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Reengineering the Electrical Wiring System of Cebu Technological University,Tuburan Campus

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Abstract—**This study aimed to assess the condition of the electrical wiring system at Cebu Technological University (CTU) during the fiscal year 2019-2020, serving as the basis for proposing a cost-effective electrical wiring system. The research was conducted specifically at CTU-Tuburan Campus (CTU-TC), utilizing the energy audit and descriptive research methods. To gather the necessary data for analysis, an inventory of electrical loads, electrical wirings, and circuit breakers was conducted. Electrical engineering computations were performed to calculate relevant data related to capacity, cost savings, and safety during the inventory process. The findings revealed that the existing electrical conductors and circuit breakers were inadequate to handle the total load of 483.285 kilowatts. Consequently, it was concluded that the current electrical wiring system at CTU-Tuburan is neither cost-effective nor safe, and it lacks the capacity to accommodate the existing electrical loads. Therefore, it is strongly recommended to implement a proposed electrical wiring system alongside a regular maintenance program. The proposed electrical wiring system aims to address the identified shortcomings by ensuring cost-effectiveness, safety, and improved capacity to handle the electrical loads. The regular maintenance program will help maintain the system's functionality and longevity, ensuring its sustained effectiveness. Implementing these recommendations will result in an optimized electrical infrastructure for CTU-Tuburan, supporting the efficient and safe operation of its electrical systems.**

Index Terms—**Electrical wiring, energy audit, electrical loads, capacity, cost savings, safety, circuit breakers, maintenance program.**

I. Introduction

The electrical wiring system poses significant challenges within an electrical system. In fact, one of the primary causes of electrical system failure is attributed to faulty wiring and inadequate maintenance. To ensure the safety of individuals, buildings, and their contents from potential electrical hazards, it is crucial to adhere to electrical regulations and standards during the installation of the wiring.

Faulty wiring and insufficient maintenance are key factors that contribute to electrical system failures. Conducting regular monitoring and evaluation of the current wiring system is essential to optimize operations, prevent breakdowns, and ensure overall safety. In 2019, the Bureau of Fire Protection reported that a significant number of household fire incidents in Cebu City were caused by faulty electrical wiring. Statistical data revealed that out of the 537 fire-related cases, 266 were directly attributed to faulty electrical wiring.

These findings highlight the critical importance of addressing issues related to electrical wiring. By prioritizing proper installation, regular maintenance, and adherence to safety protocols, the risk of electrical system failures and associated fire incidents can be significantly reduced. It is imperative for homeowners, electricians, and relevant authorities to recognize the significance of electrical wiring quality and maintenance in promoting overall safety and preventing hazardous situations.

An energy audit is a comprehensive assessment conducted on a facility's energy-consuming system. It serves several important purposes, including examining historical energy usage and cost data, verifying current energy data, and investigating operating practices and procedures [26].

The institution experiences a year-on-year increase in actual power consumption due to the growing student population and the need to provide additional instructional equipment, machinery, lighting, and ventilation systems. As technology continues to advance, there is a rising demand for electricity, compelling universities and other institutions to expand and meet global standards.

Therefore, it is essential to evaluate the energy consumption in order to establish energy conservation goals. This evaluation will also facilitate the reengineering of the electrical wiring system and identify opportunities for energy savings. By conducting an energy audit, the institution can identify areas of improvement, implement energy-efficient practices, and optimize energy usage while aligning with sustainability objectives.

The ultimate goal of the energy audit is to reduce energy consumption, minimize operational costs, and contribute to environmental conservation [27][28]. Through careful analysis of energy usage patterns and the identification of potential efficiency measures, the institution can develop a more sustainable and cost-effective approach to energy management.

The Cebu Technological University-Tuburan Campus electrical wiring system has existed for more than 30 years from now. Even though, there are improvement on the electrical system but the existing wiring system remain unchanged. The system might be still being functional but there is no assurance

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that it will last long and its safety. So far there is no study has been conducted to explore the condition of the electrical wiring system and energy conservation.Thus, this research study is conducted to assess the electrical wiring system of Cebu Technological University-Tuburan Campus as the bases for energy saving.

This research study is anchored on energy conservation act of 2001 of energy audit and the Philippine electrical code (See Fig. 1).

