

Queen's Building, DeMontfort University

1. Project Basics

Location: Leicester, England

Latitude/Longitude: 52°37'N/1°08'W

207' elevation

HDD, CDD; annual precipitation: ?

Building type: Educational/
Laboratory

Square footage/ stories: 10,000m²
(100,000 s.f.)/2–4 stories

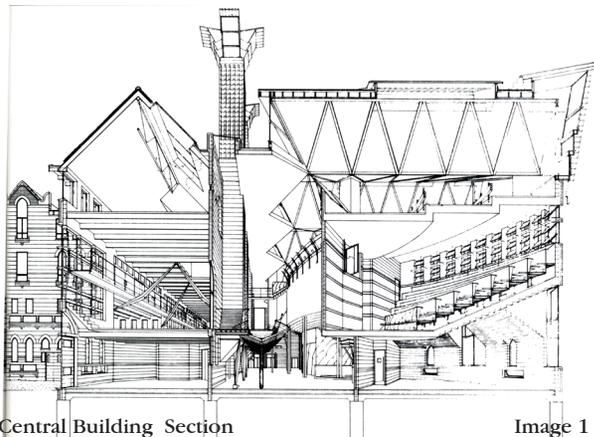
Completion date: 13 August 1993

Client: de Montfort University

Design team:

Architects: Short Ford Associates—
Alan Short & Brian Ford

Engineers: Max Fordham Associates—
Max Fordham & Randall Thomas



2. Background and Context

The Queens Building was designed for the School of Engineering and Manufacture on the City Campus at De Montfort University in Leicester, England. De Montfort University set out to design Europe's largest naturally ventilated building in 1989; it was completed 4 years later in August 1993, costing roughly £9.3 million. After construction on 13 August 1993, the Queen herself christened it as The Queen's Building.

The building was designed to hold 1,000–1,500 full-time students, faculty members, and staff. The building would need to deal with the heat that would be produced by the people occupying the building as well as the electrical equipment within the space.

According to Bill Bordass, "The architect's concept for the Queen's Building was for a highly insulated, thermally-massive envelope with both a shallow plan and generous ceiling heights to facilitate natural ventilation and daylighting."

"The intention was to tackle and face this environmental morale problem of the campus and the neighborhood and to make a building that was as naturally conditioned as possible." Alan Short *Dimensions of Sustainability* 37.

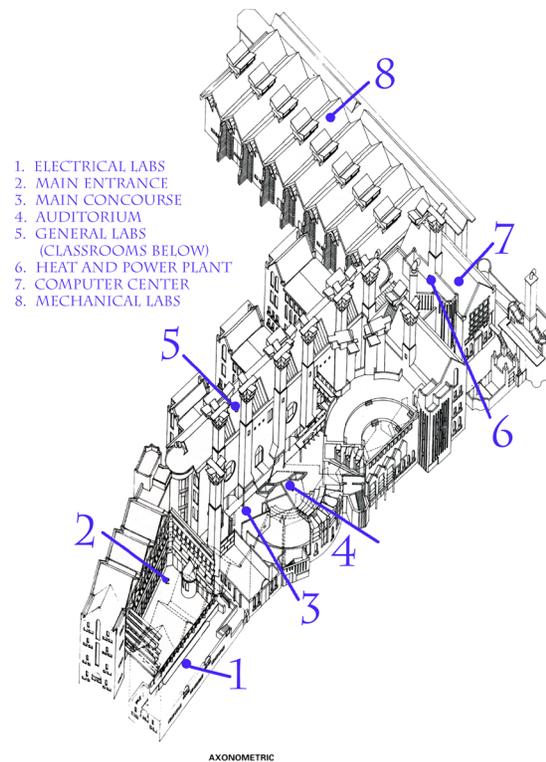


3. Design Intent and Validation

The floor plan of this building was dictated by the architect's goal of designing a naturally ventilated building. The labs have a narrow floor plan and operable windows to allow for cross-ventilation. The main floor has a wider floor plan which cannot rely on windows for cross-ventilation, so eight, large venting chimneys were constructed to exhaust warm stale air created by the people and computers. These chimneys rely on the stack effect to operate properly. "When the temperature difference in the air between the top and bottom of the flue is greater than that of the air outside, warm air vents out." This effect draws in cooler air through the vents lower in the building cooling down the building. The architect's first design had fewer chimneys, but later increased the number so that now two spaces need to share one. To ensure that all the chimneys were built, Short and Ford designed them to be structural so budgetary concerns could not determine their importance and cut them out of the construction process.

