Korea Green Building Design Code and Role & Outcome of KIRA

ACGSA Report
5th Nov, 2019

Korea Institute of Registered Architects (KIRA)
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Sustainable Architecture Academy of KIRA

- KIRA started to operate Sustainable Architecture Academy, commissioned education program for green building experts from MOLIT since 2009.

- 2009 ~ Present: **1,113 trainees**

- 59 instructors: professors, experts etc.

- Education Program:
  - G SEED ID course: 40 hours (7 days)
  - Expert course: 130 hours (24 days)
Why Green Building?

Since 1960s, Korea has achieved rapid developments of cities and buildings and now the cities have entered into a period of stability. From now on, Urban Regeneration and Green Building would become a task for cities and buildings in Korea.

- Existing Building = 7.10 million buildings/3,376,000,000m²
- Approximately 230,000 buildings are under construction every year (150,000 new buildings, remodeling of 55,000 buildings, others 25,000 buildings)
- Construction Investment Size = 195 billion US dollar (15% of GDP) (OECD average 13%)
- Construction Production Size = 59 billion US dollar (4.5% of GDP)
- Architectural Design Market = Approx. 2.7 billion US dollar

Current condition of existing buildings in Korea (based on area)

- Residentia 47%
- Commercial 20%
- Industrial 10%
- Education 9%
- etc. 14%

(based on area)
Why Green Building?

Architects face new challenge to reduce 26.9% of CO2 compared to 2010, through buildings by 2020

- Currently buildings take 25% of CO2/ Emission and 21% of energy consumption
- 4% of self-sufficiency in energy / New Renewable energy ratio of 2%
- In Seoul, buildings use 63% of energy (Consolidation of Design Standard)
- In 2012, 「Green Building Construction Support Law」is established
- Green Building becomes a significant issue to Architectural Design Industry

Seoul in 2019
Heat wave,
Fine dust, Ozone…

Climate change
→Climate crisis

How is your country coping with the global Heat wave?
Why Green & ZEB?

Korea's Green Building Support Law will become ZEB mandatory by 2025 under PH standards in 2018 is reinforced.

2018: PASSIVE HOUSE  →  2025: ZERO ENERGY BUILDING (ZEB)
Korea Green Building Code has been established in 1979 and it has been highly upgraded since 2017. It applies to public buildings by priority and is promoted to be applied to private building.

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<tr>
<th>1979 ~2002</th>
<th>2003 ~2015</th>
<th>2016 ~2025</th>
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<tr>
<td>Initial Stage</td>
<td>Development Stage</td>
<td>Upgrading Stage</td>
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</table>

- **1979 ~2002**
  - Establishment of code for thermal insulation thickness for each building part
  - Submission of Energy Saving plan (1992, office with 3,000㎡ or above)

- **2003 ~2015**
  - Environment-friendly Housing Performance Grading Indication System (Green Home, 2012)
  - Certification for Environment-friendly Building Materials

- **2016 ~2025**
  - Development of EPI Code (2018)
  - Development of Energy Saving plan
  - Total Building Annual Energy Use System
  - Development of Energy Efficiency Rating System (10 grades)
  - Green Remodeling (2013)
  - Energy Consumption Certification System (2013)
  - Development of Maintenance and Inspection (2013)
  - Zero Energy Building (2025)
Green Building Code

Energy Efficiency Rating System (2013~)

- Comprised of 10 grades (Grade 1 ~ 10)
- Application = Detached housing, Apartment, Office, building with 500㎡ or above
- Central Government Act = Compulsory for public service facility with over 500㎡ (Grade 1), public rental housing with over 500 households (Grade 2), private building with over 3,000㎡ or 500 households (Grade 7 or above)
- Local authority (Seoul) = building over 3,000㎡, apartment housing with over 20 households = Above Grade 2 (application to the private)
- Accomplishment (’01~’13) = 2,121 buildings certified
- Incentive for the private = Appeasement of Building regulation (floor area ratio, height etc.), tax reduction
Several Green Building Guidelines are provided to promote sustainable built environment.

