東京大学大学院 新領域創成科学研究科
武蔵野大学 Musashino University
住友不動産 —信用と創造—
News Release

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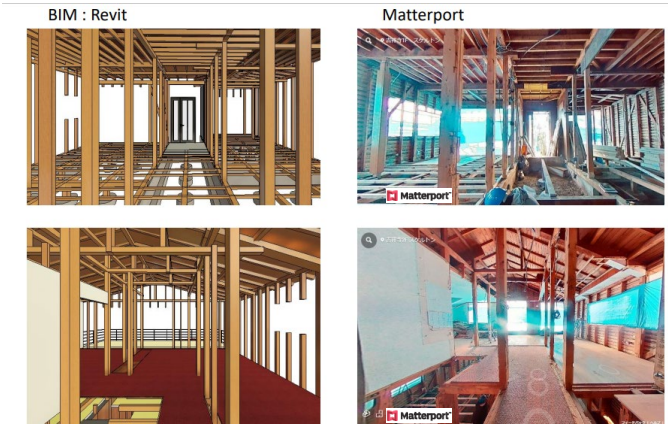
Graduate School of Frontier Sciences, The University of Tokyo
Musashino University
Sumitomo Realty & Development Co., Ltd.

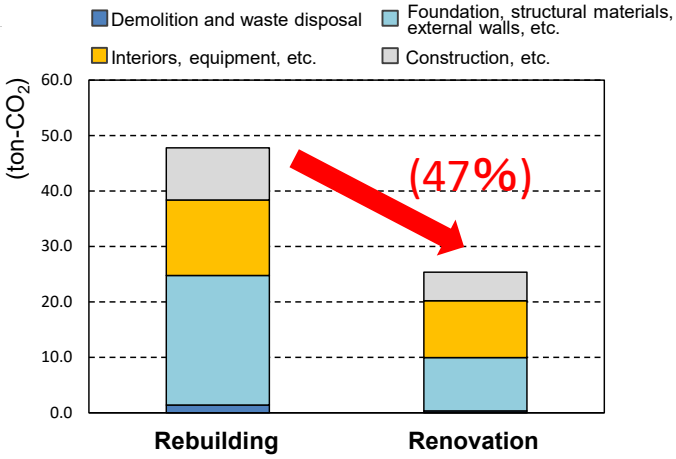
The University of Tokyo, Musashino University, and Sumitomo Realty Announce the Results of Their Research on Decarbonization Through "Shinchiku Sokkurisan" Building Renovation

Improving Building Performance While Reducing CO_2 emissions by 47% Compared to Rebuilding

From December 2021 to March 2022, Tsuyoshi Seike, Professor of the Graduate School of Frontier Sciences at The University of Tokyo, Takayuki Isobe, Lecturer of the Department of Environmental Systems Sciences in the Faculty of Engineering at Musashino University, and Sumitomo Realty & Development Co., Ltd. (President: Kojun Nishima) carried out the first phase of joint research to establish an environmental evaluation method*1 for the renovations of existing detached houses, with the aim of achieving a decarbonized and the sound material-cycle society. The results of this research are detailed below.



BIM (Revit) and 3D modeling (Matterport) were used to create accurate data models of the material compositions, etc. of existing buildings for analysis



Reusing foundations and structural materials made it possible to reduce the amount of CO_2 emissions from the manufacture of construction materials by 47%, or approximately 22 t-CO_2, per house

This research project performed a building LCA evaluation*2, using digital technologies such as BIM*3 and 3D modeling to assess the amount of the building components reused, both before and during renovation of existing detached houses. The amount of new materials used was also determined based on order statements, etc. The results of evaluation performed at Sumitomo Realty renovation worksites found that **for detached houses in which full renovation was performed and significantly improved building performance (earthquake resistance, thermal insulation performance, etc.), the reuse of foundations, main frames, etc. dramatically reduced the amount of new materials used compared to rebuilding the entire building, and cut CO_2 emissions by 47%.**

Dealing with existing detached houses, which account for a large percentage of Japanese housing stock, will be essential for Japan's decarbonization. As such, the renovation of detached houses that reuses existing foundations and structural materials is drawing attention as one effective approach. We will continue this research, with the aim of further advancing decarbonization.

