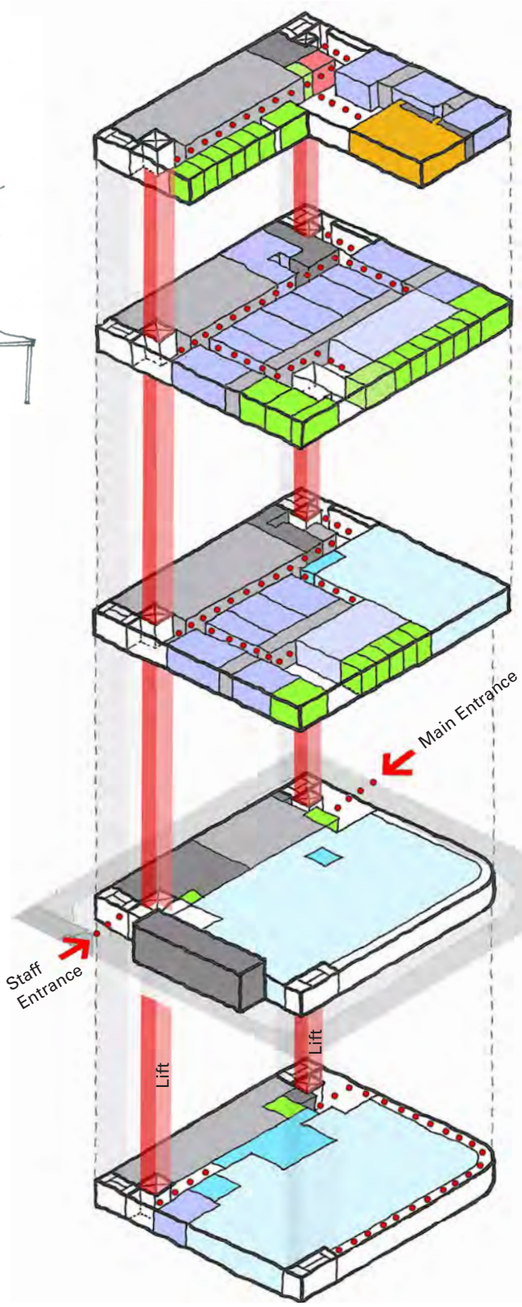
All the office spaces are envisaged to be naturally ventilated and all have external windows.

In terms of massing and form, the building extends to all boundaries of the site and rises to a height of around 18m overall, with the CUB having an additional open storey of enclosed roof plant. The form is a basic cube with some articulation at the roof level and the CUB as a distinct element on the west side.

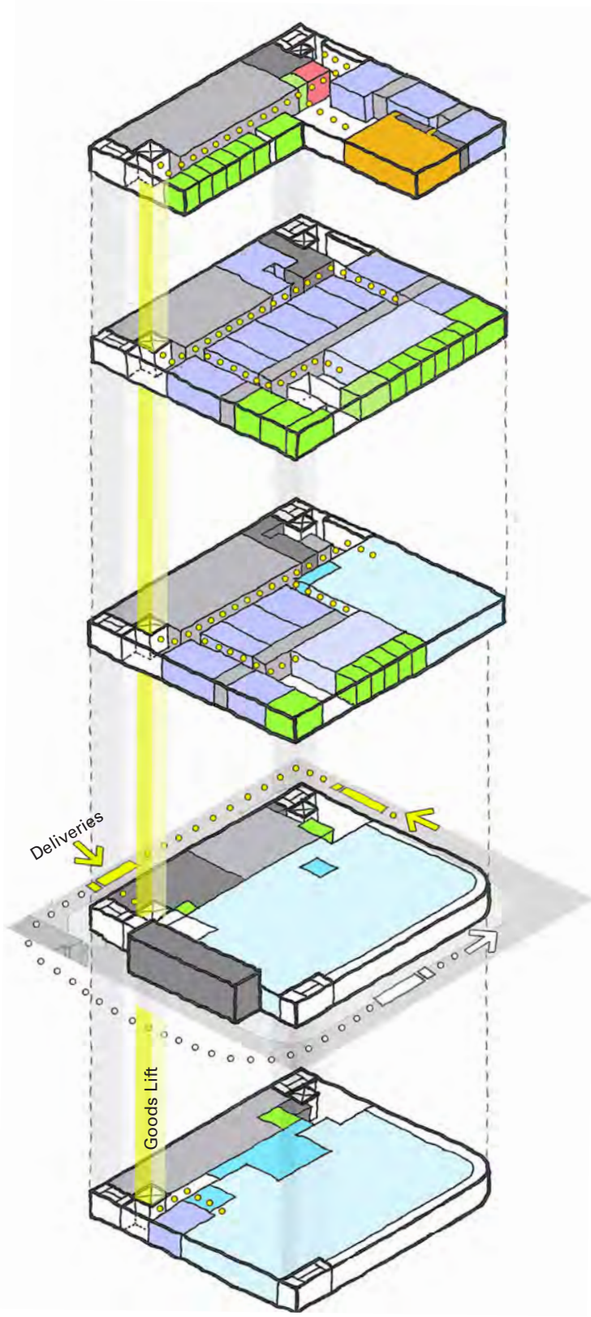
The overall height and massing of the building sit comfortably amongst the existing adjacent neighbours. It is lower than the new James Chadwick Building on the north side of Booth St, as well as the car park building to the east and Crawford House to the west. It is taller than Prospect House to the southwest, but does not overlook it directly, being more to the east of that building. in terms of scale and proportion it resembles the Alan Turing Building to the southeast, but is much smaller in foot print and also less tall and imposing. There are no overlooking, overshadowing or loss of light or view issues in respect of any of the surrounding buildings.



