Re-living the Concrete City

Existing Apatu as an Open Building

Research Plan

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Contents

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Introduction

Like other Asian countries, Korea traditionally made buildings and formed villages by harvesting and using circular materials such as wood, straw and earth from nature. However, most of the traces of tradition disappeared during the Korean War in the 1950s, and they suffered severe housing problems. At the same time, housing problems caused by urbanization also increased, so the Korean government radically introduced the concrete high-rise housing system proposed by Modernist Architect, Le Corbusier in order to solve this problem. Such a system was an innovative way to efficiently provide housing in a short period of time, and became very popular with the public in that it provides a new and modernized living environment. Such an architecture has become a representative residential type in Korea so far under the unique name of "Apatu[1]," and currently account for the highest proportion of about 63.5% among various housing types in Korea (National Statistical Office 2021). The problem, however, is that more housing is still needed today due to the ever-growing population problem in Seoul, and the answer Korea select is to completely demolish old Apatu complex at once and rebuild around twice as tall concrete apartments. Most Apatu in Seoul have already been reconstructed, and some are waiting for re-reconstruction because it has been 30 years again.

1 Typical apartment typology in South Korea for the family of around four. Generally, each housing unit consist of one large living room, kitchen, three rooms and two bathrooms. In addition, one apartment building is about 15 stories in total, with four unit and two core per floor. In most cases, dozens of buildings are composed of one complex.

Figure. 01 A view of Seoul in 1894

Figure. 02 A view of Seoul in 1976

Figure.03 A view of Seoul in 2019

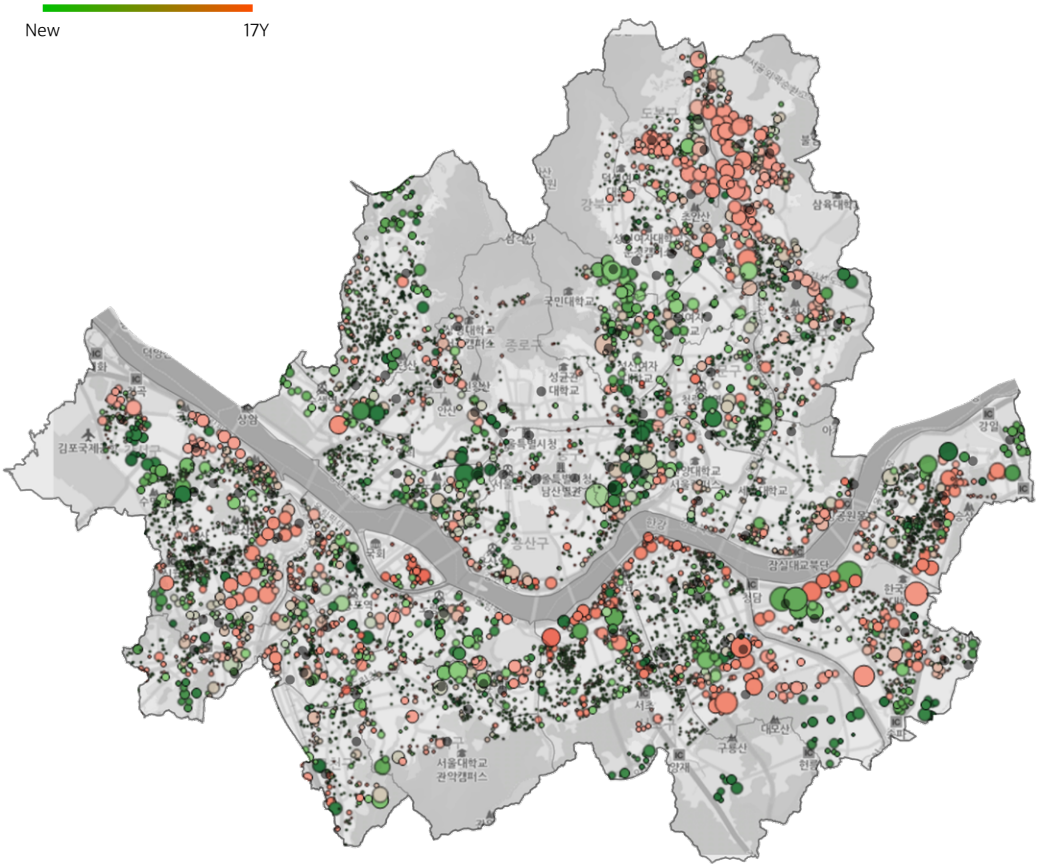

Figure.04 Age by Apatu Complex

Reason of Problem

Then, why is the Apatu in Korea not reusable and demolished and reconstructed every 30 years, even though there are no serious problems with the structure and function of the building?

