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서울시 구민회관 공연용 할로겐 조명을 LED 조명으로 교체시 에너지 절감에 관한 연구

A Study on Energy Savings When replacing Performing Halogen Lights with LED Lights in Seoul Community Hall

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요 약 서울시에는 25개 구역의 구청이 있으며, 구청에는 최소 1곳에서 최대 4~5곳으로 소중대규모의 다양한 공연장을 운영하고 있다. 공연장의 용도는 연극이나 뮤지컬의 일반적인 공연에서 학예회, 발표장 등 다양한 용도로 사용되고 있다. 이 점을 착안하여 다양하게 사용되기에 용이한 LED등기구를 기존 할로겐 등기구로 대체 하였을 때 에너지 절감 부분에 대한 측면에서 어떤 이점이 있는 지를 알아보고, 실제 구민회관의 공연장을 대상으로 에너지 절감에 대한 수치로 적용하기로 한다. 기존 할로겐 등기구에서 LED등기구로 교체하였을 경우 약80%가량의 전력량 절감이 나타나며, LED자체의 소자 칩으로 다양한 기능적 특성을 가지는 장점을 지녀, 앞으로 할로겐 등기구를 대체하기에 용이한 LED 등기구라고 할 수 있을 것이다.

Abstract Seoul has 25 areas of City Hall, the ward office has been operating theater at least 1 in maximum 4-5 locations to various sized places. The purpose of theater has been used for a variety of purposes to typical performances of Drama and Musicals, School play, Lecture. This points to a Variety of ideas for use, when replacing an exsting halogen luminaires, appropriate LED luminaires, Learn more if there is any advantage in terms of the energy saving part. it will be applied to the value for the energy saving to ward office hall of the actual targets. In case replacement in existing halogen luminaires to LED luminaires, to energy savings of about 80% appear around. Get the advantages of the various functional properties a device chip of the LED itself, Forward will be referred to as easy to replace the halogen luminaires and LED luminaires.

Key Words : LED LIGHTING FIXTURE, HALOGEN, ENERGY SAVING REPLACEMENT

I. Introduction

Now Halogen lights are used widely in the field of stage lighting. Therefore, stage lighting or Halogen lighting are used by many community halls in Seoul. However, because of the high energy consumption and heat in stage lighting, lights using new materials are gradually emerging out, thus I think it is necessary to take a deeper look at the replacements of lights. Especially it has widely reported by the mass media

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that LED lights are being used for multi purposes as the alternative means. Therefore, this paper aims to investigate the energy savings in the community halls. when the existing Halogen lights are replaced with LED lights.

II. Main Points

Firstly, I explore how much energy can be saved when using stage lights compared with the general lights.

표 1. 무대조명 등기구와 일반등 등기구의 전력량 차이점
Table 1. Energy Differences between Stage Lighting Fixture and General Lighting Fixture

	Halogen lights	Tungsten lights
capacity	500W ~ 1kW	50W

From the above table, we can see that compared with the Tungsten lights, 100-200 times of energy will be saved when using Halogen lights.

Although the energy consumed will vary depending on the purpose of use and time, the heat emitted and the useful life show that the stage lights are highly energy consumed.

Then I will take 00 community hall as the example to show the enegry saving when replacing Halogen lights with LED light.

1. Structure of Big auditorium in 00 Community Hall

The structure of Big Auditorium in 00 community in Seoul is shown in the following figure.

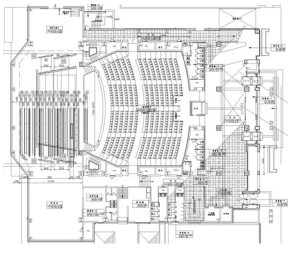

그림 1. 00구민회관 대공연장 평면도
Fig. 1. Floor Plan of Big Auditorium

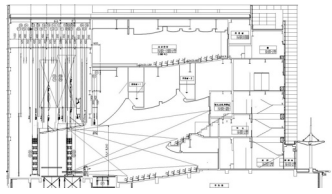

그림 2. 00구민회관 대공연장 단면도
Fig. 2. Cross-Sectional Diagram of Big Auditorium

With about 600 seat in the Big Auditorium of 00 community hall, this is a concert hall of medium scale among the concert halls in Korea.

Let's look at the chart of lights arrangements as shown in Fig 3.

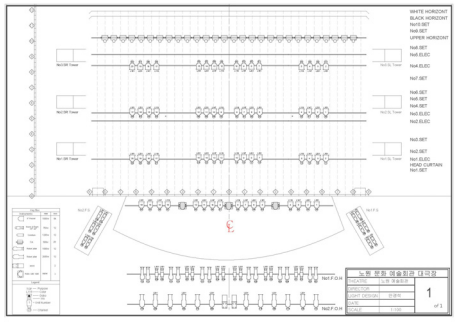

그림 3. 대공연장 장비재치도
Fig. 3. Equipment Chart of Big Auditorium

We can see that there are over 150 pieces of lights are equipped in the auditorium. Despite the quantity of lights used in each stage might be different during the performance, here I will assume with the quantity used in general.

2. Characteristics and Consumption of LED Lights

Next I am going to explore how much energy can be saved when replacing Halogen lights with LED lights as the equipment chart above shows.