The building's brick enclosure acts as a thermal wrapper, buffering the building from temperature peaks at midday. The brick also acts as a noise barrier, isolating the noise created by the mechanical labs. The load-bearing brick façade was chosen because the university wanted the construction of the building to create job opportunities during the construction phase. Wide insulation-filled cavity walls and concrete slabs in the ceiling create thermal mass which absorbs the heat during the

day while the space is occupied and releases it at night when the building is empty.



Axonometric



Electrical Labs: Lighting and View Windows

Image 6



Chimney

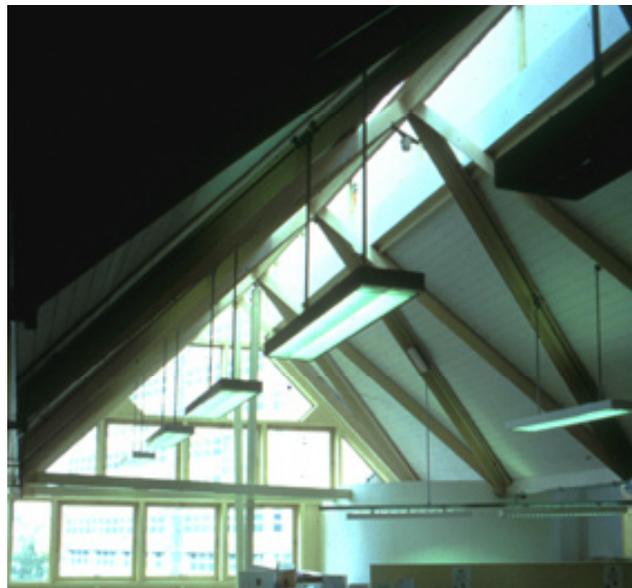
Image 7

Image 5

The building was designed to have three different parts. The first one is the two wings of electrical laboratories that create an entrance courtyard. As the building increases in floors, the floor plan increases as well to minimize the direct sun that penetrates the three floors of the laboratories. Small windows with deep reveals were used to decrease the amount of direct solar gain. Within this space there are light shelves which bounce the daylight off the ceiling deeper into the space. The courtyard walls are painted white to bounce the light down into the lower levels.

The second part of the building is the central building, which has the eight chimneys piercing through the double-height concourse which creates a separation between the labs and the auditoria. This space creates a comfortable meeting area in the winter. The roof is broken up to allow for natural light to penetrate deep into the space and to exhaust the warm air in a stack effect. The daylight was intended to reduce the need for electrical lighting. The ramps throughout this space contain glass brick to allow light to pass through it. In the general lab toplighting is used to bring light into the space. In the offices, auditoria, studios, and computer labs sidelighting is implemented to allow light to enter the space. In the auditoria fresh air enters through louvers in the north façade by means of plenums below the raked wooden floor and wall inlets which are controlled by the BEMS allowing ventilation throughout the space. Two 133-meter-high chimneys ventilate the space.

The third part of the building houses the mechanical labs. This part of the building is located around the corner from the central building and is delineated by its peaked roofs. The gabled street façade is covered with large windows allowing natural daylight to enter the space without introducing too much glare. “Gantries inside run parallel to the roof ridgeline, supported on one side by exterior brick piers. Each of these buttresses, its brick coursing perforated, doubles as an air intake louver.” (Philip Arcidi). The mechanical labs implement toplighting like the general labs to bring light into the spaces.



Toplight and Large North Windows in Studios

Image 8



NE Elevation

Image 9



SE Façade

Image 10



NE Elevation to Courtyard

Image 11

4. Key Design Strategies

Daylighting. The central concourse has large roof lights which allow for deep sun penetration. Offices, studios, auditoria, computer labs, and classrooms are sidelighted by small windows with deep reveals on the east and west to control the amount of thermal gain, but still let in fresh air and daylighting. Narrow floor plans, with external courtyard and white painted walls were designed to bounce light into the interior spaces. Light shelves are used in the electrical labs. Toplighting is used in the mechanical and general labs. Glass brick ramps in the main circulation space allow light to pass through to light the space under. The electrical lab floor plans increase in width as the floors go up which block the direct sunlight and reduce the thermal gains.

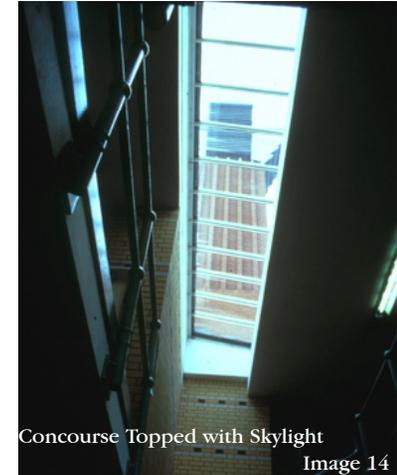
Thermal Mass. The building was built of brick creating a large amount of thermal mass which helps to stabilize the temperature fluxes.

