Greening Seoul: A New Toolkit for Adaptive Reuse

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Greening Seoul: A New Toolkit for Adaptive Reuse

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Abstract
The Carbon Emissions in Construction Part

Introduction

Site Analysis
The Introduction of Nakwon Arcade 13
The Characteristics of the Site 14
The History of Nakwon Arcade 16
Timeline of Climate Change / Nakwon Arcade 17
Past Plan Drawings 19
The Analysis of Transportation 21
Urban Context 22
Carbon Emission in Seoul 24

User Analysis
User Information 27

Precedents
Green Facade / Wall 29
Bosco Verticale 30
Caixa Forum 31
ACROS Fukuoka 32
Parkroyal on Pickering 33
Powerhouse Brattørkaia 34
Zero Carbon Building 35
The Farmhouse 36
Tour Bois Le Prêtre 37
Villa M 38

Programs
Existing Structure 42
Sustainable Plug-In Components 43
Sun Analysis 45
New Extension 46
The Application of New Extension 47
Section Detail 48
Programs 50
Plan Drawings 51
Section 58
Elevation 60
Renderings 62

Bibliography

Image Credit

TABLE OF CONTENTS
As cities continue to develop and become denser, carbon emissions are increasing, causing the Earth’s temperature to rise and accelerating climate change. Construction and buildings account for about 40%-50% of the causes of carbon emissions, in addition to the embodied energy of the materials used. This thesis proposes a sustainable toolkit of greening strategies that can be applied to countless existing buildings, consisting of elements to create green facades, green walls, and energy efficiency systems. Because the majority of carbon emissions occur during the demolition of old and construction of new buildings, the top priority should be to avoid demolition altogether and instead to improve the energy efficiency of old buildings.

As a test case for applying the sustainable tool kit of greening strategy I have chosen one wing of the Nakwon Arcade complex in Seoul, South Korea. The Nakwon Arcade is the first generation of musical instrument shopping malls. Because this building is a typical Korean arcade style complex, a my sustainable toolkit strategies can be applied and installed in numerous buildings of the same or related construction systems. The project aims to demonstrate that sustainable design is not only possible but also essential for the future of our planet.

The sustainable components I propose to install on the exterior will reduce carbon emissions and increase the efficiency of older buildings. This will have a great direct impact on the city’s microclimate, and together these modified buildings can reduce carbon emissions to a greater extent, creating a solution that can slow down climate change.
INTRODUCTION

With the development of modern technology, many buildings, infrastructure, and transportation were built in the city, and the city gradually developed. As a result, radical urbanization progressed, and with it energy consumption. The related carbon emissions have dramatically increased the Earth’s temperature, much earlier than expected in climate change models. In fact, many countries around the world are currently experiencing climate-related disasters decades before expected, including floods, heat waves, and rising sea levels. Efforts have been made to solve this problem, but no comprehensive measures have been taken.

New and existing buildings contribute 40%-50% of greenhouse gas emissions each year. Climate countermeasures tend to focus entirely on new construction. My thesis proposes a realistic architectural solution to climate change, combining energy systems, green wall and facade through adaptive reuse in such a way that each becomes an integral part of the architecture. Building new buildings requires a lot of energy consumption, emits a lot of carbon during the construction process, and even creates air pollution. Therefore, the goal is not to build a new building, but to adaptively reuse an existing building to address climate change. It is not possible to think of these issues separately. The greenery toolkit will have a green facade and expanded space(glazing system) and be installed into old buildings in Seoul. This toolkit will be demonstrated in the Nakwon Arcade, a typical 1960s concrete construction in Seoul, South Korea.
The Nakwon Arcade is a historic complex located next to Tapgol Park (Pagoda Park), and it is hidden because it is old and dark, but it is a representative building of the first generation of Korean residential and commercial complexes. In particular, in the early days, it became famous as a luxury apartment along with Namsan Citizen Apartment. Along with the nearby Sewoon Shopping Center, it is considered a representative modern shopping mall in Seoul. The huge roads are through the building because there is void space in the 1st Floor.
Nakwon Arcade is the world’s largest musical instrument shop complex. There are over 300 shops on the second and third floors of the arcade, and its size is beyond comparison to that of other musical instrument specialty stores. In addition, there are offices related to instruments, practice rooms, and an outdoor stage called Art Lounge Meotjin Haneul on the fourth and fifth floors, making Nakwon Arcade the strongest source for musical instruments in Seoul.

The musical foundation of Nakwon Arcade is the result of 40 years of history. It is the fruit of history as instrument shops and musicians started to gather around and ordinary people also started to have musical hobbies. Just as it takes a long time to master an instrument, Nakwon Arcade has also gone through essential period of time to consolidate its status as a central attraction of instruments and music.