First, according to the "2025 Seoul Housing Plan," about 650,000 more housings are needed by 2025 because the population in Seoul is still being concentrated. However, since there is no more site for housing development in Seoul, the government has chosen to provide housing by demolishing old low-rise Apatu in the city center and reconstructing them into higher buildings. According to the "Cumulative Apatu reconstruction case (1983-2021) in Seoul," it can be confirmed that 210,988 households of Apatu have been demolished so far, and 344,546 households have been reconstructed (Ministry of Land, Infrastructure and Transport 2022).

Secondly, it is difficult to reuse concrete Apatu made by wet construction. Despite maintenance and replacement work is required due to the aging of the building's installation and structure over time, partial intervention is impossible, because every building elements is woven into one by wet construction. That's why inevitable demolition is happened. In fact, the main installation of the building, such as electricity, heating, and water pipes, are buried in the center or floor of the building by wet construction.

Next, it is difficult to modify the space because the building itself is supported by reinforced concrete bearing wall structure. According to the "Population Census 2021," the average number of household member in 1970s when Apatu were built in earnest in large scale was 5.2, while there was more than a double decrease to 2.1 in 2021 (National Statistical Office 2021). However, since all the spaces inside the Apatu are divided into bearing walls, the house cannot be transformed to suit the changes in household members. Therefore, the demand for Apatu, which was built according to the average number of household members in the past, gradually decreases and eventually it is demolished.

Finally, since the increasing number of vehicles per household every year, various problems are occurring due to insufficient parking spaces in the Apatu complex. According to "Automobile Registration in Seoul", despite the considerable development of the public transportation and shared automobile system in Seoul, the status of automobile registration continues to rise (Seoul Metropolitan Government 2022). Most of the old Apatu complexes are difficult to handle the current amount of cars that have risen dramatically over several decades, since parking lots were planned to fit the vehicle's capacity at that time.

Problem Statement

Korean representative housing type that could not accommodate such rapid social changes were demolished and rebuilt repeatedly every 30 years, and this phenomenon has become a kind of culture in Korean society with various social and environmental problems.

First, in the process of demolishing it, not only a lot of energy is consumed, but also a huge amount of construction waste is generated. According to the “Daily Generation by Waste Type” released by the Ministry of Environment, the amount of construction waste accounts for the largest portion at 44.5% (Ministry of Environment 2022). Also, most of the waste is not reused and is just moved to landfill.

Next, after the demolition is completed, a high-rise Apatu is built again with a wet construction of reinforced concrete method, and a considerable amount of CO2 is emitted. Among the world’s CO2 emissions, the amount in the construction industry accounts for the largest portion with about 47%, and the use of cement, steel, and aluminum is 23%, accounting for about a quarter of the total emissions (Global ABC Global Status Report 2021). Nevertheless, it is repeated by sticking to the same method as before, which pursued only construction efficiency.

1960s
Concrete Apartment

1990s
Demolition

1990s
Re-constru

Also, the amount of energy people consume in the process of using the building cannot be ignored. As mentioned earlier, only construction efficiency was a major issue, so there is no consideration for the indoor environment and building energy sufficiency when the building was designed. All households rely on air conditioning throughout the summer, and still use large amounts of gas to heat their rooms. As a result, among the total energy use of buildings in Korea, Apatu are the highest at 43% (Ministry of Land, Infrastructure and Transport 2021).

Finally, the whole process of constructing an Apatu complex consisting of thousands of households is carried out by a construction company with a supply-oriented top-down method. Also, most Apatu projects are monopolized by some major construction companies. According to the "2018 Economic Justice Implementation Citizens' Association," the domestic top four construction companies exclusively carried out 55% of Korea's Apatu projects that year (Economic Justice Implementation Citizens' Association 2018). Due to the efficiency and business feasibility of their construction, it has become a type of building that is difficult to reflect the requirements of users in that design of thousands of households is completely same until the wallpaper color. In addition, the average of Apatu ceiling height has remained unchanged for decades at 2.2m. Although the average height of Koreans has grown 6.4cm for men and 5.3cm for women compared to 40 years ago, they keep making same ceiling height to build more floors within the legally prescribed building height limit. (Ministry of Trade, Industry and Energy 2022)