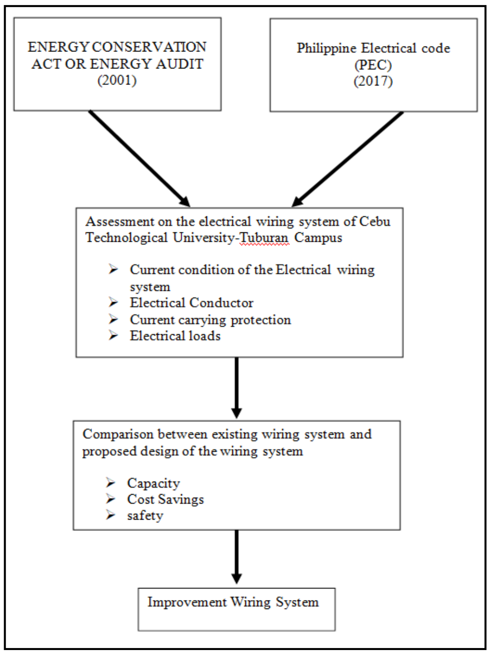

Fig. 1. Theoretical Framework of the Study

Energy audit is the verification, monitoring and analysis of use of energy including submission of technical report containing recommendation for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption (Energy Conservation Act of 2001).

Furthermore, it is the translation of conservation ideas into realities by leading technically feasible solutions with economic and other organizational considerations within a specified frame. The primary objective of energy audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. Energy audit provides a "benchmark" for managing energy in the organization and also provides the basis for planning more effective use of energy throughout the organization (Energy Conservation Journal of 2001). In energy audit, it consists of two types such as historical energy audit categorized as the simplest and the least expensive and the diagnostic energy audit.

The first phase of energy audit is examining historical and descriptive data for the facility to determine where energy is used and how the use varies with time. Each of the physical systems within the facility is inspected carefully and the results are not noted for future use. The result of the phase a complete description of the time varying energy consumption together with an assessment of its condition a chronology of usual operating and maintenance practices, performing a detailed inspection of the major systems that make up a facility such as air-conditioning system, refrigeration system, lighting system and other electrical consuming devices is the second phase. And lastly, collecting ideas for remedying deficiencies that have been noted. The amount spent on energy puts an automatic upper limit on the amount that can be saved the bills give the relative importance of various energy sources in the total energy consumption and an examination of where energy is used can point out previously unknown energy wastes, (Kennedy and Turner, 1984).

Temperature measurement devices used are the thermometer, surface pyrometer, portable electronic thermometer, thermocouple probe and sanction pyrometer.

These tools used to determine and checked for comparison with designed or intended conditions,equipment,operating temperatures,process fluid temperatures and reaction temperatures.

Pressure measurement. Pressure measurements are required for maintaining the safe operation of equipment. Pressure of gases and liquids is determined to assess restrictions or abnormal conditions of flow or utility use.

Humidity measurement. The humidity of the atmosphere is usually measured of the place is considered critical such as in computer rooms. At high temperatures, humidity's are difficult to measure and special equipment maybe required instruments available for humidity measurement such as psychrometers, dew point hygrometers,electrical conductivity and infrared thermography [30].

Electrical measurement. This aspect includes measurements of lighting levels for possible reduction in the power consumption of lighting system, voltage amperage, power factor and time cycling. The monitoring of these parameters misaimed to reduce electrical energy used. The instruments usually in carrying out and electrical energy audit are the ammeter, voltmeter, wattmeter, power factor meter and light meter [31].

Lighting Systems. The efficiency of the lighting system depends on maintained policies. Lighting system is degraded by lumen depreciation of the light sources, dirt accumulation on the luminaries and dirt accumulation on the surrounding reflective surfaces [32].

In determining where are how the lighting system can be made more efficient, there are three steps involved, first is to collect data to describe both the present lighting system and the needs of the present facility. Second is the careful survey of possible improvements in the system and the implementation of the most promising. The final step is the periodic monitoring of the lighting system to assure its continued efficiency.

Air-conditioning System. There are preparatory steps to consider in conducting an energy audit of an air conditioning system. The following steps are get familiar with the air-conditioning system such as the cooling equipment ,gather information on the power consumption, gather log sheets, relate power consumption to operation of major equipment, set a reasonable target for energy saving, plan these sequence of energy audit and last is to set a time table to follow [33].

