

# \*\*\* A Study on the Color and Lighting in the Assisted Living Facilities for the Elderly

- Focused on the Facilities in Korea and the United States -

노인주거복지시설의 색채와 조명에 관한 연구

- 한국과 미국의 사례분석을 중심으로 -

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## Abstract

고령사회 2001의 발표에 의하면, 노인인구의 증가는 전 세계적으로 21세기까지 지속될 전망이며, 우리나라도 예외가 아니어서 이에 대한 심각한 사회문제가 예상되고, 이들을 위한 특수주거시설에 대한 환경개선이 요망된다. 본 연구는 노인주거복지시설에서 색채와 조명에 대한 개선방향을 제시하기 위한 것으로, 색채와 조명환경을 정량적, 정성적으로 비교 분석하는데 연구의 목적이 있다. 이를 위해 2003년 2월부터 8월까지 우리나라와 미국의 양로시설 20사례에 대한 현장방문조사가 수행되었고, 모든 시설이 공통적으로 가지고 있는 로비, 복도, 식당, 침실 등 4개 영역이 집중적으로 조사되었다.

1) 색상분포도 조사 결과, 한국시설은 미국 시설과 달리 주조색으로 한색을 많이 사용하고 있으며, 보조색, 강조색의 활용도가 낮은 것으로 나타났다. 2) 색상·명도의 간격별 조화 정도에 대한 정량적 평가를 통해 한국시설은 명도대비보다는 색상대비가, 유사조화보다는 대비조화가 두드러졌는데 기능적 측면에서는 이상적이거나 친근한 분위기를 만들기에는 한계가 있다. 3) 미도(Aesthetic Measure) 측정 결과, 한국과 미국 시설 모두 평균 이상을 보였는데, 특히 한국시설은 색상 대비 이외에 유사색 조화와 같은 질서요소를 강화시킬 필요가 있다. 4) 한국시설은 미국에 비해 조명 환경이 매우 열악하였는데, 자연채광의 유입은 어느정도 만족스러우나 이를 양질의 조명으로 만들기 방안이 요구된다. 5) 조명방식, 광원유형 등 인공조명에 대한 분석 결과, 한국시설은 매우 단순하며 경제적인 방법에 의존하고 있는데 광원의 선택, 배치, 설치 등 기술적인 보완이 요구된다. 6) 한국시설들의 시설별, 영역별 평균조도는 매우 낮았는데, 활동시간대의 권장조도 유지는 물론, 영역 간의 조도 차이를 줄이는 방안이 요구된다.

키워드 : 한국, 미국, 노인주거복지시설, 사례조사, 색채, 조명

## 1. Introduction

The world's population age 65 and older is growing by an unprecedented 800,000 people a month, according to a report, *An Aging World : 2001*, predicted that this phenomenon of global aging will continue well into the 21st century, with the numbers and proportions of older people continuing to rise in both developed and developing worlds.<sup>1)</sup>

Between the years of 1980 and 2020, it is anticipated that the elderly will increase numerically and as a percentage of total population in Korea, where the ratio of the elderly head count will 14% and over<sup>2)</sup>. The United States also will experience a relatively increase in the number of people age 65+, projections indicate that by 2030 there will be more people over age 65 than under age 14<sup>3)</sup>.

On the other hand, about 60% of the elderly have low

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\*\*\* This work was supported by the Korea Research Foundation Grant (KRF-2002-042-G00003)

1) NIH News Release, National Institute on Aging Dec. 13, 2001

2) Housing/Population-Related Statistics, Korean Bureau of Statistics, 2002

3) Aging America-Trend and Projections, U.S. Senate Special Committee on Aging, U.S. Department of Health and Human Services, 1991, p.252

physical and mental level almost close to disabled people. Among them, according to a recent survey, one third report a problem with their vision<sup>4)</sup>. Normal and pathological vision changes for the elderly provide a challenge for the design of environments<sup>5)</sup>. For the elderly, there is a need to re-examine how environments can incorporate design concepts which enhance accessibility and efficiency, and are aesthetically pleasing and user-friendly.

The recent studies conducted by designers, architects, and medical doctors have found direct correlation between design elements in the older person's environment and one's quality of life. Our physical and emotional well-being are influenced by six major environmental factors: light, color, sound, aroma, texture, and space. These have such an enormous physiological and psychological impact on the individual that a well-designed facility properly applying these factors can be considered good medicine in itself<sup>6)</sup>. It has been demonstrated that color strongly influences not only human emotions but also physiology, and color application is one of the most important factors for smooth understanding, communication and psychological remedy effect for them. Light is also the most important environmental input in controlling body function for the elderly<sup>7)</sup>.

However, it should be doubtful whether the assisted living facilities in Korea are reflecting the demands of residents. In other word, the current environments for the elderly are not satisfactory allowing the elderly to maintain their independence and increase their sense of well-being, although numbers of residential and welfare facilities for the elderly increase<sup>8)</sup>.

Therefore, this research has been done to analyze the interior color and light status in assisted living facilities for the elderly in Korea and the United States as a part of the research project to suggest the advanced solution about the Korean residential welfare facilities for the elderly.

4)Geram, Monica, Mitchell Giurgola, *The Lighthouse*, Interior Design, Aug. 1995, pp.80-87

5)Stuen, Cynthia, *Vision rehabilitation and older adults : the Prevention of disability*, Technology and Disability, 1997, pp.147-158

6)Millicent Gappell, *Psychoneuro-Immunology*, Design for the 21st Century, Hofstra University, June 1998, p.115

7)Ibid.

8)It is predicted that accommodation capacity of facilities for the elderly and its rate those facilities takes compared to whole social welfare facilities will be accelerated considering past increase speed in Korea., *The Number of Welfare Facilities and Residents*, Korean Ministry of Health & Welfare, 2000

## 2. Method

### 2.1. Methodology of Analysis

#### (1) Samples

Total numbers of samples this research examined were 20 in Korea and the United States. Sampling was done through a preliminary examination over Internet portal sites. Researchers excluded nursing homes with patients incapable of going through daily activities without assistance. Considering the location, type, level of the institute, ten assisted living facilities each from Korea and the United States (Table 1) were chosen. The lobby, hallway, dining room, and bedroom were studied, because these areas are common to all the facilities.

<Table 1> Selected Samples

	Facility	Province	City		Facility	State	City
K O R E A	A: La vie D'or	Kyunggi	Hwasung	U S A	A: Rosewood Estate	MN	Roseville
	B: Hain Yoyang-won	Kyunggi	Pyungtaik		B: Jones Harrison Residence	MN	Minneapolis
	C: Pyungan ei Gyp	Kyunggi	Icheon		C: Seabury	MN	Saint Paul
	D: Incheon Youngrak-won		Incheon		D: Damenik's Care Home	CA	San Francisco
	E: Youngrak Yo yang ei Gyp		Incheon		E: Saratoga Retirement Community	CA	San Francisco
	F: Seoul Seniors' Tower		Seoul		F: Jeanne Juan Residence		Washington D.C.
	G: Lodem Silvertel	Kyunggi	Osan		G: Chevy Chase House		Washington D.C.
	H: Yoodang mael	Kyunggi	Suwon		H: Sunrise McLeane	VA	Mc Lean
	I: Chungwoon Yangro-won		Seoul		I: Crestwood Manor	FL	Englewood
	J: Jacken Anna ei Gyp	Kyunggi	Kwangju		J: Heron East House	FL	Sarasota

#### (2) Procedures

Data were collected by visiting the each facilities from February through August 2003. In order to maintain the same condition, researchers measured colors from 11 am to 4 pm on fine days at all sites and gathered visual data using the same digital camera taping within the medium distance. Images, then, were transferred into a personal computer and printed on 5 by 7 inches lusterless photographic papers. Printed matters were measured using Minolta CM-503i based on the Munsell Color System and were classified into dominant, sub-dominant, and accent colors according to the surface dimensions in the space. Hue, value, and chroma measures were each recorded on analysis worksheet such as <Table 2>.