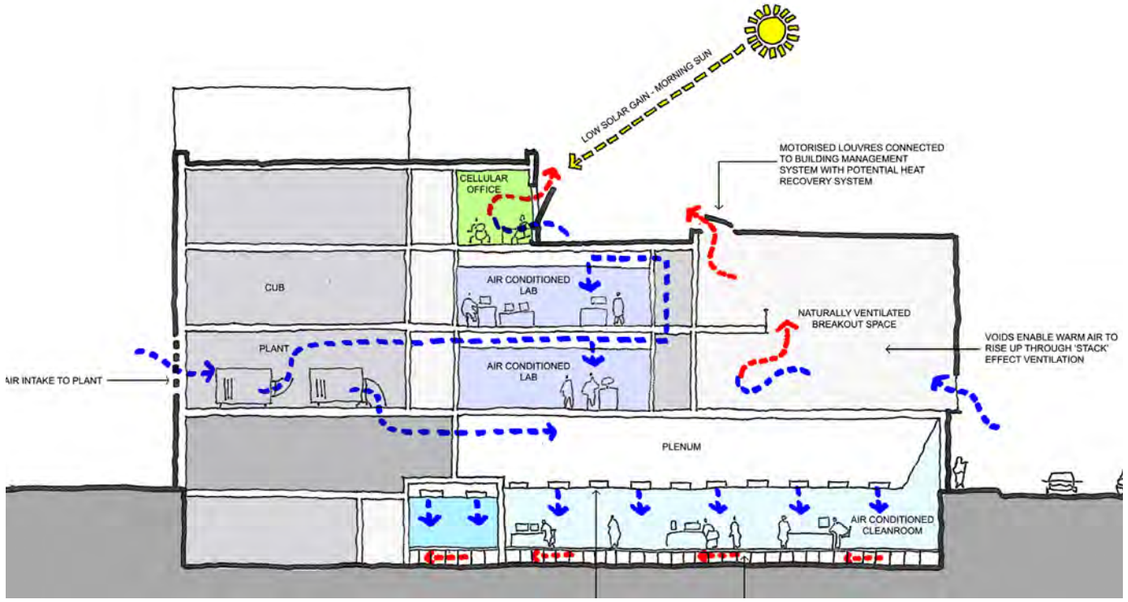
Interior sketch of typical office



Staff Circulation Diagram



Delivery and Move-In Diagram



Ventilation Strategy

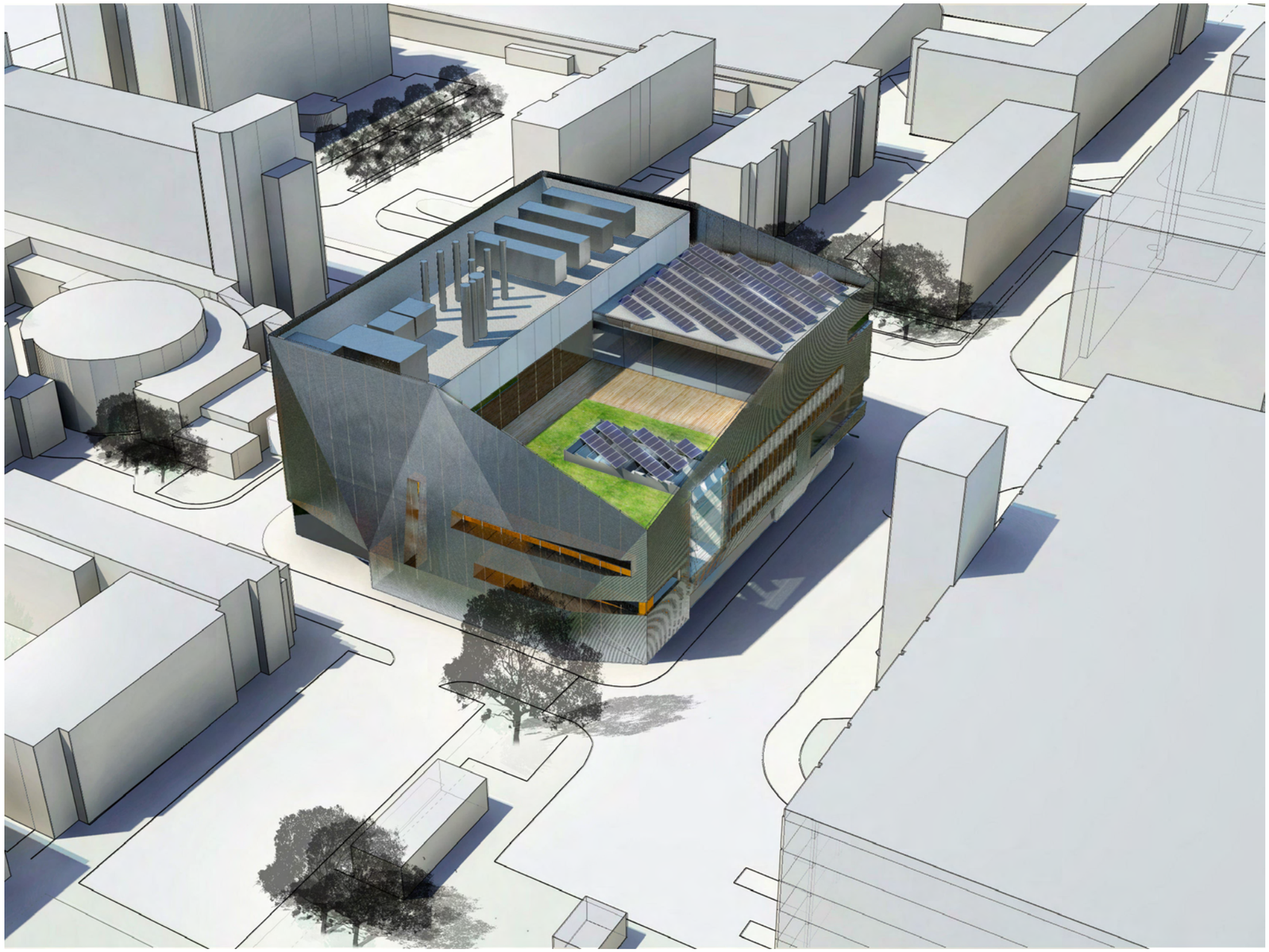
6/ Façade Design

The surrounding buildings are clad in a variety of materials including brick, render, zinc and other metal cladding systems. The site context therefore has no distinct character which suggests a particular material treatment for the National Graphene Institute. The proposed elevational design therefore responds more specifically to the functional requirements of the interior spaces.

The architectural arrangement of the building has two principal elements: the usable, occupied component, which houses the cleanrooms, laboratories, offices and other areas ancillary to these uses, and the predominantly servicing component, which contains the mechanical, electrical, hydraulic and processing plant areas, including loading and storage which serve to support the occupied areas.

Horizontal windows in offices and laboratories provide good daylight and views out for building users. In the offices, some of these will be side hung opening outwards to provide natural ventilation of these spaces. A cill height of 900mm above floor level in offices allows for a 750mm high desk to be positioned against the external wall with up to 150mm high dado trunking above. Since all laboratories will be air conditioned, windows to these rooms will be fixed shut. A slightly higher cill height of 1200mm above floor level allows for 950mm benching and up to 250mm high dado trunking underneath. A consistent window head height of 2700mm above floor level is provided in both offices and laboratories.