uction

2020s
Demolition

2020s
Re-Re-construction

Figure.05 Problem Diagram

Context

"Mapo Samsung Apatu" in the center of Seoul is one of the clear reference explaining Korea's reconstruction culture. This building has already been reconstructed in 1990s. But it is very symbolic project in that they are preparing second reconstruction which is the first case in Korea. Before the current Mapo Samsung Apatu exist, in the same site there was "Mapo Apatu," the first high-rise apartment in Korea, in the 1960s. At the time, it became a symbolic architecture of Seoul under the government's radical drive to introduce a new modernized residential environment, along with resolving the housing shortage problem in Seoul. In fact, the project gained popularity from the public and became the object of the desire which gives modernized and luxurious lifestyle.

However, due to the aggravated population concentration problem of Seoul, Mapo Apatu, Korea's first high-rise apartment, was demolished in the 1990s to build apartments that could accommodate more households. So, Mapo Samsung Apatu which consist of 982 households was rebuilt by Samsung in the same period. Currently, Mapo Samsung Apatu, which going to be 30 years old, will be subject to reconstruction again and be repeated the existing houing development method.

Figure.06 Mapo Apatu

Figure.07 Mapo Samsung Apatu

Objective

This Korean apartment which is inflexible, cannot be reused, and cause various environmental problems, need transition. As Stewart Brand's Shearing Layers said, buildings consist of changes in various layers. It is necessary to take into account the unique characteristics and timescale of each layer such as skin, structure, service, space plan, and stuff (Brand 1994). However, the existing Apatu was constructed using a wet construction method based on the logic of construction efficiency. So, all the building elements were integrated, in other words, partial replacement and repair work is difficult.

Therefore, in order to overcome the phenomenon of simultaneous demolition of buildings according to lifespan of some elements, Open Building principle considering separation between the Support and Infill should be applied (Habraken 1961). Namely, rather than completely demolishing old apartments after 30 years, it will be necessary to reuse the concrete structure itself as a vertical land and vertical infrastructure for new housing unit, add a new installation which makes the building more flexible, and plug-in a new fill system for the living. And over time, structures, services, and infill will not only be freely changed according to the needs of users, but will also be flexibly replaced according to their life cycle.

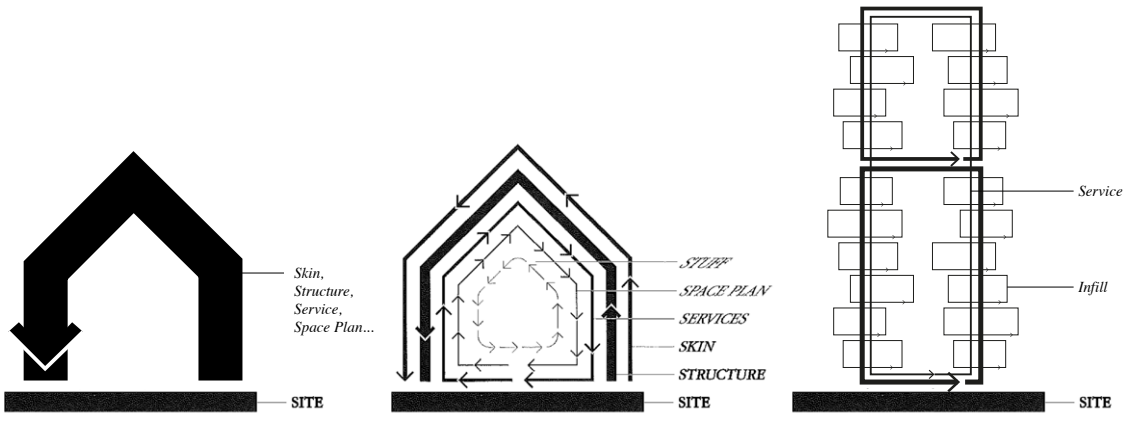

Figure.08 Shearing Layer and Future Apatu

Overall Design Question

In order to achieve this project objective, more detailed configuration will be needed. First, regarding the existing apartment structure that has passed about 30 years will need to be reinforced with the foundation and concrete wall and slab. In addition, there should be a rational demolition plan that can make maximum flexibility by analyzing existing floor plans and structural drawings to determine which is the bearing wall and which can be demolished.