Other Electrical Devices. Electrical devices bad systems will include all the facilities that which consume power except lighting, refrigeration, freezer, drinking fountain dispenser, electric fan and air conditioner. Causes of energy losses of the following design and management faults such as motors, computer machines, water pumps, air compressor and other unaccounted consuming devices, lack or faulty load and demand control devices, low power factor and excess or idle equipment and fixtures (Energy Management Training Manual,1992).

Electrical Power Distribution. Electricity distribution system take electricity from CEBECO I stations where it is generated and transmitted to CTU-TC where it is used. The network of power lines and cables that distribute electricity around a nation or region is called grid. A typical grid can supply electricity to customers who are often far from where the electricity is generated [34].

Electricity is a form of energy created by the movement of minute charged particles called electrons. It is a vital source of power in the modern developed world (Society of Petroleum Engineers, 2009-2023**)**.

When current passes through a wire, the wire becomes hotter and some of the electrical energy is lost as heat energy.The heating effect increases rapidly with the size of the current. If the current doubles, for example, four times as much heat is produced, so four times as energy is wasted. Since electricity often flows hundreds of kilometers through the cables of a grid, wasting energy all the way, it makes sense to use the smallest possible current to keep the energy losses low.

Fortunately, raising either the current or the voltage of the supply can increase the amount of power transmitted by a cable. Long distance cables use extremely high voltages and low currents to reduce energy loss [35].

Electricity from local network first passes through a meter when it enters a household or institutional system. The meter records how much energy is used. Cables leads from the meter to main switch, which can be used to disconnect the supply to the whole building/houses when the electrical wiring system has to be examined or repaired by an electrician.

The power then passes to a box that contains fuses or circuit breaker. Fuses are wire that burn and break the circuit if the gets too large. Circuit breakers are switches that disconnect the current if the current gets too much. Both are safety devices, since a large current could potentially cause an electrical fire.

At the fuse box or circuit breaker box, the wire device into separate circuits. Each circuit has a fuse or circuit breaker that is suited to the current that would normally pass through it. Lighting circuit draw the least current and for safety reasons their fuses blow if the current is greater than a few amperes [37].

II. Materials and Methods

A. Design Energy Management Procedure

In this section, we outline the research methodology and describe the environment in which the study took place. We conducted an inventory of electrical loads, electrical wiring, and circuit breakers to gather essential data for analysis. Subsequently, electrical engineering computations were performed to assess various aspects, including capacity, cost savings, and safety, based on the collected inventory data.

B. Study Framework

The study follows a structured approach, as illustrated in Fig. 2, employing a system model that incorporates the input, process, and output phases.

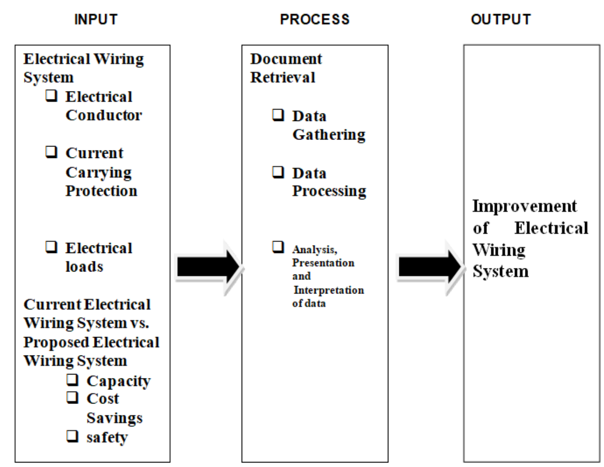

Fig. 2. Flow of the Study

The input presented the assessment on the current condition of the electrical wiring system in terms of electrical conductor,current carrying protection and electrical loads.The evaluation was conducted aiming to distinguish the most favored and accepted electrical wiring system for energysaving.

Presented in the throughout is the process in collecting and gathering datathroughdocumentanalysis. A proposal for energy saving and improvement on the electrical wiring system design is intended output of this study.

C. Methods

This study utilized the energy audit and descriptive methods of research using the instruments in assessing the present condition of the electrical wiring system. This study utilized the energy audit and descriptive methods of researchusing the instruments in assessing the present condition of the electrical wiring system.

D. Study Location

The study was carried out at Cebu Technological University - Tuburan Campus, situated at coordinates 10.7188° N latitude and 123.8192° E longitude. This campus is part of the CTU system and is located in Barangay 8, Tuburan, Cebu, Philippines. The town of Tuburan is situated in the northern region of Cebu province and is classified as a second-class municipality within the province of Cebu.