A series of larger glazed openings provide a counterpoint to the horizontal fenestration serving the offices and laboratories. At street level, a continuous frameless glass 'viewing' window wraps around the northern and eastern sides providing views down through the viewing corridor into the lower cleanroom, as well as valuable daylight into this subterranean working zone. Daylighting is also provided to the upper cleanroom above, with 3 metre tall fixed glazing around its northern and eastern facades. In addition, four storey high glazed curtain walling to the principal circulation spaces (including main and staff entrances, lift lobbies and staircases) on the north-west and south-west sides of the building flood these areas with natural light and also allow glimpses in from the outside world. Finally, the double height break-out space is filled with light via a full height and full width 'picture window' on the east façade.



Bird's eye view from south-east

6/ Façade Design

The primary functional requirement of the façade to the Central Utility Building is to provide large areas of air intake to air handling and make-up units and further free areas for heat rejection to internal plant equipment. The façade treatment therefore must provide large areas of louvres on the west elevation for this purpose. At CUB roof level, a continuous acoustic barrier is required around the full perimeter in order to control noise outbreak from rooftop plant equipment.

An inner skin comprising powder coated metal composite cladding panels encloses the rectilinear form of the building envelope and accommodates flush windows and other openings as required under operational requirements. Fixed to the outside of this inner skin is a separate perforated metal 'veil' which wraps around the volumes of the different elements of the building continuously to provide a unifying texture and fluid shape.

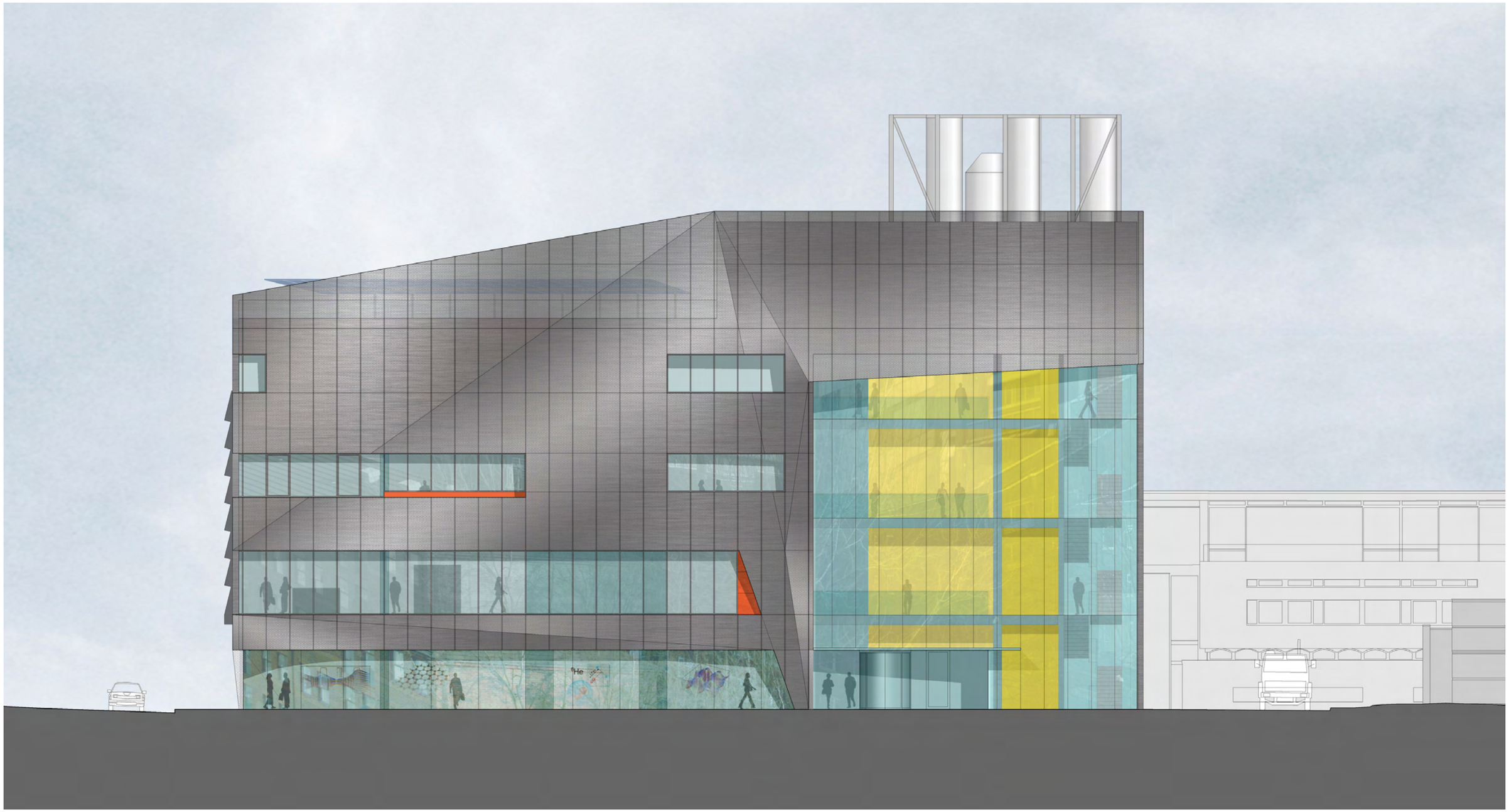
The precise choice of material, perforation pattern and density is flexible and will be explored further at the detail design stage. One option would be to use hexagonal perforations instead of the conventional circular or square versions as a subtle reference to the molecular structure of Graphene.

On the north, east and west facades, the perforated panels are fixed back to the inner skin via simple brackets. The perforated cladding continues over louvres on the face of the CUB on the west side of the building, allowing complete flexibility in the locations for air intake and heat rejection. On the south side, the cladding embraces the external gas and plant compound on the ground floor into the overall architectural form, which requires a secondary steel structure to support the perforated cladding. The perforated cladding also rises up on two sides of the roof garden to provide a sense of enclosure to this external space.

Cut-outs in the perforated cladding provide clear views out from internal spaces and allow access for window cleaning via water fed extendable pole or cherry picker. Gantries are provided at 1st, 2nd & 3rd floors along the south façade for window cleaning purposes.