Next, in terms of the new infill system to be plugged in, a mass customized infill system to meet the needs of residents will be a solution to the uniform residential environment created through the existing top-down method. Also, It will be supplied efficiently and eco-friendly through digital production methods using bio-based materials. In addition, it will be a remountable system that residents can easily assemble and transform it as they want, and disassemble it so that they can reuse it other place.

Also, new installation system will be needed to ensure that the combination of these existing concrete structures and new infill can operate in maximum flexibility. In the process, consideration of the passive energy system would be crucial in order to reduce the amount of energy consumed in the building operation, and to minimize the volume of the existing installation for sufficient ceiling height. In addition, all installation systems should be easily maintained and replaced according to their life-cycle.

Finally, as explained earlier, there should also be configuration for vertical extension to solve the problem of housing shortage in Seoul, which was one of the main reason of the reconstruction culture. If the structure, service, and infill system discussed above are expanded vertically with the consideration of the structural acceptance range of the existing building, efficient housing supply will be achieved.

“How could existing Korean apartments (Apatu) be renovated by applying Open Building principles with new installations and mass customized infill systems, using CNC-milled bio-based material, to make buildings future proof and change the Korean reconstruction culture?”

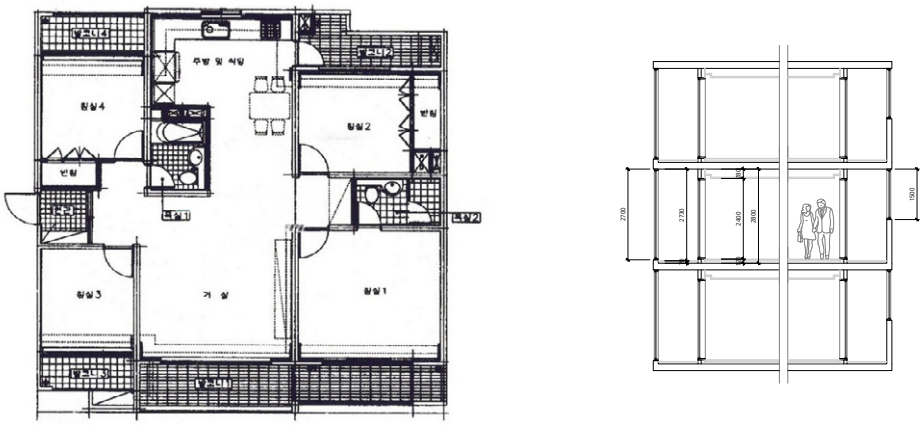

Figure.09 Existing Drawing of Mapo Samsung Apatu

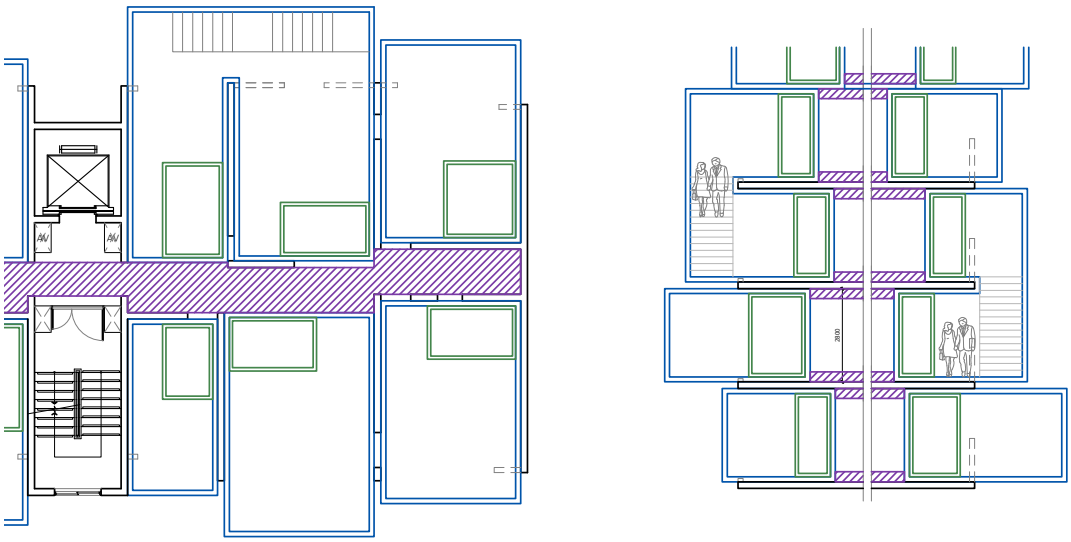

Figure.10 Concept Design

Thematic Research Question

With the consideration of the major topics mentioned above, in order for existing Apatu to become flexible buildings that can be reused in the future again, especially in-depth research regarding installation will be essential. The new system of installation will serve as a medium between existing concrete structures and newly added infill to act like an organism. Also, depending on the position of the new installtion, the program layout of future infill can be flexible, so it's possible to create a unique space configuration which is customized to the needs of users in each housing unit.

