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Housing Stock Renovation and Accessibility -The Renaissance Plan -

Monica Perez Baez

1.0 INTRODUCTION

In Japan, high-density housing and numerous apartment complexes were built after 1955 to alleviate the severe housing shortages resulting from the massive influx of population to major cities during the period of rapid economic growth. Now, there are about 760,000 properties of rental housing stock, most of them being large-scale suburban types, where problems such as insufficient earthquake resistance, poor floor area per capita and inconvenient or unsuitable facilities and layouts for aged and handicapped people are present.

In recent years, sustainable developments have been pursued and changes from a consumption-oriented society to a stock-oriented society as well as major shifts in the focus of housing policies have become required. In the housing sector, this philosophy has been reflected in an emphasis on stock-related priorities considering the creation of good-quality, accessible, durable and maintenance-friendly housing. Therefore, to improve the overall quality of residential life, to make the most of the housing stock and to respond to the global environmental impacts, the creation of sustainable renovation strategies and technologies has become necessary.

2.0 POLICIES ON HOUSING STOCK IN JAPAN

Since 2006, The Basic Plan for Housing has been enforced by the Japanese Ministry of Land, Infrastructure, Transport and Tourism

to offer prosperous lifestyles for actual and future citizens. It established targets and measures related to the accelerated stabilization and improvement of housing and residential living standards and pursued the development of good-quality housing stocks as well as the creation of quality residential environments meeting diversified housing needs. In addition, to promote housing renovation practices and long-life quality houses development, the Act on the Promotion of Popularization of Long-life quality Houses was enacted in 2008 and came into effect since 2009.[1]

As part of these plans, a new policy to promote the adaptive re-use and renovation of existing rental housing stock was announced by the Urban Renaissance Agency[2] (UR) in December 2007. The purpose was to initiate a restructuring process which will lead to a reduction of about 50,000 units by 2018 and about 30% of its total housing stock around 2048.[3] Since then, UR has been undertaking apartment reconstructions and renewals proposing appropriate countermeasures to meet the diverse needs of Japan's falling birth rate and ageing society. It has also been conducting renovation research and technological development and carrying out several projects under the named 'Renaissance Plan'.

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[1] "White Paper on Land, Infrastructure, Transport and Tourism in Japan", Ministry of Land, Infrastructure, Transport and Tourism, Japan, 2009, pp.26 <http://www.mlit.go.jp/english/white-paper/2009.pdf> referred on 08/04/2011.

2 The Japan Housing Corporation and the Land Development Corporation merged in 1981 to form the Housing and Urban Development Corporation. In 2004, it merged with the Regional City Development Division of the Japan Regional Development Corporation to form the Urban Renaissance Agency, today best known as UR.

3 "A Quick Look at Housing in Japan", 6th ed., The Building Center of Japan, Tokyo, 2008.

3.0 THE RENAISSANCE PLAN

The 'Renaissance Plan' establishes concrete actions to renovate and recycle entire buildings at aging housing complexes. It is comprised of converting spatial divisions, re-fitting interiors, making housing spaces barrier-free and providing facilities suitable for the 21st century (Figure 1). Furthermore, it considers the necessity to develop continual technical advancements to perform an image renovation of the conventional stairway-type buildings creating new and attractive façades and considering environmental impacts.[4]

