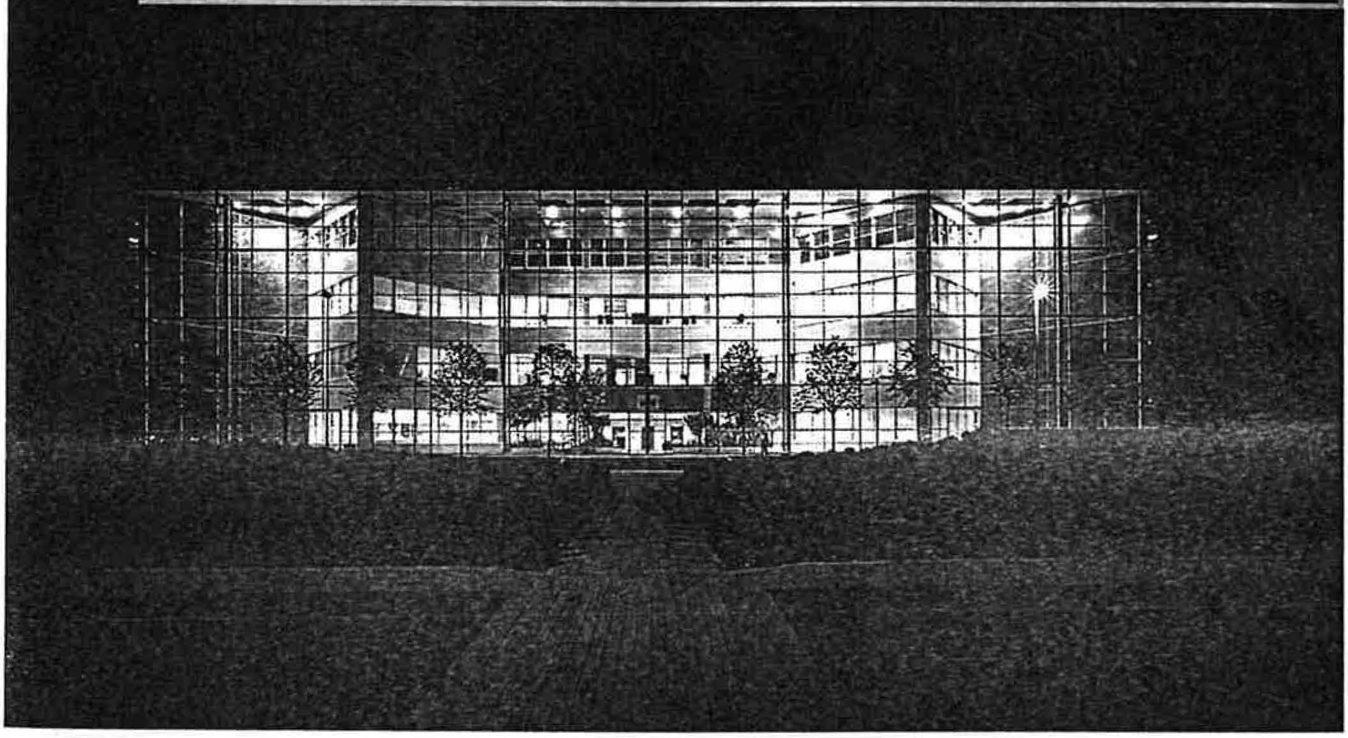
CASING THE JOINT



A speculative building, begun in the recession, built to very low cost, occupied on completion and recently sold on as quality office space. The developer? Stockley Park Consortium. The building? 3 The Square, Stockley Park. The concept? Turning atrium buildings inside out.

BY JOHN FIELD

Stockley Park virtually defines contemporary corporate architecture. A product of the late 1980s boom and gaining a second wind as the recession fades, the office park is becoming a display case for speculative buildings of the more advanced kind.

And not just advanced, but advancing. 3 The Square represents one of a family of buildings with which Arup Associates is refining the principles of the atrium form. Based on the success of The Square project, Arup Associates has won repeat orders for the building form – one triangular and one circular – all at Stockley Park.

