# Design and Estimation of Electrical Installation for Mechanical Engineering Complex

Biresh Monger
*Department of Elecrtical Engineering*
*Jigme Namgyel Engineering College*
Samdrup Jongkhar, Bhutan
05200164.jnec@rub.edu.bt

Choney Dorji
*Department of Elecrtical Engineering*
*Jigme Namgyel Engineering College*
Samdrup Jongkhar, Bhutan
05200166.jnec@rub.edu.bt

Jigme Choda
*Department of Elecrtical Engineering*
*Jigme Namgyel Engineering College*
Samdrup Jongkhar, Bhutan
05180149.jnec@rub.edu.bt

***Abstract*— indeed a project is a planned, scheduled task that must be completed within a certain time frame. It is one of the most effective and beneficial activities in which we have the possibility to learn a lot of new things and gain a lot of new knowledge from fresh research that we were previously unaware of.**

***Well, now if we confine our attention to our real project work, the topic of our project is "Design and estimation of Electrical installation for Mechanical Engineering complex". It is purely theoretical project since the capital investment is nil.***

***In general, the following are the various actions that we have completed during the tentative timeframe of our project: Preparation of an electrical drawing for the Mechanical Engineering Complex, representing different electrical fittings in exact locations with appropriate electrical symbols, determining the number of electrical fittings, length and size of cable required, main switch rating, Number of main circuits and sub-circuits, switch distribution board (MDB), sub distribution board (SDB), and tiny circuit breaker (MCB). Designing the buildings electrical fittings using Dialux software to compare the manually calculated number of electrical fittings with the Dialux's automatically determined lux level. A single line schematic of M.D.B, SDB, and earthing is drawn. Finally, a bill of quantity (BOQ) for the building is prepared.***

***Keywords*— estimation, dialux and autoCAD, Light distribution, false color 3-D modeling, lighting design, lighting performance.**

## I. INTRODUCTION

Every electrical installation, whether in a residential, commercial, or industrial structure, begins with a thorough plan or design. Building installation design requires a number of calculations depending on a variety of elements such as the type of building, its purpose, and its physical parameters. Electrical design is the process of planning, developing, testing, and installing electrical equipment in conformity with established guidelines. Lighting, power, power distribution, and television arrangement are all included in the design. This project covers lighting layout design, power layout design, cable sizing, and protective system design, such as earthing, which are all key aspects of design. Each building or part of a building apartment has a different amount of illumination, as well as a different number of sockets outlets, accessories, and electrical appliances. The amount of light in each segment differs depending on the reason for its creation. During the design process, many issues such as safety, durability, installation flexibility, and cost of installation were taken into account. Estimation and costing are constantly concerned with preparing quantity and cost-based calculations that help determine the ultimate project costs.

## II. METHODOLOGY

The project is basically carried out to execute the electrical installation design and costing estimation of the mechanical complex. Calculation of the number of the electrical fittings required for the building is calculated manually. After doing the calculation in line with applicable norms and standards, it was compared to the Dialux software specified illumination level. We used the Dialux software to compare the manually estimated electrical fittings to the automatically determined illumination level by the Dialux software. The Dialux software simulates artificial lighting and daylight illumination levels to calculate building energy performance. Following the comparison, prepared the drawing using the AutoCAD software. After the completion of the preparation of the electrical drawing, we have started with the preparation of the bill of quantity where we have estimated the cost of the fittings and fixtures requirements in the building and then to the end results. We have focused more on the energy efficient lighting as in earlier days more energy is wasted due to usage of less reliable electrical fittings.

