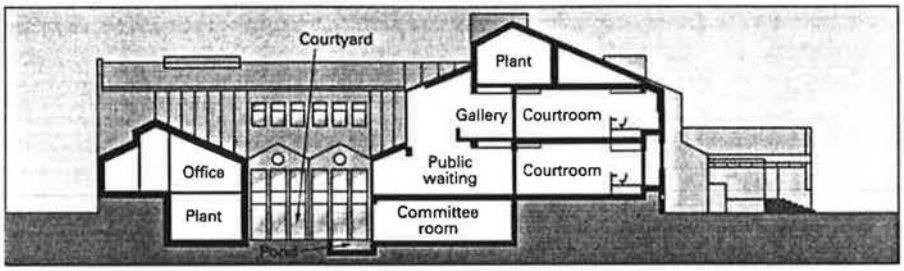
Stuart Blackwood

The south facing elevation of Rotherham Magistrates Courthouse, **above**, from across the canal. The elevation shows the building's basic layout.



Natural justice

The design of Rotherham's new courthouse adopts passive solar architecture and heat recovery systems in an effort to make the legal process less energy intensive. Stephen Ashley reports.

Being an old established northern town with an architectural heritage stretching back to medieval times, Rotherham might seem like an unlikely location for ground-breaking building design. Yet when Rotherham Borough Council's architecture department was looking to provide the district with a new courthouse, the opportunity was taken to incorporate the latest ideas in low energy building design without recourse to full air conditioning.

Hence the building became one of 35 'live' building projects to receive funding from the European Community through the Building 2000 scheme. Here, participating design teams receive support from national and European specialists in energy conservation, solar energy, daylighting, natural ventilation and passive cooling.

In many ways the designers could not have chosen a more difficult building in which to apply passive strategies. By definition courthouses are three-dimensional puzzles of some complexity, with magistrates, staff, prisoners and the general public (the latter needing separation for adults and juveniles) all requiring access without their paths crossing.

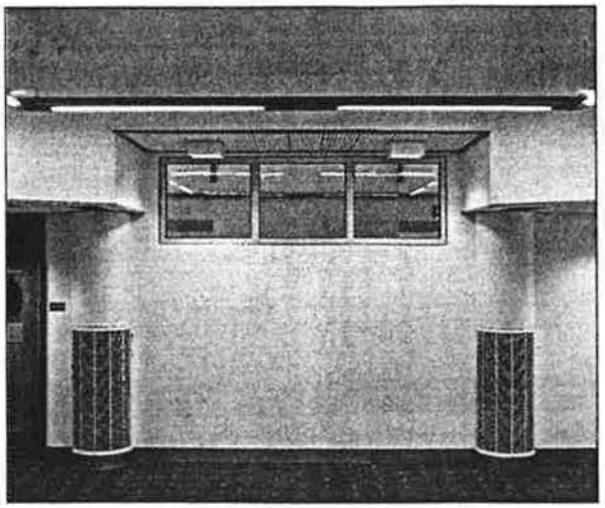
Another problem the designers had to overcome was the magistrates' demand for good daylighting and natural ventilation in every court, something that is never an easy task where security is a prime concern.

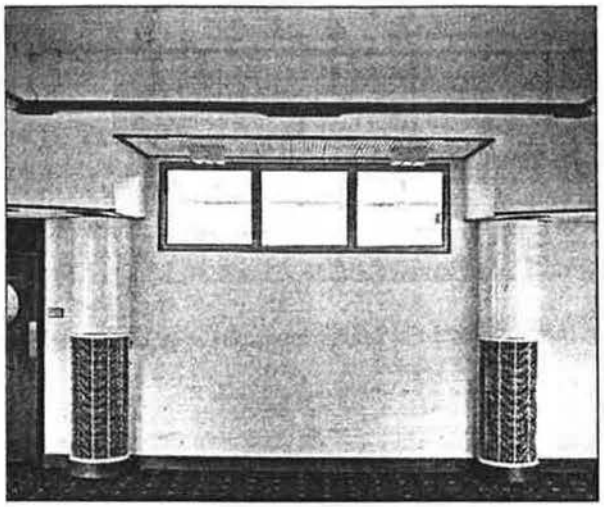
The result is a building on three levels with three separate blocks: two blocks of courtrooms face north with an L-shaped administration block on the south west corner. The client's spatial requirements have been met by spreading the courthouse onto a large footprint.

