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Daryl Prasad is associate director at Buro Happold, specialising in acoustics. He leads the UK audio-visual team, a group of interdisciplinary experts with a passion for delivering cutting-edge projects.

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Acoustics case study: UCL School of Management

The top floor of Canary Wharf's One Canada Square has been converted into new quarters for the UCL School of Management. The architect and the acoustic engineer describe the challenge of working with new and reused materials to achieve a range of different acoustic environments.

Photographs by Alan Williams

Architect's account: David Tompson, Nicholas Hare Architects

One Canada Square is an iconic tower building with 50 floors, holding a striking position on the London skyline. A typical upper floor has a net internal area of approximately 2,500 sq metres with a central core housing escape stairs, lifts, WCs, services risers and plant space. On floors 47 to 50, the building's footprint reduces, providing a net internal area of approximately 2,100 sq metres. However these upper floors have a higher floor to ceiling height of 3m.

Nicholas Hare Architects' brief was to convert level 50 into space for the UCL School of Management, apportioned almost 50:50 between student teaching and study space, and staff/academic office accommodation. The student and staff zones are joined by an expansive communal "street", which provides a generous welcome and arrival space.

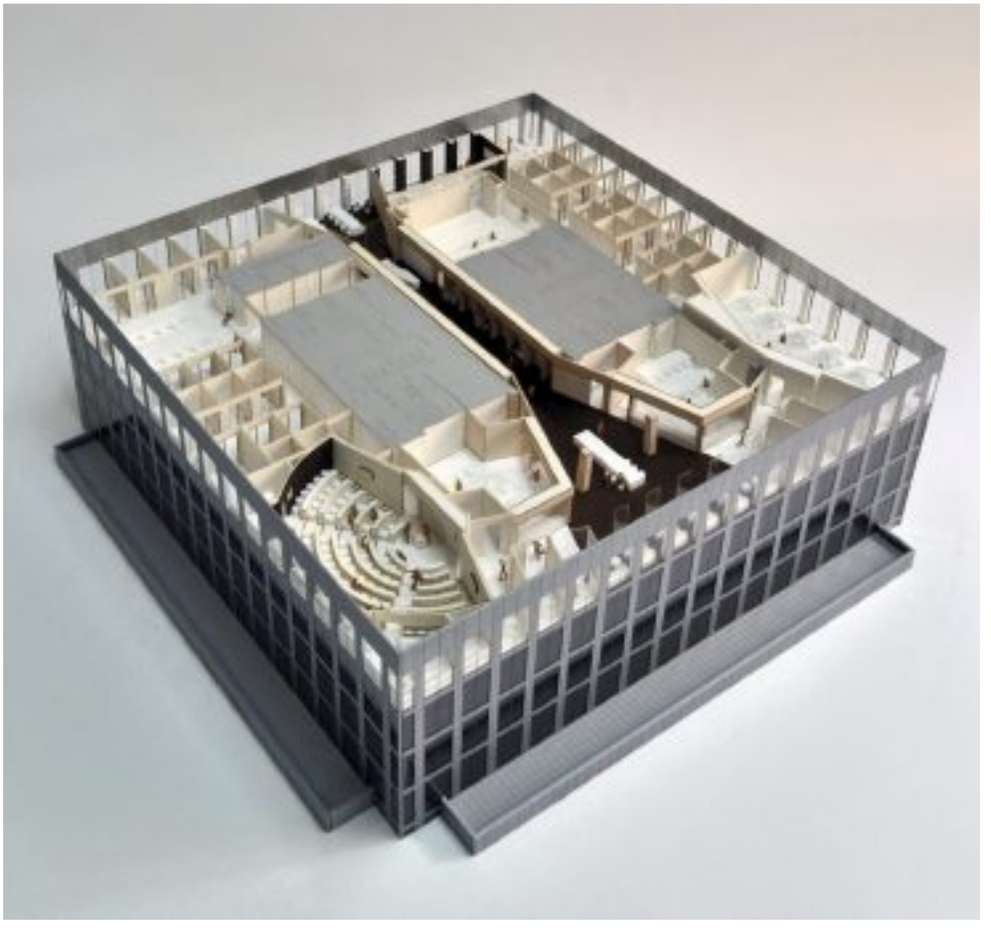
To the west the street is open to a large student social hub which gives access to the principal teaching and study spaces. At the eastern end, glazed doors give controlled access to the staff social space. The opportunity to create this central street provides an important arrival and orientation space. This will hopefully engender a sense of clarity and facilitate more fluid interactions between students and staff.