**Methodology based on phases;**

Phase 1; data collection and literature study

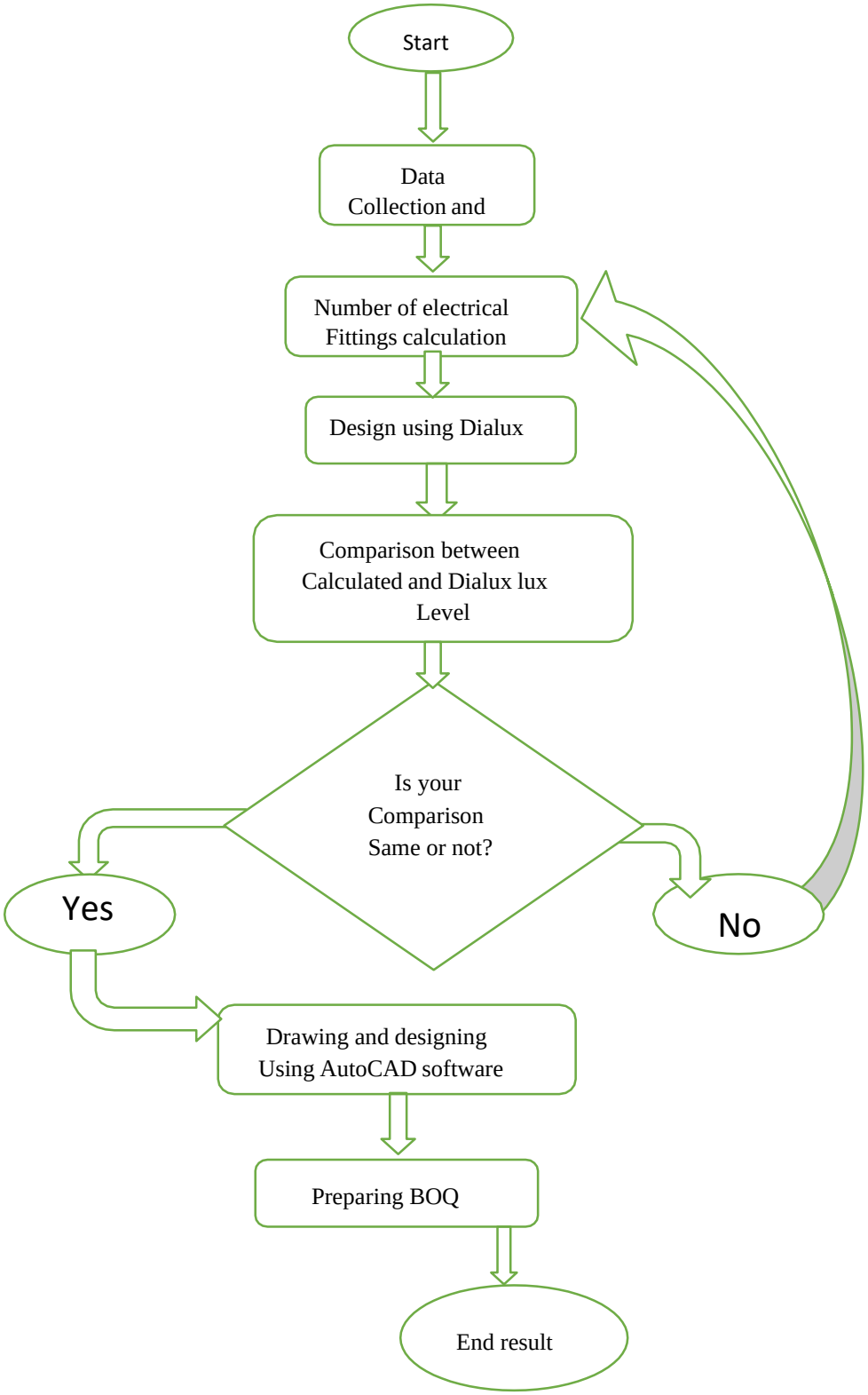
- ✓ Collection of the architecture drawing from the site engineer
- ✓ Study on the methods of lighting and the articles related to lighting schemes

Phase 2; calculation

- ✓ Calculation of the requirement in electrical fitting and fixtures
- ✓ Done with the help of AUTOcad drawing

Phase 3; application in design and comparison

- ✓ Conceptual phase;
  - Visualization
  - Free hand sketching
- ✓ Implement phase;
  - Calculated values putting into drawing and design
  - Drawing and designing with AUTOcad and Dialux evo


Start
Data
Collection and
Number of electrical
Fittings calculation
Design using Dialux
Comparison between
Calculated and Dialux lux
Level
Is your
Comparison
Same or not?
Yes
No
Drawing and designing
Using AutoCAD software
Preparing BOQ
End result

## PROBLEM STATEMENT

In earlier days, most of the lamp used are incandescent lamp which consumes more energy and even the energies are wasted. The life limit of the lamp is less as the filament of the lamp is easily damaged when there is voltage variation in the power system. So, there was no energy efficient lighting. Calculation of the number of fittings required for the electrical installation is calculated manually where there was inadequate illumination of the room.

## PROBLEM BASED LEARNING

Use of LED lamp

Before, most of the electrical equipments and the fittings are low quality and high cost. The lamp they used before was incandescent and the fluorescent lamp which is expensive to run. As of incandescent lamp the life limit is very less as its filament can be damaged when there is voltage variation in the power system and they consumes more energy and the energies are wasted. So, the drawbacks are overcome by the use of LED technologies where it has more life limit and it consumes less power as compared to the incandescent lamp.

Use of DIALux evo software

Earlier, the manual calculation were done to calculate the number of fittings required for illuminating the room. When doing the manual calculation there is false in the calculation so, illumination of the room was inadequate. So, to overcome this fault we use the software called DIALux to create the 3D model. The luminaires were installed within the DIALux, allowing us to determine the required number of luminaires for the space. DIALux gives us the lux level automatically when the building is imported for the visualization. So, due to accurate lux level calculation by the DIALux software there will be adequate illumination of the space or the room.

