calculation. And the shading was studying to material and method of install for effective shading effect. But the study of energy consumption by complex applied of orientation and climate is lack. The researcher was classified by various standards in Korea. But the specific guideline and regulation about application is not enough. The government was effort to energy saving in buildings through grade of performance of insulation and air-tightness. But government not regulated to energy saving by solar control through shading. This study was referenced regulation and standard and confirmed result of simulation of standard building. And this study confirmed to impact on variation of heating & cooling load by the shading install. The variation affected installation of shading. Building Energy Conservation in KOREA was defined that shading is blocked solar and distinguished exterior shading, interior shading and between of the glass shading. Also EPI(Energy Performance Indicator) checked exterior shading and admit just auto controlled interior shading. Green building certification was proposed standard for decrease greenhouse gas. And this standard proposed that minimum length of horizontal shading for decrease glare and view environment improvement. Minimum length of horizontal shading is following equation 1.

$$P = \frac{H}{\tan A} \tag{1}$$

Where P is length of horizontal shading, H is horizontal length to shading from bottom of window and A is meridian altitude in summer (90-latitude+23.5).

'The Window Design Guideline for Energy-saving of Buildings' was published the Ministry of Land, Transport and Maritime Affairs. The purpose of the guidelines is to allow a variety of designs to considering the energy performance in building design. This guideline confirmed the impact of the window design of office buildings to the energy consumption of buildings and proposed orientation, WWR, and types of windows in each region. In addition, it can be considered to calculate the energy savings. Seok-Hyun Kim, Sun-Sook Kim, Kwang-Woo Kim, Young-Hum Cho confirmed the needs of complex apply of window elements in 'Analysis of the energy consumption of window elements through simulation' . Also they analyzed correlation of energy consumption and they analyzed impact of energy consumption by simulation. But they studies just confirmed energy consumption by variation of window performance not shading of controlled solar radiation. As a result, this study confirmed the variation of heating & cooling load by similar study review and simulation of base modeling.

STANDARD BUILDING MODELING

Standard building for confirm to variation of energy consumption of building by variation of shading must be define. The standard building was not defined in

KOREA but this study reference standard building by previous research results. This study's standard building referenced to 'The Window Design Guideline for Energy-saving of Buildings' and used 'unit area' in guideline. This method revealed the energy demand and the best way according to the variation of the window elements at each orientation. This study selected the unit space to standard buildings and size of this unit space was 6 × 4.5 × 2.7 m. This size is the result of research that considers the average commercial building by an analysis of the buildings. The gap between the columns of the building was 6 m, the depth to the considering environment of light was4.5 m, and the height of room was 2.7 m.

SIMULATION CONDITION

This study used COMFEN 4.1 by LBNL (Lawrence Berkeley National Laboratory) and simulated standard modeling. This tool is a facade design tool based on the Energy Plus engine and provides a systematic evaluation of various elevations. COMFEN 4.1 can model the fenestration facade to the number of windows, size, location, glazing, frame, outside shading. In addition, it can be compared using a range of facades. The facade can select the daylight controls and has the option of orientation of the buildings. The annual energy consumption (heating, cooling, fan, and lighting) and peak energy were analyzed by comparing the charts. The simulation condition shows Table1 and schedule shows Figure1.

Table 1. *Simulation condition*

Section	Contents
HVAC	Packaged Single Zone
Temperature Set point	Cooling : 24℃, Heating : 21℃
Lighting Load	16 W/㎡
Equipment Load	10 W/㎡
People	3 people
Simulation period	Annual

