Lighting Computer Programs in Lighting Technology

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ABSTRACT

It is well known that the computer in lighting technology is a vital component for lighting designers. Lighting computer programs are preferred in preparing architectural projects in lighting techniques, especially in lighting calculations. Lighting computer programs, which arise with the aim of helping lighting designers, gain more interest day by day. The most important property of lighting computer programs is the ability to enable the simulation of lighting projects without requiring any real life applications. In addition, with the use of lighting computer programs, incomplete parts of projects are determined to make necessary calculations. In this study, the details about lighting computer programs, especially as used in interior lighting, are mentioned. A comparison of programs will be made by pointing out necessary characteristics in lighting computer programs.

Key Words: Lighting design, Lighting computer programs, Calculux, DIALux, Europic, Silicht.

1. INTRODUCTION

Fast developing computer technology provides many facilities in many areas in the course of daily life. Lighting, having an important place in people's lives, is an issue positively affected by these technological developments. The significance of computers has greatly increased because of the utilization of lighting computer programs by architects and electrical engineers for lighting design. Consistent with this situation, the utilization of the lighting computer programs and the work carried out in relation to those programs are drawing more and more attention day by day.

The use of lighting computer programs in architectural or interior lighting projects makes things much easier for both the client and the provider with an architectural formation or experts (lighting designers). The light values of the real world, like lumen and candela, can easily be transported into the computer environment. Nowadays, lighting technology is developing parallel to computer technology.

With the IES-photometric data files- prepared by the IES (Lighting Engineering Society), which sets the standards for lighting- work can be carried out by the lighting computer programs giving photo realistic results [1]. Lighting designers can create an environment by using the lighting computer programs, add furniture etc. to this environment, and by determining the required lighting level, they can determine the lighting level at some point within the environment. They can increase or decrease the number of lamps in the environment, change the lamp types and observe what kind of changes take place as they like. They can observe how the other lighting parameters change as a result of changing one of the parameters in the created environment.

2. LIGHTING DESIGN

The concept of lighting design is usually more important for the lighting of urban assets like buildings, which are the subject of the architectural design; public squares, monuments, parks and sculptures. Lighting design, in a sense, can be defined as the creation of a special lighting system based on the lighting technique and in order to meet the real requirements like architectural design. In this definition, it is clear that there are two aspects of the lighting design: the

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technical aspect and the artistic and architectural aspect [2].

While a lighting project is being prepared, the functional and structural characteristics brought by the semi-conductor technology offer us many choices in the use of lighting and also contribute to the creation of different lighting systems. This situation, also nice for quality of life and human psychology, is important with regard to the effective use of energy. The developments in lighting technique and the lighting industry also contributed to the meaningfulness and increasing significance of the lighting issue in architecture. More favorable solutions within the different options have been considered. One of those solution is lighting computer programs. As an advantage of those programs, very special solution proposals were put forward for the engineers and architects. Those programs provide simulations of the designs of the designer before realizing the project in the real world. It also helps to enhance the creativity of the designer who designs by using those programs.

3. SELECTION CRITERIA OF THE LIGHTING COMPUTER PROGRAMS

Computer programs which help to create 2- or 3-dimensional images of the lighting design to be applied in the architectural projects by using the real photometric values in the virtual environment, and helping to measure the necessary lighting level and find out the number and type of the armatures are called lighting programs. The optimization of the lighting system should be realized before the application stage for the lighting projects carried out using lighting computer programs. In this way, the effective use of energy is realized by enabling maximum lighting with minimum energy. The benefits of the lighting programs created today are much more than giving only numerical values related with the light sketches [1]. There are lighting computer programs which carry out all kinds of operations from determining the lighting level to lamp type and architectural drawings.

Lighting programs help to test the light effect created by all kinds of armatures at the places they are located within the computer environment in an early stage and show the light effects to be created after the real application in the virtual environment, and therefore correct the faults in the design and make the necessary changes without any time and money loss. This application can be realized in all the places which were modeled 3-dimensionally, regardless of whether the place is an interior or exterior. Some of the examples are offices, stores, showcases, residences, exterior facades and gardens [1].

Enarun[4] classified selection criteria of the lighting computer programs in six categories. When choosing a lighting program, usage convenience of the program, lighting calculation methods and models, the quality of the armature data, provision of the hardware and the operating system with ease, the quality of the inputs and outputs, and the portability of the inputs and the outputs

should be taken into consideration. All of the criteria mentioned above are generally interrelated with each other [4].