<Table 2> Sample Worksheet for Analysis of Color Trend (American "C" Facility)

Element	Area Area in Color	Lobby			Hallway			Dining Room			Bedroom		
		Dominant color	Sub-dominant color	Accent color	Dominant color	Sub-dominant color	Accent color	Dominant color	Sub-dominant color	Accent color	Dominant color	Sub-dominant color	Accent color
Floor	H	4.2Y			9.1YR			9.6B			9.6B		
	V	4.2			4.7			5.6			5.6		
	C	0.7			3.5			0.8			0.8		
Wall	H	5.6R			7.7YR			3.2Y			8.9B		
	V	6.8			6.2			7.1			5.9		
	C	1.7			0.8			0.6			0.7		
Ceiling	H	8.6PB			7.7YR			6.6PB			8.9B		
	V	6.9			6.2			7.4			5.9		
	C	3.0			0.8			2.1			0.7		
Furniture	H			3.3R				1.5P	5.5PB				6.7R
	V			3.4				7.0	3.3				2.5
	C			0.8				1.0	4.0				2.1
Door	H		8.8R										
	V		4.5										
	C		1.3										
Skirt	H		8.8R		0.9YR			0.2Y			0.9YR		
	V		4.5		3.6			4.7			3.6		
	C		1.3		6.1			3.5			6.1		
Hand Rail	H		8.8R		0.9YR								
	V		4.5		3.6								
	C		1.3		6.1								

For lighting analysis under the same condition at same locations, researchers used the illuminometer (Sekonic 246) to measure lighting, ambient light levels were measured at about 75cm above the floor in a horizontal plane, and the average value in Lux was obtained after measuring three spots in one area. Other analysis items for lighting status were recorded on the analysis worksheet.

## 2.2. Contents of Analysis

This paper analyzed the following contents through the field survey in order to clarify the samples' current status.

1. Trends in color were examined using the hue and value distribution charts by areas (Figure 1 - Figure 8).
2. Quantitative analysis was performed on the degree of harmony of hue and value based on Moon and Spencer's theory of color harmonization by areas (Table 3 - Table 4).
3. Aesthetic measure (M)<sup>9)</sup> was quantified and analysed to

9) M=O/C is a measure of beauty by G.D. Birkhoff. M stands for 'Aesthetic measure' (or beauty), O for order, and C for complexity. C Complexity is the total number of colors, plus the number of color combinations manifesting the difference in hue, plus the number of color combinations showing the value difference, and finally, plus the number of combinations of colors showing the difference in chroma. Classifying all the arranged colors into two and checking to which categories the combination go from 'identity' to 'glare' using the three attribute colors, the value is obtained. O Order is the total number of the above-mentioned value multiplied by the differential or integral coefficient. If the outcome exceeds 0.5, then it is proposed

indicate the degree of harmony of colors in numerical values (Table 13).

<Table 3> Pleasing & Displeasing Interval in Moon - Spencer Color Theory

Pleasing Interval	Displeasing Interval	Hue Difference in Munsell Law	Value Difference in Munsell Law
Identity		0-1 j.n.d.	0-0.1 j.n.d.
	1st Ambiguity	1-7	0.1-0.5
Similarity		7-12	0.5-1.5
	2nd Ambiguity	12-28	1.5-2.5
Contrast		28-50	2.5-10
	Glare	>50	>10

j.n.d : just noticeable difference

<Table 4> Sample Worksheet for Analysis of Aesthetic Factor (Lobby in American "C" Facility)

Pleasing & Displeasing	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	Glare
Hue	(+1.5)	(0)	(+1.1)	(+0.65)	(+1.7)	-
		***		*****	**	
Value	(-1.3)	(-1.0)	(+0.7)	(+0.20)	(+3.7)	(-2.0)
	*	*	**	**	****	

Color Combination: Floor(4.2Y4.2/0.7), Wall(5.6R6.8/1.7), Ceiling(8.6PB6.9/3.0), Door(8.8R4.5/1.3), Furniture(3.3R3.4/0.8)

4. Level of usage of natural light was examined by checking how much natural light comes in, the type of windows used, and light pattern created (Table 14).

5. Level of usage of artificial light was examined by checking the lighting system, fixture type, and light source (Table 15).

to be statistically significant.

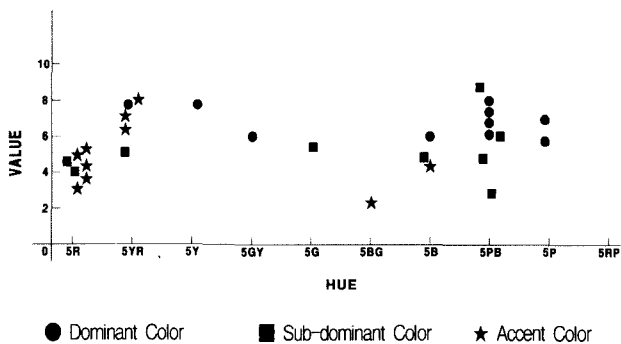
6. Quantitative analysis was performed on the lighting conditions by measuring the illuminances of each areas (Figure 13 - Figure 14).

### 3. Results

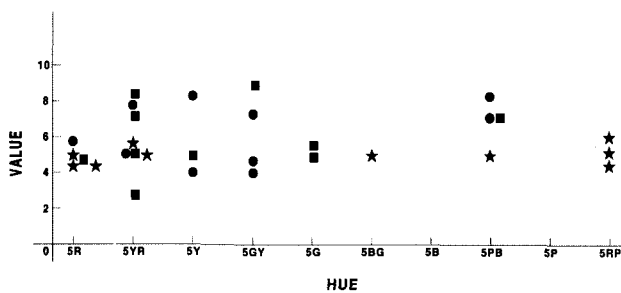
#### 3.1. Color Trend and Harmony by areas

##### (1) Lobbies

In case of the lobbies of Korean facilities, the dominant colors were concentrated between the P(Purple) and B(Blue) groups. PB(Purple Blue) was used in four cases, P in two cases, and B in one case respectively. The sub-dominant colors were also concentrated between the B and PB groups, and majority of the lobbies favored cool colors as the dominant and sub-dominant colors. Whereas, for the accent colors, R was used in five cases, and YR in three cases.



