

Dedicated to my beloved parents, wife and my daughter...

“ I hereby declare that I have read through this report entitle “Design and Develop the Load Detail Calculation Software for Construction Field” and found that it has comply the partial fulfilment for awarding the degree of *Bachelor of Electrical Engineering (Industrial Power)*”

Signature :

Supervisor's Name : ENCIK ANUAR BIN MOHAMED KASSIM

Date : 2 Julai 2012

I declare that this report entitle “Design and Develop the Load Detail Calculation Software for Construction Field”” is the result of my own research except as cited in the references.

The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : MOHD AZIZI BIN ABD AZIZ

Date : 2 Julai 2012

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ABSTRACT

In order to calculate load detail while designing for electrical work installation in construction work, every consultant must calculate it manually. They do not have any software or any method that can perform calculations automatically. So this project promotes the new systematic software which can perform the common calculations of load detail. In this project, there are three objectives to be achieved. First, study and determine the basic load detail calculation and the JKR specification. Then, design and develop load detail calculation by using visual basic software. Finally, to evaluate the performance of load detail calculation through the develop software. This software will be generating by doing programming using Visual Basic software.

ABSTRAK

Dalam usaha untuk mengira jumlah beban tersambung semasa mereka bentuk untuk pemasangan kerja elektrik dalam kerja-kerja pembinaan, setiap perunding elektrik mesti mengira secara manual. Mereka tidak mempunyai apa-apa perisian atau mana-mana kaedah yang boleh melakukan kiraan secara automatik. Jadi projek ini menggalakkan perisian baru sistematik yang boleh melakukan pengiraan biasa detail beban. Dalam projek ini, terdapat tiga objektif yang perlu dicapai. Pertama, mengkaji dan menentukan butir-butir pengiraan beban asas dan spesifikasi JKR. Kemudian mereka bentuk dan membangunkan beban pengiraan terperinci dengan menggunakan perisian asas visual. Akhir sekali, untuk menilai prestasi pengiraan terperinci beban melalui perisian membangunkan. Perisian ini akan menjana dengan melakukan pengaturcaraan menggunakan perisian Visual Basic.

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

To have an accurately and efficient method to calculate load detail calculation is the main factor that been used to design this software. Kindly the old method that been used by consultant is calculate manually or use Microsoft excel. But it can be improve by applying visual basic in order to generate the auto calculation. The old method that been used which is not so efficient in terms of accuracy of results, caused a lot of time and directly make consultant fee and construction fee become more high then it should.

In addition, human factor can be the one of the major factor can make the calculation become not so accurate and efficient. Human always do a minor mistake that should not apply in this calculation. Total connected load (TCL) and maximum demand (MD) is important thing that can cause a major accident to consumer or during installation. These calculations can make other calculation such as MCB calculation or cable sizing calculation wrong. So this calculation must accurate, efficient, save time and easy to use by consultant.

This project conducted to programme the Visual Basic software to produce software that can used to calculate the load detail calculation such as total connected load and maximum demand. The software created will be practically use by consultant. The availability of this software will increase the speed and accuracy of calculation. As a whole, this software brings more benefit to the users.

1.2 Objectives

The main purpose of this project is to:

- (i) Study and determine the basic load detail calculation and the JKR specification.
- (ii) Design and develop load detail calculation by using visual basic software.
- (iii) Evaluate the performance of load detail calculation through the developed software.

1.3 Scope

The scope of this project limited on a number of things. Firstly, the software that uses to solve the cable sizing process will be programme using Visual Basic software. This project studies are focus on load detail calculation mainly practice by M&E consultant. The most important thing is to fulfil the requirement from JKR specification for each building and application.

1.4 Thesis Outlines

Basically, this report divided into five chapter, which include introduction, theory and literature review, methodology, expected and preliminary result, discusion and conclusion.

Chapter 1

Include the project objective, problem statement, scope of work and thesis outlines.

Chapter 2

Present the literature review on this project such as manual system to calculate load detail calculation, using excel to calculate the load detail calculation, and latest version of calculate for load detail calculation.

Chapter 3

Detail the methodology to achieved the research objective. The methodology will be summarize in flow chart.

Chapter 4

Present the preliminary result from visual basic software.

Chapter 5

Conclude all the works and studies that had been presented in the previous four chapters.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Load detail calculation is a calculation about the lumen calculation, total connected load and maximum demand. This calculation method has been used for along time for any construction and consultant. This calculation is very important calculation because if got any mistake from this calculation it can make a major disaster. From this calculation also, the consultant or contractor can choose the size of cable and type of miniature circuit breaker (mcb) or moulded case circuit breaker (mccb) and residual current circuit breaker (rccb) that been use for the electrical installation.