*1: Environmental evaluation method (for renovations) refers to tools and methods for quantitatively and generally assessing the amount of waste generated, new resource usage, CO_2 emissions, etc. associated with buildings. By quantifying, it makes possible to visualize reductions, and make comparison with rebuilding, etc. While methods such as the LCA Guidelines for Buildings already exist for newly constructed buildings, such methods have not yet been established for building renovations.
*2: LCA stands for Life Cycle Assessment. LCA is a method of quantitatively evaluating the overall environmental impact of a product across its entire lifecycle.
*3: BIM stands for Building Information Modeling. BIM is a technology to create three-dimensional digital models of buildings by entering and combining material data, etc.

■ Research methods leveraging digital technologies

In this research, data obtained through 3D modeling using 360° cameras was used to create a digital model using BIM with a database of structural materials. The movement of materials before and during renovation was then assessed in detail. As the equipment and material compositions of buildings differ depending on how and when a building was constructed, close visual confirmation was performed for areas that could not be determined from the camera data, which enhanced the accuracy of the system.

The above data confirmed the amount of existing materials used, making it possible to quantify the amount of waste generated and new materials used, etc., compared to rebuilding on an empty lot, after demolition and removal of foundation, and to calculate the corresponding reduction of CO_2 emissions.

◆ Research procedure

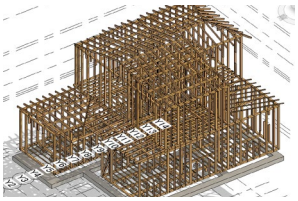
1. Assess the material composition of an existing detached house before and during renovation

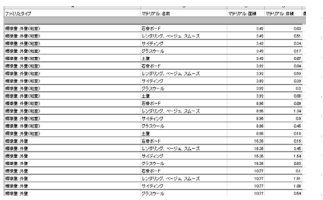
- Perform imaging using 360° cameras and carry out 3D modeling
- Visually confirm locations that could not be observed by cameras, such as behind walls
- Visually confirm waste, and determine the amount of new materials used

Building dollhouse model created using 3D modeling

2. Enter the obtained data into the BIM system and perform a detailed analysis

- Organize information by dimensions and materials for each building material, and enter the data to the BIM system to create detached house database
- Categorize reused and replaced materials


