

Case Study on Characteristics of the Bedroom Environment in Korean Nursing Homes

Dae-Nyun Kim, Young-Sun Yoon¹, Jae-Ho Moon², Hea-Ryung Byun^{3*}, Miryum Chung⁴, Min Jung Hong⁵

Professor, Dept. of Architecture, Seowon University, Korea

¹Professor, Dept. of Interior Design, Keukdong College, Korea

²Professor, Dept. of Industrial Design, Semyung University, Korea

³Doctor, Institute of Millenium Environmental Design & Reserach, Yonsei University, Korea

⁴Doctoral Student, Graduate school of Architecture Engineering, Yonsei University, Korea

⁵Doctoral Student, Dept. of Design and Craft, Graduate school, Hongik University, Korea

Abstract : The purpose of this study was to analyze characteristics of the bedroom environment of nursing homes for the elderly in Korea. Field case research was performed using a structured checklist and measurements, from Oct. 28th to Dec. 2nd, 2006. Collected data were analyzed for cognitive efficiency, privacy, safety, supportiveness and amenity. Based on nursing homes for the elderly nationwide (Ministry of Health and Welfare, 2006), we choose 43 facilities in which Seoul and six megalopolis areas that had answered our questionnaire in 2006. We then narrowed the list to 14 facilities, balanced them in terms of regional population. The contents of investigation consisted of eight categories: that general characteristics of the bedrooms (including number of residents per room, using a bed or floor mat, the size and shape of the chamber, space for wheelchair turning, signage), door of bedroom (including door, doorknob, door sill/level difference), windows in the bedroom (including type of window, window sill height, window treatment, window safety device/shape, view/daylight), furniture (including personal furniture and lock), finishes (material, character and color of wall, floor, ceiling), lighting (including types of lighting, night lighting, switch), bathroom in the bedroom (including signage, door size/type, doorknob shape, height of the washbowl, size of toilet bowl, handrail, finishes), and other facilities (including outlet and handrails).

Key Words : nursing home, bedroom, cognitive efficiency, privacy, safety, supportiveness, amenity

I. Background and Purpose

Population aging has become a social issue in Europe, United States, and Japan. Korea is not an exception in this social phenomenon. Korea became an aging-society (population of over 65 age is 7%, UN) in 2000, and changes are occurring at a remarkably fast pace compared to other mature societies. It is anticipated that Korea will become an aged-society (population of over 65 age is 14%, UN) in 2018, and super-aged society (population of over 65 age is 20%, UN) in 2026.

However, the society's traditional family-centered system, in which the family supports the elderly, has been collapsing due to the increase of single elderly households since the growth of the nuclear family, and the growth of women's social participation (including economic activity)¹⁾.

In these circumstances, a systematic social care for the elderly, especially for those with dementia or paralysis, is in demand, so the need for expanding and improving nursing homes has increased. Accordingly, research projects on this issue are being carried out under

*Corresponding Author: Hea-Ryung Byun, Institute of Millenium Environmental Design & Reserach, Yonsei University, 134 Sinchon-Dong, Seodaemun-Gu, Seoul, Korea Tel: +82-2-922-8317 E-mail: bhr3359@hanmail.net

government support. In 2007, the bill *National Insurance of Long-term Care for the Elderly*, passed by the National Assembly and part of medical expenses for those with geriatric diseases, will be expensed by the government. Approximately 100 nursing homes have been newly opened annually since 2003, and at present there are 542 nursing homes nationwide.

With quantitative expansion of nursing homes, research on the significance of the residential environment has become an important issue. In this regard, research on overall characteristics of the environment in nursing homes by Kwon (2000) and Yoon *et al.* (2005), and a case study concerning the features of public space in nursing homes by Lee *et al.* (2004, 2005) were conducted.

Internal space in a nursing home consists of private space, public space, supporting space, and management space. A bedroom as a private space for the elderly is designed to maintain their privacy, to enable sleep and for them to rest every day. In order to support both residents' diverse life styles and care activities at Korean nursing homes, it is necessary to undertake research on actual conditions. However, few published studies have focused on the bedroom as a private space. Several research projects and case studies were conducted with a focus on the capital area (Yoon and Byun, 2005) and Jeon-ra Province (Lee and Ryu, 2004), but more must be conducted nationwide.

The purpose of this research was, thus, to understand and discuss the actual conditions and problems of private spaces in Korean nursing homes by analyzing the environmental characteristics of bedrooms, and on a national scale.

II. Research Methodology

1. A frame of environmental analysis for living space in nursing homes

In order to build a proper framework for analysis, previous research frames by Weisman (1998), Byun

(2001), and Yoon & Byun (2005) have been carefully studied. Weisman (1998) developed the PEAP (Professional Environmental Assessment Protocol) with several experts in the field of medicine, nursing, environmental psychology, and architecture, to conduct an environmental evaluation for those with dementia. Within PEAP, eight indexes were identified: a maximization of awareness and orientation, provision of privacy, opportunities for personal control, continuity of the self, maximization of safety and security, support for functional abilities, regulation and quality of stimulation, and facilitation of social contact. Evaluation standards and scores were applied to each index, and this method was recognized as the most expansive way among all environmental evaluation tools to study the elderly with dementia²⁾.

Regarding environmental factors for the elderly with dementia, Byun (2001) classified the concepts/standards related to environment for the elderly into 12 indexes such as cognition/awareness, orientation, privacy, personalization, safety/security, control, independence, accessibility, supportiveness, residential, variability, and socialization. Based on these classified indexes, she analyzed eleven facilities for the elderly with dementia in USA³⁾. Yoon and Byun (2004, 2005) suggested the NEAP (Nursing home Environmental Assessment Procedure), by summing up the principles of universal design and PAF (Physical and Architectural Features) standards, for analyzing characteristics of environmental design of nursing homes in Japan and Korea. Based on NEAP, employing seven analysis standards including efficiency in perception, safety, flexibility, accessibility, supportiveness, amenity, and social interaction, internal and external spaces of nursing homes were analyzed⁴⁾.

In this study, a new conceptual frame was developed to analyze environmental characteristics of bedrooms in nursing homes by comparing analytical indexes of the three research studies mentioned above. It consists of five indexes: cognitive efficiency, privacy, safety, supportiveness, and amenity.

<Table 1> Items and contents of analytic frame

Item	Contents	Example
1. Cognitive efficiency	<ul style="list-style-type: none"> Degree of potential improvement in cognition of space and time Ease of comprehension regardless of the resident's experience, knowledge, language or present attention 	<ul style="list-style-type: none"> Is there a sign on each door distinguishing between bedrooms?
2. Privacy	<ul style="list-style-type: none"> Feature that supports desirable degree of social interaction and creates a boundary Feature that allows private space to avoid undesirable social interaction 	<ul style="list-style-type: none"> Are there curtains or partitions to divide personal space?
3. Safety	<ul style="list-style-type: none"> Environment that minimizes the danger of accident without hindrance of space use or mobility 	<ul style="list-style-type: none"> Do they use non-slip floor finish in bathrooms?
4. Supportiveness	<ul style="list-style-type: none"> Supply of functional aid Supply of equipment for physical/mental aid for the resident's disability in his/her daily life Supply of a barrier-free condition 	<ul style="list-style-type: none"> Is the shape of door knob proper to use for all, even with less capacity to control both hands?
5. Amenity	<ul style="list-style-type: none"> Supply of comfort as in one's home, and a varied, beautiful environment State of physical and mental amenity by the proper condition of light, heat, sound and air Activeness to control stimulus and decision making 	<ul style="list-style-type: none"> Does one feel comfortable, as in his/her home in the bedroom? Does each bedroom have an air conditioner, and can one control the temperature him/herself?

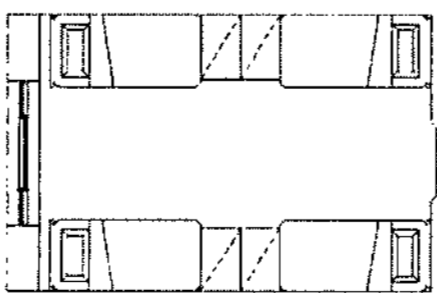
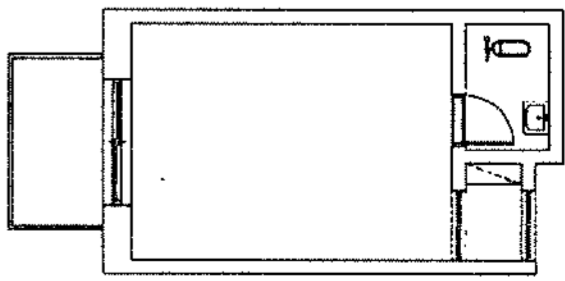
2. Selection of Research Cases

This research was done by the case study method and was conducted from October 28, 2006 until December 2, 2006. A specially designed checklist was used as a primary method to analyze environmental characteristics of bedrooms at nursing homes, and some photographs were also taken.

