

# Environmental Research Laboratory

## ●Outline

In The Environmental Research Laboratory, research on resource conservation, energy conservation and improvement of health and safety in buildings has been carried out.

Specialized experimental facilities and equipment needed for the experiments related to the architectural environment engineering shown in the following are featured.

Physical phenomena related to heat, moisture and light.

Test and evaluation of building materials, parts and construction.

Study of physiological and psychological influence of indoor environment on occupants and required condition of indoor environment.

Research results are adopted to energy conservation standard of Japan, JIS and ISO as technical proofs. Also, those results are published and spread as a design guideline relating to energy saving house.

Main facilities and devices:

1. Artificial Sky Laboratory: for the research on the effects of daylighting by the windows.
2. Indoor Environment Simulator: for the research on the complexed effects of thermal, aerial, acoustic, and luminary condition.
3. Solar Radiation Simulator: for the measurement of solar heat gain coefficient of windows.
4. Test Chamber for Measurement of Heat Transfer Coefficient: for the performance test of building thermal insulation.
5. Performance Test Facility for Ventilation System: for the study of building ventilation characteristics.
6. Test Chambers for Air Conditioning System; for the study of mechanical and physical characteristics of air conditioning system.

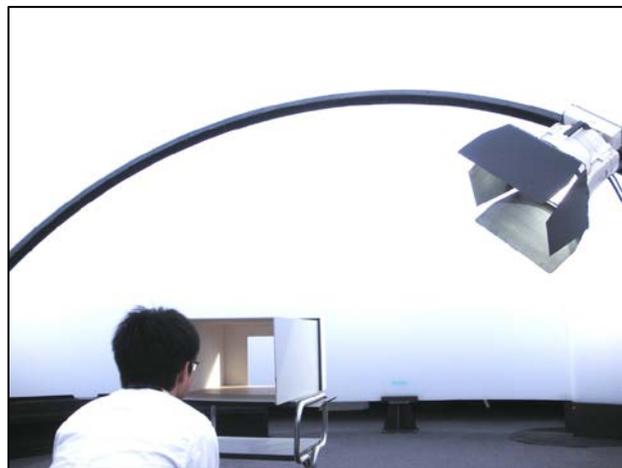
7. Experimental Facility to Verify Indoor Environment: for the comprehensive analysis of the building indoor environment.

### 1. Artificial Sky Laboratory

Daylighting by the windows in indoor environment is the important factor for occupants' visual comfort and lighting energy saving.

Daylight under the actual sky always changes by the weather and the time. Therefore, the experimental laboratory which can reproduce the stable brightness of the sky almost close to the brightness level of the actual sky, is necessary to clarify the relation among visual comfort, energy-saving effect and daylighting technique in the indoor environment.

This Artificial Sky Laboratory is made of semitransparent acrylic hemisphere (7m diameter) dome and many artificial luminaires installed in the back of the dome, and can simulate the various sky conditions artificially on behalf of the actual sky. The brightness level of the sky is optionally changeable by the controller. The subjective experiments using scale models in the properties of various windows and interiors are carried out under the stable artificial sky dome.



Subjective experiment using scale model under the artificial sky

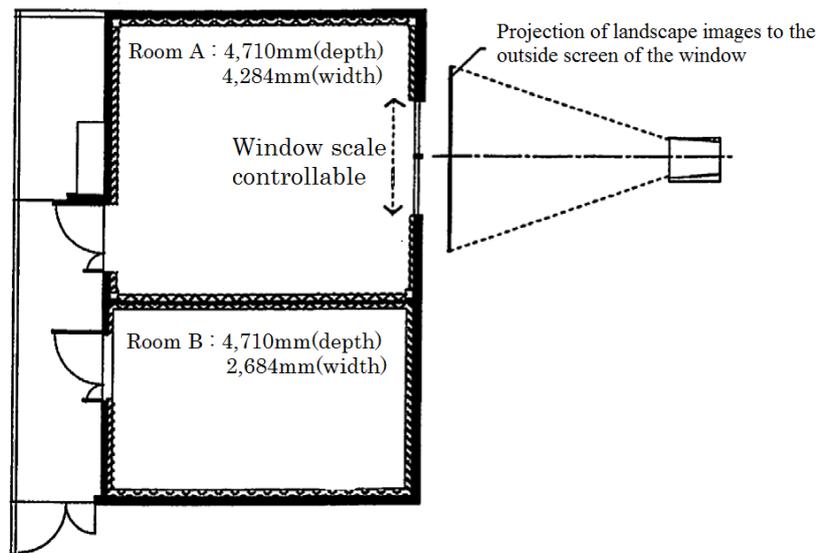
### 2. Indoor Environment Simulator

Indoor environmental factors which influence the occupants' comfort are mainly categorized into "Thermal environment", "Air environment", "Acoustic environment" and "Light and Visual environment".