"How could new installation system make existing Korean apartment buildings more flexible?"

"What installation are basically needed for Korean apartment?"

"How to measure and quantify flexibility?"

"Which layout of new installation and service shaft maximize flexibility of infill customization?"

"Which passive energy system minimizes the amount of installation to overcome the low ceiling height problem?

Methodology

Existing Technical Drawing Analysis

: Through the analysis of the existing Apatu installation system, what installations are basically needed and which essential conditions are provided for smooth operation will be studied.

Literature Study

: Prior to researching the installation system and layout that will maximize flexibility, research on parameters for evaluating flexibility will be needed. It will be necessary to investigate existing literature on what the criteria for flexibility is needed to achieve the design question and how it can be evaluated and measured.

Reference Analysis

: General ceiling height of Apatu built in the 1990s and 2000s is 2.2m, which is quite low to be recognized as a comfortable space. It will be necessary to conduct a case study on the passive energy system that can not only increase the ceiling height by minimizing the amount of floor and ceiling installation but also save energy in the building operation for the future proof.

: In addition, through a case study applied with this new installations and various layouts of vertical shafts (Central, De-central, Facade, Exterior, etc.), there will be study of what advantages and disadvantages each option has and what impact it can have when applied to existing Apatu in the future.

Product Methodology

: After summarize the new installation systems and their layout options as a result of these initial research, There will be additional comparative analysis between each options based on the tool for evaluating the flexibility created through Literature Study. This will lead to a conclusion as to what new installation system and its layout can maximize the flexibility of the new customized infill system as well as the flexibility of the existing building itself.