<Figure 1> Hue · Value Distribution Chart for Korean 10 Lobbies



<Figure 2> Hue · Value Distribution Chart for American 10 Lobbies

On the contrary, dominant colors in American facilities were warm or medium colors. GY(Green Yellow) was used in three cases, Y or YR(Yellow Red) in two cases, and R(Red) in one case respectively. For the sub-dominant colors, YR was used in four cases, G(Green) in two cases, R, Y, GY in one case each, and majority sub-dominant colors concentrated between the R and G groups. For the accent colors, majority cases used RP(Red Purple), R, and YR. Therefore, the colors of American lobbies were

coordinated in warm colors between R and Y with medium colors between G and GY. As shown above, the lobbies of Korean facilities are predominantly in cool colors in using dominant and sub-dominant colors. Compared to the ones in the United States, those cool colors do not evoke such a bright and active feeling that they are not recommended.

<Table 5> Degree of Hue Harmony for Lobby

Pleasing & Displeasing Facility	Korean Facility						American Facility						
	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	
A		2	1	4	3	10		2	2	1	5	10	
B		2		1	3	6		2	3	4	1	10	
C	1	4	1		9	15		3		5	2	10	
D		4	1	5	5	15		4	1	1		6	
E		6			4	10		1	3	4	2	10	
F	1	5	1		8	15		1	1	4	4	10	
G		4		2	9	15		2	4			6	
H		1	1	1	7	10		1	2			3	
I	1	4	2	4	4	15	1	2	1	3	3	10	
J		4		2	9	15		1	3	4	2	10	
T	N	3	36	7	19	61	126	1	19	20	25	19	85
	%	2.3	28.6	5.6	15.1	48.4	100	1.2	22.4	23.5	29.4	22.4	100

<Table 6> Degree of Value Harmony for Lobby

Pleasing & Displeasing Facility	Korean Facility						American Facility						
	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	
A	1		2	1	6	10		1	2	4	3	10	
B	1		2	1	2	6	2		4	4		10	
C	1	1	2	5	6	15	1	1	2	2	4	10	
D		2	2	4	7	15		3		1	2	6	
E	1	2		2	5	10	1		3	2	4	10	
F	1	2	2	4	6	15	1	1	3	2	3	10	
G	1	1	2	5	6	15			2	2	2	6	
H		2	4	1	3	10	1				2	3	
I	1	1		4	9	15	2	2	2	2	2	10	
J	1	1	3	4	6	15	1	1	4		4	10	
T	N	8	12	19	31	56	126	9	9	22	19	26	85
	%	6.3	9.5	15.1	24.6	44.5	100	10.6	10.6	25.9	22.4	30.6	100

In terms of color harmony for lobbies, the high contrast hues(48.4%) and values(44.5%) as functional color combinations are used in Korean facilities. American facilities show greater value contrast(30.6%) than hue contrast(22.4%), albeit not as strong as the ones used in Korea. And the ratio of similarity harmony in American facilities is much higher than that in Korean facilities. These American color combinations are not appropriate<sup>10)</sup>, considering the elderly

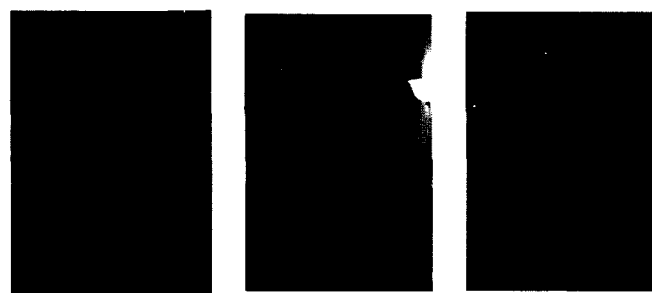
10)According to the "Visual performance data for 156 normal observers of various ages" by Blackwell, normal 65 year old requires about 2.5 times as much contrast as does a 20 year old to see equally well. if 95 percent of 60 year olds are to be accommodated, the contrast would need to be increased by about 5.5 times., Journal of the

residents' declining color sensing ability and the diverse functions of the lobby.

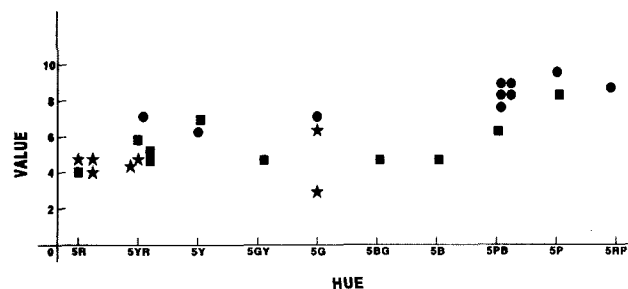
(2) Hallways

The dominant colors in the hallways of Korean facilities were as follows: PB was used in five cases, and P, RP, YR, Y, and G in one case each. For the sub-dominant colors, YR was used only in three cases. For the accent colors, which were concentrated between R(3 cases) and YR(2 cases), and were not used in three cases. It shows that Korean facilities don't use the accent colors in hallways sufficiently in terms of the hue quantity by applying the accent color only to seven cases. On the contrary, dominant colors in American facilities were used as follows: YR and GY were used in four cases each, Y, P, and PB in two cases each, BG and R in one case each. The sub-dominant colors were distributed from YR through G, and YR, Y, G were used in three cases each, GY in two cases. The accent colors were concentrated among YR(5 cases), R(2 cases), and Y(2 cases). As shown above, the colors between YR and G were used in American hallways dominantly.

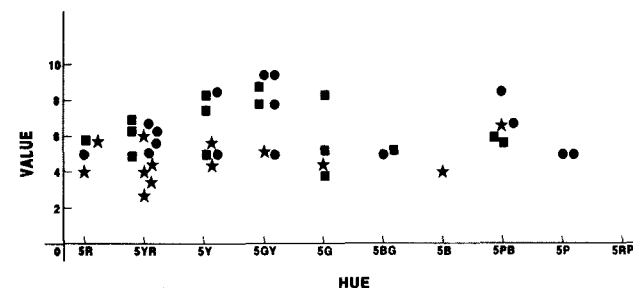
and safe traffic, the color combinations used in the hallways have to be distinguishable<sup>11)</sup>. In that aspect, Korean facilities need to enhance the value contrast to the accent colors in the handrails, floor patterns, and borders, whereas American facilities need to enhance the hue contrast to accent colors. In case of American facilities, A, B, and C, a similar color or identity color harmony is used for residents in fairly good health, with the complementary color harmony used to identify different floors for residents who are physically impaired, or whose memories have declined. These different color combinations are highly recommended, since they help residents find their way.