The design includes two large teaching spaces. The first is a semicircular "Havard-style" lecture theatre with a 1m-high rake, accommodating just under 100 students. On the opposite corner of the plan a second large teaching space is provided: a flat floor "executive education suite". This accommodates 84 students in total with flexible furniture that can be arranged in grouped or linear formats or cleared away to the perimeter.

Both these large spaces have lobbied access from the student hub with secondary entrances from the staff side of the plan, again with controlled access.

To support the student teaching spaces, the proposals provide a variety of quiet study spaces for both individual and group study. Support functions such as student kitchen, printer room and individual acoustic booths for video calls are accessed from the street.

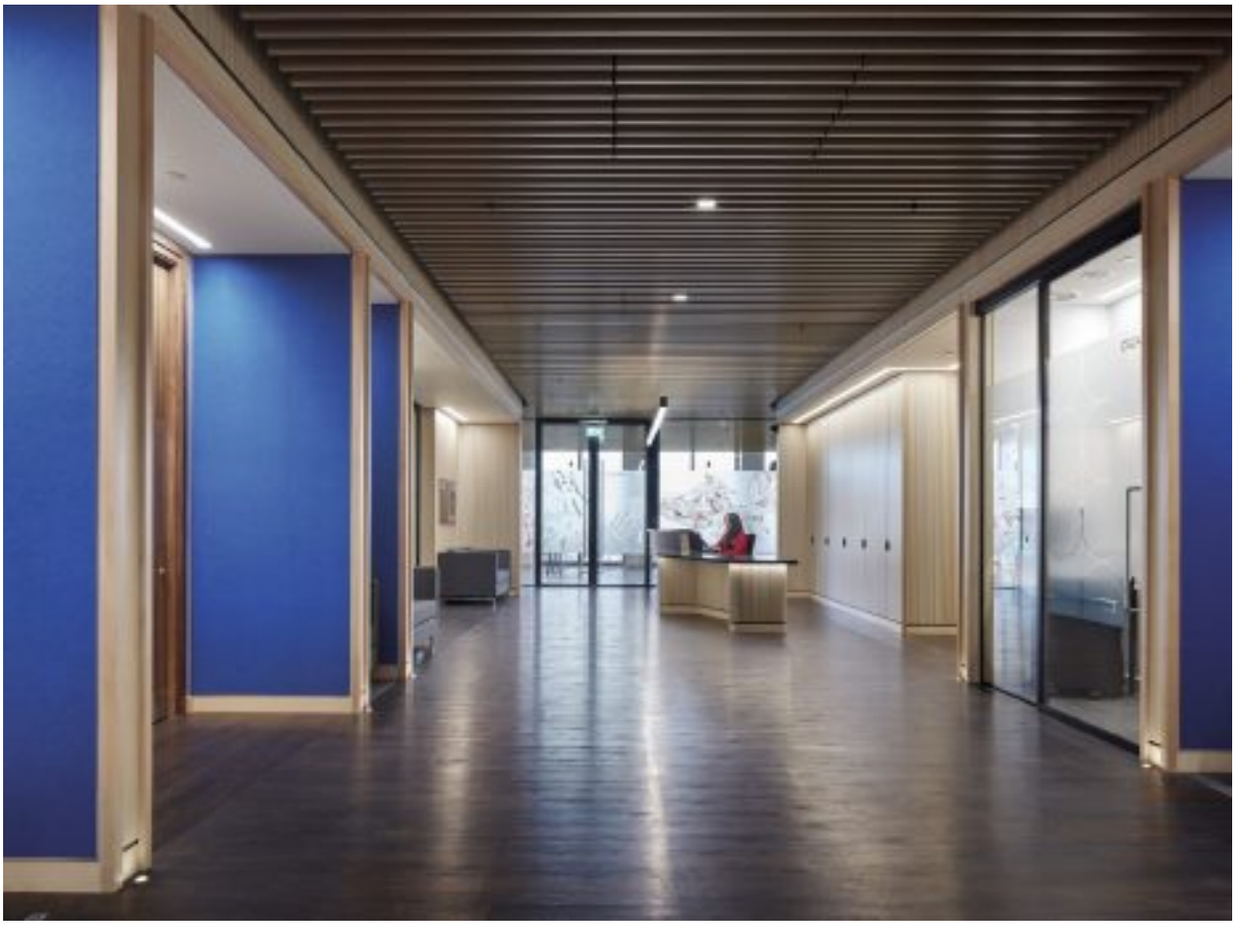
The staff accommodation provides a combination of efficiently arranged one and two-person cellular offices complemented by an open-plan working area and several cellular AV-enabled meeting rooms. To the



Cutaway model showing the new lecture theatre set in a corner, and the central corridor between teaching and staff spaces.

