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A Study on Recommendations for Improving Minimum Housing Standards

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Abstract: Minimum housing standards aim to safeguard housing rights and enhance residential conditions. Governments develop housing policies, including provision, preservation, and support for welfare programs, guided by the status of households below these standards. Growing nations commonly utilize this approach to decrease the proportion of households not meeting these criteria. In South Korea, the ratio of households below these standards was 4.5% in 2021, down from 16.6% in 2006, as indicated by the initial Korea Housing Survey. However, this downward trend has stalled over the past decade. With the 2004 and 2011 revisions, the standards have been effective for 12 years, yet no longer mirror current housing realities due to ongoing improvements. This study aimed to propose enhancements to Korea's minimum housing standards. Through analyzing laws, prior research, present household statuses, international cases, and expert insights, recommendations emerged. Categorizing households by size, we developed precise standards covering area, facility, and location aspects. These new standards led to an 8.4% non-compliance rate in 2021. This research's findings anticipate aiding the revision of minimum housing standards, formulating pragmatic policies for enhancing residential conditions in line with present situations.

Keywords: minimum housing standard; housing rights; Korea housing survey; semi-underground house; accommodations for students studying for exams

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1. Introduction

1.1. Research Background

In the past, South Korea maintained a supply-based housing policy to address the shortage of housing inventory. With the steady increase in the housing supply rate, however, people have become more interested in the quality of housing, as well as related demands. In particular, South Korea has shown a growing interest in solving unique problems in the country, such as providing accommodations for students studying for exams and developing compact buildings with small rooms. In this sense, the Korean government has broadened the spectrum of housing policies by including housing management and welfare, rather than adhering to supply-based policies.

As the housing policy has focused more on welfare, there has been a need to create comfortable residential environments, apart from the supply of sufficient housing. The necessity for housing that satisfies minimum housing standards has been the most important factor, because if the stability and comfort of housing are not guaranteed, people would have to continuously live with anxiety [1–6]. Under these circumstances, minimum housing standards were provided for people to live in comfortable and stable residential environments, resulting in the establishment of standards regarding room configuration, area, essential facilities, and structure/performance/environment for the first time. The minimum housing standards suggested by the Ministry of Construction and Transportation (Currently, the Ministry of Land, Infrastructure, and Transport) in 2000 were enacted into law in 2004 as the "Housing Act" or "Enforcement Decree of Housing Act", and they have

since been applied to housing policies along with the enhancement of area standards in 2011 [7,8].

Despite the newly strengthened standards, the ratios of households below the minimum housing standards showed a general decreasing tendency, falling to 4.5% in 2021 (Table 1) [9]. A steady supply of new housing, a decrease in the average number of household members, a drastic increase in one- to two-person households, and a decline in substandard houses have been reported as contributors to the decline. As the ratios of households below the minimum housing standards have decreased, the minimum housing standards required by people have naturally improved. Additionally, the suitability and effectiveness of the revised 2011 minimum housing standards have been in question due to the current situation of housing inventory and supply.

Table 1. Households below the minimum housing standards in South Korea [9].

	2006	**2008**	**2010**	**2012**	**2014**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Ratios (%)	16.6	12.7	10.6	7.2	5.4	5.4	5.9	5.7	5.3	4.6	4.5

1.2. Research Background and Purpose

This study was conducted for the following reasons:

First, investigating the areas of small houses of 60 m^2 or smaller, the area standard of the minimum housing standard in 2011 was determined while considering the area of the bottom 3% of them. However, it was assumed that the current bottom 3% standard would be higher than that in 2011. Second, as the residential area per capita generally increased from 20.2 m^2 in 2000 to 33.9 m^2 in 2021, there should be considerations regarding this tendency (Table 2) [9]. Third, as the physical characteristics of Koreans have changed, there should be new standards considering the human scale. Fourth, facility standards should be reconsidered. Finally, it is necessary to prepare standards regarding the quality of housing and housing safety, which are not included in the current minimum housing standards. In Korea, safety accidents in semi-underground houses due to flood damage have become a recent social issue, and the government has implemented a policy to remove semi-underground houses [10].

Table 2. Average residential area per capita (m^2) [9].

2000	...	**2006**	**2008**	**2010**	**2012**	**2014**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
20.2	...	26.2	27.8	28.5	31.7	33.5	33.2	31.2	31.7	32.9	33.9	33.9

Accordingly, this study aims to propose new minimum housing standards (area, bedroom, facility, and location) and measures for utilizing policies.

2. Materials and Methods

2.1. Definition of Terms

2.1.1. Minimum Housing Standards

As minimum housing standards are intended to guarantee people's housing rights, the standards were categorized into area, bedroom, facility, and location criteria. While standards can be subjective depending on the era and viewpoints, we aimed to establish them in as objective a manner as possible.

2.1.2. Area Standard

This standard pertains to the minimum area required by a resident in a house. An "exclusive residential area", defined as an enclosed space usable exclusively by a resident upon opening the front door, was established as the area criterion. For multi-unit dwellings, we excluded communal areas like hallways, parking lots, elevators, and open spaces.

Regarding detached houses, non-exclusive residential areas such as yards and detached parking lots were excluded.

The essential rooms included bedrooms, kitchens or dining rooms, bathrooms, and other spaces, which were aggregated to calculate the ultimate exclusive residential area.

2.1.3. Bedroom Standard

This standard defines the quantity and types of specific rooms that must be provided for each household member. The variables of "per household member" encompass the number, age, and gender of household members.

2.1.4. Facility Standard

This standard pertains to the facilities that residents must have while living in houses. We focused on the following facilities: (1) kitchen, (2) toilet, (3) bathing facility, (4) water supply facilities, (5) sewer system (septic tank), (6) heating systems, (7) fuel for cooking, (8) entrance (front door), and (9) fire-fighting appliances.

2.1.5. Location Standard

This is the standard covered in this study for the first time, and it pertains to the location of a house. We aimed to establish a standard for the location of a house that may pose safety and health risks to residents [11]. In this study, houses were categorized into the following four types: underground, semi-underground, above-ground, and rooftop houses.

2.2. Scope and Methodology of the Study

Households ranging from one-person households to six-person households were targeted. The sub-standards to be established were categorized into area, bedroom, facility, and location standards.

This research was conducted based on five steps: analysis of the current status, overseas case studies, collection of expert opinions, derivation of improvements, and assumptions (Figure 1).

First, we investigated households falling below the minimum housing standards to analyze the current status. Since 2006, Korea has been conducting Housing Surveys, utilizing Housing Survey data from 2006 to 2021. We reviewed the situation of entire households below the minimum housing standards, as well as the status of households unable to meet sub-standards (e.g., areas, bedrooms, and facilities).

Second, in the section on overseas case studies, the focus was on the United Kingdom and Japan, which employ similar housing standards to South Korea's and their housing standards were analyzed. These countries were selected as target cases because their situations are akin to Korea's situation in terms of country size (e.g., area and population), population density, state earnings, and urbanization rates. Cases from other countries like the United States and France were also considered, but they utilized minimum housing standards (area, bedrooms, facilities, etc.) different from those of South Korea. Therefore, the United Kingdom and Japan were selected as case study destinations.

Third, expert opinions were collected by interviewing 22 experts in four fields for approximately three weeks. The questions mainly consisted of topics that cannot be identified from the current status alone, and opinions regarding the outcomes of the current analysis.

Fourth, improvements in minimum housing standards were derived through three detailed methodologies. First, a prerequisite was derived based on theoretical studies. Next, we determined the direction for specific improvements, based on the outcomes from the literature review, analysis of the current status of households unable to meet the standards, overseas case studies, and expert opinion collection. Additionally, a design simulation was conducted considering estimates of furniture sizes, universal design, and human scale. Through these three methodologies, we suggested the final improvements based on the area, facility, and location standards.

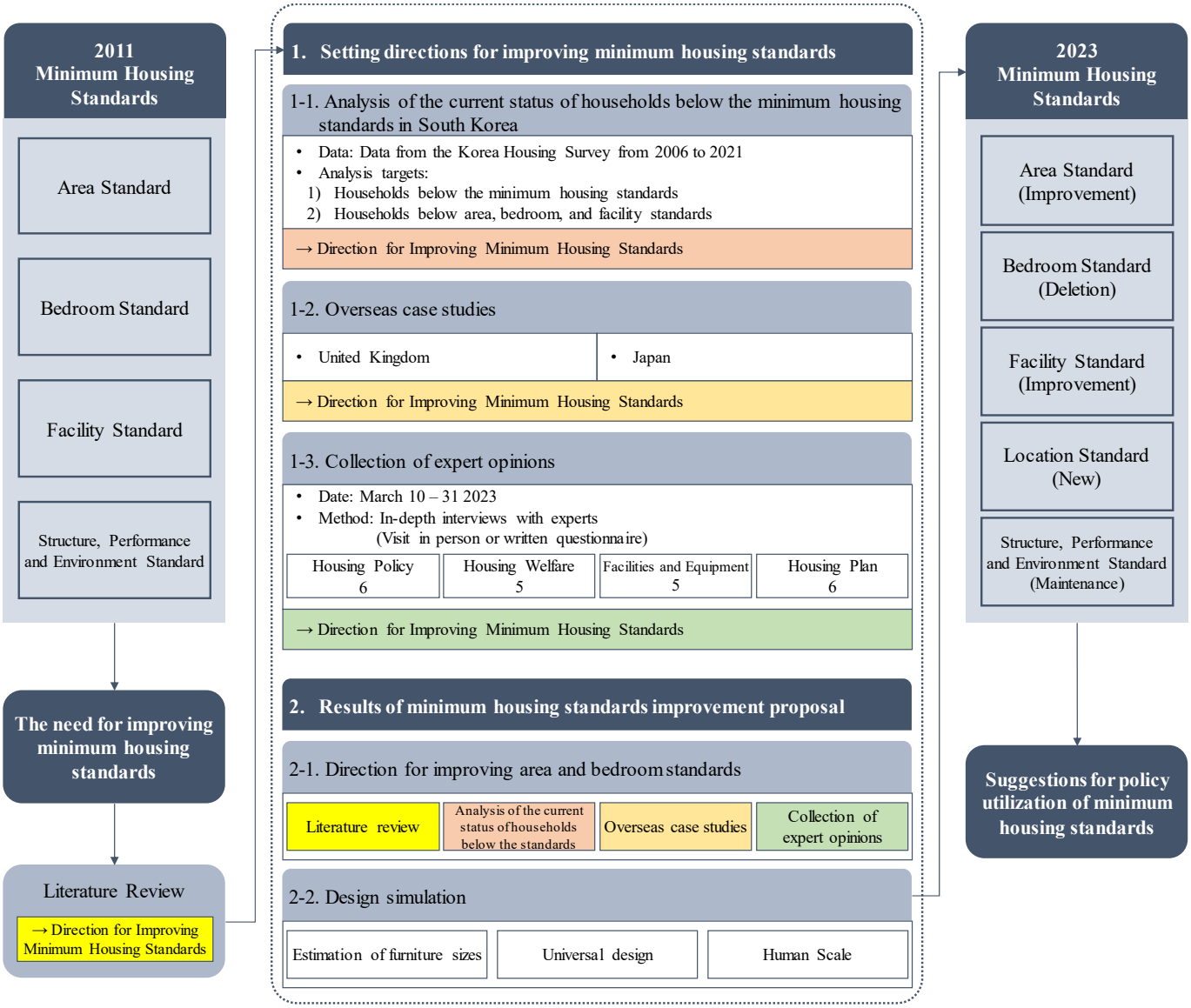


Figure 1. Research Methodology.