<Figure 5> Different Color Combinations of Hallways in American "A" Facility



<Figure 3> Hue-Value Distribution Chart for American 10 Hallways



<Figure 4> Hue-Value Distribution Chart for U.S.A 10 Hallways

The color combinations used in hallways in Korean facilities are composed of high contrast hues(51.4%) and low contrast values(39%). The ones in America are composed of low contrast hues(21.1%) and values(36.6%). For a smooth

<Table 7> Degree of Hue Harmony for Hallway

Pleasing & Displeasing Facility	Korean Facility						American Facility						
	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	
A	1st F								1	2	3	6	
	2nd F	1			2	7	10	1	1	5	8	15	
	3rd F							2	1	1	6	10	
B	1st F							2	2	2	4	10	
	2nd F							1	4	3	7	15	
	3rd F	2	1	1	2	6		2	4	5	4	15	
	4th F							6	4	5		15	
C	5th F							1	3	2	4	10	
	1st, 2nd F		2	1	1	6	10		1		4	5	10
	3rd F							2	1			3	
D		4	2	2	7	15		4	1	1		6	
E		2			4	6	1	2				3	
F		1			2	3		1		2		3	
G		2		5	8	15		1	4	1		6	
H	1	2	1	4	12	20		4	2			6	
I		1	5		4	10		1	2	3		6	
J		3	1	4	2	10			2	1		3	
T	N	1	20	11	19	54	105	3	36	30	43	30	142
	%	0.9	19.1	10.5	18.1	51.4	100	2.1	25.4	21.1	30.3	21.1	100

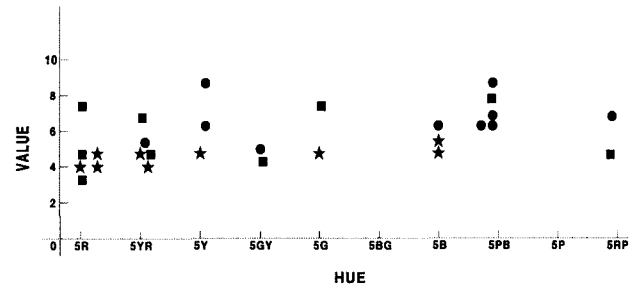
11) Aging eyesight affects their ability to perceive depth, discriminate details, and distinguish colors. Decreased peripheral vision and lessened ability to discern color differences can make steps disappear. To create better circulation space, much skillful color combination should be given to the hallway, because sameness and repetition are the chief sources of disorientation and danger. Brown, Albert, Hospitable Design for Healthcare and Senior Communities, Van Nostrand Reinhold, 1992, pp.137-140

<Table 8> Degree of Value Harmony for Hallway

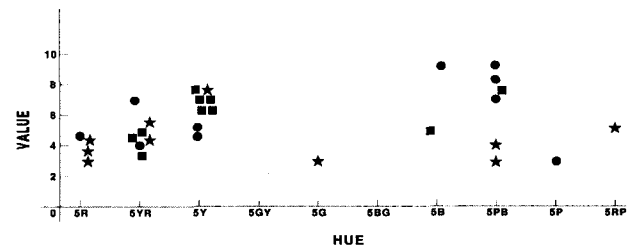
Pleasant & Displeasing Facility	Korean Facility						American Facility						
	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	
A	1st F							1	1	2	2	6	
	2nd F	1		3		6	10						
	3rd F							2	3	2	3	10	
B	1st F							1	1	1	7	10	
	2nd F							1	4	5	5	15	
	3rd F		2	2		2	6		1	4	4	15	
	4th F							1	4	5	3	15	
	5th F								3	1	6	10	
C	1st, 2nd F		1	3	4	2	10	1	2	1	2	4	10
	3rd F								2		1	3	
	D		1	4	4	6	15		2	1		3	6
E			1	2	3	6	1			2		3	
F			1		2	3			1		2	3	
G	3	1	2	3	6	15		1		2	3	6	
H		2	2	7	9	20	1	2			3	6	
I			1	4	5	10			3	2	1	6	
J	2	1	3	4		10	1				2	3	
T	N	6	8	22	28	41	105	8	16	36	30	52	142
	%	5.7	7.6	21.0	26.7	39.0	100	5.6	11.3	25.4	21.1	36.6	100

(3) Dining Rooms

Dominant colors in the dining rooms of Korean facilities were used as follows: PB was used in four cases, and B in one case. These suggest that 50% of the subject facilities favored cool colors as the dominant colors. For the sub-dominant colors, R was used in three cases, and YR in two cases. For the accent colors, R was used in three cases, YR in two cases, and Y in one case respectively. As shown above, the colors were coordinated in the contrasting harmony of cool dominant colors with warm sub-dominant and accent colors. On the contrary, dominant colors in American facilities were used as follows: warm colors(YR and Y in two cases each, and R in one case) were used in five cases, and cool colors(PB in three cases, B in one case) were used in four cases respectively. For the sub-dominant colors, YR was used in three cases, and Y in five cases. For the accent colors, R was used in three cases, YR in two cases, and Y in one case. These results show that American facilities use colors that are in similarity harmony with cool or warm dominant colors and warm sub-dominant or accent colors. Since the dining room is the place where the residents stay for short time, and where they require appetite and energy for a variety of activities, it is advisable to choose dominant colors from the warm color group.



<Figure 6> Hue · Value Distribution Chart for Korean 10 Dining Rooms



<Figure 7> Hue · Value Distribution Chart for American 10 Dining Rooms

<Table 9> Degree of Hue Harmony for Dining Room

Pleasant & Displeasing Facility	Korean Facility						American Facility						
	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	
A		1	3	2	6	1	5	4			5	15	
B	1	9				10		2	3	1	9	15	
C		2		2	6	10		6	1		8	15	
D		2	1	5	7	15		1	3		2	6	
E		1	1	2	6	10	2	5	3			10	
F	1	3			6	10			2	2	2	6	
G		2		2	6	10	1	2		3		6	
H		2	1	4	8	15		1	2	2	1	6	
I		4	2		4	10	1	2			3	6	
J		1		5	4	10		4	2			6	
T	N	2	27	5	23	49	106	5	28	20	8	30	91
	%	1.9	25.5	4.7	21.7	46.2	100	5.6	31.4	22.5	9.0	31.4	100

<Table 10> Degree of Value Harmony for Dining Room

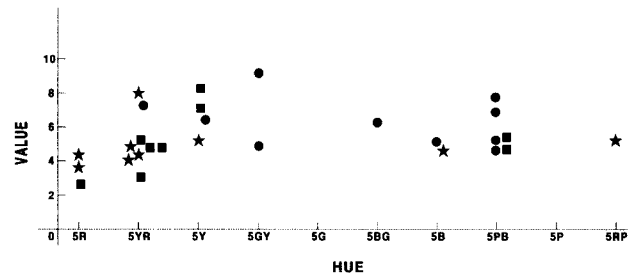
Pleasant & Displeasing Facility	Korean Facility						American Facility						
	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	Identity	1st Ambiguity	Similarity	2nd Ambiguity	Contrast	T (N)	
A			2	1	3	6		2	3	5	5	15	
B		2	6	1	1	10		4	7	3	1	15	
C			3	4	3	10	1	2	4	4	4	15	
D			4	3	8	15	1		2		3	6	
E		2	1	1	6	10		1	5	2	2	10	
F		1	3	2	4	10	1		2		3	6	
G		2	4	1	3	10	1		2		3	6	
H		2	3	5	5	15		1	2	2	1	6	
I			1	1	2	6	3	1	2			6	
J			3		5	10	1		2		3	6	
T	N	0	13	27	25	41	106	8	11	31	16	25	91
	%	0	12.3	25.5	23.5	38.7	100	8.8	12.1	34.1	17.6	27.5	100

In terms of rate of color contrast in hues and values, Korean facilities show lower value contrast(38.7%) than hue contrast(46.2%). The value harmony in American facilities,

which is low in contrast(27.5%) and high in similarity (34.1%), is good in terms of their soft and smooth overall harmony. Yet, where the distinctive characteristics of the room are required, such as the dining room, color coordination must utilize the contrast of the three properties of colors<sup>12)</sup>. In other words, the serving counter and the floor, the main pathways and the tables, the tables and the chairs, and the table wares and the tables must be distinguished with contrasting chroma and value.

