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**REFINING ARCHITECTURE® Rental Housing****Study Finds that Reusing the Existing Frame Reduces CO2 Emissions  
by 72% in Comparison with Reconstruction****- Results Obtained through Joint Research  
with the University of Tokyo -**

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Tokyo, Japan, September 22, 2021 – Mitsui Fudosan Co., Ltd., a leading global real estate company headquartered in Tokyo, conducted joint research (“the Joint Research”) into REFINING ARCHITECTURE, which is a construction method that reuses existing frames, with Professor Tsuyoshi Seike of the Graduate School of Frontier Sciences, the University of Tokyo (“UTokyo”), with the cooperation of SHIGERU AOKI Architect & Associates Inc. The Joint Research performed an evaluation of the CO<sub>2</sub> emissions reduction effect of REFINING ARCHITECTURE. It studied the CO<sub>2</sub> emissions reduction effect of a REFINING ARCHITECTURE project that Mitsui Fudosan is now planning with SHIGERU AOKI Architect & Associates (Shinjuku-ku, Tokyo; a rental property built in 1971; “the Project”). As a result, the study found that CO<sub>2</sub> emissions could be reduced by 72% through the reuse of approximately 84% of the existing frame, in comparison with the case of reconstructing the existing structure into a building of the same size.

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**■ Summary of the Property Studied Through the Joint Research**

In the Project, a rental property built 49 years ago to previous seismic standards (Shinjuku-ku, Tokyo; 9 aboveground floors; total floor area: approx. 2,610 m<sup>2</sup>; steel-reinforced concrete structure, partly reinforced concrete structure) will be revitalized using REFINING ARCHITECTURE. With this construction method, surveys, maintenance, and repairs of the frame will be carried out to restore the building’s useful life to that of a new building. The building’s seismic functions will also be improved to meet the level of current laws and regulations. Moreover, under the REFINING ARCHITECTURE method, work such as replacing window sashes and upgrading insulation will also be carried out to restore the energy performance when the completed building is in operation to the same level as a new building.



Perspective  
drawing of the  
completed building

**■ Results of the CO<sub>2</sub> Emissions Survey Through the Joint Research**

Generally, building construction generates significant amounts of CO<sub>2</sub> emissions during the manufacturing of construction materials such as steel and cement, which are purchased in connection with the dismantling of an existing building and the construction of a new frame. REFINING ARCHITECTURE enables CO<sub>2</sub> emissions to be reduced greatly in comparison with reconstruction because the existing frame is reused.

Accordingly, the Joint Research focused on the manufacturing stage, where the CO<sub>2</sub> emissions reduction effect is the greatest among the manufacturing, transportation and construction stages. The amount of construction materials used when implementing REFINING ARCHITECTURE was calculated, and the amount of CO<sub>2</sub> emissions released during the manufacturing of the materials was estimated. The same calculations were made for the case of reconstructing the property. By comparing the results, the Joint Research studied\* the CO<sub>2</sub> emissions reduction effect of the construction method.

As a result, the estimates of the Project showed that CO<sub>2</sub> emissions from the manufacturing of frame materials in the case of reconstruction was 1,761 tons. In comparison, since 84% of the frame is reused in the case of REFINING ARCHITECTURE, CO<sub>2</sub> emissions from the manufacturing of frame materials was estimated to be 40 tons. The study found that REFINING ARCHITECTURE would provide an overall CO<sub>2</sub> emissions reduction effect of 1,721 tons (approx. 72%) in comparison with the case of reconstruction.

