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SiLab: A Fire Safety Information Laboratory Website on Selected Small-Medium Construction Companies in the City of San Fernando, Pampanga

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ABSTRACT

Fire can cause damage and danger to many structures and spaces. Thus, building fires are now viewed as a significant threat to both human life and economic output in the Philippines. A significant portion of the risk factors that trigger fire can't be entirely avoided, yet they can be mitigated. As an effect, fire safety became an essential factor to consider in buildings. However, a growing concern has emerged over implementing effective fire safety measures in terms of lowering the risk of a fire occurring, minimizing the loss and damage it causes to buildings, and ensuring building fire safety. It has been shown that small - medium construction companies rarely conduct a fire risk assessment. They only assess after construction is over or before they issue an occupancy permit, and fire safety is not considered in the future.

This study assessed the level of fire safety of the small-medium construction companies of the City of San Fernando, Pampanga using fire safety assessment. The risk-index score provided by the Bureau of Fire Protection Region III and the fire safety scores of the participants were used to calculate their fire safety level. The researchers utilized quantitative research approaches, particularly descriptive-quantitative design. The information required for analysis and interpretation was gathered using survey questionnaires. The results of the study have shown that building characteristics have a significant influence on the fire safety level of participating construction companies. The vast majority of the participating construction companies were identified as having medium fire safety levels, which account for 45 percent of the population. Exit features, fire protection

systems, fire alarm systems, electrical wiring, areas of safe refuge, firefighters' accessibility, and training and drills all directly impact the level of safety of companies.

Keywords: *Descriptive-quantitative, Fire Code of the Philippines, Hazard Identification, Occupational Safety Health Standards, Risk-index Score*

1. INTRODUCTION

Throughout the lifespan of a building, it is consistently subjected to different types of hazards. One of them is fire, which can greatly affect the building's structural stability and jeopardize the occupants of the building. As a result of the world's fast development, the severity of fire hazards has changed. Brushlinsky et al. [1] differentiated developed and developing countries in terms of fire occurrences between the years 2010 and 2014. The United States of America experienced the highest number of fires but a low number of deaths. On the other hand, India and Pakistan had the largest number of fire fatalities among emerging nations. In 2013, the most frequent disaster in the Philippines was fire [2], which averaged about 8,600 reported incidents annually from 2005 to 2012. From 2013 to 2018, there were an average of 15,733 fire occurrences, resulting in 855 fire-related injuries and 253 fire-related deaths [3]. The Regional Office of the Bureau of Fire Protection Region III has registered an average of 3,048 fire occurrences between 2013 and 2020. Due to this concern, a spatiotemporal analysis of fire incidents in Pampanga was carried out [4] and according to their data, cities like Angeles City, City of San Fernando, and Mabalacat City are linked to about 38% of the fire occurrences that have been reported and most of them are from the City of San Fernando, which majority of them are small to medium type of buildings. The Revised Fire Code of the Philippines (R.A. 9514) and the National Building Code of the Philippines (P.D. 1096) are the two pieces of law that ensure building fire safety in the country. Reference [5] established privately and publicly owned building structures' compliance with the Republic Act 9514. The results showed that only 45% complied, while the remaining did not. Despite collective efforts of different agencies and codes mandating and ensuring fire safety, fire incidents are still on peak because of different reasons. One of the major drawbacks of ensuring fire safety is the high installation and maintenance costs of fire safety devices [1] Most small-medium enterprises (SMEs) avoid implementing a formal, organized occupational safety and health (OSH) management system due to lack of money, lack of management and training experience, the complexity of adhering to rules, and the expense of hiring an OSH expert. [6] Based on the review of related literatures and studies [1] [6], it was found that cost is one of the top reasons why fire safety management systems are not implemented properly.

2. METHOD

2.1 Research Design

Regarding materials, you should include a description of examined objects as well as tools used during the experiment. Give every detail that could affect experiment results [7].

2.2 Data Collection about the Population and Selection of Respondents

Researchers used purposive sampling, a non-probability technique, to select participants based on traits, independent of underlying ideas [8].

The Department of Trade and Industry provided a list of Region III construction firms accredited by the Philippine Contractors Accreditation Board (PCAB) as of 2022. The firms were narrowed down based on criteria, including central or main offices in San Fernando, Pampanga, and capital ranging from Php 100,000 to Php 200,000,000. Out of 33 companies, 12 were pilot tested, reducing the population size to 21. The sample size was determined using Raosoft software with a 5% margin of error, 95% confidence interval, and 50% response distribution.

Table-1: Master list of Participants

No.	Company Code	Address (Barangay)
1	Company A	San Jose
2	Company B	San Jose
3	Company C	Dolores
4	Company D	Dolores
5	Company E	Dolores
6	Company F	Dolores
7	Company G	Dolores
8	Company H	Del Carmen
9	Company I	Magliman
10	Company J	San Agustin
11	Company K	San Isidro
12	Company L	San Isidro
13	Company M	San Isidro
14	Company N	Bulaon
15	Company O	Sindalan
16	Company P	Sindalan
17	Company Q	Sindalan
18	Company R	Dela Paz
19	Company S	Telabastagan
20	Company T	Telabastagan

2.3 Participants' Information
Twenty companies willingly participated in an endeavor, interviewing representatives, and employees, and evaluating the building using a survey questionnaire. Respondents from different roles were surveyed to remove biases. Out of 40 respondents, 25% were CEOs, 17.5% were Office Staff, and 12.5% were Safety Officers and Architects. Most respondents work daily, while the remaining percentage leaves the building frequently.

2.4 Development and Construction of Survey Questionnaire
Researchers used written questionnaires and interviews to conduct surveys on building safety. The final draft was ready for pilot testing, containing general questions about participants, building history, hazards, fire safety measures, exit features, fire protection systems, alarm systems, electrical wiring, safe refuge areas, firefighters' accessibility, and training drills. The survey collects data on fire safety levels in small-medium construction companies using various parameters. The tool was validated with subject-matter specialists to ensure appropriate measurement of variables. Validators included Fire Officers Christian Lambert C Sanchez and Edgar M Zapata, and Master of Science in Chemistry and Master Teacher II Christopher O. Lumba.