Fifth, we estimated households not meeting the new standard for minimum housing standards. Finally, we suggested policy utilization measures for the minimum housing standards.

3. Literature Review and Theoretical Framework

3.1. Literature Review

There are two types of studies on minimum housing standards: studies on how to utilize the standards and studies on how to improve and amend the standards.

First, there are studies on how to utilize the standards. Choi et al. [12] applied the 2011 revised standards to population and housing census data to analyze changes in households falling below the standards. They indicated how the minimum housing standards can enhance the residential environment for those with inadequate housing conditions, while also highlighting the limitations of applying the standards to vulnerable populations living in non-housing spaces [12]. Lim [13] discussed how to employ minimum housing standards in designing welfare policies, estimating households below the standards, emphasizing the need to enhance minimum housing standards, and assessing their effectiveness [13]. The above study emphasized the need not only to establish minimum housing standards but also to pursue policy measures to address households below these standards. Specific

proposals, such as the establishment of housing management norms and improvement of residential environments, were suggested.

Regarding the study of improving and amending minimum housing standards, Yun [14] compared how the standards were used in South Korea with their utilization in other countries. He underscored the need to improve the current minimum housing standards in South Korea for efficient usage, citing their abstract and unclear nature [14]. Kim et al. [11] asserted that poor physical residential environments detrimentally affect residents' health, highlighting that the current minimum housing standards should consider such factors [11]. Lee [15] suggested that the existing standards are overly broad and lack specific criteria, leading to weak effectiveness. He proposed additional countermeasures, incorporating social and economic criteria [15]. Kim [16] reviewed the composition and utilization plans of the 2011 revised minimum housing standards and the Long-term Comprehensive Housing Planning of cities and provinces. The aim was to propose directions for improving minimum housing standards to utilize them as tools for housing welfare policies [16]. Lim [17] mentioned that South Korea's minimum housing standards lack effectiveness in enabling the state to take minimal protective measures. To enhance effectiveness, improving the 2011 revised minimum housing standards is necessary [17]. The aforementioned studies can be summarized as having two main opinions regarding minimum housing standards: one suggesting that they should be more "specific", and the other suggesting that they should be "strengthened". However, they only emphasized the need for these improvements without providing specific proposals.

Thus, this study examined Korean research on minimum housing standards from 2011 to 2021 to understand relevant scholars' perspectives on the standards since their first revision. While most studies highlighted issues with the current minimum housing standards and the need for improvements, they did not offer precise criteria for enhancing the standards. Therefore, efforts were made to provide specific plans for improving and utilizing the standards at a policy level through a systematic research methodology.

Furthermore, recent research has revealed a broader spectrum of keywords associated with "housing standards". In Wang et al.'s study [18], it was emphasized that "air quality" can be considered as one of the housing standards, as it was found to influence property values [18]. Wang et al. [19] indicated that both homebuyers and renters consider "air quality" a significant factor in their housing choices, asserting that clean air should be perceived as a form of environmental amenity provided to residents [19]. Boadi et al. [20] demonstrated the substantial impact of "residential satisfaction" on quality of life and resettlement [20]. Since current housing standards in Korea primarily consider physical elements, there is an opportunity to additionally incorporate the subjective aspect of residents, "residential satisfaction". Bangura et al. [21] shed light on the surge in property prices due to the COVID-19 pandemic, which subsequently contributed to housing inequality [21]. This suggests that unforeseen external factors like COVID-19 can indeed influence housing standards.

Recent research has thus explored new "factors" that were not previously given much consideration concerning "housing standards". This, in turn, provides significant direction for shaping the focus of this study.

3.2. Theoretical Framework

3.2.1. Housing Rights

According to the UN's Universal Declaration of Human Rights, housing rights pertain to economic, social, and cultural rights while safeguarding the right to live as a human being [22]. South Korea addresses housing rights in Article 35 of the "Constitution", which states: "All citizens have the right to live in a comfortable environment, and the state shall actively implement policies for this purpose" [23]. Article 2 (Housing rights) of the "Framework Act on Residence", enacted in 2015, asserts that "all citizens have the right to live in decent, comfortable, and stable residential environments free from physical and social dangers, as stipulated by related laws and ordinances" [24]. Article 3 of the same act

outlines the responsibilities of the state and local governments in guaranteeing the housing rights of all citizens [24].

Several overseas studies define housing rights as follows. Pane et al. [25] provide the following definition: "The right to adequate housing is the right of all citizens without exception" [25]. Concerning housing rights, Kucharska-Stasiak et al. [26] said the following: "Adequate housing conditions are an indicator of a decent life, whereas the lack is one of the main reasons behind so-called social exclusion. The importance of housing, in ensuring the social safety of citizens, as well as supporting social equity, has been emphasized for decades" [26]. Some studies also assert that basic residential conditions or conveniences are necessary to safeguard fundamental human rights and enhance human welfare [27]. Moreover, Azarnert [28] said the following: "Minimum residential conditions requirements may also reduce population density and lead to a decline in social costs associated with population overcrowding and congestion in general" [28].

3.2.2. Minimum Housing Standards in South Korea

Article 17 of the "Framework Act on Residence" stipulates the establishment of minimum housing standards. Paragraph 1 of the Article states that the purpose of minimum housing standards is to set the necessary standards for people to maintain a pleasant and fulfilling life; the duties of the Minister of Land, Infrastructure, and Transport are to set and solidify the standards. In addition, Paragraph 3 of the Article specifies factors of minimum housing standards as follows: (1) residential area, (2) the number of rooms per use, (3) structure of a house, (4) facilities in a house, (5) performance of a house, and (6) environmental factors of a house [24].

Article 18 of the Act also stipulates the following priority supports for households below the minimum housing standards: (1) The State or a local government may give priority to supplying housing or subsidizing improvement funds for households below the minimum housing standards. (2) The State or a local government shall endeavor to reduce the number of households below the minimum housing standards. (3) The Minister of Land, Infrastructure, and Transport or the head of a local government shall take necessary measures for granting authorization and permission, such as issuing an order to supplement an application for approval for project plans in compliance with the minimum housing standard. (4) The Minister of Land, Infrastructure, and Transport or the head of a local government may take necessary measures to preferentially construct rental houses in an area densely packed with households below the minimum housing standards [24].

Although minimum housing standards play a crucial role as a policy indicator for the quality of housing, as mentioned in the Introduction, South Korea has not had a second revision since its enactment in 2004 and the first revision in 2011. Although the Ministry of Construction and Transportation (currently, the Ministry of Land, Infrastructure, and Transport) first proposed it in 2000, it was not eventually enacted into law, and it is not discussed in this study. This study aims to suggest the second revision of the minimum housing standards, which have been applied in the last 12 years since 2011.

3.2.3. Minimum Housing Standards in South Korea (in 2004 and 2011)

Minimum housing standards were initially legislated based on the "Housing Act" in 2004. The number of household members was categorized into 1–6 persons, establishing a standard household composition and specifying the minimum residential area per standard household composition and the number of rooms per use (Table 3). Concerning facilities, households are obligated to have a private walk-in kitchen, a private flush toilet, and bathing facilities, along with water supply facilities or groundwater facilities with good water quality. Furthermore, for structure, performance, and environmental standards, four criteria are proposed to ensure housing safety and comfort as follows: (1) The permanent building must possess structural strength, and principal structural parts must be heat-resistant, fire-resistant, and moisture-proof. (2) Adequate soundproofing, ventilation, lighting, and heating facilities must be provided. (3) Environmental factors like noise,

vibration, odor, and air pollution must adhere to legal standards. (4) Housing should not be situated in areas at significant risk of natural disasters like tsunamis, floods, landslides, and cliff collapse [7].

Table 3. Minimum residential areas per household composition, and number of rooms per use (2004, 2011) [7,8].

Number of Household Members	Standard Household Composition [1]	Space (Room) Requirement [2]		Total Living Area (m^2)	
		2004	2011	2004	2011
1	One person household	1 K	1 K	12	14
2	Married couple	1 DK	1 DK	20	26
3	Parents + 1 Child	2 DK	2 DK	29	36
4	Parents + 2 Children	3 DK	3 DK	37	43
5	Parents + 3 Children	3 DK	3 DK	41	46
6	Grandparents + Parents + 2 Children	4 DK	4 DK	49	55

[1] Based on 1 child aged 6 years old or older in a 3-person household. Based on 2 children (1 male and 1 female) aged 8 years old or older in a 4-person household. Based on 3 children (2 males and 1 female, or 1 male and 2 females) aged 8 years old or older in a 5-person household. Based on 2 children (1 male and 1 female) aged 8 years old or older in a 6-person household. [2] K refers to the kitchen, and DK refers to a combined dining room and kitchen; the figure refers to the number of rooms that can be used as bedrooms (including areas for living rooms) or rooms that can be used as bedrooms. Note: The principle of bedroom separation for setting the number of rooms is based on the following criteria: (1) married couple shares one bedroom; (2) children aged 6 years old or older have a separate room from their parents' rooms; (3) opposite-sex children aged 8 years old or older have individual rooms; (4) grandparents use separate bedrooms.