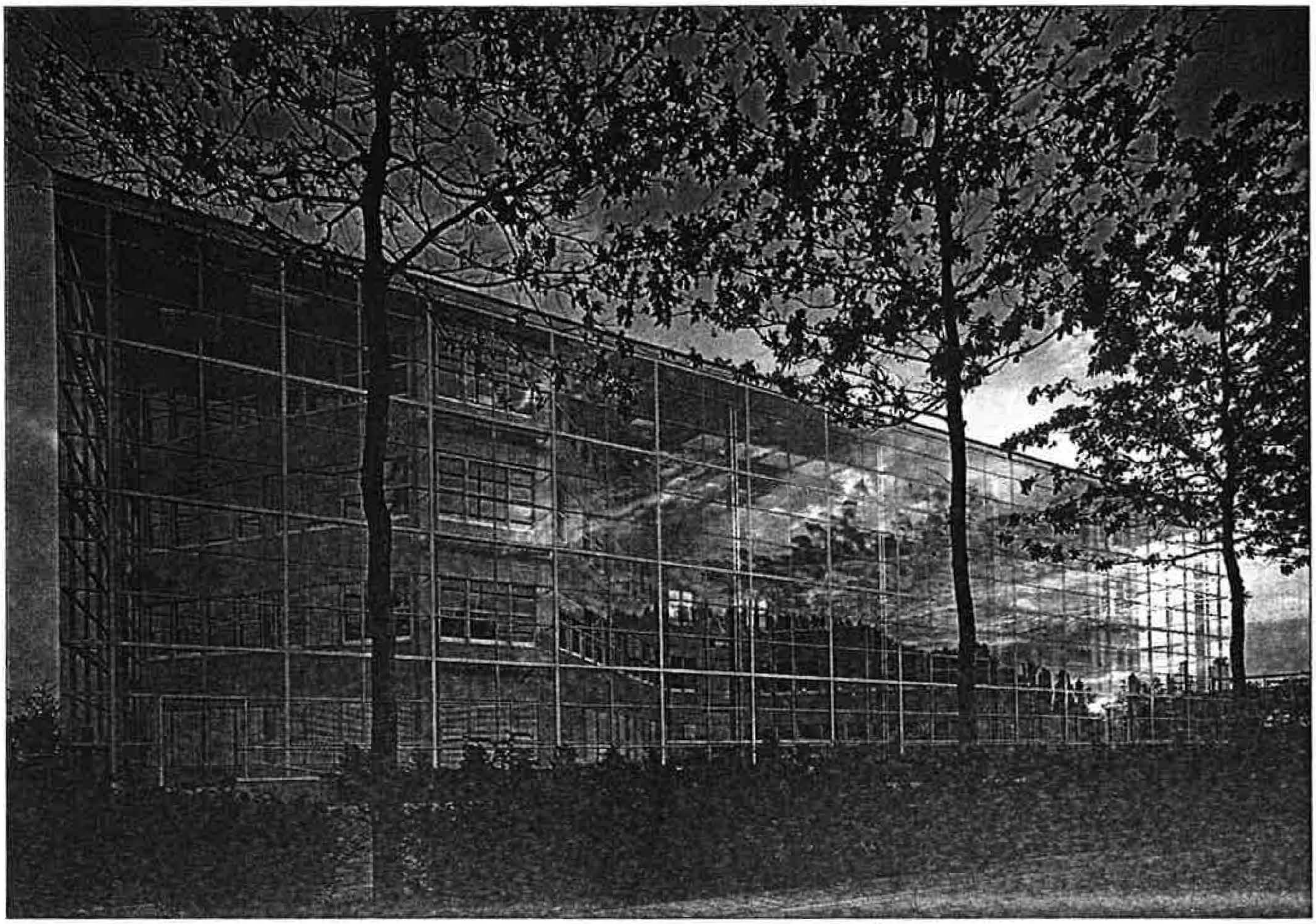
So what's so special about The Square? For a start it's a slight misnomer. Beneath the outer shell of a single-glazed curtain wall lies an X-shaped, four-storey building. The resulting diagonal cross has created four large atriums and a number of small atriums between the building and the external envelope (figure 1).

The inner curtain wall has a maple-covered skin, with a ribbon of aluminium-framed double-glazing at each floor level fitted with external blinds. The central core area is oriented on the orthogonal outer grid, as is the undercroft car park which extends under the whole outer square.