3.1. Usage Convenience of the Program

Lighting computer programs should be easy to use by all people who have a basic knowledge of lighting techniques. In order for the program to be used easily, it should request the necessary parameters- such as volume and dimensions of the room, reflection percentages, calculation methods to be used etc.- from the user by clear and easy to follow commands. It should direct the users by providing enough help and by warning them when making a faulty entry or a general mistake. Programs enable the users to make changes in the present designs and observe the changes on the other parameters when a change is made in the design [4, 5].

3.2. Calculation Methods and Model of the Program

There are many methods used in the lighting calculations. Those methods require application according to the media to be illuminated. The efficiency method and the light intensity method are the most preferred methods for interior lighting calculations. Glade calculation is preferred for road and area lighting. Nowadays, complex methods such as Ray Tracing and Radiosity are used in the advanced programs which especially use simulation techniques. Since daylight (the only meaningful light source with regard to natural lighting) is dependent upon many variables, modeling is required for it to be used in the calculations. These variables are related not only to hours, days and seasons, but also to geographical conditions. In order to find the most convenient and realistic solution in the lighting calculations, these variables should be taken into consideration [4, 5].

3.3. Quality of the Armature Data in the Program

Information about the armatures sets the basic principles for the artificial lighting. Armature efficiency and armature data light distribution is formed according to the lamp light flux. If the armature data are more sensitive and conform to the reality more, then the results are more accurate. The important thing is that the armature information in the database of the program should not be limited by the producer's company and it should be convenient to enter new armature information from other resources like catalogues. Only in this way can the users be presented with the opportunity for many choices [4, 5].

3.4. Hardware and Operating System of the Program

It requires significant changes in the computer configuration because of the graphical outputs in the

lighting calculation programs, which use three-dimensional design and simulation. Therefore nowadays, when new programs are purchased, then the hardware should also be renewed. Computer programs generally operate on WINDOWS versions or (more seldom) on DOS operating system. The latest lighting computer programs can also be run on the latest WINDOWS operating systems like WINDOWS NT, WINDOWS 2000 and WIN XP [4, 5].

3.5. Quality of the Program Outputs

Quality of the outputs is related to all the features mentioned above. Outputs are numerical or graphical (2D or 3D). Sometimes, numerical results do not mean anything useful for the client or for the users. Therefore, visual presentations conforming to the reality provide great convenience [4, 5].

3.6. Portability of the Inputs and the Outputs of the Program

A CAD module in the program, taking the architectural project drawn on the computer as data and running it on any kind of CAD program or transferring a file into that program, shortens the time it takes to carry out the work. They also minimize the risk of any faults [4, 5]. All the features which should be present in a lighting computer program are explained. In this research, we will analyze the most convenient lighting programs which help us to complete our designs faster than the others. Those lighting computer programs are CalcuLuX, DIALux, Europic and SiLICHT [4, 5].

4. LIGHTING COMPUTER PROGRAMS

4.1. Calculux Lighting Program

The Calculux Indoor Lighting program is a lighting computer program developed by Philips Lighting Company. This computer program has been developed as two different types, an exterior lighting computer program and an interior lighting computer program. There are many versions of Calculux, however the most frequently used version is Calculux 5.0 Additionally, it has a database. In this database, in addition to armature and lamp information, there are also armature features. It allows entering data related with the latest armature information by using the internet or other means. There is also information- such as light distribution curves of the armatures- besides the lamp and armature information [6].

It only supports rectangular and square areas as room type; it does not support the oval or circular offices or spaces. It allows the positioning of armatures in any place and can determine the lighting level at a point. Nowadays, Philips Lighting Company uses this program for the lighting calculation or lighting level

calculation for its architectural projects. It does not support three-dimensional lighting analyses. This program also does not support the addition of furniture into the internal environment, nor can it be used for the aim of simulation[5,6].

4.2. DIALux Lighting Program

The DIALux computer program has been developed by the German Applied Light Technique Institute in order to gather armature data from companies and standardize the calculations made by using different methods. There are many versions of the DIALux program. The latest version is DIALux 4.4. DIALux includes the armature and lamp information from many companies, such as AEG Lichttechnik, Zumtobel, Regiolux, Siemens, Thorn, Erco, Wila, Ridi, LBM and Idman, in its database [4,7].