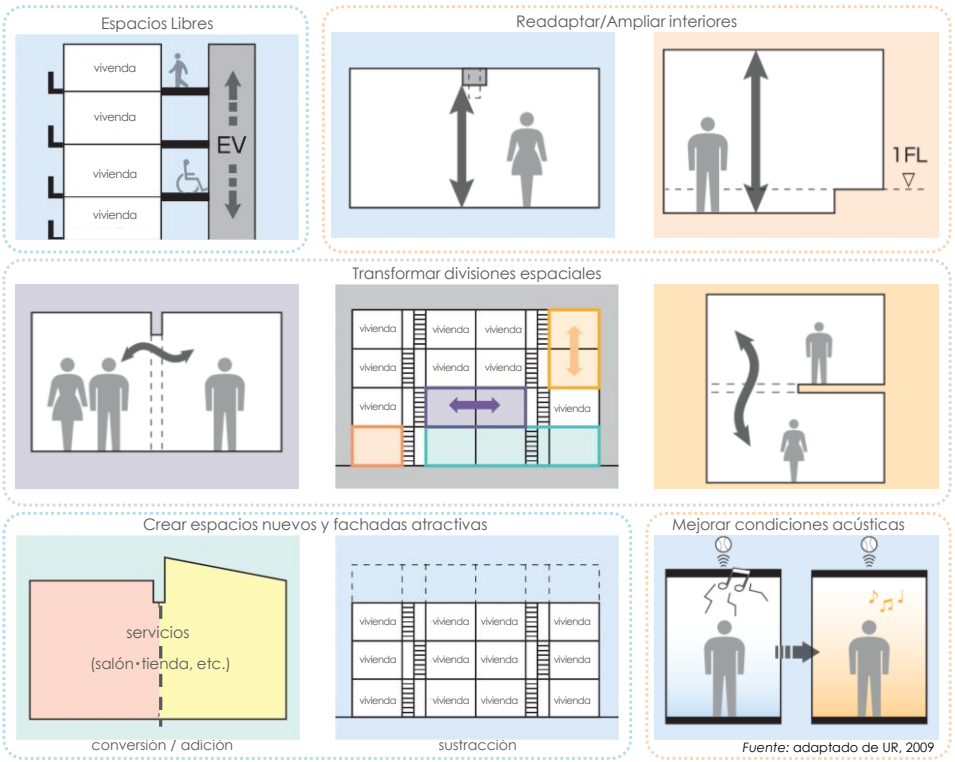

Figure 1 Renaissance Plan Principles

In 2008, UR announced the Mukogaoka Housing Complex Renovation Trial where public participation for technical proposals and cooperative research were required. The project consisted of

4 "The Renaissance Plan: Building Renovation Technology Development", Urban Renaissance Agency, Japan, 2009. <http://www.ur-net.go.jp/rd/rn1/technical/pdf/01.pdf> referred on 10/04/2011.

renovating buildings No.26, No.27 and No.28 within this complex[5] located in the city of Sakai at the Osaka Prefecture in Japan (Figure 2). The aim was to re-organize, remodel, and improve the entire buildings' interior and exterior spaces including the surrounding green areas using the Renaissance Plan principles and mixing different construction techniques while satisfying residents' needs.[6]

Figure 2: The Mukogaoka Housing Complex. Site plan and general view before the renovation

Toda Corporation Group[7] in association with Osaka Gas Ltd. submitted several proposals that met the basic requirements. As

[5] The complex consisted of 38 buildings built between 1960 and 1965. During the last years, some of them have been demolished or rebuilt and others, as buildings No. 26, No. 27 and No. 28, still remain. Buildings No.26 and No. 27 were originally four-storey buildings with 16 apartments and reinforced concrete box frame structures each one. Building No. 28 was a five-storey building with 30 apartments and a reinforced concrete frame structure. None of them had an elevator installed

6 The Renaissance Plan proposals are based on results obtained from questionnaire surveys conducted to residents in other UR complexes with similar characteristics to the Mukogaoka Housing Complex.

7 Toda Corporation Group is formed by: Toda Corporation Ltd., Wakachiku Corporation, Ltd., Kyoto Institute of Technology Suzuki Laboratory, Itsuro Hoshida Urban Research Institute, Maitani Yoshiaki Design Studio and Wada Structural Engineer Consultants.

they added the idea to incorporate the existing landscape to the design, which gave a significant improvement to the living environment, they resulted selected and were nominated as collaborators to develop the project from its conceptualization to its construction as well as to carry on further research.[8]

4.0 RENOVATION CONCEPTS

The proposals aimed to contribute to the creation of social environments ensuring better living conditions for present and future generations. Thus, the integration of concepts of 'Function' 'Space' and 'Technology' to develop places where everyone, from elderly to young people, could enjoy a lively life for a long time was the fundamental idea for this project. Moreover, considering topics like energy conservation and resources recycling, economic activities and employment capacity, coexistence between living and natural environments as well as the creation of better societies, the following sustainable measures were assumed as important targets:

a) *Environmental sustainability*, considering energy efficiency improvement, waste reduction and resources consumption control

b) *Social sustainability*, considering social welfare and community regeneration, and

c) *Economic sustainability*, considering housing management stability and economy formation and growth.

The project was designed as a whole, but a particular theme was assigned to each building to give them an own identity (Figure 3). For building No.26, the renovation was focused on the

[8] "Mukogaoka Housing Complex Renovation Trial. Competition Overview and Selection Results", Urban Renaissance Agency, Japan, 2008. <http://www.ur-net.go.jp/west/Renaissance/result.html> referred on 30/04/2011.

'achievement of a sustainable community', for building No.27 'quality of life improvement' was the objective and, for building No. 28 'harmony between environment and society' was intended.