III. Results and Discussion

A. Present Condition of Electrical Wiring System

This section offers an overview of the current state of the electrical wiring system. It encompasses the respondents' assessments of the conditions of electrical components within each building, including conductors and circuits, particularly in relation to lighting and other electrical devices. This assessment encompasses various aspects such as device type, quantity, rating, estimated daily usage hours, and daily power consumption. It also presents and describes the data presented in tables the comparison on the usefulness between of capacity,cost savings and safety.

B. Electrical Conductor

Table 1 displays the current wiring configuration originating from Feeder 1. The table reveals that there are a total of fourteen primary conductors directly connected to the main line originating from Feeder 1. Notably, among these fourteen primary conductors, five are further subdivided into sub-conductors, resulting in a higher count of sub-conductors compared to primary conductors.

Furthermore, an observation highlights that the wire sizes employed in this setup are mismatched with the number of electrical loads they are intended to support. It is important to note that this existing electrical wiring design does not conform to the standards outlined in the Philippine Electrical Code. The code specifies that an excessive number of sub-conductors pose an increased risk of fire incidents and potential damage to electrical equipment. This means that this electrical wiring design does not only compromise safety, it also adds electrical consumption and expenses.

TABLE I. EXISTING ELECTRICAL CONDUCTORS OF THE ELECTRICAL WIRING OF CTU-TC IN FEEDER 1

	BUILDING NAME	SIZE OF MAIN CONDUCTOR/FEEDER	SIZE OF SUB CONDUCTOR/FEEDER
1	FARM HOUSE AND MAKESHIFT BUILDING	3-14 mm² TW COPPER WIRE	
	1.1 FARM HOUSE		2-3.5 mm² TW COPPER WIRE
	1.2 MAKESHIFT BUILDING		3-8.0 mm² TW COPPER WIRE
2	TECHNOLOGY BUILDING 1	3-14 mm² THW COPPER WIRE	
3	TECHNOLOGY BUILDING 2	3-14 mm² THW COPPER WIRE	
4	TECHNOLOGY BUILDING 3	3-14 mm² THW COPPER WIRE	
5	TECHNOLOGY BUILDING 4	3-14 mm² THW COPPER WIRE	
6	BULAWANONG TINUBDAN CULTURAL CENTER	3-22 mm² THHN COPPER WIRE	
7	LADIES DORMITORY, AGRICULTURE BUILDING, SCIENCE BUILDING AND RADIO STATION	3-8.0 mm² THW COPPER WIRE	
	7.1. RADIO STATION		2-5.5 mm² TW COPPER WIRE
	7.2 LADIES DORMITORY		2-5.5 mm² TW COPPER WIRE
	7.3 AGRICULTURE BUILDING,		2-5.5 mm² TW COPPER WIRE
	7.4 SCIENCE BUILDING		2-8.0 mm² THHN COPPER WIRE
8	ALLIED SUBJECT BUILDING1	3-8.0 mm² THHN COPPER WIRE	
	8.1 ROTC OFFFICE		2-3.5 mm² THHN COPPER WIRE
	8.2 NSTP OFFICE		2-5.5 mm² THHN COPPER WIRE
	8.3 RELATED SUBJECT ROOM		2-3.5 mm² THHN COPPER WIRE
	8.4 MEDICAL STATION		2-5.5 mm² THHN COPPER WIRE
	8.5 COT OFFICE		2-5.5 mm² THHN COPPER WIRE
9	TENNIS COURT	2-8.0 mm² THHN COPPER WIRE	
10	RELATED ALLIED SUBJECT MAIN BUILDING	3-14 mm² THHN COPPER WIRE	
	10.1 COLLEGE OF ARTSAND SCIENCES		2-8.0 mm² THHN COPPER WIRE
	10.2 LIBRARY		2-14 mm² THHN COPPER WIRE
	10.3 COLLEGE OF EDUACTION		2-8.0 mm² THHN COPPER WIRE
11	GAD CR, PASALUBONG CENTER, PERIMETER LIGHTS, P.E SPORTS OFFICE, GUARD HOUSEAND ATM MACHINE	3-8.0 mm² THHN COPPER WIRE	
	11.1 PASALUBONG CENTER		2-5.5 mm² THHN COPPER WIRE
	11.2 GAD CR		2-3.5 mm² THHN COPPER WIRE
	11.3 PERIMETER LIGHTS		2-3.5 mm² THHN COPPER WIRE
	11.4 P.E SPORTS OFFICE		2-3.5 mm² THHN COPPER WIRE
	11.5 GUARD HOUSE		2-3.5 mm² THHN COPPER WIRE
	11.6 ATM MACHINE		2-3.5 mm² THHN COPPER WIRE
12	ALLIED SUBJECT BUILDING2	2-8.0 mm² THHN COPPER WIRE	
13	CTU-TC CANTEEN	2-8.0 mm² THHN COPPER WIRE	
14	CTU-TC ADMIN BUILDING	3-22 mm² THHN COPPER WIRE	
MAIN FEEDER/CONDUCTOR IN FEEDER 1		**3-100 mm² THHN COPPER WIRE**	

