Architectural Initiative to achieve Sustainable Society in Japan

ECTP CONFERENCE 2009
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BRUSSELS

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TAKENAKA CORPORATION
Key Issues for Sustainable Society in Japan

1. Reductions of Greenhouse Gas Emissions

2. Takenaka’s Sustainable Activities
   - Technologies and Works -

   2-1 Concept of “Sustainable Works®”
   2-2 Environmentally - friendly Use
   2-3 Environmentally - friendly Design
   2-4 Environmentally - friendly Construction
   2-5 Ecological System

For the future
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For the future
Paradigm Shift from Mass Consumption Society to Low-Carbon Society

Dissipation of Japan’s advanced low-carbonization technology into the world through its achievements in environmental model cities and other cases.

Source: Pekka Huovila, The 2008 World Sustainable Building Conference

Source: Shuzo Murakami, Building Research Institute
Prime Minister Hatoyama’s Commitment
- U.N. Summit 2009

Political situation of Japanese government

25% reduction of greenhouse gas emissions by 2020 comparing to 1990 level

the U.N. Summit on Climate Change  2009.9.22
Japan’s Energy Consumptions in Private, Industry, and Transportation Sectors

YEAR 1990=1

- Consumption in industries stay at around the same levels.
- Private sector consumption continue to rise.
CO2 Emissions in Japan’s Construction Industry

- World’s 4th CO2-generating country (5%)
- World’s 9th CO2 emission per GDP (0.46 kg CO2/US$)

Japan’s CO2 emission estimate (1990)

Source: Architectural Institute of Japan, Global Environment Committee Life Cycle Assessment Sub-Committee
Overview of Energy Consumption in Japanese General Office Buildings

Survey by The Energy Conservation Center, Japan: Tenant buildings with the rentable ratio of over 60% and equipped with heat source systems.
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For the future
Concept of “Sustainable Works®”

- Environmentally-friendly Use
  - Avoid polluting the earth
  - Careful use of items not easily disposed of

- Environmentally-friendly Design
  - Efficient use of energy

- Environmentally-friendly Construction
  - Comfortable residential environment

- Long-term use of buildings

Together with our customers

Create, maintain and nurture rich landscapes
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For the future
Operating CO₂ Reduction -Technology

Integration of building and mechanical systems

Reduction of loads by exterior wall
Dehumidification through exterior wall
Use of floor slabs
Air conditioning and lighting utilizing building materials
Harnessing of natural energy
Underground thermal storage

Utilization of perimeter environments and natural energy

Double skin
Exterior louvers

Operation evaluation and new energy

Commissioning technology
New energy solution
Biomass energy, lithium ion batteries, etc.

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Energy Commissioning and Improvement

Building Outline

Building Name: Takenaka Corporation Tokyo Main Office
Completion: Sep-2004
Gross Floor Area: 29,747 m²
Typical Floor Area: 4,150 m²
Number of Floors: 7 space
Design/Build: Takenaka Corporation

Transition of Tokyo Main Office Primary Energy Consumption

- Turbo Refrigerator parameter tuning
- Enlargement of natural ventilation and night purge
- Promotion of Cool-biz and Warm-biz (mild cooling and heating)
- Installation of Individual Lighting System
- Experimental Installation of LED Lighting System
Tokyo Tower

Interior and exterior renewal: Highly-durable paint

Coating at construction

7th recoating
6th recoating
5th recoating
4th recoating
3rd recoating
2nd recoating
1st recoating
Restoration of the Main Hall of *Toshodai-ji* Temple

*Toshodaiji* Temple was founded in 759 by Chinese priest Ganjin. About a quarter of a century after that the *Kondo* or Mail Hall was completed.
Restoration History of Toshodai-ji
Main Hall

Original
8th c.

1270
Genroku
Repair
1693-4
Heisei
Repair
1998-2009

Bunei
Damage
1270

Repair
at 17th c.

Knee bracing
Hanegi

Repair
at 19th c.

Knee bracing
removed
Two-fold Hanegi
Roof truss
Steel rod

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Elevated roof

Original
Completion
780?
Why inward drift occurs?