In addition, to make the most of the buildings and to take over the appeal that the apartments had 40 years ago, the policies listed below were also implemented for the renovation of the entire project.[9]

- **To give top priority to the renovation and improvement of basic performances.**
- **To recover and improve comfort and quality of life conditions.**
- **To establish precise and well-defined renovation techniques.**
- **To take advantage of the existing structural qualities of the buildings**
- **To propose renovation methods based on residents' needs.**
- **To adopt the 'Open Building and Skeleton-Infill' principles as practical methods.**
- **To consider all public and private areas as living spaces.**
- **To get rid of the conventional box-type apartments.**
- **To make economically feasible and profitable renovations.**
- **To improve the methods of construction and the construction works.**
- **To shape a renovation process and provide a framework for future research.**

9 "Building Renovation Proposals for the Mukogaoka Housing Complex Renovation Trial", Toda Corporation Group, Osaka, 2008.

Figure 3: Renovation proposal image

5.0 DESIGN IMPLEMENTATION AND CHALLENGES

The tendency to demolish old buildings and start new ones rather than renovating and reusing them has existed for many years in Japan.[10] However, during the last years building renovation and adaptive re-use design have been adopted as measures to save resources, to reduce waste and to achieve sustainable developments. Thus, for buildings No.26, No.27 and No.28 most of the original structure was preserved and only some improvement in terms of durability and adaptability as well as specific modifications were made to each building.

5.1 Building No.26

The creation of a multi-generational building with common spaces was planned in order to enable harmonious coexistence among

10 According to the Housing and Land Survey Results presented by the Ministry of Internal Affairs in 2003, the typical lifespan for a reinforced concrete building was calculated about no more than 30 years.

residents and to promote community formation and living environmental health.

A common green roof terrace was created by removing part of the 4th floor and installing high-inclined roofs to give thermal and water infiltration protection. The 'Mingle House' was designed considering room-sharing between young people -students or employees- who could give voluntary assistance and support to elderly people living in other apartments. A multipurpose room for meetings and studying, working or recreational activities was also included.

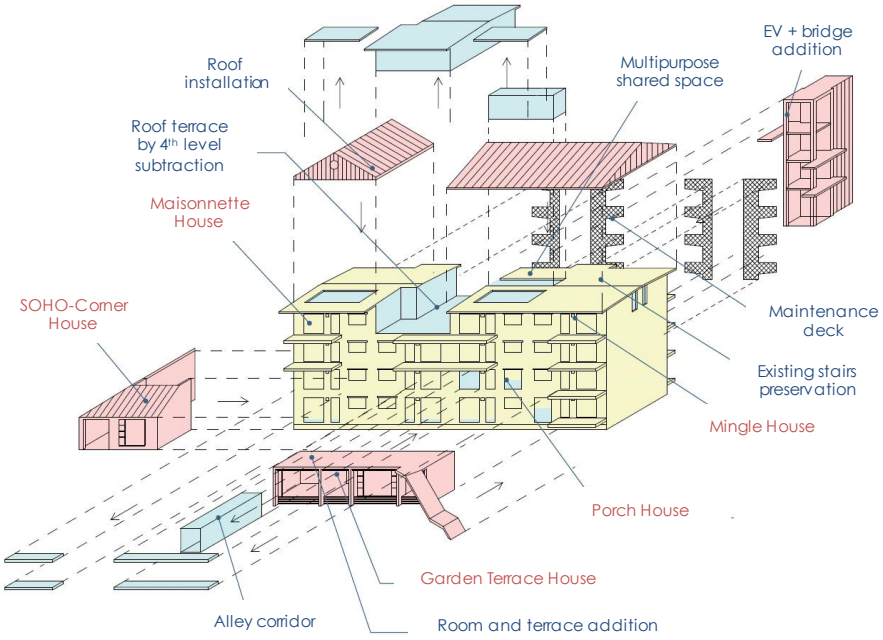

Figure 4: Building No.26 main modifications

The slab between two apartments on the 3rd and 4th floors was cut and the 'Maisonnette House' was created by joining them together and by using the existing exterior stairs as the interior connection. The 'Porch House' was planned on the 2nd floor as a two-space apartment where residents could enjoy their privacy and individuality as rooms were separated by a communal open

corridor. On the 1st floor, the 'SOHO-Corner House' and the 'Garden Terrace House' were proposed and rooms and terraces were added to be used as relaxing spaces (Figure 4).

The corridor on the 2nd floor was created by reducing some beams height and cutting or removing some structural walls. It was designed as a bridge leading to the north side of the building and as an extension of the street-connecting exterior stairs (Figure 5). Also, to make accessibility easier, especially for elderly and handicapped people, existent stair halls were preserved and re-adapted as entrances to other apartments while an elevator was installed in the north façade where pipes were concentrated and maintenance decks were integrated to facilitate equipment care and repair.