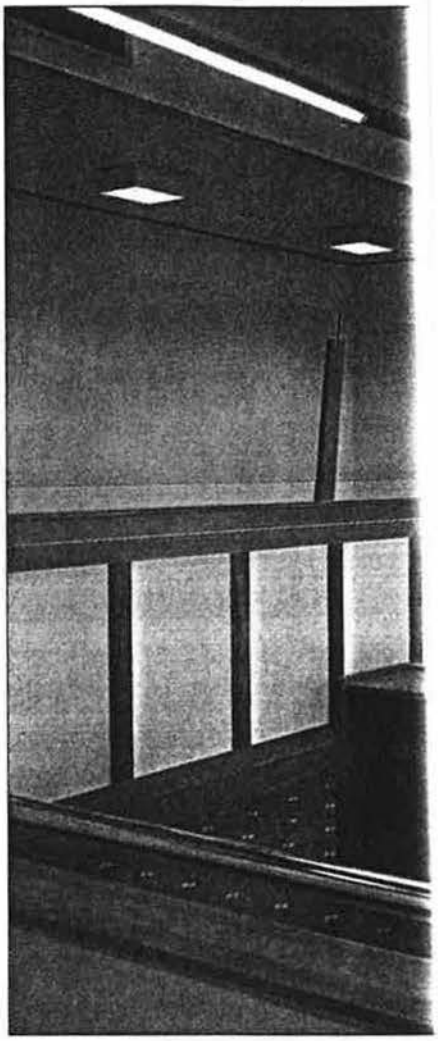
From concept to detailed design

Owing to a variety of factors – including the building's complexity and the clearly defined and exacting requirements laid down by the client – the building spent a long time in the development stages. Concept work started in the mid-1980s, while construction began in 1992.

With a design based on earlier *Building Regulations* there is nothing remarkable about the U-values or the structural elements. The main structure is a heavyweight concrete







These two photographs demonstrate the daylighting strategy. **Above:** The courts receive a modicum of daylight via the public waiting areas. **Right:** The same window with the effect of unfiltered fluorescent lighting.

Daylighting and solar glare: study results

Rotherham Magistrates Court has been planned so that every courtroom receives daylight, direct and/or borrowed. The borrowed daylight is introduced to four of the ten courtrooms for the glazed public waiting areas.

The partition wall between the courtroom and the waiting area has a long high-level window fitted with acoustic double glazing. This provides a noticeable level of borrowed daylighting in the courtroom and some contact with the outside world.

The windows in the partition wall are oriented 18° west of south, and are directly opposite the magistrates bench. To ascertain the effect of glare, the GNOME computer program at the Humberside School of Architecture was used to produce a wide angle interior perspective showing the window and a plot of the monthly sunpath perspectives at ten-minute intervals.

The studies demonstrated that the sun will be visible from the chosen viewpoint when it is within the window outline. The direction within which complaints of solar glare can be expected is also outlined, and so the season and duration of complaints can be estimated.

The study also showed that there would be a problem with glare at the magistrates bench in the early afternoon during winter. It was decided that curtains should be introduced, to be controlled by the courtroom ushers.

frame with brick walls. To increase the building's thermal and acoustic performance, dense concrete blockwalls have been used for the inner leaf.

Whereas the north elevation rises vertically to the full height, the south elevation is around 40% glazed and stepped back. An open landscaped courtyard between the administration block and the courthouse provides daylight deep into that section of the building.

The plant rooms are zoned according to need – two ahus serving the six courts and public areas on the ground and first floors of the north block, two more serving the three courts and public areas in the south block and the remaining two ahus serving the lower ground floor courts and the cells.

Cooling and ventilation

The first problem for the designers was the client's stipulation that the building should not be air conditioned. This meant that it could not be controlled to a tight 21±1°C. With likely fluctuations in occupancy levels in the courts and public areas caused by people entering and leaving *en masse*, there would also be plenty of opportunity for massive swings in spatial gains.

Cambridge Architectural Research analysed the full extent of the problem, applying the SERI-RES thermal simulation program. This showed that the space temperature in the public areas could be expected to range between 16°C in winter and 26°C in summer.

The chosen solution for both courtrooms and the public areas was a 100% fresh air displacement ventilation system (ideal for courtrooms), with winter heat requirements being satisfied by a combination of heat recovery from the extract air and a conventional lthw system serving radiators. Control is by room thermostats in the public areas, with weather compensation.