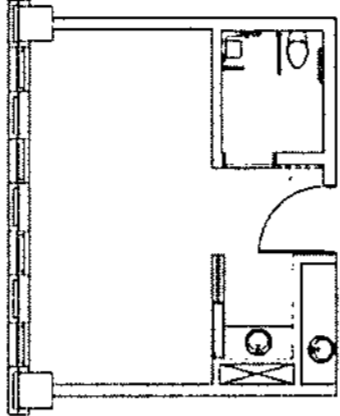
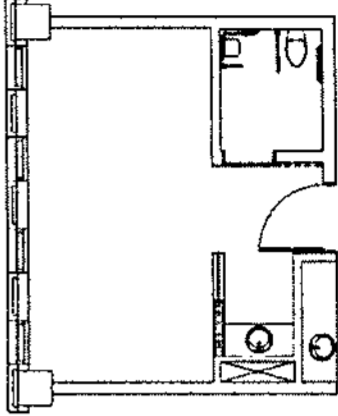
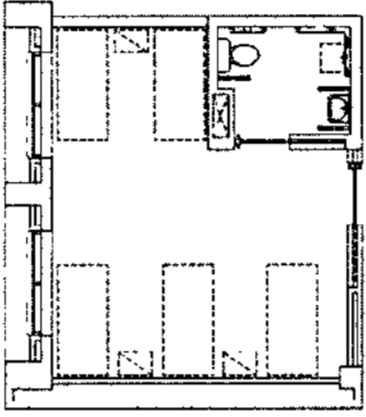
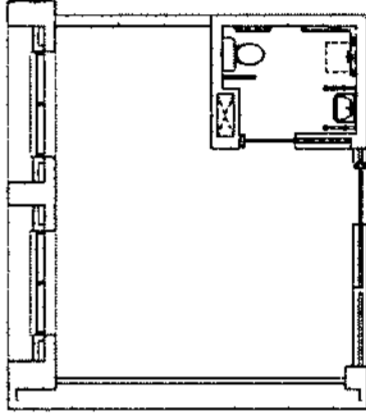
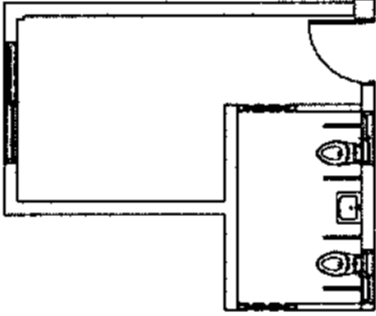
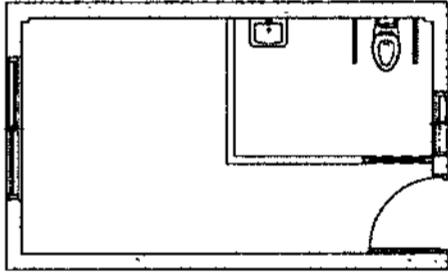

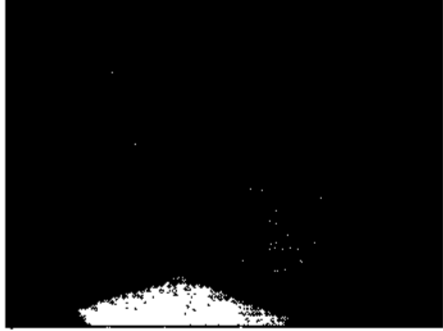
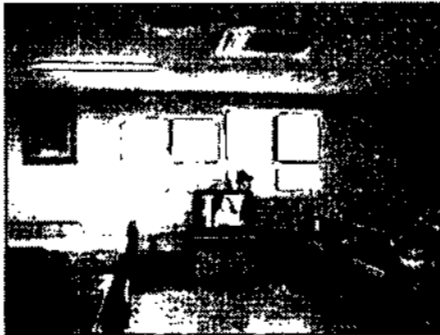

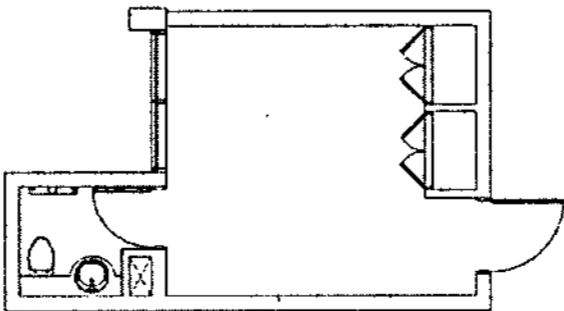
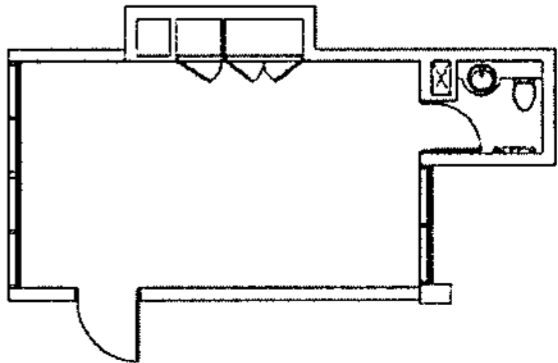
The objects of this study were identified as follows. Among 542 nursing homes in Korea (status report of nursing homes, Ministry of Health and Welfare, 2006), 182 nursing homes in Seoul and other metropolitan areas (Gwangju, Daegu, Daejeon, Busan, Ulsan,

Incheon) were initially selected. Afterward, 43 were randomly selected as initial research objects. In order to select nursing homes equally from all the major cities above, researchers requested cooperation through telephone calls. Three facilities from Seoul and two from each metropolitan area accepted our request, but only one nursing home was selected from the metropolitan area of Ulsan. Of these, 14 nursing homes were finally selected as research objects. <Table 2> outlines the location, type and floor plan of each bedroom of selected nursing homes. The research includes six free nursing homes, six free skilled nursing homes and two skilled but low cost nursing homes⁵⁾.

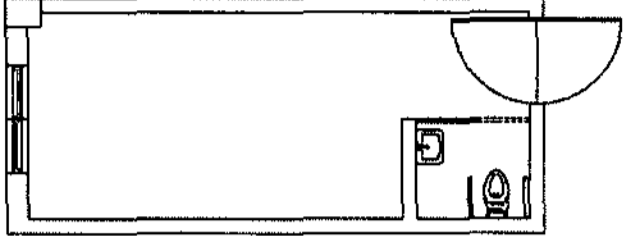
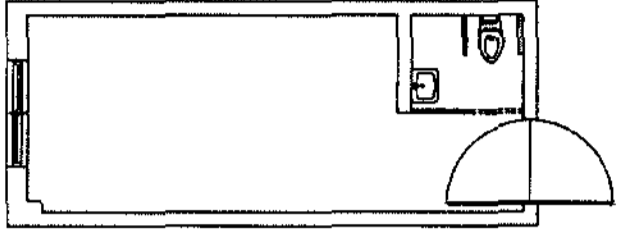
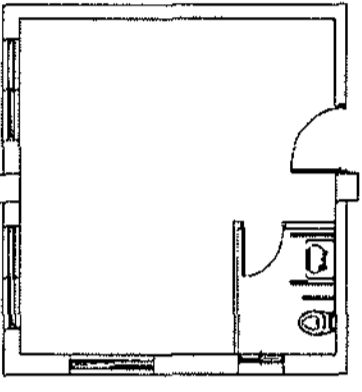
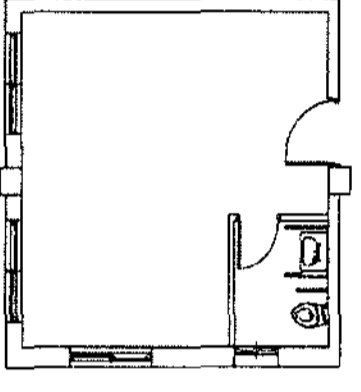
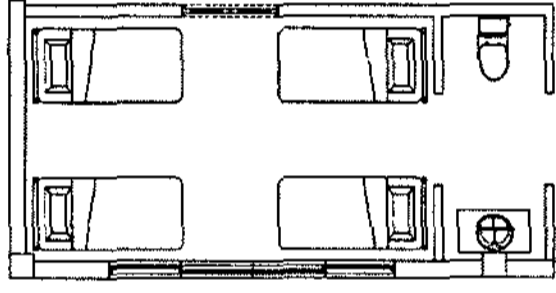
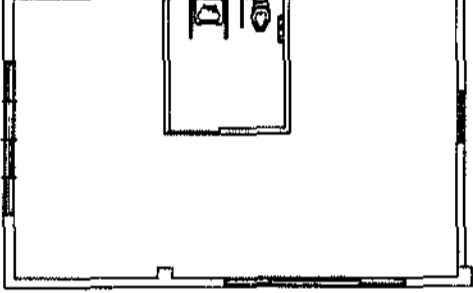
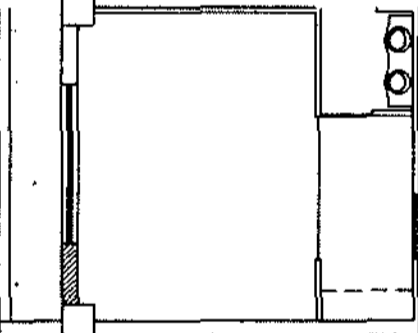
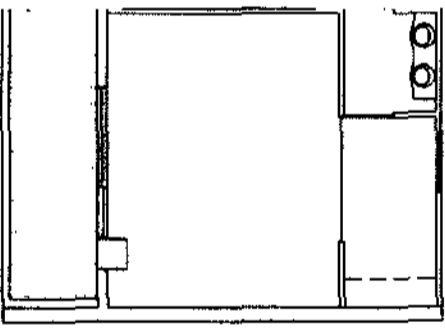