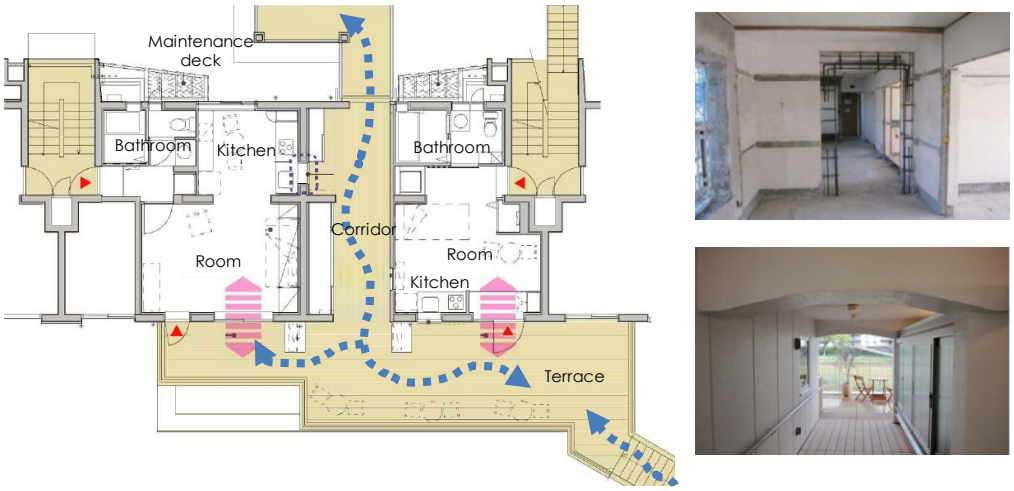

Figure 5: Corridor developed on the 2nd floor

5.2 Building No.27

By the creation of living spaces fully integrated with a comfortable outdoor environment, an improvement in the community-living performance based on the concept of 'Quality of Life' was pursued.

Some slabs were cut and inclined roofs were installed as it occurred in building No.26 (Figure 6). Maintenance decks and an

elevator were set up in the north façade and new variations to the south façade were given by extending the existing balconies on the 3rd and 4th floors.

Figure 6: Slab cuts to join apartments and install inclined roofs

Another 'Maisonnette House' was proposed and, as the elevator[11] was connected to the existing stair halls to access other areas (Figure 7), new inner stairs were built and a different configuration was created. Also, public rooms and offices were established to give residents the opportunity to coexist, relate and share experiences with others.

On the south façade of the 1st floor an additional space was built. This space was part of the 'Life Support and Consultation Corner' which was an apartment converted into a community support plaza where residents could receive help and assistance on daily life problems. Children indoor playing facilities were also suggested and, by the transformation of an apartment into a passage, a community deck was designed to connect and access all green open areas.

[11] ***In order to allow residents to access their apartments while installation works were carried on, an additional structure was set up before the existing stairs were cut and once they were removed, slabs were added to connect the structure to the building and to the elevator.***

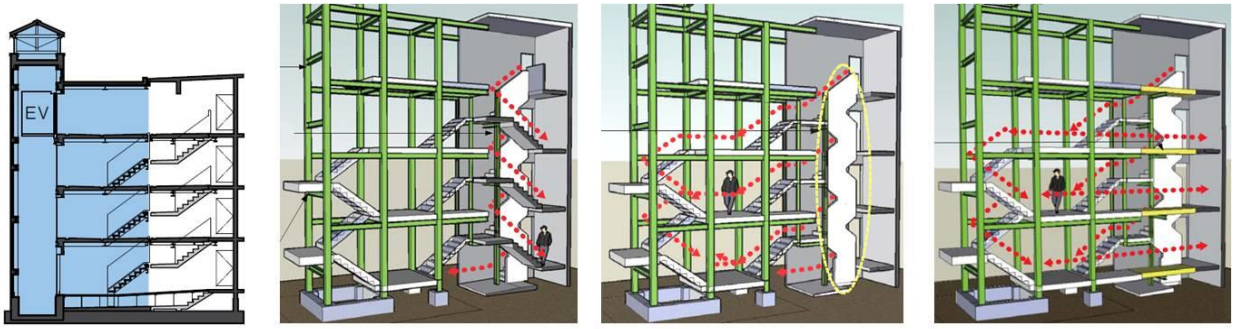

Figure 7: Elevator addition system. Installation works can be done without interrupting residents' activities (Source: UR)

5.3 Building No.28

Re-use and recycle concepts were integrated in the proposals focusing on the idea to create an 'eco-cool' building which will help to reduce the environmental impacts.

The first two upper levels were removed (Figure 8) to have a more human-scale building and, after structural seismic capacity improvements were made, high-inclined roofs with photovoltaic panels were installed and a rooftop garden was designed (Figure 9). Also, to enhance energy efficiency in the building, the 'Eco House' and the 'Re-use House' were planned on the 3rd floor. The 'Eco-House' considered a green terrace where water supply heating systems, gas equipments, rainwater collectors and domestic garbage processors were set up. The 'Re-use House' was built re-using and recycling most of the scrap materials that resulted from the renovating works in other apartments.[12]

12 The Re-use Idea Competition was carried out in 2007 by UR and some of the winning design proposals were considered for the realization of this project. <http://www.ur-net.go.jp/reusecompe/index.html> referred on 30/04/2011.