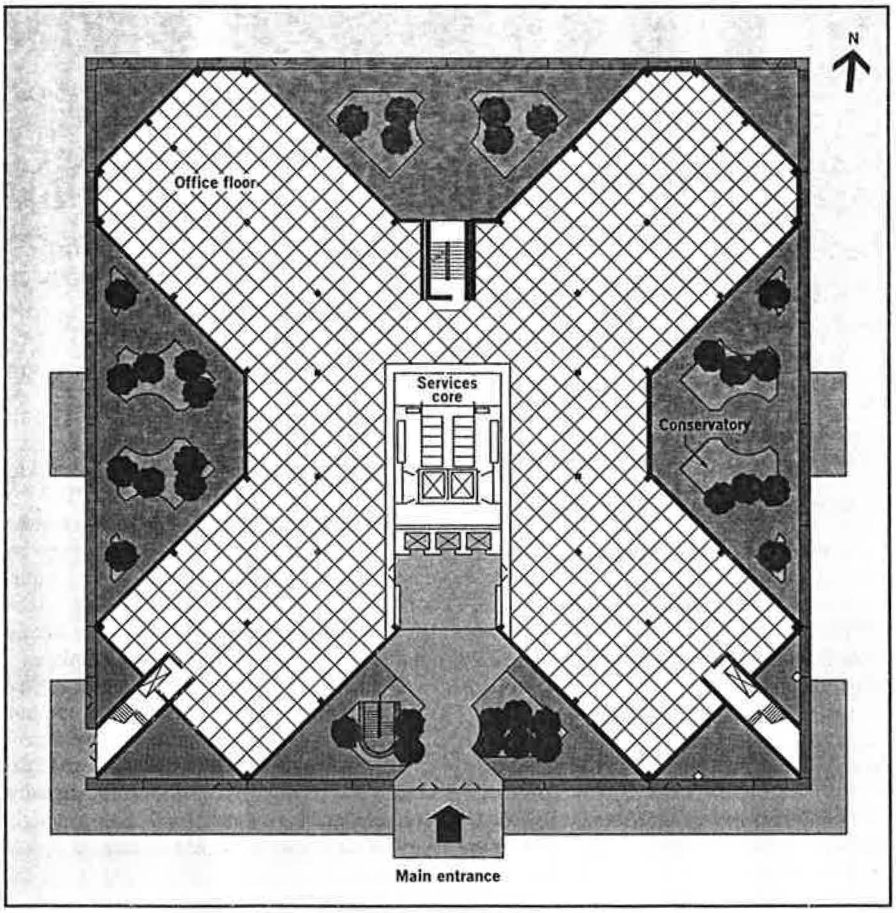
Arup Associates' building services director Peter Warburton states that the building's form provides enhanced views out in three directions from the office areas (as opposed to only one or two directions of view in traditional building forms). Also, on the upper floor (currently let but not occupied), there is a striking impression of openness and a narrow-plan feel which belies the building's plan depth of at least 18 m.

Arup Associates claims significant reductions in thermal load through the use of external blinds, which only allow 5-10% of incident solar heat to penetrate the building, compared with around 30% for mid-pane blinds and 50-75% (or more) for internal blinds.

As the blinds are on the outside of the windows but inside the atrium, they do not have to be weather-resistant, and are therefore cheaper and easier to use. Also, they do not have to be motorised – as would normally be necessary for automatic retraction in high wind conditions – so local mechanical operation is possible, avoiding problems of ganging and switch location.



The building's inner curtain wall has a maple-covered skin, with a ribbon of aluminium-framed double-glazing at each floor level, fitted with external blinds.



Venetian blinds are individually operated by a simple and accessible hand-operated winder which lets the blind down and then tilts it. The blinds appear to be widely used, and the external glazed envelope succeeds in avoiding the patchy effect that randomly deployed external blinds can give to a building.

Atrium buffer zones which surround the offices help to augment the high insulation levels by obstructing the flow of heat in or out. The atriums themselves are intended to be comfortable spaces at intermediate temperatures: in winter giving elevated temperatures, while in summer providing pleasantly cool conditions with the possibility of wind and some stack-induced ventilation. Condensation on the outer, single glazed atrium envelope is avoided by temperature and humidity-based control of ventilation openings.

The atriums create the opportunity for natural ventilation of the offices (or at least the outer limbs) for much, or all, of the year. The deep central core areas of the cruciform floor plan are unsuitable for this form of ventilation and need to be mechanically ventilated. This mixed-mode strategy was recommended to the tenants, but has not yet been implemented.

The basement car park, on the other hand, uses the whole outer square area. It is open on two sides to provide highly effective natural ventilation.

FIGURE 1: The building's diagonal cross shape has created four large atriums and a number of small atriums between the building and its envelope.

The building was able to make use of plant and structural steelwork ordered for a previous project, but not used. The designer insisted that the chillers and air handling units (ahus) were returned to the Italian manufacturers for checking to remove doubts about the liability for any problems. In the event, this proved a wise precaution as some motors are now on their third rewind. Re-using plant did not constrain the design – the plant actually turned out to be slightly oversized.

