

AKUAN KEASLIAN DAN HAK MILIK

TAJUK : ECO EXIT SIGN

SESI : JUN 2019

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2. Kami mengakui bahawa 'Exit Sign Board' dan harta intelek yang ada di dalamnya adalah hasil karya/ reka cipta asli kami tanpa mengambil atau meniru mana-mana harta intelek daripada pihak-pihak lain.

3. Kami bersetuju melepaskan pemilikan harta intelek 'Projek tersebut' kepada 'Politeknik tersebut' bagi memenuhi keperluan untuk penanugerahan Diploma Pengajian Perniagaan kepada kami.

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ACKNOWLEDGEMENT

We like to express gratitude to our supervisor Puan Rosida Binti Haji Ahmad who contributed her time and energy to help and guide us throughout this research for our Final Year Project entitled “ Eco-Exit Sign ” session December 2018 and Jun 2019. We have highly benefited by this research and have gained a lot of knowledge about the process to develop a new product.

Secondly, we would also like to thank my subject lectures who had helped us in improving the product within limited time. In addition, we would also like to thank my classmates for encouraging us during this final year project.

ABSTRACT

Eco Exit Sign is an eco-friendly and yet a high-quality function as the common exit sign. It is installed in buildings near any possible exits or exit routes. It plays important role in the building especially during emergencies when occupants are required to evacuate the building immediately. It indicates the where about of nearest exits to the occupants. It is in fact a great innovation for a better future as it is made up of eco-friendly material that can be recycled. Other than that, Eco Exit Sign does not require any electricity in order to function properly. It applies on the situation that the earth is facing nowadays. Eco Exit Sign reduces the usage of power which will help to not only reducing the usage of limited sources that are used to produce electricity, it also reduces the pollution and global warming as electricity produces a colossal amount of heat. Finally, the Eco Exit Sign eliminates the need of maintenance as it does not contain any electrical components that need to be taken care of. It only needs to be dusted every once a while in order to maintain the brightness of the sign. Most importantly, Eco Exit Sign fulfills all the regulations that are stated in Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA).

ABSTRAK

Eco Exit Sign adalah sebuah product yang bermesra alam dan berfungsi sebagai tanda keluar biasa yang berkualiti tinggi. Ia dipasang di bangunan berhampiran dengan sebarang pintu keluar atau laluan keluar. Ia memainkan peranan penting dalam bangunan terutamanya semasa kecemasan apabila penghuni dikehendaki untuk mengosongkan bangunan dengan segera. Ia menunjukkan di mana tanda-tanda keluar yang terdekat kepada penghuni. Ia sebenarnya merupakan inovasi yang hebat untuk masa depan yang lebih baik kerana ia terdiri daripada bahan mesra alam yang dapat dikitar semula. Selain itu, Eco Exit Sign tidak memerlukan tenaga elektrik untuk berfungsi dengan baik. Ia merupakan tanda exit yang tidak menggunakan sumber elektrik secara tidak langsung dapat mengurangkan masalah global yang dihadapi sekarang iaitu kekurangan sumber elektrik. Tanda Eco Exit mengurangkan penggunaan kuasa yang akan membantu bukan sahaja mengurangkan penggunaan sumber terhad yang digunakan untuk menghasilkan elektrik, ia juga mengurangkan pencemaran dan pemanasan global kerana elektrik menghasilkan jumlah panas yang sangat besar. Akhir sekali, Tanda Eco Exit menghapuskan keperluan penyelenggaraan kerana ia tidak mengandungi komponen elektrik yang perlu dijaga. Ia hanya perlu ditapis setiap seketika untuk mengekalkan kecerahan tanda. Paling penting, Eco Exit Sign memenuhi semua peraturan yang dinyatakan dalam Pentadbiran Keselamatan dan Kesihatan Pekerjaan (OSHA) dan Persatuan Perlindungan Kebakaran Kebangsaan (NFPA).

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CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION

Normally, a workplace must have at least two exit routes to permit prompt evacuation of employees and other building occupants during an emergency. Exit routes must be located as far away as practical from each other in case one is blocked by fire or smoke. Exit signs must be clear of decorations, equipment which may impair visibility to means of an Exit. An Exit sign, or similar designation, with an arrow indicating the directions, shall be placed in every location where the direction of travel to reach the nearest exit is not immediately apparent or as directed by local fire marshal which is governed by the Occupational Safety and Health, OSHA.

Exit signs typically are box-shaped, with an outer metallic sheet having a cutout forming the word "EXIT." A translucent piece of red plastic lies adjacent to the outer sheet, and an incandescent light bulb inside the box illuminates the red plastic from behind. The light source is usually connected to an emergency power supply, or a battery backup. This satisfies the requirement of having both a guide sign and a red light, although sometimes a separate red-light bulb is placed adjacent to an exit sign having external illumination only.

Photoluminescence is light emission from any form of matter after the absorption of photons which is electromagnetic radiation. It is one of many forms of luminescence and is initiated by photoexcitation. Photoluminescence also having the ability to store incident electromagnetic radiation typically from ambient light sources, and release it in the form of visible light.

1.2 BACKGROUND RESEARCH

An emergency exit is a clear, safe way to evacuate a premise. It provides fast exit in case of emergency such as a fire. Fire fighter may also use it as a way into the building so it is very important to make sure they are ready to be used at all times. It is each individual's responsibility to make sure that exits are clear and visible in case of an emergency. Emergency exit signs are an easy way to find a way out of a building fast. The emergency exit signs are one of the most important parts of your building's safety system. In the event of a fire or other building emergency, people cannot always rely upon their personal knowledge when it comes to finding their way

outside. Strangers to the building would not know the best exit routes, and even those familiar with the building layout can become confused. Exit signs and lights have to be bright and clear, able to be viewed through smoke and in darkness. An emergency exit is marked by a white sign, normally above the doorway, with red or green lettering. The sign should be lit at all times and clearly visible (Maturo, 2015).

The Life Safety Code offers many details regarding acceptable illumination of exit signs. Under section 7.10.1.2 it states that all exit signs must be illuminated by a reliable light source and must be legible in both normal and emergency exit lighting modes. Section 7.10 breaks illumination into two broad categories: externally illuminated and internally illuminated. Externally illuminated refers to a source of illumination that comes from outside the exit sign while internally illuminated exit signs possess the illumination source inside the sign.

The evolution of exit sign technologies over the past several decades is a story of new technologies that have dramatically reduced their appetite for energy. Indeed, the most common exit signs sold today, those using LED lighting, use as little as two watts—one-twentieth the electricity consumed by older incandescent models. And some exit signs today don't use any electricity at all.

Today, most of the exit signs worldwide differ significantly from these earlier models, and are often designed as part of an emergency escape route. The standard sign consists of a pictogram of an individual running with an arrow indicating the direction towards the exit. According to BS 5499-4:2013 – Safety signs. Code of practice for escape route signing, this sign should be placed at an appropriate height and angle, and should be in compliance with related international standards. The standard document gives examples of their appearance as:



Figure 1.1: Exit Sign Example Appearances

1.3 PROBLEM STATEMENT

Early exit signs were generally either made of metal and lit by a nearby incandescent light bulb or were a white glass cover with "EXIT" written in red, placed directly in front of a single-bulb light fixture. An inherent flaw with these designs was that in a fire, the power to the light often failed. In addition, the fixtures could be difficult to see in a fire where smoke often reduced visibility,

despite being relatively bright. The biggest problem was that the exit sign was hardly distinguishable from an ordinary safety lighting fixture commonly installed above doors in the past. Better signs were soon developed that more resembled today's modern exit sign, with an incandescent bulb inside a rectangular-shaped box that back lit the word "EXIT" on one or both sides. Being larger than its predecessors, this version of the exit sign solved some of the visibility problems. The sign was only useful as long as mains power remained on. Complications occur when this electrical exit signs failed to operate mainly during current failure or fire in a building. This is due to non-maintenance of these electrical exit signs. Through my research for this proposal, I have found that the old electrical exit signs will be replaced to new electrical exit signs instead of doing regular maintenance. Mr. Asmira Bin Ashari, Department of Occupational Health and Safety, Sultan Salahuddin Abdul Aziz Shah Polytechnic, stated that cost for replacing the exit signs are cheaper than the maintenance cost. Furthermore, inspections are not done regularly to check the working condition of these exit signs for it to be improvise. My proposal aim is to lessen the burden to making regular maintenance and inspections of exit signs with a non-electrical exit sign made of photoluminescence. Therefore, we could lower the cost of maintenance and replacement of these exit signs in building with an alternative method with relies UBBL requirements.