Figure 8: Cutting process to remove upper levels

On the 2nd floor, the 'Healthy House' was designed as a body-and-mind-friendly place where non-chemical materials were used. Therefore, cork-tile flooring, paper-covered ceilings and walls as well as a ventilation unit with humidifying and air-cleaning functions were proposed. On the east side of the 1st floor, the 'Garden House' including a little vegetable garden was established and, to improve the image of the south façade, a wood deck and a pergola corridor were built using concrete and wood waste materials resulting from the renewal works. A green-wall was proposed on the east façade and EPS insulated panels were installed to increase acoustic and thermal insulation and to reduce the necessity of air-conditioning equipments.

Figure 9: Building No.28 south façade level subtraction

5.4 Green open areas

Preserving the existing vegetation, comfortable spaces where people could enjoy nature while doing other activities were

created and, considering landscape design principles, continuity and integration between the surrounding open areas and the buildings were achieved. For the deck between buildings No.26 and No.27, public benches and tables were suggested to promote and enhance communication among residents. Along the north side of building No. 28, the 'Shade Garden' was proposed as a tall-tree area where people could rest or walk especially during sunny days. Furthermore, the 'Playing Plaza' was designed in front of the west façade of building No.27 as a place where children could play safely inside the complex and, to encourage and support the idea of urban farming, an area for planting and growing plants and vegetables was also assigned.

6.0 VERIFICATION PLAN AFTER COMPLETION

The renovation works took eight months. After the completion, a verification plan was created, and monitoring studies were executed to evaluate whether the trial achieved the intended objectives (Table 1). The plan considered not only the executability, the cost and the construction period, but the livability, the design and the profitability of the project. It also focused on future housing complex renovation practices and took into account the following points:

- **Structural repair, thermal insulation, sound isolation, living comfort as well as scenery evaluation.**
- **Living experience examination from resident's perspectives, sensations, and opinions.**
- **Cost plan and existing environmental impacts, maintenance esteem and reuse of existing materials and resources.**
- **Building technologies selection, execution and obtained results evaluation.**

Table 1: Verification points

Classification	Evaluation and verification items
Functionality improvement	1) Elevator addition during residents' occupancy 2) Buildings' entrance renovation
Structural modification and improvement	1) Structural removing (full and partial) 2) New wall openings establishment and reinforcement 3) Slab cutting and reinforcement 4) Maintenance deck addition for piping equipment external concentration 5) Beam height reduction and reinforcement
Environmental and architectural performance	1) Exterior thermal insulation improvement 2) Thermal environment improvement 3) Floor and wall sound isolation performance improvement.
Living environment improvement	1) Residents' opinion on living space 2) Scenery and design attractiveness improvement 3) Visitors' questionnaire survey
General aspects	1) Development technology (design, construction) 2) Cost efficiency 3) Living conditions 4) Green areas and buildings' indoor-outdoor relations

Once the verification concluded, the complex was open to the public, visits to the apartments were organized and a questionnaire survey was conducted in order to evaluate the renovation effects as well as to know people's opinion on the project. Furthermore, an evaluation using the Sustainable Environment Assessment Method (SEAM)[13] was held to diagnose

[13] This method is divided into four main evaluation fields (society, natural resources, environment and economy) subdivided into five or six specific items. The results are shown in a diagram where segments are highlighted using different colors which represent the levels of sustainability. The closer the segment is to the centre of the diagram, the weaker the conditions, and the further away from the centre, the stronger.

and determine the degree of achievement the improvements had towards sustainability.

6.1 Survey results

The visits were carried out twice a day four times a week for a period of eight months from July 2010 to February 2011. A total of 3,165 visitors from all over the country attended and 2,751 (86.9%) answered the questionnaire survey. About 80 per cent of the respondents - whose ages ranged between 20 and 70 years - were male with the majority being in their fifties and 20 per cent were female with the majority being in their twenties.

Visitors were given a guided tour of the facilities and some of them had the opportunity to use some spaces (kitchen, living rooms, etc.) as if they were owners. After having visited and experienced the areas, they were asked to indicate which of the renovated apartments they like the best to live in and why they would prefer it. Most of the respondents chose the 'Maisonnette House' (33.6%) followed by the 'Garden Terrace House' (21.6%) and the 'SOHO-Corner House' (14.1%) all located in building No. 26. Among the given reasons were the possibility to have pleasant and enjoyable daily-life activities, the adaptability to an own lifestyle, the easiness to live in the apartment, as well as the new distribution, design and dimension's suitability of the spaces. The possibility to have an energy-saving life was also supported but the 'Eco House' was the only apartment with the highest number of respondents (Figure 10).