**PROBLEM**

Density within buildings

This Jongno area, which has a long history in Seoul, has preserved the site of hanok since ancient times, so there are many narrow alleys, and villas and buildings are densely located. Even in the alley of Nakwon Shopping Center, the distance from the nearest building is only 11.4 ft and 13.77 ft. Due to the characteristics of such a dense area, there is no room for breathing of buildings and the air quality is very poor. And because some buildings do not receive enough sunlight, energy efficiency in winter may decrease. In addition, since there is not much green space in the area, the air is not sufficiently purified, and the temperature of the area rises a lot in summer due to the heat island phenomenon.
Before the Nakwon Shopping Center was built, there was a traditional market called Nakwon Market. It was a fairly historic market that existed before the Korean War. Part of this market has remained since the Nakwon Shopping Center was built in 1967.

In the 1960s, the Seoul Metropolitan Government was planning an arterial road from Anguk-dong to Hannam-dong through Jongno from north to south. However, there was Nakwon Market at the planned site of this road, and demolition was inevitable to open the road. After consultation with market merchants, the Seoul Metropolitan Government decided to demolish the market and open a road, but to build shopping malls and apartments on the road to move in market merchants. Most of the market merchants moved into this shopping mall.

In the 1970s, Nakwon Shopping Center was originally used as an alternative to Nakwon Market, so market merchants came in, and in the case of the second floor, clothing stores were almost mainstream. And in the early 1970s, as the government’s policy to supply traditional musical instrument and piano nationwide increased demand, there was a keyboard instrument store called “Pagoda Arcade” in Tapgol Park, and wind instrument-related stores were gathered next to Jongno 2-ga. However, it is said that the government demolished the Pagoda Arcade in 1979 due to the Tapgol Park maintenance project and moved them to Nakwon Shopping Center, which was the beginning of the Nakwon Shopping Center’s musical instrument stores.

**TIMELINE**

- **Observed**
- **Simulated human & natural factors**
- **Simulated natural factors only**

**Human has warmed the climate**

- **Nakwon Arcade was built**
- The Golden Age of Nakwon
- Decrease of Popularity
Nakwon Shopping Center, which stretches in two directions, has a unique shape. Situated on a large road, it is very accessible and closely connected to the urban context. On the First Floor, there is a big road connecting Nakwon-dong and Anguk Station, and on the Second and Third Floors, there are mainly musical instrument shops. Because there is a big road on the First Floor, the level of carbon emission is higher than other areas. There is a small exhibition space and practice room on the Fourth Floor, and a lecture hall on the Fifth Floor. Also, there is a residential apartment on the middle of this building. Apartment is directly connecting to the arcade.
Columns
There are square-shaped pillars that are uniquely placed in a row in Nakwon Shopping Center. The pillars of the main retail space, the blue marked space, are placed in line with the flow of the main entrance. One peculiarity is that there is also a pillarless space between the middle building and the main retail building.

Entrances
One of the interesting things about this site is that there are entrances on both sides of the second floor. Many people enter this entrance directly from the next alley when they come here. This entrance seems to have been built on the 2nd Floor because the space on the 1st Floor is used as a void space as a large road.

Transportation
Nakwon Arcade

The area near the site is the center of Seoul, so public transportation is very well connected. There are bus stops everywhere, and the subway station is also close. This place, where commercial areas and old historical and cultural heritages coexist, is always filled with many office workers and tourists.
The area near Nakwon Shopping Center, the project site, lacks a lot of green parks. With its densely packed buildings, there is also a lack of parks for people to rest and take walks. Concrete buildings and severe traffic result in more carbon emissions. Green parks are essential in urban areas to absorb carbon, and green spaces should be put in concrete buildings to mitigate climate change.
Carbon emissions are serious in many parts of Seoul's cities. Among them, Jongno, the center of Seoul, came out as an area with high carbon emissions. Jongno is a business area, so large and small concrete buildings are concentrated, and heavy public transportation, vehicles, and traffic are causing severe carbon emissions all day.
Nakwon Shopping Center is the first and only musical instrument store in Korea. Since the 1960s, there have been steady merchants selling musical instruments in Nakwon Shopping Center. In the 1980s and 1990s, there was a boom in musical instrument shops, but fewer and fewer people are coming to buy musical instruments and they are not as popular as they used to be. If the musical instrument store creates synergy with other programs and revives the store, it will be popular again.

There are many young musicians in Korea. But they don’t have enough space to practice because of Seoul’s high monthly rent, nor do they have enough opportunities to generate income. If you provide a space for young musicians as a user, it will be a new space of opportunity for them. And musicians will have space to perform and will be a big motivation to bring local people into this musical instrument store.
Green walls – are structures that contain soil or another growing medium across their surface or volume, and are thus normally filled or interpenetrated by the root systems of the plants that grow on or in them. In the 1930s, Green Wall system were invented by Stanley Hart White, a professor of landscape architecture at the University of Illinois.