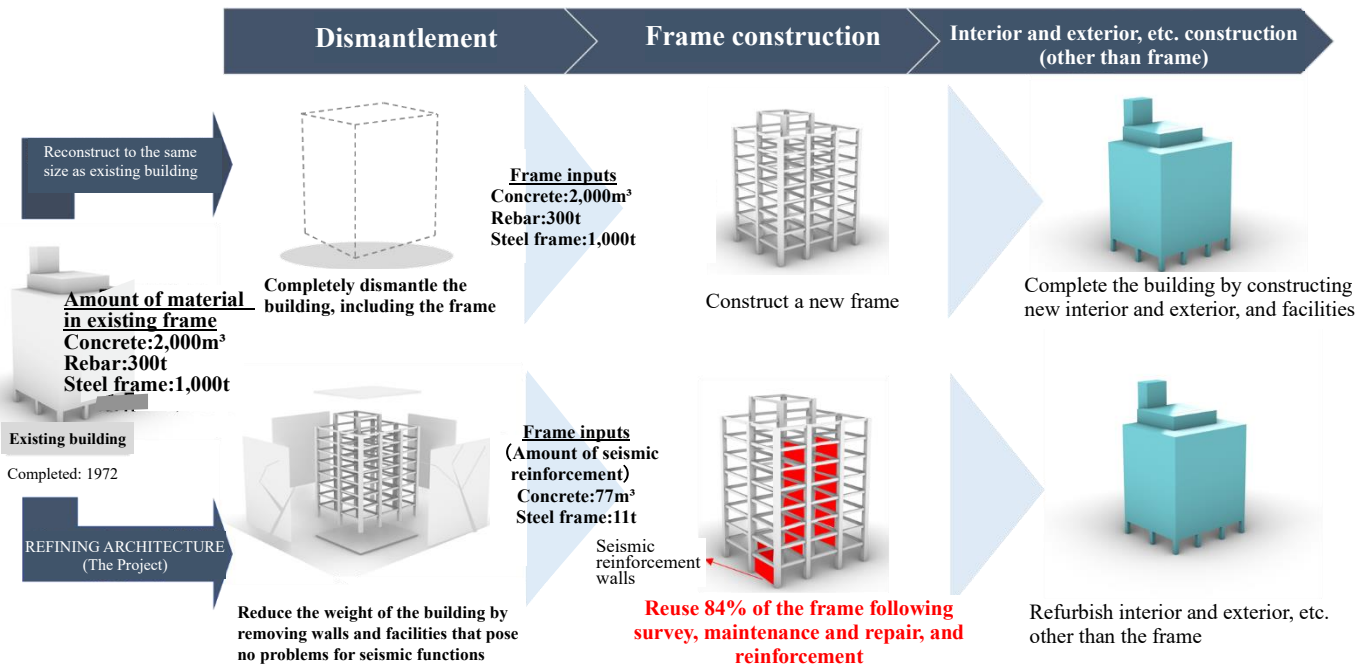
In general, REFINING ARCHITECTURE reuses 80% or more of the frame. REFINING ARCHITECTURE not only allows the seismic upgrade of aging property, but it also enables a substantial reduction in CO<sub>2</sub> emissions during construction in comparison with the case of reconstruction. For this reason, this research clearly established that REFINING ARCHITECTURE could serve as a viable solution proposal for realizing a decarbonized society.

**< Difference in CO<sub>2</sub> Emissions between Reconstruction and REFINING ARCHITECTURE Found by the Joint Research >**

	CO <sub>2</sub> Emissions from the Manufacturing of Construction Materials		Total
	Frame	Interior and exterior, and facilities, etc. (other than frame)	
Reconstruction	<b>1,761t</b>	614t	<b>2,375t</b>
REFINING ARCHITECTURE	<b>40t</b>	614t	<b>654t</b>

CO<sub>2</sub> emissions were reduced by 1,721 tons, or 72%, overall, through the reuse of frame