About the surrounding green and public areas, 53.1% of the visitors liked the roof terrace created after part of the slab was removed from the 4th floor of building No. 26 and 44% evaluated the community deck connecting buildings No. 26 and 27 as a

graceful and joyful space. The corridor and the terrace between the 'Porch House' were considered as places that enhanced communication and allowed easy access to the building for both visitors and residents (33.3%). Also, the fact that existing trees were preserved and integrated to the new areas was supported by 43% of the people while 35.4% agreed that having a communal garden, promoted, encouraged and provided the opportunity to practice and integrate environmental activities in their daily lives.

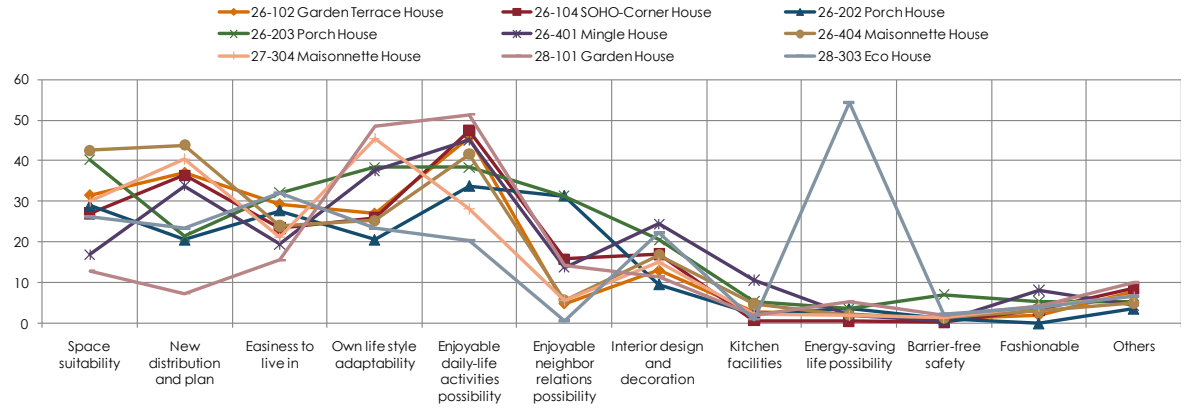

Figure 9: Respondents' reasons to live in renovated apartments

The developed technologies and their potential for future renovation projects were evaluated by about 80% of the respondents as very effective and effective methods that improved not only the living but also the environmental conditions (Figure 10). For instance, the elevators addition which enhanced the accessibility in buildings No.26 and 27 was supported by 91.7% of the visitors -with the majority being elderly people- and 90.3% agreed with the floor space expansion and the conversion of two apartments into maisonnette houses. Respondents also supported the creation of new wall openings (80.5%), the partial or total subtraction of structural elements (77.4%), and the existing balconies enlargement (73%). And, about 70% agreed that modifications to the façades significantly improved the image of the complex and added value to the urban landscape and the

local area (Figure 11) while about 75% considered roof and wall greening as well as exterior thermal insulation as good measures to reduce energy consumption and environmental problems.

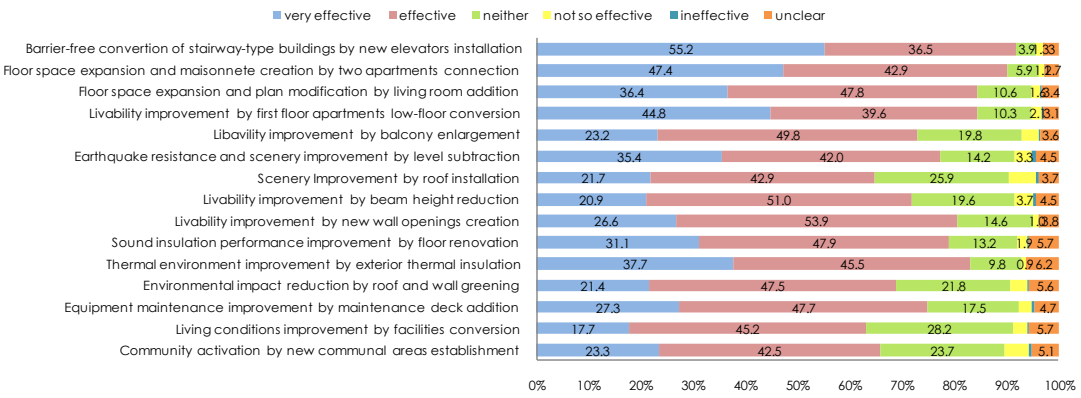

Figure 10: Respondents' opinion about developed renovation technologies

People's opinion and attitude towards housing renovation were also surveyed and most of the respondents (75%) supported the strategies and practical approaches of this trial (Figure 12). The majority agreed that, apart from the conventional housing renovations and renewals, new techniques and new attractive projects can be expected (86.65%), and that existing buildings reuse and renovation can help to reduce construction costs (66.8%) as well as to preserve and improve the cityscapes (67.7%).