Being a simulation program, DIALux supports many room shapes, such as rectangular, square, polygon, L shaped or the shapes designed by the user, and allows the user to choose from among those shapes. The program, which supports the addition of more than one piece of furniture to the place, also takes into consideration factors such as lighting level, reflection and glitter which can be seen on the furniture [7, 8, 9].

4.3. Europic Lighting Program

The Europic lighting program from General Electric Company (GEC) can compute lighting levels and lighting calculations. It is a user-friendly computer program. The latest version is Europic 5.S3. It supports both the regular volumes, such as square or rectangular, and the irregular room shapes designed by the user. It conforms to CIE standards, allows additional furniture in the environment, and provides all of the different views of the room with its camera system. It is easy to use and can respond to the demands of the designer. Factors such as lighting level in the environment, glitter on the furniture and shades can be taken into consideration. It is possible to view the every detail of the environment by placing the armatures automatically. It has only the armature types of GEC in its database and does not include the armature data of other companies. Also, its database structure does not allow the users to enter the armature data of other companies [10, 11].

4.4. SiLICHT Lighting Program

Silicht, a program from German Siemens Lighting Department, was developed for the planning of interior lighting. The latest version is Silicht 2.3. Its features are designed to calculate the lighting level for the ceiling and walls, smoothness percentage and glitter. It allows you to get information about armature location, definition, dimensions, lamp type and features. If the lighting level according to the function of the environment is set in conformity with the International

Lighting Commission Standards, the program finds out how many armatures will be used and calculates the distance between the armatures in order to provide the determined level. By controlling the final calculation and the smoothness percentage according to this determination, comfortable lighting is provided at the planning stage[12].

4. COMPARISON OF THE LIGHTING COMPUTER PROGRAMS

The use of lighting computer programs is gaining importance in the field of building design[13]. Rather than choosing a lighting computer program according to its advantages over the others, it is more appropriate to choose from among them according to our aim for use. It is not possible to see the advantages and disadvantages of the computer programs in Table 1. For example, if a tunnel lighting calculation is to be carried out, then first of all the most appropriate computer program should be chosen. If we look at Table 1, it is clear that Europic is the most appropriate program in order to carry out the calculations according to this lighting environment. Since the usage of the lighting computer programs is directly related with the computer configuration, if we are to carry out the calculations with our present computer and our computer's configuration is not compatible with our ideal program, then we can also use the other computer programs. As we have already mentioned, what is important is to work with the ideal program-the program most appropriate for our aim- to minimize the margin of error and make designs that will be perfect in a real environment. For a lighting project, we can either use one lighting program to realize the lighting design or armature placing or more than one lighting program to carry out all these works.

Besides, there should be an interface in the computer program for the inexperienced users which asks the new users the values to be entered respectively and directs them. There are no user interfaces that ask the user to enter the necessary values in Calculux. DIALux, Silicht and Europic have such an interface within them. The menus of Europic and Calculux programs are user-friendly and a lighting design can easily be carried out by following those menus respectively [6, 7, 11].

There is an enter menu in Silicht lighting program. With this menu, the information can be entered respectively. DIALux is the most ideal program with regard to user-friendliness. All of these programs allow the user to change the current design and save those changes. In terms of the data entry, nearly all of them are easy to use [12].

The use of model in lighting technique is carried out for natural lighting. Since the sky, the basic light resource in natural lighting, is very changeable, it has been modeled in various ways in order to be used in engineering. It is necessary to use the most realistic model in order to find the optimum solution with regard to lighting. The most realistic models are complex and

affect the calculation period significantly. Programs use the CIE standards- and therefore the lighting calculation method of CIE- for the internal lighting calculation. Although the lighting computer programs use the lighting calculation programs of CIE, their drawings are seen as different in the light flux distribution curves, ground, wall and ceiling isolines. Although the armatures used have similar characteristics, this difference results from the different light flux reflection coefficients and light flux curves [7].

The quality of the armature data is one of the basic components of the artificial lighting programs. The more sensitive and similar to reality the data, the more sensitive and similar to reality the results will be. From this point of view, since the programs of the armature producers include only their own armature types, they limit the user significantly.

