Feature

Introduction of Sanyo Denki Technology Center

Tatsuo Kuwabara Susumu Yamamoto Shin Shimamura
Akio Sawaji Kenichi Yamaguchi

1. Introduction

SANYO DENKI has completed construction of the Sanyo Denki Technology Center in the Ueda Research Park at Shimonogo, Ueda city in order to amalgamate the design and development departments of SANYO DENKI, and create an environment that encourages creative thinking among these departments. For this construction project, the Research Park Design Project Committee was formed, including general managers of design and development departments, and the Ueda Research Park Construction Master Plan as shown at the top of this technical report was drawn up.
NTT Power And Buillding Facilities Inc. was asked to take charge of design and construction management (central management and coordination of all construction activities) of the Technology Center.
In this report, we introduce various unique research projects and related facilities of the master plan and concept of SANYO DENKI Technology Center.

2. Outline of Construction Site and Building

2.1 Ueda Research Park

The Ueda Research Park is located south of Ueda city, Nagano prefecture in the Green Techno Park system, which is set among a rich natural environment, historic relics and various parks. The Ueda Research Park is the core of research and development activities of the Asama Technopolis where academic research and information technology is being developed for the 21st century.[(1)]
Near to the Center, various public technical training institutes run by Ueda City such as the Multimedia Information Center, Ueda City Technical Training Center, and other academic facilities such as the Nagano Prefecture Engineering College have been established.
R&D enterprises are being invited to purchase land and set up here. In addition to SANYO DENKI, various software developers, related companies, and firms in Ueda City have set themselves up and established design and development departments.

2.2 Site and Layout Plan

The Ueda Research Park was built by filling and backfilling a hill in the east, so the Park slope faces west.
The total site area of 4,500 m^2 is divided by a slope 12 m high into two flat areas of about 21,000 m^2 each.
The main features of the layout are as follows:
1. Parking lot for at least 400 cars, and facilities for commuting by car in winter
2. Co-existence with the neighboring Ancient Hill (historic relics) Park
3. Countermeasures for afternoon sunlight and securing maximum panoramic view
4. Finishing of the slope and outside appearance of building
5. Use of the land in view of future plans

The main difficulties were the layout of the roads from outside of the site into the Center, how to dispose of the large volume of surplus soil including slope, countermea-sures for the afternoon sunlight and securing the maximum panoramic view. All of these were investigated before finaliz-ing the layout of the building. The final plan is to place the main building on top of the site (Fig. 1).

Outline of building

Name of building	SANYO DENKI Technology Center
City planning required	Not required, not specified as fire requirement prevention area
Site area	44,926.94 m^2
Building area	4,376.01 m^2(including annex buildings 43.52 m^2)
Total floor area	13,311.24m^2(including annex buildings 43.52 m^2)
B1	265.52 m^2
F1	4,280.35 m^2
F2	3,646.26 m^2
F3	3,603.22 m^2
F4	1,438.95 m^2
Main span	7.2 m×12.8 m
Maximum height of building	19.750 m
Structure and size	RC-1+4 (partially steel frame structure)
Foundation	All-casing method
Construction period	April 23, 1996 to June 30, 1997 (Building)
	August 2, 1996 to June 30, 1997 (Equipment)

2.3 Outline of Building

The Technology Center building stretches (140 m) from east to west, connecting the two sites that are divided by a slope. The colonnade-shaped wall of exposed architectural concrete and the wooden sashes from the second floor to the fourth floor blend in well with the pine tree woods, displaying the beauty of natural materials.

The west side of the building is a full glass wall having a dynamic structure like a sky-scraper. The north side of the building has the minimum opening in order to maximize the insulation.

The approach connecting the entrance to the 12 m high lobby creates a unique outside appearance of the Center. The Technology Center is divided into zones. The research zone, welfare zone and public zone are clearly situated in the cross-sectional direction. Zones are connected with each other through different spaces (such as an atrium, refreshment corner and so on) in between the lateral space that provides a soft atmosphere.[2] (Fig. 2) The central staircase connecting the floors offers a sense of openness through the use of heat-resistant fire-retarding glass. The layout of each floor is shown in the floor plan (Fig. 3).

