Resident's Assessment of the Effects of External Thermal Insulation Retrofitting in Condominiums

(Research period: FY 2023 to FY 2025)
MAKI Naho (Ph. D.), Senior Researcher
Housing Stock Management Division, Housing Department
UTSUMI Koya (Ph. D.), Senior Researcher
Housing Planning Division, Housing Department
FUJIMOTO Hidekazu, Director, Housing Department

(Key words) condominium, external thermal insulation retrofitting, retrofitting effect, questionnaire survey

1. Introduction

As of the end of fiscal year 2022, the total stock of condominium units in Japan has reached about 6.943 million. Many aging condominium buildings exhibit insufficient thermal insulation in their primary structural components. To enhance long-term durability and advance national carbon-neutral goals, promoting energy-efficiency retrofitting has become essential.

This paper reports the findings of a questionnaire survey conducted among condominium residents to assess the effects of external thermal insulation retrofitting.

2. Survey Overview

The survey targeted three condominiums in the suburbs in Kanto that had undertaken external wall thermal retrofitting – specially, external thermal insulation systems - in recent years. Only dwelling units for which at least one year had passed since completion of the works were included. Key building characteristics are summarized in Table-1 (upper section). In all cases, the retrofitting was accompanied by additional improvements to window openings and rooftop insulation..

A structured questionnaire comprising 16 questions (35 sub-questions) was administered, covering respondent demographics, household lifestyle patterns, and residents' assessments of indoor environmental conditions before and after external thermal insulation retrofitting. Survey implementation details for each complex are presented in Table-1 (lower section).

Table-1. Building and Survey Overview

		Condo A	Condo B	Condo C
Building Overview	Location	Chiba City, Chiba	Tama City, Tokyo	Inagi City, Tokyo
	Completed	Sept. 1968	Mar. 1983	Mar. 1993
	Buildings/Units	40 /1,530*1	14/293	7/160
	Floors	5F	3 - 5F	5 - 6F
	Type / Elevator	Staircase w/o E	Staircase w/o E	Single-corridor w/ E
	Structure	RC wall	RC wall (PC)	RC frame / wall
	Major Energy-Efficiency Retrofit Record	2006: Doors 2012: Roof and rooftop 2020: Windows 2021-23: Exterior walls	2021-22: Exterior walls, doors, windows Roof and rooftop	2015: windows 2018: Roof and rooftop 2020: Exterior walls, doors
Survey Overview	Period	Jan. 11 - 26, 2024	Jan. 12 - 26, 2024	Jan. 12 - 26, 2024
	Vaild / Distributed*2	270/879	176/288	108/160
	Response Rate	30.7%	61.1%	67.5%

*1 980 units surveyed, retrofit completed >1 year ago
*2 Excludes vacant units and similar cases.

3. Results

(1) Respondent Characteristics

The average age of the respondents was 70.6 years, the average length of residence was 28.6 years, and the average household size was 2.06 persons. Disaggregated data for each condominium complex are shown in Table-2.

Table-2. Respondent Characteristics

	Overall	Condo A	Condo B	Condo C
Average Age [years]	70.6	72.6	63.8	68.3
Average Years of Residence [years]	28.6	30.1	28.4	25.2
Average Household Size [persons]	2.06	1.76	2.36	2.31

(2) Summer Indoor Environmental Before and After Insulation Retrofitting

① Evaluation of Living-room Temperature

Overall, residents reported predominantly positive evaluations of indoor temperature conditions after retrofitting (Fig.-1). In Condo A, the most frequent response was "No change," whereas in Condo B and C, "Somewhat less hot" was most common, accounting for slightly below 40% of responses.

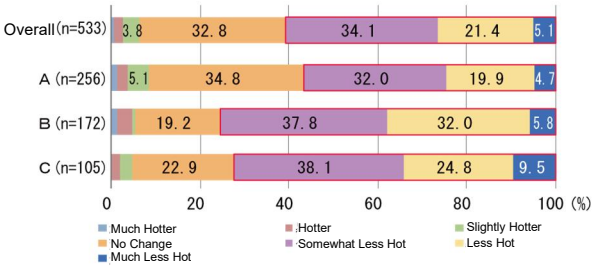

Fig.-1.Summer Living Room Temperature Evaluation After Retrofit

② Changes in Summer Housing and Lifestyle

Across all the three condominiums, residents consistently reported improvements in their summer living conditions, including "Less mold on windows and doors", "Less heat near windows", and "Less heat when entering the house" (Fig.-2). Condo A exhibited a particularly strong trend toward " Less mold on windows and doors", whereas Condo B and C, "Less heat when entering the house " was most prominently reported.

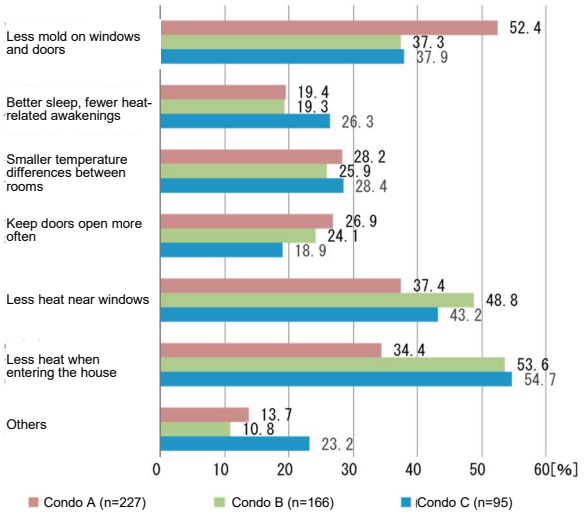

Fig.-2. Changes in Summer Housing and Lifestyle (multiple responses)

③ Summer Electricity Cost and Consumption Before and After Retrofitting

Average summer electricity expenditures in all three condominiums following external thermal insulation retrofitting (Table-3).

