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Electrical Design for Medical Center

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Abstract: In this paper the electrical design for medical centres is discussed. I designed and made all programs that required calculating and making distribution for the Lighting, Ac System, Sockets, the main Transformer with the Power Factor Correction for the system and Emergency System used in the project. We made a MATLAB program by using Graphical User Interface (GUI) to get the exact value, and the AutoCAD program to distribute the lamps and the socket on each floor. Moreover, I designed the system in emergency case, which is called Automatic Transfer Switch (ATS) that all system required in any cases to make the system keep working for specific time.

Keywords: Medical, Medical, ATS, Electrical, Design.

I. INTRODUCTION

Air conditioning systems are very important for designers because it is considered as one of the most basic requirement of constructing of building so it is necessary to know its characteristic identify its types and how much power it consumed from the network.
Based on Heat Transfer that is known heat is a form of energy. Every object on earth has some heat energy. The less heat an object has, the colder we say it is. Cooling is the process of transferring heat from one object to another. When an air-conditioning system cools, it is actually removing heat and transferring it somewhere else. This can be demonstrated by turning on a Spot Cooler and placing one hand in front of the cold air nozzle and the other over the warm air exhaust. You will feel the action of the transfer of heat.

Lighting has large amount of information. It would really require a rather lengthy summary to give all the technical information for standards to follow in choosing a light fixture for our project [1]. Because our industry uses mostly custom items, we have focused on how to communicate the required information that needs to be given by both a designer and a purchasing agent to a lighting manufacturer for ac custom light fixture.

Electrical devices used to connect to a power source onto which another device can be plugged that we called AC sockets as indicated in. Plugs and sockets may sometimes combine male and female aspects, but the exposed pins or terminals in the socket are not energized always used for fixed the plugs of load .AC power plugs and sockets are devices for removable connecting electrically operated devices to the power supply. A plug connects to a matching socket. Plugs are mostly or completely male, while sockets are mostly or completely female; the plug has protruding prongs or pins that fit into matching slots or holes in the socket. Generally the plug is the movable connector attached to an electrically operated device's power cord, and the socket is a fixture on equipment or a building structure. Wall-mounted sockets are also called receptacles, outlets, or power points [2]. To reduce the risk of electric shock, plug and socket systems can incorporate a variety of safety features. Sockets can be designed to accept only compatible plugs and reject all others, for example, and some systems are designed such that dangerous voltage is never present on an exposed contact. Exposed contacts are present in some sockets, but are used exclusively for grounding. A distribution transformer is a static device constructed with two or more windings used to transfer alternating current electric power by electromagnetic induction from one circuit to another at the same frequency but with different values of voltage and current.

II. AIR CONDITIONERS DESIGN

There are many types of air conditioning (AC) systems specifically designed for different types of applications. Listed on the below are some of the more common systems and their applications. One of the first steps in choosing an AC unit for any location is to choose the type of the air conditioning unit. There are several types of AC units. Anyway, here is a brief review of some of the major types of industrial and residential AC units. Then we will select the suitable types for our project.
Window AC is the most commonly used AC for single rooms. In this type of AC units all the components, namely the compressor, condenser, expansion valve or coil, evaporator and cooling coil are enclosed in a single box [4]. This unit is fitted in a slot made in the wall of the room, or often a window sill. This is a small packaged unit designed to fit in a window, primarily for residential use. Windows AC are one of the most widely used types of AC because they are the simplest form of the AC systems. Window AC comprises of the rigid base on which all the parts of it are assembled. The base is assembled inside the casing which is fitted into the wall or the window of the room in which the air conditioner is fitted.The whole assembly of the window AC can be divided into two compartments: the room side, which is also the cooling side and the outdoor side from where the heat absorbed by the room air is liberated to the atmosphere. The room side and outdoor side are separated from each other by an insulated partition enclosed inside the window air conditioner assembly. In the front of the window AC on the room side there is beautifully decorated front panel on which the supply and return air grills are fitted the whole front panel itself is commonly called as front grill. The louvers fitted in the supply air grills are adjustable so as to

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supply the air in desired direction [6]. The split AC comprises of two parts: the outdoor unit and the indoor unit. The outdoor unit, fitted outside the room, houses the compressor, condenser and expansion valve figure 1.

