UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MODELING SOFTWARE TO DETERMINE RATING OF CIRCUIT BREAKER IN DESIGN ELECTRICAL INSTALLATION FOR DOMESTIC BUILDING

This report submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

…….

(Project Supervisor)

ABSTRACT

This paper presents the development of software for the electrical schematic drawing for 1-phase in determining the rating of the circuit breaker in electrical installations for buildings, especially in Malaysia. This software will be developed using Microsoft offices excel. Development of this software is to overcome the delay in completing the construction of buildings in terms of providing drawings of electrical construction drawings. Delay in completing the construction of the building is a big issue in our country. This software will be designed to ensure that it gives a decision on determine the circuit breaker rating in accordance with the standards and regulations in Malaysia's electrical installations such as the Electricity Supply Act 1990, the Energy Commission, Malaysian Standard and others. This software provides a calculation system that is faster, easier and more accurate to do some basic calculations such as determining total connected load (TCL), maximum demand (MD), and rating the circuit breaker during the design. This software can be used by professional engineers, students and technicians in preparing the design of electrical installations for residential construction or building. With the software it also will also help in the system documentation.

ABSTRAK

Kertas kerja ini membentangkan tentang pembangunan perisian lukisan skematik elektrik bagi 1 fasa dalam menentukan kadar pemutus litar dalam rekabentuk pemasangan elektrik bagi bangunan domestik terutamanya di Malaysia. Perisian ini akan dibangunkan dengan menggunakan perisian Microsoft Office excel. Pembangunan perisian ini adalah untuk mengatasi faktor kelewatan dalam menyiapkan pembinaan bangunan dari segi menyediakan lukisan pembinaan untuk pemasangan elektrik. Kelewatan dalam menyiapkan pembinaan bangunan merupakan isu besar di negara kita. Perisian ini akan direka bentuk untuk memastikan ia dapat menentukan kadar pemutus litar mengikut standard dan peraturan dalam pemasangan elektrik di Malaysia seperti Akta Bekalan Elektrik 1990, Suruhanjaya Tenaga, Standard Malaysia dan lain-lain. Perisian ini disediakan bagi memudahkan sistem pengiraan yang lebih cepat, lebih mudah dan lebih tepat dalam melakukan pengiraan asas yang terlibat dalam rekabentuk pemasangan elektrik seperti menentukan jumlah beban yang disambungkan (TCL), permintaan maksimum (MD), dan kadar pemutus litar semasa reka bentuk. Perisian ini boleh digunakan oleh jurutera profesional, pelajar dan juruteknik dalam menyediakan reka bentuk pemasangan elektrik untuk pembinaan kediaman atau bangunan. Dengan perisian juga ia akan membantu dalam sistem dokumentasi.

DEDICATION

To my beloved parents

Father

Mohd Yasin Bin Tua

Mother

Rokiah Binti Samin

Siblings

Mohd Azahar

Haslinda

Adif

Aryaty

Rohaya Mohidin

For the love.

For the prayers, supports and encouragement.

Thank you very much.

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Alhamdulillah, first of all I would like to express gratitude to Allah SWT for the blessing and help of Allah SWT in giving me the opportunity and help in doing this project. Here too, I would also like to express its gratitude and my greeting love goes to my family especially to my Emak and Abah who always gives encouragement, help and prayers for me to complete this project. Thanks appreciation is also extended to my project supervisor, Madam Nurbahirah Binti Norddin with the precious guidance, support and constructive criticism to help me complete this project. In addition, I would like to take the opportunity to all those who participated and contributed to science in this project. Finally, thanks to the infinite to the Faculty of Engineering Technology for giving me the opportunity to participate in this project. Without the support, guidance and constructive criticism of you all, I shall not be able to complete this project. Hopefully, with experience and knowledge received in developing a project of my sergeant will help me to be useful to the family, religion and country.