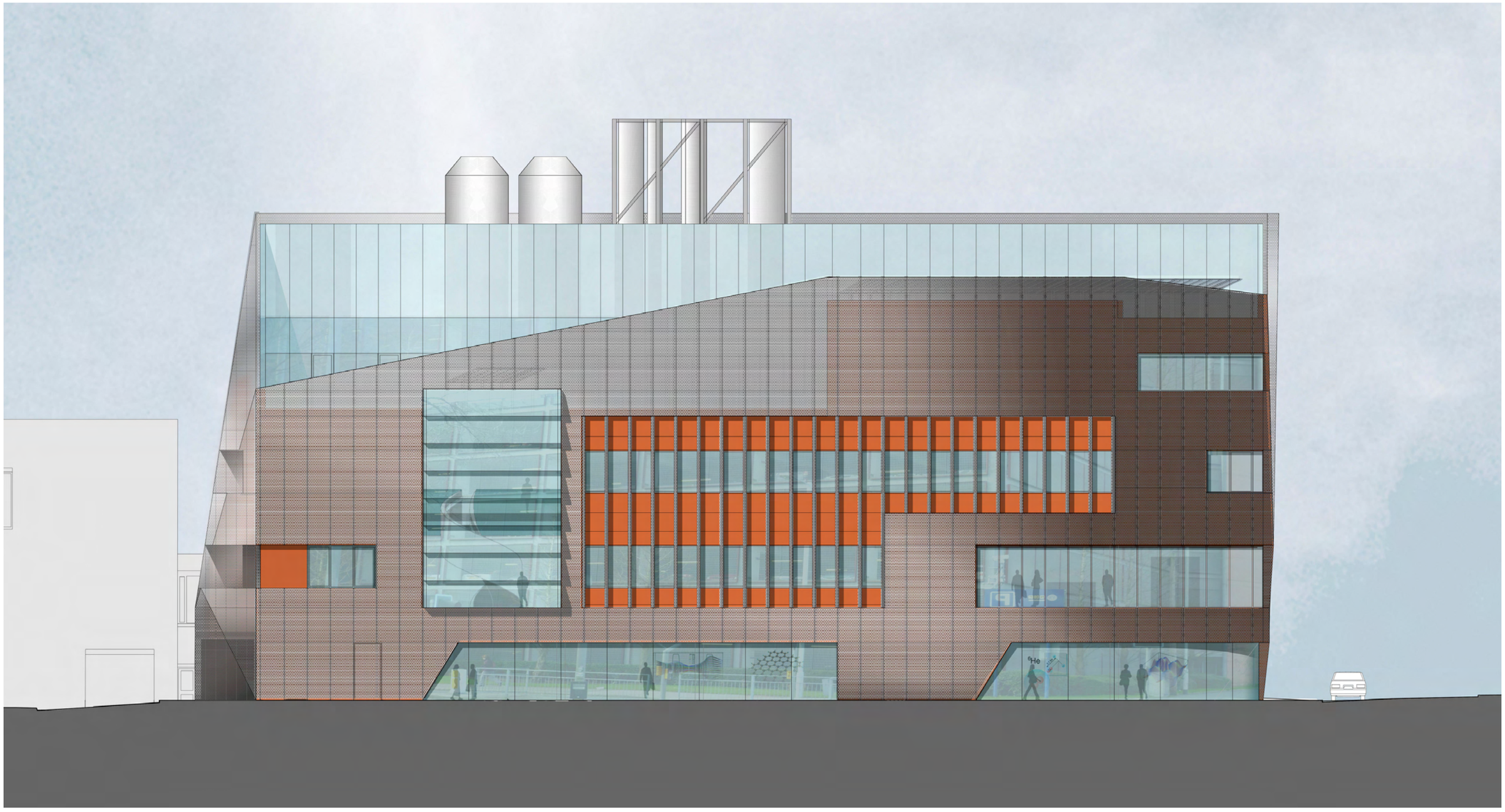


Façade detail

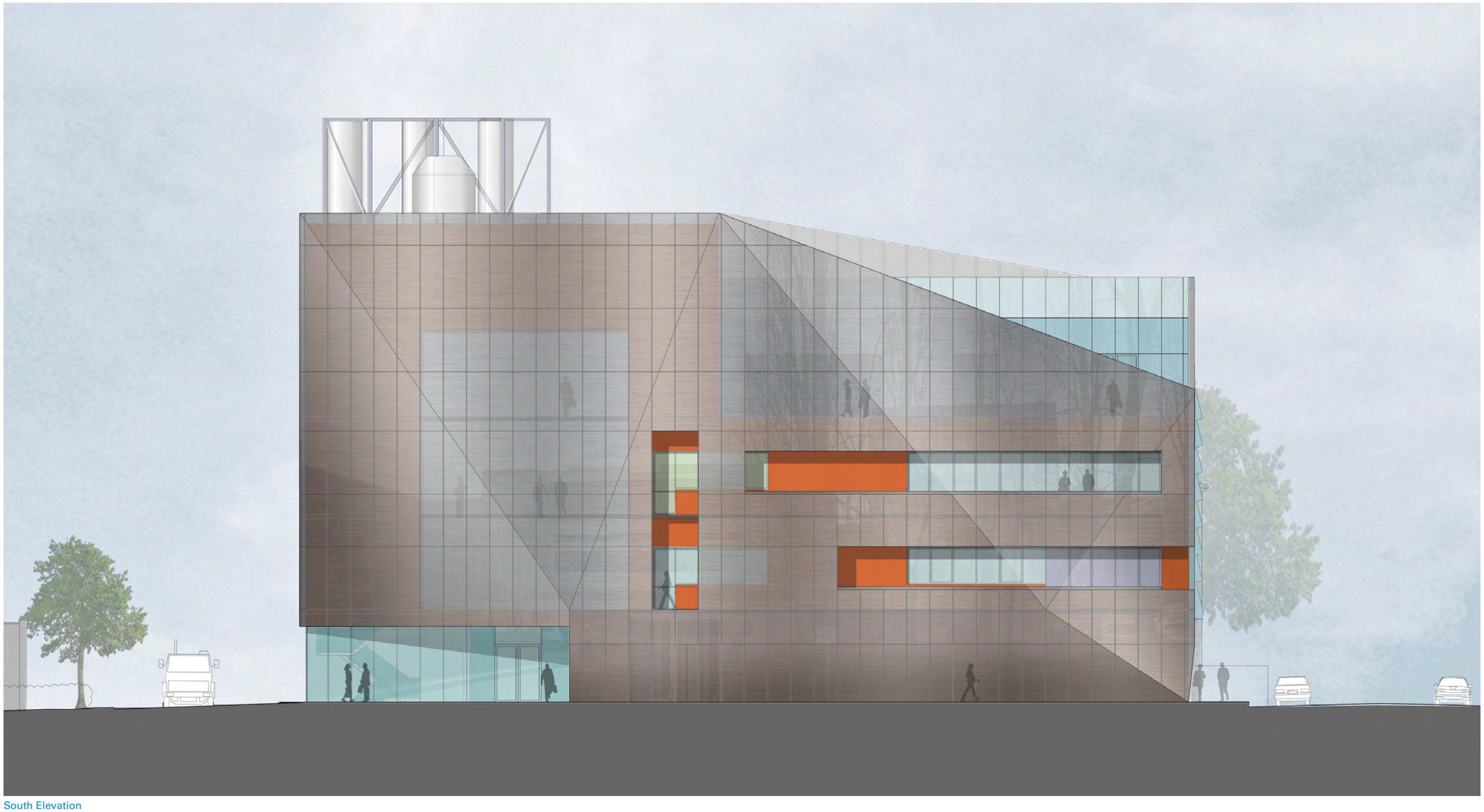


Booth Street East Elevation

6/ Façade Design

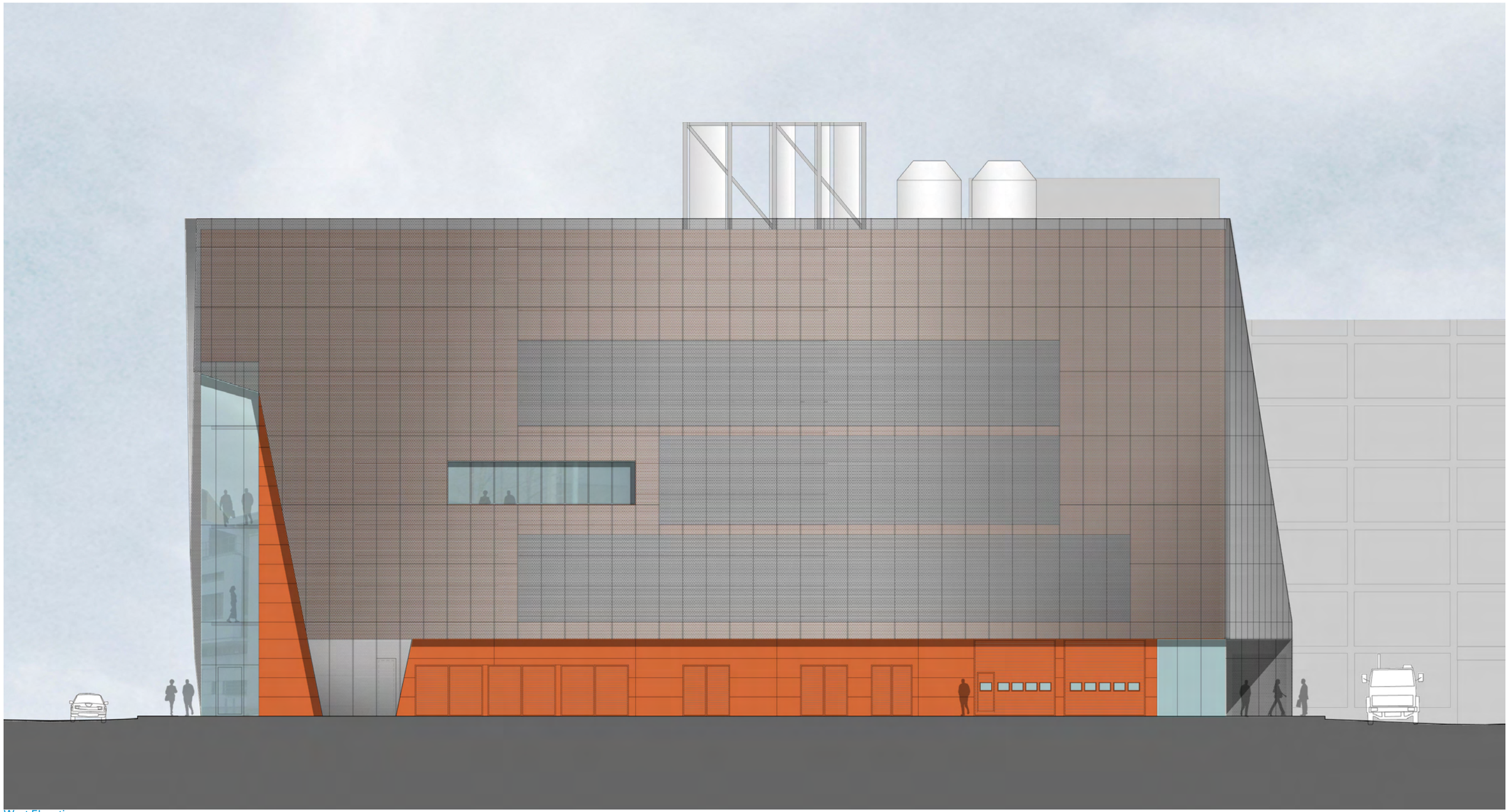


East Elevation



South Elevation

6/ Façade Design



West Elevation

6/ Façade Design



View from Booth Street East

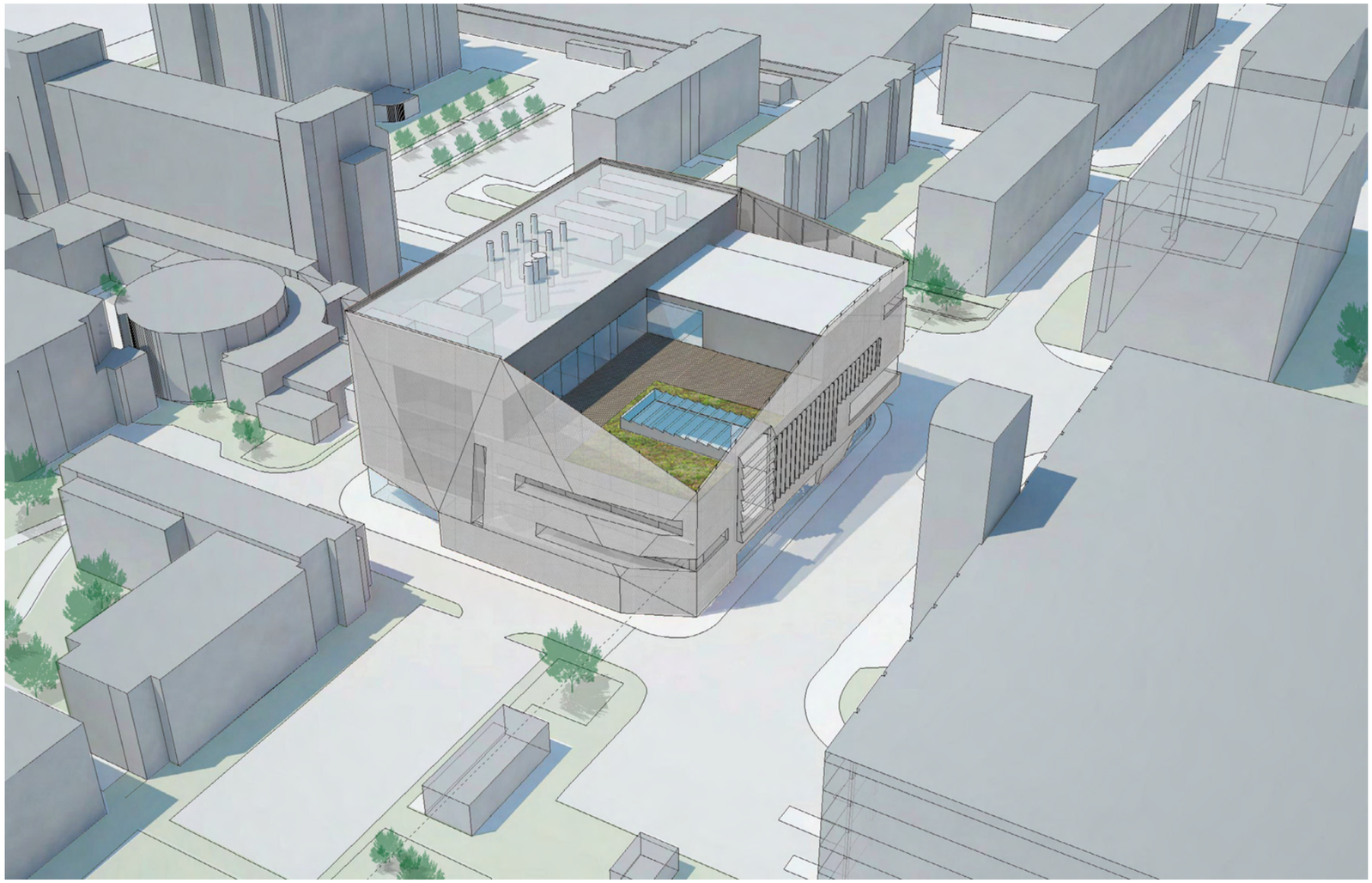


View from south-east

7/ Landscaping

The new building foot print covers the site 100%, to the back of the pavement in each direction, in the case of the southern boundary, the pavement and road way configuration will be modified to suit. There is therefore no landscaping treatment on grade to speak of, with the exception of the paving materials to the pavements. On Booth Street East, this will need to comply with applicable MCC standards. The other three roads belong to the University of Manchester and will be treated to university standards, from the same palette of materials that has been used across campus on the public realm works.

The only other landscaping element is the roof level treatment to the outdoor terrace and remaining roof covering. The terrace is L-shaped and accessible from the seminar room/foyer side as well as from the individual offices that line the western edge of it. The terrace will be a hard surface finished either in timber or paviours, with no significant planting. The remaining roof area will be treated as a planted bio-diverse roof, the construction details are being developed.