BIM framework model of an existing building

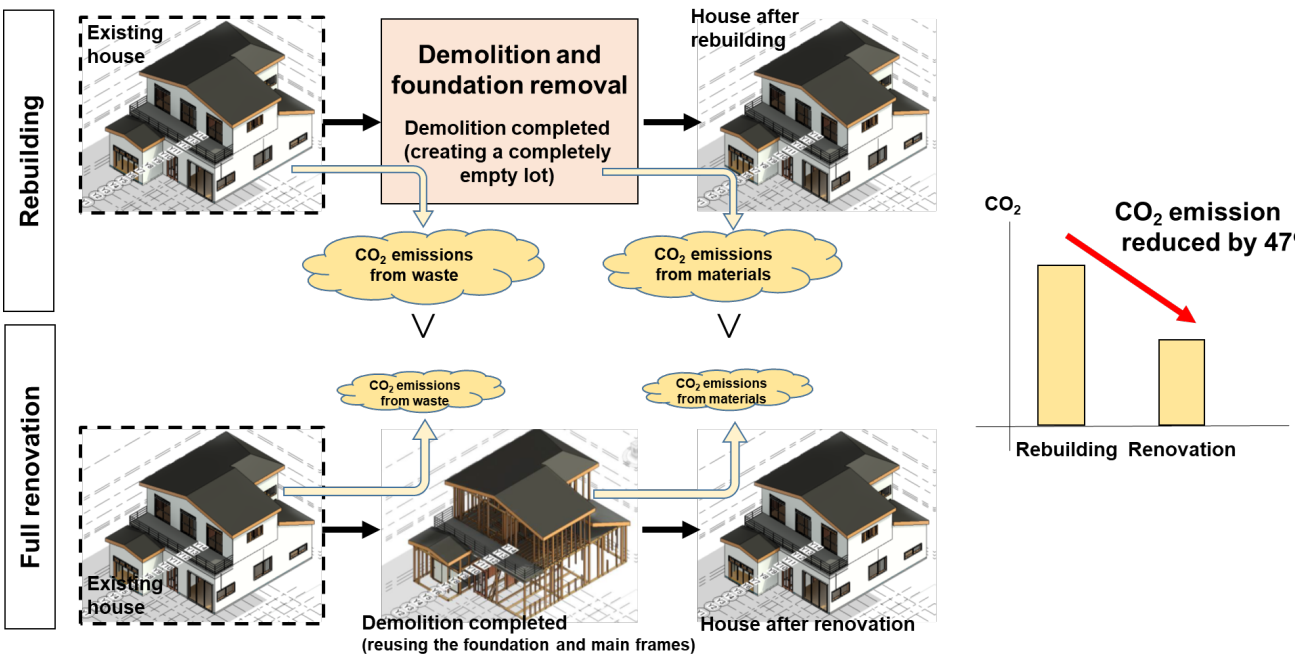


Creation of a wooden house renovation model and tabulation of individual materials using the BIM

3. Enter the data into the LCA tools to calculate the amount of CO_2 emissions resulting from the new materials used, waste generated, construction, etc. individually

- Detached house data (BIM)
- New material usage data (order statements, etc.)
- Waste generation data (manifests, etc.)

Input into tools according to the LCA Guidelines for Buildings

CO_2 emissions



■ Background behind the joint research project

In its efforts aimed at achieving carbon neutrality by 2050, the Japanese government has set an interim target of a reduction of CO_2 emissions from the household sector by 66% by 2030, compared to the FY2013. Achieving this target will require immediate action. Although discussions have been carried out on various topics for newly constructed detached houses, such as improving their environmental performance, little progress has been made toward promoting energy savings or decarbonization for existing houses, which far outnumber new houses (there are currently roughly 50 million existing houses).

In 1996, Sumitomo Realty started the housing remodeling business, with its Shinchiku Sokkurisan remodeling brand. Since then, we have carried out approximately 150,000 “full remodeling” projects to enhance house safety and livability. In these projects, we have improved earthquake resistance and insulation performance of existing houses while keeping construction costs down by utilizing existing materials, such as foundations and main frames. We have also been actively working to promote the decarbonization of existing houses. For example, last December, we have started offering a high thermal insulation remodeling plan to improve the energy-saving capabilities of houses. In April, we launched SUMIFU × ENEKARI, a service to install solar panels and storage batteries at zero initial cost in conjunction with our renovation work.

Establishing methods for evaluating the environmental contributions of renovations is a fundamental part of building systems to promote the decarbonization of existing detached houses. The Graduate School of The University of Tokyo and Musashino University contacted Sumitomo Realty to request our assistance in their research to create these evaluation methods, due to our broad-ranging construction track record, which covers from partial to full remodeling. We agreed to give our full cooperation in performing studies at construction sites and providing data, and the research project began in December 2021.