To study each category in general, the specialized laboratories are

designed for each of them respectively. But this Indoor Environment Simulator is able to control these environmental factors simultaneously for the study on the occupants' comfort by synthetic indoor environment.

This simulator has two rooms, which can control temperature and humidity, artificial light, and sound independently. Moreover, these rooms are able to project the landscape images to the outside screen of the window, and to change the height of the ceiling from the range of 2m to 4m,



Section of Indoor Environment Simulator

### 3. Solar Radiation Simulator

This simulator is a device to measure solar heat gain coefficient of windows including effects of window frames and solar shading devices used by simulated solar radiation by xenon lamps.

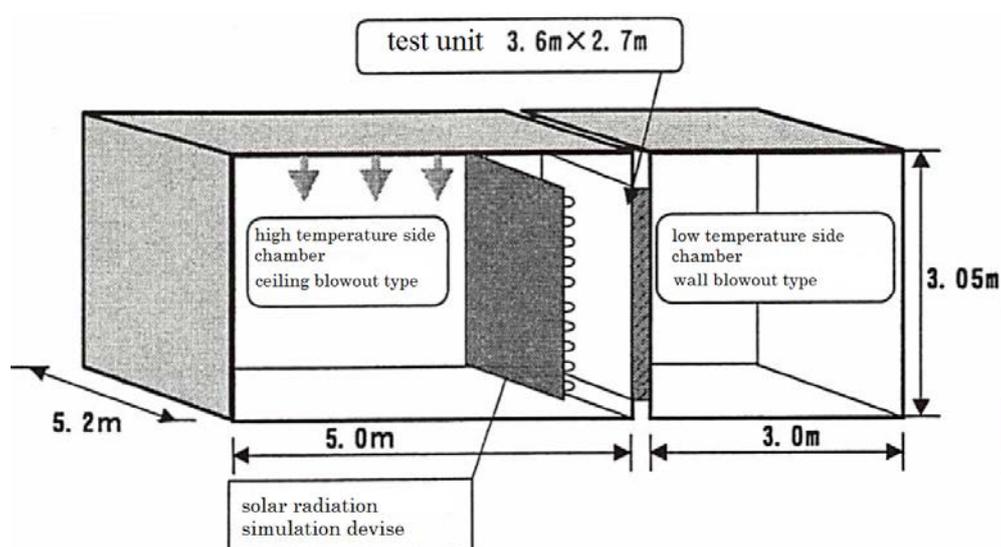
The measurement method for solar heat gain coefficient of windows which was developed by using this simulator was enacted by JIS in April of 2014. Besides, the method is currently being modified for ISO.



#### 4. Test Chamber for Measurement of Heat Transfer Coefficient

This test chamber consists of two chambers that can be adjusted to different temperatures and humidity. Effects of material combination and construction technique are measured and studied by wall or opening made from actual materials installed between the chambers.

As thermal insulation and airtightness level has been increasing recently, additional devices for experiments of solar radiation and moisture transfer was installed to the chamber in order to study mechanism and preventive measures of concealed condensation.



#### 5. Performance Test Facility for Ventilation System

Experiments of natural ventilation and mechanical ventilation in order to develop practical design method are conducted in this facility.