In 2011, the first amendment was introduced. In comparison to 2004, the total residential area per household member slightly increased. The standard household composition and the number of rooms per use remain unchanged. The standard for essential facilities has been updated to include a private walk-in kitchen, a private flush toilet, and a private bathing facility, along with water supply facilities, groundwater facilities with good quality, and sewage facilities. Additionally, "safe electricity utilities and structures and facilities for safe evacuation in case of fire" were added to the previous four criteria within the structure, performance, and environmental standards [8].

4. Setting Directions for Improving Minimum Housing Standards

4.1. Analysis of the Current Status of Households below the Minimum Housing Standards in South Korea

4.1.1. Overview of the Analysis

To analyze the current situation of households below the minimum housing standards, data from the Korea Housing Survey were utilized (Table 4) [9,29]. By Article of the "Framework Act on Residence" and Article 13 of the Ordinance for Enforcement of the Act, South Korea has implemented the Korea Housing Survey since 2006. The survey was sponsored by the Ministry of Land, Infrastructure, and Transport, and the Korea Research Institute for Human Settlements under the Ministry of Land, Infrastructure, and Transport conducted the survey; considering that, these data are reliable.

The minimum housing standards in Korea, which are currently published (refer to Table 3), were utilized. Additionally, information gathered from the following statements was used to confirm the status of households below the minimum housing standards.

(1) Exclusive residential areas per number of household members:

In general, as residents do not know the exclusive residential areas of their houses, data registered in the building register was utilized.

(2) Private walk-in kitchen:

Confirmation was conducted on whether the kitchen was used exclusively and as a walk-in. If either of these two conditions were not satisfied, the households were treated as households below the standard.

(3) Private flush toilet:

The status of the toilet was confirmed, whether it was for private use or a flush toilet. If either of these two conditions was not satisfied, the households were treated as households below the standard. The presence of a Western-style toilet was not taken into consideration.

(4) Private bathrooms:

Confirmation was solely based on whether bathrooms were used exclusively. If not, the household was treated as falling below the standard. The presence and absence of hot water were not considered.

(5) Water supply and drainage facilities:

We confirmed whether the water supply and drainage facilities were installed or not. As for the water supply facility, the availability of a groundwater facility with good water quality was recognized.

(6) Number of bedrooms per household composition:

Since the minimum number of bedrooms varies depending on the household composition (e.g., a married couple), the presence or absence of children, the age of children, and the gender of children, such a factor was applied. The number of living rooms used as bedrooms was included in the number of bedrooms.

Table 4. Outline of Korea Housing Survey [9,29].

	Details		
Rationale	Article 20 of the "Framework Act on Residence" and Article 13 of the Ordinance for Enforcement of the Act		
Survey sponsor	Ministry of Land, Infrastructure, and Transport		
Survey implementer	Korea Research Institute for Human Settlements		
Survey period	2006~2016: Biennial survey in even years 2017~2021: Every year		
Survey targets and scope	General households residing nationwide		
Survey methods	Face-to-face interview		
Total number of households in South Korea	21,448,463 households (in 2021)		
Number of valid samples	Approximately 51,000 households		
Survey period	The period between July and December every year		
Weighting	The weighting applied in consideration of the sampling probability of the population		
Survey items used for this analysis	(1) Area standard	(2) Bedroom standard	(3) Facility standard
	☐ Number of household members ☐ Exclusive residential area	☐ Household composition ☐ Number of bedrooms (including areas for living rooms)	☐ Private walk-in kitchen ☐ Private flush toilet ☐ Private bathroom ☐ Water supply and drainage facility

4.1.2. Analysis Results

The current status analysis of households below the minimum housing standards from 2006 to 2021 is as follows (Figure 2). The 2022 data were excluded since the Korea Housing Survey result has not yet been released.

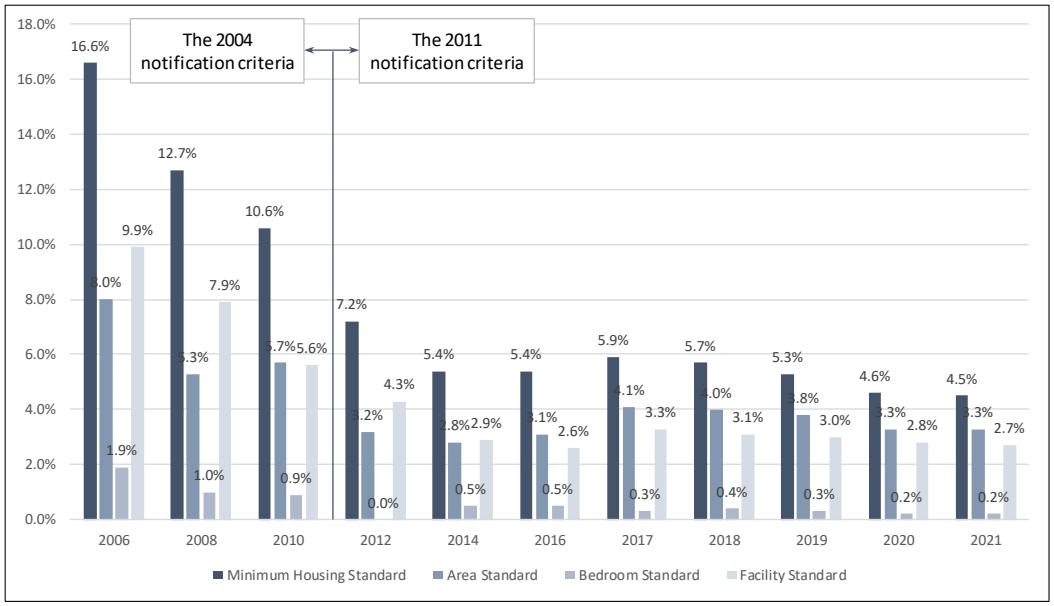


Figure 2. Status of households below the minimum housing standards.

(1) Households below the minimum housing standards:

The overall trend is downward, from 16.6% in 2006 to 4.5% in 2021. Since the trend was around 5% in 2014, it remained between 4% and 5% until 2021. Considering that the minimum housing standard was upgraded once in 2011, the rate of households below the standards since 2012 seems somewhat lower. This trend can be attributed to the following.

First, the average number of household members continuously decreased (2.7 persons in 2010 to 2.3 persons in 2021) [30]. In Korea, the main reasons for changes in family structures include nuclearization of families, children migrating for education, and spouses moving for employment opportunities. Additionally, a shift away from the traditional practice of living with elderly parents, and the trend of elderly parents residing in various facilities such as senior towns, nursing homes, and healthcare facilities, can also be considered contributing factors.

Second, only the area standard increased when the 2011 standard was upgraded (refer to Table 3). Korea possesses advanced construction technology, and the relatively high real estate values have resulted in a relatively short building lifespan that often leads to redevelopment. As a result, the quality of facilities has continuously improved due to the ongoing replacement of existing housing and redevelopment projects.

Third, the area standard of one-person households increased very limitedly, whereas the ratio of one-person households continuously increased (23.9% in 2010 to 33.4% in 2021) [31]. As mentioned earlier, Korea has witnessed a rapid and significant increase in the proportion of one-person households over a short period, driven by factors such as education, employment, the pursuit of independent livelihood by the elderly, and divorce.

Fourth, there were effects of residential environment improvements in line with the higher number of housing losses. The number of housing losses rapidly increased from 62,485 in 2010 to 99,321 in 2015 and 146,396 in 2021 [32]. The sharp increase in the number of housing losses by more than double in just 11 years is related to the real estate market. Korea has experienced a robust real estate market over the past decade, and large-scale housing supply initiatives have been pursued by private construction companies that could secure profitability.

(2) Households below the area and facility standards:

The ratio of households below the area and facility standards generally showed a decreasing trend. The households below the area standard decreased from 8.0% in 2006 to 3.3% in 2021. The households below the facility standard dropped from 9.9%

in 2006 to 2.7% in 2021. In 2021, the ratio of people residing in non-housing, including accommodations for students studying for exams, and compact buildings with compact rooms was approximately 1.7% [33]. Considering that, the ratio of households below the area and facility standards is likely to remain stuck in the range of 2–3% unless non-housing is fundamentally eliminated.

(3) Households below the bedroom standards:

The ratio of households that cannot reach bedroom standards was also downward in general. The rate decreased from 1.9% in 2006 to 0.2% in 2021, implying that most households satisfied the bedroom standard. This trend can be attributed to the following. First, since the minimum housing standards were first announced in 2004, the 2006 Korea Housing Survey, which was conducted for the first time, showed a low rate of households below the standard (1.9%); the standard was low from the beginning. Second, when the 2011 standards were upgraded, the bedroom standard was not changed. Third, living rooms that can be used as bedrooms were included as bedrooms. Compared to Western countries where bedrooms and living rooms are relatively separated, there are frequent cases where living rooms are used as bedrooms in Korea. Fourth, the average number of household members decreased, and the number of required bedrooms dropped [30].

4.1.3. Direction for Improving Minimum Housing Standards Based on the Current Status Analysis of Households below the Standards

First, considering the fact that the rate of households below the minimum housing standards dropped from 16.6% in 2006 to 4.5% in 2021, it is necessary to upgrade minimum housing standards in general. There are two contributors to the lower rate. First, the residential environment has been improved by housing losses and the supply of new housing. The average number of household members continuously decreased as well. As standards can change in each era, it is necessary to upgrade standards in line with the current situation, since South Korea can contemplate more on the residential quality such as environment and safety, rather than the quantity of housing.

Second, it is also necessary to upgrade area and facility standards. As mentioned earlier, unless non-housing types such as accommodations for students studying for exams, and compact buildings with compact rooms are removed, the rates of households below area and facility standards cannot significantly decrease, which already dropped to those rates of 3.3% and 2.7%, respectively. As for the facility standards, there should be more new standards, such as the installation of Western-style toilets, utilization of hot water in bathrooms, and security of parking lots.