Figure 11: Building No. 28. South façade modifications

Moreover, more than 75% believed that negative environmental impacts can be mitigated through waste reduction and that existing buildings' negative aspects could be enhanced during a renovation process while the positive ones are preserved (65.1%).

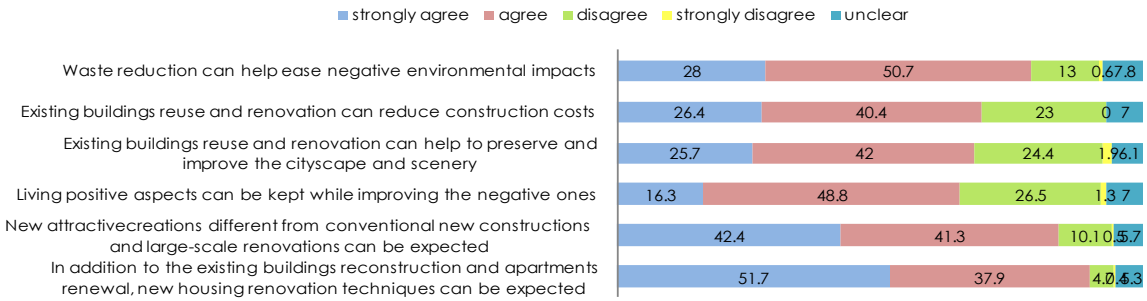

Figure 12: Respondents' opinion about housing renovation

Finally, visitors were also asked about the monthly amount they would pay for rent for the apartments and, compared to the existing value before the renovation[14], the five surveyed cases presented considerable increases (Table 2). For example, the 'Maisonnette House' received the highest average amount (141,600 yen) but it had the lowest value when comparing the prices per square meter (1,520 yen). And, despite the 'Garden House' had almost the same area as the original apartment, it was given a monthly average rent that made the price per square meter increase almost 90% (2,240 yen). Younger respondents (20s or less) gave the highest values for all the apartments but the 'Eco House' and the 'Garden House' were also given high values by elderly people (70s or more) who agreed both places had suitable characteristics that matched their specific needs.

[14] The rent value before the renovation works was assumed to be 50,000 yen for a 42 m^2 apartment (1,190 yen/per m^2).

Table 2: Respondents' proposed rent values

Apartment Type	Area	Average rent	
		per month (yen)	per m^2 (yen)
26-102 Garden Terrace House	65 m^2	114,700	1,760
26-104 SOHO Corner House	59 m^2	105,400	1,790
26-404 Maisonnette House	93 m^2	141,600	1,520
28-101 Garden House	35 m^2	78,500	2,240
28-302 Eco House	53 m^2	101,700	1,920

These results were also used to determine the possibilities, opportunities as well as the cost advantages and disadvantages renovation projects would have for future investment plans.

6.2 SEAM results

On the other hand, the SEAM evaluation was made before and after the renovation process and the diagrams showing the sustainability conditions for each space and for the site in general were obtained.

Specific fields and items were assigned for every space and using information obtained from the monitoring and the questionnaire survey they were individually assessed and given a score that ranged from 1 to 10 points which represented the worst and the best conditions respectively (Table 3). The average of the sum of the obtained points was the score each item received, and the average of the sum of those scores was the final result given to each of the four main fields.

Table 3: 'Garden Terrace House' SEAM evaluation

Evaluation Fields and Items			Score	
Society (7.47)	Community	The apartment layout allows family communication The apartment layout allows friends and neighbor visits	9.00 7.75	8.38
	Accessibility	It is easy to move around comfortably	6.40	6.40
	Amenity & User's Comfort	The ceiling height is comfortable The bathroom seems comfortable and easy to use The view from the apartment is attractive The kitchen seems comfortable and easy to use	9.50 8.75 8.25 6.50	8.25
	Safety	The security measures make residents feel protected Even if an emergency happens, safety can be felt There are no worries about slip or hit accidents	6.18 6.40 5.80	6.13
	Education & Welfare	It is easy to keep an eye on children inside the apartment	8.50	8.50
	Form & Space	There is enough storage space inside the apartment Each room has enough space for the necessary furniture	8.09 6.18	7.14
Economy (6.65)	Diversity & Inclusion	It seems easy to use for handicapped and elderly people	5.09	5.09
	Employment	It is a place where a working environment can be arranged	6.10	6.10
	Costs	It seems that utility expenses can be reduced	5.33	5.33
	Social Benefits	The apartment layout seems to be wider than its actual size	8.09	8.37