Natural Ventilation. Chimneys were constructed to create a stack effect which would allow the building to ventilate the hot, stale air and bring in fresh, cool air. Cross-ventilation was used whenever the floor plans allowed for it.



Concourse with Glass Brick Ramps

Image 12



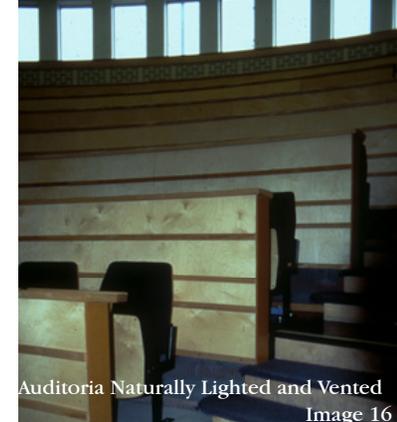
Concourse Topped with Skylight

Image 14



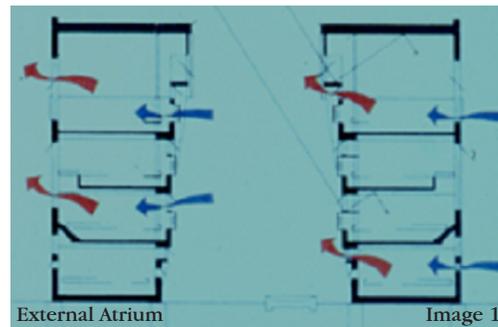
External Courtyard Painted White

Image 15



Auditoria Naturally Lighted and Vented

Image 16



External Atrium

Image 13

5. Performance Studies

Awards

The Independent Newspaper “Green Building of the Year,” 1995

RIBA Award, 1995

Quality in Brickwork Award, 1994

Civic Trust Commendation, 1995

Shortlisted for the Royal Fine Art Commission and *The Sunday Times* “Building of the Year” Prize, 1994

RIBA Education Building of the Year, 1995

PROBE 4 (Post-occupancy Review Of Building Engineering), by Bill Bordass

Bordass conducted multiple case studies in different buildings, the aim of which was to tackle some of the issues of poor feedback on how buildings truly work (August 1994–July 1995). Based on a treated floor area of 8400m²:

	EEO* “Low” Target	Queen’s Building
Gas	185 kWh/m ²	143 kWh/m ²
Electricity	75 kWh/m ²	52 kWh/m ²
CO ₂	90 kg/m ²	65 kg/m ²

*Energy Efficiency Office

The condensing boiler provided approximately 45% of the yearly heat energy, the conventional boilers together account for 41%, and the CHP uses 14%. The CHP unit will not make any significant financial savings over its lifetime, but it will make a positive contribution to the reduction of CO₂ emissions by about 30 tonnes per year.

Lighting consumption makes up most of the electrical power use (in 1994). Now that everyone has computers, I believe that has changed.

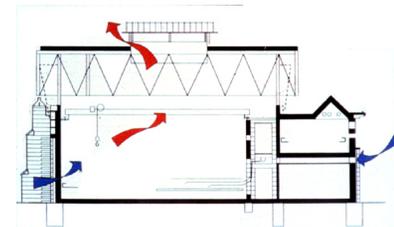
Occupancy Survey

“Overall the perception of thermal comfort and air quality is similar to national benchmarks, and overall air quality in winter is considered to be significantly better than benchmark ... Combination of thermal mass and natural ventilation was effective at maintaining a comfortable environment for most of the building during the summer of 1994.” (Bordass 1997).

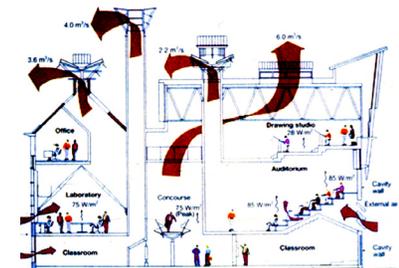
The people surveyed generally felt there was too much daylight in most of the building, and there were some areas they felt were gloomy. “Office occupants thought that the working environment had a negative effect on their productivity, with an average rating of minus 10%. This falls within the bottom 10% of all buildings on the Building Use Studies’ Database.”