Green Building Code

- G-SEED (2019: 2016-2 version)

Green Standard for Energy and Environmental Design-

- 4 grades in total (Grade 1 ~ Grade 4)
- Central Government Act = compulsory for public service facility with above 3,000㎡ (Above Grade 2), Apartment housing with over 500 households (Above Grade 2)
- Local authority (Seoul) = compulsory for building with over 3,000㎡, apartment housing with over 20 households (Above Grade 2) (application to the private)
Green Building Code

Development of Submission of Energy Saving Plan (2013~)

- Application = building with 500 m² or above with above 65 points from EPI (Energy Performance Index)
- Central Government Act = public (74 points or above), private (65 points or above)
- Seoul (Application to the private) = building over 10,000 m², apartment housing with 200 households or above (74 points or above)
- Applied since September, 2013 (Approximately 15,000 buildings per annum)

Total Building Annual Energy Use System (2013~)

- Application = apartment housing with over 100 households (below 190 kmh/m² y), office building (below 280 kmh/m² y)
- Planned to be applied to every building by 2020

Zero Energy Building Certification System (2017~2025)

- Application = Public building pilot project
- Planned to be applied to every building by 2025
Role of Architect

Development of Green Building Code is providing new opportunities and challenge to Architectural Design Market.

**Opportunity**
- New Design Market (Green Building, Green Remodeling)
- Creation of demand of Energy Consulting
- 2017 New certificates (G SEED Integrated Designer: G-SEED ID)
- Opportunity to contribute for sustainable society

**Challenge**
- Adaptation and Retraining
- Integration of design and energy technology
- Balance of policy and market (due to 5~20% increase in construction cost)
- Expanding Basics of Green Building
Korea Institute of Registered Architects (KIRA) is an organization established according to 「Certified Architects Act」 and as a leading group of registered architects in Korea. KIRA is major provider for CPD and especially commissioned to give the training for Professionals of Green Building by MOLIT.

KIRA’s Education Board (KEB)

- Target of Number of Education = 12,887 people (registered architects)
- Education Period (compulsory) = 40 hours (for 5 years)
- Education Method = online / offline
- Curriculum = comprised of 125 courses in total, within those programs 25 courses about Green Building (20% of total courses) are now provided
- G SEED ID: Expert Education 40 hours
Sustainable Architecture Academy of KIRA

Academy of Sustainable Architectural Design (Environmental Friendly)

- Environmental-friendly Architectural Design Academy operated by KIRA.
- This program functions as a core in Korea Green Building Architectural Education for registered architects which is commissioned by MOLIT in Korea.
- The G SEED ID course has been in operation since 2017.

- 2009 ~ Present = 1,113 people have accomplished education
- Comprised of 59 instructors (professors, experts etc.)
- Education Program
  - Expert course = 130 hours training (24 days)
  - G SEED ID course (2017~) = 40 hours training (7 days)
- Education Subject (6 subjects)
  Environmental knowledge / Landscape design / Passive design / Energy Integration design / Materials and Environment Regeneration / Practice of Green Building Certification System

Training System

Primary Level
- Understanding the government's policies
- Concept of Green Building
- Understanding of Certification System

Intermediate Level
- Passive / Active
- Energy Simulation
- BIM Integration Design

High Level
- Materials
- Long-life Design
- Building Renovation
Location: 11-19, EAN Bldg, Teheran-ro 77-gil, Gangnam-gu, Seoul
Building Type: Office
Site Area: 377.70 m²
Building Area: 222.97 m²
Gross Floor Area: 1997.28 m²
Building Coverage Ratio: 59.03%
Floor Area Ratio: 463.45%
Levels: 1 Basement Floor, 10 Ground Floors
Parking: Ground Floor 8EA
Site Analysis

Convenient access to public transit and national park, the precedent building in Samsung-dong was used as an office and residential building. The building condition was outdated and environmentally irresponsible. Hence, the renovation project aims to maximize the positives (superior views) and mitigate the negatives (north facing facade and surrounding environment) of the site characteristics.