Third, it is necessary to upgrade or abolish the bedroom standard. The rationale for upgrading the standard is as follows. The ratio of households below the bedroom standard was 0.2% in 2021, meaning that most households satisfied the standard. When setting the standard in 2004 and 2011, the focus was only on spaces for sleeping. Therefore, when there were a married couple and young children, sleeping together was the default. However, a bedroom is a space for sleeping, storage, and activities. One child requires some space for storage and activities, which is not smaller than a space for one adult. Therefore, it is necessary to redefine the criteria based on a bedroom per person.

The rationale for abolition is as follows: Korea had a traditional household composition in the past. Until the 1980s, Korea had a large family system with three generations living together, which could be categorized as “grandparents–parents–children”. After the 1990s, as urbanization came into full swing, the households of “grandparents” who stayed in rural areas and “parents–children” who moved to cities gradually began to be divided. Here, the households of “children”, who are independent of their parents due to marriage, employment, and study, began to become common. In this regard, the minimum housing standards, which were established in 2004 and 2011, respectively, included three types of standard household compositions.

However, the current Korean household composition is very different from the past. First, the ratios of one- and two-person households have increased. In particular, as for the

two-person households, diverse types of households have been found, including married couples, "siblings", "lovers", and "friends". The ratio of three-generation households in which grandparents, parents, and children live together has become so low that it is hard to find such cases. The traditional type of two-generation households has been more diverse: "Married couple–children", "grandparents–married couple", and "grandparents–children". Therefore, the standard household composition cannot become "standard". If it cannot have the feature of being "standard", it may be better to exclude it from new housing standards.

4.2. Overseas Case Studies

The current status of housing standards in the United Kingdom and Japan, which have similar systems to Korea's housing standards, was analyzed. In particular, the Japan case was analyzed in more detail, as this country demonstrated a similar configuration of bedroom number and area, which are sub-standards of minimum housing standards.

4.2.1. Housing Standards in the UK

The representative housing standard in the UK is the Decent Home Standard, which was established by ex-Prime Minister Tony Blair in 2000 [34]. The most recently revised standard was announced in 2016 and is still in use today. The UK government has applied this standard to council houses, encouraging council house providers to provide houses while meeting or exceeding the Decent Home Standard. The standards can be divided into one area standard and four performance standards, and the area standard is as follows (Table 5).

Table 5. Minimum residential area of the UK (unit: m^2).

Number of Bedrooms	Persons	1-Storey Dwellings	2-Storey Dwellings	3-Storey Dwellings	Built-in Storage
1b	1p	39(37) [1,2]	-	-	1.0
	2p	50	58	-	1.5
2b	3p	61	70	-	2.0
	4p	70	79	-	
3b	4p	74	84	90	2.5
	5p	86	93	99	
	6p	95	102	108	
4b	5p	90	97	103	3.0
	6p	99	106	112	
	7p	108	115	121	
	8p	117	124	130	
5b	6p	103	110	116	3.5
	7p	112	119	125	
	8p	121	128	134	
6b	7p	116	123	129	4.0
	8p	125	132	138	

[1] Where a 1b1p has a shower room instead of a bathroom, the floor area may be reduced from 39 m^2 to 37 m^2, as shown in brackets. [2] "1b1p" means one person living in a one-bedroom house.

The Technical Housing Standards, released in May 2016, indicate the area standard [35]. This is an area standard for the interior of the house and is a standard for the supply of new housing.

Houses satisfying both area and performance standards are categorized as good housing, and if they do not meet the standards, owners or landlords must make immediate improvements. If they do not implement that, the government can take action against them, including compulsory eviction and the inability to rent houses out.

In November 2020, the UK government announced that it would completely revise the Decent Home Standard, which has been used for the last two decades [36]. A draft was completed in the fall of 2021, and stakeholder consultation was finished in the fall of 2022 [36]. It is expected that the new Decent Home Standard will be related soon.

4.2.2. Housing Standards in Japan

Japan's minimum housing standards are highly similar in format to Korea's minimum housing standards, due to the composition and area of rooms according to the number of household members. Japan first introduced the concept of a minimum housing standard in 1976, while implementing the Third Five-Year Housing Construction Plan, aiming to provide housing services above the minimum standard along with a quantitative supply of housing. There is a difference between Japan's and the UK's housing standards: in the former, the minimum housing area for having a healthy and cultural residential life was set in relation to the number of household members.

(1) 1976~2005

The areas based on the minimum housing standards, which were applied from 1976 to 2005, are as follows (Table 6) [37]. The estimation of residential areas was based on architectural planning and design, targeting one to seven households. Japan's standards had a significant difference from Korea's as it did not utilize a standard household composition; the former also had a distinction from the UK's as there was no compulsion on households below the standards, and the standards were used as a reference for the analysis of housing conditions and policies.

Table 6. Minimum housing standard of Japan (1976~2005) [37].

Number of Household Members	Space Requirement	Living Area (Room + Living)	Residential Area	Total Area
1	1 K	7.5 m^2	16 m^2	21 m^2
2	1 DK	17.5 m^2	29 m^2	36 m^2
3	2 DK	25.0 m^2	39 m^2	47 m^2
4	3 DK	32.5 m^2	50 m^2	59 m^2
5	3 DK	37.5 m^2	56 m^2	65 m^2
6	4 DK	45.0 m^2	66 m^2	76 m^2
7	5 DK	52.5 m^2	76 m^2	87 m^2

(2) 2006–Current

In 2006, Japan revised its existing minimum housing standards alongside the enactment of the Basic Law of Housing-Life (Table 7) [38]. While the standards did not undergo significant increases, the criteria for calculating the living space became more detailed. Previously, the standards considered area requirements for bedrooms, facilities, and storage spaces based on the composition of household members, aggregating the required areas for each component to derive the overall area standard. In contrast, the revised version simplifies the minimum housing standards by defining them as the area needed per individual.

Table 7. Minimum residential area standard of Japan (2006~current) [38].

Number of Household Members	Residential Area	
1	25 m^2	(1) single: 25 m^2 (2) more than 2: 10 m^2 × person + 10 m^2 (3) when calculating the number of household members ☐ Below 3 years old: 0.25 person ☐ 3 years old and above but under 6: 0.5 person ☐ 6 years old and above but under 10: 0.75 person ☐ If the calculated number of household members is less than two, it is counted as two.
2	30 m^2	
3	40 m^2	
4	50 m^2	

During this period in Japan, a housing type where multiple households share a toilet and living room spread in Japan. The concept of a "standard" household composition was also discarded, and the diversity of household compositions was acknowledged. For example, in the case of a four-person household, the previous standards defined it as "parents + 2 children", whereas the revised version eliminates the notion of a standard household composition. In the revised standards, the variables for determining the area are only "number of household members" and "age". The name of the "minimum housing standard" was changed to the "level of minimum living floor area".

The level of minimum living floor area enabled estimating necessary areas per functions such as sleeping and eating. First of all, the sleeping conditions of family members were set, and the combination of public and private spaces, sanitary spaces, and storage spaces was composed to calculate the size of the main spaces. After summing the areas up, the final residential areas were calculated through the composition of the flow of human traffic and empty room spaces. Considering the population density in Japan, as it is difficult to adopt the "one room per person" standard, the value of the number of household members is corrected in line with the age of household members.

The Japanese Ministry of Land, Infrastructure, Transport and Tourism (corresponding to Korea's Ministry of Land, Infrastructure, and Transport) analyzed households below the minimum residential standards through the "Land and Housing Survey" which is implemented every five years, and the outcomes are reflected in housing policies, and utilized as the policy basis for setting the level of minimum living floor area.

4.2.3. Direction for Improving Minimum Housing Standards Based on Analysis Results of Overseas Case Studies

The UK and Japan cases were examined as these countries have similar or better conditions in terms of country size, population density, state earnings (the per capita gross national income), and urbanization rates (Table 8). As a result of examining the housing standards of the UK and Japan, the following implications were obtained.

Table 8. Comparison of minimum housing standards (area) of UK, Japan, and South Korea.

Country		**UK**		**Japan**		**South Korea**	
Country size (2021)	Area	243,610 km^2		377,970 km^2		100,410 km^2	
	Population	67,326,569		125,681,593		51,744,876	
Population density (2021)		276.4/km^2		332.5/km^2		515.3/km^2	
The per capita gross national income (2021) [39]		45,380$		42,620$		34,980$	
Urbanization rates (2023) [1] [40]		84.6%		92.0%		81.5%	
Housing standard (Area standard)		**Number of Household Members**	**Residential Area (m^2)**	**Number of Household Members**	**Residential Area (m^2)**	**Number of Household Members**	**Residential Area (m^2)**
		1	40.0	1	25.0	1	14.0
		2	51.5	2	30.0	2	26.0
		3	63.0	3	40.0	3	36.0
		4	72.0	4	50.0	4	43.0
		5	88.5	5	60.0	5	46.0
		6	97.5	6	70.0	6	55.0

[1] Urbanization rates: Percentage of population dwelling in a city among a country's total population.

First, South Korea and Japan showed passive approaches, as they utilized the minimum housing standards as the design criteria for policy indicators or public housing supply. On the other hand, the UK employed the standards as an active guideline for imposing penalties on households below the standard.

Second, South Korea showed more detailed standards of housing structure, performance, and environments than the UK. The UK utilized the minimum housing standards in terms of housing management, rather than housing supply, by providing highly specific guidelines on the remodeling of houses.

Third, Japan was utilizing the most similar system to South Korea's, as it suggested residential areas per the number of household members. However, Japan's area standard is higher than South Korea's because it is assumed that the former implemented the minimum housing standard 28 years before Korea. Japan has used the 2006 revised minimum housing standard, and it seems that there would not be many changes in the area standard. Based on Japan's case, it is likely that South Korea would not change or delete the area standard after one or two revisions. Simultaneously, there would be more housing management than housing supply, that is, enhanced criteria in terms of quality.

Additionally, the area standard of South Korea is much lower than that of the UK. Although body size, gross national income, population density, and residential life culture should be considered, it is obvious that the standard is still low. In other words, South Korea's area standard should be upgraded after conducting a comparative study of overseas cases.