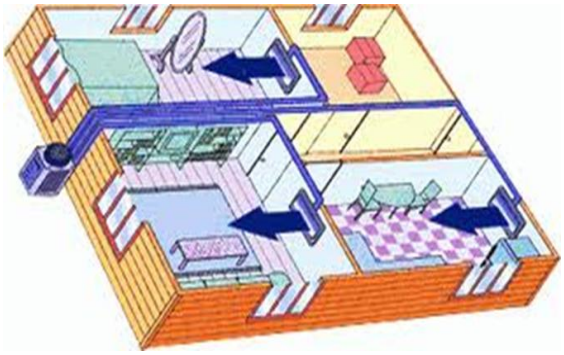


Fig.1 Outdoor Unit of Air Conditioner

The indoor unit comprises the evaporator or cooling coil and the cooling fan. For this unit you don't have to make any slot in the wall of the room figure 2. Further, the present day split units have aesthetic looks and add to the beauty of the room. The split AC can be used to cool one or two rooms. It is always advisable to keep the outdoor unit at the height above the indoor unit. If the outdoor unit is kept at level below the indoor, some of the compressor power is used in pumping the refrigerant against the gravity, thus reducing the overall performance of the compressor.

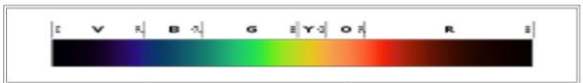
Fig.2 Indoor unit of Air Conditioner

Lighting DESIGN

There are many factors that affecting the design of a lighting scheme. Some of these factors are the type of lighting source, the total area of the building, the nature of surrounding area, and economic considerations. Forms of lighting include dome or alcove lighting, which like most other up lighting is indirect. This is often done with fluorescent lighting or rope light, or occasionally with neon lighting. It is a form of backlighting. Wall lighting can be general or a decorative wall-wash, sometimes used to bring out texture (like stucco or plaster) on a wall, though this may also show its defects as well. The effect depends heavily on the exact type of lighting source used.

A master transformer feeds all of the fixtures on the track or rod with 12 or 24 volts, instead of each light fixture having its own line-to-low voltage transformer. There are traditional spots and floods, as well as other small hanging fixtures. A modified version of this is cable lighting, where lights are hung from or clipped to bare metal cables under tension [3].

The visible spectrum is the portion of the electromagnetic spectrum that is visible to detect by the human eye. Electromagnetic radiation in this range of wavelengths is called visible light or simply light. A typical human eye will respond to wavelengths from about 390 to 750 nm.[1] In terms of frequency, this corresponds to a band in the vicinity of 400–790 THz. A light-adapted eye generally has its maximum sensitivity at around 555 nm (540 THz), in the green region of the optical spectrum (see: luminosity function) [8]. The spectrum does not, however, contain all the colors that the human eyes and brain can distinguish. Unsaturated colors such as pink, or purple variations such as magenta, are absent, for example, because they can only be made by a mix of multiple wavelengths. Colors that can be produced by visible light of a narrow band of wavelengths (monochromatic light) are called pure spectral colors. The various color ranges indicated in table 1.1.



COLOR	FREQUENCY	WAVELENGTH
VIOLET	668–789 THz	380–450 nm
BLUE	631–668 THz	450–475 nm
CYAN	606–630 THz	476–495 nm
GREEN	526–606 THz	495–570 nm
YELLOW	508–526 THz	570–590 nm
ORANGE	484–508 THz	590–620 nm
RED	400–484 THz	620–750 nm

Table.1 Wavelength and Frequency of Color for Lighting

A new software using MATLAB Graphical User Interface (GUI) is developed to calculate the currents required, cables and circuit breakers rating of each floor in the hospital for Lighting System. These two Fig 3 shows a sample of the developed software.