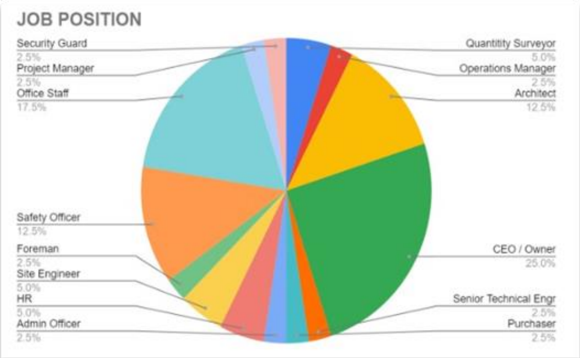


Figure-1 Pie Chart of The Participants' Job Position

2.5 Pilot Testing
Pilot testing is a crucial step in assessing the validity of a questionnaire before launching a full survey. It helps identify issues and ensures the questionnaire is gathering the intended data. A pilot test should involve 12 to 50 people, especially when limited, to ensure cost-effective and time-efficient responses. This study tested the instrument by 12 small-medium construction companies in San Fernando, Pampanga [9].

2.6 Data Collection and Distribution of Survey Questionnaire
Survey questionnaires were utilized to gather fire safety information from a small-medium construction company in San Fernando, Pampanga. Participants were informed of the study's objective, website importance, and potential hazards. Confidentiality was ensured, and data was analyzed for conclusions. The study ensures ethical considerations by obtaining informed consent from respondents and addressing potential risks. A waiver allows researchers to use their information for research purposes, while maintaining privacy and confidentiality of personal data.

2.7 Scoring Flow Diagram
Survey questionnaires were utilized to gather fire safety information from a small-medium construction company in San Fernando, Pampanga. Participants were informed of the study's objective, website importance, and potential hazards. Confidentiality was ensured, and data was analyzed for conclusions. The study ensures ethical considerations by obtaining informed consent from respondents and addressing potential risks. A waiver allows researchers to use their information for research purposes, while maintaining privacy and confidentiality of personal data.

2.7.1 Exit Features
The parameter includes eight safety questions for building exit features, ensuring compliance with the Occupational Safety and Health Standards Act and Fire Code of the Philippines. Adhering to these criteria ensures quick evacuation of workers and residents in emergency situations, ensuring structural stability and efficiency.

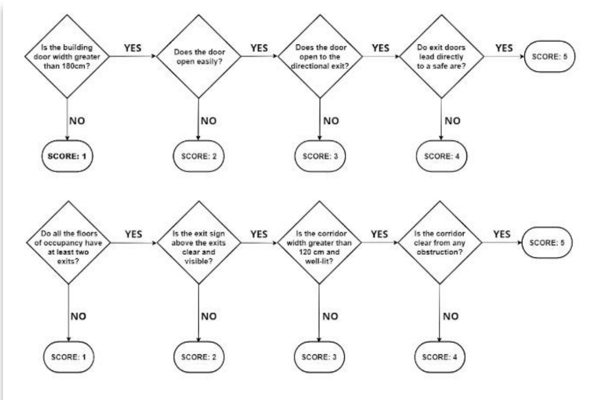


Figure-2 Scoring Flow Diagram: Exit Features

Table-2: Score Equivalence for Exit Features

Score	Description
1.0-2.9	Main exit is non-compliant with the standards
3.0-4.9	Width and distance of main exit is qualified but poses difficulty in egress
5.0	Width of exit is sufficient, accessible, and easily opens in the direction of egress

2.7.2 Fire Protection System
The parameter includes seven safety questions, focusing on major fire protection systems and their functionality. Common fire safety devices include sprinkler systems and smoke detectors. The fire assessment tool includes details on system installation and condition, as well as the availability of fire extinguishers as a first line of defense [10].

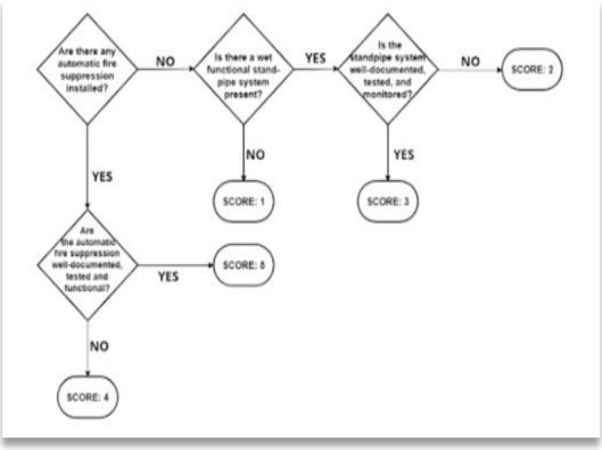


Figure-3 Scoring Flow Diagram: Fire Protection System

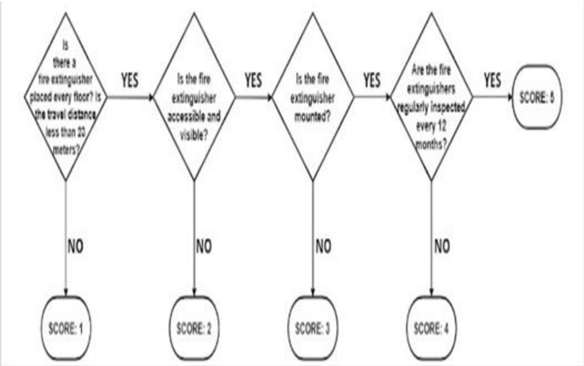


Figure-4 Scoring Flow Diagram: Fire Protection System

Table-3: Score equivalence for Fire Protection System

Score	Description
1.0-2.9	Firefighting and escape equipment are unavailable or substantially lacking
3.0-4.9	Required number of portable fire extinguishers is provided
5.0	Occupants are equipped with firefighting tools that are accessible and well-maintained

2.7.3 Alarm System

The alarm system's functionality and availability are crucial for ensuring safety in a building. A smoke detector sends a signal to the fire alarm control unit, alerting residents, and on-site emergency personnel. The alarm system's protection minimizes harm to possessions and property and is mandated by law as a first firewall against fire occurrences [11].