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INTRODUCTION

1.0 Background of Project

In 2005, there were 17.3% classification building projects as project problem where more than 3 months of delay or abandoned [Murali Sambasivan, Yau Wen Soon (2006)]. The construction of this building is 417 projects under the Government of Malaysia. Project Management System (SKALA) is a system used for the registration, monitoring and reporting the performance of all projects undertaken by the Public Works Department (PWD) Malaysia. All information related to the project including the implementation of a project undertaken by the PWD can be achieved through this online system. Completions of the project have been recorded in the database SKALA where it is divided into several parts, time, cost and location of the project. When a project is perceived delayed and has given reason Extension of Time (EOT). The Declaration of Delay and Extension of Time or Extension of Time (EOT) can be issued to the contractor if it is found to be eligible to get it. Recording to current time estimation by Jabatan Kerja Raya (JKR or PWD) shows that 25.18% of building projects completed without EOT and 74.82% were completed the project with EOT. Among the reasons that led to EOT is given to contractors has been studied where there are several main reasons that led to a construction project is not completed in the time set onward in the contract. One of the categories that cause this delay is the latest issue of the construction drawings when design changes occur where it occurs at the level of project management [Muhamad Khair Bin Hasan (2010)].

A delay in the preparation of electrical design is one of the factors causing delays in the completion of the building project. There is research that the issue of delay in completion of this project is a major problem in the construction industry and has continued until now. Thus software for determining the rating circuit breakers in electrical wiring should be designed to assist the work of the calculations in the process of preparation designing electrical installations. This method is also designed to help reduce the length of time in the design of electrical installations. In addition, this software also helps in providing electrical design documents for the purposes of the review, and audit documentation required by some parties. Therefore, this software should be designed to determine the design of the circuit breaker for electrical installations.

Especially in the early stages of a project, a large number of load assumptions must be prepared. In the design of electrical installations, drawing a floor plan of a building or residence is required for electrical engineers to provide drawings and further to prepare electrical circuit schematic drawings. To provide a circuit schematic drawing, the type and number of loads or electrical equipment should be taken note of determining the size of the cable and the rating of circuit breaker for an electrical installation. This process requires some estimates time in determining the size of the cable and the circuit breaker. This process is very complicated and time-consuming and stressful for electrical engineers because of the schedule is usually tight, using sophisticated modeling tools appropriate for detailed design can be problematic in providing electrical drawings. An alternative approach to traditional rules of thumb is the use of simplified input spreadsheets [Steven F.Bruning (2012)].

Therefore, to assist in providing electrical engineer electrical drawings especially in the calculation to determining the rate circuit breaker, the software should be designed to assist the work of the calculations involved especially in determining the rate of a circuit breaker for electrical installations for the construction of new residential and buildings.

1.1 Problem Statement

According Auditor General's Report year 2014 Series 2, there are three Syariah Court Complex in Negeri Sembilan, Kelantan and Penang is delayed projects where delays for all three complexes between 209 up to 503 days from the original due date. Among the weaknesses identified in this report is a delay in the construction drawings at the planning stage of the project.

Construction drawings on an electric stage is electric equipment layout and schematic drawings of electrical installations that have been verified and stamped by an electrical engineer involved in the project. The construction drawings should be placed at the site construction to the needs of contractors for electrical installation.

In preparing the construction drawings, electrical design must be in accordance with the requirements of building and electrical specification. But much can be important especially in the calculation of the load electrical equipment, the size of the cable, circuit breaker rating for protection purposes. These calculations require a certain formula, the power of the equipment you want to use, the cable size table, circuit breaker rating on the market. The process of calculating the electrical installation must be done correctly to ensure that safe electrical installation on the users. But it requires complicated calculations and need much time to do it. Since most electrical engineers calculate the electrical installation manually, due to the electrical engineers often face the problem of delay in the electrical design of a building construction project.

1.2 Objectives Project

The goal of this project is to design software that can determine the rating of the circuit breaker in the electrical installation design. There are 3 main objectives why the project was designed which are:

i. To learn the calculations to determine the size of the cable and determine the rating of the circuit breaker.
ii. Providing software for computing the size of the cable and determine the rating of a circuit breaker for electrical installations.
iii. Helps electrical engineers in designing electrical installation of a building in a more systematic and quick.

