The Irish energy centre

An energy-efficient building has just been completed in Glasnevin, north Dublin. Built for an environmentally aware organisation it was designed by energy-conscious architects - who are also good-design conscious! The architects at the Energy Research Group in the School of Architecture at University College Dublin built the office for 30 members of the Irish Energy Centre which was established to promote efficient use of energy by offering advice, information and expertise. The group was established with the help of EC Structural Programme funding and a further commitment to £21M over the period 1994-99.

THE architects - Eileen Fitzgerald and J Owen Lewis - set out to create a building which was architecturally responsive to climate, context and function, while using energy-efficient strategies to meet heating, lighting and ventilation requirements.

The objectives were to:

- promote awareness of energy usage,
- use traditional materials and energy standards in an innovative way,
- make a positive contribution to the existing campus.

The architects closely studied the Irish climate and found, as we know to our cost, that sunlight levels are moderate and about half of those experienced in southern Europe. In Dublin the longest day is 16 hrs 45 mins and the shortest is 7 hrs 15 mins with maximum and minimum sun angles of 60° and 13°. Global solar radiation averages 950 kWh/m^2 a year compared with 1,300 kWh/m^2 in central Italy.

The annual mean daily air temperature for Ireland is about 10°C with little difference between maximum and minimum temperatures. Rainfall is moderate.

Taking this into consideration, solar energy can make a substantial contribution to building energy requirements, and artificial cooling is rarely necessary.

Ireland has high wind speeds and high relative humidities. However, conditions of high temperature with high humidity or low temperature and low humidity are rare so winter comfort can normally be achieved simply by raising the air temperature.

Armed with this information the architects considered conditions prevailing at the site. They also had to work to a budget of IR £500,000 for both design and construction.

The long, narrow site - a former car park in the centre of a Forbairt complex - determined the elongated form of the building which is oriented north-south, thus optimising the availability of daylight, solar radiation and views while maintaining those already available to existing buildings on the complex.

The 410 m^2, two-storey building is entered along a stone path with a timber pergola above. The door leads into a small double-height atrium entrance, exhibition and meeting space which orientates the visitor immediately. This is the public face of the building and the intention was that its natural lighting, ventilation and finishes should reflect an external quality and emphasise its relationship with the external path. From the top floor corridor there are views back via the naturally lit atrium to the green space beyond.

Large open-plan offices in the building have windows on four sides for optimum daylight and views. These areas have small courtyards at the east and west ends of the building, planted with native Irish herbs and wild flowers.

Within the open-plan offices widespread use of the VDU had critical implications on the design of the lighting and servicing of individual workspaces. Workspace occupants can control the local environment with low-level opening windows for ventilation and view, thermostatically controlled radiators and task lighting. The workspaces are defined by movable screens each 1.5 m high, which provide visual and acoustic privacy, but do not block light from the high windows.

The primary energy consideration in designing the solid elements, such as walls, floors and roof, was to conserve and, where possible, store heat. The glazed elements of the building have a more complex function of solar gain, light transmission, insulation, shading, ventilation and views.

Materials and construction methods were selected with this bio-climatic approach in mind, and the impact of their manufacture on the environment was also taken into account. The finishes are easy to maintain while promoting a comfortable and healthy internal environment.

The architects specified upgraded levels of insulation achieving U-values significantly better than those required by the Building Regulations. Where newer products on the market were specified only those whose performance was already proven were selected. Energy performance, durability and aesthetic considerations for each element were balanced against cost.

The architects found that timber is much under-used in Ireland despite being the classic ecologically-sound and recyclable material when treated in an environmentally friendly way. Because of this, and because of its structural and aesthetic qualities, the architects used it throughout - in roof trusses, windows, doors, external and internal panelling and furniture.

Scandinavian timber-framed argon-filled double-glazed windows with low-e glazing have been installed. The masonry window reveals are splayed to increase the natural light from the window and reduce glare.