## <Differences in Processes between Reconstruction and REFINING ARCHITECTURE>



\* Assumptions behind the estimates of the Joint Research

- The reuse rate for the existing frame was calculated by defining the frame as the gross amount of the volume of concrete used, including non-structural walls without structural resistance. In the case of REFINING ARCHITECTURE, the amount of dismantled material was 311 m<sup>3</sup> of concrete and 12 tons of rebar.
- The frame inputs were calculated based on blueprints and actual measurements.
- CO<sub>2</sub> emissions from the manufacturing of frame materials are calculated using the frame inputs and the CO<sub>2</sub> emissions per unit of concrete, rebar, and steel frame listed in LCA Database Ver.1.01 published by the Architectural Institute of Japan.
- CO<sub>2</sub> emissions from interior and exterior, etc. construction (other than the frame) is calculated by multiplying the CO<sub>2</sub> emissions per unit of each construction material item, which is based on LCA Database Ver.1.01 published by the Architectural Institute of Japan, by the floor area of the Project. The calculation does not take into consideration items other than construction materials.
- The building life and the primary energy use of the building in operation after completion are assumed to be equivalent for the cases of reconstruction and REFINING ARCHITECTURE and are therefore not taken into consideration.
- CO<sub>2</sub> emissions from transportation and construction are not taken into consideration given that the Joint Research is focused on the CO<sub>2</sub> emissions reduction effect resulting from the reuse of the frame in REFINING ARCHITECTURE.

### ■ Division of Roles in the Joint Research



In 1991, Mr. Seiki started working as a Research Associate in the Department of Architecture of the Faculty of Engineering at The University of Tokyo. Since 1999, Mr. Seike has served in his current post. He is a professor (Engineering). Currently, Professor Seike is a member of the Department of Environmental Studies. From his standpoint of considering building construction and environmental issues, he is conducting research in areas such as building refurbishment and dismantlement, recycling technologies, and decision-making processes in the design and production stage to reflect environmental considerations. He has written books such as “Sustainable Housing” and “Creating a Façade -PCa Concrete Technology and Changes.



Licensed First-class Architect and Professor (Engineering, The University of Tokyo). Visiting Professor, Dalian University of Technology; Visiting Professor, Nippon Bunri University; Specially Appointed Professor; Mokwon University, Korea. As the creator of the REFINING ARCHITECTURE, Professor Aoki has been engaged in the structural revitalization of numerous properties, including residential complexes as well as public architecture projects and office buildings. He is the author of books such as “How to Build Long-lasting Architecture – Renovation to Ensure Lasting, Elegant Use,” “REFINING ARCHITECTURE Will Transform Society,” and “Revitalizing Architecture – Pioneering the Future with REFINING ARCHITECTURE.”



## ■ Overview of the Project

< Exterior (Before/After) >



## 【 Site Overview 】

Location	3-1 Shinanomachi, Shinjuku-ku, Tokyo
Access	Seven-minutes' walk from Shinanomachi Station on the JR Chuo Line Eight-minutes' walk from Yotsuya-sancho Station on the Marunouchi Line
Zoning District	Category 1 medium- to high-rise exclusive residential district
Site Area	968.46 m <sup>2</sup>

## 【 Property Overview (Plan) 】

Purpose	Rental housing (32 units), 1 store
Structure	High-rise building: steel-reinforced concrete, Low-rise building: reinforced concrete
Total floor area / Building area	2,610.42 m <sup>2</sup> /405.86 m <sup>2</sup>
Building certification application / Certificate of Inspection	Submitted building certification application (Construction type: Large-scale remodeling) Scheduled to obtain certificate of inspection
Reinforcement plan	Guarantee a seismic index rating of 0.6 through new installation of damper walls
Architectural firm	SHIGERU AOKI Architect & Associates Inc.
Construction firm	DAISUE CONSTRUCTION CO., LTD.
Scheduled completion date	Completion scheduled for March 2022 (The existing building was constructed in 1971.)

## **■ Features of REFINING ARCHITECTURE**

### **(i) Seismic reinforcement that does not interfere with the outside view or exterior**

Walls and facilities are eliminated when they pose no problems for seismic functions, building weight is reduced, and seismic functions are improved without interfering with the outside view or exterior by using a unique reinforcement method.