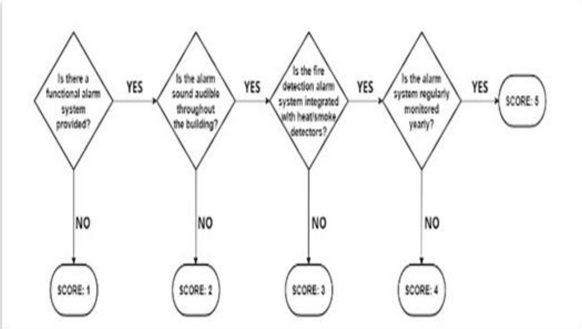


Figure-5 Scoring Flow Diagram: Alarm System

Table-4: Score Equivalence for Alarm System

Score	Description
1.0-2.9	There is no reliable alarm mechanism
3.0-4.9	Fire alarm is automatic, adequate but not regularly monitored
5.0	Fire alarm is automatic, centralized, adequate, and regularly monitored

2.7.4 Electrical Wiring

Electrical wiring is the leading cause of fires in industrial and commercial buildings, with malfunctions in machinery causing them to start on cables and circuit breakers. This survey includes electrical wiring, but it does not reduce fire hazards [12].

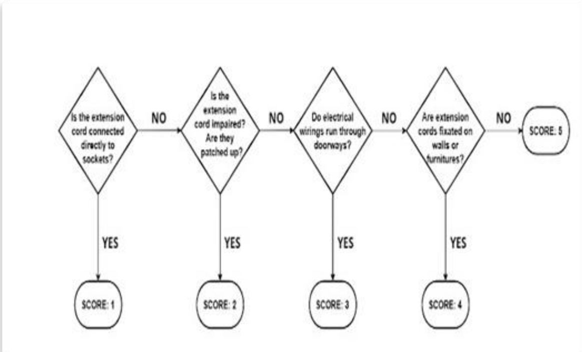


Figure-6 Scoring Flow Diagram: Electrical Wiring

Table-5: Score Equivalence for Electrical Wiring

Score	Description
1.0-2.9	Electrical wiring is exposed, damaged, poorly installed, or not maintained
3.0-4.9	Most electrical wirings are in good working order
5.0	The connections, grounding, and overall functionality of the electrical wiring are all correct.

2.7.5 Area of Safe Refuge

Refuge areas are crucial in industrial, commercial, and residential properties for providing a secure place to stay until aid is available. They offer a safe place to remain until evacuation is not an option, contributing to the structure's overall fire safety. Visiting a designated evacuation area is essential for ensuring a safe escape [13].

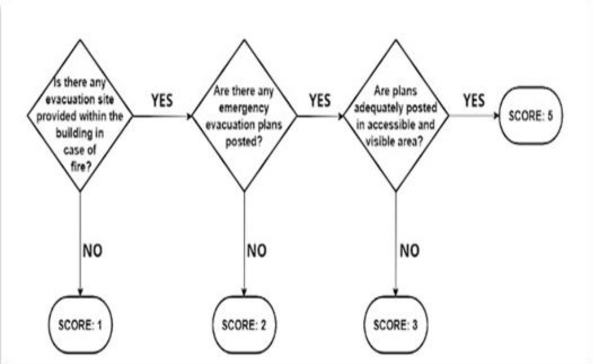


Figure-7 Scoring Flow Diagram: Area of Safe Refuge

Table-6: Score Equivalence for Area of Safe Refuge

Score	Description
1.0-2.9	Areas of safe refuge are not provided
3.0-4.9	Areas of safe refuge are provided within the building however there are some small shortcomings
5.0	Areas of safe refuge are provided within the building and complies with the code

2.7.6 Firefighters' Accessibility

Firefighters' accessibility is crucial for controlling and extinguishing fires, reducing damage and casualties. Urban areas face challenges in roadway accessibility, as large residential complexes require large vehicles and fire lifts, affecting response times and preventing optimal firefighting and emergency medical services delivery [14].

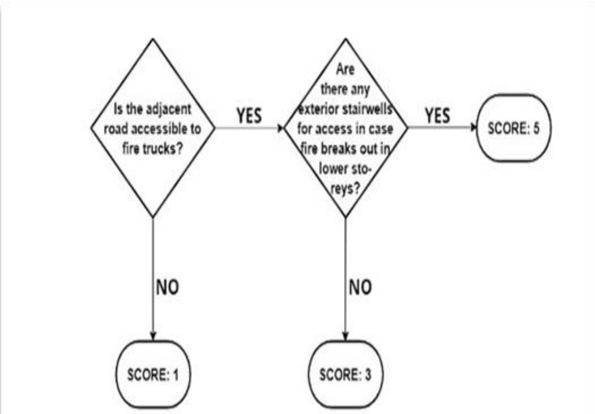


Figure-8 Scoring Flow Diagram: Firefighters' Accessibility

Table-7: Score Equivalence for Firefighter's Accessibility

Score	Description
1.0-2.9	The building is inaccessible in the event of a fire
3.0-4.9	The building is accessible, but it will take time to reach the area
5.0	The property provided appropriate access for firefighters, fire trucks and other equipment

2.7.7 Training and Drills

Fire drills simulate building evacuation techniques, providing staff hands-on training to assess emergency communication protocols' effectiveness. These drills safeguard occupants and provide familiarity with real-life fire safety, potentially saving lives if a fire were to occur [15].