The high roof is one of the features that improves the habitability of this building. The floor-to-floor height of the first floor is 5.1 m, to accommodate a crane that will be installed in the large experiment room. A ceiling height of 3.5 m is achieved in the second and third floors by exposing the beams. The heaviness of ceilings is thus removed to create comfortable, bright office spaces that are conducive to work.

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3. Equipment Introduction

3.1 Energy Equipment

Energy for the Center was selected based on corporate philosophy, environmental location and modern needs as follows:

1. Maximum advanced use of clean energy
2. Introduction of equipment suited for research and development environment
3. Extra safety, efficiency and maintainability
4. Energy conservation

3.1.1 Photovoltaic Power Generation System

Polycrytal silicon solar cells covering about 200 m^2 are installed on the roof of the Center. The DC power generated by the solar cells is converted to AC power by Sanyo Denki's interactive inverter "SANSOLAR" that is linked to the commercial power supply. The photovoltaic power generation system can supply 20 kW depending on the amount of sunlight.(Fig. 4)

The photovoltaic power system generates electricity without consuming fossil fuel, and it helps reduce air pollution and global warming. The reduction of CO_2 per year is about 15 tons, or the equivalent of about 5500 liters of oil.The photovoltaic power system will also produce actual operating data that will assist system design in the future and for other research and development. This system can also be used to test and verify our new products.

3.1.2 Gas Engine Co-Generation System

We have introduced a gas co-generation system in the Center in order to suppress peak electric power and reduce the energy consumption of the air conditioning equipment. (Fig. 5)

This is the first case of using the co-generation system in a building like the Center, which is why it took a long time to decide to use the system for the Center. The main items investigated when introducing the co-generation system were as follows:

1. Simulation of heat usage (Targets of heat usage and exhaust heat utilization factor)
2. Comparison of various engines in terms of performance, cleanliness, and maintainability
3. Installation location and effect of noise and vibration on the outside
4. Investigation of systems (heat re-cycling system, linkage system, etc.)
5. Selection of fuel, amount of gas consumption and frequency of propane gas re-fueling
6. Cost and depreciation
7. Related laws, requirement of qualification and consultation with electric power

company

We selected propane gas (LPG) as the main source of energy because it is a clean energy that allows a gas engine to be used that has clean exhaust gas and low maintenance cost. The energy efficiency ratio is as high as up to 82% (Fig. 6). The equipment specifications of the co-generation system are shown below.

Engine : Lean-burn system gas engine
Power generating output : 263 kW
Output voltage : 210 V,
Linkage classification : Commercial power high voltage
utility interactive system
Use of heat : Heat is used throughout the year as a warm water source for air conditioning during winter, as a heating source of the absorption-type cold/warm water generator, and as a heat source of LPG evaporation.
Related equipment : 2.9-ton LPG bulk tank, 2 systems (using vaporizer, electric type and warm water type)

This co-generation system supplies about 30% of total power demand, about 20% of cooling energy, and about 70% of heating energy of the Center. When the commercial power supply is stopped, the Center is separated from the commercial power supply system and the main power is kept supplied to the specified loads from our power generating system.

3.2 Variable Frequency Power Supply System for Test Laboratories (300 kVA)
This is a large-capacity static type power supply system, which is one of Sanyo Denki's products. The output frequency can be varied (45 Hz to 60 Hz). This system is installed in the electric room and supplies power to the assembly and inspection room and the anechoic room and electromagnetically shielded room on the first floor.
This system is also used to test products with an input power frequency of 50 Hz, and to test input power frequency deviation characteristics.

3.3 Air Conditioning Equipment
Warm water supplied from the co-generation system is used as the heat source. An LPG-burning absorption-type cold/warm water generator is used for air conditioning without any CFC (freon) and or adverse effect on the ozone layer.
The two generators are installed to maximize the capacity control when the air conditioning system is partially loaded, and so as not to stop the air conditioning system in case either generator fails or is inspected.
When individual air conditioning is required, separate gas heat pump packages are installed.