＜Reference＞

“High Thermal Insulation Remodeling Plan by Shinchiku Sokkurisan Launched Nationwide” released on December 10, 2021

“Shinchiku Sokkurisan Remodeling Business to Start Offering SUMIFU x ENEKARI, a Solar Power Generation Service that Delivers Continuous Peace of Mind” released on April 4, 2022

“The University of Tokyo, Musashino University, and Sumitomo Realty “Shinchiku Sokkurisan” Conduct Joint Research to Establish an Environmental Evaluation Method for Renovations of Existing Homes” released on February 24, 2022 (JP)

■ Future research plan

Phase 1	Verify the CO_2 emissions reduction effectiveness of existing detached house renovations
Phase 2	Verify the building lifespan extension effectiveness of existing detached house renovations
Phase 3	Verify the adoption of ZEH[*1] and achievement of LCCM[*2] through existing detached house renovations

The data obtained from the on-site studies explained above will be organized and used to create a renovation database. This database will be used to generalize the effect of reduction of waste and new material usage in renovations of existing detached houses, as well as reduction of the energy consumed in their construction and transport, etc. In the future, we aim to create an evaluation system that is capable of visualizing (quantifying) CO_2 emissions reductions with steady degree of precision without performing detailed studies at individual sites.

In order to verify whether CO_2 emissions reductions can be expected over the long term, not only at the time of renovation, Phase 2 of the research project will verify the effectiveness of renovation in extending the useful lives of existing detached houses, while Phase 3 will verify the effectiveness of introducing energy saving and energy creation equipment in existing detached house renovation. Through these studies, we aim to establish an environmental evaluation method (for renovations) for existing detached houses, that enables a comparison of rebuilding and full renovation with building LCA evaluation over an extremely long period, from building construction to eventual demolition.

This environmental evaluation method has the potential to be used in effective decarbonization approaches for existing detached houses, which account for a large percentage of housing stock, and can further advance the movement to reuse existing detached houses.

*1: ZEH refers to Zero Energy House. Houses with net zero annual primary energy consumption due to energy saving and energy creation.

*2: LCCM refers to Life Cycle Carbon Minus. Houses with negative CO_2 emissions over the course of their entire lifecycle, due to CO_2 emissions reduction efforts during the construction, usage, and disposal stages, together with the generation of renewable energy.

■ Joint researchers

Tsuyoshi Seike – Professor, Graduate School of Frontier Sciences at The University of Tokyo

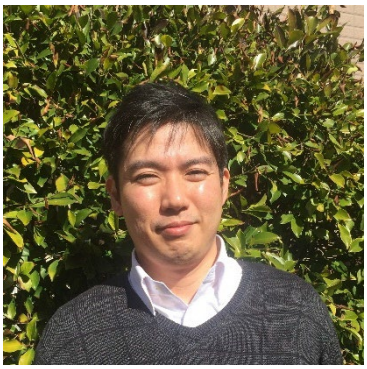
Tsuyoshi Seike graduated from the Department of Architecture in the Faculty of Engineering at The University of Tokyo in 1987. He worked as a Research Associate in the Department of Architecture before joining the Graduate School of Frontier Sciences in 1999.

He engages in research in renovation/demolition technologies, recycling technologies, and environmental evaluation systems, from the viewpoints of building production and the environment.

He is the development leader for CASBEE for Detached Houses, and plays a central role in creating health checklists and resilient house checklists.

His publications include *Sustainable Housing* (editorial supervisor and co-writer), *Creating Facades* (co-writer), and *Rethinking Living Environments - From Smart to Healthy* (co-writer).

Takayuki Isobe – Lecturer, Department of Environmental Systems Sciences in the Faculty of Engineering at Musashino University



Takayuki Isobe received his Doctorate from the Graduate School of Frontier Sciences at The University of Tokyo in 2015. In 2016, he was appointed to the Department of Environmental Systems Sciences in the Faculty of Engineering at Musashino University.

His research has focused primarily on environmental evaluation systems that relate to the recycling of construction materials and building lifecycle (construction, usage, and disposal) environments.

He is the Director of the LCA Subcommittee of the Research Committee on Global Environment in the Architectural Institute of Japan.

Sumitomo Realty & Development Co., Ltd.

Sumitomo Realty has been working to solve social issues through its business activities under its fundamental mission to “Create even better social assets for the next generation.”

Going forward, the Company will further contribute to realizing a sustainable society by creating high-value social assets with environment and social awareness.