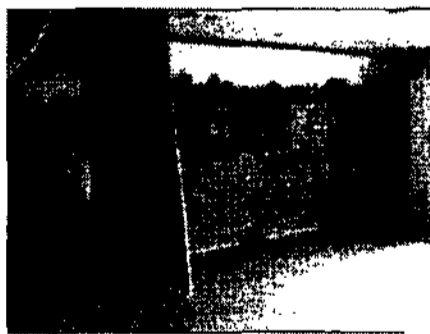

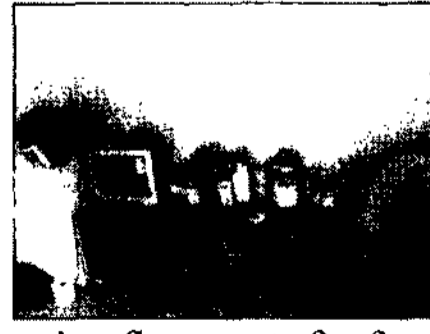
<Table 2> Location and type of facilities researched

No.	Location	Type (Type of operation)	No. of Bed-room	No. of Bath-room	Floor Plan for Bedroom Type 1	Floor Plan for Bedroom Type 2
1	Seoul	Skilled nursing home (low price)	2	2		
					Bedroom using beds for four residents. Net area of bedroom: 20.6 m ²	Bedroom using floor mats for four residents. Net area of bedroom: 15 m ²

<Table 2> continued

No.	Location	Type (Type of operation)	No. of Bed-room	No. of Bath-room	Floor Plan for Bedroom Type 1	Floor Plan for Bedroom Type 2
2	Seoul	Nursing home (free)	2	2	 <p>Bedroom using beds, for 4 residents Net area of bedroom: 30 m²</p>	 <p>Bedroom using floor mats, For 4 residents Net area of bedroom: 30 m²</p>
3	Seoul	Skilled nursing home (low price)	2	2	 <p>Bedroom using beds, for 5 residents Net area of bedroom: 24.1 m²</p>	 <p>Bedroom using floor mats, For 5 residents Net area of bedroom: 24.1 m²</p>
4	Gwangju	Nursing home (free)	2	2	 <p>Bedroom using beds for three residents. Net area of bedroom: 15.6 m²</p>	 <p>Bedroom using floor mats for three residents. Net area of bedroom: 15.6 m²</p>
5	Gwangju	Nursing home (free)	2	1	 <p>Bedroom using beds for four residents. Net area of bedroom: 23 m²</p>	 <p>Bedroom using floor mats for four residents. Net area of bedroom: 21.58 m²</p>
6	Daegu	Skilled nursing home (free)	2	1	 <p>Bedroom using beds for seven residents. Net area of bedroom: 38.5 m²</p>	 <p>Bedroom using beds for three residents. Net area of bedroom: 34.2 m²</p>
7	Daegu	Nursing home (free)	2	2	 <p>Bedroom using floor mats for three residents. Net area of bedroom: 18.8 m²</p>	 <p>Bedroom using floor mats for six residents. Net area of bedroom: 18.9 m²</p>

<Table 2> continued

No.	Location	Type (Type of operation)	No. of Bed-room	No. of Bath-room	Floor Plan for Bedroom Type 1	Floor Plan for Bedroom Type 2
8	Daejeon	Skilled nursing home (free)	2	2	 <p>Bedroom using beds for two residents. Net area of bedroom: 18.9 m²</p>	 <p>Bedroom using floor mats for three residents. Net area of bedroom: 19.7 m²</p>
9	Daejeon	Skilled nursing home (free)	2	2	 <p>Bedroom using beds & floor mats for six residents. Net area of bedroom: 28.1 m²</p>	 <p>Bedroom using beds & floor mats for six residents. Net area of bedroom: 28.1 m²</p>
10	Busan	Skilled nursing home (free)	2	2	 <p>Bedroom using beds for four residents. Net area of bedroom: 15.7 m²</p>	 <p>Bedroom using floor mats for eight residents. Net area of bedroom: 41.1 m²</p>
11	Busan	Skilled nursing home (free)	2	2	 <p>Bedroom using beds for six residents. Net area of bedroom: 35.8 m²</p>	 <p>Bedroom using floor mats for six residents. Net area of bedroom: 35.8 m²</p>
12	Ulsan	Nursing home (free)	2	2	 <p>Bedroom using beds for five residents. Net area of bedroom: 31.7 m²</p>	 <p>Bedroom using floor mats for six residents. Net area of bedroom: 31 m²</p>
13	Incheon	Nursing home (free)	2	2	 <p>Bedroom using floor mats for two residents. Net area of bedroom: 8 m²</p>	 <p>Bedroom using floor mats for four residents. Net area of bedroom: 19.6 m²</p>
14	Incheon	Skilled nursing home (free)	2	2	<p>Not available</p> <p>Bedroom using floor mats for two residents. Net area of bedroom: 14.9 m²</p>	<p>Not available</p> <p>Bedroom using floor mats for six residents. Net area of bedroom: 36 m²</p>

In this research, two typical types of bedrooms, a private bathroom in each facility, were investigated. In total 28 bedrooms and 26 private bathrooms were analyzed. However, the actual number of observation varies for different criteria, so each criteria lists both the number of cases and its percentage.

3. Research to analyze environmental characteristics of bedrooms

The research to analyze environmental characteristics of bedrooms consists of eight categories, and detailed contents are shown in <Table 3>. In the research, ambience of the bedroom and discrimination of the room sign and nameplate were evaluated through the four scales test (highly negative: 1. negative: 2. positive: 3. highly positive: 4). Results were marked to the checklist by two researchers. The dimensions included in checklist were based on the designed value (plan measurement) of housing facility for the elderly in the Korean Standard (2006).

Based on the collected information from the checklist,

the results of environmental characteristics of the bedroom in nursing homes were analyzed according to the analytical frame. <Table 4> shows the items of investigation categorized by the analytical frame.

III. Results and Discussion

The results according to the analytical frame are shown as follows.

1. Cognitive efficiency

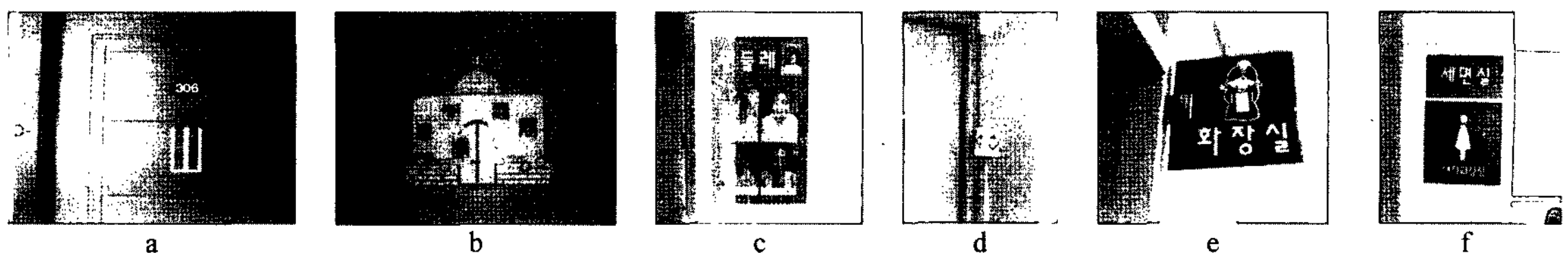
In order to raise the elders' cognitive efficiency in their own bedrooms, the room sign, nameplate of resident and bathroom sign should be considered <Figure 1>. The average installation height of signage was 1,650 mm (minimum height: 1,240 mm, maximum height: 2,070 mm),⁶⁾ which is considered to be too high because average eye level of Korean males in their 60s is 1,530 mm, and that of females is 1,410 mm. Therefore, it is assumed there must be many elderly persons who find it hard to recognize signs due to their installation