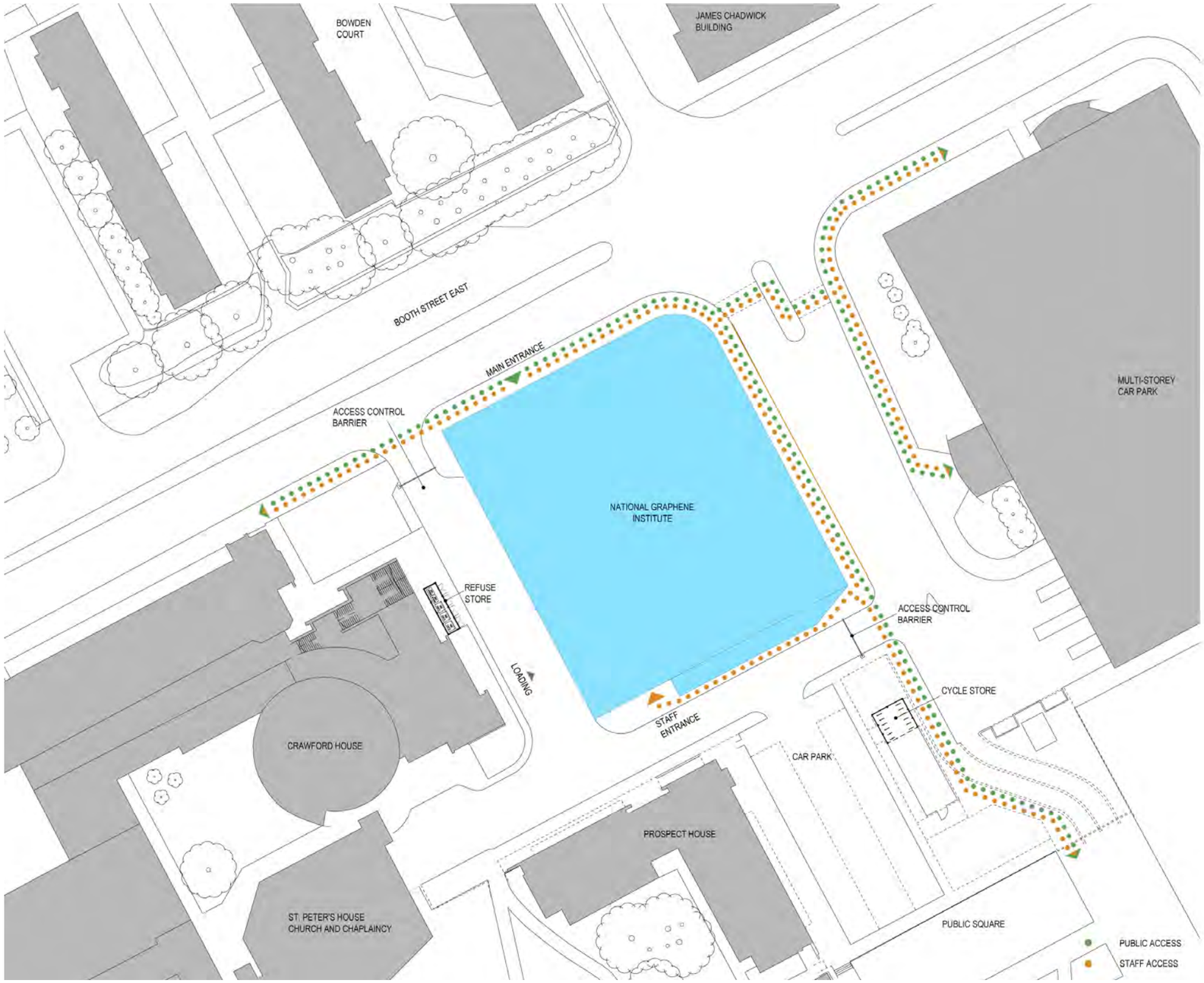


Bird's eye view from south-east

8/ Sustainable Travel

In line with the University's Sustainable Travel Plan 2012-2015 (see Appendix N), these proposals seek to reduce the reliance on car usage by encouraging staff and visitors to walk, jog or cycle to the facility. A proposed extension to the existing lockable cycle store to the south of the proposed new building provides 24 no. secure, covered cycle parking spaces. Showers and lockers are located at 1st floor level for the use of walkers, joggers and cyclists.

For disabled staff and visitors, 2 no. 3.6m wide x 5.4m deep 'blue badge' car parking spaces will be located in the multi-storey car park to the east of the site. In order to discourage journeys by car, no additional car parking will be provided as part of the proposed development. Staff needing to travel by car will be able to apply for a parking permit in order to use one of the existing car parks on campus. The site currently accommodates 3 no. blue badge car parking spaces on the west side which serve Crawford House. These will be relocated either closer to the southern entrance to Crawford House or into the multi-storey car park to the east of the NGI site prior to the commencement of the development.



Pedestrian access diagram

9/ Servicing & Refuse

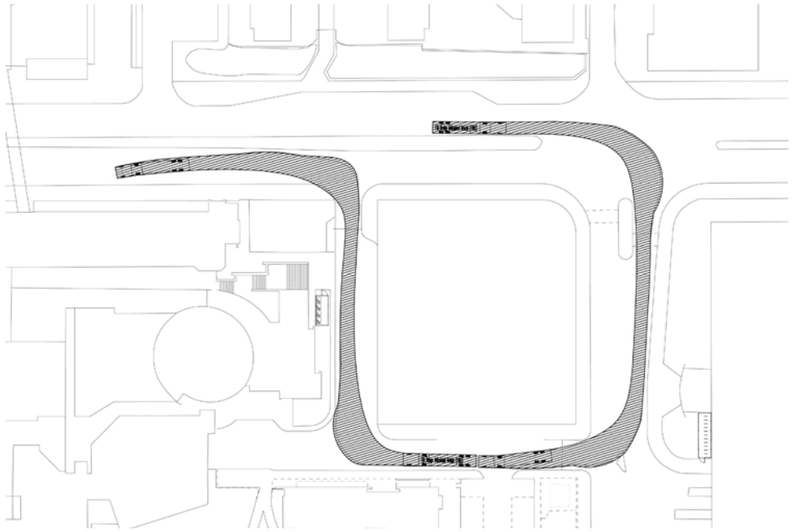
The approach to servicing and refuse has been developed in consultation and collaboration with the University. Service vehicles will typically access the building perimeter via the existing road to the west of the site from Booth Street East and exit in an anticlockwise direction back out onto Booth Street East. Both of the existing access control barriers located at the north-west and south-east corners of the site will be retained as part of this proposal.

The loading bay is located on the west façade, near the south-west corner of the proposed building, with two large loading bay doors providing convenient access to the goods inwards area and a large goods lift. The transformers, switch room and gas bottle stores are also located at ground floor level on the west side of the building, for ease of access by the relevant utility operatives as required on an infrequent basis. External bulk gas stores are located on the south façade for ease of access from the existing service road.

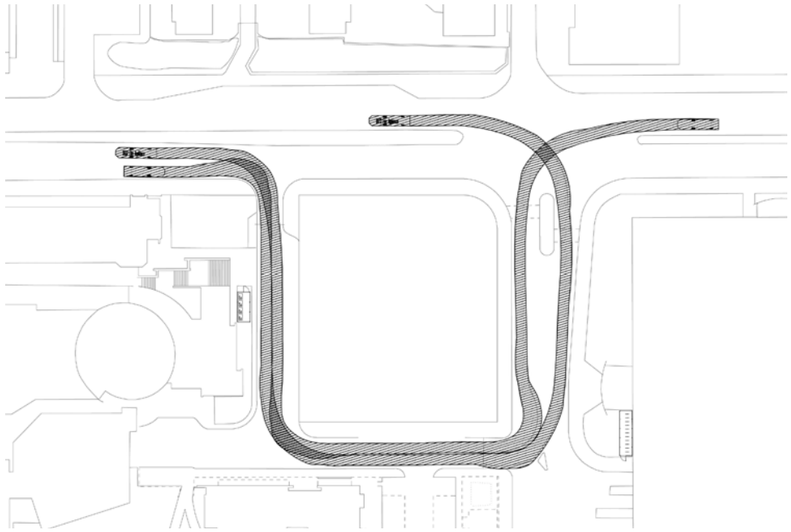
Service access will be required for deliveries, refuse collection and emergency services. Regular deliveries of office and laboratory supplies will be made by transit van or small lorry. Fortnightly/monthy deliveries of gas bottles and bulk gases will also be required, typically via rigid axle truck or cryogenic tanker. Due to the constantly evolving nature of scientific research, it is also anticipated that deliveries of equipment and 'tools' will be required on an infrequent basis. This is likely to vary from small items delivered by transit van up to large items arriving by articulated lorry. In the latter case, by prior arrangement with the University, lorries may need to manoeuvre around the site perimeter in a clockwise direction, for ease of access to the loading bay. Refer to Appendix B for vehicle manoeuvring diagrams.

A secure, lockable, covered refuse and recycling store is proposed on the west side of the existing service road to the west of the proposed building. This has been designed to avoid any impact on the existing means of escape routes from Crawford House. The volume of refuse and recycling that will be generated by the users of the building has been calculated in accordance with BS5906:2005 to be approximately 5500 litres/week. The store accommodates 3 no. 1100 litre Eurobins for refuse (typically office waste) with twice weekly collection agreed with the University and 2 no. mobile cages on wheels for recyclable waste. Refuse trucks will access the store from Booth Street East via the access control barrier and exit an anticlockwise direction. Waste from the acid and solvent tanks located in the basement will be collected by specialist operatives and disposed or recycled in a safe and environmentally sustainable manner.