Beside that safety and preservation of property also the two important elements to be consider in the design low voltage system. Safety to personal should not be compromised and only the safest system can protect our live. Most of the electric system should protect from short circuit, over current and earth fault. The designer should be aware and know about how to protect live and equipment from getting damages.

To ensure the safety and long period of the design can sustained, the design should fulfil all the established codes about safety requirement. The most established codes that being use is NEC (National Electrical Code), IEE (Regulation for Electrical Installation) and MS (Malaysian Standard) or BS (British Standard). MS is standard that being use in Malaysia. Other country has specific standard suitable in that country like Singapore (CP5). Most of the codes that have being mention usually tell the designer to protected circuit from various failure of the circuit such as short circuit and overload.

There are two type of circuit that commonly apply in domestic wiring for low voltage design. First is lighting circuit and second are powers or socket outlets circuit. The circuit is usually being present as a single line diagram. Figure 2.1.1 shown the example of lighting circuit and socket outlets circuit [6]. Let define that final circuit is from appliance to MCB (Miniature Circuit Breaker), while DB (Distribution Board) circuit is from MCB to MCCB (Moulded Case Circuit Breaker) at main.

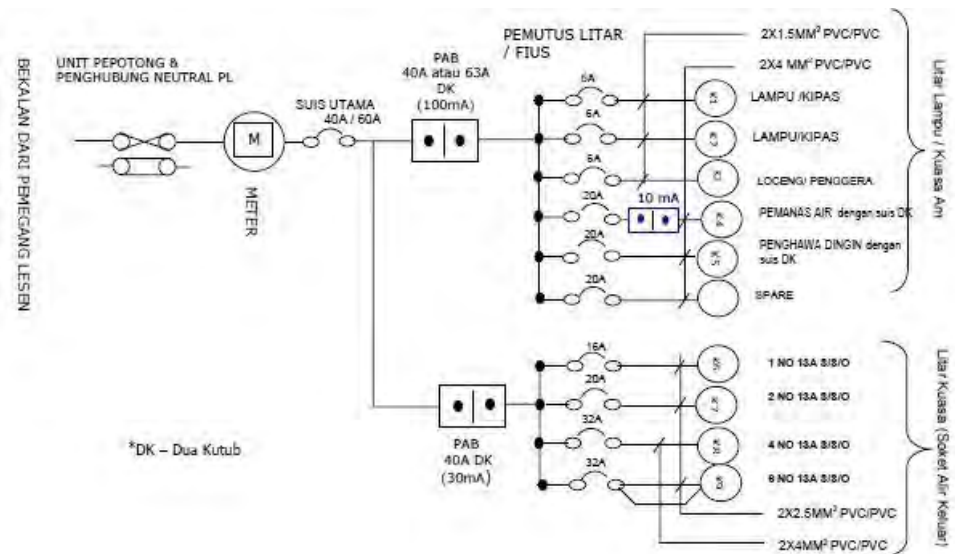


Figure 2.1.1: Lighting and Power Circuit

The designer must provide a reliable system and keep the supply demand interruption to a minimum. The designer must also provide the flexibility for future expansion and to cater of different needs during the life time of the system.

2.2 Manual Calculation Method.

Manual calculation method is actually method that only using older method such as pen, pencil and the calculator. This method can cause a lot of wasting paper because we calculate using manually calculation. Since we want to calculate some equation or method, we will take a long time to solve the calculation.

As we know the load calculation and the lux calculation is very important calculation for the electrical construction. So for that reason both calculation can't take along time to be submit to the person in charge. If the calculation delay the designer will be fine by the person who in charge the project.

Before we sent the project detail, we actually have to submit to the senior engineer to be check. When any problem occurs during checking so the submission of the project will be past back to designer in charge. So when we use the manual calculation method it will take along time to be settled.

Manual calculation has many disadvantages, one of the disadvantages we have discussed above. So another disadvantage of manual calculation is cause by human mistake. Human mistake mean when some one calculates the calculation and the project depends on the time base the designer will calculate in suspicious way. So the calculation might be wrong and the starting processes have to do it again.

Human performance can be affected by many factors such as age, state of mind, physical health, attitude, emotions, propensity for certain common mistakes, errors and cognitive biases.

