#3761

Organic services

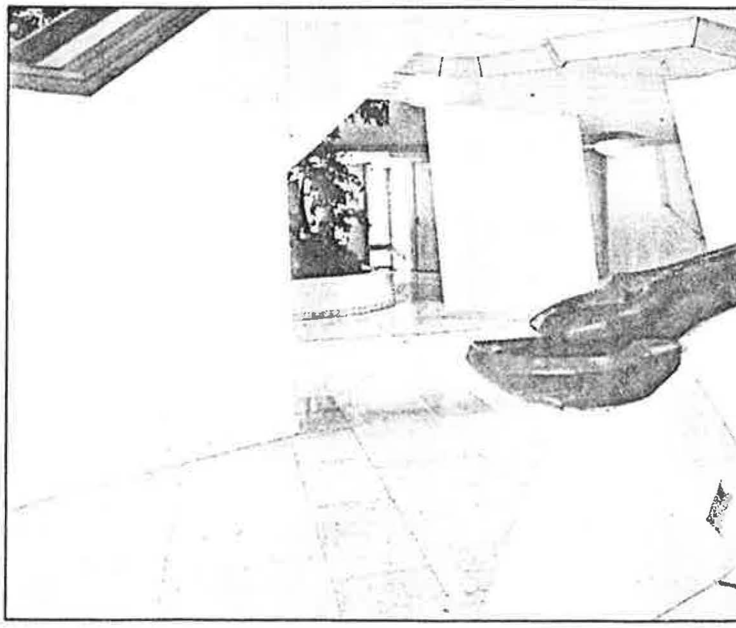
Bill Holdsworth reports on a building with the lowest energy consumption in the world: the NMB Bank headquarters in Amsterdam.

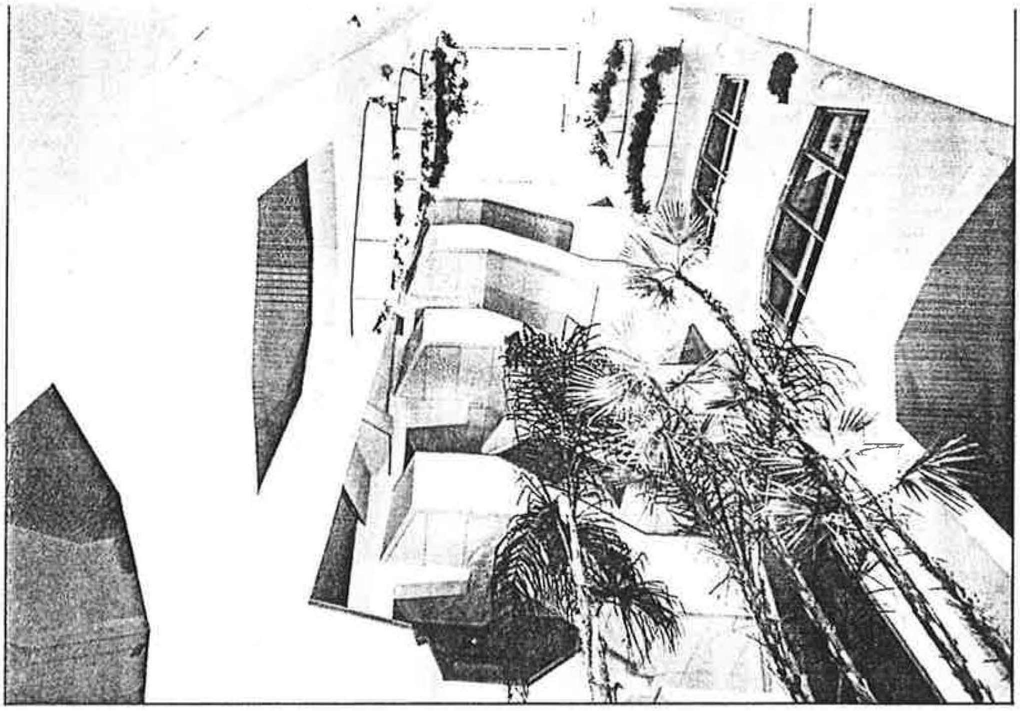
At midday on Wednesday 14 December 1988, the outside air temperature in Amsterdam was 7°C. Without any aid from a 1000 kW/h gas-fired boiler, the temperature within the new headquarters building of the Dutch NMB Bank was 21°C.