The beauty of the displacement system from the designer's point of view is that it can maintain ventilation rates while giving a quantifiable amount of convective cooling. The added benefit should ensure that internal temperatures are held at or below 24°C.

Left: A typical courtroom looking towards the magistrates bench with, **inset**, a detail of the Floormaster displacement unit which integrates well into the overall design.

Despite the intention to avoid full air conditioning, a concession to summertime comfort cooling was made by installing a 200 kW packaged chiller which drives cooling batteries to keep the ventilation supply temperature at 19°C.

Two heat recuperators were originally envisaged, one serving the public waiting area and another serving the courtrooms. The intention was to link both systems so that heat extracted from one zone could be used in another.

For example, in winter the extract from the public waiting areas and courtrooms would be passed through a recuperator dedicated to those zones in order to heat the incoming fresh air. In summer the fans would be switched off in the public waiting areas, ventilation being achieved solely by opening low and high level vents which aid natural buoyancy. The courtrooms were always designed to be mechanically ventilated.

In the end only one recuperator was installed to serve both the courtrooms and the public waiting areas, the latter being heated largely by solar gains and the lthw system. Gas-fired boilers supply heater batteries in winter should the heat recovery coils and the solar gain be unable to raise the ventilation air temperature to 19°C.

In summer the boilers will probably not be needed, the recuperators coping with any preheating of the supply air. When space temperatures rise above 26°C, heat from the recuperators is then dumped directly to the outside via the high and low level vents.

Having opted for a displacement ventilation system the designers had to decide where to position the supply air diffusers in the courtrooms. The answer was to incorporate them into the courtroom fittings; a virtue made out of necessity, but nevertheless rather incongruous on the front of a magistrates' bench.

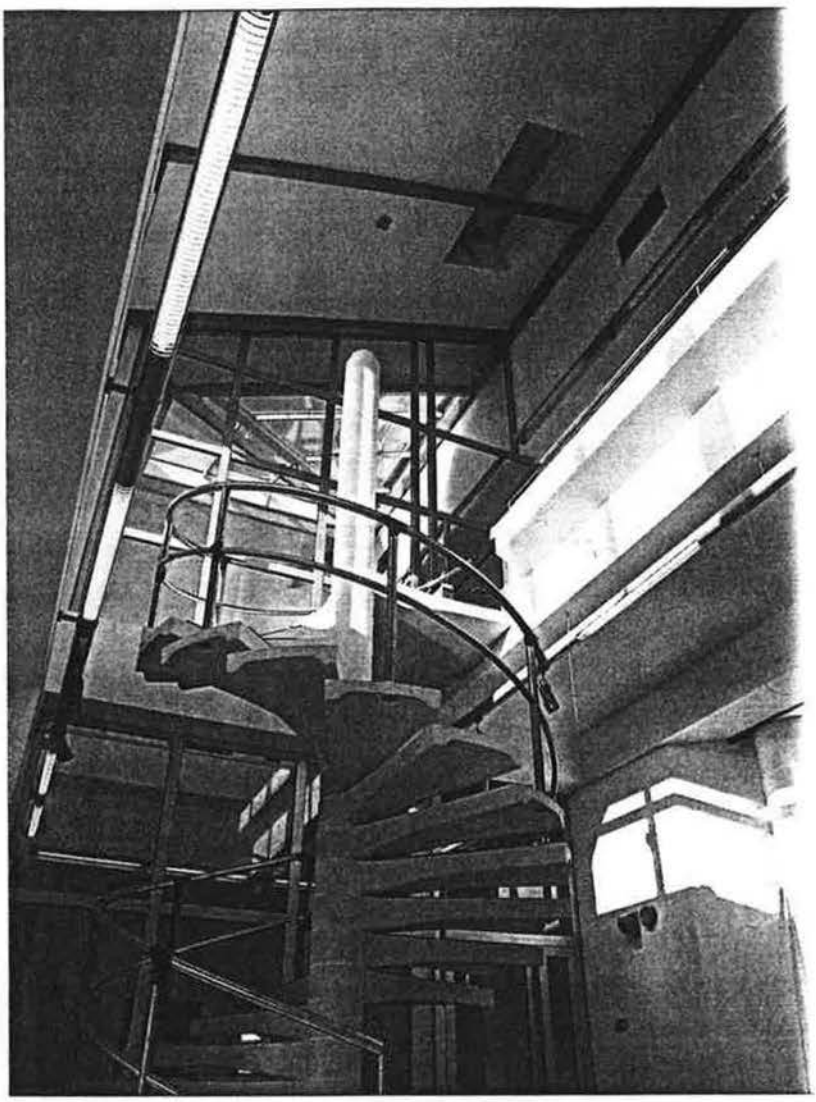
The radiator circuit is split into south and north zone circuits, the flow temperatures in the south zone being set back when sensors detect that internal temperature has risen. Therefore, when the vents are open the radiators will be 'off'.