Showing foresight, the designer fought to retain a lift to the main plantroom which, being in the centre of the roof, would otherwise require substantial cranes to deliver or remove major items of plant.

Air conditioning

The building was marketed as an air conditioned office, although it is capable of partial natural ventilation. Two ahus in the central rooftop plantroom serve a raised floor supply plenum on each floor. Air returns to the plant room through the false ceiling via perforated ceiling tiles and recessed light fittings (figure 2). Both ahus have a pair of dampered vertical supply and return air ducts serving each floor which allow fully zoned operation.

In principle, each ahu can serve both sides of the building, although the fire barriers provide some constraints.

The scheme is designed for six air changes per hour, although the system can provide anything from full fresh air to full recirculation. However, under normal occupancy only the minimum fresh air quantity would be maintained. The designer intended that floors, or parts of floors, would be naturally ventilated. With the type of mechanical ventilation system installed this could have lead to the situation where the air volume required may well be below the design supply air volume for a particular floor.

Consequently, the ahus employ variable speed motors on the main fans which, if the fans run at reduced volume and pressure, could generate substantial savings.

Swirl diffusers in the raised floor mix the supply air up to shoulder height, with stratified or laminar airflow occurring above that. Diffusers are provided at one per person, but these can be easily moved: the design air change rate can therefore be easily increased or decreased locally by adjusting their locations. These diffusers have a low resistance (only 40 Pa at full volume), so that even when added to the low resistance of the floor plenum, no additional measures are required if their density is altered locally.

Carpet tiles and floor tiles can also be easily lifted, so this provides an extremely flexible arrangement which is quick to adjust for areas of high or low gain.

The ventilation system provides fresh air at the working plane. Along with the fairly high air change rate and the visual openness (where not obstructed), the overall impression approaches the desirable "light and airy" label.

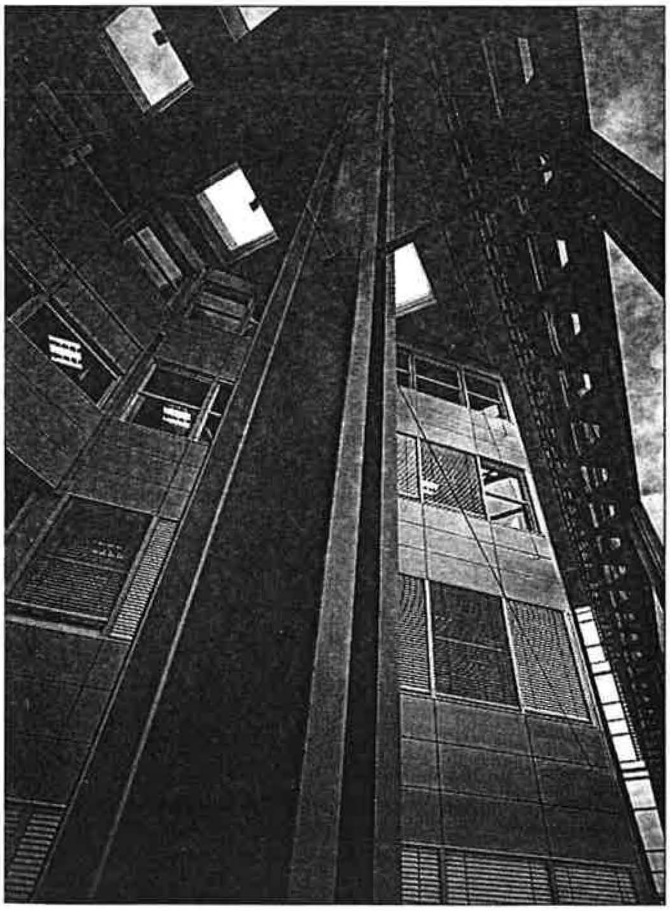
The upper occupied floors have screen-divided, open-plan areas and cellular offices. In some cases the fit-out has retained the open feel of the base building, but in general this openness has been lost by tall screens and office/corridor partitions obstructing the views. As expected, the air supply system has been adapted to this layout by simple shuffling of diffuser positions. This approach has also worked for the ground floor which mostly houses meeting and training rooms, although the tenant has installed extra cooling in highly used training rooms and computer suites.

These fully recirculating systems reject heat into the car park, which appears to cope with the extra heat. The designer is not convinced that all the extra cooling is strictly needed, but would hold out for more tenants' roof plant space in future designs.

Generally, air is supplied at 18°C, although this temperature may be increased slightly in winter. At 18°C there is potential for free cooling for at least 75% of the year, compared with say only half the year at more conventional supply air temperatures.