We can see from Table 2 that the total consumption is 279[kW]. The functional characteristics of the lights are not considered in this paper.

With Lumen in W/Lumen as the criteria of total consumption, we replace the LED lights with Halogen lights.

표 2. 와트별 할로겐 등기구 수량
Table 2. Quantity of Halogen Fixture of Different Watts

consumed electricity[W]	total consumption	total consumption[kW]
2,000	12	24(excluded)
1,000	186	186
750	52	39
500	56	28
250	8	2
	total consumption	255

표 3. 할로겐 등기구 용량 대비 LED 등기구 적용 용량
Table 3. Comparison of Applying Capacities between Halogen Fixture and LED Fixture

Electricity of Halogen[W]	Electricity of LED [W]	Saved amount compared with using Halogen[W]
2,000	-	Impossible to replace
1,000	200	800[W]
750	150	600[W]
500	100	400[W]
250	50	200[W]

First of all, when replacing the Halogen at the level of 2,000[W] with LED lights, the emitted heat is too hight that LED chip and the related components can not stand. Because of this, by now, it is still impossible to replace Halogen at this level with LED lights. When replacing Halogen lights at the other levels from 250[W] to 1[kW] with LED lights, the illumination is almost the same and the heat is stable.

3. Application of LED Lights in Big auditorium

Next I aim to show how much energy can be saved when appling LED lights in the Big Auditorium compared with using Halogen lights.

표 4. 와트별 LED 등기구 수량 및 용량
Table 4. Quantity and Consumption of LED Fixture

consumed electricity[W][W]	total consumption	total consumption[kW]
expect	12	expect
200	186	37.2
150	52	7.8
100	56	5.6
50	8	0.4
	total consumption	51

Compared with the total consumption of Halogen lights -255[kW] mentioned before, the total consumption can be saved by 228[kW] with that of LED being 228[kW], which means about 80% of energy can be saved.

Then when translating the electricity consumption into electricity cost, we can get the result as shown in Table 5.

표 5. 용량별 계약금액
Table 5. Contract Amount for Different Consumption

type	consumption [kW]	contract consumption [kW]	contract amount [10,000 won]
Halogen light	255	300	244
LED light	51	75	61
	Saved amount		183
Cyber Korea Electricity Criteria as reference general purpose(1st)I high-voltage A: option I, power factor1, Usage of July as reference			

When appling different contract amounts as shown in Table 5, the saved amount of one month is up to 1.83 million won and about 21.96 million won can be saved yearly.

Halogen lamp from the Electrical Equipment, it can be controlled by Electricity and Dimmer, but Digital LED Lamp is Electronic Equipment, Separate Digital Signal Lines are required. So if amount reflected as follows, Parts for Electric Plants and Equipment.

표 6. 설비 및 장비 별 차이
Table 6. Differences of Facilities and Equipments

type	consumption [kW]	contract consumption [kW]	contract amount [10,000 won]
Halogen light	255	300	244
LED light	51	75	61
	Saved amount		183
Cyber Korea Electricity Criteria as reference general purpose(1st)I high-voltage A: option I, power factor1, Usage of July as reference			

Compared with that using Halogen, the consumption of LED lights is smaller, about 1/6 of facilities cost can be saved while the equipment cost is about twice

higher than that of Halogen lights. The maintenance cost is as follows.

표 7. 유지비용
Table 7. Maintenance Cost

Type	Amount(10,000 won)		Total amount (10,000 won)
Halogen	lamp	3,150	3,150
LED	lamp	155	155
	Gap in amount		2,995(+)

Under the assumption that the yearly used time in the Big Auditorium is about 900 hours, as the useful life of Halogen is 200[h], the lights need to be replaced 4.5 times every year. On the other hand, as the useful life of LED lamp is 20,000 hours, the lights only need to be replaced once every 10 years.

When translating the characteristics into formula, we can get Formula (1) as follows.

$$A = a(x + z) + y \quad (1)$$

A =yearly saved amount when replacing with LED lights
a = yearly use time
x = gap in the contract amount of electricity
y = Facilities and Equipments
z = Maintenance cost

표 8. 에너지 절감 금액
Table 8. Amount of Energy Savings

	Amount gapt at the early stage	1 year later	Notice
contract amount of different consumption(x)	2,196(+)	2,196(+)	Saved amount when using LED compared with that using Halogen
Facilities and Equipments(y)	2,588(-)	-	
Maintenance cost(z)	2,995(+)	2,995(+)	
Total	2,607(+)	5,191(+)	
(+)(-)refers to the gap in amount when using LED compared with that using Halogen			

When appling the formula, we can get the result as shown in Table 8.

III. Conclusion

With the Big Auditorium of community hall in Seoul as the research object, we can see that a large amount of energy can be saved when using LED lights under the assumption that the brightness is generally similar to that when using Halogen lights. The result of this case study showed that except the investments on equipments, energy of 51.91 million won can be saved. Thus I suggest that in concert halls of similar scale, when replacing the existing lights with LED lights, significant amount of energy will be saved

In particular, under the assumptions that there are one community hall in each of the 25 Gu in Seoul, averagely energy of 0.77 billion won can be saved when replacing with LED lights.

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