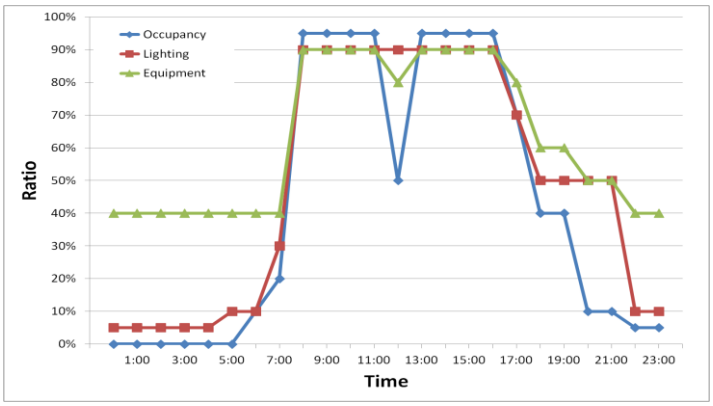

Figure 1. *Simulation schedule*

ANALYSIS OF HEATING & COOLING LOAD BY HORIZONTAL SHADING

The purpose of this study is that confirmed various heating & cooling load of building by the exterior installed shadings. This study confirmed that the annual heating & cooling load of building without shading and installed exterior horizontal shading. The Figure 2 shows the unit area by each WWR. And Table 2 shows simulation parameter.

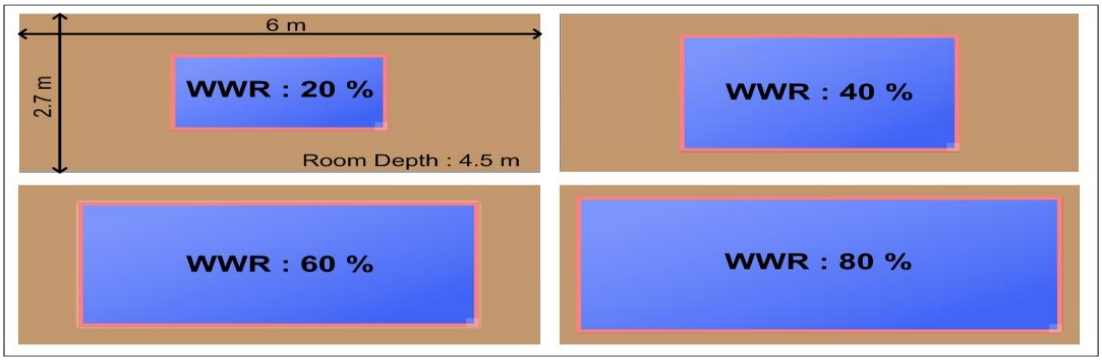

Figure 2. *Simulation Modeling by WWR*

Table 2 *Simulation parameter*

Section	Contents				
Orientation	East/West/South/North				
WWR	20% / 40% / 60% / 80%				
Window Type		Type1	Type2	Type3	Type4
	U-Value(W/㎡·K)	1.8	1.8	2.1	2.1
	SHGC	0.4	0.6	0.4	0.6
Shading	WWR	20%	40%	60%	80%
	Length	0.35 m	0.5 m	0.58 m	0.6 m

The simulation results in case of WWR60%, window type 4 of the regulation level, East façade needs 162 kWh/㎡·yr in case of non-shading and 150 kWh/㎡·yr in case of horizontal shading. West façade needs 168 kWh/㎡·yr in case of non-shading and 154 kWh/㎡·yr in case of horizontal shading. And South façade needs 137 kWh/㎡·yr in case of non-shading and 112 kWh/㎡·yr in case of horizontal shading. By the result, we confirmed that the shading installation was decreased heating & cooling load of façade. But North façade needs 112 kWh/㎡·yr in case of non-shading and 111 kWh/㎡·yr in case of horizontal shading. In case of install shading, heating & cooling load was decreased than non-shading. And the effect of decrease of heating & cooling load was efficient in South façade. This result seems to decrease of cooling load through install horizontal shading in summer period. This study confirmed the variation of heating & cooling load by length of horizontal shading, like a Table3, in case of the variation of heating & cooling load by length of horizontal shading.