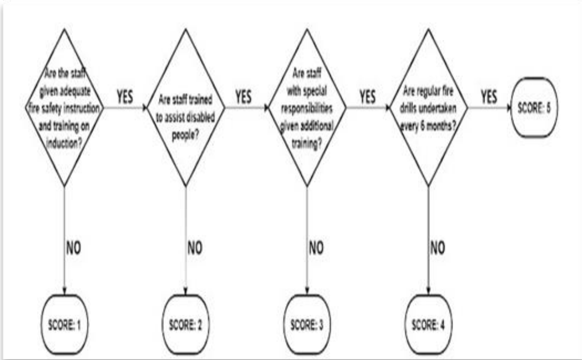


Figure-9 Scoring Flow Diagram: Training and Drills

Table-8: Score Equivalence for Training and Drills

Score	Description
1.0-2.9	Occupants have no fire safety training
3.0-4.9	Fire drills are conducted but without refresher
5.0	Regular evacuation exercises are held, and occupants get proper fire safety training.

2.7.8 Fire Level Computation

Initial score (IS) is calculated using a scoring flow diagram for fire safety parameters, while Final Score (FS) is averaging scores. The Bureau of Fire Protection Region III provides a risk-index score (I) based on fire occurrence history and parameters' impact on minimizing severity. Weighted Score (WS) is calculated using the equation.

$$WS = FS * I$$

Total Score (TS) is calculated by summating weighted scores from seven parameters.

$$TS = \Sigma WS$$

Fire safety scores are calculated by dividing the total score by maximum possible score of 5.

$$S = 5*PS$$

3. RESULTS

3.1 Building Characteristics

Different building characteristics were considered to determine if it influences the fire safety of the structures.

3.1.1 Building Ownership

It was found that out of the 20 construction companies, 80% were owned and the remaining were rented.

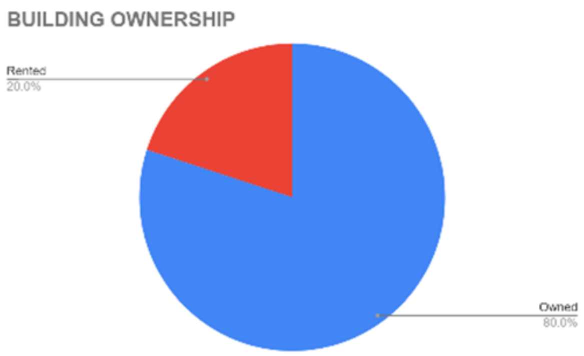


Figure-10 Pie Chart of the Company's Building Ownership

3.1.2 Building Height

In accordance with the outcome, it was discovered that half of all the low-safety level companies are situated on single-storey structures. On the other hand, two thirds of the companies that were found to have medium safety levels are composed of two-storey buildings. Lastly, two-thirds of the high safety level companies are composed of 3-7 storey structures.

Table-9: Building Height of Structures with Different Safety Levels

Safety Level	Description
Low	4 out of 8 are single storey
Medium	6 out of 9 are two-storey
High	2 out of 3 are mid-rise (3-7 storey)

3.1.3 Building Age

Based on the data provided by the representative of each of the companies, it turns out that most companies with low and high safety levels are aged 10 years and up. Meanwhile, most medium safety level companies have only been built for 1 to 5 years.

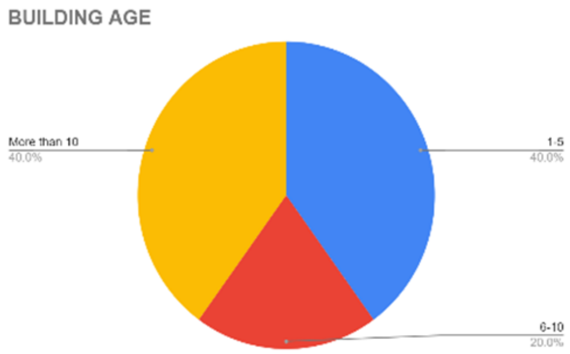
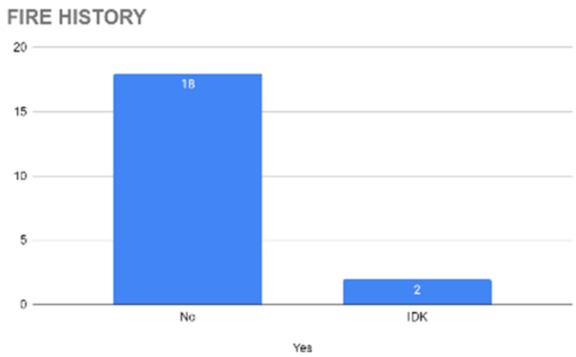


Figure-11 Pie Chart of The Company's Building Age

3.1.4 Building's Fire History

Another factor that has been investigated is the building's fire history and it was identified that it has no direct relationship between past fires and the likelihood of a repeat.



Note: "Yes" means that a fire has already occurred in the company. "No" means that there's no fire history in the company. "IDK" means they don't know if a fire has already happened or not.

Figure-12 Bar Graph of The Building's Fire Safety

3.1.5 Hazard Identification and Safety Measures

Hazard identification was considered and as indicated by the data; the majority fell under the "Electrical Source of Ignition" which comprises 24.2% of all the responses followed by "Cooking/Home Appliances" with 15.2%.

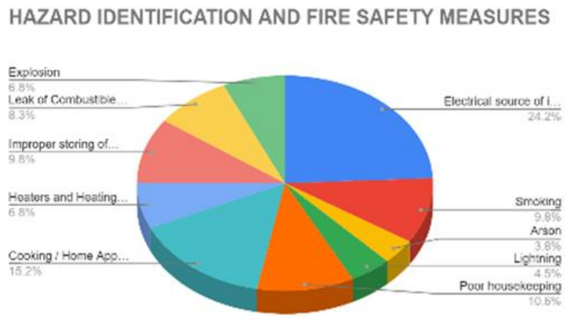


Figure-13 Pie Chart of The Identified Hazard of the Company

3.2 Average Weighted Scores of the Participating Companies Per Parameter

The average weighted score of the seven parameters which includes exit features, fire protection system, alarm system, electrical wiring, area of safe refuge, firefighters' accessibility and trainings and drills were investigated and as stated on the obtained data, trainings and drills have the most influence while electrical wiring has the least influence in building fire safety.