4.3. Collection of Expert Opinions

4.3.1. Summary of Expert Opinion Collection

The direction for specific criteria per sector (area, bedroom, facility, and location standards) was set through theoretical consideration, literature review, the analysis of the current status of households below the minimum housing standards in South Korea, and overseas case studies.

In this section, we attempted to set the direction for the parts that could not be determined earlier, by collecting experts in each field (Table 9). We targeted 22 experts in four fields, visited them in person, and used a written questionnaire to collect opinions. This process proceeded from 10 March to 31 March 2023. Experts were selected if they satisfied one of the following specific criteria: (1) participants in research projects related to housing standards; (2) authors of papers related to housing standards; (3) employees of housing-related policy organizations, research institutes, and execution organizations; (4) professors in housing and architecture-related departments.

Table 9. Outline of expert opinion collection.

	Date	10–31 March 2023			
	Method	In-depth interviews with experts (visit in person or written questionnaire)			
Expert	Field	Housing Policy	Housing Welfare	Facilities and Equipment	Housing Plan
	Number of Experts	6	5	5	6
	Participant Groups	• L Research Institute • A&U Research Institute • K University • The S Institute • K Research Institute • S Metro. Government	• N Carpenter Co., Ltd. • P University • Y University • Y Life-tech Institute • L Research Institute	• K Laboratories • M Architects • U Architecture • S Research Institute • S E&C	• U Architecture • SH Corporation • GH Corporation • Y University • Y University • S Government

4.3.2. Result of Expert Opinion Collection

Questions were posed to those experts based on the direction for minimum housing standards, area standards, bedroom standards, and facility standards, and the findings are as follows:

(1) Direction for minimum housing standards

Regarding the question "Is it necessary to improve the current minimum housing standards?" the majority of experts answered as follows: "Active improvements should be followed". Experts indicated that the current standards are outdated and cannot reflect the current situations since the rate of households below the standards is low. Furthermore,

compared to the past, household composition, housing trends, and lifestyles have changed significantly, and many experts highlighted that corresponding improvements are urgently needed. On the other hand, they agreed on the idea of changing the current standards, but some experts were pessimistic about the minimum housing standards because they assumed that the standards would not be needed in the future where people's residential environments would reach a certain level in general. As for similar opinions, some experts indicated that area or bedroom standards should be removed, and related indicators of housing safety and performance should be strengthened.

Regarding the question "If standards need to be improved, to what extent should they be improved?" the majority of experts answered as follows: "The standards should be improved at a developed country's level while considering the residential life culture of South Korea". Although the US cases were reviewed, its standards were not reflected. In particular, the substantial differences in area standards made them unsuitable as reference cases. We reflected on experts' opinions that there are limitations to using the US cases since the residential life culture of the US is highly different from South Korea's. There was the minority opinion: "A standard in which the rate of household below the standard can be between 5–10%, is appropriate". Although it is inappropriate to set a standard based on the rate of households below the standard, there are several opinions that such an approach may be practical considering the role of the standard—"improvement of residential environments".

(2) Area standard

Regarding the question "A total exclusive residential area according to the number of household members is the current criteria. Do you think that it is an appropriate method?" the majority of experts said that "it is appropriate". There were two minority opinions. First, some experts expressed that considering that the rate of one- and two-person households rapidly increased, the exclusive residential area for those households should be set differently. Second, other experts indicated that as the common area for dwelling also affected the quality of life, the common area for dwelling should be considered.

Regarding the question "If you agree to increase the exclusive residential area, do you think that the UK and Japan cases, which were handled in this study, are appropriate for comparison?" the majority of experts answered "Those cases are appropriate for comparison". When setting the 2004 and 2011 standards, the UK and Japan cases were utilized as reference data, which became the rationale for this study. Japan has a similar residential life culture to South Korea; the residential life culture of the UK is different from South Korea's, but the UK case was appropriate considering it showed a target that South Korea should pursue. Regarding the upgraded level, there were many opinions that a level similar to Japan, but lower than the UK, was most appropriate. There was a minority opinion that universal design considering people with disabilities and the elderly living alone, who are relatively vulnerable, should be applied in the area estimation.

As for the question "Do you think it is appropriate that five- or six-person households should have two toilets?" most experts expressed that two toilets were appropriate. There was a minority opinion that the universal design does not have to be applied to the second toilet.

(3) Bedroom standard

Regarding the question "Do you think that the current standard for the number of bedrooms is appropriate?" most experts stated that "It is meaningless", or "The standard is low". In the past large-family era, as there was a large number of household members, parents, and children, or children slept together, but in the current era of nuclear families, it is not common anymore. Since the household composition has become more diverse than in the past, several experts indicated that the concept of "standard" is not appropriate. The current status of households below the minimum housing standards objectively indicates that the current standard is low since almost all households satisfy the bedroom standard.

There was a minority opinion that "The distinction between bedroom and living room should be removed". There were two reasons. First, as many people sleep in a living room, the living room also serves as a bedroom. Second, several one- or two-person households reside in one-room houses or two-room houses without a clear distinction between the living room and bedroom, the living room sufficiently plays the role of the bedroom.

As for the question of "What do you think about the standard household composition? (Refer to Table 3)" a great number of experts stated that "The standard household composition, which is a specific criterion, should be removed". There were two reasons. First, as mentioned earlier, as there are more nuclear families than large families today, the previous standard household composition cannot be applied anymore. Second, the situation where young children sleep with their parents was set as the standard, this implies that a space for sleeping was only considered. In the current era where nurturing and education of young children are important, a space for young children is as necessary as a space for parents. There were minority opinions that it is better for opposite-sex children to have separate bedrooms regardless of their age and that a standard separating bedrooms in line with conditions is unnecessary.

(4) Facility standard

We explained the current facility standard in detail and asked experts about the facility standards that can be added. We also indicated the names of facilities, usage patterns, and types to induce more objective responses. We utilized facility-related questions from the questions of the Korea Housing Survey, which is conducted by the government every year [9]. The names of facilities used in the questions are as follows: (1) kitchen, (2) toilet, (3) bathing facility, (4) water supply facilities, (5) drainage system (septic tank), (6) heating system, (7) fuel for cooking, (8) entrance (front door), (9) fire-fighting appliances.

The facility standards that experts would like to see added are as follows, in order of frequency of mention: (1) presence and absence and types of heating system (except for briquettes, firewood, electric heaters, etc.); (2) private bathing facilities, and absence or presence of hot water; (3) private use of an entrance (front door); (4) a private flush toilet, and absence or presence of Western-style toilets.

There were minority opinions regarding safety, evacuation, noise, and waterproofing. However, as there are practical limitations in preparing specific standards for corresponding criteria, these opinions were excluded from this study.

(5) Location standard

As for the question "As the current standards do not consider the location of housing, do you think underground or rooftop houses are appropriate?" most experts said, "They are inappropriate".

We asked more questions to experts who gave the answer: "The locations of housing can be classified into above-ground house, semi-underground house, underground house, and rooftop house. Among them, which one does not reach the minimum housing standard? (Duplicate responses possible.)" Eighteen experts thought underground houses are below the standard; 14 experts thought semi-underground houses are below the standard; 10 experts regarded rooftop houses as below the standard. Experts considered safety and health issues the most important regarding underground housing, while safety issues regarding illegal structures were most frequently mentioned in terms of rooftop houses.

The minority experts expressing an opinion of "no necessity" agreed with the need, but considering the reality that it is difficult for some people to move to over-ground houses due to housing costs, a few experts emphasized that support policies for them should be prioritized over setting standards.

5. Results of Minimum Housing Standards Improvement Proposal

5.1. Direction for Improving Area and Bedroom Standards

5.1.1. Prerequisite

Consideration was given to the prerequisites for the area and bedroom standards, and the details are as follows (refer to Section 3.2).

First, according to the "Constitution", "All citizens shall have the right to a healthy and pleasant environment. The State and all citizens shall endeavor to protect the environment". Second, according to the "Framework Act on Residence", "The people have the right to live a decent residential life in a pleasant and stable dwelling environment protected against any physical or social danger, as prescribed by relevant statutes and ordinances". Third, according to the "Framework Act on Residence", "The State has the duty of guaranteeing the people's housing rights". Fourth, according to the "Housing Act", the minimum housing standard aims to provide "a minimum standard required for the people to live a decent residential life in a pleasant dwelling environment".

5.1.2. Direction for Specific Improvements

The literature review, analysis of the current status of households below the minimum housing standards, overseas case studies, and expert opinion collection were conducted to derive the direction for improving area and bedroom standards in line with the aforementioned prerequisites. As a result, the following direction for specific improvements were derived (Table 10).

Table 10. Direction for specific improvements in minimum housing standards.

		2011	2023	
			Improvement Direction	Rationale
Area standard	1-person	14 m^2	▲	a, b, c, d
	2-person	26 m^2	△	a, b, c, d
	3-person	36 m^2	△	a, b, c, d
	4-person	43 m^2	△	a, b, c, d
	5-person	46 m^2	△	a, b, c, d
	6-person	55 m^2	△	a, b, c, d
	Universal design	Absence	▲	d
Bedroom standard [1]	1-person	1 [2] K [3]	△	b, d
	2-person	1 DK [4]	▲	b, d
	3-person	2 DK	=	b
	4-person	3 DK	=	b
	5-person	3 DK	=	b
	6-person	4 DK	=	b
	Standard household composition	Presence	×	b, d
	Standard separating bedrooms	Presence	×	b, d

[1] Bedroom standard: The direct criteria for room configuration are deleted, but it is utilized as a sub-criterion for calculating the area standard. [2] Figures in bedroom standard: Number of rooms that can be utilized as bedrooms (including spaces for living room). [3] K: Kitchen; [4] DK: Dining room and kitchen. ▲: Active improvement; △: Passive improvement; =: Maintenance; ×: Deletion. a: Literature review (refer to Section 3.1); b: Analysis of the current status of households below the standards (refer to Section 4.1.3); c: Overseas case studies (refer to Section 4.2.3); d: Expert opinion collection results (refer to Section 4.3.2).

As for the area standard, opinions supporting an upgrade of the standard were found in almost all rationales. In particular, with the increase in the rate of one-person households, there was a rationale indicating the need for active improvements. Therefore, we decided to estimate the area standard by applying universal design principles that were not reflected in the 2011 minimum housing standards.