There is some dehumidification, achieved by cooling part of the supply air below dewpoint before mixing to the required supply temperature. Steam humidification has been allowed for in the design. However, this option has not been taken up by the tenants, even those who were in residence last winter.

Other systems installed in the building include a low pressure hot water perimeter heating system that serves to offset fabric losses, as well as an electric domestic hot water heating system which serves the toilets in the core area.



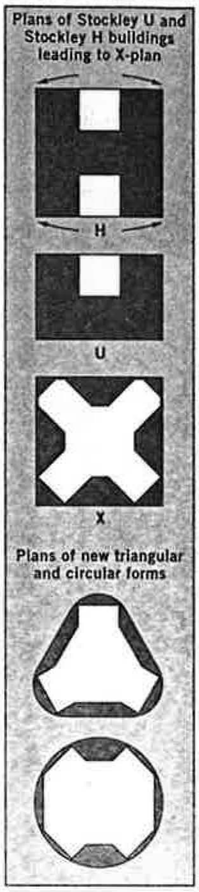
The atrium buffer zones which surround the offices help to augment the high insulation levels by obstructing the flow of heat in or out.

BUILDING FORM DEVELOPMENT

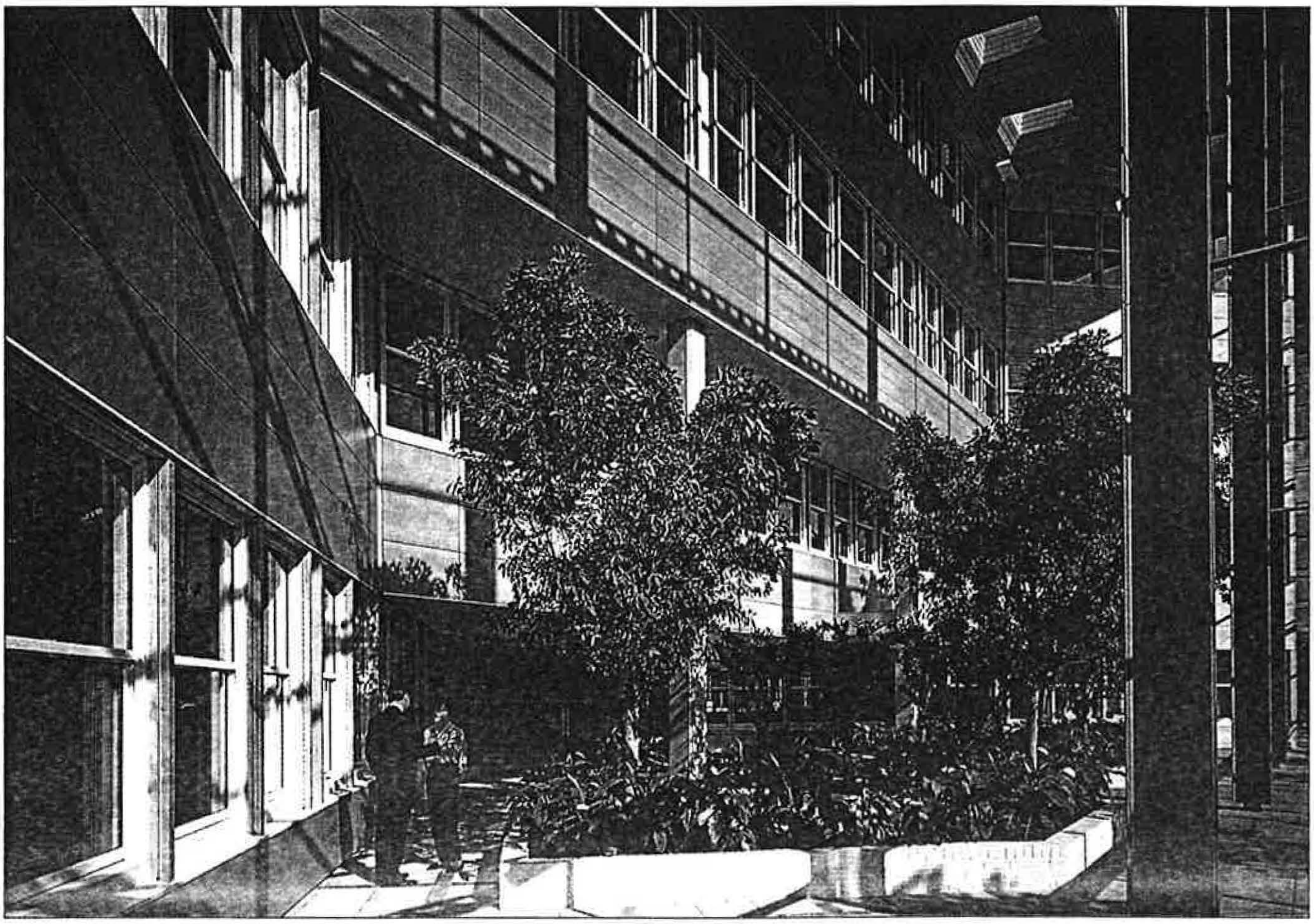
Architect, m&e consultant and structural engineer Arup Associates plays down the novelty of the building form at 3 The Square, stating that there is nothing new in the concept - the developer did not want a research project.