Recirculated air with a modicum of fresh air was raised 3°C by pentagon shaped solar passive collectors inclined on ten rooftop clusters which house heating, cooling, ventilating and heat recycling equipment. A further 10°C is added from recycled air from offices, an internal street system, and the major energy store of four, 25 000 litre water tanks contained in heavily insulated concrete bunds that lie beneath the building's energy centre.

Here waste heat from the dual-fuelled gas/oil turbines that produce independent electricity for the building, is stored in heat buffers along with heat dissipated from the refrigeration machines. Even the warmth produced by the lift machinery is collected and stored here.

Stored and recirculated energy is used for independent plant serving computer rooms, theatres, conference spaces, restaurants and kitchens, as well as being directed to the office space via heat wheels which boost the temperature to within a few





Left: Daylight and fresh air enters the office levels via the central shaft which contains a stairway.

degrees of desired room temperature. The remainder comes from the 5200 kW heat buffer.

Finely balanced radiators, low level lighting, coupled with simple but effective use of reflected natural light, helps to create a well tempered environment.

The flat lands of Holland demand winter design criteria of −10°C. The temperatures are often lower. Building services engineers, Treffers and Partners, have proved that on a clear, open winter sky with the outside air temperature at −16·7°C, the solar greenhouse roof "shield" can raise the temperature prior to the heat wheel to 5°C (a 22°C jump). After the heat wheel, the resultant temperature of 15°C is raised to comfort warmth by the stand-by boiler.

The building both externally and internally is exceptional. It also demands a place in the Guinness Book of Records for being the lowest energy consumption building in the world.

The primary energy consumption is 96 kWh/m^2 for an overall floor space, contained in ten office clusters, of 48 600 m^2. An additional 15 kWh/m^2 of primary energy is available for shops, offices and apartments that form low density white-walled rectangular blocks across the plaza from the dark brick sculptured building facade.

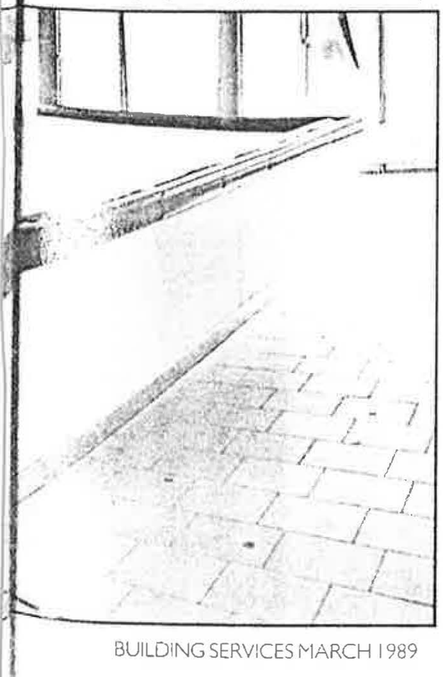
The total consumption of 111 kWh/m^2 was exhaustively investigated by the Dutch Research Establishment, (TNO), and found to be correct and lower than the 114 kWh/m^2 of the Obayashi Gumi building in Japan.