Table 2 shows the existing wiring from Feeder 2. It is shown that six main conductors are directly connected to the main wire without sub-conductors,however the sizes of the wires used are not suitable to the number of electrical loads. This existing electrical wiring does not conform to the Philippine Electrical Code.It is stipulated there that a greater number of sub conductors will lead tofire incident and will cause damage to electrical equipment. This means that this electrical wiring design does not only compromise safety, it also adds electrical consumption and expenses on the electrical equipment. Thus, the electrical conductors of the existing system are not in good condition since the sizes are not suitable to carry the existing electrical loads,and the numbers of sub-conductors are more than the main conductors.

TABLE II. EXISTING ELECTRICAL CONDUCTORS OF THE ELECTRICAL WIRING OF CTU-TC CAMPUS IN FEEDER 2

	BUILDING NAME	SIZE OF MAIN CONDUCTOR/FEEDER	SIZE OF SUB CONDUCTOR/FEEDER
1	STUDENT ACTIVITY CENTER	3-22 mm² THW COPPER WIRE	
2	HOMETEL	3-14 mm² THW COPPER WIRE	
3	HOSPITALITY MANAGEMENT BUILDING	2-5.5 mm² THW COPPER WIRE	
4	ENGINEERING BUILDING	2-50 mm² THW COPPER WIRE	
5	FABLAB	3-8.0 mm² THW COPPER WIRE	
6	FOOD INNOVATION CENTER	3-8.0 mm² THHN COPPER WIRE	
MAIN FEEDER/CONDUCTOR IN FEEDER 2		**3-50 mm² THHN COPPER WIRE**	

C. The Condition of the Circuit Breakers of the Existing Electrical Wiring

This section presents the current configuration of the Protection/Circuit Breakers within the Electrical Wiring of CTU-Tuburan Campus, specifically in Feeder 1 (See Table 3). Notably, it becomes evident that only sub breakers have been installed, and their capacity is inadequate to handle the electrical loads connected to them. This insufficiency has resulted in frequent occurrences of electrical trips, leading to damages not only to the breakers themselves but also to the electrical equipment utilized by the school.