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4. A Review of the Spaces - Ⅰ (Public Zone)

4.1 Entrance Hall and Lobby
The west side of the building is as high as about 32 m above ground. Two thick pillars standing more than 10 m high are located on both sides of the entrance, supporting the lobby on the first floor. The outside entrance to the building is from the west side.
The entrance hall that appears to be embedded into the slope has a spacious floor

Porch

constructed by exposed architectural concrete wall and wooden panel. Guests and company staff enter the Center from this entrance that has no reception, thus giving a natural feeling. Two elevators connect the entrance to the lobby that is 12 m above the entrance. When the elevator door opens, a panoramic view unfolds toward the company reception desk.
The lobby is surrounded by glass. The guest reception area has four reception booths separated by low partitions and an open table space laid out so as not to interrupt the scenery.
Looking toward the foyer that is connected directly to the lobby, one sees a part of the atrium. Visitors can enter the lobby. Entrance to the foyer is via a card-type locking door.

Entrance hall

Lobby

4.2 Conference Room

The large conference room on the first floor is about 370 m 2 and is the largest single room in our company, sufficient for about 400 staff to gather. The large conference room can be divided into four small areas by movable partitions so that the conference room can be used for two or more purposes at the same time. For example, on-site inspection using carried-in equipment and demonstrations are possible, as three-phase 200V power is also supplied. The large conference room has a foyer of 130 m 2 and atrium at the front.
Each of the meeting rooms on the second floor can hold 16 people and is designed for focused discussion yet in a relaxed atmosphere. The rooms are used for technical investigation meetings and managersmeetings, and come equipped with a video broadcast system (large conference room only), OHP screen, TV receivers/video monitors, electronic white board (copy board) and network terminals.

Large Conference Room

Meeting Room

4.3 Reception Room
The reception room is located on the top floor of the west side of the building and therefore has an excellent view. Individual air conditioning units are installed and are controlled from the office on the first floor only when the reception room is used.
Approach to the reception room is only possible by an elevator that is controlled by the company staff ID card.

5. A Review of the Spaces - Ⅱ (Research Zone)

5.1 Design Rooms and Experiment Rooms
The research zone occupies the 2nd and 3rd floors of the Center. The south part of these two floors is home to the design rooms and the north part is for the experiment rooms. Staircases and refreshment corners are in the center of these floors. The air conditioning equipment, electric machinery rooms and atriums are located between the design room and experiment room. This layout satisfies the follow requests of our employees:
1. The design room and experiment room should be located as close as possible.
2. Sound from the experiment room should not penetrate into the design room.
3. The design room should be a place to think.
The light well is a buffer that connects the experiment room to the design room that is an independent space, and also provides natural lighting and air circulation.

5.1.1 Design Rooms
The design room is designed with the following features:

Design room

1. Wide wooden sash doors and a high ceiling of 3.5 m assure a spacious area. Natural illumination from outside including the atrium and fluorescent lamps with louvers for the ceiling lights provide sufficient illumination.
2. The hollow elevated floor of the design room can be used to house various cables and wirings under the floor, and facilitates changes of the layout or addition of cables.
3. The four-tube air conditioning coupled with the air conditioning system supplying air from the floor provides uniform air conditioning throughout the entire room and smooth switching in the intermediate seasons between heating and cooling. Double-glazed windows facing the outside improve the heat insulation.
4. In the office space, large desks of 1600 mm (w) × 800 mm(d) are laid out facing each other. The desks are partitioned by desk panels to allow design engineers to concentrate.
A 20-inch CRT screen is placed on each desk along with a mouse ceiling place to improve the workability.
5. Several small meeting areas are located outside the design rooms so as not to hinder the design engineerswork.