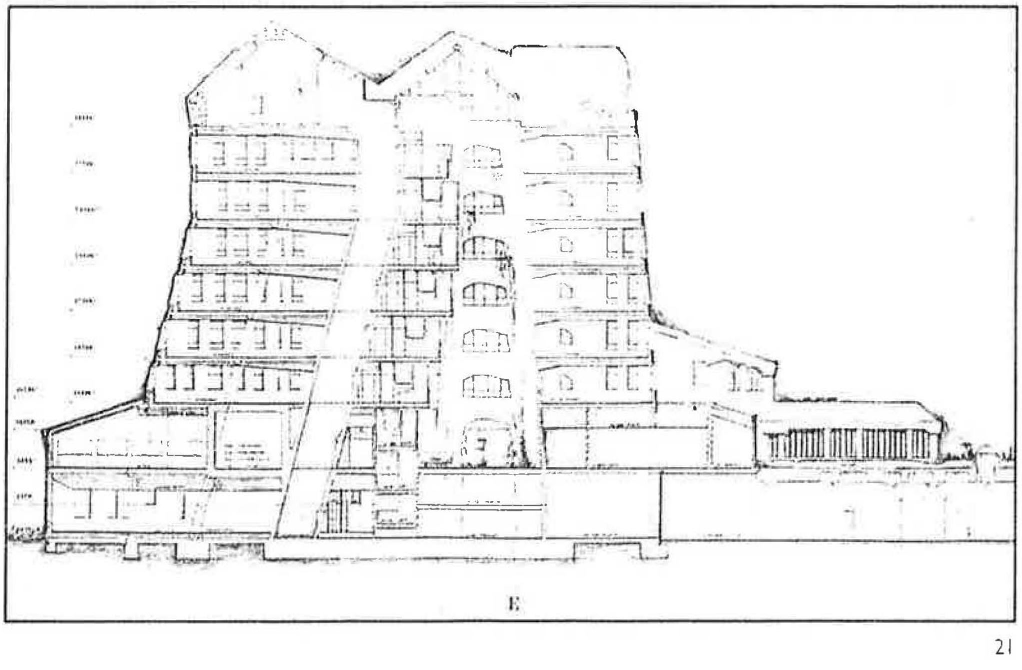
The result is put into perspective when compared to the Bank's previous hq building, built 10 years previously, that had an energy consumption of 1320 kWh/m^2. For an additional investment of £360 000, a saving of £1·3 million/year has been made on energy costs alone.

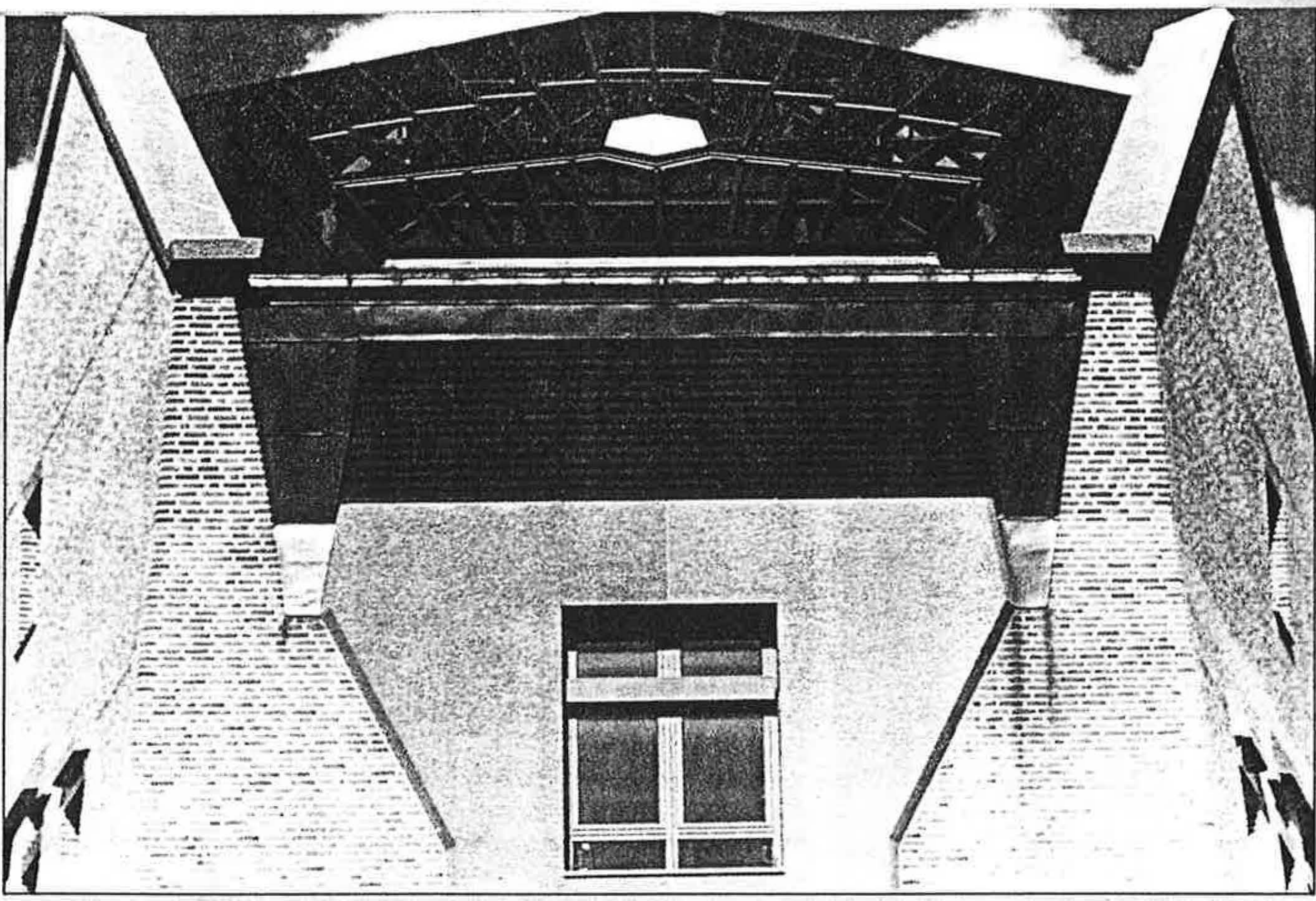
Such figures have made the Bank's accountants happy people, but the creative process that led to this sound investment might not have happened had there not been the synthesis of disciplines, and probably even more importantly, a client board of directors who were aware of the rich history of architectural expression that existed in The Netherlands, and had an understanding of ecological survival.