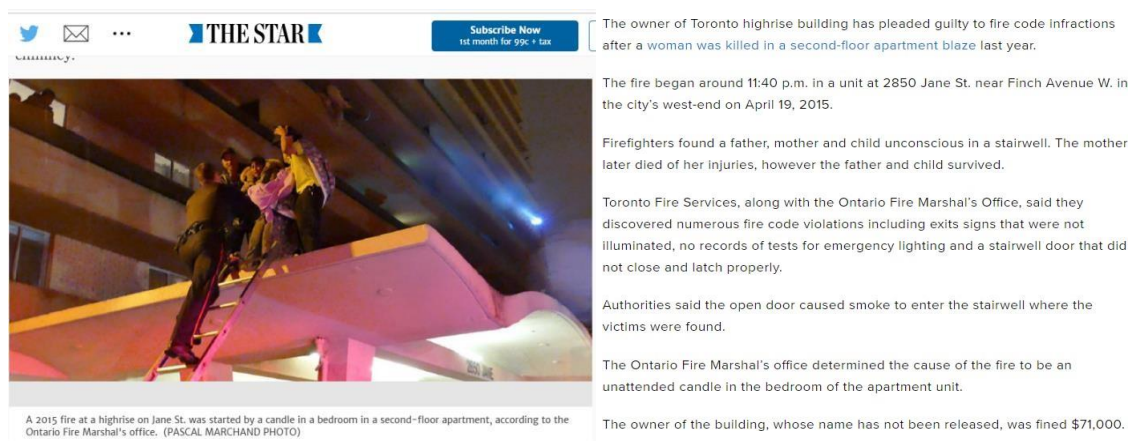


Figure 1.2: Accident occurred due to emergency exit sign

1.4 OBJECTIVE

- i. To reduce the regular requirement of maintenance

The first objective of this project is to reduce the regular requirement of maintenance of exit sign. As mentioned earlier, an electrical exit sign needs to be inspected at least once a month in order to ensure the function ability of the exit sign. In contrast, photo luminescent exit signs require little or no maintenance as it does not use any batteries, light bulbs, electricity, or testing.

- ii. To provide an eco-friendly emergency exit sign

Other than that, we also want our product to be an environmentally friendly product. Eco exit sign can save up the electricity bill as it uses photo luminescent to lit up. Photo luminescent is a non-chemical and non-radioactive material. it also supports the 3R (Reuse, Reduce, Recycle) concept as we are planning on using environmentally friendly material to build the body of our exit sign which is fire resistant glass.



Figure 1.3: 3R

- iii. To ensure safety and visibility during evacuating

Photo luminescent exit signs will improve the safety of your building and provide illumination no matter what unfolds. A photo luminescent exit sign is reliable during emergency as they provide at least 90 minutes of illumination in complete darkness, as required by code. Once it is dark as the power has been cut off, building occupants can quickly evacuate the building safely.

1.5 RESEACRH SCOPE

- i. Distance of visibility of Eco Exit Sign

An experiment will be conducted on Eco Exit Sign. This test will determine whether the maximum distance of visibility of this product comply the regulation of exit sign in Malaysia. The objective

of this test is to ensure that the eco exit sign is noticeable from certain distance for the safety of building occupants during emergency. It will be a big help for building occupants to identify the location of nearest exit during emergency. Every exit sign must be visible no more than 30.48m (NFPA 101 (7.10.1.5.1)). If the distance of visibility of this product is less than that required, we will need to improve it until it reaches the standard distance required.

ii. Effect of Heat towards materials involved

This test will show the effect of heat towards material involved in the making of Eco Exit Sign. During emergency especially fire, it is very important for the exit sign to be functional until each and every person in the building evacuated out of the building safely. Hence, a heat resistance exit sign plays a very important role during this kind of situation.

iii. Brightness of Eco Exit Sign

This test will determine whether the Eco Exit Sign complies the standard requirement for exit sign. The illumination level of Eco Exit Sign will be compared with the illumination level that has been regulated in any regulation books such as OSHA and NFPA. Every light put out by exit sign should be at least an average of 1 foot-candle which is 10.7639 lux.

iv. Glowing duration of Eco Exit Sign

There must be at least 1.5 hrs. of emergency light if the building lighting fails. Therefore, this test will determine whether the Eco Exit Sign can glow within 1.5 hours or more. If it fails to glow for at least 1.5 hours duration, some modification will be carried out in order for it to pass the test and complies the regulation of exit sign.

1.6 IMPORTANCE OF RESEARCH

Emergency exit signs and lights are among the most important parts of building's safety system. In the event of a fire or other building emergency, people can't always rely upon their personal knowledge when it comes to finding their way outside. Strangers to the building won't know the best exit routes, and even those familiar with the building layout can become confused. Exit signs and lights have to be bright and clear, able to be viewed through smoke and in darkness.

i. Clearly Leading the Way

Exit signs come in more than one type. Some are simple placards that are mounted on a wall. Others are intended to adhere to the emergency lighting that automatically activates when a fire is detected. Using both types in the overall safety plan is a smart move on the part of the occupants.

Exit sign serve to point occupants in a building in the right direction. This is important, since there needs to be specific routes for exiting the building and gathering at a safe place for a quick head count. The luminescent signs that are mounted over doors and are part of the emergency lighting system serve as beacons even if the smoke is beginning to thicken. As long as people can see the signs and know which direction to go, they have a better chance of getting out of the building without injury.

1.7 REPRESENTATION OF TERMS / OPERATIONS

- I. Exit sign - a sign above a door or along a pathway through which a person can leave a building.
- II. Eco - not harming the environment; eco-friendly.
- III. Photoluminescence – is glow in the dark light emission from any form of matter after the absorption of photons through electromagnetic radiation.
- IV. Regulation - a rule or directive made and maintained by an authority.
- V. Maintenance - the process of preserving a condition or situation or the state of being preserved.
- VI. Escape route - a route by which a person may reach a place of safety, and in relation to: a storey, a space or an access deck, means a route from an exit from that storey, space or access deck. a room, means a route from an exit of that rooms.

VII.	Materials	Quantity	Price per unit	Overall price
1	Photoluminescence powder	100g	RM90/100g	RM90
2	Clear premier	500ml	RM40/500ml	RM40
3	Fire resistance wood (12x600x1200) mm	4	RM75	RM300
4	Acrylic glass	2	RM15	RM30
5	Nuts and screw 35mm	4	RM5	RM5
	Exit sign plate	3	RM130	RM390

	Reflective paper	1	RM25	RM25
	Fire resistant spray	1	RM25	RM25
	Steel rod	2	RM20	RM40
Total amount			RM945	

Table 1.1: Material Costing

1.8 CHAPTER CONCLUSION

Overall, the condition and the design of the emergency equipment is very important in order to ensure the occupant safety in the building especially during an emergency when a flame is out of control, you need to evacuate a building. Emergency and exit signs will help to provide a clear path to an exit during a fire. Having clear signage and lighting will help contain panic and guide your team members to an appropriate exit in time. So, I strongly believe that our eco-exit sign board is absolutely can the lowering energy consumption, and lowering the installation and maintenance cost and saving the environment.

Not only that, this eco-exit sign board is actually an eco-friendly exit sign because it is made of the material that can be recycle. It also will be coming with numerous of design in order to be multifunction and placing the exit sign in different of the location.

CHAPTER 2 LIERATURE REVIEW

2.1 INTRODUCTION

An emergency exit sign is incorporated directly into the floor adjacent an emergency exit door. The emergency exit sign includes visual and tactile properties that allow the sign to be read on a day to day basis by those walking through the doorway. (Chiarucci, 2004).

Orlando states that under current local fire and building codes, signage is required for buildings to which the public has access therein identifying the exits. The present invention relates generally to illuminated exit signs and, more particularly, to illuminated exit signs equipped with a plurality of low voltage incandescent lamps. Two 15-watt incandescent lamps driven by one hundred twenty volts alternating current (120 VAC) have been employed to provide normal illumination while two 3.6-watt incandescent lamps driven by a self-contained emergency battery power supply are used for illumination during power failure situations traditionally. Upon current failure, a switching or transfer device will automatically operate the emergency backup illumination system.

The traditional exit sign lighting has a few drawbacks even it performed adequately. Firstly, the relatively high wattage bulbs consume large amounts of electrical energy, particularly, when the building has many of such exit signs. Then, the bulbs give off heat and are aimed to premature failure due to vibrations and the like requiring a considerable amount of maintenance to change the lamps. Finally, the traditional exit signs, employing the lower wattage lamps during emergency situations. It does not provide the same amount of illumination as during normal operation with the larger wattage lamps.

It is an object of the present invention to provide a novel exit sign which uses most effective non-electrical exit sign than the existence exit signs.

2.2 CONCEPT

A photo luminescent exit sign operates by absorbing light energy known as photons earlier from the surroundings in the present of any light source. This stored energy is slowly re-emitted to the surroundings as light which causes the exit sign to glow when a building is in a dark condition. This shows that photo luminescent exit sign does not need any electricity to operate during emergency. A photo luminescent exit sign is always on once it has absorbed sufficient amount of

energy. UL924 required that the photo luminescent exit sign to be exposed to a minimum of 54 lux fluorescent, metal halide or mercury light to fully charge the sign. Brighter light intensity produces shorter charging time. After it is fully charged with photons, it takes about 16-69 hours in total darkness for a photo luminescent to be fully discharged. Under a normal condition, the lifespan of a photo luminescent sign is up to 25 years.

2.3 EARLY RESEARCH

2.3.1 Requirements for exit signs

2.3.1.1 Based on OSHA's requirements for lighting and marking exit routes are covered under 1910.37(b). According to the requirements, each exit route must be adequately lighted so that an employee with normal vision can see along the exit route and each exit must be clearly visible and marked by a sign reading "Exit." Additional requirements include the following:

- I. Exit signs must be clear of decorations, equipment which may impair visibility to means of an Exit.
- II. Access to exits must be marked by visible signs in all cases where the exit or way to reach it is not immediately visible to the occupants.
- III. Consisting with any door passage, or stairway which is neither an exit nor a way of exit access, and which is so located or arranged as to be likely to be mistaken for an exit, shall be identified by a sign reading "Not an Exit" or similar designation, or shall be identified by a sign indicating its destination, examples include "To Break Room," "Electrical Room," "Machine Room". (OSHA)

2.3.1.2 Section 4.1 of BS5266 Pt 7 states that "Signs which are provided at all exits intended to be used in an emergency and along escape routes shall be illuminated to indicate unambiguously the route of escape to a point of safety". As known direct sight of an emergency exit is not possible, an illuminated directional sign (or series of signs) shall be provided to assist progression towards the emergency exit.