However, the common system of heating and displacement ventilation – separate systems being ruled out on cost and space grounds – does mean that the heating may not be as efficient as it might have been.

For instance, you could easily imagine a scenario where one court may play host to only a few people, while another court might be packed with 50 or 60. Without controls to limit the temperature rise in the packed courtroom, the radiator circuit could still be running on the basis of needs in the other courtroom. In the end the designers decided to accept the potential space temperature rise rather than bear the cost of extra heat recovery equipment and a much more complex controls system.

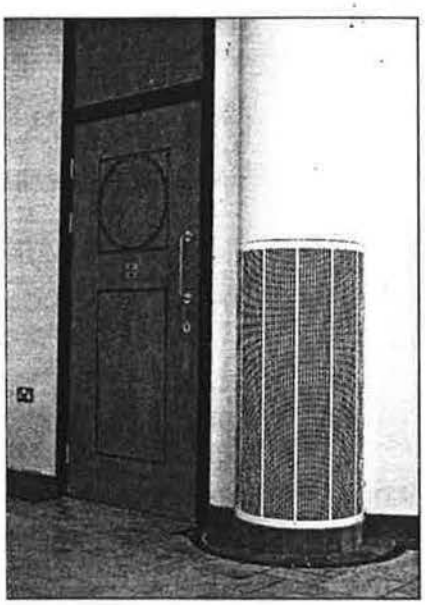
However, the close correlation between the size of the cooling load and the minimum fresh air requirements does suggest that the maximum temperature in any courtroom is unlikely to exceed 24°C. Time will tell.

The lower ground floor plantroom contains secure rooms for the air handling plant at the behest of the Home Office. Apparently prisoners are not above using the ventilation ductwork to make good their escape from the judicial process.



On a sunny January day the public areas receive a good amount of daylight via glazed lightwells. Note that the fluorescent downlighters are still on – a case for retrofitting daylight sensors?

Below: One of the displacement units in the public areas, less ornate but still well integrated into the building's design.



Daylighting design

Daylighting the courts was not particularly easy. The need for multiple security access usually means that courtrooms are surrounded by concrete and access corridors.

At Rotherham all the courts have daylighting, direct or borrowed. Six have an external wall allowing direct daylight via windows, but the space planning of the court had to ensure that the daylighting was not on such an elevation that people inside the courtroom would constantly have to look at it – the windows could not be directly behind the magistrates bench, for example.

To solve this problem more computer simulation was carried out, this time by Joe Lynes at the Humberside School of Architecture. Lynes used the GNOME (*aka* Gnomon – part of a sundial) simulation program to help design the daylighting scheme. GNOME was particularly valuable in predicting the incidence of glare through the courtroom windows (see "Daylighting and solar glare: study results").

In the event the worst predicted daylight factor in the public waiting area is 6·5; at this stage it is rather too early to tell whether or not this has been achieved.

In four courtrooms the daylight (and the external view) is restricted to high level glazing at the back of the court. At the very least this allows the magistrates and the clerks to see some sky, albeit borrowed from the outside curtain wall glazing in the public waiting areas.

Security considerations were not simply restricted to the possibility of sound and stones passing between the courtrooms and the public waiting areas, but were also aimed at preventing people outside the court from disturbing the judicial proceedings in a visual sense. Window sill levels therefore vary according to the position of the courtrooms.