Regarding the bedroom standard, two main directions for improvements were identified. First, the decision was made to eliminate the standard itself. As household compositions have become more diverse, the concept of a "standard" has lost its relevance.

Consequently, the "standard separating bedrooms" based on the "standard household composition" has also become less meaningful. However, the "room configuration (1 K~4 DK)" was removed but retained as an auxiliary standard for calculating the area standard. Essentially, this implies that insufficient rooms based on the number of household members will not be considered as falling below the minimum housing standard. Since the number of rooms is already included in the area standard, and configurations (K, DK) are covered in the facility standard, duplications are unnecessary.

5.1.3. Design Simulation

(1) Premise

This sector aims to calculate the size of each room that satisfies the minimum housing standards. After calculating the size of each room, it becomes possible to determine the exclusive residential area that meets the minimum housing standard per the number of household members. To achieve this, we conducted a design simulation in the following sequence. The methodology was partially based on the approach by Bae et al. [41].

(2) Estimation of Furniture Sizes

Initially, we selected the furniture that should be placed in each room to fulfill the minimum housing standards (Table 11). A bedding or bed, a wardrobe (blanket chest), and a desk are placed in the bedroom. A sink table, kitchen counter, gas table, and refrigerator are positioned in the kitchen and dining room. A toilet, washstand, and shower booth are located in the bathroom. The entrance, shoe rack, and boiler rooms were regarded as other spaces. However, for one-person households, where common heating systems are often used, boiler rooms were not taken into account. In Korea, standardized sizes known as the Korea Standard are commonly adopted in the industry [42]. Based on this standard, we computed the standard size. If checking the Korea Standard poses challenges, consideration was given to the minimum unit size of commercially available products. The dimensions from the Korea Standard and commercially available items already take into account the body sizes of Koreans.

Table 11. Standard sizes per furniture item (width × length, unit: mm).

Bedroom	Bedding	Bed (Bed frame)		Closet (Blanket chest)	Desk (Chair)
	Bedding for one person: 1000 × 2100 Bedding for two persons: 1400 × 2100	Single bed: 1000 × 2100 (1100 × 2300) Double bed: 1400 × 2100 (1500 × 2300)		900 × 700	800 × 600 (800 × 1200)
Kitchen and dining room	Sink table (free space)	Kitchen counter (free space)	Gas table	Refrigerator	Table
	840 × 550 (600)	Length: 550 (600)	2 burners: 700 × 600 4 burners: 750 × 600	1 person: 600 × 600 2 persons: 800 × 700 More than 3 persons: 1000 × 900	1~2 person: 800 × 800 More than 3 persons: 1200 × 825
Bathroom	Toilet (free space)		Washstand	Shower booth	
	550 × 700 (650 × 800)		550 × 400	800 × 800	
Others	Entrance		Shoe rack	Boiler room or Utility room	
	1 person: more than 0.5 m^2 2 persons: more than 0.8 m^2 More than 3 persons: more than 1.6 m^2		1 person: 600 × 300 2 persons: 900 × 300 More than 3 persons: 1200 × 300	1 person: more than 0.7 m^2 2 persons: more than 1.0 m^2 More than 3 persons: more than 2.0 m^2	

(3) Application of universal design

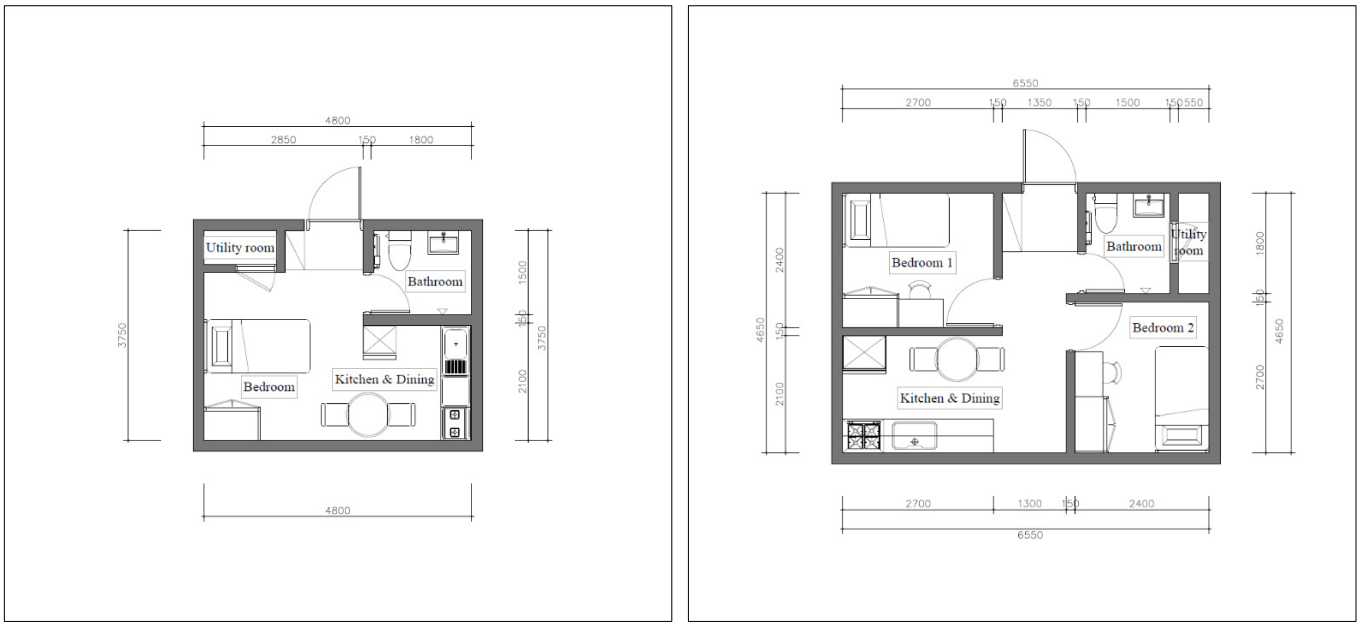
Among universal design considerations, we only took into account factors that could impact the calculation of exclusive residential areas, specifically focusing on the indoor

use of wheelchairs by individuals with disabilities or the elderly living alone. In such instances, the entrance door's effective width should exceed 900 mm, and a space of over 1200 mm should be available in front of and behind the entrance door [43]. Furthermore, the minimum effective width of indoor pathways, considering wheelchair accessibility to bedrooms and kitchen, has been set at 800 mm or more. In the bathroom, handrails for individuals with disabilities have been planned to facilitate use without the need for a wheelchair.

(4) Design simulation results

Criteria for furniture arrangement and sizes, as well as universal design, were previously established. With these criteria in mind, a design simulation of a housing floor plan that meets the minimum housing standards was conducted using an AutoCAD LT 2021 program. The criteria are outlined as follows:

First, we arranged the essential furniture based on a standard for each household member. Second, we arranged openings while considering universal design principles. Third, we ensured the flow of human traffic, particularly accommodating those using wheelchairs. Fourth, we allocated free spaces to cater to the activities required for daily life, such as sleeping, cooking, washing dishes, resting, cleaning, and bathroom usage. Fifth, regarding bedrooms, the principle of one room per person was applied. However, if the number of bedrooms was fewer than the number of household members, the two people per room principle was also used. Sixth, all spaces were organized using 30 cm as the minimum unit of length, reflecting the common practice in Korean housing construction sites. Seventh, the simulation used interior dimensions, consistent with how the calculation of exclusive use area is based. Eighth, the bathroom area was assumed to be equipped with a combined shower and washbasin, adhering to minimum housing standards. Finally, the proposed residential area meeting all eight criteria was identified as the minimum housing standards' residential area (Figure 3).



(**a**) (**b**)

Figure 3. *Cont.*

Figure 3. Design simulation of minimum housing standard per household composition (unit: mm): (**a**) 1-person (18 m^2); (**b**) 2-person (30 m^2); (**c**) 3-person (40 m^2); (**d**) 4-person (48 m^2); (**e**) 5-person (56 m^2); (**f**) 6-person (63 m^2).

5.2. Improvements in Minimum Housing Standards

5.2.1. Area Standard

The criteria in detail for calculating the area standard are as follows:

First, among the 2011 bedroom standard, the room configuration standard was utilized (1 DK~4 DK). Considering the direction of improving details in the minimum housing standards, for a one-person household, the "kitchen" was upgraded to "dining room and kitchen". This change was made since a one-person household should have a basic and minimum space for dining. Furthermore, the number of rooms for two-person households

was shifted from one to two. When setting the 2011 standard, two-person households were standardized as "Married couple", and the number of rooms was set as one. However, as the composition of households became diverse, consideration was given to other types of households rather than "Married couples" and an additional room was added (refer to Table 10).

Second, the design simulation of the housing floor plan was also considered in terms of human scale. Based on these criteria, we suggest the following minimum housing standard improvements per household composition (Table 12).

Table 12. Improvements for minimum housing standards per household composition (area standard) (unit: m^2).

Number of Household Members	**1**	**2**	**3**	**4**	**5**	**6**
Spatial Composition	1 DK	2 DK	2 DK	3 DK	3 DK	4 DK
Bedroom 1	6.48 (2.4 × 2.7)	6.48 (2.4 × 2.7)	9.90 (3.0 × 3.3)	9.90 (3.0 × 3.3)	9.90 (3.0 × 3.3)	9.90 (3.0 × 3.3)
Bedroom 2	-	6.48 (2.4 × 2.7)	6.48 (2.4 × 2.7)	6.48 (2.4 × 2.7)	9.90 (3.0 × 3.3)	9.90 (3.0 × 3.3)
Bedroom 3	-	-	-	6.48 (2.4 × 2.7)	6.48 (2.4 × 2.7)	6.48 (2.4 × 2.7)
Bedroom 4	-	-	-	-	-	6.48 (2.4 × 2.7)
Kitchen & Dining	4.41 (2.1 × 2.1)	5.67 (2.1 × 2.7)	6.48 (2.4 × 2.7)	7.29 (2.7 × 2.7)	8.91 (2.7 × 3.3)	8.91 (2.7 × 3.3)
Bathroom 1	2.70 (1.5 × 1.8)	2.70 (1.5 × 1.8)	2.70 (1.5 × 1.8)	2.70 (1.5 × 1.8)	2.25 (1.5 × 1.5)	2.25 (1.5 × 1.5)
Bathroom 2	-	-	-	-	1.80 (1.2 × 1.5)	1.80 (1.2 × 1.5)
Others	4.41	9.13	14.34	15.09	16.64	16.86
Total Area	18	30	40	48	56	63

(1) As for the area of a room, the area is different by separating rooms into 1 bedroom and 2 bedrooms. (2) Total Area is rounded to zero decimal places. (3) Others: Entrance + Shoe rack + Boiler room or Utility room + Hallway inside the household + Wall inside the household.