The traditional "prima donna" architecturally dominated team structure was abandoned. The pernicious polarisation of each specialist "doing his own thing", and putting technology before people, was thrown into the waste bin. System build contractors and "let us refer to the catalogue" designers were also excluded. The client provided his own in-house building co-ordinator J van Rijs who, with architect A Alberts and building physicist adviser W M Treffers, started from first principles.

Above left: the main entrance from the Bijmeerplein. *Below left:* Detail of the wide, easy to climb stairs. Note the obliqueness of the internal architecture. *Bottom right:* an architectural cross-section through one of the ten cluster towers. Note the central lightwells and their relationship to the light-gathering plant rooms on the top of the building.







Above: A solar pentangle collector on one of the cluster towers.

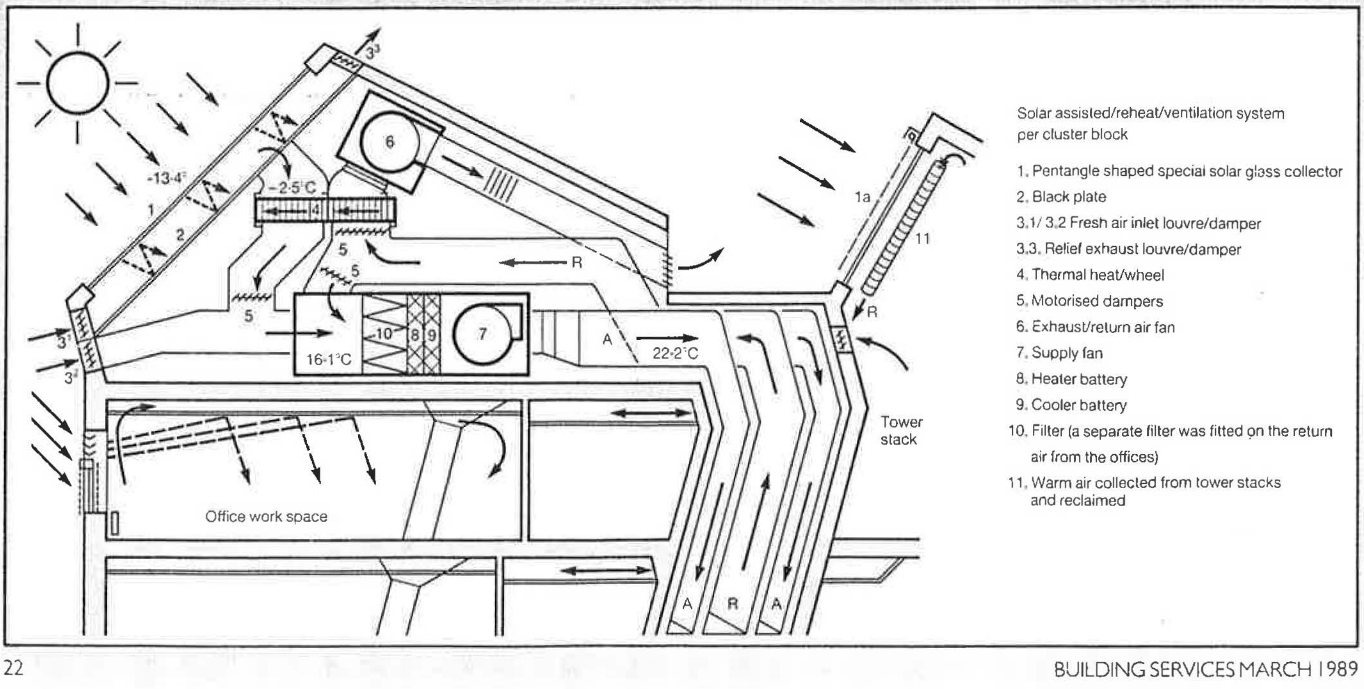
The "Chinese scroll" method of design was commenced without any external design award facade or treatment to act as a constraint. Every member of the team, including the acoustician, structural engineeer, and later the interior designers, had the right to enter the province of the other. No one person had overall responsibility; the whole team was responsible for the entire concept. The design process developed organically.