Client
UCL Estates
Architect
Nicholas Hare Architects
Acoustics
Buro Happold Engineering
Services engineer
Buro Happold Engineering
Structural engineer
Conisbee
Project manager
Gardiner & Theobald
Cost manager
Aecom
Management contractor
Canary Wharf Contractors
Principal designer
Nicholas Hare Architects/Aecom (Stage 5 onwards)
SKA assessor
Rider Levett Bucknall (RLB)
Planning consultant
Deloitte Real Estate
Fire engineering
Arup
Branding/wayfinding
Studio Blackburn

Above and below: Slatted ceilings allow ventilation diffusers and smoke detectors to be placed above them. The ceiling above is either painted black or has a black sound-absorbing finish.



Above and right: Free-hanging rafts and acoustic wall panels in the lecture theatre are micro-perforated to make them sound-absorbent despite having the appearance of solid timber.

eastern side of the plan, either side of the central staff common room, there is a large board room, staff breakout space and kitchen area.

Environmental aspirations: SKA, recycle and reuse

Materials and suppliers with the highest environmental credentials were specified to replace the project's sustainability goals and SKA requirements.

The project has achieved the highest SKA rating of Gold in the higher education scheme. The SKA rating system, operated by the Royal Institution of Chartered Surveyors (RICS), is an environmental assessment tool for sustainable fit-outs. SKA Higher Education is the latest scheme, designed to meet the requirements of higher education interior fit-outs and refurbishments to achieve clear sustainable good practice.

Level 50 had an existing Cat B fit-out – a mixture of open plan, cellular offices and meeting spaces for insurance company MetLife. A condition survey of the existing fit out was undertaken, as well as a pre-refurbishment audit, to assess retained elements of the fabric such as core walls, raised floor and mechanical services, as well as to explore opportunities to reuse existing architectural elements and building services. Despite the significant physical differences between the School of Management design and the previous office fit out, considerable success was achieved in reusing elements from the previous fit out – for example:

Glazing: 64.7 linear metres of full-height laminated glazing (195 sq metres) was salvaged, surveyed and reused in new internal glass partitions.

Doors: 49 out of 53 pre-existing 3m-high walnut veneered timber door leaves were reused in the new fit-out. This equates to 67% of the timber doors in the project.

Ceilings: 771 sq metres of metal acoustic ceiling tiles and diffuser grilles were salvaged, equating to just over 30% of the total ceiling area.