## III. LIGHTING DESIGN

According to Adelakun there are two key ways for determining the type of luminaire to employ. The point-by-point approach and the lumen method are the two main methods. The inverse square law, commonly known as the point-by-point approach, can be used to determine what is required to provide a certain amount of illumination on a given area. Because of its complexity and limitations, this method is rarely used. The lumen approach is used to make rough calculations for indoor lighting system planning. The approach is used to figure out how many luminaires and lamps are needed to attain a certain brightness. The lumen method was employed in this project to compute the illumination point required in each room, with the total lumen stated mathematically as:

*a)* $N = \frac{E * A}{O * UF * MF}$

Where,
N= Number of fitting and fixture
E= Required Illumination
A= Area of the room
O= Luminous flux produced by the lamp
UF= Utilization factor
MF= Maintenance factor

## IV. LIGHTING PERFORMANCE

Introduction to dialux software were chosen to be best for the designing of the lighting with suitable illumination level and for a good performance. This software is use for simulation of different types of beam and at the end select the best suitable beam. It also tells that, the program can be used for different textures and furniture. The calculation, visualization of light, light intensity falling on particular object or field, glare effect, position of light and many more calculated. Many companies and designer worldwide while planning lighting system for both indoor and outdoor are using this software.

For 3D Modelling visualization concept are used and accurate result are declare by drawing with autoCAD and dialux software's.

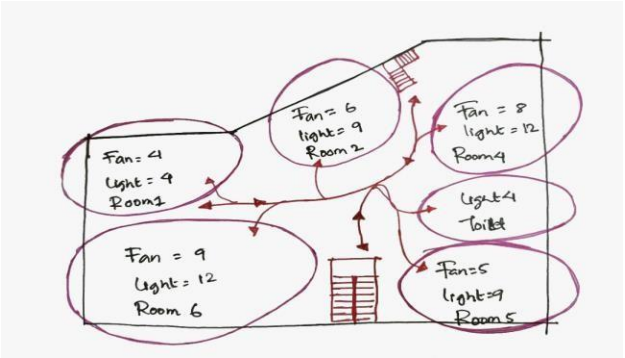



*Figure 1. Conception drawing by free hand sketching*

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*Figure 2. Model with dialux evo*

## V. RESULT AND DISCUSSION

**Showing illumination level through working plane display at computer lab**

Computer lab is consider to be one of the most common area where the lighting needs to be up to standard. Usually it required total of 300 lux. To satisfy required illumination we have calculated the required Luminaires considering the proper area and also the types of luminaires i.e. LED 18 W and 1800 lm.

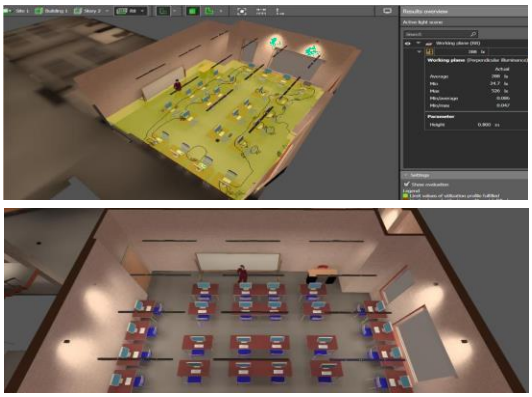

*Figure 3. Comuter lab at ground floor with and without working plan*

**Illumination distribution at conference hall**

Conference hall is one of the room where illumination needs to be consider with proper color rendering index, color temperature and also need to be consider the glare produced while producing the light. Placing of table chair needs to be consider through the working plane display so that light is equally distributed all over the hall. Usually it required total of 300 lux as same as for classroom.

To satisfy required illumination we have calculated the required Luminaires considering the proper area and also the types of luminaires. Total luminaires placed at the conference hall are 14 nos. i.e. LED 18 W and 1800 lm. With maintenance factor 0.7 and utilization factor 0.8.

*Figure 4. Conference hall at second floor with working plane display*

## VI. Conclusion

Our project mainly focus on the preparation of electrical drawing, estimation and costing, and comparing between the manually calculated electrical fittings and the automatically given lux level by the Dialux. Moreover, we focused on the efficient lighting design as the educational buildings consumes more energy compare to other residential and commercial building.

Our project report includes complete details of the work to be carried out such as detailed drawing of the work in 2-D AutoCAD and 3-D design using the Dialux software, use of lighting software such as Relux and Dialux evo would make lighting designs more effective. However, errors must be considered while designing and calculation, complete details of the required materials with costing in accordance with the latest Bhutan Standard Rate (BSR).

Main objectives of our project are to gain the designing skills and to explore the new software. Moreover, our project is to estimate the full electrical cost of the Mechanical Engineering Complex behind the ZB block.

## VII. Acknowledgement

Expression and words fall short in expressing our heartfelt gratitude to those persons who provided enormous support and effective aids at a time when we needed it most. This endeavor is also the result of the moral support and persuasive interest of many people who are involved directly or indirectly.

Despite the fact that the project's concept began with the goal of defining a circular duty, it has pushed our enthusiasm in learning to new heights. Apart from the module information we got while working on this project, we also learned management skills that are highly useful in our daily lives and grasped the actual meaning of teamwork.

Therefore, we the project members are in depth to:

- We would like to sincerely thank Royal University of Bhutan and in particular, Jigme Namgyel Engineering College (JNEC) for providing us an opportunity to carry out project as a module.
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- The site engineer and supervisor of the building of the mechanical complex for proving us with the architectural drawing and other required data in accomplishing of this project work.

And lastly to all the electrical department staffs and the classmates of Jigme Namgyel Engineering College for their kind supports and help being rendered in making this project a success.

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