They relate the form to previous 18 m floor plan U-shaped and H-shaped atrium buildings at Stockley Park (note the plans of Stockley U and Stockley H buildings leading to X-plan, right).

The proof of the product is in the repeat order. This concept has further evolved for two more buildings at Stockley Park (one is a triangular variant and the other circular), in addition to a larger building for British Telecom.



RIGHT: Sections detailing the development of the building form.



In winter, the atriums afford elevated temperatures, while in summer they provide pleasantly cool conditions with the possibility of wind and some stack-induced ventilation.

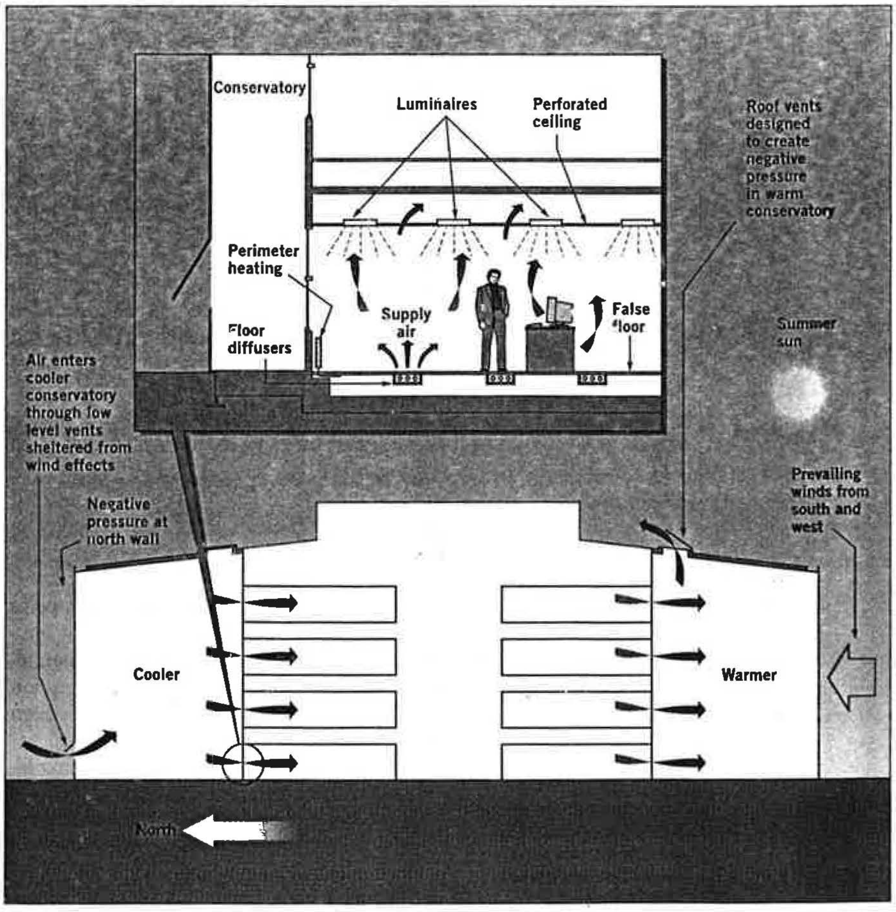


FIGURE 2: The natural ventilation strategy. With a southerly wind, roof vents in the sun-heated south atrium are opened to vent the warm air, while the windows in the north atrium are opened to pull air into this cooler void. INSET: The mechanical ventilation strategy. Air returns to the plantroom through the false ceiling via perforated ceiling tiles and light fittings.

Natural ventilation

Although the building is essentially air conditioned, it does have a mixed-mode/natural ventilation strategy. This strategy takes into account both the building's plan depth (which varies from 18 m to nearly 30 m depending on the section), and its wind-induced ventilation paths which are obstructed by the outer skin.