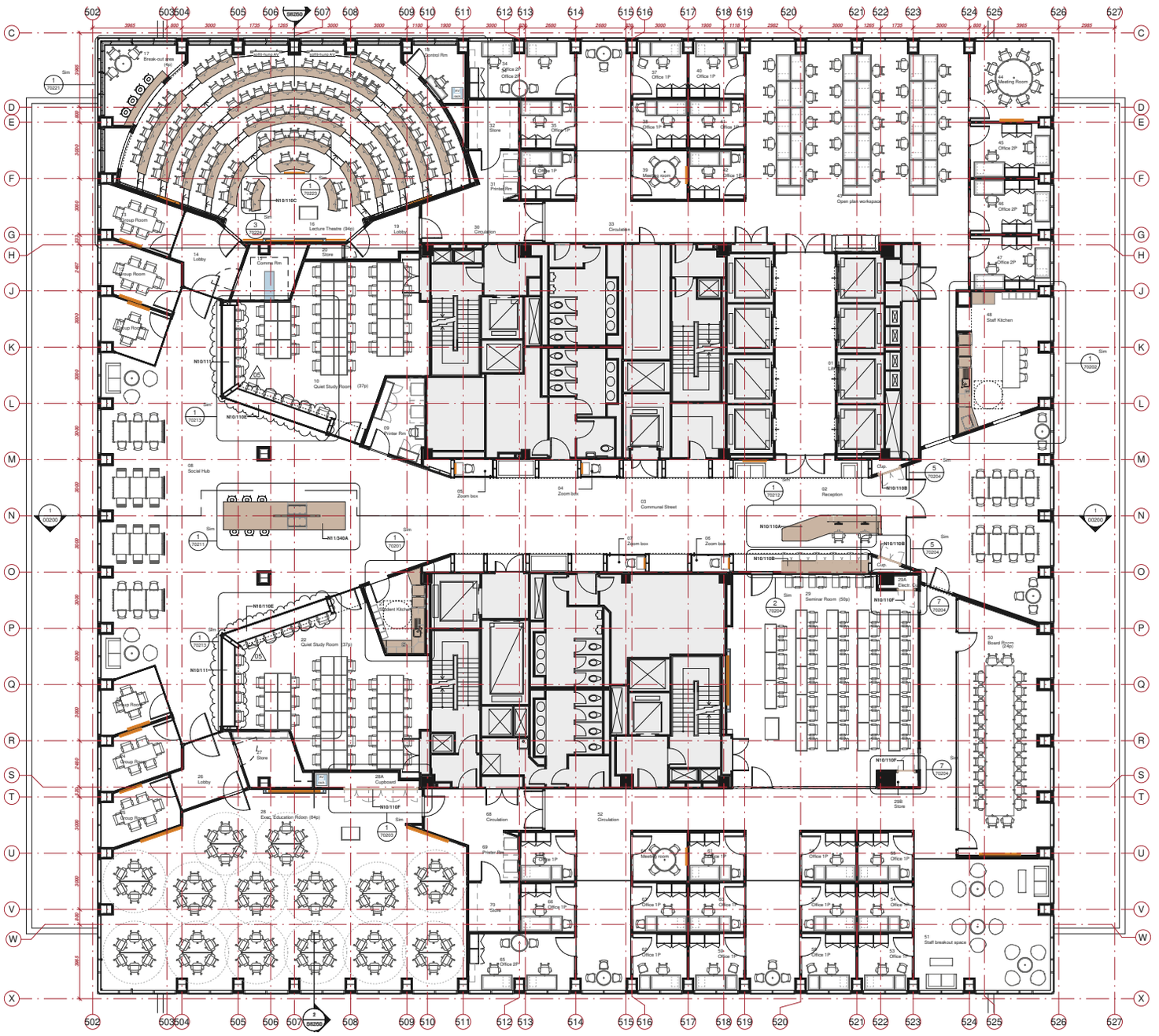
Blinds: 42 reused blinds – equating to approx 63 linear metres of full-height blinds were used on the perimeter of the building.

Material quality and acoustics

Acoustic quality was a key design challenge, as well as forming an essential part of the brief. Inserting educational functions and specialist teaching rooms into an office building with existing services and physical structural constraints demanded particular attention to services distribution routes and effective sealing around penetrations. The need for acoustic privacy between adjacent staff offices and video call booths called for careful sound separation between spaces. Room acoustics for teaching and learning spaces as well as more informal social spaces were carefully assessed and modelled to optimise the acoustic environment.

The selected materials and finishes play a large part in the acoustic performance of the different spaces. The ceilings play a key acoustic role but also visually distinguish between key front-of-house social spaces and teaching spaces, and the more restrained cellular office and meeting rooms for staff and academics:

Slatted metal: The street, student hub and staff social hub all have a slatted metal ceiling, finished in a light gold colour that complements the adjacent maple wall linings. The ceiling is formed by vertical slats with open gaps between. This allows ventilation diffusers and smoke detectors to be located above the ceiling while the gaps between the slats allow for positioning of sprinkler heads and other services.



Above: Floor plan showing the combination of cellular and larger spaces.

Below: Acoustic models of the lecture theatre confirmed that sound reflections would travel upwards.

Above and right: Suspended acoustic perforated rafts provide acoustic modulation within the teaching space.

Suspended acoustic perforated rafts: In the lecture theatre and executive education suite these provide acoustic modulation within the teaching space as well as providing visual screening for high-level services. A dark walnut finish is used in the lecture theatre with perforated metal rafts used in the executive education suite.

Suspended modular acoustic metal tile and plank systems: Within the staff areas, acoustic absorption and access is provided by a modular powder-coated metal access ceiling, much of which was salvaged from the previous fit out.

Acoustic spray / black out painted finish: Areas with slatted ceilings or suspended rafts take advantage of the full sense of height in the spaces since the services and structural soffit are visible through the gaps. Soffit and services are blacked out with either an acoustic spray coating (when required) or a blackout paint coat.