I. Maximum viewing distances

For all format of safety sign the maximum viewing distances and luminance conditions are given in BS 5266 pt7/EN 1838 Signs can be either internally illuminated, such as exit boxes or edge lit emergency luminaires with a screened sign that have a controlled illuminance,

or painted signs with an external emergency light illuminating them. Maximum viewing distances are:

- Internally illuminated signs - 200 x the panel height
- Externally illuminated signs - 100 x the panel height

II. Illumination requirements

The sign must conform to the colours of ISO 3864, which states that exit and first aid signs must be white with green as the contrast colour. The ratio of luminance of the white colour to the green colour must be between 5:1 and 15:1. The minimum luminance of any 10mm patch area on the sign must be greater than 2cd/m² and the ratio of maximum to minimum luminance shall be less than 10:1 for either colour.

2.3.1.3 Exit signs must be properly illuminated by a reliable light source, with a minimum of 5 foot-candles (54 lux) on the illuminated surface. Ambient light sources giving illumination to exit signs other than the electrical exit signs must have screens, discs, or lenses of not less than 25 square inches area made of translucent material to confirm Contrast.

2.3.1.4 NFPA sets the requirements for the illumination of exit signs are in their life safety code, or NFPA 101. It dictates that all signs should be lit under the following standards:

- I. Every sign required should be suitably illuminated via a reliable source of light. Externally, internally, and photo luminescent illuminated signs are all permissible.
- II. There must be at least 1.5 hrs. of emergency light if the building lighting fails.
- III. If a photo luminescent sign is used, a light must be provided to charge that sign so that if the lights go out, the sign will stay illuminated for at least 1.5 hours.
- IV. Any signs with internal illumination should be listed and comply with the standards of UL 924.

2.3.2 Types of exits

2.3.2.1 Final exits

According to UBBL 133, final exit refers to the point of discharge for the escape route from a building which yield to evacuation ending point.

2.3.2.2 Alternative exits

According to UBBL 166, in a building shall be provided at least two exits from each storey. This ‘designing for redundancy’ principle applies to all aspects of evacuation.

2.3.2.3 Horizontal exits

UBBL 171 states that exits that lead to a horizontal pathway separated compartment within the same floor. Horizontal exits shall be provided by protected staircase.

2.3.2.4 Storey exits

Defined in UBBL 167 and 174 that exits from a floor which is neither a different level from the final exit nor if on the same level, a distance away from the final exit. A storey exit is to lead to a final exit.

2.3.3 Locate exit signs at mandatory “points of emphasis”

I. At corridor and building final exit.

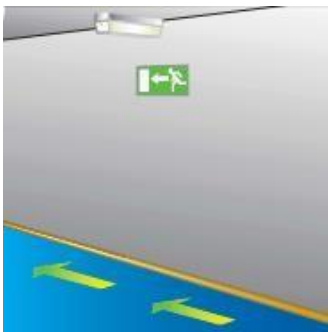


Figure 2.1: Exit sign at corridor

II. At each exit door.



Figure 2.2: Exit sign at exit door

III. At each change of direction.

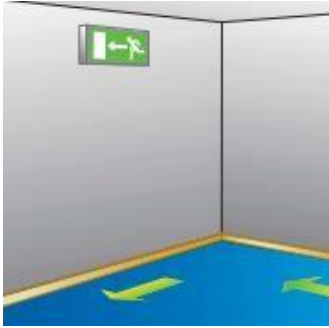


Figure 2.3: Exit sign at change of direction

IV. On stairs.

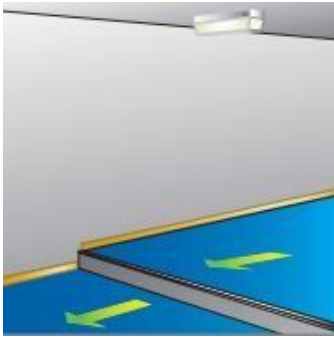


Figure 2.4: Exit sign on stairs

2.3.4 Types of Exit Sign

2.3.4.1 Thermoplastic LED Exit Sign

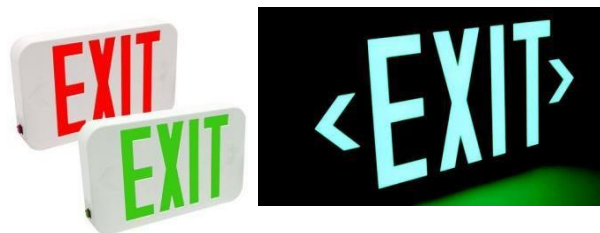


Figure 2.5: Thermoplastic LED Exit Sign

The most common type of exit sign is made of economical thermoplastic and is illuminated with LED. Thermoplastic is essentially plastic that can withstand high temperatures and has a higher melting point between 3500-4000°C. These signs are typically found with a white housing and red or green glowing letters. The signs are shaped like rectangles and can be mounted from their top,

side, or back. When this sign is mounted from the top or side, a bracket is required, however, when the sign is back mounted the housing is fastened directly to the wall. The lights inside use less than 5 watts of electricity and typically have a 5-year expected life span and warranty, although, it is reasonable to expect a longer life span. The signs have a strip of LED located either at the top or the bottom of the word EXIT and generally use a battery which is located on board to stay illuminated in the event of a power outage. The signs have a button to test the battery. The battery has a 5-year lifespan or shorter depending on the temperature variances. These signs are the least expensive of the group and it is often more cost effective to replace the sign than to try to repair it. These signs are very popular with contractors because they are easily configurable at the time of installation.

2.3.4.2 Edge Lit Exit Sign



Figure 2.6: Edge Lit Exit Sign

Typically seen as the most beautiful of the bunch, edge-lit exit signs are often seen at restaurant, hotels, or upscale business building. The effect achieved by edge lighting is one best described as a floating and glowing transparent sign. The effect is achieved by a row of LED located at the top of the panel shooting light down into the panel. The edge of the Exit panel is often lined with a reflective strip that accentuates the effect by reflecting light back up into the panel where the light illuminates the word EXIT. The word exit may be etched into the panel which is typically made of acrylic or the lettering may be a vinyl sticker. If the arrows were pre-etched, then the installer would need to know the various locations and counts for each panel configuration ahead of time. The panels can be found with either clear lenses, white lenses, or mirrored lenses. Sometimes the lenses are mirrored but seem transparent. This is due to the viewing angle below which helps create an optical illusion one which makes you think that you are seeing through the panel, to the area behind the sign, when actually what you are seeing is the reflection of the ceiling in front of the sign. Edge Lit signs are typically single panelled, which means that the word EXIT appears on one

side of the sign and with a clear panel. However, if the sign needs to be seen from both sides, such as when it is top mounted and in a hallway intersection, the sign must be double face and use either a mirrored lens inserts or a white panel background. The reason for this is simple: the word EXIT will read backwards on the back side of the sign. To combat this, you insert an opaque lens between the two sides of the panel.

2.3.4.3 Self-Illuminated Exit Sign



Figure 2.7: Self Illuminated Exit Sign

Exit signs that glow in the dark often contain a radioactive gas called tritium filled in small tubes. These signs do not require electricity or batteries and can be used where it is hard to install electric signs, such as above doors. They serve an important safety function by marking exits to be used during power outages and emergencies. There are a couple ways to know whether an exit sign contains tritium. When the lights are off, tritium will make the word “EXIT” glow green or red. The sign should also have a permanent warning label that mentions tritium, 3H or H-3, displays the three-bladed radiation warning symbol and states "Caution-Radioactive Materials". If all four letters in “EXIT” are fully lit, the sign is working properly. If not, the sign may be damaged or have reached the end of its working life. Tritium exit sign can usually be found at public and private office buildings, theatres, stores, schools and churches. However, tritium exit signs must not be disposed of as normal trash as radioactive isotope which is harmful to human health and the environment. Besides that, a damaged sign could contaminate the immediate area and require expensive clean-up. Therefore, in order to dispose a tritium sign properly, a general licensee must transfer the sign to a specific licensee such as a manufacturer, distributor, licensed radioactive waste broker or licensed low-level radioactive waste disposal facility. These facilities may charge a fee for disposing of the sign.

2.3.5 Comparison between electrical exit sign and non-electrical exit sign.

Electrical Exit Sign	Non-electrical Exit Sign
I. The system in a building should be tested every 6 months.	I. No power cost due to absent of electricity usage.
II. The most common problem is the failure of the lamp which is normally illuminated within the fitting.	II. Eco Friendly (Nontoxic) are an excellent way to stay in line with eco-friendly policies while still
III. Any faulty lamps prior should be replaced during the inspection. May also be required to replace the lamp starter when replacing a faulty lamp.	installing reliable safety precautions.
IV. During maintenance period, it may also affect general lighting as the exit lights may be wired on the same electrical circuit.	III. Adhere to UBBL, Occupational Safety and Health (OSH) and National Fire Protection Association (NFPA).
V. The cost of fault diagnosis and repair in-situ may be more costly than the cost of the provision of a new fitting. As such, it is Maintenance Essentials standard procedure to replace faulty exit light fitting rather than components of the unit (except for the lamps).	IV. Last 20+ Years V. Virtually maintenance free. should be kept free of dirt and debris with simple cleaning VI. High-level or low-level mounting VII. Thin surface, solid construction features a vandal resistant and non-glare ceramic surface.