Mechanical Labs Daylighted and Naturally Ventilated Image 17



Mechanical Labs Daylighted and Naturally Ventilated Image 18



Section of Central Building Image 19

6. Further Information

Contact:

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UK

7. References

Web Sites

<http://www.coldhamarchitects.com/greenbuilding/greengrandtour/UK_Queens/uk_queens_desc.htm>

<<http://www.environmentcity.org.uk/article.asp?ParentID=105&ArticleID=123>>

<<http://www.usablebuildings.co.uk/>>

Directions

<http://www.thetrainline.com/Buy_Tickets/Delivery/your_journey_details.asp?T2ID=6977_200641102233>

<http://www.ukhtb.org/leicestermap_tcm2-9575.pdf>

Publications

Asbridge, R. and R. Cohen. *Probe 4: Queen's Building, de Montfort University*. BSJ 35–41.

Bordass, W., R. Bunn, R. Cohen, M. Standeven, and A. Leaman. "Probe: Lessons Learned from the First Eight Buildings." CIBSE National Conference, Oct 1997.

Browning, William. "Knock on Brick." *Progressive Architecture* 74 no. 3 (1993): 80–81.

Edwards, Brian. *Green Buildings Pay*. London: E&FN Spon, 1998.

Farmer, John. *Green Shift*. 2nd ed. Oxford: Architectural Press, 1999.

Scott, Andrew (ed.). *Dimensions of Sustainability*. London: E&FN Spon, 1998.

Presentation

Peffer, Therese. "Ecological Office Buildings in Europe." Sep–Oct 1998.

Images

1. Browning, William.
2. Google Earth
3. Peffer, Therese.
4. <<http://www.environmentcity.org.uk>>
5. Browning, William.
- 6.–19. Peffer, Therese.

8. Map and Transportation Options



Your journey details

Outward journey: Sunday 11 June 2006

Station	Arr	Dep	Travel by	Service Provider
LONDON ST PANCRAS		10:30	Train	MIDLAND MAIN LINE
LEICESTER	12:12			

Send me this by SMS >>>

Return journey: Sunday 11 June 2006

Station	Arr	Dep	Travel by	Service Provider
LEICESTER		20:02	Train	MIDLAND MAIN LINE
LONDON ST PANCRAS	21:41			



Google Earth

Getting to DMU

Information at a glance

By taxi

Leicester taxi firms: ABC (24 Hour Service)

Tel: (0116) 255 5111

Swift (24 Hour Service) Tel: (0116) 262 8222
(Freephone available at Leicester Railway Station)

Approximate cost of single journey to DMU site from Leicester Railway Station: City Campus £4, Charles Frears Campus £4

By bus or coach

Leicester bus information: Arriva Travel

Tel: 0870 608 2608 (ask to be transferred to Leicestershire Enquiries)

To **City Campus** from Leicester city centre (Belgrave Gate, stand H5) No.52

Approximate single fare £1

National Express Nationwide Tel: 08705 808080

On-line information at www.gobycoach.com

By rail

National Rail Enquiries Tel: 08457 484950

On-line information available from

www.thetrainline.com

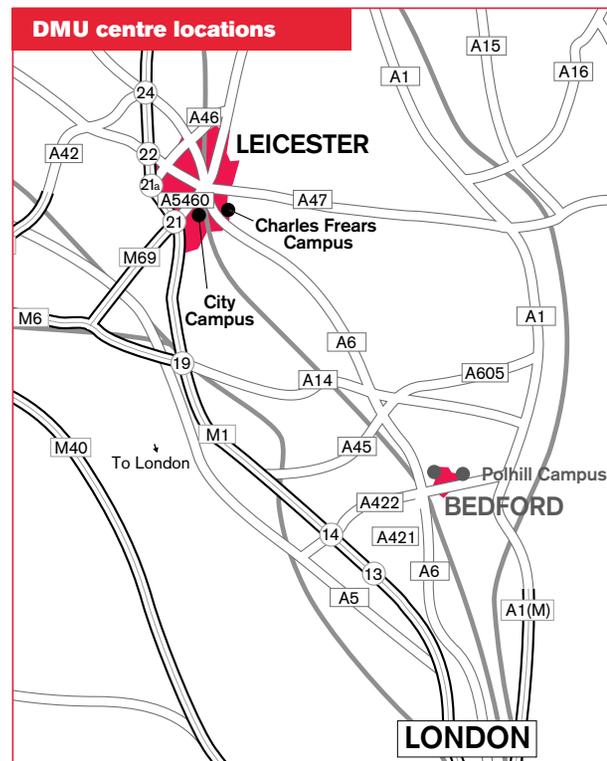
or www.midlandmainline.co.uk

By foot

Approximate walking times from Leicester Railway Station to DMU Campuses:

City Campus: 10–15 minutes, **Charles Frears**

Campus: 20 minutes uphill (not suitable for all visitors).



Case study by C. Megan Compton,
Spring 2006