Where required, additional acoustic absorption is provided by timber wall linings, both walnut and maple, which are used throughout the front-of-house social space and primary teaching rooms.

Acoustic engineer's account: Daryl Prasad, Buro Happold

The aspiration for a highly sustainable development, achieving a Gold SKA rating, has driven the acoustics in two ways: the desire to reuse materials from the previous office fit-out; and the aim of achieving the acoustic credits outlined in SKA D29.

In acoustic engineering, materials and solutions are often specified to meet specific targets, verified via commissioning testing at the completion of the project. Successful commissioning test results can be contractually tied to handover or planning conditions, particularly when acoustic performance or noise levels are of strategic importance.

For example, performance space or recording studio clients generally will not take ownership of a development if agreed acoustic targets are not met, and residential developments cannot achieve Building Regulations sign-off without Approved Document E test certification.

Because of this, there is an inevitable temptation within the industry to rely on brand-new products and processes (which arrive complete with laboratory test certification), to build in margins of safety in designs and to steer clients away from "riskier" low-carbon solutions – eg natural ventilation in noisy environments, or lightweight timber structures in lieu of concrete when aiming for high levels of sound insulation.

This project is an example of an alternative approach, where a brave attitude towards risk is balanced by diligent design and engagement to fully support the most sustainable solutions practicably achievable.

Material reuse

Level 50 had previously been fitted out for office use and already contained a number of cellular offices and meeting rooms. Sustainability is high on UCL's agenda and it was decided early on in the project to try to reuse some of the existing materials.

It was difficult to determine the acoustic performance of the doors, but we knew they were solid core and had reasonable mass. By retaining the blanks and applying new full perimeter seals, we believed we would be able to achieve a suitable acoustic standard. The existing glazing in the door was determined to be 12.8mm acoustic laminate, which is common in today's glazed partition systems, so there was some confidence that this would not undermine performance.

The efforts to reuse materials paid off. When acoustically tested, these elements

The wide central corridor separates student study and social space from staff areas.

A space intended originally as an office has been transformed with creativity and economy of materials.

all performed well with no noticeable difference between reused and brand-new elements.

Project challenges

We had to achieve the acoustic standards outlined in Building Bulletin 93 Acoustic design of schools – performance standards (BB93) to achieve the D29 SKA credit. BB93 is a well-known design guide for educational spaces and provides designers with targets for various aspects of acoustic performance.

UCL wanted to ensure there was good sound separation, particularly around academic offices. To achieve this, we knew we needed full-height structural-slab-to-structural-soffit partitions. This was difficult due to the number of existing services and structure below the soffit at high level.

We could not have services penetrating walls between rooms as the openings would degrade the sound insulation performance. It is considered best practice to bring high-level services into the room over the door, as the door is generally a weaker-performing element anyway and so any minor reduction in performance to the partition surrounding it is less noticeable than in an otherwise high-performing element (eg partition between two private spaces).

We were successfully able to relocate most services, however some items such as sprinkler pipes had to remain, and partitions had to be detailed around these accordingly. There were some deep beams and difficult to reach areas, particularly close to the facade. The beams were also fire protected, which made sealing up to them difficult. Quite some time was spent investigating this area and meeting with London Drywall to develop the high-level partition closures.

Most of the on-floor air was extracted above openings over the Zoom boxes on the communal street. Full-height partitions were not possible here as these would restrict the airflow. We had to develop a detail that was both sound-insulating to maintain speech privacy while also being sound-absorbing to control the internal acoustic. Furthermore, these also needed to be accessible so we had to develop a detail that incorporated an acoustic access hatch.

Upon final commissioning all spaces tested either met or exceeded the sound insulation requirements.

Lecture theatre design

The lecture theatre has been designed for good, unamplified speech transmission. The circular form of the seating did raise some early concerns since concave surfaces are known to create acoustic focal points, as found at the whispering gallery in St Paul's Cathedral. We undertook early studies to validate the circular form of the seating, carefully angling the front so sound reflections are directed upwards rather than back at the lecturer.

The final room acoustic strategy used a combination of free-hanging rafts and acoustic wall panels. The rafts are finished with black acoustic spray behind to conceal services. Acoustic panels have been strategically placed around the rear wall. The rafts and panels, by Topakustik, are micro-perforated to make them sound-absorbing despite having the appearance of solid timber.

The acoustic spray finish (also used in the communal street) is SonaSpray from Oscar Acoustics. This is made from recycled cellulose fibres which helped bolster the project's sustainability credentials.