

## TOKYO GAS EARTH PORT, TOKYO, JAPAN

|                       |   |                            |      |                          |                                     |
|-----------------------|---|----------------------------|------|--------------------------|-------------------------------------|
| <b>Building name:</b> | Tokyo Gas Earth Port  | <b>Year of completion:</b> | 1996 | <b>Type of building:</b> | Office/ showroom/<br>cooking school |
| <b>Design Team:</b>   | Architect / Structural Design / HVAC Design / Electrical Design / Environmental |                            |      |                          |                                     |



### Site data

| Design conditions winter |      | Design conditions summer |      | Average wind speed (m/s) | Prevailing wind direction | Terrain shielding | Dust pollution | Noise pollution | Latitude | Longitude | Altitude (m) |
|--------------------------|------|--------------------------|------|--------------------------|---------------------------|-------------------|----------------|-----------------|----------|-----------|--------------|
| T                        | g/kg | T                        | g/kg |                          |                           |                   |                |                 |          |           |              |
| -0.7                     | 1.3  | 33.4                     | 17.5 | 3.7                      | N                         | flat              | moderate       | moderate        | 35.33    | 139.35    | 41           |

### *Design philosophy for IAQ and Thermal Comfort and issues of concern for this building*

With the natural ventilation system, the automatically controlled ventilation windows are open when the outdoor air is thermally comfortable enough. Because of the large air volume of fresh outdoor air obtained by natural ventilation, IAQ is improved.

With the mechanical air-conditioning system (when natural ventilation is not functioning because the outdoor air is not comfortable enough), the supplied air flow rate is controlled by a VAV system, and the mixed air volume of fresh outdoor air is automatically controlled based on indoor CO<sub>2</sub> concentration for energy savings and IAQ.

## *Principle of hybrid ventilation*

In the design process of this building, testing methods like thermal dynamic simulations of natural ventilation were carried out to test the efficiency of the various components used in the principle of hybrid ventilation system design of the building.

The various measures taken to improve the quality of indoor and outdoor environment include the automatically controlled natural ventilation windows, atrium “ecological core”, and ventilation tower, taking advantage of the optimum outdoor air quality and conditions at any time, to cut energy consumption costs of the building. Post-occupancy evaluations were carried out at various stages to analyse the energy consumption trends of the building, regular maintenance meetings are being held between residents, the maintenance body and architects to reflect on the operation, fault-detecting devices were installed and counter-measures implemented where necessary.

## *Components used to solve main issues or problems*

**IAQ control:** CO<sub>2</sub> sensors to control the air volume of mixed outdoor fresh air

**Temperature control:** Temperature sensors positioned in a room or zone area.

**Energy conservation:** BEMS.

**Control of airflow rate:** VAV system controlled by BEMS (mechanical air-conditioning system). Windows are automatically controlled, and airflow rate by natural ventilation is controlled by the rate of openings of the windows (natural ventilation system).

**Fire regulations:** Smoke sensor. The natural ventilation windows are opened automatically at the fire to exhaust the smoke.

**Maintenance:** Periodical inspection and supervision by BEMS

## *Control Strategies*

Introduction of the Ecological core and ventilation tower using the concept of natural ventilation. Automatic outdoor air intake control system based on CO<sub>2</sub> sensor. Building environment and energy management system.

### *Particular control strategy issues*

The general architecture of the control system is centralised supervisory control.

Occupant interface is via an operation switching panel in each room. Operations by the occupants are learned by the BEMS.

The type of management is internal.

## *Overall performance*

The use of a natural ventilation system utilising design features like the “Ventilation Tower” and the atrium “Ecology Core”, reduced the energy required for ventilation and cooling/heating considerably. The overall performance of the building, based on the hybrid ventilation system on top of the optimisation of the building shape to obtain the advantage of the solar geometry, managed to achieve the following savings in energy consumption :

Coefficient of Energy consumption for air conditioning : 77% of Japanese Codes

Coefficient of Energy consumption for ventilation : 77% of Japanese Codes