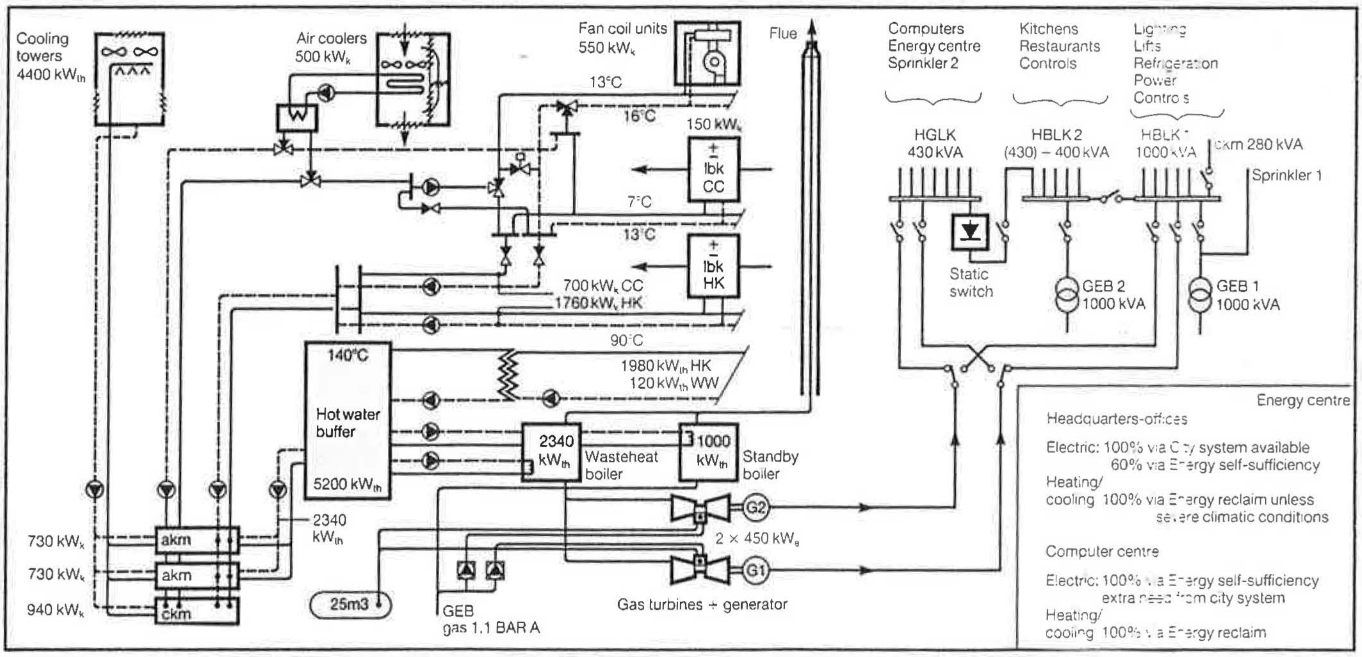
The site for the new building was decided, by a majority vote of the employees, to be south of Amsterdam on land reclaimed from an inland lake. In this situation there was no constraint of adjacent buildings, factories, or limitation in height. Nonetheless the design flow moved step by step from traditional rectangular forms, until all the needs and requirements slowly moulded the building shape that at first stunned the civil and structural engineer Bart Overmans into a deep reflection on his training and experience. Apart from energy savings, job efficiency was governed by:

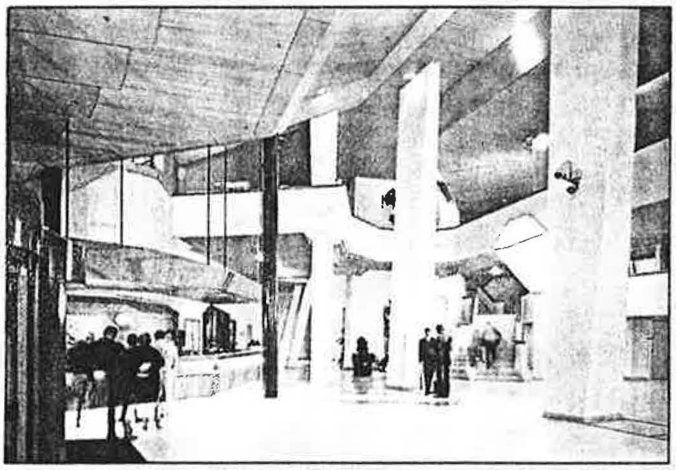
☐ the close relationship to work-stations;
☐ the need for easy change-over to forever-new technology of communications;
☐ reduction of noise transmission;
☐ optimisation of natural light;
☐ walking distances;
☐ and correlation to other aspects of the Bank's business, both financial and social.

The architect, who previously had developed his own brand of thinking on small scale houses and churches, was able to realise his dream of using reclining and oblique forms to express the building's essentially earthbound character, as well as provide windows that obstructed noise and that, for only 20% of the wall

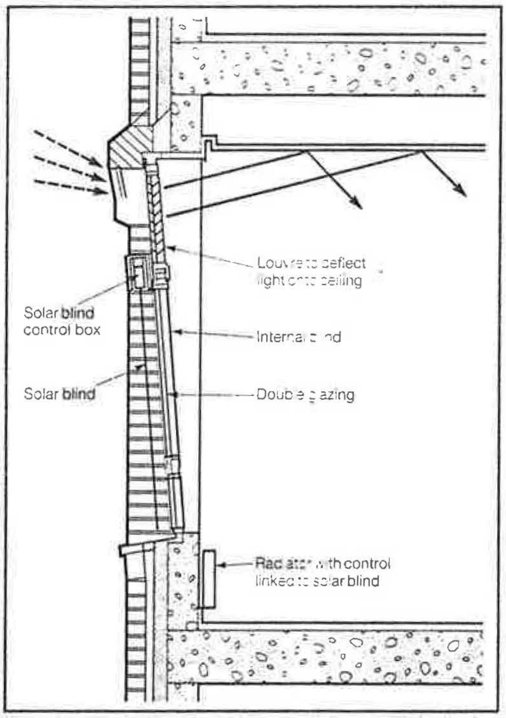
Below: Principle of the solar-assisted ventilation system in each of the ten cluster blocks. Annotation is based on an external temperature of −13·4°C.







Above: Services schematic. The heater batteries are served with energy collected in the heat store buffer situated in the energy plant under the main entrance block.
Left: The main entrance foyer.
Right: Detail of the glazing and roller blind system.



area, achieve at least 500 lux of natural light during most of the working hours.

The use of the segmented form offers each cluster the optimum sun path orientation, into areas where the staff is located. It also breaks up the wind impact, and therefore reduces energy consumption. Trees and plants, both externally and internally, are provided with rain water which is collected, stored and filtered before being warmed and pumped to the plants. Rain water is also used on the beautiful water sculptures that adorn the building.

There is a pleasing synthesis between architecture and construction. Where hands come into contact with surfaces, natural materials are used. Attention and care to every item specified by all the team members ensured that nothing polluting or contaminating was used. A healthy building is the result.

