



## Myongji University

[Office Building] | [April 5, 2022]

### Hybrid Hanok : OUN(僞樓) for Business Incubator Center

#### Project Summary

Sajik Shrine, adjacent to the site, is the historical center of Seoul, South Korea. The proposed site near is surrounded by a number of contemporary office buildings that need contextual relationships with various historical sites. Our team proposes a “hybrid Hanok”, the Korean traditional architecture style, for a business incubator center, preserving the past and present coexistence of Seoul's history and culture. The blend of the site context and traditional Korean architecture styles is a significant challenge for the coexistence of modern buildings and historical landmarks in sustainable public open spaces of urban environments.

#### Design Constraints and Strategy

The first constraint of site strategy is to blend diversity between the past and the present by coordinating historical sites, contemporary buildings, and spatial components in and around the site. The boundary-less public space between the city and the site can promote active social interactions and healthy urban life through planned spatial functions. The proposed building incubator center extends the spatial functions from private offices to public open spaces.

The second constraint of building strategy is to enhance energy performance and constructability for marketability while adapting to changeable climates. The Government of Korea strongly drives the policies for CO2 emission reduction by 2030; however, Hanok encounters the critical phases of not meeting the requirements of ZEB concerning the energy performance of passive, active, and renewable systems. Essential requirements for ZEB performance are to advance poorly-insulated envelopes and airtightness while maintaining its unique design of the Hanok styles and materials.

This project begins with partial retrofitting the existing community center built in 1970 so that it functions to serve the quality of private shared offices and urban public spaces to neighbors. The proposed *hybrid Hanok* for business incubator center will shape a sustainable community that serves those who establish a start-up business, visit historical sites, and need administrative support and public conferences.



#### Project Data

- Location:** Seoul, South Korea
- Climate Zone:** Similar to Zone 4A
- Lot Size:** 3,800m<sup>2</sup>
- Building Size:** 2 stories (4,136m<sup>2</sup>)
- Occupancy:** 275 of people (15m<sup>2</sup>/person)
- Construction Cost:** \$4,538/m<sup>2</sup>
- Energy Performance:**
  - Source EUI (187kWh/m<sup>2</sup>yr) w/o PVs
  - Site EUI (129kWh/m<sup>2</sup>yr) w/o PVs
  - Zero Energy Building by -4 kWh/m<sup>2</sup>yr
    - Geothermal systems produce 41 kWh/m<sup>2</sup>yr
    - BIPVs/BAPVs produce 92 kWh/m<sup>2</sup>yr

#### Technical Specifications

##### R-values

- Wall: 0.11W/m<sup>2</sup>K (Composite-SIPs)
- Roof: 0.12W/m<sup>2</sup>K
- Floor: 0.13W/m<sup>2</sup>K
- Windows: 2.03W/m<sup>2</sup>K
- Infiltration rate: 7.2 m<sup>3</sup>/m<sup>2</sup>-h

##### HVAC

Geothermal Heat Pumps, EHPs, ERVs,  
Window ventilation system w/ heat exchangers  
UFAD, Radiant heating/cooling, BEMS

##### Onsite PVs

92 kWh/m<sup>2</sup>yr from BIPVs, BAPVs, and parking canopies

#### External Partners

- Architecture Firm:** Haeglim Architects
- Structure:** Dr. YM Kim
- HVAC:** Korea HVAC
- Simulation:** Namoo Tech.
- Geo-thermal:** Korea HVAC
- Envelope:** Axia Materials



## Project Highlights

- 1. Architecture:** A *hybrid Hanok* structure is made of a Korean timber structure retrofitted on the existing reinforced concrete structure of a community center in 1970. Applied materials and new technologies to a *hybrid Hanok* office help building occupants improve their productivity and comfort by optimizing indoor environmental quality (IEQ) and improving energy performance. The proposed project is intended to identify new types of offices, an atrium, commercial facilities, an administrative community center, a historical site (Anyandcheong), and several outdoor spaces.
- 2. Engineering:** Applied passive/active technologies to achieve a site EUI of 129kWh/m<sup>2</sup>·yr (40.9kBTU/ft<sup>2</sup>·yr) and a source EUI of 187kWh/m<sup>2</sup>·yr(59.3kBTU/ft<sup>2</sup>·yr) include H-shaped columns with composite-SIP walls for high-efficient insulation and airtightness, triple-glazed windows, integrated BIPVs & BAPVs to all building envelopes, geothermal heat pumps, window ventilation systems w /ERVs, and UFAD systems for stable heating/cooling/hot water energies, and thermally isolated structures.
- 3. Market Analysis:** The transformation of traditional Hanoks advances a high-performing Hanok office, which is a *hybrid Hanok*, is an inevitable process as the globe strives toward a carbon-neutral society. It will positively affect the expansion of construction markets of net-zero Hanok models that target \$4,500 per m<sup>2</sup>, although high-performance building materials, active systems, and renewable systems increase the total construction cost by about 20 to 30% relative to conventional construction costs.
- 4. Durability and Resilience:** The *hybrid Hanok* Hanok adopts climate-adaptive designs and seismic-resilient structures despite the growing frequency of earthquakes in South Korea. During the hottest season, extended eaves reduce cooling energy by blocking solar radiation, and filtered greywater can be reused for flushing and gardening, leading to annual water savings for the cycle of the ecosystems.
- 5. Embodied Environmental Impact:** Recycled CLT/GLT wood materials from the local manufacturers can contribute to a reduction of CO<sub>2</sub> emissions by 24% and 13%, respectively. And modular design and construction are expected to cut down the cost by 20%.
- 6. Integrated Performance:** For structural weakness and envelope performance, integrated H-shaped columns are integrated with composite-SIP walls. The proposed envelope design resulted in a higher bending moment by 21% and better thermal performance. The air cavity of a double-skin façade with PV-integrated shading devices can block and absorb solar radiation before it enters an indoor space of buildings depending on expected seasons.
- 7. Occupant Experience:** The Integrated systems of radiant heating, window ventilation, and underfloor air distribution system (UFAD) can increase ventilation efficiency by 20% and thermal comfort. Applied window ventilation systems and UFAD systems in a *hybrid Hanok* reduce the exposure of air ducts to maximize efficient spatial uses.
- 8. Comfort and Environmental Quality:** Building occupants can access collected real-time visual data from IEQ sensors to the comprehensive control apps, allowing them to control room temperatures, relative humidity levels, and indoor air quality (e.g., CO<sub>2</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub> levels) for a healthy office environment. Acoustic panels and polymer dispersed liquid crystal (PDLC) double glazing are used for acoustic and visual privacy.
- 9. Energy Performance:** The proposed project targets a site EUI of 129kWh/m<sup>2</sup>·yr and a source EUI of 187kWh/m<sup>2</sup>·yr for the five primary energy end uses of heating, cooling, hot water, ventilation, and lighting. Finally, it shows zero-energy building by -4 kWh/m<sup>2</sup>·yr with BIPVs and BAPVs(92 kWh/m<sup>2</sup>·yr) and geothermal heat pumps (41kWh/m<sup>2</sup>·yr, 24RT).