Table-3. Electricity Cost and Consumptions in Peak Month (July-September)

	Average Electricity Cost		Average Electricity Consumption	
	Pre-Retrofit / Post-Retrofit	Difference from Pre-Retrofitting	Pre-Retrofit / Post-Retrofit	Difference from Pre-Retrofitting
A	7,916 yen / 7,712 yen	-204 yen (n=111)	255kWh / 255kWh	0 kWh (n=36)
B	10,655 yen / 8,844 yen	-1,812 yen (n=90)	313kWh / 293kWh	-20 kWh (n=46)
C	11,416 yen / 10,686 yen	-731 yen (n=45)	378kWh / 344kWh	-35 kWh (n=24)

(3) Winter Indoor Environmental Before and After Insulation Retrofitting

① Evaluation of Living-room Temperature

Residents reported overwhelmingly positive evaluations—such as “Somewhat warmer,” “Warmer,” and “Much warmer”—across all complexes (Fig.-3). Notably, the degree of positive response was higher in winter than in summer.

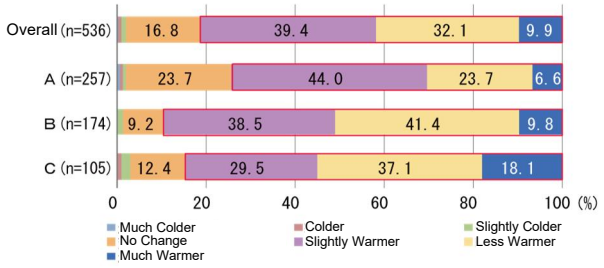

Fig.-3. Winter Living Room Temperature Evaluation After Retrofit

② Changes in Winter Summer Housing and Lifestyle

In all condominiums, “Less mold on windows and doors” was the most frequently reported improvement (Fig.-4). In condo B, where windows improvements preceded external thermal insulation retrofitting in 2021-22, over 60% of residents reported " Less cold near windows" . In Condo B and C, many also cited " Less cold when entering the house".

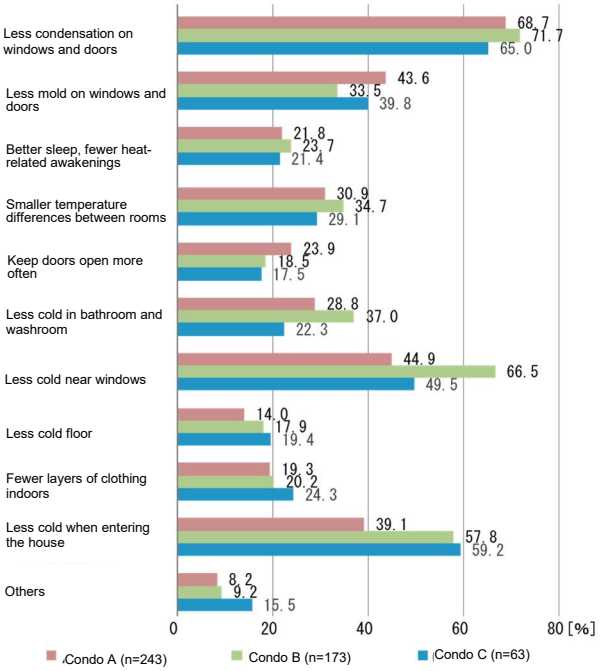

Fig.-4. Changes in Winter Housing and Lifestyle (multiple responses)

③ Winter Electricity Cost and Consumption Before and After Retrofitting

As in summer, average winter electricity expenditures and consumption decreased after retrofitting across all condominiums (Table-4). Gas and kerosene consumption also declined, except for gas expenditures in condo C.

Table-4. Electricity Cost and Consumptions in Peak Month (December – February)

	Average Electricity Cost		Average Electricity Consumption	
	Pre-Retrofit / Post-Retrofit	Difference from Pre-Retrofitting	Pre-Retrofit / Post-Retrofit	Difference from Pre-Retrofitting
A	8,703 yen / 8,204 yen	-499 yen (n=93)	296kWh / 250kWh	-46 kWh (n=37)
B	10,903 yen / 9,778 yen	-1,125 yen (n=81)	337kWh / 286kWh	-50 kWh (n=49)
C	11,992 yen / 11,717 yen	-275 yen (n=43)	411kWh / 344kWh	-66kWh (n=23)

4. Future Work

The survey results confirm both quantitative and qualitative benefits of external thermal insulation retrofitting. Building on the collected data on retrofitting outcomes and associated costs, future work will focus on developing methodologies to quantitatively assess the cost-effectiveness of energy-efficiency retrofitting measures in condominium buildings.