<Table 3> Eight Items and details of investigation in the environmental features of the bedroom

Space	Item	Details
Bedroom	General	Number of resident (s), Style of space use (floor-based living / chair-based living), size and shape of room, ambience, capacity of wheelchair turn
	Door	Effective width, type, shape and height of doorknob, door sill/faulting and height, room sign (display/design/installation height), nameplate of resident (s) (display/design/installation height)
	Window	Type, knob type, wall height from bottom to window opening, treatment, safety device, view / natural lighting/ventilation
	Furniture	Type, holding of private pieces from one's original dwelling, safekeeping of private belongs, use of washstand inside a room
	Finishing	Interior finishing (wall, floor, ceiling), color (color combination, cold/warm color coordination)
	Lighting and Other Equipment	Type, local lighting, type of lamps, night light, emergency communication equipment, electric / light switch (type/position/installation height), electric outlet (safety cover/installation height), type of heating / air-conditioning
Bathroom	General	Ambience, type, size, space for wheelchair use, effective door width / door type, shape of door-knob, height of door sill/faulting, room sign (display/design/installation height), natural lighting / ventilation, finishing material (wall, floor, ceiling), wash basin (installation height / room of the lower part / safety device), toilet (height of seat /flushing device/safety grip), type of faucet, shape of mirror, color, use of bath chair/bath tub
	Other Equipment	Lighting, electric/light switch (type / position / installation height), electric outlet (safety cover / installation height) type of heating/air-conditioning, emergency communication equipment, grab bar, heating system

<Table 4> The Items of Investigation categorized by the Analytic Frame

Analytic Frame	Items of Investigation in Bedroom	Items of Investigation in Bathroom
Cognitive efficiency	Room sign (display/design/installation height), nameplate of resident (s) (display/design/installation height)	Room sign (display/design/installation height)
Privacy	Number of resident(s), style of space use (floor-based living/ chair-based living), size and shape of room	Type and size of room, effective door width/ door type
Safety	Style of space use (floor-based living/ chair-based living), height of door sill/faulting, safety device for window, floor finishing, night light, electric/ light switch (type/ position/ installation height), electric outlet (safety cover/ installation height), emergency communication equipment	Height of door sill/faulting, floor finishing, wash basin (safety device), lighting, electric/ light switch (type/ position/ installation height), electric outlet (safety cover/installation height), emergency communication equipment, grab bar, heating system
Supportiveness	Style of space use (floor-based living/ chair-based living), capacity of wheelchair turn, effective door width/ door type, door type, shape and height of door knob, window type, shape of window knob, furniture type, use of washstand inside a room, electric/ light switch (type/ position/ installation height), electric outlet (safety cover/installation height)	Capacity of wheelchair turn, effective door width/ door type, shape and height of door knob, wash basin (installation height/room of the lower part), toilet (height of seat/ flushing device/ safety grip), type of faucet, shape of mirror, color, use of bath chair/bath tub, lighting, electric/light switch (type/ position/ installation height), electric outlet (safety cover/installation height), grab bar
Amenity	Ambience, wall height from bottom to window opening, window treatment, safety device, view/ lighting/ ventilation, holding of private furniture pieces from one's original dwelling, safekeeping of private belongings, Interior finishing (wall, floor, ceiling), color (color combination, cold/ warm color coordination), lighting type, partial lighting, type of lamps, type of heating and air-conditioning	Ambience, lighting/ ventilation, Interior finishing (wall, floor, ceiling), color, heating system



<Figure 1> Examples of room sign (a, b, c, d) and private bathroom sign (e, f).

level. In addition, eye levels of the elderly who use wheelchairs (male: 770 mm, female: 720 mm) were not considered at all, even though there are many wheelchair users in nursing homes. Also, during the research, researchers observed some of the frail residents moving around in the facility on their bottom instead of using wheelchairs. However, there was no proper signage consideration for those individuals with exceptionally low eye levels. Therefore, we need to understand old people's changing eye levels related to changes in their physical condition and mobility patterns, and to propose a proper solution for them.

According to our checklist for bedroom signage types,

the nameplate of residents (17 bedrooms out of 26 bedrooms, 65.3%) was most commonly used as the signage. The room number (15 bedrooms, 57.6%), pictures (eight bedrooms, 30.7%), colors/graphics (five bedrooms, 19.2%), and drawings/ figures (two bedrooms, 7.6%) were also used. Two bedrooms did not use any signs, but there were also several bedrooms where two or more sign systems were used. Nine bedrooms used two different types of signage, and six bedrooms used three. Regarding the placement of attached sign plates, most were installed on the wall next to the door (80.8%) and on the door (19.2%).

Signage characteristics were also studied. Average

<Table 5> The height of room signage and cognitive efficiency

	N	Mean	S.D.
Height of bedroom signage (mm)	26	1,653.08	190.87
Cognitive efficiency of bedroom signage (point)	26	2.58	1.21
Height of residents' nameplate (mm)	20	1,490.00	293.00
Cognitive efficiency of signage for residents (point)	19	2.42	1.35
Height of bathroom signage (mm)	3	1,836.67	188.24
Cognitive efficiency of bathroom signage (point)	3	3.33	1.15

installation height was 1,490 mm, which is close residents' eye levels. The nameplate of each resident was most commonly used (16 bedrooms), followed by pictures (12 bedrooms), colors/graphics (four bedrooms), and drawings / figures (three bedrooms). Six bedrooms (21.4%) did not use any signage, seven bedrooms used two different types, and four bedrooms used three. As a result of analyzing the cognitive efficiency regarding the bedroom signs on a scale of one to four, an average of 2.58 points was received. The cognitive efficiency of signs with the residents' personal information received an average of 2.42 points. This result shows that cognitive levels should be improved for old people in these situations.

Concerning the signs of private bathrooms, only three bathrooms had signage out of 26 private bathrooms. This result shows that most nursing homes consider it is not necessary to install specific signage for the private bathroom, which is usually located inside the bedroom. However, cognitive efficiency of private bathrooms with sign received an average of 3.3 points (SD = 1.15), and this score is relatively high compared to private

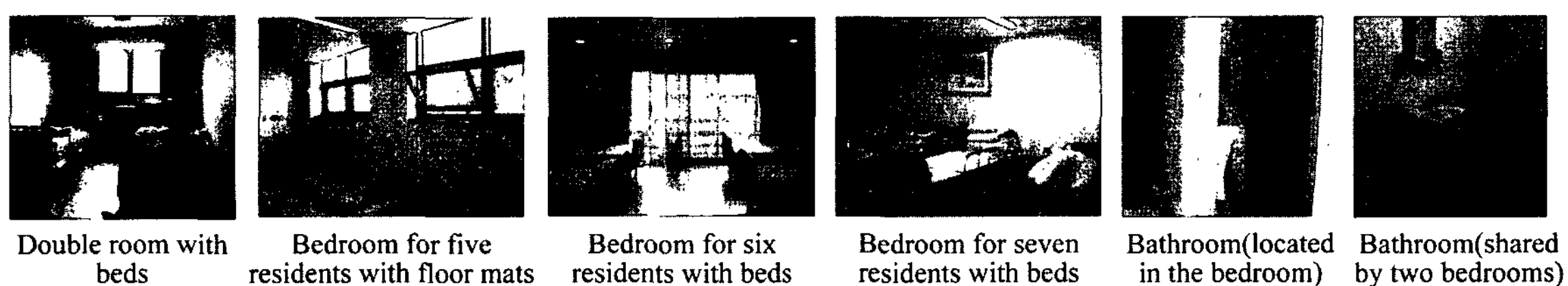
bathrooms without sign. It should be carefully considered if symbolic signs such as those for the bathroom do influence elderly residents' cognitive patterns, especially elderly with dementia, for using the bathroom. Further research regarding this issue should continue.

2. Privacy

Privacy of the bedroom is identified with the number of residents per room, degree of physical and visual divide, size of the room, and the number of bathroom users. Regarding privacy of the bedroom at nursing homes, Perkins (2004) noted that sharing a room with a stranger, with nothing but a curtain for privacy, is the single most disliked aspect of them. In advanced countries, the current trend is that facilities offer single rooms exclusively, and they also try to offer more privacy for residents by partitions or floor shapes with a shared bathroom in double rooms. According to our research, four persons were sharing one room at eight bedrooms (28.6%), six persons were sharing one room at seven bedrooms (25.0%), and three bedrooms had a double room system (10.7%). There were also two bedrooms in which seven or eight persons were sharing one room, which were used as intensive care units.