On entering the main entrance from the Bijmeerplein the sense of sparkling light and space is immediate. Reflected light cascades down shaped and angled towers, acting both as giant light wells and natural ventilating smoke stacks.

Apart from temperature, the oxygen content and humidity are the main factors affecting the internal climate. There is no factory-made humidification plant, apart from the computer room systems, neither is there separate heating for the internal street. Warmth is provided by partial exhaust from office and other spaces.

Plants are used as natural and vital regulators of the internal environment. Any added moisture to the space comes from the shell-filtered, rain-watered plants and other water-borne elements. Plant selection was carefully controlled by Jorn Copijn, who was an early member of the design team.

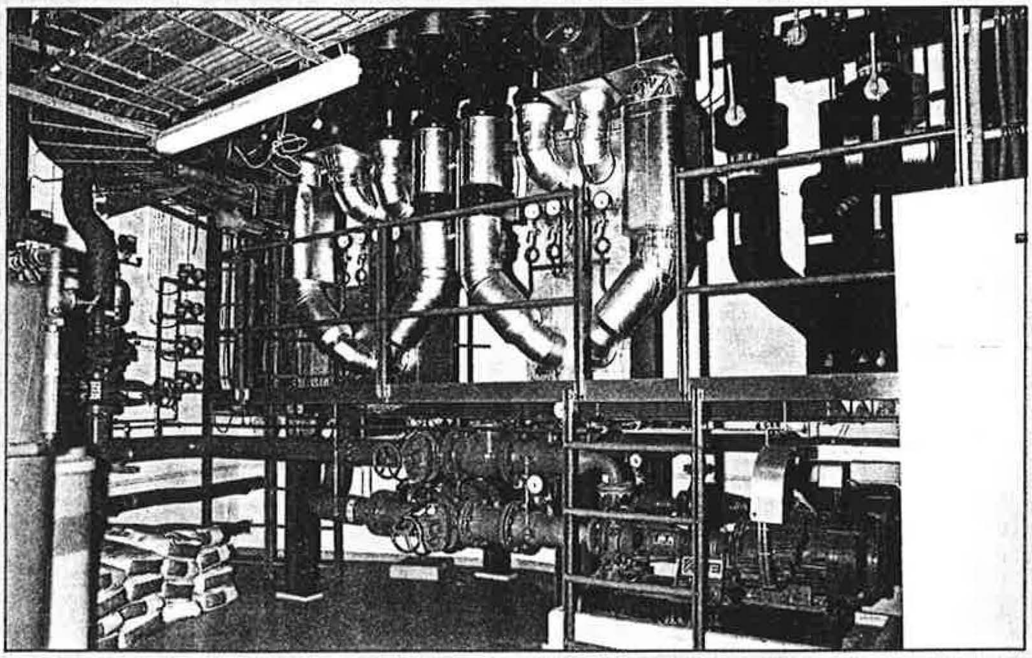
Diffuse, almost eastern style light fittings were designed by Theo Crosby, whose London-based Pentagram group controlled the design of much of the internal furnishings.

The building structure is constructed with an infiltration rate of 0·1 litres/s, and the structural facade is a thermal sandwich of 180 mm brick, 30 mm air space, 100 mm insulation, and 180 mm internal concrete facing. A lot of concrete with an exceptional smooth finish is used.

A good characteristic of concrete is that it has a stabilised temperature for a long time. In the hot summers, the night temperature drops to ±17°C. Cool air streams are allowed to flush through the building at night, cooling off the concrete. Should the building get too hot during the day, air is cooled through the ventilation system, using the dissipated energy from the generation of electrical power.

The standby gas boiler is used only for emergencies and exceptional cold weather. The two gas turbine/generators that provide combined electricity and hot water generation of 1220 kW/h capacity, also have standby power from the national grid.

Primary circuits connect to both radiator heating systems and also to the separate ventilation plants. Absorption cooling is used for the air conditioning of the computer rooms, (Figure 1). The



Left: The main energy centre.

total energy system is computer controlled by a Sauter EY2400 bms system. Nothing is left out. Every climatic zone is controlled including the varying electrical loads and the CO_2 emissions and other pollutants from car exhausts in the underground garages. The high vaulted roofs of the entrance hall, internal street and tower shafts require both sprinkler and fire control systems.