### **(ii) Low cost and reduced construction timeframe compared to reconstruction**

Facilities and exterior and interior are refurbished at around 70% of the cost of reconstruction. Because there is no need for dismantling and construction of a new frame, the construction timeframe is also reduced. ※<sup>1</sup>

### **(iii) Revitalize property to the equivalent of a new building in legal terms by re-obtaining the certificate of inspection**

Standalone rules applicable to the building are updated to conform with existing laws and regulations. Doing so allows a new certificate of inspection to be obtained and guarantees future asset liquidity. In particular, with regard to the structural frame, a “home information record”<sup>\*2</sup> is created to provide a record of all the maintenance and repair processes.

### **(iv) Reduces construction waste and is environmentally friendly**

Reuse of the existing frame makes it possible to greatly reduce CO<sub>2</sub> emissions from construction.

\*1 Actual results for SHIGERU AOKI Architect & Associates Inc. and Mitsui Fudosan. However, the results will depend on the features of the property.

\*2 An information record of the building, proposed by Professor Tomonari Yashiro of the Institute of Industrial Science, The University of Tokyo.

**[ Please visit the URL below for a video that explains REFINING ARCHITECTURE. ]**

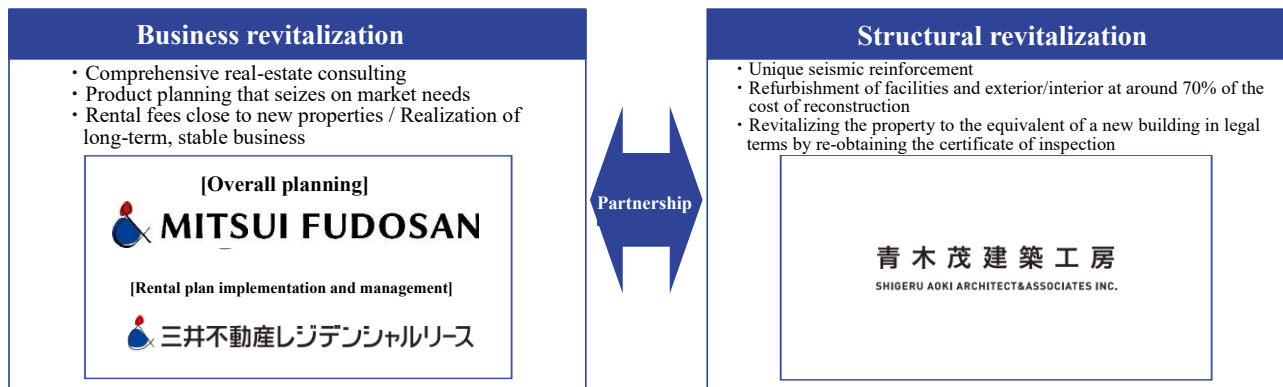
<https://lets.mitsuifudosan.co.jp/refining/02.html> (Japanese)

## **■ About the Consulting Service for Aging Property Revitalization**

Mitsui Fudosan offers a consulting service for aging property revitalization together with SHIGERU AOKI Architect & Associates. The service applies REFINING ARCHITECTURE, which is SHIGERU AOKI Architect & Associates' construction method.

For owners of aging properties, primarily those built to previous seismic standards, this service strives not only to structurally revitalize their properties, but also to offer support ranging from comprehensive real estate consulting to product planning, rental management and operation, and business revitalization. This support is offered in partnership with the Mitsui Fudosan Group. Through this service, Mitsui Fudosan will solve the various issues faced by aging properties.

< Business Structure >



■ Mitsui Fudosan Group's Contribution to SDGs

[https://www.mitsui-fudosan.co.jp/english/corporate/esg\\_csr/](https://www.mitsui-fudosan.co.jp/english/corporate/esg_csr/)

The Mitsui Fudosan Group aims for a society that enriches both people and the planet under the principles of coexist in harmony with society, link diverse values and achieve a sustainable society, and advances business with an awareness of the environment (E), society (S) and governance (G), thus promoting ESG management. By further accelerating its ESG management, the Group will realize Society 5.0, which the Japanese government has been advocating, and contribute significantly to achieving the SDGs.

\* The initiatives covered in this press release are contributing to three of the UN's SDGs.