Green facades – are essentially vertical trellises or framework structures that support the branch systems of plants – ones planted in the ground or containers at the facade’s base, or in floating containers attached at regular intervals to the facade frame.
The Bosco Verticale, located in Milan, is one of green facade’s most representative projects. There are several types of trees planted on the terrace on each floor, and there are a total of 800 trees installed. Plant-based shielding filters sunlight without reflecting or magnifying it, creating clean air without harmful effects on the environment. At the same time, green curtains regulate humidity, produce oxygen and absorb CO2.

The French botanist has installed eye-popping vertical gardens all over the world, and is sometimes credited with inventing the concept altogether. His design for CaixaForum Madrid, an enormous shopping and cultural center, crawls four stories high and includes 15,000 plants from over 250 species. This large green facade will absorb and purify carbon in the region and have a significant impact on the local climate.
The building’s lush green roofs allow for a significant reduction in the urban heat island effect. It also helps reduce and capture rainwater runoff at the site. The vertical garden created its own ecosystem using rainwater as irrigation water. As for sustainability, it should be mentioned that green roofs use less energy for both heating and cooling, which significantly lowers operating costs.

Massive curvaceous sky-gardens, draped with tropical plants and supporting swathes of frangipani and palm trees, are cantilevered at every fourth level between the blocks of guest rooms. Greenery flourishes throughout the entire complex, and the trees and gardens of the hotel appear to merge with those of the adjoining park as one continuous sweep of urban parkland.

In a style similar to the Vertical Forest example, the green space placed on the exterior facade interacts with the interior space. The interior temperature of this building will also be properly maintained due to the green space, and CO2 will be absorbed and fresh air will be provided. The difference from Vertical Forest is that it has a larger proportion of green terrace space, and a large atrium is located on the first floor.
The building's site has been carefully chosen to ensure maximum exposure to the sun throughout the day and seasons. Its skewed, pentagonal roof and the upper part of the façade is clad with almost 3,000 m² of solar panels, strategically placed to harvest as much solar energy as possible. Over a year, this amounts to a total of about 500,000 kWh with clean, renewable energy. In effect, the building dually functions as a small power plant in the middle of the city. Ample space for energy storage is built into the building footprint, allowing it to store surplus energy in the summer months of near-total daylight, to then use it in the winter months when daylight is at a minimum.

The building goes beyond the traditional definition of zero carbon. It is connected to the local grid and produces on-site renewable energy, from a combination of photovoltaic panels and a biodiesel tri-generation system, to offset the power consumed on an annual basis. The excess is exported to the local grid to cover the embodied energy of its construction process and building materials.

The large-scale use of biodiesel as a renewable tri-generation fuel is also a first in Hong Kong. The system uses waste cooking oil to generate power, solving two problems – waste treatment and energy generation – in one go.

The ZCB also features Hong Kong’s first urban native woodland with 220 native trees of over 40 species and a diversity of shrubs. The woodland creates a high-quality ecosystem embedded in a built-up area to benefit both the environment and people.
THE FARMHOUSE

Prefabricated A-frame housing modules made from cross-laminated timber (CLT) would be stacked to provide flexible living spaces. CLT is more sustainable than other low-cost building materials such as concrete because it locks in the carbon absorbed by the trees that were grown to make it.

Each of the module’s walls would be made of three layers. An inner layer, facing the home interior, would hold the electricity and pipes with the surface finishes. A layer of structure and insulation would form the middle layer, and on the outside layer would hold all the gardening elements and a water supply.

Studio Precht

TOUR BOIS LE PRÊTRE

A facade of corrugated aluminium clads the new exterior of the tower, interspersed with large windows and glazed balconies. Floor-to-ceiling glass separates the apartments from the new terraces to let more natural light into each residence. The new winter gardens and balconies would be added using prefabricated modules erected like scaffolding around the outside. Punching through the old facade to connect these modules to the apartments could take only one day per apartment. Residents who left for work in the morning would return in the evening to find an entirely new, much larger home, with floor-to-ceiling glass doors opening onto glassed-in winter gardens that gave way to balconies with panoramas of the distant Eiffel Tower and La Défense.