5.1.2 Experiment Rooms
Experiment rooms are located next to the design rooms on each floor and a large experiment room is located on the first floor.
The experiment rooms feature the following:

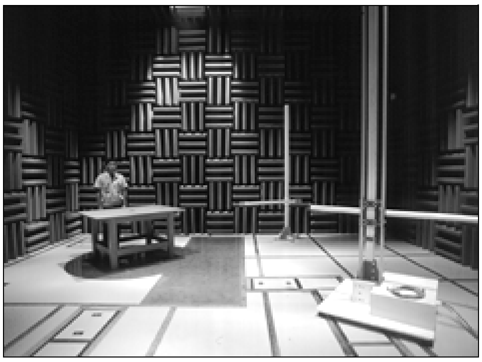
Experiment room

1. The electric power for experiments is routed by movable fact lines so that three-phase 200 V and single-phase 100 V can be supplied to any location easily. The fact lines enable experiment equipment and the layout to be moved or changed easily.
2. Wirings for equipment other than power are made using racks of 2.5 m or higher above the floor.
3. Two 2.8-ton cranes are installed in the large experiment room running east-west on the first floor, for carrying in and out, and moving heavy machinery.
4. For special experiments and evaluation tests, there are also the vibration test room, high-speed operation test room and environmental test room.

Large experiment room

5.2 Anechoic Room and Electromagnetically Shielded Room

Anechoic room and electromagnetically shielded room



The anechoic room and electromagnetically shielded room serves the dual purposes of an electromagnetically-shielded room and an anechoic room. The electromagnetically-shielded room is used for EMC measurement (note 1) such as interference radiowave measurement for radiative products, and for terminal noise voltage measurement. We have been using external facilities thus far, but this has caused problems of high costs and time. In addition, EMC product regulations are becoming stricter (i.e., CE marking system, EMC Directives, and the JIS version of the EMC Directives), forcing us to install our own facility. We have also long needed a large, semi-anechoic chamber that has a low background noise.
Because an anechoic room and electromagnetically shielded room have different functions, separate installation was initially investigated. However, since their structures have many similarities, we decided on a dual-purpose room; either acoustic absorption materials or radiowave absorption materials are installed in a gigantic chamber for the respective purposes. A normal reflective floor is placed in this chamber for use as a semi-anechoic chamber. And by fitting an absorption floor, the chamber can be used as a full electromagnetically-shielded room or a full anechoic room.
There are two types of electromagnetically-shielded room: One satisfies the 3-meter measurement specification and the other the 10-meter measurement specification. (The difference is in the distance between the test piece and receiving antenna.) Because the chamber can serve as an anechoic room, the entire chamber must be sound-isolated which involves tremendous cost. Following an investigation of the cost and construction, we therefore decided to construct a chamber satisfying the 3-meter measurement specification, even though a 10-meter specification room would have been preferred. The cost savings will be allocated to other equipment.

The main additional equipment of the acoustic and anechoic chamber is a turntable having the withstand load of 2 tons for a diameter of 2 m; most turntables used in acoustic and anechoic chambers are 0.5-ton class. Also, various large-capacity power supplies are installed for test pieces satisfying the requirements of 10-meter class chambers.
1. Three-phase delta connection 0 to 240 V variable/200 A
2. Three-phase star connection 0 to 480 V variable/100 A
3. Single-phase 0 to 240 V variable/100 A
4. DC 0 to 140 V variable/10 A
(Items 1 and 2 are exclusively used.)
As a result, we can now perform EMC tests for most of our products ourselves. Fig. 7 shows an outline of the EMC measuring equipment permanently installed in the anechoic room and electromagnetically shielded room.
We now have a very large anechoic chamber (semi-anechoic chamber) having a background noise of as low as 15 dBA, enabling us to perform noise measurement of large products that was difficult to do in the past.

Note 1: Abbreviation of Electromagnetic Compatibility. EMC is the product evaluation method from the two viewpoints that a product must not generates interface radiowave to its surrounding as much as possible and that a product must have immunity to external interference radiowave to some extent.