3.3 Fire Safety Level of the Participant

Based on the standards established on the Score Equivalence Table shown in Table X, the level of fire safety of the participating companies was determined.

Table-10: Score Equivalence for Fire Safety Level

Safety Level	Description
Low Safety Level	the level of safety with a score of 1.0 to 2.9
Medium Safety Level	the level of safety with a score of 3.0 to 3.9
High Safety Level	the level of safety with a score of 4.0 to 5.0

Companies with high safety levels have fire safety scores ranging from 4.03 to 4.55 while companies with medium safety levels have obtained scores ranging from 3.14 to 3.66. In contrast, companies with low safety levels obtain scores from 1.72 to 2.9.

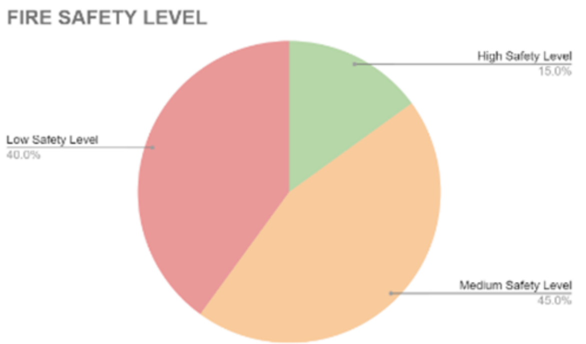


Figure-14 Fire Safety Level of The Company

Figure-14 shows that fifteen percent (15%) of the general population is represented in the high safety level companies. Forty-five percent (45%) of companies were at a medium level of safety and the remaining percentage falls under a low level of safety.

Table-11: Average Estimated Cost of Damage per Fire Safety Level

No. of company	Safety Level	Average Estimated Amount of Damage
8	Low Safety Level	₱ 2,312,500
9	Medium Safety Level	₱ 1,297,000
3	High Safety Level	₱ 867,000

4. DISCUSSION

4.1 Building Characteristics

Building ownership has a direct influence on fire safety of a structure since the owner has the power over the construction of the building. It is supported by the study conducted by Tymvios et al. [16] as they stated that the owner of the facility oversees all necessary daily maintenance, repairs, and renovations.

Building height also has an impact on fire safety and the two variables have a direct proportional relationship. It is shown in Table-10 that as the storey of building adds up, the fire safety level of the structure also increases.

The age of the building is an important factor to consider since companies that were built earlier should show less fire safety than those that have only been built recently. According to Kumar & Gardoni [17], as time goes by, due to routine use and exposure to harsh conditions such as earthquakes and corrosive environments, infrastructure systems deteriorate while they are in use. However, the data gathered presented otherwise. Building age has no direct influence on building fire safety as low and high safety level companies are aged 10 years and up.

If a fire already broke out in a building before, its root cause must be something to look out for in the future, to prevent it from happening again. A building's fire history has no direct relationship to fire safety since data gathered showed that none of the companies have experienced fire before.
Almost all possible causes of fire breaking out were listed and considered in the fire assessment tool and most of the answers provided fell under electrical source of ignition and cooking/home appliances. In conclusion, giving a closer look to the data gathered, it has a relation to the parameter with the least contribution to the fire safety level which is the Electrical Wiring.

4.2 Average Weighted Scores of the Participating Companies Per Parameter

Training and drills have the most contributory factor in fire safety while electrical wiring has its least. This result can be translated as equipping the employees with proper knowledge and skills when dealing with fire-related incidents can go along the way in minimizing further damages both in life cost and building cost. This view was supported by Shamsuddin et al. [18] as who stated that one crucial factor in achieving a building's development is the employees.

Also, as stated in the Rule 1940 of the Labor Code of the Philippines, fire drills shall be conducted at least twice a year. The score indicated that small-medium construction companies conduct fire drills inefficiently.

On the other hand, electrical wiring seems to be the greatest hurdle in achieving fire safety as they often overlook the threat that it possesses. This also supports the result of the spatiotemporal analysis of De Leon & Miranda [4] wherein Faulty Electrical Wiring ranks second as the main cause of fire in Pampanga from 2013-2020, next to Rubbish.

4.3 Fire Safety Level of the Participant

Most of the 20 participating companies fell under the classification of medium safety level and it is comprising of 9 companies out of 20. It is followed by a low safety level with 8 companies out of 20, while high safety level companies are comprising with 3 companies.

The relationship between fire safety and the average estimated cost of damage is indirectly proportional because as the fire safety level increases, the estimated cost of damage in the case of fire decreases. Because they comply with OSHA standards and other fire safety-related building codes, the study's participating companies with high safety levels have estimated low costs of damage. This is because they are confident that their buildings are safe from fire hazards.

In contrast, based on their provided answers in the fire assessment tool, companies with low safety standards anticipated significant costs for damage because they understand how vulnerable their structures are to fire hazards and how much damage could result if a fire broke out in an area without sufficient exit features, firefighting equipment, or an alarm system.

The results were influenced by many constraints such as the period, quantity of respondents, and location covered.

5. CONCLUSION

The study developed a fire safety assessment tool to evaluate a building's fire safety, aiming to reduce the likelihood of a fire occurring. The tool uses an indexing approach, incorporating both quantitative and qualitative safety indicators, to produce a fire safety score.