In general, too many people were sharing one room in the nursing homes examined. Privacy was not well guaranteed because most of the rooms were designed in a open square shape, and the overall size of the bedrooms was too small (average size of private space per person: 5.77 m², SD = 1.72). Having a personal space for privacy seemed to be difficult, especially if there were no dividers such as curtain or partitions.

Regarding the bathroom in the bedroom, the door was



<Figure 2> Examples of bedrooms and bathrooms in the bedroom.

<Table 6> Distribution of bedrooms by the number of residents

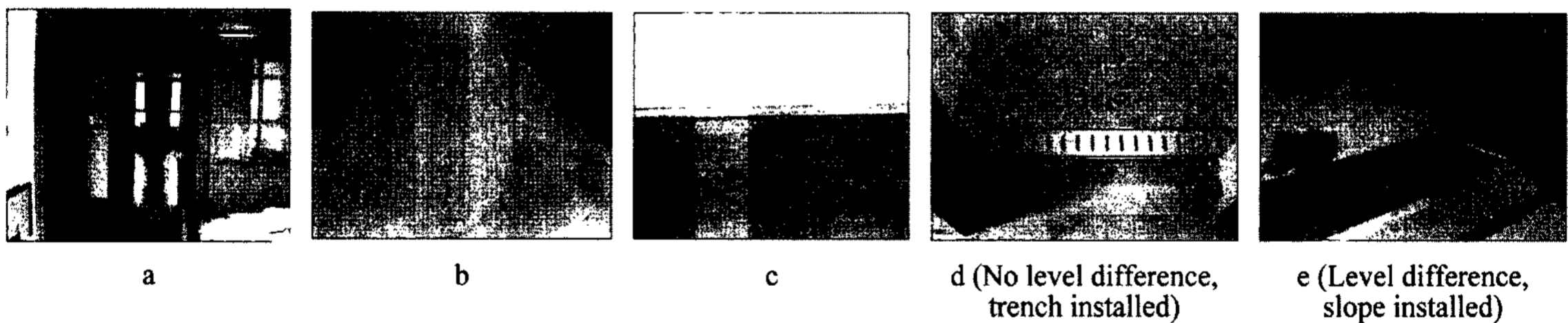
Number of residents	Frequency (%)	Average area (S.D.)
2	3 (10.7)	13.9 m ² (5.5)
3	5 (17.9)	20.8 m ² (7.7)
4	8 (28.6)	21.9 m ² (5.7)
5	3 (10.7)	26.6 m ² (4.4)
6	7 (25.0)	30.5 m ² (6.2)
7	1 (3.6)	38.5 m ² (0.0)
8	1 (3.6)	41.1 m ² (0.0)
Total	28 (100.0)	-

usually open because of high frequency in use of several residents sharing a bedroom. The residents seldom closed the door while using it. There were three bathrooms (11.5%) which did not have doors. There was even a bathroom in which two toilets were located inside the same bathroom, without any partitions, and this situation could raise issues of violation of privacy.

3. Safety

Based on residents' health conditions, the bedroom was classified by three different types (beds for those with serious illness; sleeping mats; beds and sleeping mats). Although door sills (threshold) were found from 10 bedrooms (35.7%), door sills from nine bedrooms were less than 5 mm. There was only one bedroom which had a 25 mm door sill. There was little floor level difference between corridors and bedrooms. If any, it was less than 3mm, which was within the safety standards. Without a door-check, the residents can hurt their hands when using sliding doors. Only two bedrooms out of eight bedrooms, which had sliding doors, installed door-check system for the safety.

Regarding the safety of windows in the bedrooms, 19 bedrooms have installed window safety system (window opening control equipment at eight bedrooms (28.6%), and bars at six bedrooms (21.4%), and others at five bedrooms (17.9%)) for safety accidents. However, nine



<Figure 3> Examples of door sill and level difference of bedrooms (a, b, c) and bathrooms (d, e).

<Table 7> Door sills of bedroom door and level differences between bedroom and corridor

		Frequency (%)			Frequency (%)
Door sill of Bedroom	Total	28 (100)			
	No door sill	18 (64.3)			
	Door sill installed	10 (35.7)	Height of door sill	0 mm	0 (0)
			2 mm	2 (20)	
			3 mm	2 (20)	
			5 mm	5 (50)	
			25 mm	1 (10)	
			Sub total	10 (100)	
Level differences between bedroom and corridor	No level difference	26 (92.9)			
	Some Level difference	2 (7.1)	Height of level difference	3 mm	2 (100)
			Sub total		2 (100)

bedrooms (32.1%) did not install any type of window safety system. Therefore, it is necessary to point out this situation. Besides, only eight bedrooms were using a night light system (28.6%), so it is necessary to consider safety of residents who use bathrooms at night. According to our research, none of the bedrooms had installed handrails for residents, which means the possibility of falling accidents in the room still exists.

Eleven bedrooms (39.3%) had not installed emergency communication equipment. Although the rest of bedrooms had these systems (17 bedrooms, 60.7%), there were only five bedrooms (17.5%) where residents could use the system from their beds. Some communication equipment (12 bedrooms, 42.9%) was installed too high. It seemed that the system was only concerned with convenience for the staff, who usually stand while working. Therefore, the design of equipment should be changed for the residents. The emergency communication equipment should also be designed for patients who are lying on the bed, because the system can help them to cope with emergency situations immediately. For example, an extension cable can be utilized for flexible usage of this system.

The bathroom (a combined shower stall and toilet) is where many safety accidents happen to old people. Most nursing homes in Korea do not have separated shower stalls. In order to block the inflow of water from the contiguous space, they usually make artificial slopes or door sills. Based on our research, door sills were installed at 18 private bathrooms (64.3%) and 14 private bathrooms (50.0%) made level difference between bedrooms and private bathrooms. The average height of level difference was 21.06 mm, but the range of heights was very wide, from 2 mm to 100 mm. Among 14 private bathrooms which had some level difference, 13 private bathrooms used visual warning effects through contrast brightness or saturation. Two private bathrooms, which had considerable level difference, installed slopes to prevent safety accidents.

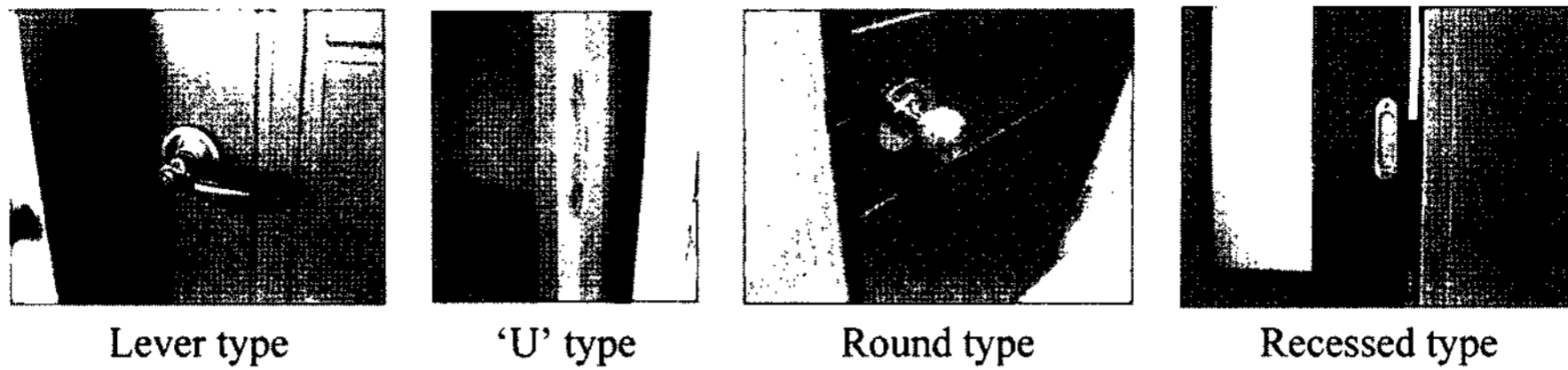
In order to prevent electric shock, safety covers were installed at 15 private bathrooms out of 16 private

bathrooms with outlets. There were also grab bars, which installed at diverse places such as walls of bathroom, wash basins, and toilets. However, there were three private bathrooms (10.7%) that did not have any grab bar. 12 private bathrooms (42.9%) had emergency communication equipment next to toilet, and one private bathroom had it next to the wash basin (3.6%). However, another 13 private bathrooms (46.4%) did not have any emergency communication equipment. This result shows that nursing homes need proper prevention systems regarding possible emergency situations.