Energy Usage Analysis of Existing Building

Energy efficiency analysis of the existing building demonstrated poor energy performance of the building.
Facade design (North)
Horizontal Facade Louver

Horizontal louvers were installed at the facade of lower floors to achieve acoustic and visual comfort of building occupants. The occupants also have control over the louvers to adjust the daylight / solar radiation according to the season. The horizontal louvers at the lower floors eventually improve the workplace environment and image of the building.

Facade design (North)
Wind-capture Design

Wind-capture design was proposed to improve natural ventilation performance of the building’s higher floors. Considering the high wind speed at the upper part of the building, extruded vertical louvers were installed for higher floors to maximize natural ventilation performance.

Facade design (South)
EVB (Electric vertical blind)

The size of the south-facing window which has large amount of solar radiation were enlarged and EVB (Electric vertical blind) were installed to achieve two design elements: highlight view of urban landscape and control incoming daylight / solar radiation.

Daylight / Solar Radiation Control of Horizontal Louvers in Summer Season
Prevent direct daylight and ensure visual comfort
Maximize the amount of daylight entering the room

Daylight / Solar Radiation Control of Horizontal Louvers in Winter Season

Wind-capture Design
Wind-capture design utilizes the infiltration between buildings. Facade is designed with a structure that allows wind to flow through.

Solar Radiation Simulation for External Shading and External Electric Blind Installation
Cumulative solar radiation of the building facade were analyzed and excessive cumulative solar radiation at the back/core was identified.

EVB Installation to Improve Work Environment
A sense of openness was achieved by adjusting daylight/solar radiation.
The main entrance and lobby provided a sense of openness. They act as a main symbol of the company as it emphasizes the vision in achieving excellence in sustainability.

1F Floor Plan
Main Entrance

Horizontal louvers were implemented for securing visibility and daylight/solar radiation, and high-performance windows were installed in the south-facing facade. The communal space was designed to improve work efficiency and performance of building occupants through giving a sense of openness and a comfortable atmosphere.

2~5F Floor Plan
Communal Space

The upper levels of the building have excellent views. Plans were adjusted to maximize views of the surrounding landscape and design elements were applied to maximize natural ventilation performance.

8~10F Floor Plan
Higher Level

Improving a sense of openness and emphasizing the firm’s vision
Indoor Thermal Environment
Improving Insulation Performance

Roof Insulation Before Renovation (without vacuum insulation)

Roof Insulation After Renovation (with vacuum insulation)

2.73 times better performance of roof insulation

External Wall Insulation Before Renovation (Glass Wool Panel 24K)

External Wall Insulation After Renovation (with PF board)

2.23 times better performance of external wall insulation

Floor Insulation Before Renovation (without floor insulation)

Floor Insulation After Renovation (with PF board)

1.93 times better performance of floor insulation

Indoor Lighting Environment
Increasing Daylighting

Daylight Simulation Before Renovation
The higher illuminance was investigated around the window, but the illuminance of the internal zone is below the recommended lighting level for the office (300~600 lux)

Daylight Simulation After Renovation
Extended window width to bring natural light into the internal space (up to 420lux)

Opening area 50% + curtain wall
Improving Daylighting Performance
Enhancing Thermal Performance with Low-E Glass
Adjusting daylighting with internal shading

Indoor Air Quality Environment
Enhancing Ventilation Performance

The simulation was conducted to analyze occupants’ thermal comfort in the summer season.

Indoor Airflow Simulation

Airflow Environment Before Renovation
Due to the influence of surrounding buildings, the previous building has low indoor airflow speeds and low air circulation.