Lacaton & Vassal
The Villa M project in Paris has a grid-shaped structure installed on the façade, covering the entire façade vertically and horizontally with plants to create a vertical garden.
To create an efficient and sustainable solution to climate change, we need to build on three key elements. Green space, sustainable materials, and renewable energy are three factors that must be considered to combat climate change. This project will focus on these elements and create a solution. In order to create a toolkit to prepare for climate change, these three elements should be properly mixed according to the situation, and a toolkit that considers the surrounding environment should be designed.
Design Proposal: Toolkit System that can be applied to Facade

The purpose of this thesis is to make an adaptable sustainable toolkit that can be applied to existing facades. Each building has a different problem and situation. So, according to building's problem, different types of toolkits will apply to the facade. The toolkit module will consist of green walls, renewable energy, sustainable materials.

TOOL KIT SYSTEM FOR ABSORBING CO2

The Idea of Plug-In System

Many modern buildings built in Korea after the Korean War have inefficient energy systems. The toolkit mentioned in this thesis project is a plug-in system and will be mainly installed on the facade of old buildings in Seoul. New extensions, which are installed in existing buildings, absorb the city's carbon, purify the air, and increase the efficiency of the internal energy system. Also, this is not a reconstruction of the building, but it will also preserve the history and memory of the building in a sustainable way. As it is gradually installed in many buildings, it will create a synergistic effect and make Seoul a green city.

SUSTAINABLE PLUG-IN COMPONENTS

Tool-Kit Module

Nakwon Arcade
Currently, the thermal performance of buildings is very poor due to the old energy efficiency system in Nakwon Shopping Center. There are parts that receive a lot of sunlight, but due to the concrete wall, there is a considerable lack of space that receives natural light in the interior space, so heating energy is consumed a lot in winter.

In addition, due to the characteristics of narrow alleys, there is a lot of time for shadows to occur in some parts. Based on this solar data, an efficiently optimized sustainable toolkit facade will be installed.
The new toolkit system consists of two zones. On the outer façade, a vertical wireframe is installed as a green façade. Through this wireframe, climbers such as vines or ivy climb along the wire to create a green façade. To grow these plants, a plant basket is installed in the planter zone, which will consist of not only vines but also various plants that make up the living wall.

Inside the green façade, an expanded shop area is created, which replaces the existing solid walls with a transparent glazing design. By replacing glass walls, the interior space receives more sunlight and increases internal energy efficiency.
SECOND FLOOR

Taking Out Area (Atrium) : 3,365 ft²

New Extension Area

Planter Zone : 1,869.73 ft²
Expanded Shop Area : 2,648.73 ft²
Beacon Space : 1,406 ft²

= Total 5,942.46 ft²

THIRD FLOOR

Taking Out Area (Atrium) : 3,365 ft²

New Extension Area

Planter Zone : 2,974.55 ft²
Expanded Shop Area : 4,427.10 ft²
Beacon Space : 1,406 ft²

= Total 8,807.65 ft²
FOURTH FLOOR

Taking Out Area (Atrium) New Extension Area
= 3,365 ft²
Planter Zone : 2974.55 ft²
Expanded Shop Area : 4427.1 ft²
Beacon Space : 1406 ft²
= Total 8,807.65 ft²

FIFTH FLOOR

Taking Out Area (Atrium) New Extension Area
= 3,365 ft²
Planter Zone : 2974.55 ft²
Expanded Shop Area : 4427.1 ft²
Beacon Space : 1406 ft²
= Total 8,807.65 ft²
In the front facade, there will be an urban beacon area where people can see city view and surrounding environment. In the original building, the concrete wall covers the large area in the facade, so it seems like disconnecting from the urban context. But with the glazing structure on the facade, it will have a visual connection with outside.
Added to the existing façade, this new terrace consists of a green façade and glazing room. At the edge of the terrace space, a plant basket will be installed where plants can grow, from which climber plants grow along the wire frame. The green façade made in this way blocks outside noise, making the interior space more pleasant. The newly added glazing room provides more sunlight to the interior, maintains the temperature and acts like an insulator. Also, this new terrace allows people to move to different stores.
This image shows the new green façade applied to the Nakwon Arcade in Seoul. The green façade system consists of a vertical wire frame, and climber plants such as ivy and vine will grow along the wire to create a green façade. This green façade will absorb the city's carbon dioxide. It also keeps the temperature inside the building constant. Inside the green façade, a new glazing system is designed to allow more sunlight to reach the interior space, unlike existing building's concrete walls. This will make the building more energy efficient.
An atrium garden was created in the middle of the Nakwon Arcade, and a glazing roof was installed on the ceiling so that natural light permeates from the ceiling to the second floor. In the Garden, plants purify the air inside and maintain the temperature. The narrow hallway has a more efficient space arrangement with a new layout.
Each instrument shop has more space thanks to new extensions, and glazing, which has replaced concrete, brings more daylight into the interior. In addition, the green façade not only conveys a nature-friendly atmosphere to the interior, but also controls the temperature inside.