＜Our Initiatives on ESG and SDGs＞
https://www.sumitomo-rd.co.jp/english/sustainability/

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The initiatives related to this release contribute to the following SDGs objectives:

Goal 3: Good health and well-being
Goal 7: Affordable and clean energy
Goal 9: Industry, innovation and infrastructure
Goal 11: Sustainable cities and communities
Goal 12: Responsible consumption and production
Goal 13: Climate action
Goal 15: Life on land

＜Reference＞
“Shinchiku Sokkurisan” Remodeling by Sumitomo Realty

The Shinchiku Sokkurisan remodeling business was launched after the Great Hanshin Awaji Earthquake of 1995 with the desire to renovate existing houses to make them earthquake resistant without the high cost of rebuilding. Based on our concept of safe and secure housing, it boasts the industry’s foremost track record for full remodeling featuring earthquake reinforcement work and a clear fixed-price system.

It marked 25th anniversary this year, since its launch in 1996, and the cumulative total of units contracted exceeded 150,000 units (as of June 30, 2021). Today, the Shinchiku Sokkurisan has become so popular across the nation that it is a brand synonymous with full remodeling. By leaving main structural components intact and improving housing functionality without rebuilding, the Shinchiku Sokkurisan remodeling contributes to not only extending the useful lives of existing houses, but also to addressing the social issues concerning houses in Japan by being environmentally friendly, i.e. minimizing industrial waste, CO_2 emissions, and waste of resources.

Unique Features of “Shinchiku Sokkurisan” Remodeling

Interior stripped down to its main frame

(1) Clear fixed-price system with no additional charge* (developed by the Company)

There will be no additional charges in the event that an unforeseen situation arises after construction has begun, such as discovering a rotten pillar that needs to be replaced after a wall is torn down.
This relieves customers’ concerns about costs, which is often the case with remodeling work, and allows them to leave the work to us with peace of mind.

*Only when there are no changes to the scope of work requested by the customer.

(2) A dedicated sales engineer with knowledge and proposal skills manages the entire project

From initial consultation to planning, estimating, and construction management, a dedicated sales engineer manages the entire project. This prevents problems, such as the customer’s requests not being clearly communicated to the constructor and not being reflected in the construction work, and allows us to proceed with the construction of the house based on the customer’s requests.

(3) A lineup of reliable seismic resistance and vibration control reinforcements for buildings of all ages

For earthquake countermeasures to ensure the safety of buildings, we have established a system that can propose the most suitable seismic resistance and vibration control reinforcement plan for buildings of all ages. Our plans combine seismic reinforcement proven through our experience in construction and vibration control reinforcement, which includes a new patented method.

(4) Reliable quality through dedicated master carpenters, extensive construction manuals, etc.

We achieve reliable construction quality through the mastery of our dedicated master carpenters who are skilled in large-scale remodeling, as well as detailed construction manuals based on data accumulated over many years and a thorough inspection system.

(5) Reliable support system (after-sales service)

As for our regular after-sales service, we visit our clients for inspection one month, three months, and one year after completion. In addition, our Customer Center always responds to inquiries about problems and repairs regardless of the urgency of the situation.

＜Reference＞
“Shinchiku Sokkurisan”– Model of extending useful life of existing houses by renovation

Key issues with the housing stock

- Shorter life cycle than houses in Europe and the U.S.
- Insufficient earthquake resistance and insulation
- Mismatches between lifestyles and floor plans
- Environmental impact from waste generated when rebuilding

Through the Shinchiku Sokkurisan remodeling:

Extended useful life through improved functionality
Earthquake-proofing and seismic retrofitting
Revised floor plans to suit changing lifestyles

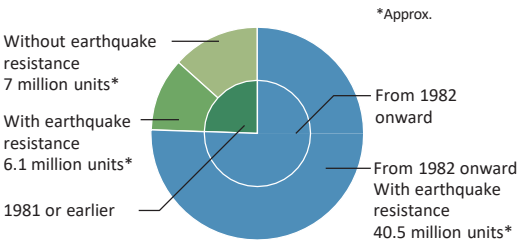
Reduced environmental impact
Reduced waste by leaving main structural components intact to lower CO_2 emissions and improve energy-saving functionality