Although the energy centre expresses sophistication, there is a straight forward, well engineered plant room. For the building services engineer, the gem of learning is found in the design of the office workplaces. Here, with the imaginative use of solar energy, the engineering physicists Treffers and Partners have produced a well tempered environment without the need for complicated controls. The large office spaces are simply ventilated. No control boxes of any kind. No worrying about incremental zoning. The whole space is gently ventilated via a linear ceiling slot, with slide control through a series of holes in a circular cork insert. It is a commissioning engineers dream.

The external office window was finally a joint design of Treffers and Alberts, whereby a top window section has fixed deflecting louvres that reflect the light onto the profiled ceiling surface. The double-glazed, opening window has internal blinds with local adjustment and external motorised blinds that operate when the external temperature is above 16°C. They are also interlinked with the radiator situated under the window. This arrangement gives 500 lux of natural light.

Specially designed light fittings give both ceiling reflected and downwards light, with electric lights close to the windows programmed to cut out when natural daylighting is sufficient.

Task lights for the work-stations are seldom used, one of the reasons being that the designs of the independent furniture suppliers lacked the same degree of human understanding as the team of builders.

As part of tuning a building system, I have often asked the new occupants the question "How do you like the conditions you are working in?" From experience the occupants will usually suggest that it could be a little warmer. In most cluster offices there were no complaints, but the occupants of one cluster complained of being too cold. It is interesting to note that, although internal temperatures and occupancy rates are uniform throughout the building, the cluster with the complainants had pale blue walls, whereas the others were painted pale pink.

During the early days of conceptual design, Treffers and Partners desired to construct a passive solar greenhouse tube stretching up the whole elevation and across the roof to a heat collector. A flight of fantasy perhaps, but one that may have saved even more energy.

I doubt if such an imaginative and energy efficient building would have resulted had not the clients been fully aware of the necessity to move away from established thinking. No restrictions were put upon the planning team with fee cutting. The Bank's own project manager was the Bank's ears and eyes.

Building contractors and installers tendered in the time honoured style, but then they themselves were party to the same humanistic interaction. No idea was ignored. It is a lesson that should be learned by clients, builders, and designers alike, in the current British craze for throwing writs about, and seeking to prove that cheaper would have been better.

NMB should be congratulated for illustrating a new way of living and being able to work in a free-flowing environment. People are coming far and wide to admire this example of architectural bravura.

Client
NMB Bank, Amsterdam
Property development/management
NMB/MBO, N V Amsterdam
Architect
A Alberts, Amsterdam
Construction engineers
Aronsohn B V Rotterdam
Building services engineers
Advisers Treffers & Partners, Baarn
Landscape consultants
Copijn B V Utrecht
Acoustic consultants
Peutz, The Hague
Interior designers
Billing Peters Ruff, Stuttgart;
Theo Crosby, Pentagram, London
Mechanical contractors
ULC Group Utrecht
Electrical contractors
GTI Haarlem
Main contractor
Voormolen-Heijmans-IBC, Amsterdam

Site
Total area: 43 500 m²
Built-on area: 29 000 m²
Gross floor space and car park: 78 000 m²
Gross office space: 50 000 m²
Occupants ± 2500
Number of lifts: 21
Number of towers: 10
Number of restaurants: 4 + 1 snack bar.
Total length of indoor street: 350 m

Suppliers
Electronics/controls: Geveke/Sauter
Boilers: Standard Fasel
Cooling machines: York
Air handling equipment: Holland Heating bv
Air distribution: Bodair bv
Radiators: Zehnder
Pumps, valves: Wollard & Wessels

Dates
First pile driven: April 1983
Commencement of building work: August 1983
Completion: April 1987

Design criteria
Winter: −10/+20°C with provision for 3°C swing.
Summer: +28/+24°C
Heating capacity: 3400 kW
Cooling capacity: 2400 kW
Energy demand: 111 kWh/m²/year

Costs

Land:	£7 million*
Total services costs:	£24 million
M&E:	£303/m².
Total cost £75·75 million (£909/m²)	

*approx £100/m² gross floor area