		It seems that an own life style and hobbies can be realized	8.64	
	Property Strength	The desire to continue living in the apartment can be felt	8.36	8.36
Environment (8.16)	Design & Operation	The interior design is attractive	7.82	7.82
	Health	The apartment has good ventilation and is comfortable	8.50	8.50
Natural Resources (7.96)	Solar Energy	The apartment has good sunlight and daylight qualities	9.50	9.50
	Energy Efficiency	The apartment considers energy saving	6.70	6.70
	Materials	Materials considering people and the environment are used	7.67	7.67

Before the renovation, most of the segments were on the 'good' levels (4.00-6.99), with some exceptions that were near the 'not good' ones (1.00-3.99). However, after the project was completed, all the apartments presented considerable improvements and, despite the diagrams for each space were different, almost all the segments ranged only from the 'good' (5.50-6.99) to the 'excellent' levels (7.00-10.00). The 'Garden Terrace House' was the apartment with the best conditions as the diagram had the highest number of excellent (light and dark green) segments as shown in Figure 13.

Figure 13: 'Garden Terrace House'. SEAM diagrams and images

The diagram obtained for the site also showed the improvements achieved after the renovation works, and although all the segments were among the good levels, they changed to the excellent levels, except for the cost one which kept the same values (Figure 14).

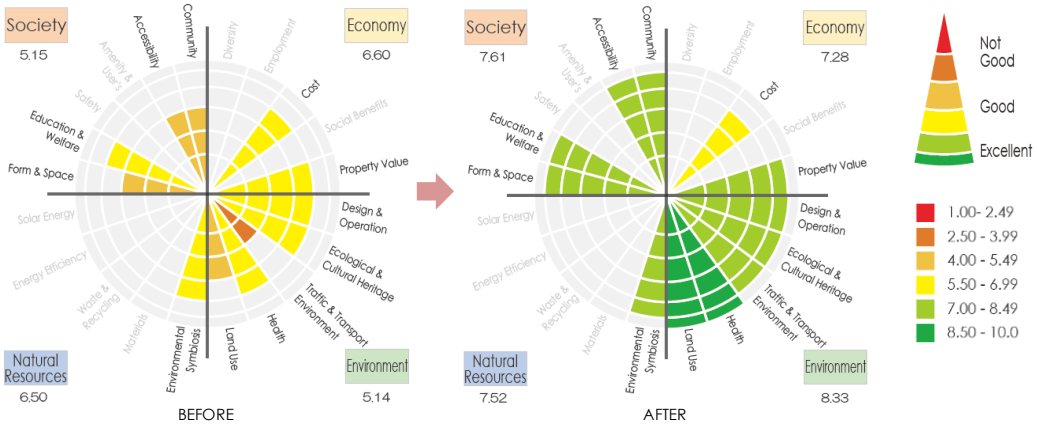

Figure 14: Site improvements. SEAM diagrams

The SEAM evaluation clearly helped to identify and determine where the project was weak and where it was strong. Therefore, all these results in combination with those obtained from the survey could be used to guide future studies and renovation proposals to focus on specific areas that need improvement in order to achieve better projects with high sustainability levels.

Figure 15: Buildings No. 26, 27 and 28. Before and after the renovation

7.0 CONCLUSION

Housing developments are facing many challenges and specific actions should be taken to make them suitable for the new and different lifestyles, including various types of family structures and occupancy patterns expected for the coming years. Building new houses would help to meet the housing demands but also by changing, renovating and improving existing properties there is a good chance that they could be met.

The renovated Mukogaoka Housing Complex is a comprehensive project that, contributing to new knowledge and practice, demonstrates and experiments with adaptive re-use and sustainable design programs which can improve and extend the life of existing buildings. Through the process of design, construction, operation and evaluation it illustrates how design guidelines and renovation practices can be achieved and how, through these measures, we can protect and enhance our environment to provide better living conditions and to meet the future by maintaining our past.

The Renaissance Plan principles also provide viable options to sustain future cities and societies. Therefore, the presented proposals and technologies represent an opportunity for the use in practice and should be considered as examples for future housing stock renewals. In addition, to support the principles and goals of a sustainable culture in planning, construction, and renovation, the framework of policy measures, interdisciplinary work approaches as well as permanent cooperation and coordination are needed, and new approaches should be combined

with the traditional techniques to achieve a harmonious coexistence between man, nature and architecture.

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