1.3 Scope of research

The scope of this project should be a guide to ensure that the progress of the project is not out of the objective to be achieved. The scope of the project focused on the practices of the Public Works Department to design their electrical installation of a government building in Malaysia. Here is the scope necessary for the execution of this project:

- The focus is on the construction of the kindergarten building for 1-phase supply.
- Prepare the electrical layout drawing in the kindergarten building floor plans (AutoCAD).
- Prepare load calculations, formula, regulation, act, requirement and so on for all electrical equipment involved in the design.
- Prepare suitable software to determine the circuit breaker by using Microsoft excel.

1.4 Result Expectation

The final decision is expected in the modelling of the software to determine the rating of the circuit breaker will be successfully developed and performed. If the software is successfully built, it will also help you work in calculation more systematic and easy for an electrical design especially to the technical side like assistant electrical engineer, engineers, and electrical contractors and so on. The software also helps simplify the work of electrical engineers in case of any changes in site design or requests from customers. For the purpose of calculating the electrical documentation can also be printed by this software. Further it also helps in solving a part of the factors that cause delays in a building project to be developed.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

A literature review is a summary of a combination of explanation and complete knowledge about something or research in a reference books, online databases, articles, journal and other. Literature review is a good start for students who are undergoing Undergraduate Project (PSM) in conducting new research in which students must make a summary, evaluation and comparison of original research in any case. In this chapter, there are two main parts of the review. The first part is past studies related to the project Circuit Breaker. The second part will focus on the design of electrical installations for buildings or residences.

2.1 The overview about circuit breaker.

2.1.1 Need for Circuit Protection.

Nowadays in modern life, electricity is an inseparable part of our daily lifestyle. In residential, commercial, and industrial sectors there are variety systems, equipment‟s and powerful appliances that depend on electrical energy. Uncontrolled electrical power can be highly dangerous. Overloads, crowded wiring, short-circuits and all kind of interruptions in electrical supply can lead to devastating losses and least of them being death and financial [Standard Electricals (2015)].

Cable or wire used in electrical circuits need some method of protection to prevent fire or damage if there is a short circuit or an over-loaded in circuit. A short circuit occurs when electricity travels from the positive to negative conductor without passing through an electrical load (a device that consumes the energy,

creating electrical impedance), allowing more electricity to flow than the wire can carry. Heat builds up and eventually melts the insulation, which it can cause a fire or damage to the electrical system.

Current flow in a cable or wire (conductor) always generates heat. Where the higher the current flow in conductor, it will be the hotter the conductor. Excess heat able to damage electrical components. The high levels of heat will cause the insulation of conductor breakdown and flake off, exposing conductor. For that reason, cable or conductor in wiring must have rated continuous current carrying capacity or ampacity. Excessive current in electrical circuit known as overcurrent. An Overcurrent happen when the current flow the conductor is exceeds than the rating current of conductor or equipment. Overcurrent can be result from an overload, short circuit or ground fault.

An overload is a condition in which the equipment or conductors current exceed the carry current rating or their rated amp city. An overload occurs when too many devices are operated on a single circuit or when electrical equipment making it work beyond capacity of specification of equipment. A short-circuit is the unintentional electrical connection between any two normally current carrying conductor of a circuit like example always happen in power system is line-to-line or line-to-neutral. When a short circuit occurs with the voltage applied in the circuit, the resistance of the conductor will be decrease in a short circuit current where it can be thousands of times higher than normal operating current. Ohm‟s Law describes the relationship of voltage, current and resistance. For example, a 240 voltage supply applied in circuit with 24 Ω of resistance draws 10 Amps of current. When a short current occurs, resistance will drops which is value of resistance drops to 24 milliohms and then current increases to 10,000 amps [Basics of Circuit Breakers by Siemens].