Natural ventilation performance was maximized through expanding ventilation (opening and closing) area of window and applying turn and tilt windows.
Technical Items / BEMS, PMV, CO2 Monitoring

BEMS Developed by EAN

Applying in-house development of BEMS

To maximize the energy efficiency of the building, the energy consumption of the building, the environment variables for the building, and the operation pattern of the facility system were analyzed.

Monitoring Scope

Objective
Energy consumption, lease operating costs, inefficient equipment discovery and action, efficient execution of M&V

Monitoring Duration

Function of BEMS

1. Identify Building Type and usage
2. Long-term Data Storage
3. Analysis of collected data

PMV Evaluation

This remodeled building was set up to be able to represent PMV by BEMS through receiving input values of the following six factors.

CO2 Monitoring

The air conditioner operates when the CO2 value in the occupied space exceeds the legal standard (1,000ppm).

Occupant Thermal Comfort: PMV and CO2 Monitoring

Total Actual Energy Consumption

5,000

ACTUAL ENERGY CONSUMPTION

- Heating
- Cooling
- Hot water
- Lighting
- Ventilation

Future Improvements

- Improve measurement accuracy / analysis performance of BEMS
- Establishment of Optimal Operation Control Strategy

Energy performance evaluation for the first year of operation: Primary energy consumption 176,641 kWh/yr

The air conditioner operates when the CO2 value in the occupied space exceeds the legal standard (1,000ppm).

Actual Energy Consumption

2017 2018

Total Actual Energy Consumption

40,000

30,000

20,000

10,000

0

2017 2018

Measurement Result of BEMS

Energy performance evaluation for the first year of operation: Primary energy consumption 176,641 kWh/yr

- Improve measurement accuracy / analysis performance of BEMS
- Establishment of Optimal Operation Control Strategy

Future Improvements

- Improve measurement accuracy / analysis performance of BEMS
- Establishment of Optimal Operation Control Strategy

Energy performance evaluation for the first year of operation: Primary energy consumption 176,641 kWh/yr
Achievements

Optimized Building Performance

Building Before Renovation

- Poor daylighting and ventilation performance affected by the window design
- Improper Insulation outside the legal range
- External wall before the renovation - Glass wool panel 24K
- No External Shading Devices

Building After Renovation

- Systematic Window Application
- Automatic control such as occupancy sensor, dimming control
- Semi Manual Lighting Control

Major Green Building Technology and Certification

Certified in 2017.10.26 / Certification No.: 17-

Building Energy Efficiency Rating: LEED NC v3.0_ GOLD

Acquired GOLD rating with a total score of 61 points.

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<td>Securing Energy Saving Rate</td>
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<tr>
<td>Materials and Resources</td>
<td>Use Environmental Product Declarations (EPC products)</td>
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<tr>
<td>Water Circulation Management</td>
<td>Application of water-saving type sanitary facilities (26.27% saving rate compared to the previous one)</td>
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<tr>
<td>1) Water-saving Faucet</td>
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<td>2) Water-saving Toilet</td>
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<td>3) Water-saving Urinal</td>
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<td>4) Water-saving Shower Head</td>
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<tr>
<td>Maintenance</td>
<td>Operation and maintenance of buildings through information on green remodeling</td>
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<tr>
<td>1) Green Remodeling Construction Details</td>
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<td>4) Green Remodeling Related Construction Information</td>
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<td>Planning to minimize the impact of existing structures through the Green Remodeling Project</td>
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<tr>
<td>1) Green Remodeling Process Plan</td>
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<td>2) Green Remodeling Work Plan and Notes</td>
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<td>3) Construction Site Noise / Dust Generation Management Plan</td>
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<td>4) Construction Site Waste Management Plan</td>
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<tr>
<td>Indoor Environment</td>
<td>Improve the indoor environment for warm, light, and sound environment to create pleasant indoor environment</td>
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<tr>
<td>1) Thermal Comfort: Wall Insulation and Window Reinforcement</td>
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<td>2) Visual Comfort: Replacement of High-efficiency LED Lighting Equipment</td>
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<td>3) Air Quality: Installation of Heat Exchanger</td>
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<tr>
<td>4) Acoustic Comfort: Noise Barrier Through Window Reinforcement</td>
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Division | Sustainable Sites | Water Efficiency | Energy & Atmosphere | Materials & Resources | Indoor Environmental Quality | Innovation in Design |
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<tr>
<td>SS</td>
<td>Establishment and Implementation of Construction Management Plan</td>
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<td>WE</td>
<td>Preferred Parking Space for Low Emissions Vehicles</td>
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<td>EA</td>
<td>Improved Insulation Performance</td>
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<td>MR</td>
<td>Enhanced Commissioning</td>
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<td>IEQ</td>
<td>Use Recycled Materials</td>
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<td>Use Local Materials</td>
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<td>TOTAL</td>
<td>Reduced Annual Energy Consumption Costs by 18% or more Compared to ASHRAE 90.1-2007</td>
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<td>Construction Phase Waste Management Plan</td>
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<td>M&amp;V Plan (BEMS)</td>
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<td>Enhanced Commissioning</td>
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<td>Individual Control of Lighting and Thermal Comfort System</td>
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<td>At Least One LEED AP Qualifier Participates in the Project</td>
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Architectural Drawings