5.3 Machining Room

The machining room of this center is equipped with all the necessary equipment and machinery required to manufacture prototypes, samples and jigs for experiments.
The precision machinery room that is located in a corner of the machining room is a constant temperature room that maintains the target temperature within �}2°C for the high precision measuring equipment and precision machinery. The precision machining room is electromagnetically shielded to contain the EM waves that are radiated by the N.C. wire cutter within the room.
The machining room greatly assists product development, from design work in the technical center to production at the factory.

5.4 Library

Library

A library in the technical center provides a useful reference source for research and design engineers.
The basis of engineer development is through self-study and OJT (on-the-job training), and systematic training through Off-JT (off-the-job training). Off-JT, such as attending seminars and group training, supplements the OJT. In addition to these forms of training, engineers are encouraged to take correspondence courses. The library provides a true environment for learning where all the reports and documents needed are available.
The library is carefully organized in line with the three principles of training engineers, corporate philosophy and human resources development of the company.
In addition to the existing books from design departments, about 4,500 books have newly been purchased from the catalog of all books in Japan and the book catalogs of major science and engineering publishers.
Books in the library can be freely accessed for greater convenience as the shelves are open, based on a spirit of trust. A new book control system has been introduced which enables books to be retrieved from the name or author of the book. The lending and return of books are controlled by book numbers (barcodes) and

company staff ID numbers.
The library also has a unique book copying machine which enables books to be copied without damage. A patent retrieval PATOLIS terminal is also installed. The library dimensions are as follows:

- Size of library: About 145 m^2
- Max book capacity: About 11,000
- Numbers of readersseats: 10

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6. Introduction of Spaces Ⅲ (Welfare Zone and Other Zones)

6.1 Cafeteria and Roof Garden

The staff cafeteria is located on the top floor, the fourth floor, with a 180-degree panoramic view. There's also a roof garden with a lawn surrounding the cafeteria.
The architectural design of the cafeteria provides a spacious, quiet area for staff to relax. The pillars feature exposed concrete with built-in wooden sashes and panels, reflecting the theme of the center. The floor is two-tone colors, with continuous curves blending in with the lawn slope of the roof garden. And the high ceiling creates a spacious feeling.
The wooden chairs in the cafeteria are easy to clean and fit in with the theme that runs throughout the center. Half of all the tables are square, allowing free layout of chairs. Since the size of the cafeteria has been limited for eating in two shifts by staff, and the number of seats and space between them have not enough, staff were not satisfied.

Cafeteria

Roof garden

Therefore, the cafeteria does not operate on two shifts, but rather is open continuously since most staff in the center work on flex-time.
The number of seats is calculated as follows:
Total number of people using the cafeteria (planned) : 380
Assumed actual usage (business trips and absenteeism) : 85%
Shift turnover : 1.5 rotations
Seat margin : 15%
Required number of seats = (380×0.85÷1.5)÷(1 - 0.15) = 253.3
There are therefore 250 seats, with a space of 1.5 square meters per seat, which is roomy (design index), allowing the free layout of chairs. As a result, free seats can usually be found where desired without much waiting, while enjoying relaxed conversation and the good views.
An automatic water sprinkler system run by solar batteries supplies water to the garden lawn.

6.2 Refreshment Spaces

Design and development engineers today work under extreme pressure on complex

OA equipment requiring deep thinking. Mental and physical fatigue are ever-present.(3)
The refreshment spaces are laid out to ease such fatigue and stress, and thus serve an important role in this advanced center.

6.2.1 Observatory Rooms

The observation rooms are located in the west side of the 2nd and 3rd floors. Staff can take a seat in the high chairs to relax during work hours, and enjoy the hioda-daira plateau and surrounding mountains, as in the reception room. The splendid views of the distant scenery, as well as changing one's physical posture, refresh the mind and body.

6.2.2 Browsing Corners and Refreshment Corner

The refreshment corners located in the center of the 2nd and 3rd floors are divided into the following three groups. These spaces provide a sense of openness and are interconnected with the design rooms, and engineers can simply drop in for a break.