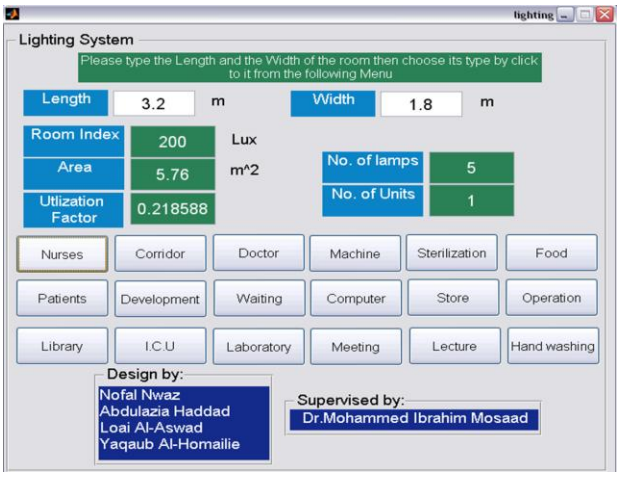


Fig. 3(GUI) Program

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III. AC SOCKETS

Many receptacles and plugs include a third contact for a connection to earth ground, intended to protect against insulation failure of the connected device. A common approach is for electrical sockets to have three holes, which can accommodate either 3-pin earthed or 2-pin non-earthed plugs. Types B, H, I, J, K and L use this approach (NEMA 5-15 accepting NEMA 1-15 plugs and types H, J, K and L accepting Type C). The Euro plug (type C) will fit Type E and F sockets, and the earthed type E/F 2-pin plugs will fit Type C (and certain hybrid) sockets, though without making earthing contact. Types D, G and M plugs are exclusively 3-pin, and are used for both earthed and non-earthed appliances. Multiphase plugs and sockets provide a connection to the electrical mains rated at higher voltages and currents than household plugs and sockets. They are generally used when more than two current carrying conductors (polyphase system), high currents and/or protection from environmental hazards (particularly water) are required. In many countries sockets are available that completely enclose a normal plug and have seals around the cable to exclude water. These reduce the need for special plugs and sockets but are often only suitable for fixed sockets due to their bulk, shape, and cable entry arrangements. Sockets on domestic extension leads are usually either not covered at all or covered with small covers that don't enclose an inserted plug [7].

Recently, there are 13 different styles of plugs and sockets because many countries preferred to develop a plug of their own, instead of adopting the US standard. Moreover, the plugs and sockets are only very rarely compatible, which makes it often necessary to replace the plug when you buy appliances abroad. Below in Fig 4 is a brief outline of the plugs and sockets used around the world in domestic environment. The outline map below visualizes the spread of the different plug types used around the world [9]. For easy reference, compatible plug types are represented with the same color.

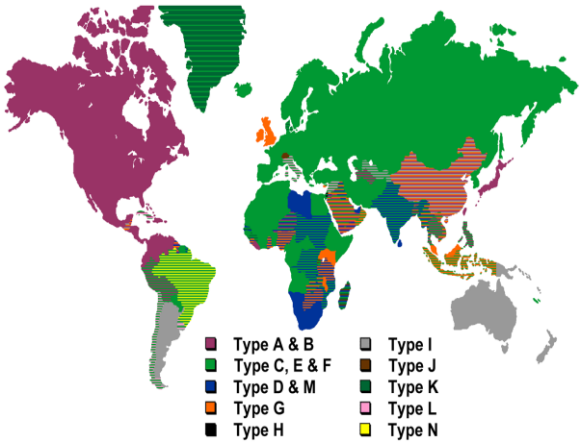

Fig. 4 Sockets Types Used Around the World

A new software using MATLAB Graphical User Interface (GUI) is developed to calculate the currents required, cables and circuit breakers rating of each floor in the hospital for AC Socket. These two Fig 5 shows a sample of the developed software

