YKK80 High Efficiency Building
Radiant control both outside and inside

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Kitaro MIZUIDE, General Manager
M&E Design Department of NIKKEN SEKKEI, Japan
natural breeze under the shade of a tree
Location of Building - Akihabara -

In 2015, completed in Akihabara

YKK 80 BUILDING

Akihabara station
Locating on two distinctive districts

- AKIHABARA
  - New Electric and subcal town,

- KACHIKURA
  - Old down town,

In the EDO Period, 18th century, the household-based handcraft industry had risen up.
Confronting to Akihabara from Kachikura
The Aluminum Fabric Façade in Akihabara
Outline of YKK 80 Building

Concept

• Symbolic design as a global company.
• Functionality, safety and comfort.
• Aluminum screen façade, and radiant panel for workplace has enabled both outside and inside radiant control.

Location       Tokyo Akihabara
Total Floor Area 22,574m² (242,985sf)
Building Height 40m regulated
# of Floor      B2F-10F
Structure       S+SRC, Seismic isolation
Completion      2015 June
Radiant control both **Outside** & **Inside**

**Outside**
- Solar radiation
- Bottom-Up Blind
- View

**Inside**
- Linear diffuser for slight airflow
- Aluminum radiant panel
- LED Lighting fixture

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**Organisers:**
- Construction Industry Council
- HKGBC
- SBE Series

**International Co-owners:**
- CIB
- iiSBE
- UNF
- Sustainable Buildings and Climate Initiative
- Global Alliance for Buildings and Construction
Radiant control both Outside & Inside

Outside / Façade

Solar radiation

View

Bottom-Up Blind
Environmental Façade “sudare”

Image of Japanese “sudare” screen
The Façade controls the radiant from outside

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Outline of Radiant Control Façade System

• Minimizing radiation from window is crucial in radiant systems.
• Aluminum screen, deep eaves and bottom-up blind mitigates solar radiation.
SHGC diagram

- Double glazed window
  SHGC: 0.66 (simulation)

- Sudare screen + Double glazed window
  SHGC: 0.39 (simulation)
  0.35 (actual measurement)

- Sudare screen + Double glazed window + monitored climbing blinds
  SHGC: 0.10 (simulation)
  0.14 (actual measurement)
Radiant control both **Outside** & **Inside**

**Inside**

**Workplace**
Open workplace for high quality office

West Façade is 70m length. We have Large Solar Heat Gain in summer, and in winter we have to think about cold draft in the perimeter zone.

Office area: 1,250m²

- Open refresh space & pantry
- Both side natural daylighting
- Daylight for WC
- Internal stairs for communication
- Aluminum sun screen
Open office space for high quality workplace
Outline of Radiant Cooling & Heating System

• Radiant panels = aluminum ceiling panels equipped with water pipes.
• Tilted panels allowing cool air to descend from the gap between panels. Fans are installed for extra airflow during the hottest season.
• Active chilled beams installed for perimeter zones.
Work place around the window-side

- Chilled beam
- Radiant panel
- Window
- Underfloor return air

connection of Y bar perimeter

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Section diagram about the radiant cooling/heating with soft breeze system

Outside air supply ducts / Desiccant air supply ducts

Linear diffuser for slight airflow

Aluminum radiant panel

LED Lighting fixture
Radiant Cooling/Heating, Desiccant Air & Soft Breeze like ‘natural breeze under the shade of a tree’

- Outside air supply duct (air temperature and humidity regulated by HVAC system with desiccant based dehumidification)
- Fan
- Air supply duct for slight air flow
- Chilled/hot water piping
- Ceiling surface temperature 23°C (73.4°F)
- Supply of dehumidified air from gap between panels
- Inclined radiant panels for light reflection and natural convection
- Slight air flow
- Body surface temperature
  Temp. 32°C (89.6°F)
  MRT. 25°C (77°F)
- Radiant panel removes heat from the body
- Even at a room temperature of 28°C (82.4°F), the radiant cooling and soft breeze can provide the same comfort level as a room at 26°C (78.8°F)
- Return air
- Underfloor return air

Organisers:

International Co-owners:
CFD Analysis Coupled with BIM

- BIM model created for space coordination were used to perform CFD analysis.
- (Upper left) Temperature: cool air (25°C) sinking from gaps between radiant panels.
- (Upper right) Air speed: airflow (0.2m/s) created by fan.
- Uniform temperature + comfortable airflow.
Outline of HVAC System

- Aims to improve system COP through higher/lower chilled/hot water temp for air conditioning.
- Dedicated desiccant AHU to treat outdoor air (latent heat).
Air Temp. and MRT necessary for comfort (PMV=0)

Reference: 2013 ASHRAE Handbook Fundamentals, ch9, fig15
Expansion of comfort zone

- Humidity ratio (%): $\frac{\text{lb H}_2\text{O}}{\text{lb dry air}}$
- Air temperature $\text{ta} (\text{°C})$
- Expansion of comfort areas by 75% of subject

The analytical method per section 5.32

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26°C, 27°C, 28°C
Holistic Solution toward the ecological and healthy building

60% energy reduction - based on Many technologies installed in this building.

- Centralized HVAC heat source equipment
- Sweet potato vegetation for HVAC equipment efficiency improvement by evapotranspiration of leaves
- Emergency generator
- Natural ventilation window for BCP
- Network room
- Central control room
- Seismic-isolation
- Trench cooling & heating: geothermal

Common
- LED lighting
- Lighting and occupancy sensor
- Water-efficient fixtures
- LEED-CS Platinum certified
- Radiant panel + desiccant OA + local fan
- Economizer + OA mist
- Task & ambient lighting
- Smart plug outlet
- Supply and drain water cistern
- Kitchen waste water reclaim system
- Well water: geothermal and water source use
- Radiant panel + desiccant OA + local fan

※Compared to ECCJ energy use intensity of office building (20,000m², privately owned)
Other Technologies

- Dry mist around the street
- Seismic Isolation space for cool/heat trench
- Roof top PV
- Roof top greenery for efficiency of heat source
- Roof top edible garden
One Year Monthly Operating Data of Building Energy Performance

### Baseline
- **ASHRAE**: 153.65 kWh/㎡-yr (48.71 kBtu/ft -yr)
- 1,371 MJ/㎡-yr (120.74 kBtu/ft -yr)

### Proposed (model)
- **Proposed**: 111.40 kWh/㎡-yr (35.31 kBtu/ft -yr)
- 1,034 MJ/㎡-yr (91.06 kBtu/ft -yr)

### Actual
- **Actual**: 103.69 kWh/㎡-yr (32.87 kBtu/ft -yr)
- 932 MJ/㎡-yr (82.08 kBtu/ft -yr)

### Source-Site Ratios in Tokyo Japan
- **Electricity**: 2.711
- **Natural Gas**: 1.005

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**Annual Site Energy Performance**
Source energy of office buildings over 10,000 m² in Tokyo (2009)

YKK80 is rated 4th of 465 buildings (Top 0.9 %)

Frequency Distribution of Source Energy Consumption in Tokyo Area (MJ/m²-yr)

- YKK80 Actual = 932 MJ/m²-yr
Thank you for your attention!