Table 2.1: Comparison between electrical exit sign and non-electrical exit sign

2.3.6 Installation of exit signs

NFPA 101 requires exit signs shall installed at least 80 inches above the approved floor, and mounting heights shall be 60 inches above the approved floor to the center line of the sign with no possible obstructions blocking visibility. Also taken into consideration that additional exit signs must be installed on the wall adjacent to the latch side of the door, and

braille should also be printed on the exit signs for those with visual impairments. Exit signs shall be placed in pathways to exit access in ways as:

2.3.6.1 Wall mount

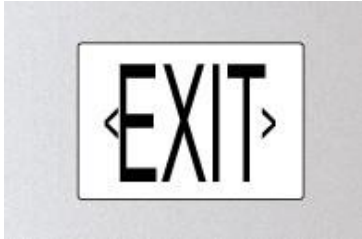


Figure 2.8: Wall mount exit sign

The use of mounting canopy does not involve in wall mounting. Units typically have knock-out pattern on back plate to mount directly to junction box.

2.3.6.2 Ceiling mount



Figure 2.9: Ceiling mount exit sign

Typically requires use of mounting canopy from top of fixture of the ceiling. Use of ceiling mount for exit signage may require double face. These ceiling-mount signs tuck between ceiling tiles and tracks for easy installation.

2.3.6.3 Side mount

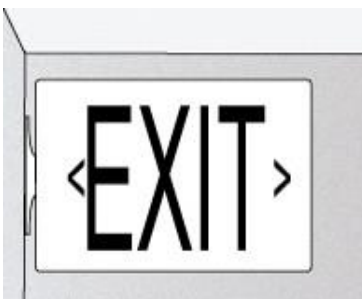


Figure 2.10: Side mount exit sign

Mounting canopy is required for side mounting. Canopy is affixed to the side of the unit and then attached to wall. Double face may require for the use of side mount for exit signage.

2.3.6.4 Wall mount angel down

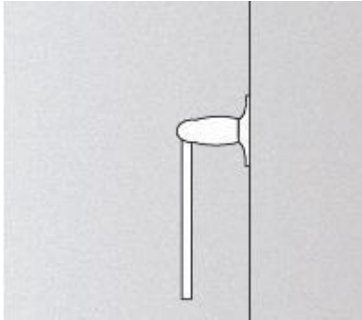


Figure 2.11: Wall mount angel down

Special mounting configuration mostly limited to edge lit exit signage. Mounting canopy may require by affixed to the top of the unit and then attached to wall. Edge lit face then rotates down. In recessed applications, the face itself may be curved down.

2.3.6.5 Recessed mount



Figure 2.12: Recessed mount exit sign

Commonly used for ceiling mount units in which housing is actually located above the ceiling.

2.3.6.6 Pendant mount



Figure 2.13: Pendant mount exit sign

This configuration requires the use of a pendant kit. It is an optional to add on. Allows to be more visible by ceiling mountable units to be suspended from a high or sloped ceiling.

2.3.7 Materials

2.3.7.1 Photoluminescent

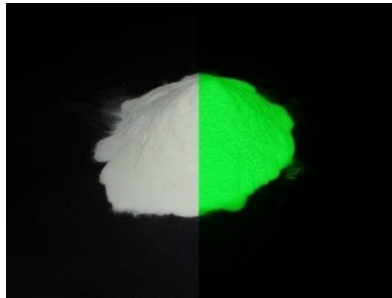


Figure 2.14: Photoluminescent powder

Photoluminescence, a Luminescence stimulated by light absorption in UV-Vis-NIR spectral region, represents any process in which material absorbs electromagnetic energy at a certain wavelength and then emits part of it at a different (usually longer) wavelength. Therefore, only a part of the absorbed energy is transformed into luminescent light. The rest of it ends up as molecular vibrations, or simply as a heat. Photoluminescence is the most popular type of Luminescence because a large selection of reliable and inexpensive excitation sources is available and also because the effect can often be observed with the naked eye. Usually an excitation source emits in UV and the Photoluminescence occurs in Vis or NIR.

2.3.7.2 Acrylic

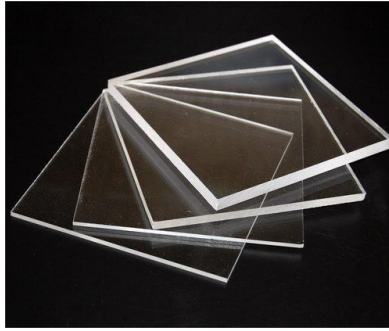


Figure 2.15: Acrylic glass

Acrylic is a transparent plastic that have gained widespread use because its ability replaces the glass. In everyday products it is particular used for signs, sales displays, roof windows, lenses and screens. Acrylic plastic is highly resistant to variations in temperature and humidity, making it useful in outdoor applications. Acrylic plastic is highly resistant to inorganic acids and bases but can be dissolved by organic substances, especially petroleum products. But also, for demanding constructions such as windows in submarines and fiber optics in the flat-screen TV's. In future, polymethyl methacrylate (PMMA for short) – better known as acrylic glass – could be made from natural raw materials such as sugars, alcohols or fatty acids. Compared with the previous chemical production process, a biotechnological process is far more environmentally friendly.

2.3.7.3 Epoxy Liquid



Figure 2.16: Epoxy Liquid

Liquid epoxy coating is a coating system composed of two substances. It is mainly applied on floors and gives off a unique finish compared to traditional coatings because of its distinct chemical composition.

The two elements of liquid epoxy coating are kept separated before application. When combined, these components, which are composed of thermosetting polymers, go through a chemical reaction which builds a closely impassable bond. Once this reaction has occurred, liquid epoxy coating can be very difficult to remove. Removal typically necessitates breaking the liquid epoxy coating bond with the use of a methylene chloride or extreme heat.

2.3.7.4 Plywood



Figure 2.17: Plywood

Plywood has high tensile strength, derived from the cross lamination of panels. This distributes force over a larger area and reduces tensile stress. Therefore, able to withstand overloading by up to twice its designated load. This is useful where the seismic activity or cyclonic winds occur. These plywood properties are effective when used as a flooring or concrete formwork. Plywood combines the structural strength of the timber from which it is manufactured. This is in addition to the plywood properties obtained from its laminated design. Cross-graining allows the plywood sheets to resist splitting and provides uniform plywood strength for increased stability. It is cost effective when used in structural applications such as flooring, formwork, shear walls, etc.

Plywood can be manufactured to fit every requirement. The veneer thickness varies from a few millimeters to inches. The number of veneers used also ranges from three to several, increasing the thickness of the sheet. The extra layers add more plywood strength. Thin veneers are used to increase flexibility for use in ceilings and paneling.

Plywood can be treated with a fire-resistant chemical coating. It is combined with non-combustible materials such as fibrous cement or plasterboard. This makes it ideal for use in fire resistant structures. It's a natural product made from a renewable resource. Therefore, it is one of the most environmentally friendly decorative products available to the consumer.

2.3.7.5 Fire Resistant Spray



Figure 2.18: Fire Resistant Spray

A fire-resistance rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. This can be quantified simply as a measure of time, or it may entail a host of other criteria, involving other evidence of functionality or fitness for purpose. There are many international variations for nearly countless types of products and systems, some with multiple test requirements.

Canada's Institute for Research in Construction (a part of the National Research Council and publisher of Canada's model building code - NBC) requires a special test regime for firestops for plastic pipe penetrants. Fire endurance tests for this application must be run under 50Pa positive furnace pressure in order to adequately simulate the effect of potential temperature differences between indoor and outdoor temperatures in Canada's winters. Special hoods are applied here to

provide suction on the top side of a test assembly in order to reach the 50Pa pressure differential. Afterwards, a 30PSI hose-stream test may be applied.

Outdoor spray fireproofing methods that must be qualified to the hydrocarbon curve may be required to pass a host of environmental tests before any burn takes place, to minimize the likelihood that ordinary operational environments cannot render a vital system component useless before it ever encounters a fire.

If critical environmental conditions are not satisfied, an assembly may not be eligible for a fire-resistance rating.

Regardless of the complexity of any given test regime that may lead to a rating, the premise is generally product certification and, most importantly listing and approval use and compliance. Testing without certification and installations that cannot be matched with an appropriate certification listing, are not usually recognized by any Authority Having Jurisdiction (AHJ) unless it is in a realm where product certification is optional.

2.3.7.6 Reflective Sticker



Figure 2.19: Reflective Sticker

Reflective labels are printed on a silver-based stock, which provides a high-visibility metallic sheen to all printed colors. When light is shined on reflective stickers or decals, the sticker will bounce the light, making it appear as if the sticker or decal is glowing. Given the reflective nature of this product, to get the best results we advise that only a minimal amount of black or dark ink colors be used on this material. Reflective stickers are usually cut into single sheets but are available in rolls in certain situations.

Reflective stickers serve the dual purpose of ensuring your logo, sign, text, or other information becomes legible or noticeable at low visibility times such as at night, or during poor weather conditions. This also provides a safety benefit as they attract attention in the dark. For this reason, reflective stickers are commonly used on hard hats, bicycles, for emergency signage and on slow moving vehicles or in construction sites.

Fill out this custom quote form below and a StickerYou associate will respond to your inquiry promptly with a formal quote.