TABLE III. EXISTING CURRENT CARRYING PROTECTION/CIRCUIT BREAKER OF THE ELECTRICAL WIRING OF CTU-TC IN FEEDER 1

	BUILDING NAME	SIZE OF MAIN PROTECTION/CIRCUIT BREAKER	SIZE OF SUB PROTECTION/CIRCUIT BREAKER
1	FARM HOUSE AND MAKESHIFT BUILDING	NONE	
	1.1 FARM HOUSE		20 AT, 2P
	1.2 MAKESHIFT BUILDING		60 AT, 3P
2	TECHNOLOGY BUILDING 1	NONE	100 AT, 3P
3	TECHNOLOGY BUILDING 2	NONE	70 AT, 3P
4	TECHNOLOGY BUILDING 3	NONE	60 AT, 3P
5	TECHNOLOGY BUILDING 4	NONE	60AT, 3P
6	BULAWANONG TINUBDAN CULTURAL CENTER	NONE	100 AT, 3P
7	LADIES DORMITORY, AGRICULTURE BUILDING, SCIENCE BUILDING AND RADIO STATION	NONE	
	7.1. RADIO STATION		40 AT, 2P
	7.2 LADIES DORMITORY		40 AT, 2P
	7.3 AGRICULTURE BUILDING,		40 AT, 2P
	7.4 SCIENCE BUILDING		60 AT, 2P
8	ALLIED SUBJECT BUILDING 1	NONE	
	8.1 ROTC OFFFICE		30 AT, 2P
	8.2 NSTP OFFICE		30 AT, 3P
	8.3 RELATED SUBJECT ROOM		30 AT, 2P
	8.4 MEDICAL STATION		30 AT, 2P
	8.5 COT OFFICE		30 AT,2P
9	TENNIS COURT		60 AT, 2P
10	RELATED ALLIED SUBJECT MAIN BUILDING	NONE	
	10.1 COLLEGE OF ARTS AND SCIENCES		60 AT, 2P
	10.2 LIBRARY		100 AT, 3P
	10.3 COLLEGE OF EDUACTION		100 AT, 2P
11	GAD CR, PASALUBONG CENTER, PERIMETER LIGHTS, P.E SPORTS OFFICE, GUARD HOUSE AND ATM MACHINE	NONE	
	11.1 PASALUBONG CENTER		40 AT,2P
	11.2 GAD CR		30 AT, 2P
	11.3 PERIMETER LIGHTS		30 AT, 2P
	11.4 P.E SPORTS OFFICE		20 AT, 2P
	11.5 GUARD HOUSE		20 AT, 2P
	11.6 ATM MACHINE		20 AT, 2P
12	ALLIED SUBJECT BUILDING 2		60 AT, 2P
13	CTU-TC CANTEEN		60 AT, 2P
14	CTU-TC ADMIN BUILDING		100 AT, 3P
MAIN PROTECTION/CIRCUIT BREAKER IN FEEDER 1			**200 AT, 3P**

Table 4 shows the existing current carrying Protection/Circuit Breaker of the ElectricalWiring of the CTU-Tuburan Campus in Feeder 2. It can be observed that main breakers are installed unlike in feeder one that no main breakers that were installed. However, the size of these main breakers is still not sufficient to carry the electrical loads connected. This still leads to recurring incidents of electrical trips which caused damages not only to the breakers but also to the electrical equipment of the school. Thus, the circuit breakers of the existing electrical wiring system is not in good condition since the sizes of the breakers are not suitable to carry electric current and there are more sub-breakers than main breakers.

TABLE IV. EXISTING CARRYING PROTECTION/CIRCUIT BREAKER OF THE ELECTRICAL WIRING OF CTU-TC IN FEEDER 2

	BUILDING NAME	SIZE OF MAIN PROTECTION/CIRCUIT BREAKER	SIZE OF SUB PROTECTION/CIRCUIT BREAKER
1	STUDENT ACTIVITY CENTER	NONE	100 AT, 3P
2	HOMETEL	NONE	100 AT, 3P
3	HOSPITALITY MANAGEMENT BUILDING	NONE	60 AT, 3P
4	ENGINEERING BUILDING	NONE	150 AT, 3P
5	FABLAB	NONE	100 AT, 2P
6	FOOD INNOVATION CENTER	NONE	70 AT, 2P
	MAIN PROTECTION/CIRCUIT BREAKER IN FEEDER 2		**150 AT, 3P**

D. Existing Electrical Loads

This section provides an overview of the existing electrical loads within CTU-Tuburan Campus, as illustrated in Table 5. Notably, the Bulawanong Tinubdan Cultural Center emerges as the facility with the highest total power consumption in terms of kilowatts, while the Physical Education room records the lowest total power consumption in the same unit of measurement.

In summary, the cumulative power consumption for all electrical equipment utilized across various offices, centers, and classrooms within CTU-Tuburan amounts to 483.285 kilowatts.

TABLE V. EXISTING ELECTRICAL LOADS OF CTU-TC

	BUILDING NAME	TOTAL POWER (KW)
	FEEDER 1	
1	AGRICULTURE BUILDING	1.576
2	ALLIED SUBJECT BUILDING	13.829
3	BASKETBALL COURT	8
4	BULAWANONG TINUBDAN CULTURAL CENTER	126.54
5	CTU-TC FARM	0.417
6	CTU-TC LADIES DORMITORY	1.969
7	ATM MACHINE	1.03
8	RADIO STATION	2.633
9	GAD CR	1.27
10	GUARD HOUSE AND PERIMETER LIGHTS	0.675
11	MAKESHIFT BUILDING	6.381
12	ICT BUILDING	66.78
13	PASALUBONG CENTER	14.44
14	P.E. ROOM	0.069
15	SCIENCE BUILDING	3.53
16	TECHNOLOGY BUILDING 1	50.03
17	TECHNOLOGY BUILDING 2	28.407
18	TECHNOLOGY BUILDING 3	5.4
19	TECHNOLOGY BUILDING 4	3.986
20	TENNIS COURT	5
	TOTAL POWER (KILOWATTS) IN FEEDER 1	**341.962**
	FEEDER 2	
1	ADMIN BUILDING	39.604
2	CTU-TC CANTEEN	6.684
3	ENGINEERING BUILDING	24.4
4	FABLAB AND FIC	13
5	HOMETEL	54.019
6	STUDENT ACTIVITY CENTER	37.738
	TOTAL POWER (KILOWATTS) IN FEEDER 2	**175.433**