In order to protect bathroom users from burns, five private bathrooms (17.9%) covered hot water pipes with safety covers under the wash basin, and six private bathrooms (21.4%) installed a temperature control system. Most nursing homes noted that it is not dangerous to residents because the temperature of hot water from district heating system is not that high. For the safety grip next to the toilet, a horizontal, L shape, or folding shapes were most common. 19 private bathrooms (67.90%) installed safety grips at both sides of toilets.

4. Supportiveness

The number of bedrooms without enough space (a circle 1,500 mm in diameter) for wheelchair turns was only two bedrooms (7.1%), and the rest had enough space. Especially for a bedroom with sleeping mats, a resident could secure wider floor space in the daytime after folding a mattress. The effective door width of 27 bedrooms (96.4%) was also wider than the standard⁷⁾ to pass the wheelchair. Regarding the door type, 20 bedrooms were using sliding doors (71.4%), and eight bedrooms were using hinged doors (28.6%). The sliding door was frequently used because it could allow a wheelchair to enter the room conveniently and use the space effectively. A kick-plate usually protects the door from wheelchair overuse in nursing homes, but there was only one bedroom where a kick-plate was installed. A 'U' type of door knob was the most used, and at the 15 bedrooms (53.6%), followed by a recessed type (five



<Figure 4> Examples of doorknob types.

bedrooms, 17.9%), lever type (four bedrooms, 14.3%), and round type (two bedrooms, 7.1%). For the height of the window knob, a lever type (ten bedrooms, 35.7%), which is easy for elders, was the most used, but a few cases have a recessed type (five bedrooms, 17.9%), which is more difficult to use, and 13 bedrooms (7.1%) did not have even a knob.

No bedrooms had handrails, and eleven bedrooms (39.3%) did not have emergency communication equipment for help and only 17 bedrooms (60.7%) installed them. Only five bedrooms (17.9%) had the emergency call within reach of resident on the bed, and others could be inconvenient situations like needing help.

For light switches, lamp-type switches with wide panels were installed in nine bedrooms (32.1%), and

general-type switches with wide panels were installed in 17 bedrooms (60.7%). The result shows that most bedrooms (92.8%) used wide panels for residents. However, the number of lamp switches that could be found easily at night was only a third of total. Installation heights of all light switches were much higher than 900~1,000 mm, which is recommended.

Only seven bedrooms (25%) kept the standard heights of electric outlets between 500 and 850 mm; in 15 bedrooms (53.6%) it was lower, and in three bedrooms (10.7%) it was higher than the standard, which means that many elders could not use them themselves. In addition, it was not convenient to use the switch because it was located on the opposite wall (40.8%) of the doorknob, not on the same side.

<Table 8> Emergency call, switch, outlet of bedroom

		Frequency (%)	Frequency (%)	
Emergency call	Total	28 (100)		
	No emergency call installed	11 (39.3)		
	Emergency call installed	17 (60.7)	Location easy to access	5 (29.4)
			Location difficult to access	12 (70.6)
			Sub total	17 (100)
Switch	Total	28 (100)		
	No switch installed in the bedroom	2 (7.1)		
	Switch installed in the bedroom	26 (92.9)	Higher than standard ⁷⁾	26 (100)
			Standard ⁷⁾ height (900~1000 mm)	0 (0)
			Sub total	26 (100)
Outlet	Total	28 (100)		
	No outlet installed in the bedroom	3 (10.7)		
	Outlet installed in the bedroom	25 (89.3)	Lower than standard ⁷⁾	15 (60.0)
			Standard ⁷⁾ height (500~850 mm)	7 (28.0)
			Higher than standard ⁷⁾	3 (12.0)
Sub total	25 (100)			

For furniture types, 26 bedrooms furnished storage. Additionally, bed, mattress, refrigerator, dressing table, low cabinet, television, hanger, folding table were set, but the number of pieces of furniture arranged within one bedroom were limited due to a lack of space. In addition, there was no motorized adjusting system for the bed, so it was hard for some residents (with various physical disabilities from aging) to raise their own body. They had to be assisted by a care-giver to adjust the angle of the beds.

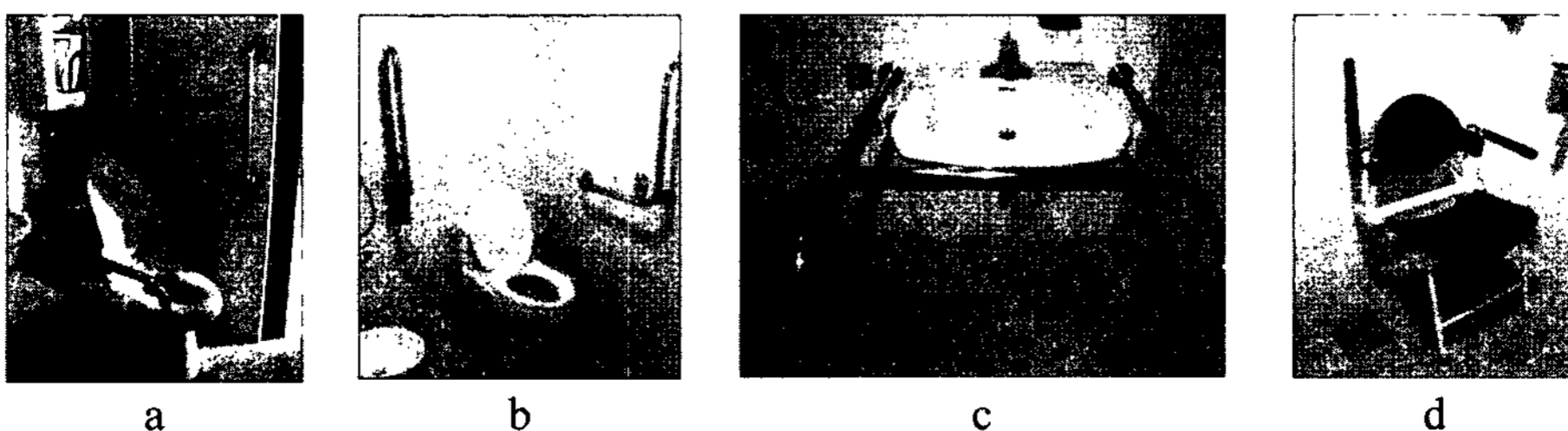
Because the daily schedule is fixed, the all elders wash and brush their teeth together at the nursing homes. Therefore, it is convenient to locate a washbasin at a corner of the bedroom, apart from one installed in the bathroom. However, among responding nursing homes, only three bedrooms (10.7%) had washbasins.

Regarding the bathroom, 24 bedrooms (85.7%) had private bathrooms inside them. However, more than half of them (14 bathrooms, 53.8%) had a smaller space than the standard⁷⁾ for wheelchair turning. Also, no type of kick-plate or door-check was installed. The door width of eleven private bathrooms (39.3%) was smaller than the standard (850 mm)⁷⁾. The doors of nine private bathrooms (34.6%) were sliding doors, followed by curtain/folding doors (eight private bathrooms, 30.8%), hinged doors (5 private bathrooms, 19.2%), and open style without any door or curtain (3 private bathrooms, 11.5%). Eleven private bathrooms (42.3%) kept the standard for height of the washbasin from 750 mm to 850 mm, and others had problems like a lower wash basin or difficulty for wheelchair entrance and turning. Regarding types of water supply, all researched bathrooms used a lever type system, which adjusts the

warm and cold water together. Although a mirror for the wash basin was recommended at 15 degree angle for wheelchair users, all used a vertical mirror.

A grab bar installed near a wash basin, toilet and bathroom wall allowed the elders to move easily. Switches in bathrooms were generally wide (23 private bathrooms, 82.1%), and 19 private bathrooms (67.9%) located switches higher than the standard⁷⁾. 15 private bathrooms had electric outlets, and most were the same height or higher than the standard⁷⁾ (14 private bathroom, 93.3%). Most researched private bathrooms kept the standard⁷⁾ height of the toilet between 400~450 mm, and the others used a lower toilet height. For the toilet bowl, 16 private bathrooms (61.5%) considered the lever-type flushing system as the most convenient method, and 9 private bathrooms (34.6%) were using button-type system. 27 private bathrooms, except only one private bathroom, installed the safety grip on the side of toilet. 19 private bathrooms (73%) had the safety grip on both sides of the toilet, and 15 private bathrooms of them located the toilet on the wall side with 'L' type safety grips on the wall, with horizontal type safety grips on the opposite side. Also, there were some private bathrooms that had horizontal types and folding types (without a close wall), or two 'L' type grips (in case of a small bathroom). Because the distance between the center of the toilet and both walls was wider or smaller than the standard (450 mm)⁷⁾, more detailed and ergonomic construction was required afterwards.