(4) Bedrooms

The dominant colors used in the bedrooms of Korean facilities were as follows: PB(4 cases) and P(2 cases) were used in six cases, and Y(2 cases), GY(1 case), and G(1 case) in four cases. Nonetheless, the sub-dominant colors were concentrated among Y(3 cases), YR(1 case), GY(2 cases), and G(2 cases), whereas the accent colors were used only in five cases, among which R was used in two cases, and YR, B, and P in one case each. The use of dominant colors in the bedrooms of American facilities was as follows: PB was used in four cases, B, YR, and Y in one case each, and GY in two cases. The sub-dominant colors and accent colors were concentrated among R, YR, and Y. Some American facilities used warm colors as dominant, sub-dominant, and accent colors. It is advisable to avoid using warm colors in bedrooms. Such color combination which can evoke tension, excitement, and anxiety should be reconsidered for the elderly<sup>13)</sup>.



<Figure 9> Hue · Value Distribution Chart for American 10 Bedrooms

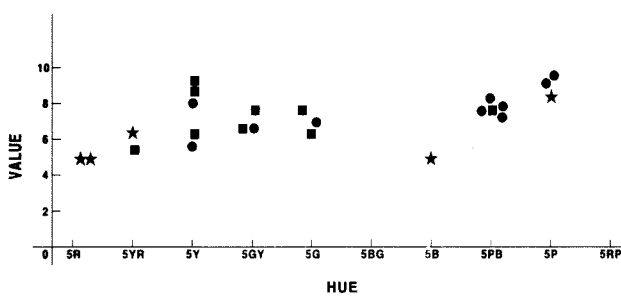
<Table 11> Degree of Hue Harmony for Bedroom

Pleasing & Displeasing Facility	Korean Facility						American Facility					
	Iden tity	1st Ambi guity	Simila rity	2nd Ambi guity	Con trast	T (N)	Iden tity	1st Ambi guity	Simila rity	2nd Ambi guity	Con trast	T (N)
A		1	1	1	3	6	1	2		3		6
B		3	2	3	7	15	1	3		1	5	10
C			1		2	3	1	1		4		6
D	1			2		3	1	2		1	2	6
E	2	1		1	6	10		1			2	3
F			2		4	6		1	1	4	4	10
G		1			2	3		1	2	2	1	6
H	1	1			4	6		2	3	4	1	10
I			1		2	3	1	2			3	6
J			1	2		3		4	2	1	3	10
T	N	4	7	8	9	30	58	5	19	8	20	73
	%	6.9	12.1	13.8	15.5	51.7	100	6.8	26.0	11.0	27.4	100

<Table 12> Degree of Value Harmony for Bedroom

Pleasing & Displeasing Facility	Korean Facility						American Facility					
	Iden tity	1st Ambi guity	Simila rity	2nd Ambi guity	Con trast	T (N)	Iden tity	1st Ambi guity	Simila rity	2nd Ambi guity	Con trast	T (N)
A		2	4			6		2			4	6
B		3	2	5	5	15	1	1	2	2	4	10
C		1			2	3		1	1	2	2	6
D			1	1	1	3		1	1		4	6
E			4	2	4	10			1	1	1	3
F	1		2	1	2	6	1		4	2	3	10
G			1	1	1	3			2	1	3	6
H			2	1	3	6			3	3	4	10
I	1	1	1			3	1		4	1		6
J		1		2		3	1	2	1	1	5	10
T	N	2	8	17	13	18	58	4	7	19	13	30
	%	3.4	13.8	29.3	22.4	31.1	100	5.5	9.6	26.0	17.8	41.1

The bedrooms in Korean facilities, compared to the other areas within the same facilities, used higher rate of contrast in hue(51.7%), and higher rate of similarity in value(29.3%). American facilities used relatively high contrast combinations in hues, and especially values (41.4%). Considering the fact that the bedroom is the most familiar place to the person using it, it will be advisable to harmonize colors with the same or similar tones from the cool color group as its dominant color and use the sub-dominant and accent colors of the warm color group to evoke a cozy and comfortable feeling.



<Figure 8> Hue · Value Distribution Chart for Korean 10 Bedrooms

12)Pease, P., "Clinical Implication of Color Vision Research", J Am Optometric Soc. 50, 1977

13)If colors such as red and orange tend to increase blood pressure, pulse rate, and other autonomic functions, the stimulation will be temporary, after which response may drop below normal. Faber Birren, Color & Human Response, Van Nostrand Reinhold, 1978, p.105 Therefore, cool color combinations which create a restful and smoothing feeling unless they are too intense in chroma are recommendable for relaxing and restful areas. Rosemary Kilmer, Designing Interiors, Harcourt Brace Jovanovich College Publishers, 1992, p.145

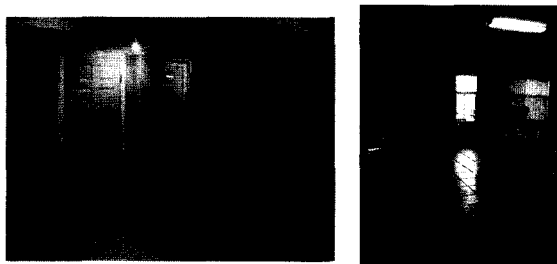
### 3.2. Aesthetic Measure

#### (1) Average Aesthetic Measure by Nations

The aesthetic measure of Korean and American facilities ranged from 0.61 to 0.94, with the average set at 0.84. On the other hand, American facilities ranged from 0.51 to 0.85, with the average set at 0.7. The results proved that the facilities in both countries are above the reasonable level (0.5). Generally, the higher aesthetic measure is ideal and more functional because it contains more factors of order and positively influences the improvement of recognition and the communication ability among residents. Nonetheless, whether the color environment in Korean facilities is better than that of American facilities remains to be seen. The main reason why the aesthetic measure of Korean facilities is high(Average:0.84) is that they used more color contrast than American ones did. However Korean facilities used much more contrasting hues(Average:49.4) rather than contrasting values(Average:38.3) in color every areas. These color combinations are effective for senior residents whose visions are impaired, but they can be too strong and stressful to residents who have healthy, normal vision.

#### (2) Average Aesthetic Measure by facilities

Although the aesthetic measures of American facilities "C", "D", "H", "I", and Korean facility "B" ranged from 0.51 to 0.66, which are above 0.5, they do not mean that the color environment in those facilities are satisfactory. Since the aesthetic measure suggested by Moon and Spencer is not designed for a person with special requirements on living facilities, the standard of aesthetic measure was not set high enough. The American facilities "D" and "I" are small-scale facilities consisting of less than 15 beds, emphasizing their home-like environment. The facility "D" therefore uses the monotonous color combination of white and related colors.