Site Plan, Floor Plans, Section Drawing

2F Floor Plan
1. Office
2. Male Toilet
3. Female Toilet
4. Female Toilet

1F Floor Plan
1. Lobby
2. Security Office
3. Preferred parking for Carpool
4. Preferred parking for LEV vehicle

3F Floor Plan
1. Office
2. Meeting Room
3. Data Server Room
4. Data Storage Room
5. Terrace
6. Female Toilet
7. Male Toilet

5F Floor Plan
1. Cafeteria
2. Meeting Room
3. Data Server Room
4. Data Storage Room
5. Terrace
6. Female Toilet
7. Male Toilet

6F Floor Plan
1. Office
2. Terrace
3. Male Toilet

9F Floor Plan
1. Office
2. Male Toilet
3. Female Toilet

Site Plan
1. Office
2. Male Toilet
3. Female Toilet

Section
1. Neighborhood Living Facility
2. Parking
3. Office
4. Cafeteria
5. Terrace
6. Courtyard
7. Rooftop Garden
Culture Platform

DAEGU BANK SECOND HEADQUARTERS

Republic of Korea

PROJECT NAME: DAEGU Bank 2nd H.Q.
LOCATION: Daegu, Korea
BUILDING TYPE: Financial Office
PROJECT COST: $ 65,000,000
COMPLETION: 2016
LAND AREA: 9,638.90㎡
BUILT AREA: 3,637.12㎡
GROSS AREA: 37,055.34㎡

ARCHITECT: JUNGILM ARCHITECTURE, Co., Ltd
MEP & IBS: Woowon M&E | Jungwoo Eng | I-Controls
STRUCTURE: YIST Structural Engineering Group
LANDSCAPE: Solto Landscape Architecture
CERTIFICATION: LEED NC 2009 - Gold
- G-SEED - 1st class
- Building Energy Efficiency Rating - 1st class
- Intelligent Building Certification - 1st class
This project is the Second HQ of Daegu Bank, the first regional bank in Korea established in 1967. It contains not only the functional requirements of a company, but also its values, philosophy, history, and vision. Daegu Bank has been a leader in regional environment conservation and environmentally friendly businesses with ‘sustainable management’ as its motto. From the early stages of planning, Daegu 2nd HQ had a clear goal of not only satisfying the basic requirement of expanding the lacking work area, but also to build a world-class sustainable building that protects the environment and conserves energy in order to realize the corporate value of ‘sustainability.’ Hence the project was not planned through conventional design process in which sustainable technology is applied bluntly, but through Integrated Design process in which all project officials discuss the requirements, functions, and the performance of sustainable design factors and develop the design together. This project completed ‘Integrated Project Delivery’ through the close supervision in the phase of construction for the realization of variable sustainable items on design concept. Such environmentally friendly ideology has been maintained even to the management level. Sustainable design concept flows consistently from the planning, design, construction, and operation phase of this project, making Daegu Bank 2nd HQ an innovative green building.
Proposing a common point of interest between the public, civic, regional community and corporate