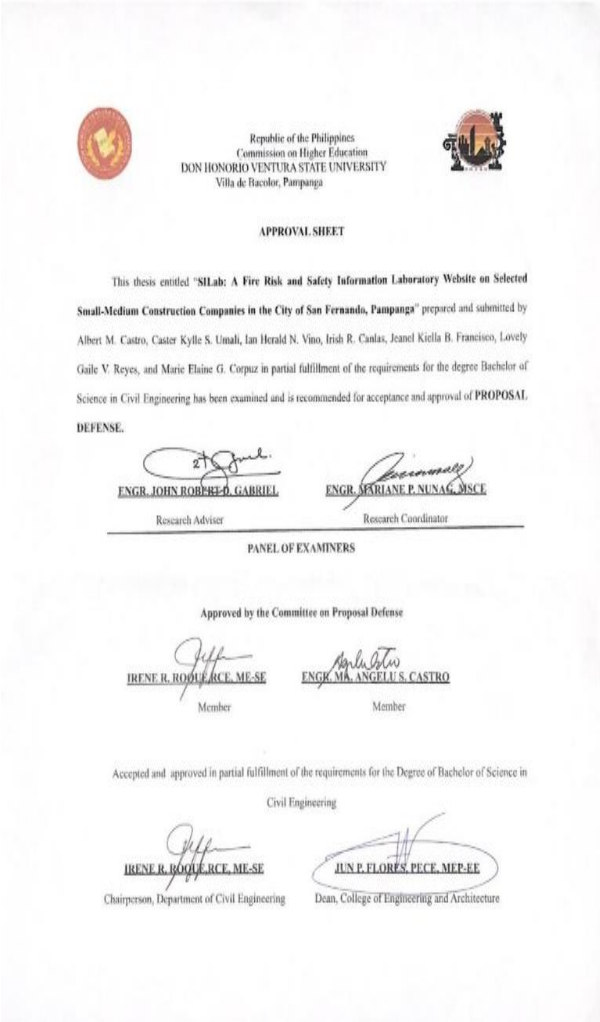
The results showed that 45% of the construction companies in the City of San Fernando, Pampanga fall under a medium degree of safety, with 15% reporting a high score. The remaining 40% had a low degree of safety. Factors such as exit features, fire protection systems, fire alarm systems, electrical wiring, area of safe refuge, firefighters' accessibility, and training and drills contribute to the level of protection among companies.

The lower the safety level, the larger the anticipated damage. The average anticipated damage for companies between low-high levels of safety ranges from ₱867,000 to ₱2,312,500. Observing compliance and allocating expenditure for fire prevention, protection, and mitigation significantly prevented construction companies from experiencing higher losses. We also designed a platform for companies or building owners to assess their operations in terms of fire safety, providing a map, the fire assessment tool, and relevant information. This application could also help the Bureau of Fire Protection monitor the city's fire safety status.

This study focuses on small-medium construction companies in San Fernando, Pampanga, but it should be expanded to larger enterprises to determine if fire safety assessments reflect the values portrayed. A more diverse sample population is recommended for more reliable results. The fire safety assessment tool can be enhanced by conducting time studies and adjusting it to consider other building risk indicators.

Future researchers can compare the indexing method with quantitative methods for more detailed analyses by including more risk factors related to fire and life safety can improve the fire safety index and ensure the overall dependability of fire safety systems. Additionally, obtaining professional consultation from accredited specialists is recommended for further development of the website and mobile version.

6. APPENDIX



Republic of the Philippines
Commission on Higher Education
DON HONORIO VENTURA STATE UNIVERSITY
Villa de Bacolor, Pampanga

APPROVAL SHEET

This thesis entitled "**SILab: A Fire Risk and Safety Information Laboratory Website on Selected Small-Medium Construction Companies in the City of San Fernando, Pampanga**" prepared and submitted by Albert M. Castro, Caster Kylle S. Umali, Ian Herald N. Vino, Irish R. Canlas, Jeanel Kiella B. Francisco, Lovely Gaile V. Reyes, and Marie Elaine G. Corpuz in partial fulfillment of the requirements for the degree Bachelor of Science in Civil Engineering has been examined and is recommended for acceptance and approval of **PROPOSAL DEFENSE.**

ENGR. JOHN ROBERT D. GABRIEL
Research Adviser

ENGR. MARIANE P. NUNAG, MSCE
Research Coordinator

PANEL OF EXAMINERS

Approved by the Committee on Proposal Defense

IRENE R. ROQUE,RCE, ME-SE
Member

ENGR. MA. ANGELU S. CASTRO
Member

Accepted and approved in partial fulfillment of the requirements for the Degree of Bachelor of Science in Civil Engineering

IRENE R. ROQUE,RCE, ME-SE
Chairperson, Department of Civil Engineering

JUN P. FLORES, PECE, MEP-EE
Dean, College of Engineering and Architecture

Figure-15 Approval of Proposal Defense

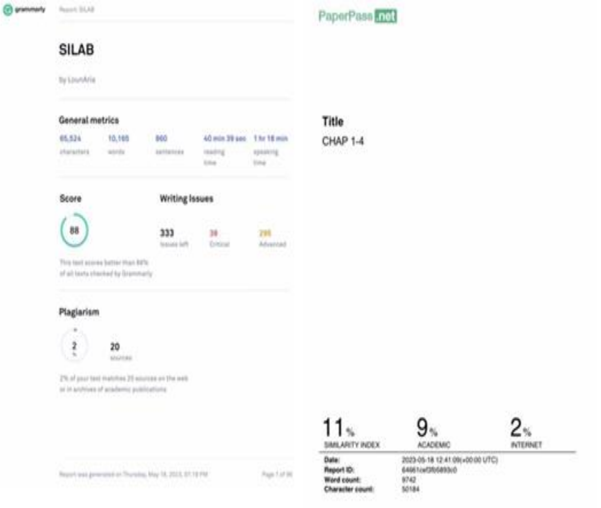


Figure-16 Grammar and Plagiarism Report

DON HONORIO VENTURA STATE UNIVERSITY
COLLEGE OF ENGINEERING AND ARCHITECTURE
CIVIL ENGINEERING DEPARTMENT

February 2023

Bureau of Fire Protection Region III
City of San Fernando, Pampanga

To whom it may concern,

Warm greetings! We are a group of fourth year students of the College of Engineering and Architecture - CE Department conducting a thesis study entitled "*SiLAB: A Fire Safety Information Laboratory Website on Small-Medium Construction Companies in the City of San Fernando, Pampanga*".

We are writing for the purpose of asking for your assistance and cooperation for our data collection. The data that will be collected will be used for research purposes only and there will be no misuse of information. We express our gratitude for your consideration of this kind favor and we hope you will be able to fulfill our request.