This is also true for the above mentioned lighting programs. The lighting programs (except DIALux) do not contain information from other products in their database. DIALux includes the products of all the lamp producers in its database in order to open the program for use by all lighting designers and provide different points of view. With this feature, it establishes its difference from the other lighting programs we have inspected above. Special hardware can be a matter of fact due to the importance of graphical outputs (especially in the programs where simulation is used) and the running periods of the generally long programs. Nowadays, when new programs are purchased then also the hardware should be renewed. Therefore, the programs should be in conformity with the powerful personal computers of the future. Programs mostly support DOS and WINDOWS operating systems. Besides, there are lighting computer programs which support WINDOWS NT, OS/2, UNIX operating systems and run on those systems. All the analysed lighting programs above run on WINDOWS XP. However, there are different versions of the analyzed programs. Calculux, which runs on DOS, was one of the first lighting programs.

When we analyse the programs with regard to room shapes, Calculux only allows square and rectangular room types. DIALux, Europic and Silicht computer programs also allow the drawing of circular and polygonal room types besides the square and rectangular types. They also allow the room types the users try to create themselves. There are programs which have the option to add furniture to the environment. There are furniture types in the databases of the computer programs Europic and DIALux which we have analyzed. There are no options to place furniture in the Calculux and Silicht programs.

DIALux and Europic- which stand out with the feature "render"- can show the armatures which are placed in the room by modeling them three dimensionally. There are no such options in the programs Calculux and Silicht. In Table 1, you can see the comparison of lighting programs [7,9].

Table 1. Comparison of the lighting computer programs [6, 7, 9, 11, 12].

Features of the Programs		EU	CA	DI	SI
Environment Type to be Illuminated	Interior Lighting	+	+	+	+
	Road Lighting (tunnel, street, etc.)	+	+	+	+
	Area Lighting (sports area, park, etc.)	+	+	+	+
Room Dimension Choices	Rectangular and square environments	+	+	+	+
	Polygon Environments (hexagonal, heptagonal…)	+	-	+	+
	Circular Environments	+	-	+	+
	L and U Type Environments	+	-	+	+
	Environments Designed by the User	+	-	+	+
Adding Furniture to the Environment	Furniture in the Program	+	-	+	-
	Options of Adding Furniture From Outside	+	-	+	-
Displaying the Environment Views	3D Standart View	+	+	+	+
	Upper View	+	+	+	+
	Front View	+	+	+	+
	Side View	+	+	+	+
	View with a Camera	+	+	+	-
Armature Placing	Placing One by One	+	+	+	+
	Placing as a Line	+	+	+	+
	Placing as a Group	+	+	+	+
	Placing as an Arc	-	-	+	+
Lighting Level Calculation	Calculating the General Lighting Level	+	+	+	+
	Calculating the Lighting Level at Every Point	+	+	+	+
Viewing as isoline	Wall-1	+	+	+	+
	Wall-2	+	+	+	+
	Wall-3	+	+	+	+
	Wall-4	+	+	+	+
	Ceiling	+	+	+	+
	Ground	+	+	+	+
Using the Armature Data of Different Companies		-	-	+	-
Program interface for the Convenience of the User		+	-	+	+
Updating the Database Including the Armature and Light Distribution Curves		+	+	+	-
Lighting level calculations		+	+	+	+

EU: Europic Lighting Program
DI: DIALux Lighting Program
CA: Calculux Lighting Program
SI: Silicht Lighting Program

5. RESULTS

Since DIALux, one of the lighting computer programs analyzed in this study, contains the product information of all the lighting companies in its database, it provides the lighting designers the opportunity of limitless design. At the same time, it is preferred more and more since it does not limit itself with only its own database. Other companies which do not have a lighting computer program recommend DIALux to their own clients, for it includes the information of their products. Besides the database, DIALux is also preferred because of the render feature and user-friendliness.

Although Calculux was the first lighting computer program on the market- in other words, though it paved the way for lighting computer programming- some of its features that are directly related with the users, such as its usage convenience, visual aspects, and retrieval of the required values from the program, seem insufficient. For example, there is no user interface in this program in order to direct the users if they enter incorrect information and to ask for the necessary values the user should enter respectively, so it is difficult for people without any lighting knowledge to use this program. And it does not seem that Silicht has any advantages over the other programs. It does not have an option to preview the shape of the three-dimensional room and the armatures placed into their locations. It allows users to use the program in more than one language. That the armature database can be updated makes it preferable. It seems to be at a disadvantage since it does not contain the other products in its database. The Europic program differs from other computer programs because of its camera. It has a user interface that helps users to enter the information while placing the armature. As for the usage convenience, it has been designed to be easily used by those who don't have any lighting information. The biggest disadvantage of this program is it does not have information about the products of other companies in its database. Therefore, it can't be the first choice of lighting designers.

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