5.2.2. Bedroom Standard

The 2011 bedroom standard is as follows:

First, the basis for the number of rooms was established: one room for one- or two-person households, two rooms for three-person households, three rooms for four- and five-person households, and four rooms for six-person households. This also included living rooms that could serve as bedrooms. However, the concept of "standard" has become less meaningful due to the increasing diversity of households compared to the past (refer to Sections 4.1.3 and 4.3.2). As a result, the criteria regarding the number of rooms were removed.

The second feature concerns room types. For one-person households, a kitchen was required, while other households needed a space that could serve as both a kitchen and a dining room. Since this criterion overlaps with the kitchen criterion in the facility standard, it was eliminated.

The third feature involves the standard for separating bedrooms. Implementing a standard for separating bedrooms presents challenges. The past standard household composition no longer fits the diverse household structures of today (refer to Sections 4.1.3 and 4.3.2). Consequently, the standard for separating bedrooms was also removed.

After a detailed analysis of bedroom standards, we decided to eliminate them altogether. Despite their removal, no issues are anticipated since they indirectly and directly

affect area and facility standards. The bedroom standard was incorporated when deriving the area standard (refer to Table 12). Additionally, the previous section on households failing to meet minimum housing standards indicated that only 0.2% of households were affected, which is insignificant (refer to Section 4.1.3).

5.2.3. Facility Standard

In terms of facility standards, the United Kingdom and the United States apply facility standards termed "performance standards". However, these standards are applied as benchmarks of adequacy rather than minimum requirements.

In Korea, based on the 2011 standard, only the kitchen, toilet, bathroom, water supply, and drainage facilities were subject to the standard (refer to Section 3.2.3). Expert opinions were collected to enhance this aspect (refer to Section 4.3.2). Consequently, an overall upgrade to the standard was deemed necessary. Four facility standards for potential addition were identified while retaining existing standards, based on frequency (Table 13).

Table 13. Minimum housing standard improvements per household composition (facility standard).

Facility Standard	Usage Classification	Absence or Presence of Standard		Type Classification	Absence or Presence of Standard	
		2011	2023		2011	2023
(1) Kitchen	Private	○	○	Walk-in	○	○
(2) Toilet	Private	○	○	Flush toilet	○	○
(3) Bathroom	Private	○	○	Hot water	×	○
(4) Water supply and drainage facility	Installation	○	○	-	-	-
(5) Heating system	Installation	×	○	Fuel for heating [1]	×	○
(6) Entrance door	Private	×	○	-	-	-

[1] Heating fuels: Exclude conventional fuels such as briquettes firewood, and large electrical heaters. ○: Standard available; ×: No standard available.

First, the presence and type of the heating system were considered. While this criterion was excluded assuming that few households would not comply, an analysis of the 2011 Korea Housing Survey revealed only 0.1% of households lacked heating systems, primarily concentrated in one- to two-person households [29]. It is assumed that these households live in non-residential facilities. Nonetheless, heating systems are an indispensable requirement for housing, so they were included. Regarding heating system types, households using conventional fuels like briquettes, firewood, or large electric heaters were classified below the minimum housing standard. Large electric heaters, which might be debatable, differ from Western heating methods. Western cultures utilize electric heaters or radiators to heat spaces, whereas Korea traditionally employs floor heating. Since there are minimal space-heating facilities in Korean residences, this method is considered "temporary". Given that heating systems are essential, this criterion was included.

Second, we considered the presence or absence of hot water in the bathroom. Though this aspect is fundamental, it was omitted due to a presumed scarcity of non-compliant households. Even though the ratio of households failing to meet this standard is likely insignificant, it was incorporated, assuming these households primarily reside in non-residential facilities.

Third, the exclusive use of the entrance (front door) was added. Some housing types share a front entrance and hallway access to individual rooms, prevalent in accommodations for exam-studying students, mostly catering to one- or two-person households. This criterion pertains to family and personal privacy and safety, thus considered a fundamental right. Given its strong connection to basic human rights, it was integrated as a new standard.

Fourth, there were suggestions about Western-style toilets. Since few households lack Western-style toilets in Korea, this was omitted as a criterion, as the use of Eastern-style toilets does not pose significant inconvenience or hygiene issues.

Lastly, we deliberated on the presence or absence and type of cooking facilities. Given the reduced trend of home cooking compared to the past, this criterion was excluded.

We also considered other factors like fire-fighting appliances, structural safety, waterproofing, moisture-proofing, ventilation, natural light, noise, natural disasters, crime prevention, and sanitation. As safety and quality of life are paramount, we contemplated incorporating these criteria. However, due to the absence of objective confirmation via the current Korea Housing Survey and concerns about efficacy, we maintained the declarative essence of the 2011 minimum housing standard (refer to Section 3.2.3).

5.2.4. Location Standard

The location criterion did not exist in the past. As mentioned in the Research Background and Purpose section, there is a recent issue in Korean society about the safety of underground or semi-underground houses due to flood damage (refer to Section 1.2). In this study, we collected related opinions of experts through interviews (refer to Section 4.3.2).

(1) Underground and semi-underground houses:

First of all, underground and semi-underground houses have safety issues. In the event of a flood, if people residing in those houses are not evacuated early, it is not easy to escape on their own due to water pressure. This issue is especially found in areas with low ground levels and high land prices. The South Korean government has recognized that "underground and semi-underground houses" are inappropriate for housing, and has attempted to establish policies to provide countermeasures [10]. In addition, in the event of a fire, as there are often no emergency exits in such types of houses, people residing in such houses become more vulnerable than those living in above-ground houses.

There are also health issues. Basements are very humid and often are covered by mold. This can cause problems with respiratory diseases. Compared to above-ground houses, these types of houses are highly likely to have more cockroaches and rats, leading to a higher chance of transmitting germs to humans. As ventilation and lighting are also unfavorable, those conditions can harm the health of residents. Therefore, in this study, this criterion was set as a minimum housing standard.

(2) Rooftop houses:

Rooftop houses are also related to safety issues. "Rooftop" refers to the space at the top of a house or building. In many cases, the purpose of rooftops that were originally built for purposes other than residence are changed to residential facilities, or they are illegally expanded. This makes rooftops unsafe housing. Illegal buildings sometimes do not comply with safety-related standards, and there is no public management, which is the reason why such buildings are considered safety blind spots. Therefore, in this study, this criterion was set as a minimum housing standard.

(3) Other location standard:

As mentioned earlier, health is a critical issue directly related to housing rights. Therefore, consideration was given to whether to include location criteria related to low pollution levels in the vicinity [44]. Additionally, there was consideration regarding the incorporation of the availability of green areas (such as parks and walking trails) that can promote health in the location criteria [45]. However, as these topics fall outside the scope of this study, there is an intention to address them in more detail in future research.

5.2.5. New Minimum Housing Standards with Improvements (Synthesis)

The new minimum housing standards, which integrate the previous area standards, bedroom standards (deleted), facility standards, and location standards, are as follows (Table 14).

Table 14. Suggested minimum housing standards in 2023.

1. Area Standard		**2. Facility Standard**		**3. Location Standard**	
(1) 1-person	18 m^2	(1) Kitchen	Private and Walk-in	(1) Semi-underground house	Below the standard
(2) 2-persons	30 m^2	(2) Toilet	Private and flush toilet	(2) Underground house	Below the standard
(3) 3-persons	40 m^2	(3) Bathroom	Private and hot water	(3) Rooftop house	Below the standard
(4) 4-persons	48 m^2	(4) Water supply and drainage facility	Installation		
(5) 5-persons	56 m^2	(5) Heating system	Installation and Fuel		
(6) 6-persons	63 m^2	(6) Entrance door	Private		
4. Structure, performance, and environment standards					
(1) As a permanent building, structural strength must be secured, and materials for principal structural parts shall be heat-resistant/proof, fire-resistant, and moisture-proof.					
(2) Adequate soundproofing, ventilation, natural light, and heating facilities shall be provided.					
(3) Environmental factors such as noise, vibration, odor, and air pollution shall meet legal standards.					
(4) A house shall not be located in an area with significant risks of natural disasters such as tsunamis, floods, landslides, and cliff collapse.					
(5) It shall be equipped with safe electrical facilities, and structures and facilities for safe evacuation in case of fire.					

5.2.6. Estimation of Households below the Minimum Housing Standards Based on New Standards

We estimated new households below the minimum housing standards, based on the raw data from the 2011 Korea Housing Survey [29]. As a result, 8.4% of total households were found to fall below the minimum housing standards (Figure 4). This represents an increase of approximately 3.9% compared to the 4.5% under the previous standards. Notably, high rates were observed among six-person households (19.6%) and one-person households (15.8%). The elevated rate for six-person households could be attributed to economic challenges leading to extended family cohabitation. For one-person households, the high rate might stem from temporary situations involving work, study, or employment preparations, coupled with limited financial resources. Households below the minimum housing standards were relatively low in the case of two- to five-person households, which can be attributed to the higher proportion of independently formed families.

Regarding the area standard, 6.2% of total households were identified as falling below the standard. This marks an increase from the previous standard's 3.3%, representing a rise of approximately 2.9% under the new standard. Among the sub-standards, the area standard demonstrated the most significant impact on the minimum housing standard. While the extent of this impact might vary based on the chosen standard, it can be assumed that it reflects Korea's high population density.