2.3.7.7 Pinewood



Figure 2.20: Pinewood

Pine wood is medium-weight and relatively soft. Its strength and elasticity are good. As with other coniferous woods, the properties of the wood depend upon the density of the annual growth rings: The higher the proportion of summerwood, the heavier and harder the wood. The heartwood has good natural durability except where it is in direct contact with earth or moisture. It has a high natural moisture content, which can lead to a blue staining of the wood through fungal infection. The colouring only affects the appearance, not the physical properties of the wood.

Pine wood can be worked easily by hand or machine. It can be sliced or peeled. Nailed, screwed or glued connections are straightforward. The surface can be finished with all kinds of paints. The sapwood lends itself well to impregnation, less so the heartwood.

Pine wood is available as round or sawn timber, as well as veneer. Other names: Forest pine, sandy pine.

2.3.7.8 Clear primer



Figure 2.21: Clear primer

A primer is a preparatory coating put on materials before painting. Priming ensures better adhesion of paint to the surface, increases paint durability, and provides additional protection for the material being painted. A primer consists of 20%-30% synthetic resin, 60%-80% solvent and 2%-5% additive agent. Some primer contains polyethylene, for better durability.

2.3.8 Types of Ply

The term “ply,” as it refers to plywood, means the layers manufacturers use to create the boards at various thicknesses. Some projects won’t need a thick board, while others will. Ply achieves the right depth and can also make the boards stronger.

Each layer is known as a wood veneer. A veneer is a thin piece of wood that you can glue together to create a different number of plies. Plywood, then, is the finished product when the manufacturer glues the veneers together.

3-ply is one of the most common types of plywood. This kind has three layers of veneer and is layered enough to be strong and durable but can look more decorative than plywood with more plies, making it a good choice for indoor use.

5-ply pieces of wood have five layers of veneers. This is another common type of plywood used for projects that require less durability and strength than those needed for exterior use.

2.3.8.1 Softwood plywood

Plywood that manufacturers make using softwoods, like pine, redwood, or cedar. Although the name implies that these woods aren't as strong as others, you might be surprised to know that construction workers typically use softwoods for exterior frame sheathing, roof sheathing, and sub-flooring.

2.3.8.2 Hardwood plywood

Hardwood plywood typically has between three and seven layers and uses hardwoods, like birch, maple, oak, and walnut. Manufacturers glue the layers of wood at right angles to one another to create an incredibly strong finish. Hardwoods are best for things like furniture, packing cases, sporting equipment, musical instruments, and other intricate projects that require strong frames.

2.3.8.3 Lumber core plywood

Plywood is usually made with three plies, with two thin veneers on each side and a thick core. The outer veneers are typically made of a hardwood, while the inner core consists of strips of wood glued into one solid slab.

The inner core helps grasp screws, which makes it a good choice for projects that need a strong screw hold. One disadvantage is that poorly-made lumber core plywood may have voids within the core that diminish its strength and screw holding abilities.

2.3.8.4 Exterior plywood

Exterior plywood has weather and water-resistant glue that holds each veneer together. When you create an exterior with plywood, one of the biggest – and most important – concerns is how the wood will handle wind, rain, and other weather. Exterior wood is meant to combat the elements to provide a strong, sturdy frame for years to come.

Exterior plywood sheets typically have several veneers glued together, classifying them as multi-ply. You can also choose various kinds of wood for exterior plywood, depending on the area in which you live. Some locations that experience unusually harsh seasons may fair better with wood like oak, which can resist mildew and mold from damp condition.

2.3.9 Grades of Plywood

2.3.9.1 Moisture Resistant (MR) Grade Plywood

MR grade plywood means moisture resistant plywood. It is also known as commercial plywood. In moisture resistant plywood, urea formaldehyde resin is used for bonding the plies with each

other. Remember that ‘moisture resistant’ does not mean ‘waterproof’. It means that the plywood is capable of resisting humidity and moisture, and it is not resistant to water. So, this type of plywood is not used for making furniture that are continuously in contact with water. MR grade plywood is an interior grade of plywood therefore it is suitable for indoor use, not for exterior. It can be used in wall mounted cabinets, kitchen shelves, partition, wardrobes, TV tables, showcases, etc.

MR grade plywood is an interior grade of plywood therefore it is suitable for indoor use, not for exterior. It can be used in wall mounted cabinets, kitchen shelves, partition, wardrobes, TV tables, showcases, etc.

The thickness of moisture resistant plywood is 3mm, 4mm, 6mm, 8mm, 12mm, 15mm, 18mm, 21mm, 25mm as per IS 303. It is less costly as compared to BWR grade of plywood. The price of such plywood approximately ranges from Rs.40 to 189 per sq. ft

2.3.9.2 Boiling Water Resistant (BWR) Grade Plywood

BWR grade plywood means Boiling Water Resistant Plywood. It is a waterproof plywood. It can resist water better than MR plywood. BWR plywood is glued using phenol formaldehyde adhesive (phenolic resin), which is a synthetic plastic resin. This synthetic plastic resin helps in making plywood waterproof. It is not 100% waterproof as compared to BWP plywood. Boiling water-resistant plywood is an exterior grade of plywood. Therefore, it can be used for furniture that likely to get wet, i.e. kitchen cabinet, lawn chairs, garden tables, etc.

As per IS 303, the thickness of BWR plywood is 4mm, 6mm, 9mm, 12mm, 16mm, 19mm, 25mm. BWR grade plywood is more expensive than MR plywood.

2.3.9.3 Fire Retardant plywood

A type of plywood which is treated with special fire-retardant chemicals at the time of manufacture, so that it becomes better at resisting fires. It is also known as FR grade plywood. The rate of burning of the plywood should be more than 20 minutes, the time taken for flames to penetrate the plywood has to be more than 30 minutes.

Chemicals such as diammonium hydrogen phosphate, are used to make fire retardant plywood.

The addition of fireproofing chemicals, gives the plywood better fire proofing qualities such as,

1. Lesser tendency of spark and ignite.
2. Slow burning, having a decreased tendency of the fire to spread over the surface of the plywood.

3. Low flammability and lesser smoke generation.
4. Higher flame penetration time.

The sizes and thicknesses of fire-retardant plywood are same as those for the commercial MR grade and the Exterior BWR grade types of plywood. Thickness usually ranges from 4 mm to 18 mm, while standard size sheets such as 8' x 4' are commonly used.

2.3.10 Types of photoluminescent

2.3.10.1 Strontium aluminate

A phosphorescent material emits light as a result of the energy stored in its atoms. As electrons drop down from higher to lower energy orbitals, they give off photons of light, each corresponding in energy to the difference between the two levels. The photoluminescent part indicates that the energy originally used to bump the electron up to a higher level came from light typically in the ultraviolet range. Therefore, strontium aluminate absorbs photons when exposed to light then, it will slowly give off photons. Some substances, known as fluorescent materials, re-emit such energy straight away, but the particular configuration in the strontium aluminate requires forbidden transition.

The strontium aluminate needs to be mixed with another material, europium or dysprosium. The presence of this impurity in the crystal lattice sets up the capability of making the forbidden transition, enabling the strontium aluminate to resist to the energy from the incoming photon. The commonly used photoluminescent phosphorescent material is the combination of strontium aluminate and europium results in the longest lasting.

2.3.10.2 Zinc sulphide

Photoluminescent glow powder zinc sulphide is the first generation of phosphorescent technology. Zinc sulphide is a raw pigment has a strong sulfuric odour, but it is usually masked when mixed into the medium. Zinc pigments are only slightly soluble in water. They can be stored as a water-based paint for years. The afterglow characteristics of zinc sulphide have much to be desired and is commonly used in the manufacture of non-critical application areas. It is not very bright with short glow duration relatively cheap.

2.3.11 Applications of photoluminescent

2.3.11.1 Anti-skid strips and dots (polycarbonate & vinyl)

These self-adhesive Anti-skid strips and dots have the same gritty anti-slip polycarbonate or vinyl surface as the directional marker. One dot per foot is an ideal spacing to create a visual guidance system. The polycarbonate is extra durable and the gritty surface provides very good skid prevention.

2.3.11.2 Anti-skid roles

This tape has a structured, patterned vinyl surface. It is best used for smooth, straight floor surfaces. These self-adhesive roles are used as floor tape, intended for indoor applications, may be used to mark uneven floor levels, single steps or a flight of stairs. This tape is UL-listed as Model CC-AST to UL1994–Standard for Luminous Egress Path Marking Systems and successfully passed the requirements of UL410 – Standard for Slip Resistance of Floor Surface Materials.

2.3.11.3 Directional marking for floors

This self-adhesive polycarbonate marker has a gritty anti-slip surface. The arrow and running man message clearly indicate the direction of your evacuation route.

2.4 CHAPTER CONCLUSION

As conclusion, photoluminescent exit signs are very convenient and safe to use. As it is eco - friendly, we could practice the policies while installing reliable safety precautions. We rely on our objective which to provide a novel exit sign which uses most effective non-electrical exit sign than the existence exit signs. Therefore, suitable fire rated material shall be used to overcome heat resistance over time of the existence products. I suggest to conduct experiment on observing and collecting data of illumination intensity of the latest type of photoluminescent.

CHAPTER 3 METHODOLOGY

3.1 INTRODUCTION

The purpose of methodology is to enable researchers to plan and examine critically the logic, composition and protocols arch procedures. Moreover, the performance of individual techniques to be evaluated and to estimate the likelihood of particular research designs to contribute to knowledge (Krippendorff, 2008). Researchers must become proficient in defining the terms of their analysis and justify the analytical steps taken therefore that there is evidence that can support a study or can be summed up as summarizing a study conducted.