Four private bathrooms (14.3%) used chairs for the shower that were fixed to the wall, and only three private bathrooms (10.7%) used movable chairs. Therefore, it



<Figure 5> Examples of safety grab bars (a, b, c) and a wall-attached shower chair (d) of bathrooms.

<Table 9> Variations of grab bars assortment installed on both sides of the toilet bowl

	Grab bar 2		Total frequency (%)
	'L' type frequency (%)	Folding type frequency (%)	
Grab bar 1	'L' type frequency (%)	1 (5.3)	2 (10.5)
	Horizontal type frequency (%)	15 (78.6)	1 (5.3)
	Total frequency (%)	16 (84.2)	3 (15.8)

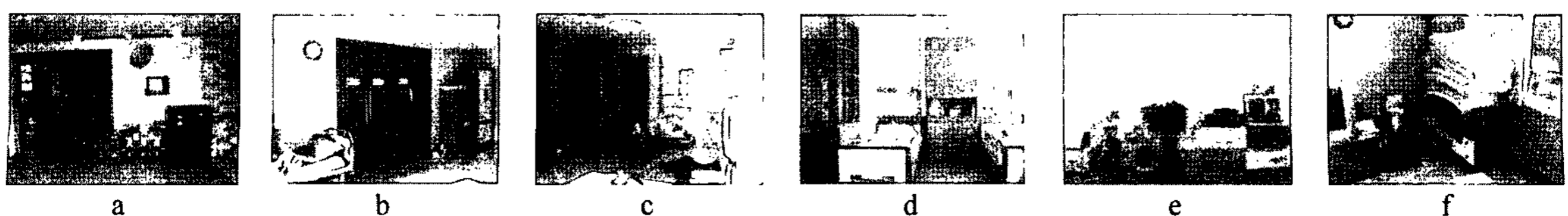
might be hard for weak elders to shower. No private bathroom installed bathtub.

5. Amenity

The main function of the bedroom is to give the elders a convenient environment like home. The overall ambiance of bedrooms was evaluated 3.04 points (SD = .744) out of four scale. Regarding the type of window treatment of the bedroom, 21 bedrooms (75%) used curtains or fabric shade; three bedrooms (10.7%) used blinder, but four bedrooms (14.3%) did not used anything. Homey ambiance materials were mainly used for the interior finish. Yellow vinyl flooring was used mostly for floors (24 bedrooms, 85.7%). Wooden flooring and plastic tiles with wood patterns were also used in two bedrooms. Wallpaper was the most used for the wall. 18 bedrooms used single colored wallpapers (64.3%), and four bedrooms (14.3%) used patterned ones. Paint (five bedrooms, 17.9%) and plastic with wooden patterns (one bedroom, 3.6%) were the next frequently used finishing materials for walls. The ceiling was finished with wallpaper (20 bedrooms, 71.4%), with paints (two bedrooms, 7.1%), and with acoustical ceiling tiles (six bedrooms, 21.4%). Because walls and the ceiling were generally finished with wallpaper in Korean houses, a ceiling with acoustical ceiling tiles can give an

ambiance to a facility. Concerning color harmony in the bedroom, adjacent color harmony comprised 17 bedrooms (60.7%), and monochromatic color harmony comprised eleven bedrooms (39.3%). Most of researched bedrooms therefore contained a warm ambiance because of warm colors.

According to J. Frank's research (2002) of elders at homes for assisted living, most residents felt that their bedrooms are home-like, but still not home. Their main reason is that they could not bring their own furniture and private things because of the space limit.⁸⁾ In Korea, it is very hard to keep one's identity and personality because many elders live together in the same bedroom. Residents brought their own furniture in only four bedrooms (14.5%), which was small because of space limits. Large and identical types of furniture were supplied by the homes themselves as types of wall-attached furniture. Residents had private belongings from their prior residence in 15 bedrooms. Regarding the possession of private belongings, general nursing homes were more flexible than skilled nursing homes. However, most private things were daily necessities (cups, medicine, and etc.) and religious goods (Bible, a cross, and etc.). So those were limited to needs for daily life not for decorations. Only seven bedrooms displayed family photos of residents in their bedrooms. Based on the research, the residents should be encouraged to bring



<Figure 6> Examples of bedroom furniture (a, b, c, d) and personal belongings (e, f).

<Table 10> Personal furniture and belongings according to type of nursing home

	Personal furniture			Personal belongings		
	Yes f(%)	No f(%)	Total f(%)	Yes f(%)	No f(%)	Total f(%)
Nursing home	4 (20.0)	16 (80.0)	20 (100)	12 (60.0)	8 (40.0)	20 (100)
Skilled nursing home	0 (0)	8 (100.0)	8 (100)	3 (37.5)	5 (62.5)	8 (100)
Total	4 (14.3)	24 (85.7)	29 (100)	15 (53.6)	13 (46.4)	28 (100)

their attached furniture and goods in order to make a homely ambiance at nursing homes.

In addition, researchers could see the low consideration given to female residents, who need full-length mirror or vanity for dressing and make-up. In addition, only five bedrooms (17.9%) supplied a lock system, so it seemed hard for residents to keep their own things.

The physical amenity of the bedroom environment is based on a view from the windows, natural lighting, ventilation, air conditioning system and light. The windows mostly affect the view and lighting in the bedroom. Because the heights of window sills were higher than the standard (450 mm)⁷⁾ and only two bedrooms (17.9%) met the standard⁷⁾, three bedrooms used glass doors to the veranda instead of windows.

Results of evaluating a view from the windows, natural lighting, and ventilation of researched bedrooms (n = 28) on a scale of one to four were as followed (Table 11). A view of outdoor from the windows got high remarks of average 3.46 (SD = .838) out of four scale. However, residents lying on the bed could not have a view of outdoor because of the high window sill. Especially, residents sitting or lying on a floor mat could see only sky from the windows. Natural lighting and ventilation were average 3.29 (SD = .810) and 3.68 (SD = .670) respectively. They were bright and well ventilated.

All bedrooms had central heating systems. In 16 bedrooms (57.1%) it was possible to control the temperature in the bedroom, and in 12 bedrooms (42.9%) it was not possible. For air-conditioning, in 27 bedrooms (96.4%) it was possible to control the temperature in bedrooms using fans, air-conditioners (usually wall-mounted), and central cooling systems. All

<Table 11> Natural lighting, ventilation, and view of the bedrooms

	N	Mean	S.D.
Natural lighting	28	3.29	.810
Ventilation	28	3.68	.670
View	28	3.46	.838

<Table 12> Lighting fixture of bathroom

	Frequency (%)	Frequency (%)
Total	26 (100)	
No lighting fixture	1 (3.8)	
Lighting fixture installed	25 (96.2)	
	White florescent	14 (56.0)
	Daylight florescent	6 (24.0)
	Incandescent	5 (20.0)
	Sub total	25 (100)

lighting was by white fluorescent lamps, and direct lighting was used in 16 bedrooms (57.1%). Half-direct / half-indirect lighting was used in 12 bedrooms (39.4%). Most bedrooms were using direct lighting on the ceiling, and two bedrooms used local lighting. Researchers could see that it was not proper for residents who might feel glare easily. In addition, white fluorescent lamps made an ambiance like institution not home, which made it less friendly and warm.

For lighting in private bathrooms (Table 12), the white fluorescent lamps with blue color was most commonly used (14 private bathrooms, 53.8%), followed by daylight fluorescent lamps (6 private bathrooms, 21.4%) and incandescent lamps (5 private bathrooms, 17.9%). One private bathroom did not use any type of lighting.

<Table 13> Ambience, natural lighting, ventilation of bathrooms

	N	Mean	S.D.
Ambience	26	2.42	.902
Natural lighting	26	2.00	1.296
Ventilation	26	3.31	.928

For color harmony in the private bathroom, monochromatic color harmony comprised 12 private bathrooms (46.2%), adjacent color harmony comprised eleven private bathrooms (42.3%), and contrast color harmony comprised 3 private bathrooms (11.5%).

Results of evaluating ambience, natural lighting, and ventilation of researched private bathrooms ($n = 26$) on a scale of one to four were as followed (Table 13). First of all, ambience of private bathrooms were average 2.42 ($SD = .902$) out of four scale. The finishing material was home-used materials such as ceramic tiles for flooring and walls, and plastic boards for ceiling in all private bathrooms. However, the handrail made of stainless material gave ambience of institution. Natural lighting was mostly dark (average 2.00), and each facility had varied lighting conditions ($SD = 1.296$). Most private bathrooms had a good ventilation system, so there was no bad odor (average 3.31, $SD = .928$). More than half of bathrooms did not have proper heating systems (15 private bathrooms, 57.7%). Therefore, addition of a new heating system is required in them.