Two-story experimental house with some types of ventilation system is installed in artificial climate chamber. The ventilation characteristics inside the house can be observed with high



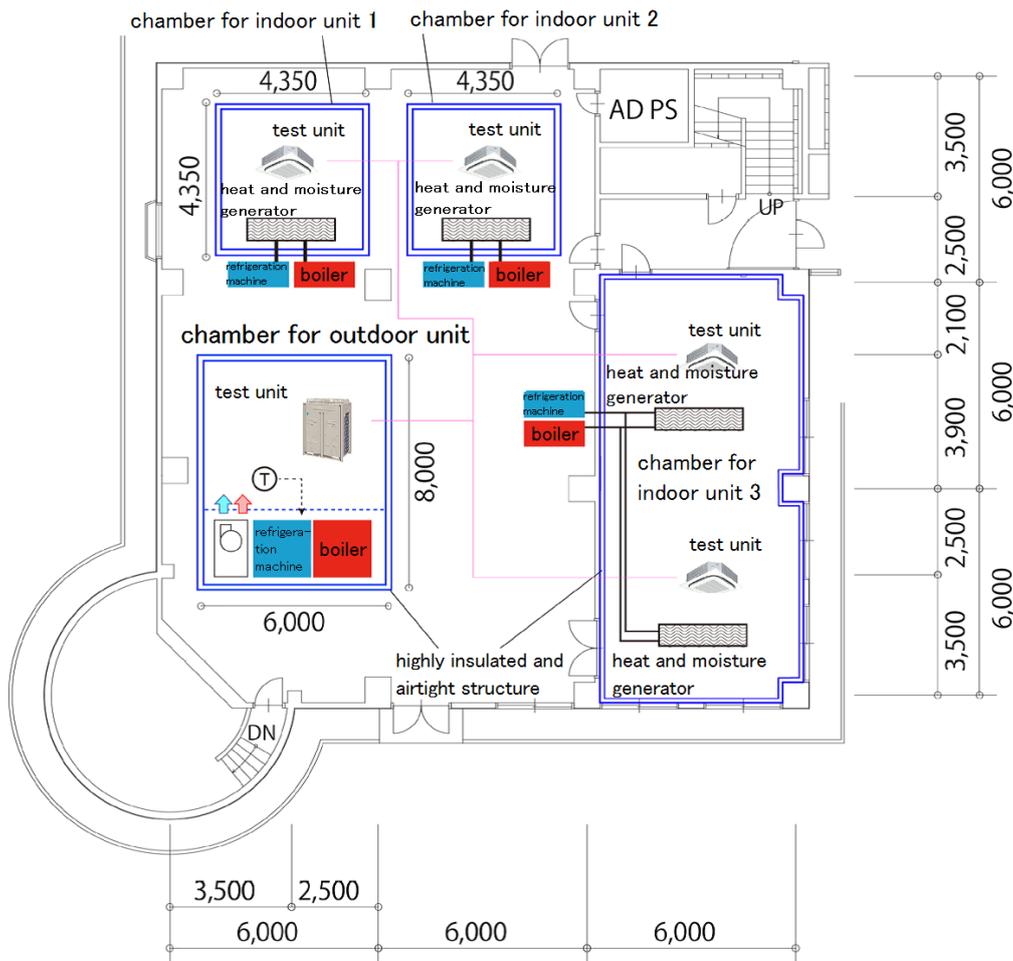
accuracy.

High-performance residential ventilation system considering easy construction and cost performance has been developed based on the research results.

## 6. Test Chambers for Air Conditioning System

Multi air-conditioner for buildings is mostly installed in office buildings. However, there is a lack of sufficient information about practical running performance of the air-conditioner.

This Test Chambers are composed of a chamber for outdoor unit where air temperature and humidity can be controlled arbitrarily, and 3 chambers for indoor unit where heat and moisture emission rate can be controlled respectively. Thus, the system performance can be measured under the actual usage condition.



## 7. Experimental Facility to Verify Indoor Environment

Thermal environment and light environment, which is formed by the impact of items shown below will be analyzed comprehensively in this facility assumed as a business building office.

outer shell: thermal insulation, solar radiation control, etc.

equipments: air conditioning system, lighting system, etc.

occupant behavior: air conditioning system, lighting system, etc.

Energy consumption and spatial distribution of air temperature and humidity, illuminance, etc. can be measured under condition of simulated heat and moisture emission from office appliances and human body according to the preset time schedule.



Floor area: About 72 m<sup>2</sup> (12 m from east to west, 6 m from north to south)

Outer shell: East façade, south façade, and roof

(The west wall and floor is adjacent to the other room. The north wall is adjacent to the corridor.)