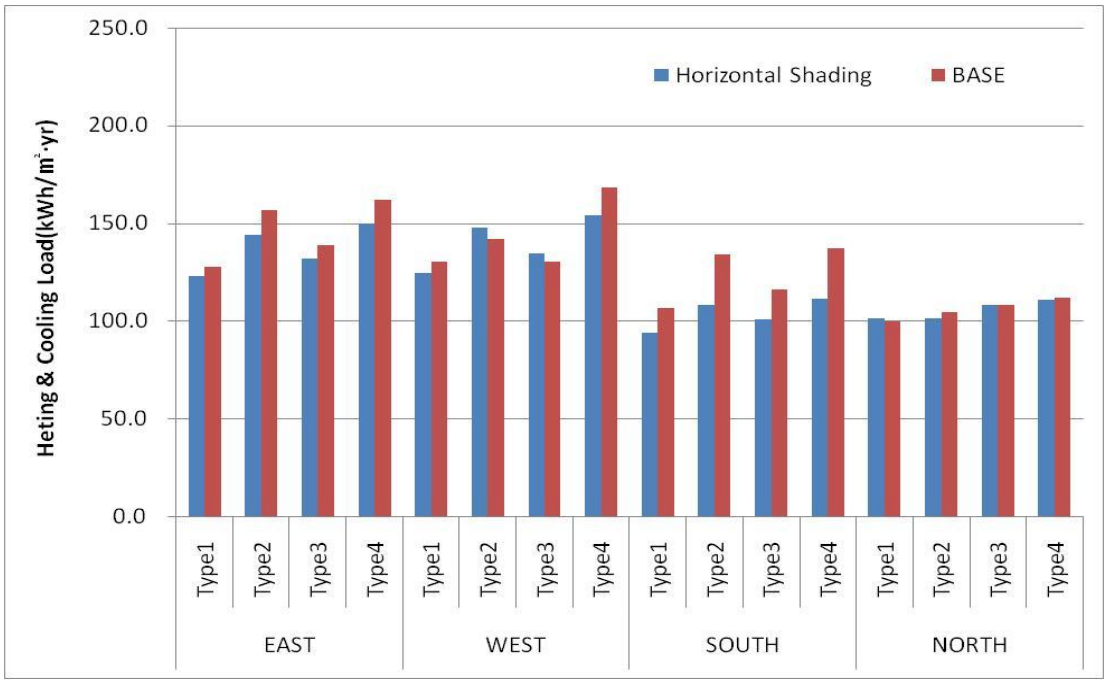

Figure 3. *Variation of Heating & Cooling Load by the horizontal shading (WWR:60%)*

Table 3 *Simulation Case*

Section	Contents				
Orientation	East/West/South/North				
WWR	60%				
Window Performance	U-Value(W/m²·K)	2.1			
	SHGC	0.6			
Shading	Length(100%)	0.5 m			
	Ratio	50%	100%	150%	200%