The designers' intention was that with the strategic control of ventilation openings in the external glazing, air movement within the offices could still be achieved. So that with a southerly wind, for example, roof vents in the sun-heated south atrium are opened to vent the warmed air. Simultaneously, the lower windows in the north atrium are opened to pull air into this cooler void. If the office windows are then opened the cool air in the north atrium will be pulled southwards through the offices (figure 2).

The sash windows in the offices are designed to open top and bottom to provide optimal cross-ventilation. The designers' experience with the Wiggins Teape building has shown that occupants do not always need high natural ventilation rates – high CO_2 levels were measured there without any reported discomfort. It appears that it is the overall feel which affects occupants' requirements, not specific individual control parameters.

When natural ventilation is used, the core and some of its adjacent areas require mechanical ventilation. The supply air within the floor plenum will need to be kept separate. It was envisaged that vertical fibre boards would be fitted and sealed to the slab and the raised floor, to allow the supply of conditioned air to the outer, naturally ventilated zones to be cut off. Motorised damper sets would be included so that the plenum supply could be restored or controlled as necessary.

To date, it appears that this arrangement has not been implemented by the tenants. The issue of natural ventilation is currently affected by a safety-related insistence of the tenants that office windows are not to be opened by their staff.

Lighting for the landlord's category A fit-out on the top floor is industry standard: fluorescent 600 mm square category 2 luminaires with manual switching to comply with the fairly stringent requirements of the current *Building Regulations* – no automatic lighting control is used. The tenants have retained this lighting system on all the occupied floors.

Low energy

The design for 3 The Square strives for a low energy label while allowing the commercial agents to market the building as fully air conditioned. This has been achieved by:

☐ reducing the heating requirement with high insulation levels and buffer spaces;

☐ reducing the cooling requirement by cutting out solar gain with easily operated "external" blinds;

☐ providing a flexible air conditioning system so that either different floors, or parts of those floors, can be serviced, thereby reducing the ventilation and cooling requirements, and by allowing either partial or total natural ventilation;

☐ reducing the need for mechanical cooling by supplying air at moderate temperatures which maximises free air cooling;

☐ providing variable speed fans which allow reduced ventilation requirements to result in significantly lower energy use.

The building's novel form creates the impression of an open and highly flexible space. The internal environment gives a fresh feel with the possibility of at least partial natural ventilation, achieving low energy use by reducing loads and providing efficient and flexible systems to service the loads.

This is a speculative building designed to tight cost limits. It has been popular with the tenant and with the developer, who was able to let and recently to sell the building on.

The design concept has spawned a series of successors which are at various stages of design and construction. The longer term feedback on occupant and energy performance is awaited with much interest.

John Field MA CEng MInstE MInstP is director of energy consultancy Target Energy Services.

3 The Square, Stockley Park, London

Client
Stockley Park Consortium
Construction manager
Schal International
Architect, m&e consultant and structural engineer
Arup Associates
Quantity surveyor
Davis Langdon & Everest
Electrical contractor
T Clarke
Mechanical contractor
M J Lonsdale
Commissioning contractor
Commissioning South West

Contract details
Tender date: August 1995-January 1996
Form of contract: Construction management
Contract period: November 1995-November 1996
National Engineering Specification: No

Mechanical suppliers
AHUs: Redbro
Swirl diffusers: Krantz
Boilers: Hoval
Chillers: McQuay
Coolant: R22
Ductwork: Hotchkiss
Flues: A1 Bridge Flues
Pumps and pressurisation: Smedegaard
Radiators: Hudevad
Raised floors: Hewitson
Sound attenuation: Caise
Computer room ac: Daikin
Strainers: Hattersley
Tanks: Balmoral
Toilet extract: Roof Units
Valves: Hattersley
Water heaters: Heatrae Sadia

Electrical suppliers
Communications: ITS
Controls: Celcius
Electrical distribution: Sapphire Industrial Controls
Electrical accessories: Wandsworth
Fire alarm/detection: Zettler
Floor boxes: Powerplan
HV and lv switchgear: Merlin Gerin
Lifts: Kone
Lighting controls: ECS
Luminaires: Concord, Kim, Marlin

External design conditions
Winter: -4°C/sat
Summer (non ac): 24°C db
Summer (ac): 28°C db, 20°C wb

Internal design conditions
Winter: 21°C ±2°C
Summer (non ac): 26°C
Summer (ac): 22°C ±2°C
Circulation and toilets: 26°C maximum, 19°C minimum