<Figure 10> Lobby of "D" Facility & Dining Room of "I" Facility in America

The facility "I" uses white tone as its dominant color

with the sub-dominant color of pale pink. It is hardly considered an appropriate color combination to accommodate the physical mental state and the functional demand of the elderly residents in the facilities.

#### (3) Average Aesthetic Measure by areas

The results of the comparison of the aesthetic measures in each area are as follows: Korean facilities showed the highest aesthetic measure (0.95) in the hallways, whereas American facilities showed the highest aesthetic measure (0.78) in the bedrooms and the second highest aesthetic measure (0.74) in the hallways. The high aesthetic measure of the hallways is due to the handrails or floor pattern distinguished easily to lead traffic lines smoothly. The use of vivid color combination and functional device to ease traffic are recommended for special spaces using by elderly. American lobbies showed the lowest aesthetic measure(0.65) among several areas. Yet, the distinctive color combination is required for those areas because of various functions such as gathering, communicating, and transitional functions. And the facility "J" in America marked the highest measure of 1.20 in its hallways. The dominant, sub-dominant, and accent colors of the hallways in the "J" facility make use of contrast harmony as well as similarity harmony with big value contrasts. Those color combinations are expected to vitalize cognitive ability. On the contrary, the facility "B" in Korea marked the lowest measure of 0.29 in its dining room, which is due to monotonous color(YR and R), rarely showing any value contrast. It is not functional in terms of vitalization<sup>14)</sup>.

<Table 13> Aesthetic Measure of Areas in 20 Facilities

Area Facility	Lobby	Hall way	Dining Room	Bed Room	Mean	Area Facility	Lobby	Hall way	Dining Room	Bed Room	Mean
	A	0.90	1.18	0.86	0.59		0.88	A	0.70	0.72	0.75
B	0.70	0.70	0.29	0.75	0.61	B	0.36	1.11	0.60	0.80	0.72
C	0.84	0.67	0.78	1.04	0.83	C	0.74	0.52	0.45	0.76	0.62
D	0.88	1.00	1.10	0.62	0.90	D	0.41	0.50	1.20	0.53	0.66
E	0.73	0.97	1.07	0.96	0.93	E	0.89	0.73	0.50	0.68	0.70
F	0.79	1.19	0.82	0.80	0.90	F	0.67	0.56	1.00	0.72	0.74
G	0.83	0.87	0.80	0.74	0.81	G	0.70	0.75	0.79	1.14	0.85
H	0.88	0.87 1.12	0.87	0.96	0.94	H	0.73	0.68	0.45	0.75	0.65
I	1.06	0.99	1.04	0.3	0.85	I	0.54	0.63	0.35	0.52	0.51
J	0.87	0.84	0.72	0.45	0.72	J	0.71	1.20	0.65	0.85	0.85
Mean	0.85	0.95	0.84	0.72	0.84	Mean	0.65	0.74	0.67	0.78	0.71

14)Lawton, M.D., Institute for the Aged", Brooks Cole Publishing Co., 1980



### 3.3. Use on Natural Light

#### (1) Degree of Daylighting Inflow

The use of natural light in Korean facilities is as follows: 19 cases out of 40 were sufficient, 11 cases were sufficient to some extent, and 10 cases were insufficient due to no windows. In the case study of Korean facilities(10 cases) and American facilities(10 cases), majority of the areas except hallways were sufficiently utilizing natural light.

<Table 14> Degree of Use on Natural Light

	Korea										U.S.A												
	Degree of Daylighting Inflow		Type of Window					Light pattern			Degree of Daylighting Inflow		Type of Window					Light pattern					
	Sufficient to some extent	in sufficient	Horizontal	Vertical	Unilateral	Clarestory	Over-hanging	Bay Window	Uniform	Non-Uniform	Sufficient to some extent	in sufficient	Horizontal	Vertical	Clarestory	Unilateral	Over-hanging	Bay Window	Uniform	Non-Uniform			
A	L	•	•						•	•	•	•	•	•						•			
A	H	•			•				•		•									•			
A	D	•			•				•	•	•			•						•			
A	B	•			•				•	•	•			•						•			
B	L	•			•				•	•	•			•						•			
B	H	•	•						•	•	•			•						•			
B	D	•			•				•	•	•			•						•			
B	B	•			•				•	•	•			•						•			
C	L	•			•				•	•	•			•						•			
C	H	•	•						•	•	•			•						•			
C	D	•			•				•	•	•			•						•			
C	B	•			•				•	•	•			•				•		•			
D	L	•			•				•	•	•			•						•			
D	H	•	•						•	•	•			•						•			
D	D	•			•				•	•	•			•						•			
D	B	•			•				•	•	•			•						•			
E	L	•			•				•	•	•			•						•			
E	H	•	•						•	•	•			•						•			
E	D	•			•				•	•	•			•						•			
E	B	•			•				•	•	•			•						•			
F	L	•			•				•	•	•			•						•			
F	H	•	•						•	•	•			•						•			
F	D	•			•				•	•	•			•						•			
F	B	•			•				•	•	•			•						•			
G	L	•			•				•	•	•			•						•			
G	H	•	•						•	•	•			•						•			
G	D	•			•				•	•	•			•						•			
G	B	•			•				•	•	•			•						•			
H	L	•			•				•	•	•			•						•			
H	H	•	•						•	•	•			•						•			
H	D	•			•				•	•	•			•						•			
H	B	•			•				•	•	•			•						•			
I	L	•			•				•	•	•			•						•			
I	H	•	•						•	•	•			•						•			
I	D	•			•				•	•	•			•						•			
I	B	•			•				•	•	•			•						•			
J	L	•			•				•	•	•			•						•			
J	H	•	•						•	•	•			•						•			
J	D	•			•				•	•	•			•						•			
J	B	•			•				•	•	•			•						•			
T		19	11	10	21	6	1	4	1	0	16	24	24	8	1	14	11	4	5	0	1	21	19

L : Lobby H : Hallway D : Dining Room B : bedroom

Using daylight effectively conserves energy, and full-spectrum daylight produces significant improvements in physical working capacity. However "good" illumination is defined as appropriate direction of light, good contrast, and freedom of glare besides sufficient quantity of light<sup>15)</sup>. In another words, quantity without quality may be self-defeating; thus considerations for the qualified daylighting are required.

#### (2) Type of Window

Three out of the American facilities studied installed clerestory windows to bring homogeneous light into the rooms. Yet, 6 cases in American facilities and 5 cases in Korean facilities had unilateral or horizontal windows which caused unnecessary dazzle on the eyes. And 4 cases in American facilities and 3 cases in Korean facilities had the narrow and long, vertical windows which brought less light and made not only long shadows but also non-uniform brightness.

The types and directions of windows make a big difference in the amount and the homogeneity of natural light. Although unilateral windows that cover entire walls or big, horizontal windows bring a huge amount of natural light into the rooms, such strong daylight from windows may provide uncomfortable light that light control devices are essential for an aging population who needs uniform ambient illumination.