Now the calculation is more about the how the lumen calculation and load detail calculation be calculate using manual calculation. At first stage is lumen calculation. Lumen measure is a measure Lumens measure "luminous flux". This is a measure of the total number of packets (or quanta) of light produced by a light source (e.g. a globe or fluorescent tube). This is the "quantity" of light emitted by the light source. The purpose of lux is intended to tell that how many lumens designers need given the area you are trying to illuminate [9]. This is how the lux calculation be calculated using manual calculation and it depends on related calculation which is calculation of the room index, calculating no of luminaries and calculating illuminance achieved. The calculation may be made more quickly and efficiency using well designed format as follows [3]:

Calculation room index:

$$\begin{aligned} \text{Room index (Kr)} & \\ & \\ & = \frac{\text{length x width}}{\text{Hm x (Length + Width)}} \end{aligned} \quad (1.1)$$

Note: Hm = W.P.H x L.M.H

Calculating no of luminaries:

$$\text{No of Lum} = \frac{\text{L x W x D. I}}{\text{Lamp per Luminaire x Lumen Lamp x C. O. U x M. F x D. F.}} \quad (1.2)$$

Calculating illuminance achieved:

$$\begin{aligned} \text{Illumination achieved in lux} & \\ & \\ & = \frac{\text{No. of Lum x Lamps per Lum x Lumens per Lamp x C. O. U x M. F. x D. F}}{\text{Area}} \end{aligned} \quad (1.3)$$

Note:

Symbol	Description
Length	Length of room dimension
Width	Width of room dimension
Area	Floor area of room dimension
Lamp per Lum	Lamp per Luminaries
Lumen per Lamp	Lumen per Lamp
C.O.U	Coefficient Of Utilization

M.F	Maintenance Factor
D.F	Design Factor
W.P.H	Work Plane Height
L.M.H	Luminance Mounting Height
D.I	Desired Illuminance
Kr	Room Index

After do a lumen calculation, and then second stage of design is load detail calculation. In load detail calculation have two calculations. First calculation is, total connected load, and the second calculation is maximum demand. The two calculations is an important factor to be considered in the design of low voltage system in building. Any error regarding the design or the calculation to estimated of load current in the circuits, it will result in either over design which is can increase the installation cost or under design, which will result in more circuits being overloaded and frequent breaker tripping.

The most important thing for this load detail calculation is safety, reliability, and the potential for expansion must be considered too. The design also must fulfil the requirement that had been told by owner or employer. So designers have to fulfil the demand from customer, safety requirement from Malaysian Standard (MS), Jabatan Kerja Raya (JKR) and Tenaga Nasional Berhad (TNB), and the designer also have to save the electrical installation cost.

This is how the load detail calculation be calculated using manual calculation and it depends on related calculation which total connected load and maximum demand. Total connected load is the sum of all the designed electrical loads in particular installations [3]. Maximum demand is the total load been used by customer for a same time [3]. This is total connected load formula:

$$I = \frac{P \times 1.8 \times \text{Quantity}}{V}$$

(1.4)

(1.5)

or

$$P = \frac{\text{Quantity} \times \text{Watt}}{1000}$$

(1.6)

And

$$I = \frac{P \times 1.8 \times 1000}{240}$$

This method must confirm the safety of the live and the equipment. Safety manner is the important thing that should be not compromised from the designer, consultant and contractor. They should make sure that the system that been used for user is the good system. This is the example of manual calculation method.

2.3 Excel Calculation Method.

This method is the advance method that been used by designer for calculate the lumen calculation and load detail calculation. From this method, the designer uses Microsoft excels to calculate the lumen calculation and load detail calculation. Designer have improve their design calculation method by uses this method.

These methods improve on how to calculate the lumen calculation and load detail calculation. The method start when designer enters lumen formula and total connected load, maximum demand formula to excel. The designer have load or enter all the formula then start to use it. Designer just enters the quantity of the equipment like quantity of lamp and fan. Then excel will calculate follow with the formula that designer set to excel. The

designer gets the result after that. So they use the final result to decide the protective device that will be use to the system.

This method can reduce the error that which doing by human. Because designer just enter the quantity and excel will do automatically the calculation. Designers don't have to calculate with calculator. It will make them happy to design everything and put the entire equipment together.

This method also has a disadvantages. Example of disadvantage which doing by junior designer is they like to copy what their senior just doing. They just copy excel and enter the quantity of the equipment which is design by them. They never check the formula from excel. Sometime senior designer enter the wrong formula but they recognise it at the site. Then they just do a correction at site and don't do it at the formula.

When junior designer use excels, then get a trouble with that thing. They don't know how to solve that thing. Then they will damage the consultant name. By the way if the consultant name getting worse, so the consultant doesn't get any project again. This can affect more trouble to consultant and consumer.

This method also not so accurate and efficient but its still more accurate and efficient compare to manual calculation. It decreases the mistake from human and does a calculation efficiently. Time to design will be short and faster compare to manual calculation. The example of this calculation show in Table 2.3.1 and Table 2.3.2 below.