1. Inward Lateral Force A&B resulted by deep overhang of Roof Weight

2. Unable to resist lateral force A&B

3. Column drift and capital block rotation occur
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For the future
Built Environment Assessment Tool in Japan

Comprehensive environmental performance assessment tools for buildings in the world

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CASBEE
Comprehensive Assessment System for Building Environmental Efficiency

BEE = \frac{Q}{L}

where:
- BEE: Building Environmental Efficiency
- Q: Environmental Quality of Building
- L: Impact of Environmental Load of Building on the Outside Area

Graph: CASBEE Distribution Chart

- Categories: S, A, B+, B-, C
- Environmental Load of the Building: low to high
- Environmental Quality of Building: low to high

Evaluate:
- Energy Consumption
- Resource Consumption
- CO2 discharge
- Load to the area
- Load to the outskirts
Labeling CASBEE

Comprehensive Assessment System for Building Environmental Efficiency

CASBEE Distribution Chart

【Labeling for BEE】
S : Excellent
A : Very Good
B+: Good
B- : Fairly poor
C : poor

CASBEE assessment results for Building Contractors Society 2006 design and built projects
(23 companies, 591 projects)
Takenaka Corporation Tokyo Main Office
Main Measurements of Sustainable architecture

- Rooftop gardens
- Light wells
- Ice storage
- Low-emission glass windows
- Natural draft
- Hybrid air conditioning using natural wind
- Low-temperature water thermal storage
- Rooftop solar heat collection ducts
- Utilization of rainwater
Recycling resources

Cyclite: Recycling technology of concrete

Concrete is broken up and reused as aggregate

Corrugated Cardboard Duct

Cardboard
Aluminum sheet
Assemble
Mounting
Installment

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Lighting Design with Circadian Rhythm

- **Morning**
- **Daytime**
- **Evening**

### Graph
- **Color temperature and illuminance**
- **Time**

#### Time Stamps
- **Work Begins**
- **Meeting**
- **Lunch**
- **Work Ends**

#### Locations
- Stair and light wall
- Office room
- Conference room
- Dining hall
- Office room
- Conference room
- Underground floor and passage
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For the future
Reduction of Resources
GIFU CITY TOWER 43

Reduction of South Sea area’s timber form material

- Use of Precast Concrete members
- Approx. 56-% cut in South-Sea area’s timber

Reduction rate in South Sea area’s timber

<table>
<thead>
<tr>
<th>Year</th>
<th>Reduction Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>40</td>
</tr>
<tr>
<td>2004</td>
<td>45</td>
</tr>
<tr>
<td>2005</td>
<td>42</td>
</tr>
<tr>
<td>2006</td>
<td>50</td>
</tr>
<tr>
<td>2007</td>
<td>55</td>
</tr>
<tr>
<td>2008</td>
<td>60</td>
</tr>
</tbody>
</table>
- Total power requirement: 7% reduction
- High safety
- Reduction of power reception systems
- Energy saving type power storage control system

Accumulator battery
Work summary

Basic plan and design developed and construction supervised by Hokkaido Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism and Yamashita sekkei Inc.

Designed by Nihon sekkei Inc.

Technology of reducing environmental load supported by Takenaka Corporation.

Constructed by Takenaka. Iwata Chizaki. Itou Special Construction Joint Venture

Structure : Steel Structure 2 floors

Total floor area : 10,692 m²

Construction Site : Izumikawa, Rusutsumura, Abuta-gun, Hokkaido
Before demolition

After demolition
99% of building materials is reused and recycled

- Lumber Form
- Snow Room Floor Material (Palette)
- Natural Coolant Refrigerator
- Non-fluorocarbon Component Insulation
- Cardboard Duct

Reuse 71%  Recycle 28%  1%

Reduce  Reuse  Recycle

99%
Snow Cooling System

Primary Use

Cooled Air

News Media Room
News Media Room

Broadcast Room
Broadcast Room

Temperature Control

Outside Air

Snow Storage Space

Pallets and Nets

Hole for “Vertical Ducts”

Water from Melted Snow

5°C

Secondary Use

Air-Conditioner

10°C

Final Use

Watering Plants

Flushing Water for Toilets

Outside Air

Final Use

Watering Plants

Flushing Water for Toilets
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For the future
Technology

Roof vegetation membrane

Wall vegetation system

Vegetation concrete

Evaluation of biodiversity

Heat island countermeasures effects evaluation
Projects

Across Fukuoka
Waterfall in the courtyard

Biotope

Entrance Bridge

Water Stream through the campus
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For the future
Target in 2050: Building Environmental Performance
Osaka Abeno Project

OBSERVATION
GARDEN
RESTAURANT

HOTEL

GARDEN/RESTAURANT

OFFICE

HOTEL
OFFICE
MUSEUM/GARDEN

RESTAURANT

DEPARTMENT STORE

STATION

300 m

Scheduled to open in 2014
I. Passive Tower Building

- Void structure
- Curtailment in electricity for lighting by adopting daylighting
- Renewable energy
- Reduction in energy loads in the department store
- Use of rainwater and water-saving

II. Active Measures

- CO2 reduction in new and existing areas
- Variable air conditioning and lighting control system

III. Communication

Abeno A-EMS (Abeno Area energy Management System)
Thank you for your attention