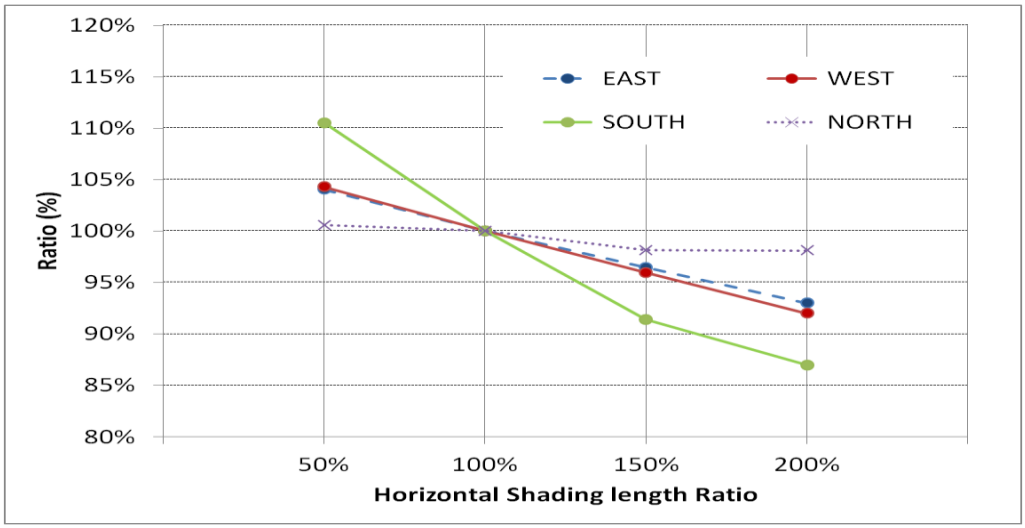

Figure 4. *Variation of Heating & Cooling Load by the shading length*

The result of WWR60% and various length of shading, this study confirmed heating & cooling load by orientation and length of shading. East façade needs 150 kWh/㎡·yr in case of the length of level of regulation and 139 kWh/㎡·yr in case of the 200% length of level of regulation. In case of West façade, decreased to 142 kWh/㎡·yr from 154 kWh/㎡·yr. South façade decreased 13% of heating & cooling load that 112 kWh/㎡·yr in case of the length of level of regulation and 97 kWh/㎡·yr in case of the 200% length of level of regulation. In case of decrease 50% of length of shading, the heating & cooling load was increased. This study confirmed heating & cooling load decreasing by longer than length of level of regulation. Figure 4 shows the variation of heating & cooling load by orientation and length.

ANALYSIS OF HEATING & COOLING LOAD BY SHGC AND SHADING

This study confirmed the variation of heating & cooling load of standard building by SHGC for confirmed effect of SHGC that is the value of performance of window. The result of compared to the heating & cooling load in case of the installed shading of level of regulation, this study confirmed to 109 kWh/㎡·yr from 150 kWh/㎡·yr in case of SHGC 0.2 to 0.75 in East façade and to 107 kWh/㎡·yr from 149 kWh/㎡·yr in case of SHGC 0.2 to 0.75 in West façade. It is increased 37%, 39% of heating & cooling load by the variation of SHGC. The result of after installed horizontal shading in South façade, heating & cooling load increased to SHGC 0.4 and reduced upper to SHGC 0.4. In case of north façade, heating & cooling load was decreased on point SHGC 0.4. In case of installed the shading of level of regulation, this study confirmed the variation of heating & cooling load by the variation of SHGC.

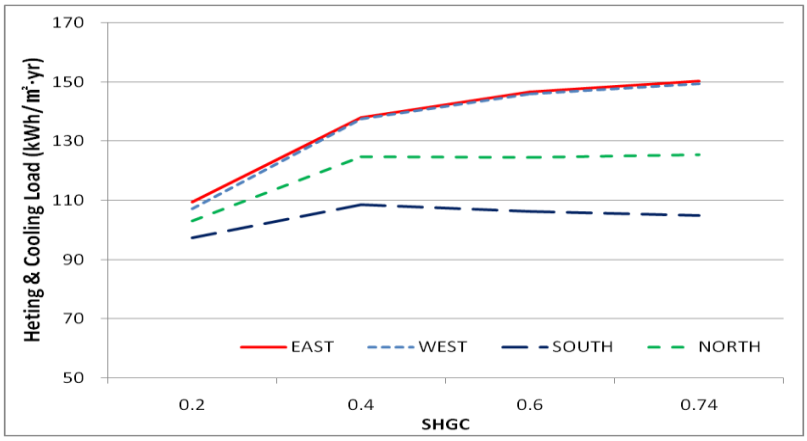

Figure 5. *Variation of Heating & Cooling Load by the SHGC*

ANALYSIS OF HEATING & COOLING LOAD BY VARIOUS SHADING

To confirm the variation of heating & cooling load by venetian blind, this study compared to case of horizontal shading and case of variation of venetian blind. This study used the types of venetian blind interior/between glazing/exterior. In case of