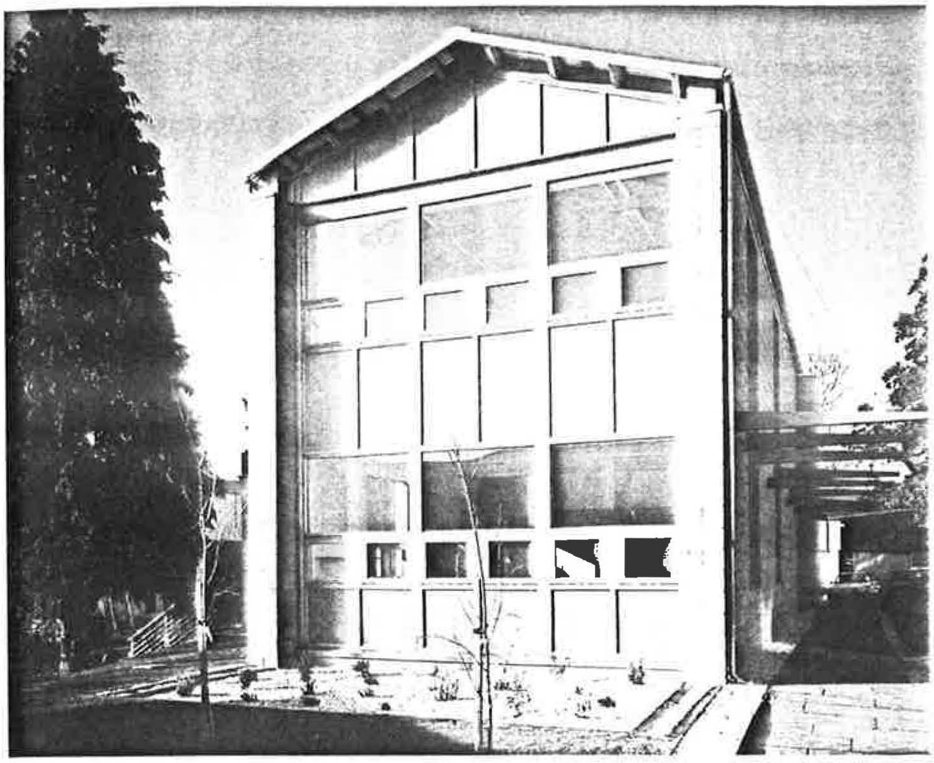
Metallic venetian blinds protect against sunlight and glare. Reflective blinds reduce the heat trapping effect compared with normal internal blinds by 15 to 20% by reflecting part of the radiation to the outside. Interior blinds are cheaper, more easily adjustable and maintained, and at night can be used to conserve energy. In this scale of building simple occupant responsive systems were more appropriate than automated, high-tech devices.

The architects increased standard U-values and reduced energy consumption through their specification and detailing of insulating material in cavity walls. The external cavity-wall construction is as follows:

External leaf:	100 mm fair-faced concrete block
Air gap:	40 mm
Insulation:	60 mm of rigid high performance insulation
Internal leaf:	215 mm load bearing blockwork
Internal finish:	Gypsum plaster painted white

The architects found evidence that heat losses through ground floors are greater than standard calculations suggest. They insulated the ground floor slab of the building with 50 mm of high density insulation. The intermediate floor is constructed of 200 mm deep pre-cast concrete slabs with 75 mm screed and the underside of the slabs are plastered and painted to enhance their usefulness as a thermal store.

The pitched roof structure is constructed from Irish softwood trusses. The roof is made from a sandwich of 150 mm insulation packaged in a vapour barrier and breathing membrane with a rain-proof cladding of mill-finished aluminium above. A relatively small



area of material is used to achieve tight weathering tolerances, long life, low maintenance and provision for recycling at the end of its design life.

All materials were specified for long life and low maintenance to minimise the use of energy and materials over the life of the building. Local materials were given preference where possible.

Floor finishes in the atrium and corridor areas are dark grey Irish Liscannor stone which will enhance the thermal performance of the slab. Elsewhere the floor finish is linoleum. Office floors are carpeted with a natural fibre.

Daylighting was considered very important because artificial lighting can account for more than 50% of total energy used in offices. Daylight excesses are controlled using internal reflective blinds.

Light-coloured finishes on walls and ceilings reflect light and contribute to higher levels of daylight and its penetration within the building. Windows are evenly spaced and higher than average resulting in light being cast deep into the room.

The artificial lighting system has two main characteristics: the installation is energy-efficient in itself, and the lights remain off as long as there is sufficient daylight. Energy-efficient lamps and luminaires and high-frequency fluorescent lights are used throughout.

A lighting control system has been installed. Light fittings and controls are zoned in relation to distance from the window. Features include:

- daylight sensors resulting in reduced electrical energy consumption,
- infra-red sensors,
- programmable time scheduling of lighting system.

The building is naturally ventilated - easier in a narrow plan building. Cross-ventilation is manually controlled by opening windows at each workspace, while the stack effect in the atrium assists the natural ventilation of the areas opening on to it. Air heats up and rises and is then replaced by denser, cooler air.

In a well-insulated building, solar gain and internal gains from occupants and equipment have a significant impact on heating demand. The objective is to minimise the consumption of fossil-fuel energy. Heat conservation is achieved through the insulation of building envelope, control of ventilation and infiltration, use of draught lobbies and thermal zoning of interior spaces

Thermal mass provided by walls and floors absorbs and stores solar energy during the day, releasing it slowly during the night. It absorbs heat generated by people, lighting, and equipment as well as by the sun. It moderates temperature swings and reduces the risk of overheating.

The atrium reduces heating loads by collecting solar energy, pre-heating ventilation air and acting as a buffer between heated spaces and the external environment.

The gas central heating system only works when it is needed, and then as efficiently as possible. Thermostatic radiator valves, timers and boiler controls are installed, while the users are well informed about how the building operates.

The building has been occupied since Christmas 1995. Gas and electricity usage is being monitored to determine whether it meets expectations. Knowledge and experience built up during the Energy Research Group's 21 year existence has been invested in the building and it is hoped that it will serve as an example for architects and organisations about how such buildings can be designed and how they work in practice.

Exterior and interior views of the new Irish Energy Centre building. The interior shot shows natural lighting available from all four sides of the open-plan spaces.