3.2 RESEARCH DESIGN

The research design refers to the overall strategy that is chosen to integrate the different components of the study in a coherent and logical way, thereby, ensuring an effective address of the research problem. It comprises the measurement, and analysis of data. Research design is about organizing research activity, including the collection of data, in ways that are most likely to achieve the research aim (Easterby-Smith, et al. 2002).

1. The function of a research design is to ensure that the evidence obtained enables researchers to effectively address the research problem logically and as unambiguously as possible. In social sciences research, obtaining information relevant to the research problem generally entails specifying the type of evidence needed to test a theory, to evaluate a program, or to accurately describe and assess meaning related to an observable phenomenon. Without attending to these design issues beforehand, the overall research problem will not be adequately addressed and any conclusions drawn will run the risk of being weak and unconvincing.

3.2.1 Eco Exit Sign Design

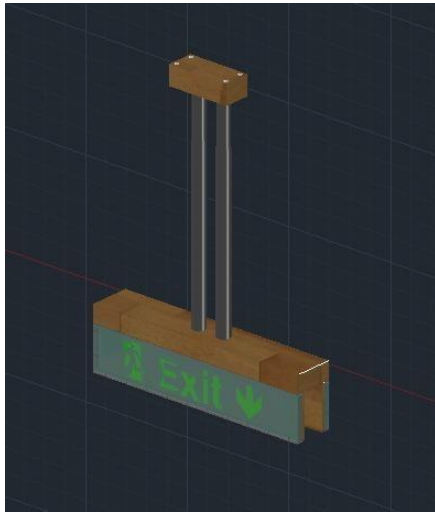


Figure 3.1: Ceiling mounted eco exit sign

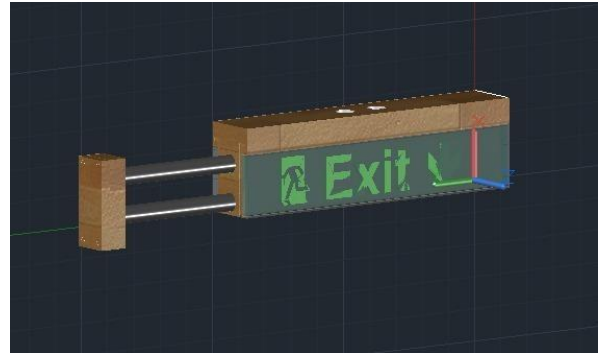


Figure 3.2: Ceiling mounted Eco Exit Sign

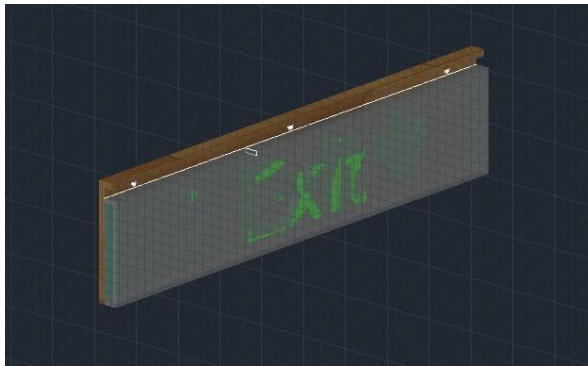


Figure 3.3: Wall mounted Eco Exit Sign

Eco Exit Sign is designed to glow during an emergency occurred which will indicate the nearest exit path or exit door for building occupants. Other than that, it is also designed to fulfill the types of exits available. It is a multi-function exit sign as it can be disassembled and serve as ceiling mounted exit sign which is often used in an emergency stair, long corridors or at the intersections of corridors. Besides that, it can also be assembled into a side wall mounted exit signage or a wall mounted exit sign which is often mounted on top of an exit door. Both ceiling mounted and wall side mounted exit sign has two surfaces that shows the word “EXIT” so that people from both sides can read it. Then, for the wall mounted application, it just needs to be disassembled and it will turn into two wall mounted exit sign.