IV. Conclusions

14 nursing homes in metropolitan cities were selected as research objects. The research analyzed environmental characteristics of their bedrooms. The analytical frame of the environment research was identified using five categories: cognitive efficiency, privacy, safety, supportiveness and amenity. In the analysis process, it was shown that all the factors were independent, and these factors could effectively describe the environment of nursing homes. The analytic results of the environmental

characteristics of the bedrooms in Korean nursing homes are summarized below.

1. Cognitive Efficiency

Installation height of bedroom signs was too high, and the residents' eye level when standing was not considered. Especially, it was not included at all for residents in wheelchairs. Attaching several signs according to changing eye levels and various walking situations of the residents should be considered more seriously. As ease of discernment was evaluated at an average level, it needs to be improved. Few bathrooms in the bedrooms had signs, or they used ready-made sign panels that were designed for other commercial space, which turned out to be easy to recognize. To enhance cognitive efficiency, the signs should be attached lower than the average eye level of the elderly. The signage for bathrooms should contain large and friendly graphics and letters (i.e. more than existing industrialized symbols) so that the elderly can recognize them easily. Responding to the changing moving posture and eye height of the frail elderly, by attaching multiple signage should be also considered.

2. Privacy

Most bedrooms were shared by several residents, and there was no adequate system of interception such as curtain or partitions. This situation could raise issues of violation of privacy. For the private bathroom, we found some that did not have doors. Researchers also discovered one bathroom whereby two toilets were located inside the same bathroom without any partial dividing wall. The privacy of residents was rarely considered in all cases. New plans to compensate for the deficiency of privacy in the bedroom are an urgent matter in order to improve the bedroom environment. For bedrooms shared by several residents, the usage of movable screens or curtains is strongly recommended, as dividing personal space can help secure basic privacy.

3. Safety

There were few bedrooms of door sills (thresholds) between corridors and bedrooms, thus there was very little possibility of falling accidents. Some bedrooms did not install any type of proper window safety system, and it is urgent to correct this situation. In addition, most researched bedrooms did not install grab bars and night lighting systems. This omission means that the potential of falling accident exists when residents use bathrooms during the night. Although most private bathrooms had door sills, the nursing homes adjusted the situation by using slope panels or placing visual warning signs. In order to protect resident from electric shock, waterproof safety covers were installed at most bedrooms. However, most nursing homes did not properly install emergency communication equipment in bedrooms and private bathrooms. The location of equipment should be redesigned to help residents cope with emergency situations immediately.

4. Supportiveness

Equipment to support residents physically such as space for wheelchair turning in bedrooms, adequate door width, doorknobs, lever type faucets in bathrooms, and grab bars, were well installed. However, there were some problems. The width of private bathroom doors was often too narrow for wheelchairs, and frequently there was lack of space for wheelchair turning inside the bathroom. Washbasins were installed at too low for wheelchair users. There was also a lack of bath stools and chairs in many situations.

5. Amenity

The overall ambience of bedrooms was like home, and it was because most nursing homes used finishing materials included in ordinary houses. However, there were still many bedrooms that installed direct lighting. Also, residents were not allowed to bring their own

furniture and belongings due to the small room size and circumstances of shared bedrooms. Although many bedrooms had fine views from their windows, elders lying on beds or floors mat often could not see outside because the window sill was too high.

The conditions of natural lighting, ventilation, heating and air conditioning were good. However, the private bathroom was rather ill-lighted, and the overall ambience in the bathroom was moderate. To increase amenity for residents, windows should be larger, and they should be installed lower as long as they satisfy safety issues, so residents can get enough natural lighting and enjoy the view even when they are lying on floor mats. For interior lighting, semi-indirect lighting is recommended so the ambience stays comfortable and glare can be reduced at the same time. The elderly should be allowed to bring in some of their furniture from their prior residence. If there is not enough room in their bedroom, furniture can be placed in a common space or corridor, providing emotional stability for residents. In addition to furniture, providing a display wall in the bedroom for placing such items as small souvenirs that the residents like, or paintings done by resident would be beneficial.

As the result of this research, nursing homes in Korea that were studied were found mostly well-designed and constructed in evaluated aspects of safety, supportiveness, and physical amenity. However, cognitive efficiency, privacy, psychological amenity need to be improved. Furthermore, additional research and understanding regarding elders' psychology and behavior patterns should be conducted.

In the future, when new bedrooms are planned, a detailed checklist should be worked out based on the five categories employed, and they should be designed to fit these criteria. Bedrooms in nursing homes are significant in that they are where the elderly spend much of their time, and they are the basis for private life in group living. The physical environment of the bedroom can influence behavioral, psychological aspect of the elderly with dementia and/or apoplexy, and an unsuitable

environment can even affect health status. For follow-up studies, systemized research on relationships among physical environment characteristics of bedrooms and the behavior and psychology of the elderly is necessary.

Acknowledgement

This work was supported by the Korea Science and Engineering Foundation Grant funded by the Korea government, and the authors are grateful for the support (No. R01-2006-000-10656-0).

Notes

1) According to the 'Research on Living Conditions and Welfare Demands for The Elderly' (Ministry of Health & Welfare, 2004), percentage of household with children was 56.2% in 1994. However, the rate was fallen to 43.5% in 2004. On the other hand, percentage of the single elderly households was rapidly increased from 14.9% (1994) to 24.6% (2004).

2) Oh, E. J. (2000). The relationship between the therapeutic quality of architectural environment and behaviors of elderly persons with dementia in long-term care setting, Yonsei University. p. 41-47.

3) Byun, H. R. (2001). A link between theory and practice of environmental design for people with dementia, Doctoral dissertation. Yonsei University. 81-81.

4) Yoon, Y. S. & Byun, H. R. (2004), A case study on characteristics of environmental design for nursing homes in Japan, *Korean institute of interior design journal*, 13(5), 144-145.

5) According to the current law on senior welfare, medical welfare institutions are categorized as follows; nursing home (free or low price), low price nursing home, private nursing home, skilled nursing home (free or low price), low price skilled nursing home, private skilled nursing home and geriatrics hospital. Skilled

nursing homes are specially for those with acute geriatric disease, such as dementia or stroke.

6) Database of physical size of Koreans (2005).

7) Standard means the plan measurement of housing facility for the elderly in the Korean Standard (2006).

8) Frank, J (2002), The paradox of aging in place in assisted living, Greenwood publishing group. p. 58-60.

References

- Cohen, U. & Day, K (1993). *Contemporary Environments for People with Dementia*. Baltimore, Maryland: The Johns Hopkins University Press.
- Database of physical size of Koreans (2005)
- Frank, J. (2002). *The Paradox of Aging in Place in Assisted Living*. Westport CT : Greenwood publishing group.
- Kim, S. J. & Lee, T. K. (2005). Study on the present states and problems of Supply Estimation and Arrangement of Long-Term Care Facilities for the Elderly in Gyeonggi Province. *Journal of Architectural Institute of Korea*, 21(5), 69-76.
- Kwon, O. (2000). Physical living environment for the elderly with dementia-type problems-focused on the assessment of two dementia care facilities, *Journal of the Korean housing association*, 11(3), 109-124.
- Lee, M. A. & Ryu, O. S. (2004). Using Behavior of Corridor and Lounge at the Residence Floor in Skilled Nursing Facilities for the Elderly. *Journal of Korean Home Economics Association*, 42(11), 31-45.
- Lee, M. A. & Ryu, O. S. (2004). A Case Study of Spatial Composition of Elderly Skilled Nursing Facility. *Korean Institute of Interior Design Journal*, 13(1), 62-69.
- Lee, M. A. (2005). A Survey on Space Use by Program of Skilled Nursing Facilities for the Elderly. *Journal of Korean Home Economics Association*, 43(10), 125-138.
- Ministry of Health & Welfare (2004). Research on Living Conditions and Welfare Demands for The Elderly
- Oh, E. J. (2000), The relationship between the therapeutic quality of architectural environment and behaviors of elderly persons with dementia in

long-term care setting, Yonsei University, Korea.
Yoon, Y. S. & Byun, H. R. (2005). A Case Study on Characteristics of Environmental Design for Nursing Home in Korea. *Journal of Architectural Institute of Korea*, 21(5), 69-76.
Yoon, Y. S. & Byun, H. R. (2004). A Case Study on Characteristics of Environmental Design for Nurs-

ing Home in Japan, *Korean Institute of Interior Design Journal*, 13(5), 143-153.
www. Mohw.go.kr : Website of Ministry of health and welfare

Received June 22, 2007
Revised August 6, 2007
Accepted August 8, 2007