External glazing and acoustics

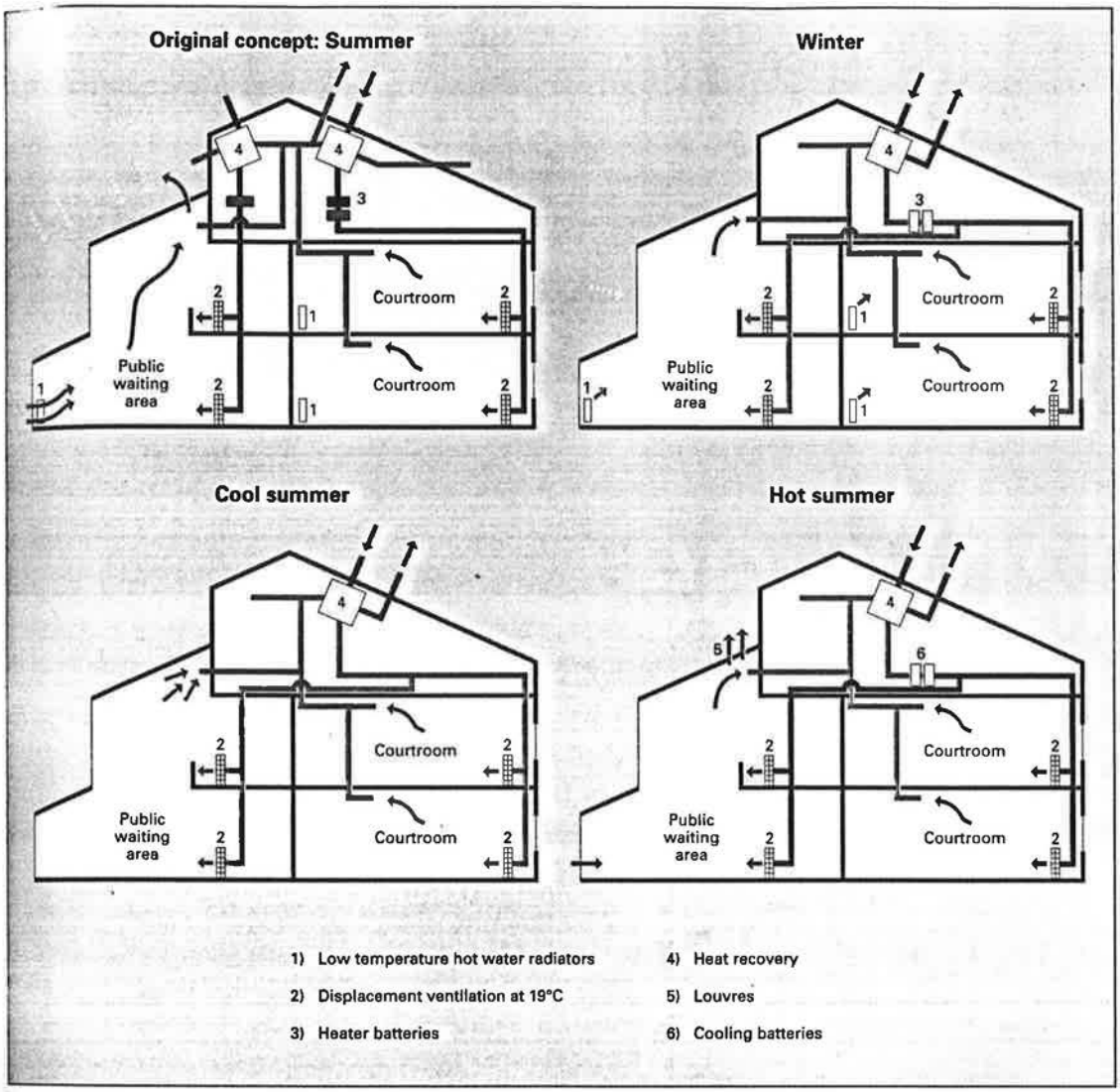
A complicated, but nonetheless interesting architectural detail involves the roof glazing at the rear of the long main entrance area. This brings some light relief to this area and also to the lower ground floor via a stairwell. A particularly neat detail was to glaze the smoke vents above the stairwells.

At the design stage the public waitin areas had both the roof and walls glazed Computer predictions suggested that thi would lead to severe overheating and so th roof glazing was omitted. There are no grea views from the ground floor glazing, bu there is a substantial feeling of openness i what is a long and not particularly larg space.

A mezzanine gallery allows the full heigh to be used without losing the potential fo first floor public access to the courtrooms From here there are good views and a cafe t take your mind off your reason for bein there.

Acoustic criteria were not particularl onerous, the courtrooms requiring NC 3 Attenuators are used in the ductwork, but special consideration was that the room should not be so quiet as to prevent th magistrates from having whispered conver sations without being overheard. Some de gree of white noise was therefore believed t be important.