Research Structure

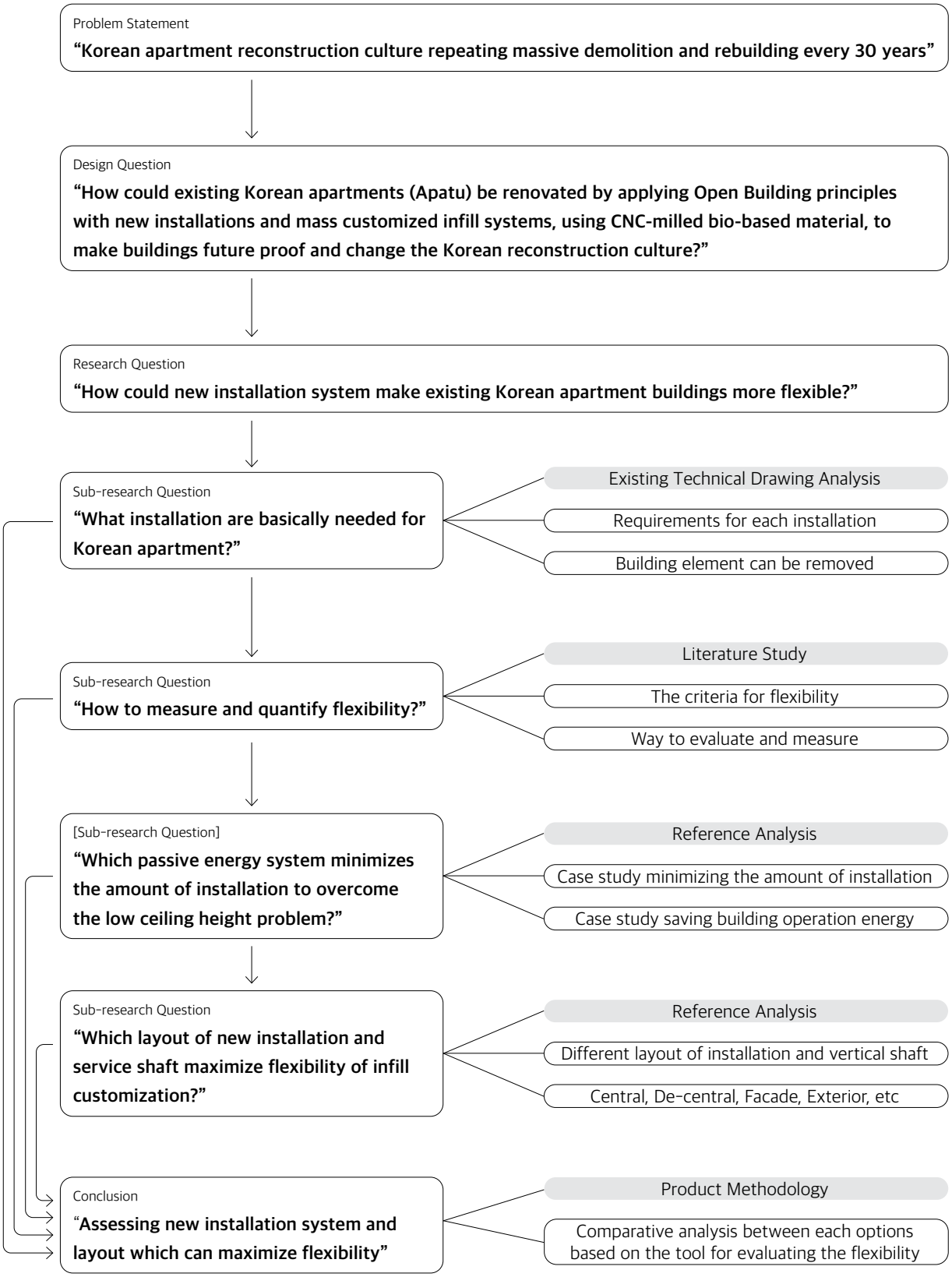

Figure.11 Research Stucture

Planning

		Presentation	Product	Research	Design
Week 45	Nov 07 Nov 13	P1	Research Plan	Preparing, Reflect and edit	Preparing, Reflect and edit
Week 46	Nov 14 Nov 20				
Week 47	Nov 21 Nov 27			Existing Technical Drawing Analysis	Existing Technical Drawing Analysis
Week 48	Nov 28 Dec 04			Criteria for measuring flexibility	Site Analysis
Week 49	Dec 05 Dec 11			Passive energy system	
Week 50	Dec 12 Dec 18			Installation layout	New parking system
Week 51	Dec 19 Dec 25				
Week 52	Dec 26 Jan 01				
Week 1	Jan 02 Jan 08				
Week 2	Jan 09 Jan 15			Flexibility evaluation	Natural air conditioning with Earth, Wind & Fire
Week 3	Jan 16 Jan 22			Synthesis	
Week 4	Jan 23 Jan 29	P2	Research Paper	Preparing, Reflect and edit	Preparing, Reflect and edit
Week 5	Jan 30 Feb 05				
Week 6	Feb 06 Feb 12				
Week 7	Feb 13 Feb 19			Mass customization	Structural concept
Week 8	Feb 20 Feb 26				
Week 9	Feb 27 Mar 05			Construction method	Infill concept
Week 10	Mar 06 Mar 12				
Week 11	Mar 13 Mar 19			Digital mass production	Climate concept
Week 12	Mar 20 Mar 26				
Week 13	Mar 27 Apr 02	P3	Concept Design	Preparing, Reflect and edit	Preparing, Reflect and edit
Week 14	Apr 03 Apr 09			Remountability	Design development
Week 15	Apr 10 Apr 16				
Week 16	Apr 17 Apr 23			Testing model	Plan study
Week 17	Apr 24 Apr 30				Section study
Week 18	May 01 May 07				Detail study
Week 19	May 08 May 14				Final drawing
Week 20	May 15 May 21	P4	Final Design		
Week 21	May 22 May 28			Preparing, Reflect and edit	Preparing, Reflect and edit
Week 22	May 29 Jun 04				
Week 23	Jun 05 Jun 11			Final Model	Final Model
Week 24	Jun 12 Jun 18				
Week 25	Jun 19 Jun 25	P5	Final Drawing / Model	Preparing, Reflect and edit	Preparing, Reflect and edit
Week 26	Jun 26 Jul 02				

Figure.12 Planning

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