U-values (W/m²K)
Walls: 0·45
Floor: 0·30
Roof: 0·35
Glazing: 1·8

Structural details
Floor-to-ceiling: 2700 mm

Occupancy
Offices: 10 person/m²

Noise levels
Offices: NR38
Toilet and circulation: NR40

Energy targets
180 kWh/m²/y treated floor area (no breakdown available)
BREEAM rating: very good

Engineering data
Gross floor area (gfa): 11 601 m²
Net usable area: 8613 m²
Plantrooms: 429 m²
Offices: 9522m²
Conservatories: 1438 m²

Loads
Calculated heating load: 0·6 MW
Installed heating load: 0·8 MW
Calculated cooling load: 0·9 MW
Installed cooling load: 1·0 MW
Fan power: 2·2 W/litre/s (13·75 W/m²)
Equipment: 15-25 W/m²
Lighting Load: 20 W/m²

Ventilation
Scheduled supply air temperature: 18°C
Room temperature: 22°C min, 24°C max
Fresh air: 20% min (12 litres/s/person)
Max recirculation: 90%
Filtration EU category: EU7

Primary air volumes
Primary air: 25 m³/s
Offices: 6·5 m³/s

Distribution circuits
LTHW: 80°C flow, 60°C return
Chilled water: 10°C

Electrical supply
800 kVA + 500 kVA supply

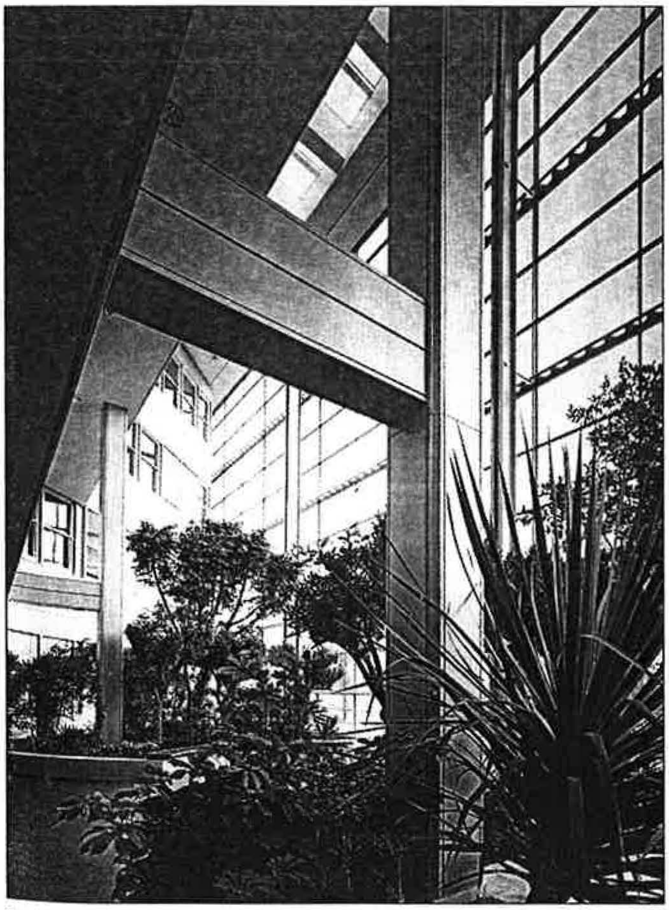
Lighting
Type: fluorescent
Office: tenant fit-out
Toilets: 500
Stairs: 150
Circulation areas: 150

Lifts
3 x 13 person @ 1·6 m/s
Goods: 2000 kg @ 1 m/s

Costs
Total net cost: £176.42/m²

Mechanical services cost (£/m² nfa)
Sanitary appliances, cold and hot water services: 2.60
Heating services: 20.80
Cooling services: 68.80
Drainage: 1.40
Thermal insulation: 5.30
Dry risers: 0.60

Electrical services (£/m² nfa)
Meter and switchgear: 9.30
Lighting installation: 8.90
Power installation: 1.60
Lighting fittings: 27.70
Controls package: 20.30
Fire detection and alarm systems: 2.50
Security encasement: 0.10
Telephone and data encasement: 0.30
Earthing and bonding: 0.40
Lifts: 1.92
External lighting: 4.00



The building is essentially air conditioned, but does have a mixed-mode/natural ventilation strategy. This takes into account both the building's plan depth (which varies from 18 m to nearly 30 m depending on the section), and its wind-induced ventilation paths which are obstructed by the outer skin.