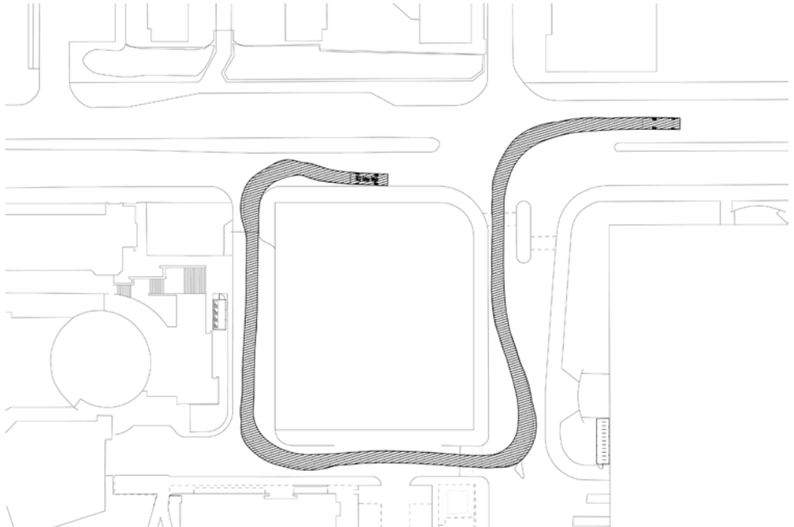
Fire appliances will be able to access the full perimeter of the building. Two dry riser inlets will be provided at low level on the west façade, connecting to dry risers within the north-west and south-west stairs.



Articulated lorry access



Fire engine access



Refuse truck access

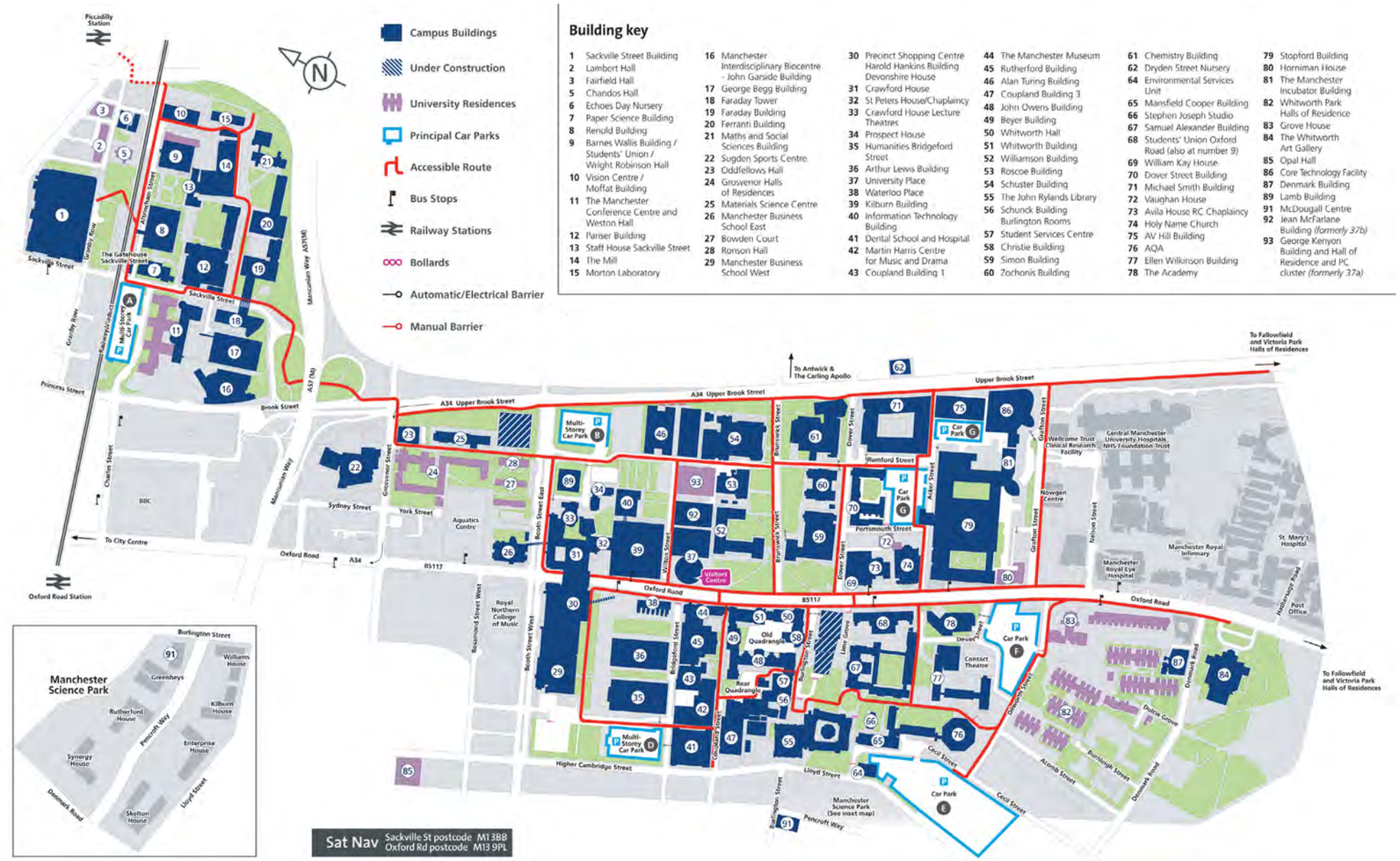
10/ Access & Inclusive Design

The University of Manchester recognises that when operating and managing their estate, the minimum standards of the building regulations Approved Documents, do not sufficiently cover the operational and statutory requirements of the University's requirements, when complying with its legal and social responsibilities towards disabled staff, students and visitors. In this context, best practice standards of accessible design has been adopted where reasonable and practical to do so.

The National Graphene Institute will be a dedicated specialist research facility, occupied by a small number of research staff and post graduate students working on various and changing aspects of progressive and adaptive research projects.

Access into, circulation around and use of facilities / ancillary provisions supporting common / circulation areas of the building have been designed to achieve high standards of accessible design. The circulation routes within the laboratories will also be accessible, however, due to the limited occupation and specialist / changing nature of the research projects, the laboratories themselves will offer little accessible provision. Any necessary provisions will be provided on a reactive and specific basis to accommodate the needs of a particular member of the research team.

A detailed Access Statement outlining the accessible design considerations and limitations within the building is included within Appendix C.



Campus map