Browsing corner and refreshment corner

(1) Browsing Corner: Newspapers and magazines provide access to the latest formation.
(2) Refreshment Corner on south side: This space has a large opening with wooden sashes and different views than the observation room, so engineers can pick their preferred view when having a break.
(3) Refreshment Corner on north side: The tables and partitions of this space can be freely arranged to set up meetings and work groups.

6.2.3 Smoking Rooms

Smoking is allowed in the refreshment rooms on the east side on the 2nd and 3rd floors. Smoking is prohibited in most of the center in line with the times, so these rooms are particularly welcomed by smokers.

6.2.4 Exercise Room

The exercise room has a floor area of about 200 m^2 and is used to reduce mental stress, physical and mental fatigue, and to overcome lack of physical exercise. It is designed not only for physical training but also as a place to relax.
The following physical training equipment is available according to fitness level and so as not to be overexercise:

Exercise room

- Ergo-meter (aero bicycle) : 5 units
- Well-road (running machine) : 2 units
- Afford (massage machine) : 2 units
- Body sonic (music and body vibration): 2 units

A supervisor oversees the use of the physical training room during opening hours. Users are requested to measure their blood pressure before starting to use the physical training center.

7. Conclusion

Construction of SANYO DENKI Technology Center started in October 1994 and took three years, which is a rather long time in this rapidly changing world. Much time was spent in designing the basic concept of how the research and design departments should be. The purpose of the project was not to construct a building, but rather to define the purpose of the building, and then create appropriate facilities and equipment to serve that purpose.
Our corporate philosophy is to develop the following:

- Technologies to protect the earth's environment
- Technologies to protect the health and safety of humans
- Technologies to use new energies and to conserve energy

The future of SANYO DENKI in the 21st century starts here, at this technical center. We would like to express our sincere appreciation to all people both inside and outside the company who worked hard to help design and complete the building.

References
(1) Nagano Prefecture: "Prefectural Research Park"pamphlet
(2) NTT Power And Buillding Facilities Inc.: Sanyo Denki Ueda Research Center (draft name) Basic Design Document(December 1995)
(3) Fuji Techno System Inc.: "Office Environment Planning Guide"pp. 307-310 (October 1994)
(4) Sanyo Denki Research Park Design Preparation Committee: "Ueda Research Park Construction Basic Plan (June 1995)

Tatsuo Kuwabara
Joined company in 1975
Production Control Division
Worked on production control after working on outside vendors control, scheduling and planning.

Susumu Yamamoto
Joined company in 1969
Design Control Division
Worked on design control after working on fan motor design and development

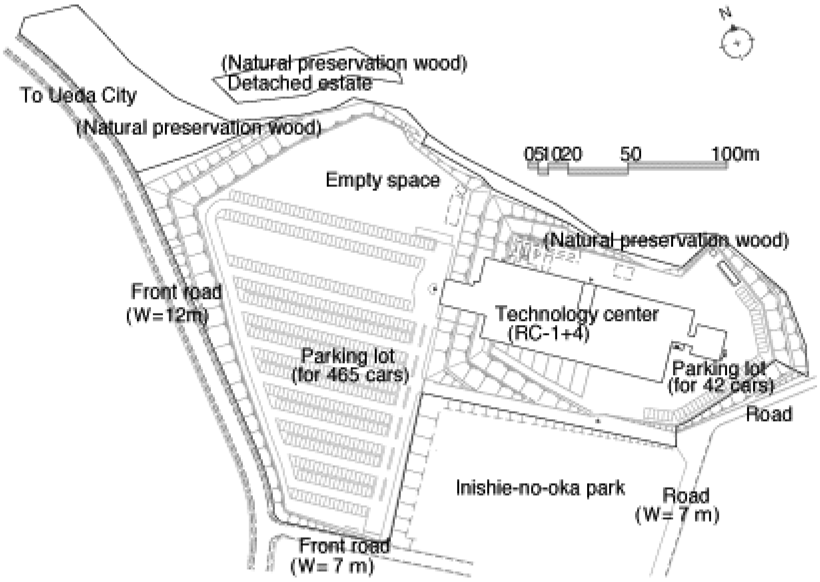
Shin Shimamura
Joined company in 1979
Technical Development Division
Worked on servo systemselement technology development after working on fans development