**Step1_PARK**
Park within the city

**Step2_RED CARPET**
Accessible and open culture street

**Step3_CULTURE PROGRAM**
Accessibility and independence achieved by placing programs around culture street

**Step4_EVENT ELEMENTS**
Various architectural elements to enrich the cultural experience

**Step5_CULTURE PLATFORM**
Fulfilling the corporate's culture marketing

**Step6_FLOATING BOX**
New office with employee communication, working environment, and welfare
The overall concept of Daegu Bank 2nd HQ is "communication and interaction." This concept is consistently applied in large scale such as relationship-building between the exterior and interior, and to smaller scale such as interaction between the occupants. The core concept of the lower levels is to propose a spatial organization consisted of the intersecting points and the borders between the regional community, corporate, city and a building.

**CULTURE PLATFORM**

Daegu Bank 2nd HQ breaks the conventional large podium design typical in bank architecture and reinterprets the program in order to divide the space into human-scale. By doing so the space not only benefits the surrounding residential buildings and the pedestrians, but also allows for spatial independence of each program while opening the possibility of active interaction between the program and the exterior space. Separated mass are arranged along the path. The intersection point of the roads is an open courtyard in which the regional community and the corporate interact through culture. Bright light falling from the ceiling and the sound of piano from the lounge – this space will deliver the first impression of the building.
Green Measures: Atrium

Operable Clerestory
- Allows for trapped hot air to escape during summer
- Increased natural ventilation during spring/fall

Interior Operable Windows
- Increased natural ventilation during spring/fall
- Air quality improvement

Protruding Sloped Skylight
- Effects of hot air trap in the upper levels removed
- Direct light reflection from skylight reduced

Exterior Roll Blind
- Controlling the passage of light and heat
GREEN MEASURES: Outside

**Greenery Planning**

The greenery located on the exterior of the building as well as the roof not only provides the occupants and the local community with pleasant resting area, but also restore the ecosystem and reduce the heat island effect.
BUILDING ENERGY CONSUMPTION

'Expected Annual Energy Consumption of 2,131MWh/yr, which is more than 33% less than the average energy consumption of newest commercial buildings.'

![Expected Annual Energy Consumption](image)

**Comparison with Average Commercial Building Energy Consumption**

- Commercial Office Building
- Public Service Building
- DGB

※ Based on large scale buildings built after 2011 - 2014 Energy Consumption Survey

<table>
<thead>
<tr>
<th>Type</th>
<th>Annual Energy Consumption (kWh/m² yr)</th>
<th>Annual Primary Energy Consumption (kWh/m² yr)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Including Process Load</td>
<td>Excluding Process Load</td>
<td>Including Process Load</td>
</tr>
<tr>
<td>per total floor area</td>
<td>57.52</td>
<td>39.37</td>
<td>137.58</td>
</tr>
<tr>
<td>per air conditioning area</td>
<td>112.79</td>
<td>77.21</td>
<td>269.78</td>
</tr>
</tbody>
</table>

※ Final Building Energy Efficiency Rating evaluation via ECO2 program resulted in 214.7kWh/m² yr, which is equivalent of 1 grade.
AWARDS

2014 BIM Design Awards “Good Practice” / 2015 Korea Institute of BIM “Best BIM Design” / 2016 Daegu Architecture Awards “Gold Prize”
2016 Korea Green Building Awards “Minister Prize” / 2017 Korea IBS Building Awards “Grand Prize” / 2018 APIGBA Awards “Gold Prize”
Thanks!!