<Figure 11> Clerestory Windows in American "J" Facility, Unilateral Windows in Korean "D" Facility, and Vertical Windows in Korean "B" Facility

#### (3) Light Pattern

For the light patterns of Korean facilities, 16 out of forty cases were uniform, and 24 cases were non-uniform; thus the rate of non-uniform only is high. On the contrary, those of American facilities were better with twenty-one cases uniform.

In case of lobbies, 7 cases each were non-uniform.

15)Sorensen, S. and Brunnstom, G., 1995." quality of light and quality of life: An intervention study among older people," International Journal of Lighting Research and Technology, Vol.27, No. 2, 1995, pp.113-119

Korean facilities showed non-uniform lighting due to the lack of shade and shutter to control natural lighting from the smooth surface of the floor, which reflects light toward the main use of direct lighting. These conditions make it hard to create an even lighting environment.

### 3.4. Application on Artificial Light

#### (1) Lighting System

The lighting system used in the lobbies, hallways, dining rooms, and bedrooms of Korean and American facilities were as follows: one lighting system was used in 24 of 40 areas, two systems in 12 areas, and three systems and more in 4 areas of Korean facilities. The architectural lighting such as coved ceiling was in two cases. On the other hand, one system was used in 14 out of 40 areas, two systems in 18 areas, and three systems and more in 8 areas in American facilities. Coved ceilings were in five cases.

It shows that American facilities install the more lighting systems than Korean ones to support the residents' activities efficiently. Additional task lighting on the lamp table at bedroom of "D" facility in America provided proper luminosity. At many areas in American facilities, recessed ceiling light and architectural lighting provide general ambient light while the wall mounted lighting and floor lamp add warmth and homelike look.

However, the light of wall mounted lamp at dining rooms of "H" and "G" facilities in America was too bright to be functional, and the color temperature of wall mounted lamp at dining rooms of "G" facility was too high to feel comfortable. The wall washer at hallway of "H" facilities in Korea cast strong shadows to throw into confusion.



<Figure 12> Recessed Ceiling, Ceiling Mounted, and Suspended Lighting Systems of "H" Facility, Ceiling Mounted and Table Lamp of "D" Facility, and Recessed Ceiling and Wall Mounted Lighting Systems of "G" Facility in America

Because many elderly persons are partially sighted, they need special task lighting. Hazardous areas, such as stairways, platforms, and doorways, must also receive special attention so that changes in elevation and

obstructions are easily recognized and navigated. Lighting for the elderly can best be accomplished by applying the combined lighting systems relevant to all lighted spaces<sup>16)</sup>.

<Table 15> Degree of Application on Artificial Light

	Korea												U.S.A													
	Lighting System						Fixture Type		Light Source				Lighting System						Fixture Type		Light Source					
	C	R	C M	W M	S	W W	T	F	D	I	F	In	H	C	R	C M	W M	S	W W	T	F	D	In	F	C	H
A	L	•	•				•	•	•	•	•	•	•	•								•	•	•	•	
	H	•						•	•	•	•	•	•	•								•	•	•	•	
	D							•	•	•	•	•	•	•								•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
B	L	•	•					•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•	•					•	•	•	•	•	•	•								•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
C	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•	•				•	•			•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
D	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•	•								•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
E	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•									•	•	•	•	
	B	•							•	•	•	•	•					•	•	•	•	•	•	•	•	
F	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•									•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
G	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•									•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
H	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•									•	•	•	•	
	B	•	•						•	•	•	•	•					•	•	•	•	•	•	•	•	
I	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•									•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
J	L	•						•	•	•	•	•	•									•	•	•	•	
	H	•						•	•	•	•	•	•									•	•	•	•	
	D	•						•	•	•	•	•	•									•	•	•	•	
	B		•						•	•	•	•	•					•	•	•	•	•	•	•	•	
T	3	28	12	3	9	2	1	0	36	15	38	11	2	5	19	14	12	9	0	11	4	21	35	34	25	0

#### (2) Fixture Type

For the fixture type of Korean facilities, direct lighting was used in 25 out of 40 areas, indirect lighting in 4 areas, and both of them in 11 areas. Whereas for American facilities, direct lighting was used in 5 out of 40 areas,

16) Recommended Practice for Lighting and the Visual Environment for Senior Living, IESNA, 1998, pp.11-13

indirect lighting in 19 areas, and both of them in 16 areas. These suggest that American facilities favored indirect lighting as the dominant fixture type.

Direct lighting is a good choice for bringing high levels into a room. But direct luminaire should be shielded so that direct glare is avoided since aging eye are sensitive to glare. Independently operated drapery or shade help prevent glare. In Korea, naked bulbs for ceiling light of lobby in "A" facility, hallway in "E" facility, and dining rooms in "D" and "J" facilities were problematic for residents, producing a glare.

### (3) Light Source

In American facilities, fluorescent lighting was used in 13 out of 40 areas, incandescent lighting in only 7 areas, both of them in 19 areas, and fluorescent and tungsten halogen lighting in 1 area. On the other hand, in Korean facilities fluorescent lighting was used in 26 out of 40 areas, fluorescent and incandescent lighting in 10 areas. This proves that the major light source in Korean facilities is fluorescent lighting.

Fluorescent lighting is good to produce a uniform brightness in interior spaces, and triphospho fluorescent lamps allow spectral choices with good color rendition, while being energy efficient and cost effective<sup>17)</sup>. But the cool, colored linear type of fluorescent lamps used in Korean "C" and "D" facilities create direct glare. Whenever fluorescent light sources are used, warm-white deluxe or prime color tubes are recommended. Also Paraboloid fixture covers on fluorescent lights provide better light distribution and eliminate glare<sup>18)</sup>.

## 3.5. Illuminances

### (1) Average Illuminances by Nations and Facilities

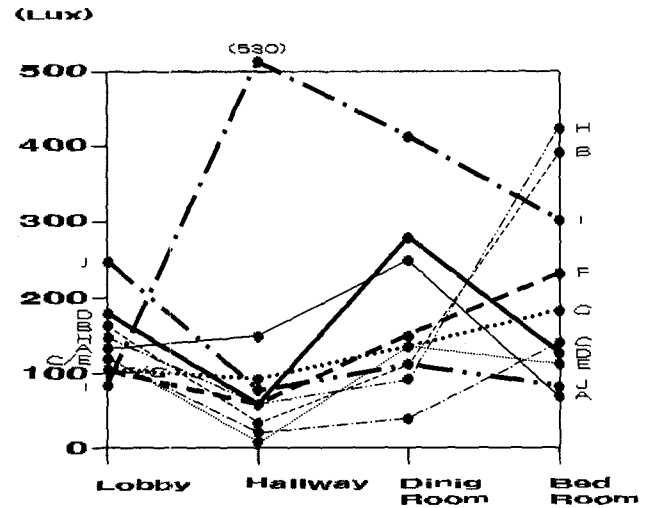
The illuminances of Korean facilities ranged from 77Lux to 333Lux, with the average set at 158Lux. On the other hand, American facilities ranged from 190Lux to 487Lux, with the average set at 330Lux. The measures prove that majority of the American facilities are above the minimum maintained average illuminance(300Lux)<sup>19)</sup>, and Korean facilities below the average illuminance for active hour.