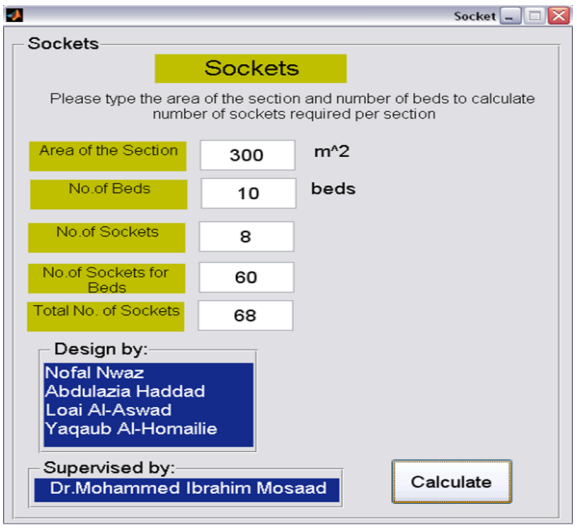

Fig.5 (GUI) program

IV. DISTRIBUTION TRANSFORMER

The purpose of a distribution transformer is to reduce the primary voltage of the electric distribution system to the utilization voltage serving the customer. A distribution transformer is a static device constructed with two or more windings used to transfer alternating current electric power by electromagnetic induction from one circuit to another at the same frequency but with different values of voltage and current. Distribution transformers in stock at an electric utility company service building [5]. The distribution transformers available for use for various applications include pole-type, pad-mounted, vault or network type. The distribution transformer is self-protected. It is equipped with a lightning arrester, a weak-link or protective-link expulsion-type fuse (installed under oil in the transformer tank), a secondary circuit breaker, and a warning light. The transformer primary bushing conductor is connected to one phase of the three-phase primary circuit through a partial-range current-limiting fuse [8]. The transformer tank is grounded and connected to the primary and secondary common-neutral ground wire. The self-protected transformer contains a core and coils, a primary fuse mounted on the bottom of the primary bushing, a secondary terminal block, and a low-voltage circuit breaker figure 6.

Fig.6 (GUI) program

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A schematic drawing of a single-phase distribution transformer appears in Figure 4.6. The single-phase distribution transformer consists of a primary winding and a secondary winding wound on a laminated steel core. If the load is disconnected from the secondary winding of the transformer and a high voltage is applied to the primary winding of the transformer, a magnetizing current will flow in the primary winding. If we assume the resistance of the primary winding is small, which is usually true, this current is limited by the counter voltage of self-induction induced in the highly inductive primary winding. The windings of the transformer are constructed with sufficient turns in each winding to limit the no-load or exciting current and produce a counter voltage approximately equal to the applied voltage. The exciting current magnetizes, or produces a magnetic flux in the steel transformer core [4].

The magnetic flux reverses each half cycle as a result of the alternating voltage applied to the primary winding. The magnetic flux produced cuts the turns of the primary and secondary windings. This action induces a counter voltage in the primary winding and produces a voltage in the secondary winding. The voltages induced in each turn of the primary and secondary winding coils will be approximately equal, and the voltage induced in each winding will be equal to the voltage per turn multiplied by the number of turns figure 7.

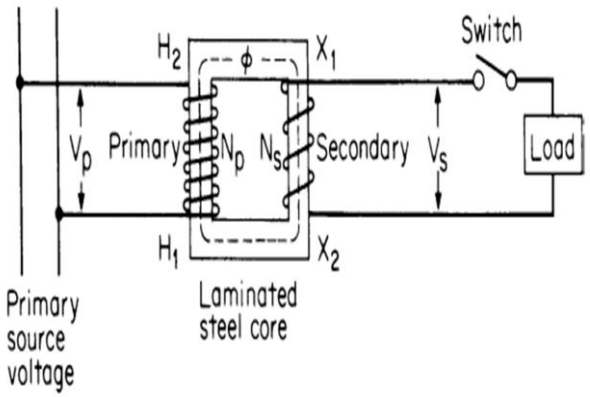

Fig.7 Schematic Drawing of Single-Phase Distribution Transformer

V. CONCLUSION

In this project the design and the layout of the main loads in a medical center of an area 1000 m2 are performed. These loads are lighting, Ac system, sockets, and distribution transformer. The design is performed according to the National Electric Code (NEC). Using MATLAB Graphical User Interface (GUI), some programs are designed to calculate the rating of cables and the CBs of these loads. For the sachets these programs are used to calculate the number of sachets needed and their distribution. For the Lighting, they are used to calculate the number of lighting units for each type or rooms in the center. Using AutoCAD program to draw the distribution of all these loads, then draw the single line diagram of the main distribution board in the medical center.

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