3.2.2 Report Flow Chart

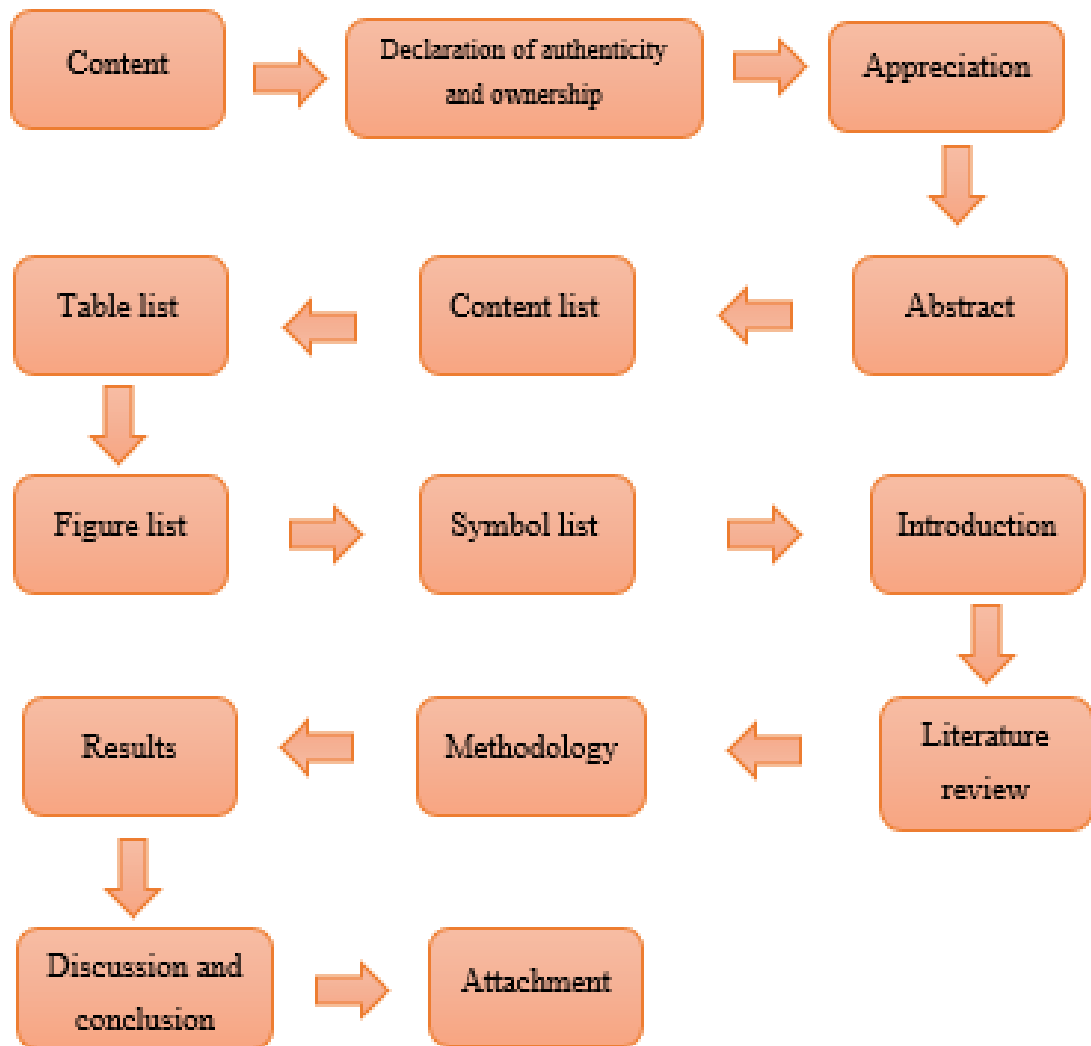


Figure 3.4: Report Flow chart

3.2.3 Project Flow Chart

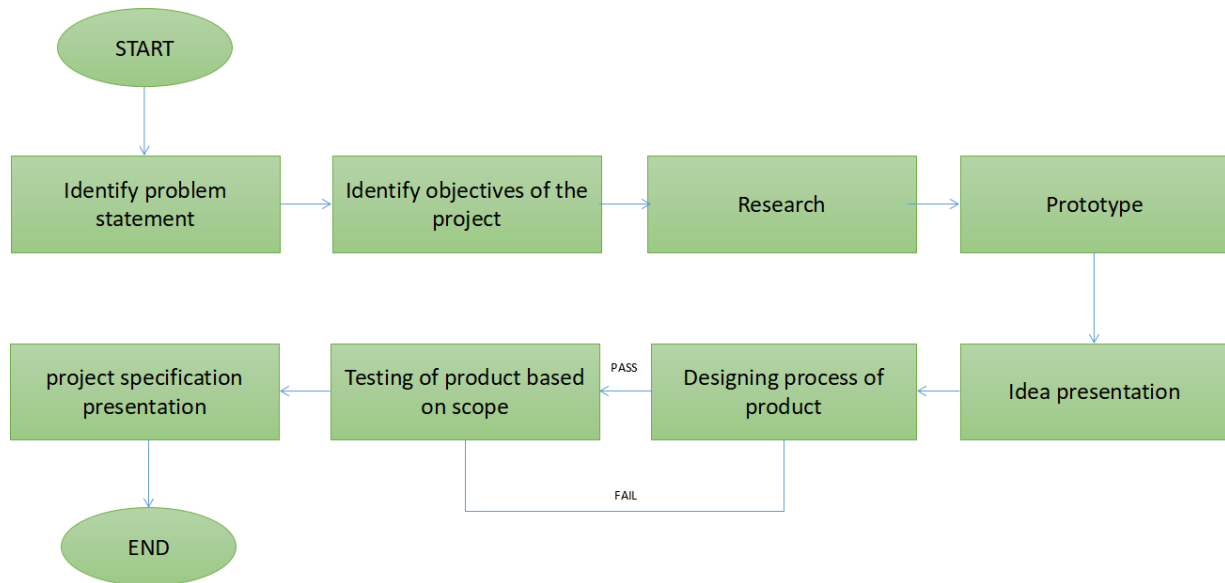


Figure 3.5: Project Flow Chart

3.3 DATA COLLECTION METHOD

According to (Sekaran, 2003) a research design is set up to decide on, among other issues, how to collect further data, analyze and interpret them, and finally, to provide an answer to the problem. (Sekaran, 2003) also wrote *“The researcher would determine the appropriate decisions to be made in the study design based on the problem definition, the research objectives, the extent of rigor desired, and cost considerations. Sometimes, because of the time and costs involved, a researcher might be constrained to settle for less than the ideal research design. For instance, the researcher might have to conduct a cross-sectional instead of a longitudinal study, do a field study rather than an experimental design, choose a smaller rather than a larger sample size, and so on, thus sub-optimizing the research design decisions and settling for a lower level of scientific rigor because of resource constraints.”*

Another study of (Cavana, 2001) stated that a research design may be narrated as a series of decisions that as a whole form a strategy for answering the research questions and testing the hypotheses. Supporting this way of thinking, (Cavana, 2001) view research design as a structured

set of rational decision-making choices, or guidelines, to assist in generating valid and reliable research results. A research design in a positivist setting covers decisions about the choice of data collection methods, and about measurement and scaling procedures, instruments, samples and data analysis (Cavana, 2001). A good research design must make sure that the information obtained is relevant to the research problem, and that it was collected by objective procedures.

The most commonly classified research designs of exploratory, descriptive, cause-effect and experimental.

Qualitative Methods	Interviews
Quantitative Methods	Questionnaire
	Experimental

Table 3.1: Classification of qualitative and quantitative method

Referred to the table, the word qualitative implies an emphasis on the qualities of entities and on processes and meanings that are not experimentally examined or measured in terms of quantity, amount, intensity, or frequency. Quantitative studies emphasize the measurement and analysis of causal relationships between variables, not processes. Qualitative forms of inquiry are considered by many social and behavioral scientists to be as much a perspective on how to approach investigating a research problem as it is a method.

There are two main characteristics of a qualitative research study and the applied forms each take in the investigation of a research problem.

i. The Design

- Naturalistic refers to studying real-world situations as they unfold naturally, non-manipulative and non-controlling. The researcher is open to whatever emerges.
- Emergent is the acceptance of adapting inquiry as understanding deepens and/or situations change. The researcher avoids rigid designs that eliminate responding to opportunities to pursue new paths of discovery as they emerge.
- Purposeful cases for study are selected because they are “information rich” and illuminative. That is, they offer useful manifestations of the phenomenon of interest.

Sampling is aimed at insight about the phenomenon, not empirical generalization derived from a sample and applied to a population.

ii. The Collection of Data

- Data is observations yield a detailed, "thick description". Interviews capture direct quotations about people's personal perspectives and lived experiences; often derived from carefully conducted case studies and review of material culture.
- Personal experience and engagement. Researcher has direct contact and gets close to the people, situation, and phenomenon under investigation. The researcher's personal experiences and insights are an important part of the inquiry and critical to understanding the phenomenon.

Other than that, quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. Quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon.

Goal in conducting quantitative research study is to determine the relationship between an independent variable and a dependent or outcome variable within a population. Quantitative research designs are either descriptive or experimental. A descriptive study establishes only associations between variables; an experimental study establishes causality.

3.4 RESEARCH

This study is based on qualitative and quantitative methods. The instruments used to get the data is questionnaire, observation, interview and experiment. Questionnaire and experiment are selected to get the data in this study while interviews and observations are to reinforce the data of the study.

3.4.1 Questionnaire

Questionnaire is a list of carefully structured questions, chosen after considerable testing, with a view to eliciting reliable responses from chosen sample. The aim of a questionnaire is to find out what a selected group of participants do, think or feel (Collin and Hussey, 2003). Questionnaires are used to collect data by asking the sample or participants to respond to exactly

the same set of questions. The questions in the questionnaire will be a combination of Yes/No questions, questions that will give the respondent an option to add comments/justification further to his/her answer. Open questions are also used to allow the respondents free to express his/her view, so that it helps in critical analysis of the Eco Exit Sign. Researcher will modify or change the project specification and acknowledge whether the project is acceptable for the community based on the results of questionnaire.

3.4.2 Observation

Observation is a method of viewing and recording the actions and behaviors of participants. It is described as being a systematic observation method, which implies that the observation techniques are sensible and replicable procedures so that the research could be reproduced. Researcher can go to various of locations such as shopping mall, institutional buildings, offices etc. to observe the types of exit signage used, whether it complies the regulations and the conditions of it. Other than that, researcher can also do some online research about the incidents that had happened before due to emergency exit signage failure. From this observation, researcher can identify the problems that should be taken into account when working on the Eco Exit Signage.

3.4.3 Interview

Interviews are a method of collecting data in which selected participants are asked questions in order to find out what they think or feel. Interviews make it easier to gather the necessary information and opinions, maybe face to face, voice to voice or screen to screen; conducted with individuals or group of individuals (Hussey and Hussey, 1997).

For the purpose of this research, conducting interviews, a qualitative method of data collection is used. According to Saunders et al. (2003) interviews are categorized as follows:

i. Structured interviews

Structured interviews are based on a pre-determined set of questions that are asked by the interviewer in a particular order with no room for flexibility. There is no much room for interaction between the interviewer and the interviewee.

ii. Semi- structured interviews

A semi-structured interview also involves a pre-determined set of questions, but gives the interviewer scope to change the order of questions asked, query certain areas of interest based on the answers given.

iii. Unstructured interviews

Unstructured interviews are informal. This method of interviewing allows the interviewer to ask any questions without being bound to a pre-determined set of questions. It looks more like a casual chat which allows the interviewer to talk about the issues pertaining to the research (Saunders et al., 2003).

3.4.4 Experiment

Experimental research is any research conducted with a scientific approach, where a set of variables are kept constant while the other set of variables are being measured as the subject of experiment. Experimental research is one of the founding quantitative research methods. There are several experiments that will be conducted for Eco Exit Sign in order to ensure that it complies the regulations of emergency exit signage and effective while operating.

a) Distance of visibility of Eco Exit Sign

Procedure:

1. Hang the Eco exit sign 0.2m above the floor level in a dark space area.
2. Stand across the room 5m away from the hanging exit sign.
3. Record the visibility level of the exit sign in a table.
4. Repeat step 2-3 with 10m,15m,20m,25m,30m,35m and 40m away from the exit sign.
5. Then, repeat step 2-4 in a lighted space area with normal lighting level.
6. After tabulating the data, determine the maximum distance of Eco Exit Sign visibility.

The maximum distance of exit sign visibility should be no more than 30.48m.

b) Effect of Heat towards materials involved

c) Brightness of Eco Exit Sign

Procedure:

1. Mix photo luminescent powder with clear primer with ratio 1:1.
2. Put one layer of photo luminescent mixture on the "EXIT" word.
3. By using a lux meter, point the sensor to the word "EXIT" and take the reading after 5 seconds.
4. Record the illumination reading measured in a table.
5. Repeat step 3-4 with more layers until the illumination reaches 10.7639 lux which is the average of illumination should be put out by any emergency sign.

d) Glowing duration of Eco Exit Sign

Procedure:

1. Charge the Eco Exit Sign under a reliable source of light for 1 hours.
2. After charging, switch off the light in the room and start the timer simultaneously.
3. Observe and stop the timer as the light put out by Eco Exit Sign started to dim and not visible anymore.
4. Record the time taken in a table.
5. If the time taken is less than 90 minutes, repeat the experiment after charging the Eco Exit Sign for 2 hours and more.

3.5 SAMPLING TECHNIQUE

Sampling techniques are a range of methods that enable the researcher to reduce the amount of data to be collected by considering only data from a subgroup rather than possible cases or element (Saunders, et al. 2003).

The samples chosen to satisfy the enquiry from researchers for Eco Exit Sign will include officer from the fire department, lecturers from Politeknik Sultan Salahudin Abdul Aziz Shah and emergency lighting seller company through interview methods. Other than that, students and staff from the same institutional building will also be enquired through questionnaire method. Questions will be given via questionnaire paper or google form. Public community such as office employee, mall visitors, library's visitors or staff etc. will also be given some questions in order to consider the suitability of Eco Exit Sign applications. The experiment will be conducted with the cooperation from Fire Department Officer in Bukit Jelutong, Shah Alam as they are willing to participate in the progress of Eco Exit Sign project.

3.6 DATA ANALYSIS METHOD

To analyze quantitative data, the first stage is to prepare data. The aim is to convert raw data into something meaningful and readable. There are four steps to prepare data as follows:

1. Step 1: Data Validation. The purpose of data validation is to find out whether the data collection was done as per the pre-set standards and without any bias. It is a four-step process, which includes fraud, screening, procedure and completeness. To do this,

researchers would need to pick a random sample of completed surveys and validate the collected data. (Note that this can be time-consuming for surveys with lots of responses.)