17)Ibid., p.15

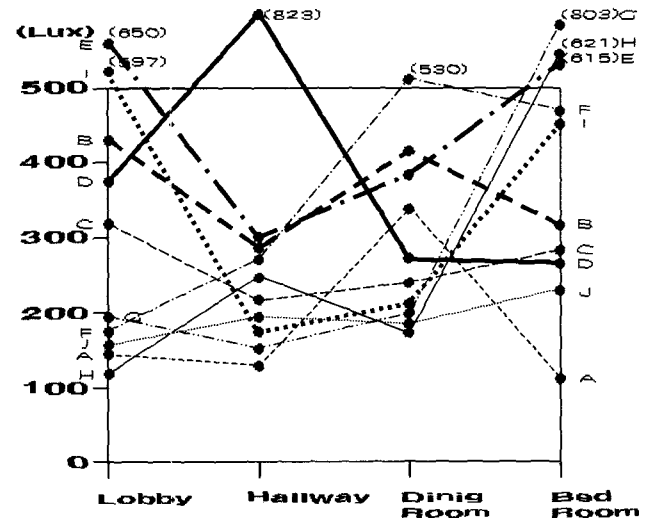
18)Christenson, Margaret A., Aging in the Designed Environment, The Haworth Press, 1990, p.10

19)According to the IESNA guideline, minimum maintained average illuminance is 300 Lux for living room, bedroom and hallway, 500 Lux for dining room during active hours.

Since Korean facilities depend the daylighting sources upon natural light due to economic reasons, they can not provide the light enough for a variety of activities for residents. For an aging population, quantity of light is a key element in the functional design of any space.



<Figure 13> Illuminances of Korean Facilities



<Figure 14> Illuminances of American Facilities

The illuminances of five Korean facilities ranged from 77Lux to 135Lux. It is rarely considered an appropriate lighting level to accommodate the functional demand of the senior residents in those facilities.

### (2) Average Illuminances by Areas

The results of the comparison of the difference in the illuminances in the different areas of the facilities are as follows: Korean facilities showed the lowest level(114Lux) in the hallways, and American facilities showed the lowest

level(283Lux) in the hallways also, the highest level (420Lux) in the bedrooms due to larger windows than other areas. Therefore dark hallways need to be brighter during day. Additionally, as shown <figure 13> - <Figure 14>, many facilities in America and Korea do not have even illuminances. Those illuminance gaps between areas are not functional in terms of light adaptation. The time required to both light adapt and dark adapt is significantly lengthened with age, and can seriously affect a person's ability to navigate between spaces lighted to very different levels<sup>20)</sup>.

#### 4. Conclusions

1. Most areas of Korean facilities were predominantly in cool colors, PB or P, in using dominant colors, whereas those of American facilities were in warm colors. The selection of cool color which creates a restful and soothing feeling are good solution for relaxing and restful bedrooms. However those cool colors do not evoke such a bright and active feeling, it is advisable to choose the dominant colors from the warm color group for lobbies and dining rooms where the residents stay for short period of time, and where they require energy for a variety of activities.

2. In hallways and bedrooms of Korean facilities, accent colors were not used as widely as in those of American facilities. In order to provide the smooth and safe circulations and to elevate the elderly residents' daily activities, more considerations on the use of accent colors should be done.

3. Korean facilities examined usually used higher hue contrast(Average of four areas : 49.4%) than value contrast(38.3%), and higher contrast harmony(49.4%) than similarity harmony(11.6%) in hue. The present color combination is distinctively composed of contrast harmony among the order factors, and it can be functional. However, it must be considered to include similarity harmony, which is 5.6% in lobbies and 4.7% in dining rooms in order to create a homelike friendly atmosphere instead of medical institutes' atmosphere.

4. In American facilities, three harmony factors such as identity, similarity, and contrast harmony were combined.

The similarity harmony creates a cozy and comfortable atmosphere. Nonetheless, that color combination can not be functional for elderly residents whose visions and color sensing abilities are impaired. The stronger contrast in lobbies and hallways of American facilities will be ideal.

5. Average of aesthetic measure(0.84) of Korean facilities is higher than that(0.7) of American facilities. Since majority of Korean assisted living facilities for the elderly are sensitive to budget, color application with contrast is a common solution to increase the function at facilities. On the contrary, the facility "B" in Korea marked the lowest measure of 0.29 in its dining room, which was due to monotonous color(YR and R). Also in "D" and "I" facilities of America, emphasizing their home-like environment, appropriate color combinations were hardly considered by using the monotonous color combination of white and related colors. It is not functional to accommodate the demand of the elderly.

6. The lighting conditions in Korean facilities were inferior in quantity and quality. Those facilities try to maximize the use of natural light, but the control devices were not properly installed. In addition, the pre-installed devices were not fully utilized even during active hours due to economic reasons. This made the overall illuminances (Average: 158 Lux) too low to support the activities of elderly residents.

7. Illuminances of many areas in Korean facilities were non-uniform(60%) due to the lack of shade and shutter to control natural lighting from the smooth surface of the floor, which reflects light. These conditions which make it hard to create an even lighting environment should be avoided.

8. Majority of areas(60%) in Korean facilities were dependent upon only one lighting systems to support the residents' activities, whereas American facilities installed the more lighting systems efficiently. The coordination of lighting systems in the spaces will be able to function fully when it is accompanied by proper planning. Therefore, combined lighting systems relevant to all lighted areas should be applied to the facilities with the low vision people.

9. The major lighting source in Korean facilities was fluorescent light in 62.5%. An advantage of fluorescent lighting is its "blue" energy, which helps older people see color. Where fluorescent are used, lights approximating the spectra of daylight should be the choice. Naked bulbs for

20)Burg, A., Vision and Driving: a report on research, J. Traffic Med. 3, 1975, pp.18-22

ceiling light in Korean "A", "D", "E", and "J" facilities and chandeliers in American facilities are problematic for older eyes, producing a glare that can be disorienting and painful.

10. Average illuminance of Korean facilities was below the minimum maintained average illuminance(300 Lux), with 158 Lux for active hour, and average illuminance of hallways in Korean facilities was the lowest level(114Lux). The recommended illuminances for daytime activities must be maintained, because quantity of light is a key element for an aging population. Additionally, many facilities in America and Korea did not have even illuminances between areas. The gap of the illuminances in the different areas must be minimized, because the elderly residents cannot adapt to change of light fast enough.

11. Contrary to Korean facilities, the American living facilities for the elderly demonstrated their efforts to distinguish their facilities from medical facilities even in selection of lighting system and fixture type. These reflect their attitude and philosophy toward senior citizens.

Notes : We want to make it clear that we tried to eliminate all the variable factors that might affect the colors and lightings of the surroundings. However, differences due to the prevailing weather during filming days, shooting position, state of light, or the method of measuring the colors pose limitations to this research.

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<접수 : 2004. 2. 28>