Regarding the facility standard, 3.1% of total households were found to be below the standard, an increase from the 2.7% under the previous standards. This difference is attributed to the inclusion of criteria such as the presence of hot water in the bathroom, the presence/absence of heating systems and relevant fuels, as well as private entrance doors. This outcome implies that most households are already equipped with these essential facilities. Notably, one-person households displayed a notably high rate of 7.7% below the standard, primarily due to their temporary residence in places like student accommodations or compact buildings with specialized compact rooms.

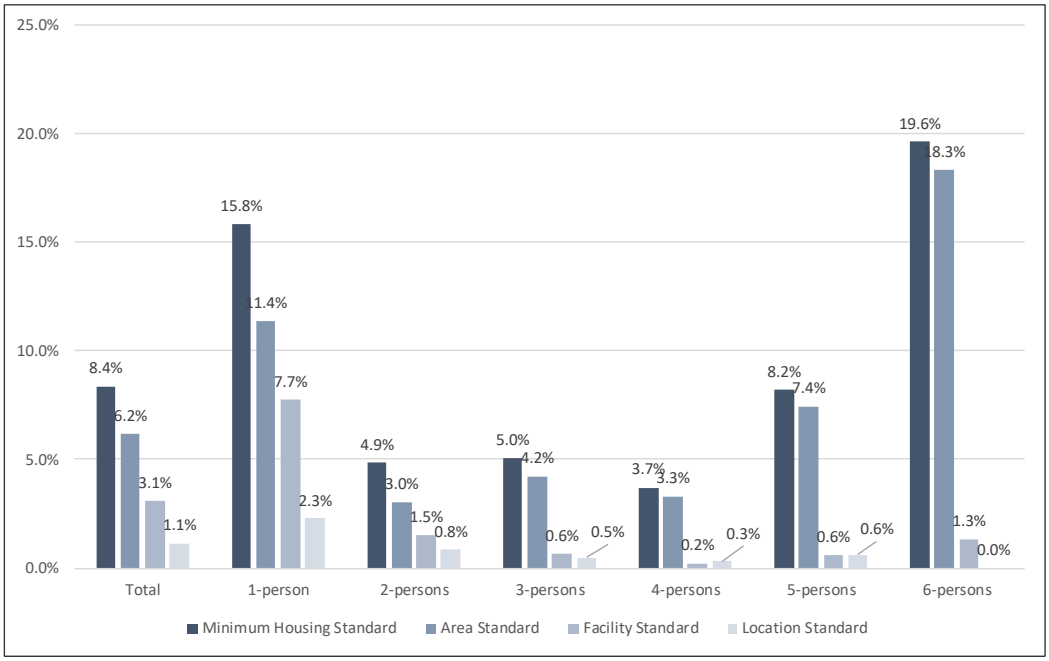


Figure 4. Households below the minimum housing standards based on new standards.

Regarding the newly proposed location standard, fewer than 1.1% of total households were found to be below the standard. This category encompasses households residing in underground, semi-underground, or rooftop houses. While constituting a small portion, such housing conditions are linked to safety and health concerns that require resolution.

Lastly, a total of 2661 households (0.013%) did not meet all three standards. These households exclusively comprised single-person households, indicative of vulnerable households in urgent need of housing improvement. Korea boasts a robust economy and a significant number of high-quality multi-unit dwellings, particularly apartments. However, the nation grapples with high population density and urbanization rates. Consequently, a relatively substantial number of households fall below the area standard, while the prevalence of households meeting facility and location standards is high.

6. Discussion

Since the enactment of the minimum housing standards in 2004, the ratio of households falling below these standards has been annually estimated through the Korea Housing Survey on a national scale. The rate of households below the minimum housing standards was 16.6% in 2006 but decreased to 4.5% in 2022, even with an update in the standards occurring in 2011.

Our study concentrated on this 4.5% rate. Even in developed countries with relatively favorable housing conditions, governments cannot fully cater to the residential needs of every individual. In this context, the 4.5% ratio could signify vulnerable segments within the population that require active government intervention to improve their housing circumstances. While this ratio may diminish assuming South Korea's continuous growth, it will eventually reach a threshold and not achieve 0%. Indeed, the percentages of households below the minimum housing standards between 2014 and 2021 have remained stagnant within the range of 4.5% and 5.9%.

Given the situation where most households, apart from those in vulnerable living conditions, meet the minimum housing standards, the standards should be elevated. In this perspective, we deliberated on the "meaning or definition of minimum housing standards" (refer to Section 5.1.1), as well as the levels of these standards. Standards are context-dependent and subject to the times and the perspectives of those defining them. Recognizing these limitations, our study aimed to create standards as objectively

as possible. We derived the direction for the minimum housing standards by examining pertinent regulations, conducting research encompassing literature reviews, analysing the current state of households not meeting the minimum housing standards, examining overseas case studies, gathering expert opinions, engaging in design simulations, and estimating households not meeting the standards under the new criteria.

Furthermore, the standards were ensured to align with contemporary circumstances. First, the standard household composition was eliminated, rendered irrelevant by the diversification of household structures. For instance, the standard household composition classified a two-person household as a "married couple", whereas in this study, "siblings", "partners", "friends", and "single-parent households" can all be classified as such. Consequently, we discarded the bedroom standard predicated on the standard household composition and instead sought to supplement it with the area standard based on the number of household members.

Second, evolving societal values were incorporated. Over time, the significance of values such as human rights, safety, the environment, and quality of life has grown compared to the past. In light of this evolution, universal design principles for individuals with disabilities were integrated into the area standard. To address safety concerns, a "private entrance door" criterion was introduced within the facility standard, and "above-ground housing" was included within the location standard. As we believed the location standard played a pivotal role in safety, environmental factors, and quality of life, we introduced this new criterion in our study. To address quality of life, the area standard was elevated and living spaces were expanded, aspects intertwined with most of the other standards.

Third, we accounted for shifts in lifestyle. For one-person households, which were predominantly found in student accommodations and communal dining areas, the COVID-19 pandemic altered behavior, leading individuals to consume meals at home through delivery services. Consequently, a "dining room" criterion was introduced for one-person households. For two-person households, our previous assumption that married couples shared a bedroom was adjusted, as an increasing percentage now had separate rooms. In response, two bedrooms were assigned for two-person households. Notably, South Korea's advanced public bathing facilities like jjimjilbang (Korean dry sauna) experienced a shift during COVID-19, with more people opting to bathe at home due to infection concerns. Reflecting this change, "hot water in bathing facilities" was introduced as a new criterion. Additionally, with heightened privacy concerns, the new criterion of a "private entrance door" was introduced.

7. Conclusions

In Section 6, we examined (1) the need to introduce new minimum housing standards, (2) the assurance of objectivity, and (3) the major changes to the minimum housing standards. In this section, we will discuss the implications of this study, focusing on the potential policy applications of the newly proposed minimum housing standards.

First, these standards can serve as criteria for government housing policies. By assessing households' housing conditions, effective policies can be formulated accordingly. The minimum housing standards can be considered a highly effective tool for making precise judgments. This accurate assessment of housing conditions empowers the government to devise housing supply strategies as well as housing policies regarding supply, loss, and housing welfare programs. Housing welfare programs can use these standards as pivotal criteria for identifying eligible beneficiary households.

Second, the standards can facilitate the establishment of housing management norms. Specifically, tailored management standards can be created for households falling below the minimum housing standards. In the public realm, this can lead to the formulation of policies concerning residential mobility and housing improvements through the allocation of public resources. In the private realm, these standards can serve as voluntary management indicators. Notably, since minimum housing standards relate to fundamental rights such

as safety, environment, and human rights, proactive public interventions are warranted. Immediate measures should be implemented for the 2661 households (0.013%) not meeting area, facility, and location standards, ultimately striving to improve the living conditions of 1,738,733 households (8.4%) below the minimum housing standards.

Third, the standards can be employed as criteria for the construction of public rental housing. Currently supplied public housing satisfies facility and location standards. As a result, minimum housing standards can serve as indicators for formulating area-specific design standards. Furthermore, when selecting prospective tenants for public rental housing, the number of household members intending to reside in the unit can be clearly established, with the area standard serving as a criterion.

Fourth, the standards can guide site selections for housing-redevelopment projects, housing-reconstruction projects, and urban-regeneration initiatives. These projects entail large-scale enhancements of residential environments in South Korea. Urban-regeneration projects require public funding, and housing-redevelopment and -reconstruction projects are anticipated to yield real estate gains from developmental ventures, making site selection highly competitive. Utilizing minimum housing standards for site selection can help address the issue of households below the minimum housing standards and ultimately contribute to enhancing residential environments.

Finally, the ultimate role of minimum housing standards is to "enhance living conditions". The causal link between the decreased ratio of households falling below the minimum housing standards and the formulation of these standards cannot be fully explained. The exact correlation remains indeterminate based solely on the findings of this study. However, as the government has communicated minimum housing standards and is actively establishing and implementing policies to address this concern, the standards are assumed to play a part in enhancing living conditions.

The limitations of this study and the need for further research are as follows:

First, concerning the facility standard, we omitted standards that could not be objectively verified. The Korea Housing Survey targets around 50,000 households nationwide, with most questions answered directly by householders. While subjective responses can provide insights into safety and quality of life (e.g., structural safety, waterproofing, moisture-proofing, ventilation, lighting, noise, natural disasters, crime prevention, and hygiene), survey results based on these responses may lack the validity of practical verification. Hence, this study utilized the declarative meaning of the 2011 minimum housing standard. In the future, we plan to conduct follow-up studies on relevant aspects once a survey methodology capable of objective validation is developed.

Second, we excluded the independent role of the living room. In the design simulation, each room was arranged, and the remaining space resembled a living room (refer to Figure 3). This aspect is a matter of choice rather than a limitation. The consideration of whether the living room's role is necessary in the minimum housing standards remains a topic for further research. In subsequent revisions, the living room could be categorized as an independent room.

Third, in this study, the concept of a standard household composition has been removed. This is because the standard household composition does not encompass the diversity of household compositions. However, if data allowing for a more detailed analysis of household composition distribution can be obtained, it may be possible to incorporate it into the minimum housing standards. This is a topic intended to be addressed in future research.

Lastly, a study is needed to gauge the extent to which the minimum housing standards can contribute to enhancing housing conditions. To achieve this, an analysis of government policies employing these standards is essential, uncovering correlations with improvements in housing conditions.

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