E. Electrical Current Capacity of the existing and the proposed wiring system

This section shows the comparison between the existing electrical wiring system and the proposed electrical wiring system in terms of electric current capacity of the wire conductor and circuit breaker (See Table 6).It can be seen that the electric current capacity of the electrical conductor of the existing wiring system in the Feeder1only has 100mm2 and in the Feeder2 has50mm2 whereas the proposed wiring system will have three sets of 3-250mm2 in the Feeder 1 and three set of 2-200mm2. This means that the wiring conductors of the proposed wiring system in Feeder 1 and Feeder 2 has greater capacity compared to the wiring conductors of the existing wiring system. In fact,it has ac omputed difference in 80% electrical current capacity both Feeder 1 and 2. Moreover, it canbe seen that the electric current capacity of the circuit breaker of the existingwiring system in the Feeder 1 has 200AT and in the Feeder 2 has 150AT whereasthe circuit breaker of the proposed electrical wiring system has 1000AT in thefeeder 1 and 750 AT in the feeder 2. This leads to a significant electrical current difference of 80% both in the Feeder 1 and 2.This means that the circuitbreakers of the proposed wiring system in Feeder 1 and Feeder 2 has greater capacity compared to the circuit breakers of the existing wiring system.

This implies that the proposed electrical wiring design's electric current capacity is sufficient enough and or more than enough to carry the electrical loads as per computed (See Table 5).

TABLE VI. COMPARISON OF THE COMPUTED VALUE OF THE ELECTRICAL CURRENT CAPACITY

COMPUTED VALUE CLASSIFICATION	**CAPACITY**			
	FEEDER 1	DIFFERENCE%	FEEDER 2	DIFFERENCE%
A. ELECTRICAL CONDUCTOR				
EXISTING ELECTRICAL WIRING SYSTEM	$100mm^2$	80%	$50mm^2$	80%
PROPOSED ELECTRICAL WIRING SYSTEM	3 sets of 3-250 mm^2		3 sets of 2 $200mm^2$	
B. CURRENT CARRYING PROTECTION/CIRCUIT BREAKER				
EXISTING ELECTRICAL WIRING SYSTEM	200AT	80%	150AT	80%
PROPOSED ELECTRICAL WIRING SYSTEM	1000AT		750AT	

Note: please see appendix C and D for the computation.

F. Cost Savings

This section shows that the proposed electrical wiring system has 360 KVA in the Feeder 1 and 149KVA in the Feeder 2 whereas the existing wiring has 462KVA in the Feeder1 and 177KVA in the Feeder2 which is bigger (See Table 7).This means that the existing system has bigger electrical consumption compared to the proposed electrical wiring system.

TABLE VII. Comparison of the Computed Value of the Cost Savings

CLASSIFICATION	COMPUTED VALUE COST SAVINGS FEEDER 1	DIFFERENCE%	FEEDER 2	DIFFERENCE%
EXISTING ELECTRICAL WIRING SYSTEM	462KVA	28%	177KVA	19%
PROPOSED ELECTRICAL WIRING SYSTEM	360 KVA		149KVA	

Note: please see appendix C and D for the computations.

G. Safety

Table 8 shows the computed value of the safety of the existing andproposed electrical wiring systems. It can be seen that the Feeder 1 and 2 of the existing system have 20KAIC whereas the Feeder 1(See Fig. 3) and Feeder 2 (See Fig. 4) of the proposed system have 70KAIC.

This means that the proposed system is safer since it is said that the higher the KIAC is, the safer the electrical wiring system will be and the higher KAIC,the more it can carry electrical faults caused by short circuits. In fact, it reaches to 71.43 computed safety value if the proposed system were used. This implies that the proposed electrical wiring system is safer.