Dewan 1 Malaysia

ILLUMINATION CALCULATION (option 1) 250W

Room	Dimension		Area	Design Lux	Maintenance factor (mf)	Ceiling ht	Mounting height above desk level (Ht = ceiling ht - desk ht (say 0.85))	Room Index = $(L*W)/(Ht*(L+W))$	Coefficient of Utilisation (uf)-Refer Catalogue	Type of light fitting	Lumen	No. of fluo. Tube	Calculation of no. of light fitting = $(lux)(Area)/[(mf)(uf)(lumen)]$	Proposed no. of light fitting	Calculated Lux
	L(m)	W(m)													
Dewan 1 malaysia															
Dewan (12court)	50.00	33	1650.00	1000	0.8	12	11.15	1.78	0.52	1x250W Pyramid	27500	1	144	144	998
Dewan (1court)	16.00	8	128.00	1000	0.8	12	11.15	0.48	0.52	1x250W Pyramid	27500	1	11	11	983
Dewan (12court)	50.00	33	1650.00	2000	0.8	12	11.15	1.78	0.52	1x250W Pyramid	27500	1	288	288	1997
Dewan (1court)	16.00	8	128.00	2000	0.8	12	11.15	0.48	0.52	1x250W Pyramid	27500	1	22	22	1966
Dewan stage	24.00	8	192.00	300	0.8	10									

Cct	Description	Unit load (kW)	Qty	CL (kW)	DF	MD (kW)
	2x36W Fluo Ftg	0.084		0.00	0.8	0.00
	1x36W Fluo Ftg	0.042		0.00	0.8	0.00
	2x18W Fluo Ftg	0.048		0.00	0.8	0.00
	1x18W Fluo Ftg	0.024		0.00	0.8	0.00
	2x11W Down Light	0.034		0.00	0.8	0.00
	1x11W Down Light	0.017		0.00	0.8	0.00
	2x11W Wall Light	0.034		0.00	0.8	0.00
	1x11W Wall Light	0.017		0.00	0.8	0.00
	Spotlight	0.200		0.00	0.8	0.00
	250W pyramid	0.250	145	36.25	0.8	29.00
	400W Metal Halide	0.425		0.00	0.8	0.00
	Ceiling Fan	0.080		0.00	0.8	0.00
	Wall Fan	0.080		0.00	0.8	0.00
	Insect Killer	0.350		0.00	0.8	0.00
	Exhaust Fan	0.080	8	0.64	0.8	0.51
	Emergency Light					
	Keluar Sign					
	Aircond Point (1hp)	0.75		0.00	0.6	0.00
	Aircond Point (1.5hp)	1.12		0.00	0.6	0.00
	Aircond Point (2hp)	1.49		0.00	0.6	0.00
	Aircond Point (2.5hp)	1.87		0.00	0.6	0.00
	Aircond Point (3hp)	2.24	20	44.76	0.6	26.86
	Spare					
Cct	Description	Unit load (kW)	Qty	CL (kW)	DF	MD (kW)
	Water Heater	3.00		0.00	0.5	0.00
	13A S/S/O (Single)	0.350		0.00	0.5	0.00
	13A S/S/O (Double)	0.700		0.00	0.5	0.00
	Isolator 30A	5.000		0.00	0.5	0.00
	Isolator 60A	10.000		0.00	0.5	0.00
	Spare					
			Total	81.65		56.37

2.4 Latest Version Calculation Method Using Visual Basic (VB).

This latest version of calculation use software. From all the software at the market, then visual basic is the suitable software compare to other software. The best thing about this software is this software is good for being front page or for interface. Visual Basic is particularly strong at creating interface for databases.

This software is user friendly and easy to use by most of the people. The language is very simple, particularly as to the executable code. Visual Basic not only a language but primarily an integrated, interactive development environment ('IDE'). Visual Basic is particularly easy to develop graphical user interfaces and to connect them to handler functions provided by the application.

After this software is ready made, then designer just have to enter the quantity of the item used. Designer also has to enter the horse power if the item used is air-conditioned or motor. If designers design motor, they have to check the motor rating to enter in visual basic system. When all the item had enter, stay for a while, visual basic will tell designer about the total connected load and maximum demand.

CHAPTER 3

METHODOLOGY

3.1 Flow of Works

Figure 3.2.1 showing the flow of work for this final project. Firstly, study on load detail calculation. Attach with consultant in order to study load detail calculation. There is a problem in manual calculation. Then, do the literature review and some research regarding load detail calculation. After that, check any suitable software to overcome this problem. Visual basic (VB) is the suitable software to overcome the limitation in manual calculation. Learn how to use visual basic, so that the programming process in Visual Basic will be easy. After that, design the load detail calculation software use visual basic until it can be running successfully. Finally, compare the result obtained from both manual and software calculation. In addition, doing calculation using the programmed software consumed less times compare to manual calculation.