Respectfully yours,

IAN HERALD N. VINO
Lead Researcher

Noted by:

JOHN ROBERT D. GABRIEL, RCE
Thesis Adviser

Figure-17 Letter to the Bureau of Fire Protection Region III

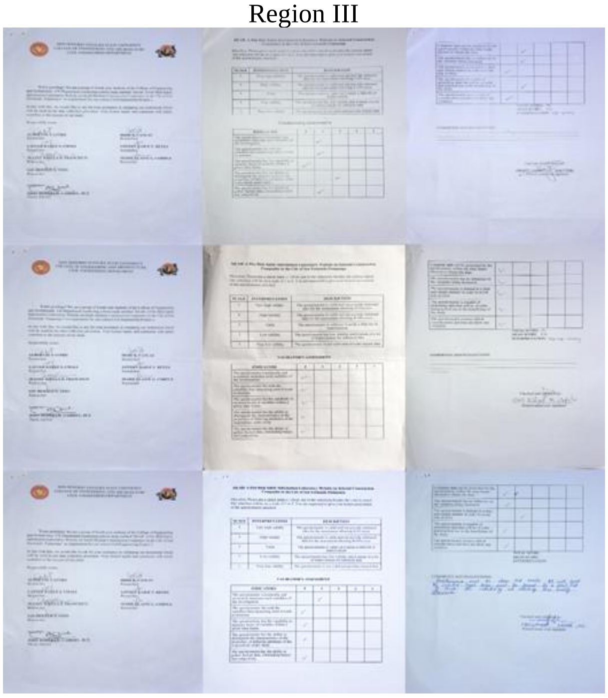


Figure-18 Validation Letters

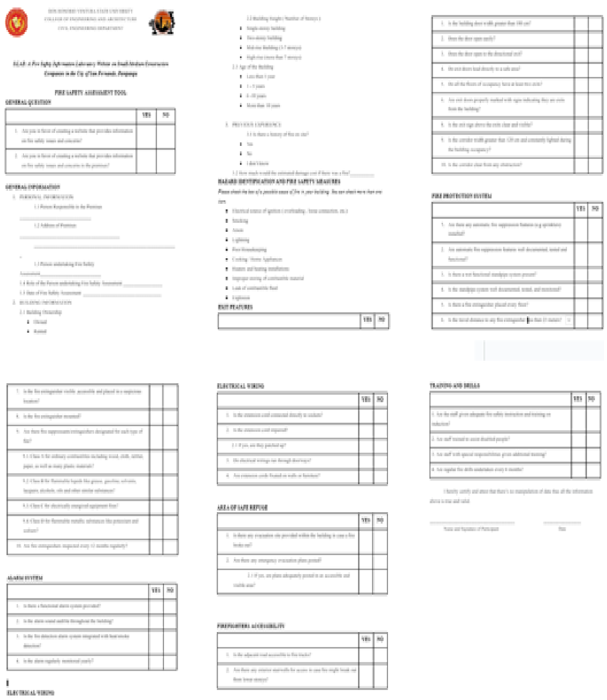
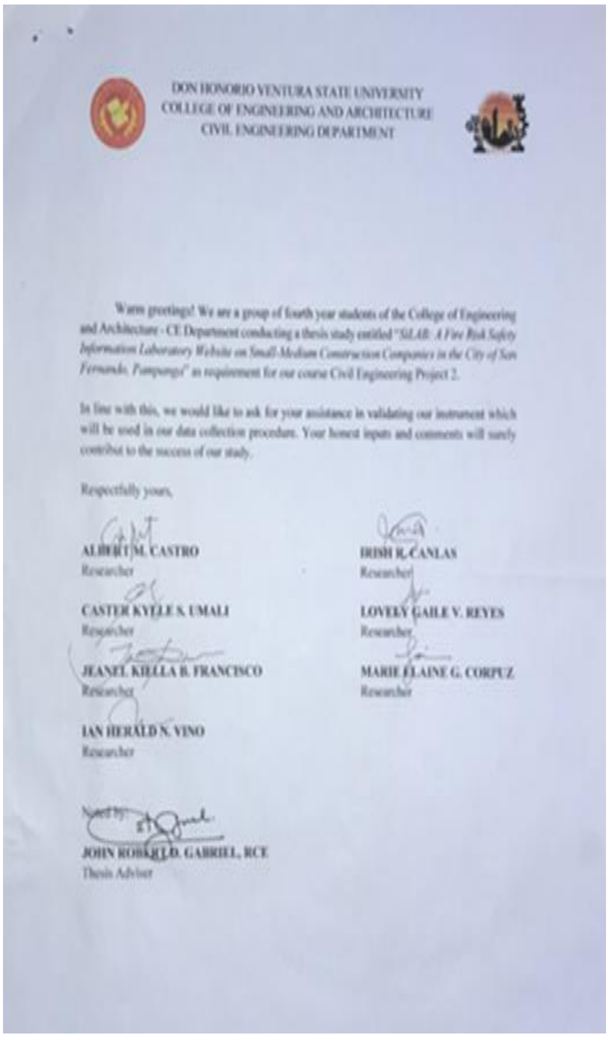


Figure-19 Fire Safety Assessment Tool



DON HONORIO VENTURA STATE UNIVERSITY
COLLEGE OF ENGINEERING AND ARCHITECTURE
CIVIL ENGINEERING DEPARTMENT

Warm greetings! We are a group of fourth year students of the College of Engineering and Architecture - CE Department conducting a thesis study entitled "*SiLAB: A Fire Risk Safety Information Laboratory Website on Small-Medium Construction Companies in the City of San Fernando, Pampanga*" in requirement for our course Civil Engineering Project 2.

In line with this, we would like to ask for your assistance in validating our instrument which will be used in our data collection procedure. Your honest inputs and comments will surely contribute to the success of our study.