WWR 60%, SHGC 0.4 and 0.6 of window, this study confirmed heating & cooling load of standard building. In case of South façade and SHGC 0.4, the heating & cooling load was confirmed that case of the horizontal shading is 362.5 kWh/㎡·yr, case of the exterior venetian blind is 355.3 kWh/㎡·yr, case of the between glazing venetian blind is 381.8 kWh/㎡·yr, case of the interior venetian blind is 429.4 kWh/㎡·yr. The heating & cooling load of case of venetian blind of between glazing and interior increased 19.3 kWh/㎡·yr, 66.9 kWh/㎡·yr to case of horizontal shading. That reason is that increased the heating load through venetian blind blocked solar radiation in winter season than installation of horizontal shading. In case of South façade and SHGC 0.6, the heating & cooling load was confirmed that case of the horizontal shading is 401.5 kWh/㎡·yr, case of the exterior venetian blind is 356.7 kWh/㎡·yr, case of the between glass venetian blind is 381.6 kWh/㎡·yr, case of the interior venetian blind is 446.2 kWh/㎡·yr. The heating & cooling load of case of venetian blind of between glazing and interior increased 19.9 kWh/㎡·yr, 44.7 kWh/㎡·yr to case of horizontal shading. By the result, the venetian blind of exterior and between glazing was not effected to SHGC and heating & cooling load of interior venetian blind is increasing.

Table 3 *Variation of Heating & Cooling Load by horizontal shading and venetian blind*

WWR	Window Performance	Type	Position	Heating & Cooling Load(kWh/㎡·yr)			
				East	West	South	North
60%	U-Value : 2.1(W/㎡·K) SHGC : 0.4	Horizontal shading	Exterior	474.6	483.9	362.5	389.7
		Venetian blind	Exterior	378.7	377.9	355.3	368.2
			Between glazing	399.9	398.4	381.8	391.8
			Interior	429.4	522.8	429.4	389.7
	U-Value : 2.1(W/㎡·K) SHGC : 0.6	Horizontal shading	Exterior	538.8	555.2	401.5	398.7
		Venetian blind	Exterior	383.8	384.6	356.7	369.0
			Between glazing	399.9	398.6	381.6	392.0
			Interior	531.0	546.2	446.2	397.6

CONCLUSION

In this study, confirmed annual heating & cooling load of standard building by simulation modeling. The result of this study is as following;

In case of install shading, heating & cooling load was decreased than non-shading. And the effect of decrease of heating & cooling load was efficient in South façade. This result seems to decrease of cooling load through the horizontal shading installation in summer period. This study confirmed heating & cooling load decreasing by longer than length of level of regulation

In case of installed the shading of level of regulation, this study confirmed the variation of heating & cooling load by the variation of SHGC.

By the result, venetian blind of exterior and between glass was not effected to SHGC,

venetian blind of exterior's reduction of heating & cooling load is more effective to horizontal shading. And this study confirmed that heating & cooling load of interior venetian blind is increasing.

REFERENCES

Ministry of Land, Transport and Maritime Affairs. 2008. *Building Energy Conservation Design Standard, Ministry of Land, Transport and Maritime Affairs*

Ministry of Land, Transport and Maritime Affairs, Ministry of Environment. 2013. Green Building Certification Criteria , Ministry of Land, Transport and Maritime Affairs, Ministry of Environment.

Ministry of Land, Transport and Maritime Affairs, 2012, The Window Design Guide-line for Energy-saving of Buildings, Ministry of Land, Transport and Maritime Affairs.

Seok-Hyun Kim, Sun-Sook Kim, Kwang-Woo Kim, Young-Hum Cho, 2013, Analysis of the energy consumption of window elements through simulation, Korea Journal of Architectural Institute Spring Conference 33 (1) (2013)261–262.

Seok-Hyun Kim, Sun-Sook Kim, Kwang-Woo Kim, Young-Hum Cho, 2013, A study on the proposes of energy analysis indicator by the window elements of office buildings in Korea, Energy and Buildings 73 (2014) 153-165.