Akio Sawaji
Joined company in 1991
Power Systems Division, Third Deisgn Dept.
Worked on development and design of photovoltaic power generation system and engine generator system

Kenichi Yamaguchi

Joined company in 1969
General Affairs Dept. Maintenance Sec.
Worked on maintenance work after working on production engineering and design

Fig. 1 Layout



(Natural preservation wood)
Detached estate
To Ueda City
(Natural preservation wood)
05 10 20 50 100m
Empty space
(Natural preservation wood)
Front road
(W=12m)
Technology center
(RC-1+4)
Parking lot
(for 465 cars)
Parking lot
(for 42 cars)
Road
Inishie-no-oka park
Road
(W= 7 m)
Front road
(W= 7 m)

Fig. 2 Conceptual drawing of zoning

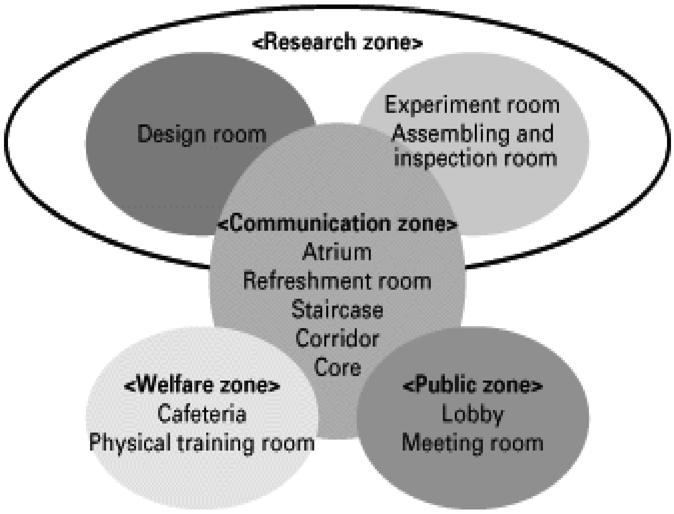


Fig. 3 Floor plan of each floor

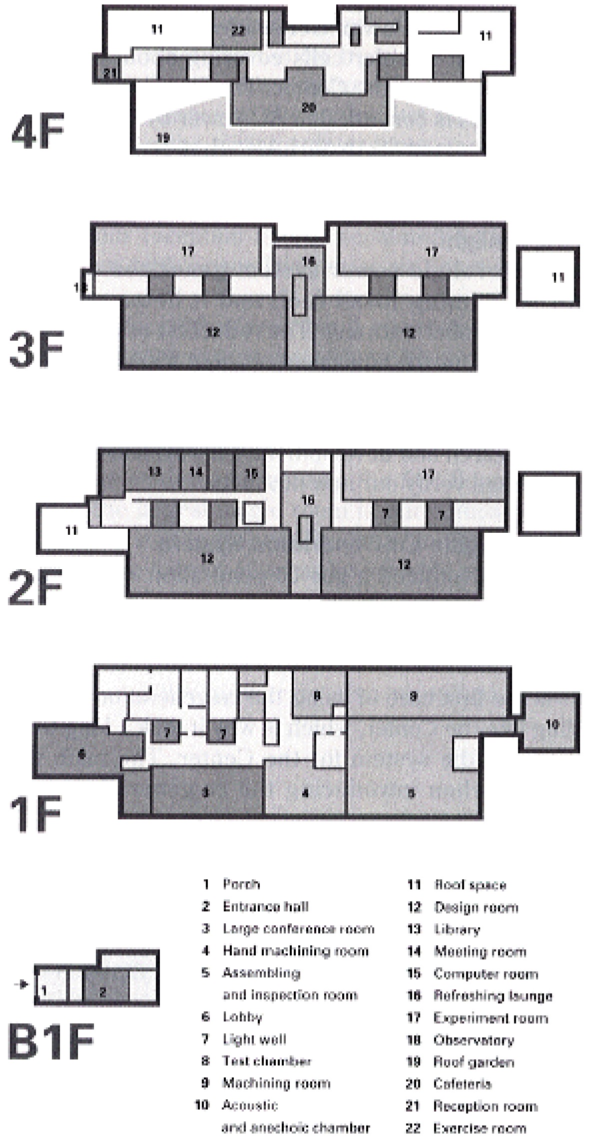


Fig. 4 Trend graph of photovoltaic power generation

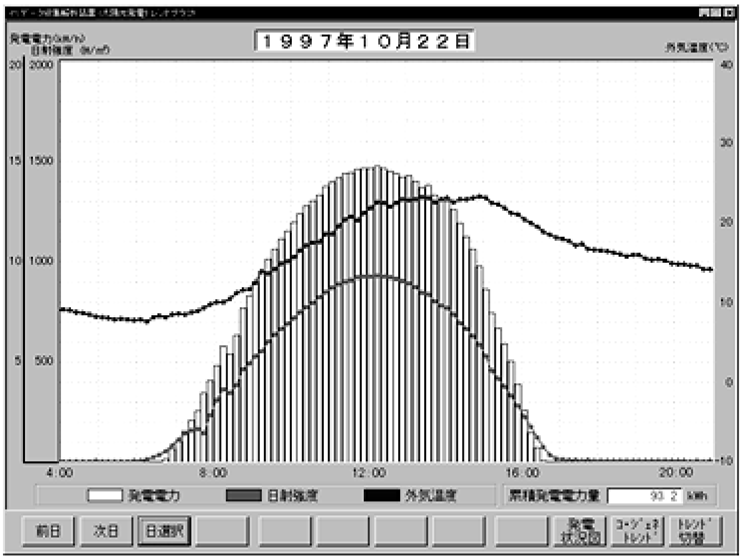


Fig. 5 Co-generation exhaust heat utilization system

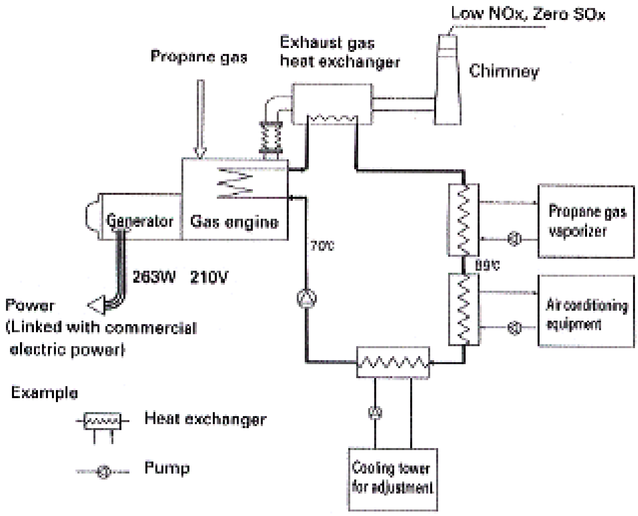


Fig. 6 Energy flow chart

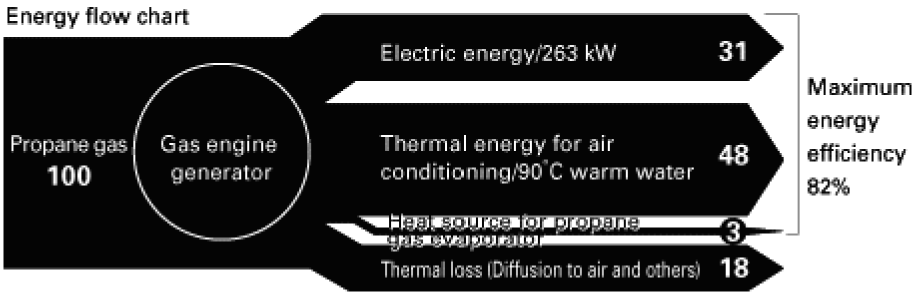


Fig. 7 Configuration of EMC measuring equipment permanently installed in the anechoic room and electromagnetically shielded room