Respectfully yours,

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Noted by:

JOHN ROBERT D. GABRIEL, RCE
Thesis Adviser

Figure-20 Validation Letters and Validated Questionnaires

Figure-21 Letter of Consent

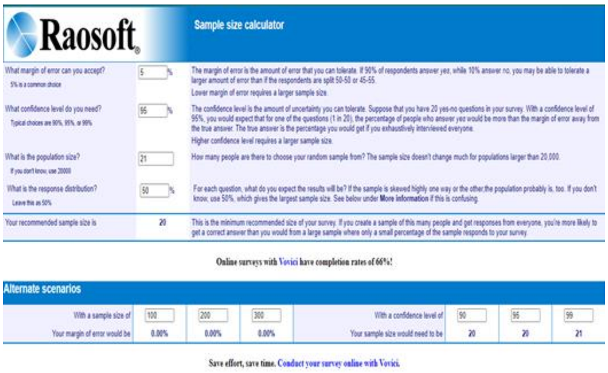


Figure-22 Sample Size Computation using Raosoft

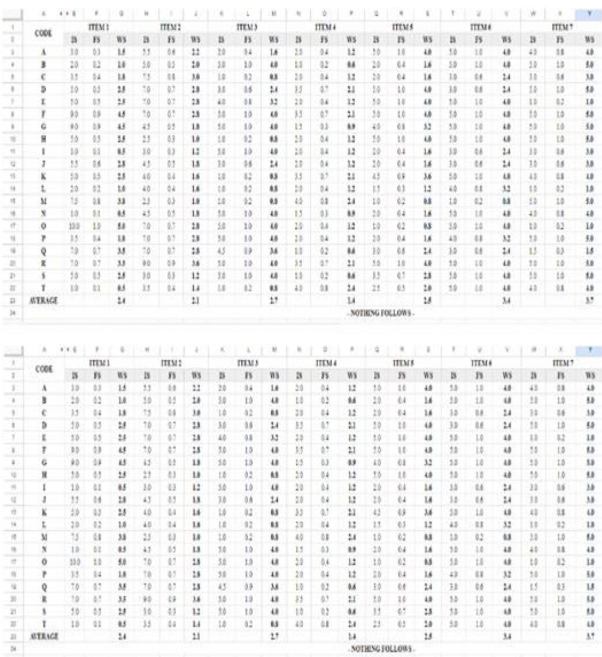
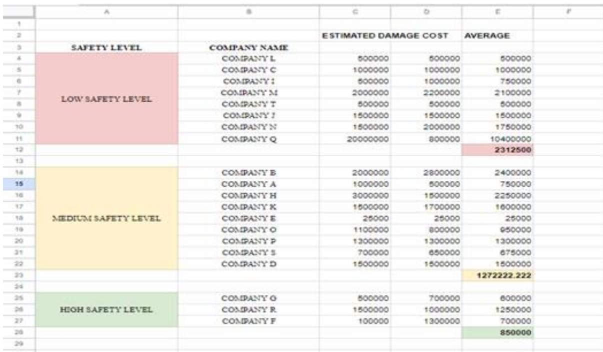


Figure-23 Fire Safety Scores



SAFETY LEVEL	COMPANY NAME	ESTIMATED DAMAGE COST		AVERAGE
LOW SAFETY LEVEL	COMPANY L	500000	500000	500000
	COMPANY C	1000000	1000000	1000000
	COMPANY I	500000	1000000	750000
	COMPANY M	2000000	2200000	2100000
	COMPANY T	500000	500000	500000
	COMPANY J	1500000	1500000	1500000
	COMPANY N	1500000	2000000	1750000
	COMPANY Q	20000000	800000	10400000
				2312500
MEDIUM SAFETY LEVEL	COMPANY B	2000000	2800000	2400000
	COMPANY A	1000000	500000	750000
	COMPANY H	3000000	1500000	2250000
	COMPANY K	1500000	1700000	1600000
	COMPANY E	25000	25000	25000
	COMPANY O	1100000	800000	950000
	COMPANY P	1300000	1300000	1300000
	COMPANY S	700000	650000	675000
	COMPANY D	1500000	1500000	1500000
				1272222.222
HIGH SAFETY LEVEL	COMPANY G	500000	700000	600000
	COMPANY R	1500000	1000000	1250000
	COMPANY F	100000	1300000	700000
				850000

Figure-24 Estimated Damage Cost of Companies if a Fire Broke out in their Company.

Figure-25 User Manual Guide

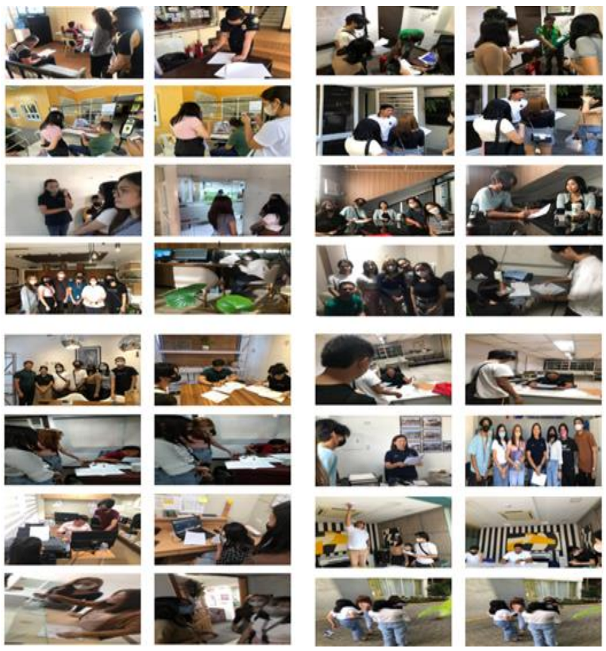


Figure-26 Documentations

7. ACKNOWLEDGEMENT

The researchers express their gratitude and appreciation to God, the Bureau of Fire Protection Region III, the Department of Trade and Industry, the Department of Science and Technology Region III, their thesis coordinators and advisers, their validators, the participants, their parents, families, friends, and classmates for providing them with a healthy environment.

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