Renovation of traditional-style houses harmonizes the cityscape
Traditional-style house exteriors left in place, harmonizing with other homes in the community; interiors modernized to match current lifestyles

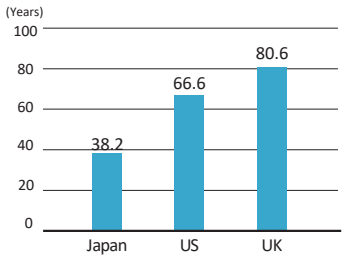
■ Social issues concerning houses in Japan

Although the penetration rate of earthquake resistant houses in Japan is increasing every year, there are still many houses with low earthquake resistance. Moreover, the lives of houses in Japan are relatively short compared with those in Europe and U.S. and the short rebuilding cycle has emerged as an issue in contemporary Japan. Waste from the demolition of houses accounts for a large share of waste discharged by the construction industry. It is called for that lives of houses should be extended to facilitate the shift to a stock-type society where houses could be used by successive generations.

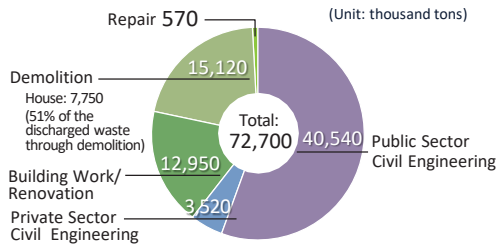
❶ Earthquake-resistance of housing stock



❷ International comparison of the average age of houses



❸ Breakdown of construction waste



Sources: ❶ Ministry of Land, Infrastructure, Transport and Tourism“Progress of Earthquake Proofing of Houses”
❷ Ministry of Land, Infrastructure, Transport and Tourism“International Comparison of Average Age of Houses Deregistered in 2018”
❸ Ministry of Land, Infrastructure, Transport and Tourism “Residential Land Session, Panel on Infrastructure Development (36th) ”

■ Shinchiku Sokkurisan initiatives concerning social issues

Extending the useful lives of houses through seismic reinforcement

Shinchiku Sokkurisan offers proposals for improving the house’s functionality to make it earthquake resistant without rebuilding mainly through seismic reinforcement work based on earthquake resistance diagnosis that meets the government’s safety standards.

Moreover, in the Kumamoto Earthquake of 2016, a series of powerful tremors caused the collapse of houses previously considered not to need seismic reinforcement under current laws. In view of such circumstances, we developed a proprietary method to counter such a series of powerful tremors. With the addition of this new method, we now offer seismic reinforcement and damping plans suitable for houses of all ages.

We are promoting houses where people can continue to live in with peace of mind by improving the safety functions through this reinforcement work.

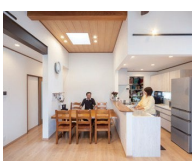
Contributing to the reduction of the environmental impact

Shinchiku Sokkurisan remodeling contributes to the reduction of the environmental burden by extending the life of the house through earthquake reinforcement while the principal structural elements of the house are retained, thus minimizing industrial waste discharge, CO_2 emission, and waste of resources, compared to the demolition involved in building a new house.


Interior stripped down to its main frame

Revised floor plans to suit changing lifestyles

In addition to seismic reinforcement, Shinchiku Sokkurisan offers remodeling that makes living comfortable, with thermal insulation, waterproofing, barrier-free design, etc. Furthermore, in response to changes in family structures and aging population, we offer solutions customized for the lifestyles without rebuilding, such as layout changes, extensions, downsizing, transformation of a two-story house to a one-story house, or a two-family house.



Solution for rapidly increasing disused houses

The high number of disused detached houses has become a social issue in Japan. Through remodeling, turning them into social welfare centers, share- houses, travelers’ inns, etc., we contribute to utilization of existing house stocks and support safe and sustainable city.