TABLE VIII. Comparison of The Computed Value Of Safety

CLASSIFICATION	COMPUTED VALUE SAFETY FEEDER 1	DIFFERENCE%	FEEDER 2	DIFFERENCE%
EXISTING ELECTRICAL WIRING SYSTEM	20KAIC	71.43%	20KAIC	71.43%
PROPOSED ELECTRICAL WIRING SYSTEM	70KAIC		70 KAIC	

Note: please see appendix A and B for the computations.

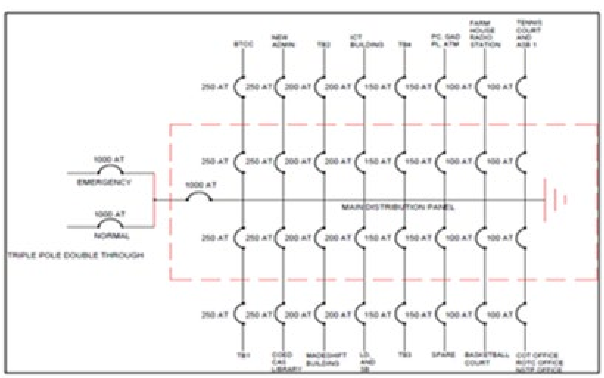

Fig. 3. Proposed Electrical Wiring System Design for Feeder 1

H. Analysis and Findings

The study investigated various aspects related to the current state of the electrical conductor and circuit breakers, electrical loads, capacity, cost savings, and safety. The findings revealed the following:

1. The existing electrical conductors are inadequate due to their size, which is not suitable for the current electrical loads. Additionally, there is an imbalance between the number of sub-conductors and main conductors;
2. The circuit breakers within the existing electrical wiring system are unsuitable for the current electric current demands, and there is an imbalance between the number of sub-breakers and main breakers;
3. CTU Tuburan's total power consumption amounts to 483.285 kilowatts;
4. The proposed electrical wiring design demonstrates sufficient or even excess electric current capacity to accommodate the required electrical loads;
5. The proposed wiring system proves to be a more cost-effective alternative compared to the existing wiring system; and
6. The proposed electrical wiring system is deemed safer in terms of overall electrical safety.

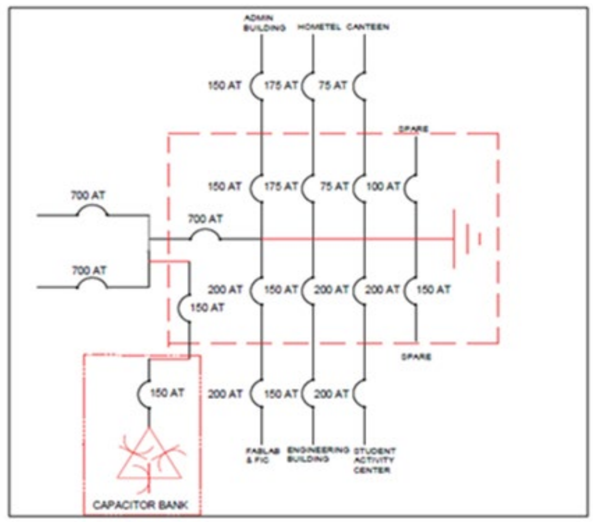

Fig. 4. Proposed Electrical Wiring System Design for Feeder 2

IV. Conclusion

Based on the comprehensive findings of this study, it is evident that the existing electrical wiring system at CTU-Tuburan faces challenges in terms of cost-effectiveness, safety, and its capacity to accommodate current electrical loads.Upon meticulous analysis and data interpretation, several key recommendations have been formulated: (a) Emphasize adherence to suggested electrical conductor sizes and the appropriate number of subconductors during electrical maintenance practices. This ensures optimal performance and reduces potential issues associated with undersized or improperly installed conductors. (b) Ensure alignment with correct circuit breaker sizes based on the number of electrical loads to enhance safety measures and prevent circuit overload or damage.(c) Consider the implementation of the proposed electrical wiring system, designed to address the identified shortcomings. Establish a regular maintenance program to ensure the continued functionality and reliability of the electrical infrastructure.

By adopting these recommendations, CTU-Tuburan can enhance the efficiency, safety, and capacity of its electrical wiring system, ultimately creating a more sustainable and dependable electrical infrastructure for the campus community.

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