Ohm‟s Law $V = IR$

$$I = \frac{V}{R} \qquad I = \frac{240V}{24\Omega} \qquad I = \frac{240V}{0.024\Omega}$$

$$= 10A \qquad I = 10{,}000A$$

The heat created by this current will bring about broad harm to associated hardware and conductor unless this current is interrupt immediately by certain protection. A ground fault is an inadvertent, where electrically leading connection between an ungrounded conduit of a circuit and the hardware establishing channel, metallic walled in areas, metallic raceways, metallic gear, or earth. During a ground fault, risky voltages and abnormally high current will exist.

The power distribution grid delivers electricity power from a power plant to your home. Inside your home, the electric charge moves in a large circuit, this is composed of many smaller circuits. One end of the circuit, the hot wire, prompts to the power plant. The other side, called the neutral wire, leads to ground. Since the hot wire interfaces with a high energy source, and the neutral wire connects with an electrically neutral source (the earth), there is a voltage over the circuit where charge moves at whatever point the circuit is closed. The current is said to alternating current, since it quickly changes direction.

The power distribution grid supplies electricity at a consistent voltage (120 and 240 volts in the United States), but resistance (and therefore current) varies in a house. The majority of light bulbs and electrical appliances offer a certain amount of resistance, also called as the load. This resistance is what makes the appliance work. For example a light bulb, has a filament inside that is very resistant to flowing charge. The charge need to move along, which heats up the filament, causing it to glow.

In building wiring, the hot wire and the neutral wire never touch straightforwardly. The charge going through the circuit dependably goes through electrical equipment, which goes about as a resistor. Along these lines, the electrical resistance in limits how much charge can course through a circuit (with a consistent voltage and a steady resistance, the current must also be consistent). Equipment are intended to keep current at a generally low level for safety purposes. An excessive amount of charge moving through a circuit at a specific time would warm the apparatus' wires and the building's wiring to dangerous levels, possibly creating a fire.

This keeps the electrical system running easily more of the time. Be that as it may, every so often, something will interface the hot wire straightforwardly to the neutral wire or something else leading to ground. For instance, a fan motor may overheat and melt, fusing the hot and neutral wires together. Then again somebody may drive a nail into the wall, incidentally puncturing one of the electrical cables. At the point when the hot wire is associated straightforwardly to ground, there is minimal resistance in the circuit, so the voltage pushes a huge amount of charge through the wire. In the event that this proceeds with, the wires can overheat and begin a fire. The circuit breakers is function is to cut off the circuit whenever the current jumps above a safe level

2.1.2 Types of Overcurrent Protection.

Nature of fault in electricity circuit if a fault occurs at the consumer level, the fault will spread to the other part until main part (power supply) in the electrical circuit. Although to prevent the fault spread to other part of electricity conductor or equipment, overcurrent protection device need to install in electricity equipment or electricity wiring. To protect a electricity circuit against overcurrent‟s, a protection device must installed and that device also must detect a fault and disconnect the electrical equipment from the voltage source by automatically. A overcurrent protection device must be able to recognize the difference between overloads and short circuit and it can take action in accordingly. The National Electrical Code (NEC) is a regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States. The NEC defines the two basic types of Overcurrent Protective Devices (OCPDs) [Tony Parsons (2007)]:

1. Fuse is an overcurrent protective device with a circuit-opening fusible part that is heated and severed by the passage of overcurrent through it.

2. Circuit breaker is a device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.

A fuse is overcurrent protective device where it is simply a piece of small wire designed to melt and break the circuit if more current flows than the fuse wire is designed to allow to flow. This happen when the heat produced by overcurrent causes the current carrying element to melt open and disconnecting the load from the source voltage. Fuses are always connected in series with the component to be protected from overcurrent, so that when the fuse blows, it will open the entire circuit and stop current through the component. A fuse is a one-shot device where the fusible link blow and can no longer carry current and it must be replaced. A fuse also connected in one branch of a parallel circuit because with this connection it would not affect current through any of the other branches.