The raised platforms for the magistrate benches were used for both ventilatio



Top, left: The building's original mode of operation relied on two heat exchangers. In the event, the building now relies on a single heat recovery strategy for both the courts and the public waiting areas, as shown in the remaining three diagrams.

ductwork and for the electrical and data services. It is expected that video evidence will become more common in the future, and so provision was made for a higher degree of data cabling between the lower clerks' desks and the benches.

Lighting is a mix of continuous fluorescent lamps in glare-reducing fittings and fluorescent downlighters. This has succeeded in avoiding a bland lighting environment in the courtrooms, but unless there are alot of artificial plants along the front of the mezzanine gallery the public areas could look a little stark.

The final analysis

It is interesting to compare this rather unsung building form with all those that have received public acclaim in the past. The Magistrates Court at Rotherham could well prove to be a design standard for others to follow, particularly in terms of its achievement in subjugating the needs of security and authority to that of the users without any apparent compromise.

Stephen Ashley is a freelance technical writer.

Rotherham Magistrates Courthouse, The Statutes, Rotherham

Client
Rotherham Metropolitan Borough Council
Architect
Rotherham Metropolitan Borough Council (Director of Architecture)
M&E consulting engineer
Pearce Design Group
Structural engineer
Rotherham Metropolitan Borough Council (Director of Engineering)
Quantity surveyor
Rotherham Metropolitan Borough Council (Director of Architecture)
Main contractor
Higgs & Hill (Northern)
Electrical contractor
L J Monks
Mechanical contractor
Haden Young
Commissioning contractor
Suttons

Main suppliers
Boilers: Hamworthy
Chillers: Formost Air Conditioning
Pressurisation: Crane
Pumps: Crane
AHUs: Packaged Air Conditioning Equipment
Fans: Vent-Axia, Roof Units
Radiators: Hudevad
Ductwork: W H Fabrications
Grilles and diffusers: Trox Brothers
Controls: Staefa Control Systems
Public address: Reflex Sound and Light Systems
Louvres: Airstream
Lights: Abacus Lighting, Harvey Hubbell, Holophane (all external)
Luminaires: Moorlite Electrical, Surelux, LB Lighting, Erco
Dampers: Actionair Equipment, Gilberts of Blackpool
Fire dampers: Actionair Equipment
Displacement ventilation terminals: ABB Fläkt
Sound attenuation: Allaway Acoustics
Valves: Crane
CCTV: Time (Northern)
Water heaters: Santon
Fire protection: Honeywell Control Systems
Clock system: H J Walsh & Sons
Lightning protection: Furse
Call and alarm systems: DMP Communication Systems
HV switchgear: Babcock Transformers
LV switchgear: GR Electrical, Ottermill Switchgear
Lifts: Express Lifts
Standby generation: F G Wilson

Engineering data
Total area (gross): 5448 m²
Net usable area: 3015 m²
Circulation (including public waiting areas): 1196 m²
Ancillary: 1237 m²

U-values (W/m²K)
Walls: 0·36
Floor: 0·33
Roof: 0·23
Windows: 3·2
Double-glazed curtain walling: 3·2

Internal design conditions
Winter: 20°C
Circulation & toilets: 18°C

Loads
Installed heating load: 800 kW
Installed cooling load: 200 kW

Ventilation
Scheduled supply air temperature: 19°C
Fresh air: 100% (12 litres/s/p)
Filtration EU category: 5
Primary air volumes
5 ahus at 15 m³/s (total for courts and courtyard)
1 ahu at 1·3 m³/s (cells)

Heating system
Boiler capacity: 800 kW

Distribution circuits
LTHW: 82°C flow, 71°C return
Chilled water: 6/12°C

Electrical supply
11 kV supply, 500 kVA
1 transformer @ 800 kVA
1 standby power unit @ 250 kVA

Lighting
Types: Fluorescent (linear and compact sources), extra low voltage
Lux levels
Office: 500
Computers: 500
Toilets: 150
Stairs: 150
Circulation areas: 150
Courtrooms: 300

Lifts
7 x 8 persons @ 0·6 m/s

Noise levels
Courtroom: NC 35

Costs (tender figures)
Total cost: £5·3 million
Building services total: £1·43 million
Total net cost: £973/m²