The solar façade requires as much sunshine falling on it as possible, and, therefore, introduces the risk of overheating interior spaces; the materials of the façade are intrinsically low mass and are, therefore, incapable of providing thermal storage; the façade has relatively poor insulating properties and, therefore, is prone to heat loss; and its curtain wall construction inhibits carefully graded, glare-free daylight into the building.

These apparent conflicts have either been reconciled to be mutually reinforcing, or to a balanced compromise. Accordingly the potentially damaging heat from the façade can be used in winter to assist in heating the building and, in summer to pull air through the office space and out through high level vents. Lack of thermal mass is countered to some extent by specifying a concrete roof slab in place of the normal trussed and pitched roofs used elsewhere on the Park. The insulating properties of the solar façade are good in the context of glazing (U value: 1.2 W/m²/°C for the PV modules), but relatively poor compared to solid wall construction (U value: 0.4.W/m²/°C). Heat loss, however, was minimised by ensuring that leakage of air through the building envelope is exceptionally low (3.7m³/hr/m² at 50Pa against a standard written into the building contract of 10).

The façade incorporates over 400,000 photovoltaic cells. The concentration of cell coverage was necessary for the maximisation of power output. Bands of clear glazing have, however, been introduced into the façade to allow views out and ensure good internal light levels. The optimum balance between PV power generation and good daylight (at least 2 DF over 80% of the office floors) was determined by modelling glazing permutations using a 1:40 scale model under an artificial sky. The risk of glare is minimised by the introduction of semi-transparent modules immediately above the clear glazed panels and by provision for introducing of locally controlled roller blinds capable of covering both the clear and semi-transparent modules.

COST

It was recognised that building integrated photovoltaics would not be cost effective. However, if photovoltaics and low energy design are considered together, significant savings can be made in operating costs. It is estimated that the Solar Office, run in its passive solar mode, will save £55,000 per annum (and reduce carbon dioxide emissions by 375,600 kg) compared with a 'good practice' air-conditioned building.

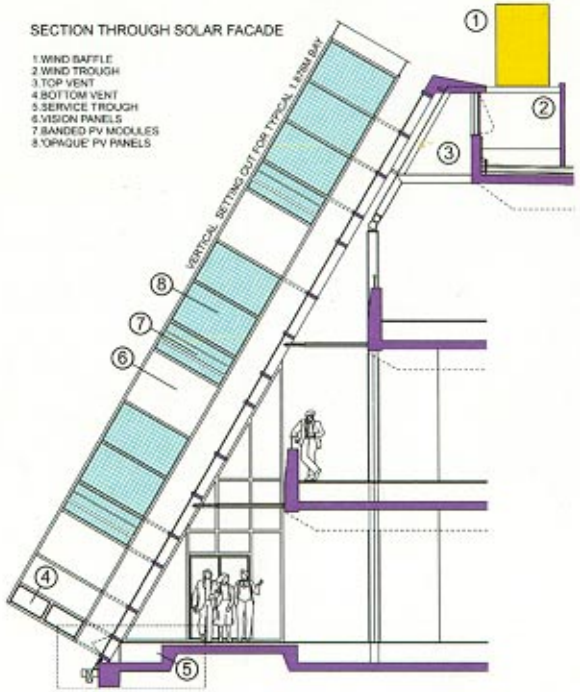
The complete cost of the Solar Office, in shell-and-core form, was about £4.225,000 at a cost of £940/m². A building with the same brief, but without some of the energy features and without the PV the at Park would be about £750m². The full PV installation including the curtain wall framework, the opening lights, the clear glazing, the wiring, junction boxes, the inverters and the monitoring equipment cost about £950,000: £200/m² of the gross floor area or £1,000/m² of external façade. The value of the PV installation, in isolation, is in the order of 50% of the total façade cost: £100/m² or £470,000.

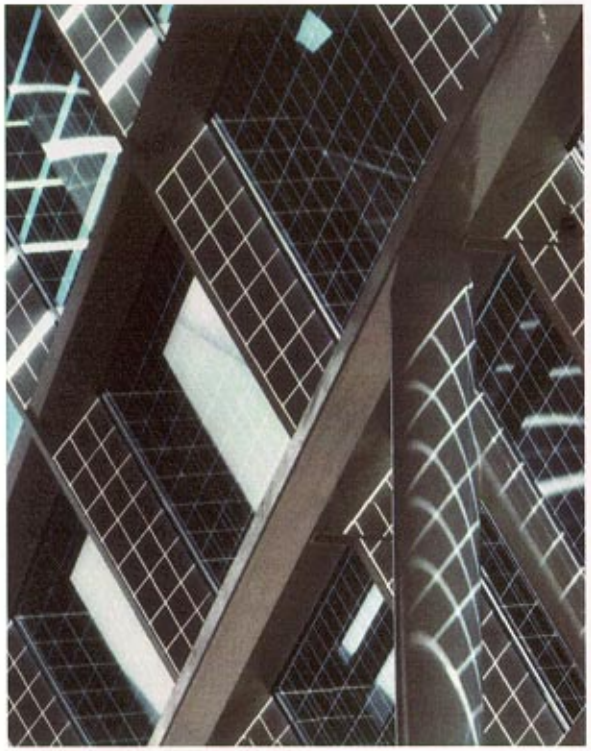
MONITORING

The PV system performance includes output measurement for all four sub-arrays as well as the complete system. Array temperatures are measured using embedded thermo couples in four of the modules, two on each side of the façade.

Energy consumption and internal comfort monitoring includes measurements of the air temperature in the office space, atrium and 'street'; humidity levels in the office space; electrical loads; gas usage; wind speed and direction. The activation of the automated solar façade vents and the upper window lights are also recorded. This will allow performance of the building to be assessed comprehensively and the success of the design reconciliation to be determined.

The PV output for the first two years of running, after extrapolating for short periods of downtime, matched predictions almost exactly. It is expected that a further period of monitoring, covering all environmental parameters as well as PV performance, will soon be initiated now that the building is occupied.





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