2. Step 2: Data Editing. Large data sets include errors. This is because respondents may fill fields incorrectly or skip them accidentally. To avoid there are no such errors, the researcher should conduct basic data checks, check for outliers, and edit the raw research data to identify and clear out any data points that may hamper the accuracy of the results.
3. Step 3: Data Coding. It refers to grouping and assigning values to responses from the survey.

The two most commonly used quantitative data analysis methods are descriptive statistics and inferential statistics. Typically, descriptive statistics is the first level of analysis. It helps researchers summarize the data and find patterns. The commonly used descriptive statistics are:

- Mean: numerical average of a set of values.
- Median: midpoint of a set of numerical values.
- Mode: most common value among a set of values.
- Percentage: used to express how a value or group of respondents within the data relates to a larger group of respondents.
- Frequency: the number of times a value is found.
- Range: the highest and lowest value in a set of values.

Descriptive statistics provide absolute numbers. Descriptive statistics are most helpful when the research is limited to the sample and does not need to be generalized to a larger population.

Inferential statistics are used to generalize results and make predictions about a larger population. Thus, researchers collect data on a sample of their population, then they generalize the results to the entire population or target group.

These are complex analyses because shows the relationship between several different variables, rather than describing a single variable. They are used when the researcher needs to go beyond absolute values and understand the relations between variables.

A few types of inferential analysis are:

- Correlation: This describes the relationship between two variables. If a correlation is found, it means that there is a relationship among the variables. For example, taller people tend to have a higher weight. Hence, height and weight are correlated with each other. However,

this doesn't necessarily mean that one variable causes the other (e.g. gaining weight doesn't cause people to grow taller).

- Regression: This shows the relationship between two variables. For example, regression can help us guess someone's weight based on their height.
- Analysis of variance: This is a statistical procedure used to test the degree to which two or more groups vary or differ in an experiment. In most experiments, a great deal of variance indicates that there was a significant finding from the research. For example, to understand the relationship between the number of children in a family and the socio-economic status, a researcher may recruit a sample of families from each socio-economic status and ask them about their ideal number of children. Analysis of variance will be used to check if the difference between the groups' answers is statistically significant or due to random chance.

These two methods are the most commonly used methods for data analysis. However, other data analysis methods and metrics, such as standard deviation and variance, are also available.

Qualitative data analysis primarily is made up of words, observations, images, and even symbols. Deriving absolute meaning from such data is nearly impossible hence, it is mostly used for exploratory research. While in quantitative research there is a clear distinction between the data preparation and data analysis stage, analysis for qualitative research often begins as soon as the data is available.

Analysis and preparation happen in parallel and include the following steps:

1. Getting familiar with the data: Since most qualitative data is just words, the researcher should start by reading the data several times to get familiar with it and start looking for basic observations or patterns. This also includes transcribing the data.
2. Revisiting research objectives: Here, the researcher revisits the research objective and identifies the questions that can be answered through the collected data.
3. Developing a framework: Also known as coding or indexing, here the researcher identifies broad ideas, concepts, behaviors, or phrases and assigns codes to them. For example, coding age, gender, socio-economic status, and even concepts such as the positive or negative response to a question. Coding is helpful in structuring and labeling the data.
4. Identifying patterns and connections: Once the data is coded, the research can start identifying themes, looking for the most common responses to questions, identifying data

or patterns that can answer research questions, and finding areas that can be explored further.

Several methods are available to analyze qualitative data. The most commonly used data analysis methods are:

- **Content analysis:** This is one of the most common methods to analyze qualitative data. It is used to analyze documented information in the form of texts, media, or even physical items. When to use this method depends on the research questions. Content analysis is usually used to analyze responses from interviewees.
- **Narrative analysis:** This method is used to analyze content from various sources, such as interviews of respondents, observations from the field, or surveys. It focuses on using the stories and experiences shared by people to answer the research questions.
- **Discourse analysis:** Like narrative analysis, discourse analysis is used to analyze interactions with people. However, it focuses on analyzing the social context in which the communication between the researcher and the respondent occurred. Discourse analysis also looks at the respondent's day-to-day environment and uses that information during analysis.
- **Grounded theory:** This refers to using qualitative data to explain why a certain phenomenon happened. It does this by studying a variety of similar cases in different settings and using the data to derive causal explanations. Researchers may alter the explanations or create new ones as they study more cases until they arrive at an explanation that fits all cases.

These methods are the ones used most commonly. However, other data analysis methods, such as conversational analysis, are also available.

Experimental method is a systematic approach to research in which the researcher manipulates one or more variables, and controls and measures any change in other variables. It has a control group, the subjects have been randomly assigned between the groups, and the researcher only tests one effect at a time. It is also important to know what variable(s) you want to test and measure. A very wide definition of experimental research is research where the scientist actively influences something to observe the consequences. A rule of thumb is that physical sciences, such as physics, chemistry and geology tend to define experiments more narrowly than social sciences, such as sociology and psychology, which conduct experiments closer to the wider definition.

3.7 CHAPTER CONCLUSION

As conclusion, this chapter has focus on the methods of investigation and data collection. Based on researches, the methods used are the most precise to analysis. This chapter is very important in order to select the right material that will lead a product quality different.

CHAPTER 4 RESULT

4.1 Introduction

Results are the changes or effects expected to take place after implementing the project with certain methods of testing such as interviews, questionnaire, observations or experiments. The results are generally positive improvements to the lives of the beneficiaries. In this project, we used all of the method stated above. All of the results obtained are presented in the form of descriptive and empirical data. Descriptive data are results related or presented in the form of numerical data while empirical data is the information received by means of the senses, particularly by observation and documentation of patterns and behaviour through experimentation.

4.2 Descriptive Data & Analysis

Descriptive data are used to describe the basic features of the data in this project study. They provide a simple summary about the projects and the measures. Together, with simple graphics analysis, they form the basis of virtually every quantitative analysis of data. There are several testing were carried out with quantitative data such as:

4.2.1 Brightness of Eco-Exit Sign

For the first experiment, the words “EXIT”, the arrow indicator and the running man on the acrylic plate are painted with the mixture of photoluminescent powder and clear primer. After painting the first layer of the mixture, the Eco-Exit Sign was to put into an experiment where the brightness of the glowing Eco-Exit Sign was measured by using a lux meter. *“If you have emergency lighting that is self-luminous or electroluminescent, it must have a minimum luminance surface value of 0.06-foot lamberts or higher.” NFPA 101 Life Safety Code Section 7.9.* The layer of photoluminescent mixture was added continuously until it reaches the satisfactory of 0.006-foot lambert which is also 0.02056 lux or higher. The photoluminescent addition was stopped at the third layer when the reading of the lux meter was 1.98 lux, which is a satisfactory to the NFPA 101 Life Safety Code Section 7.9. When carrying out this experiment, the condition of the surrounding should be taken into account. The graph below shows the relation of the brightness of Eco-Exit Sign and number of photoluminescent layer.

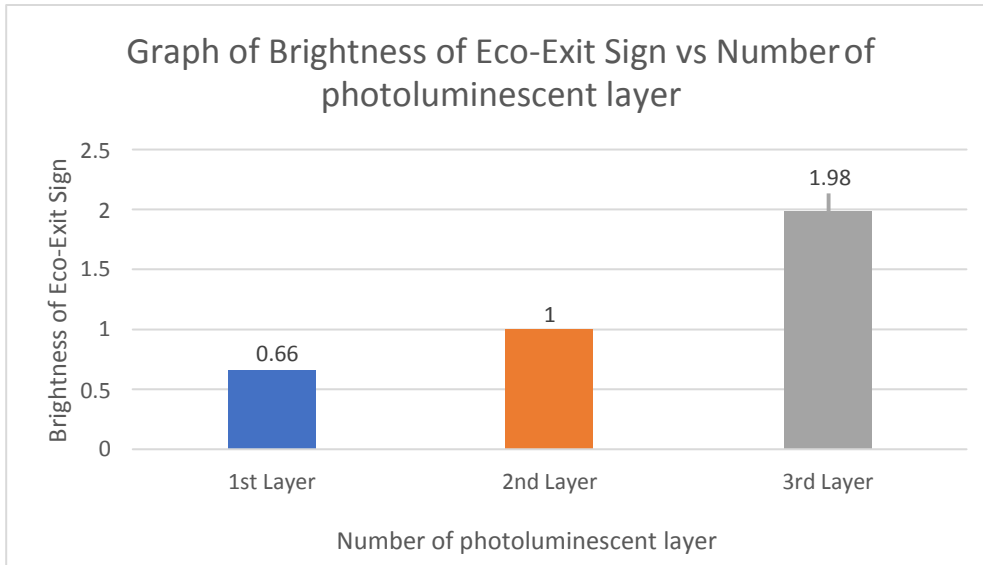


Figure 4.1: Graph of Brightness of Eco-Exit Sign vs Number of photoluminescent layer

4.2.2 Glowing duration of Eco-Exit Sign

“Exit sign should stay illuminated for at least 1.5 hours.” NFPA. For a standard exit sign, the glowing duration should be at least 1.5 hours. In this experiment, the number of layers of the photoluminescent mixture was added until it can glow up to 1 hour. The time taken for the brightness of photoluminescent to fade was taken and recorded. The graph of glowing duration of Eco-Exit Sign and the number of photoluminescent layer is shown below.

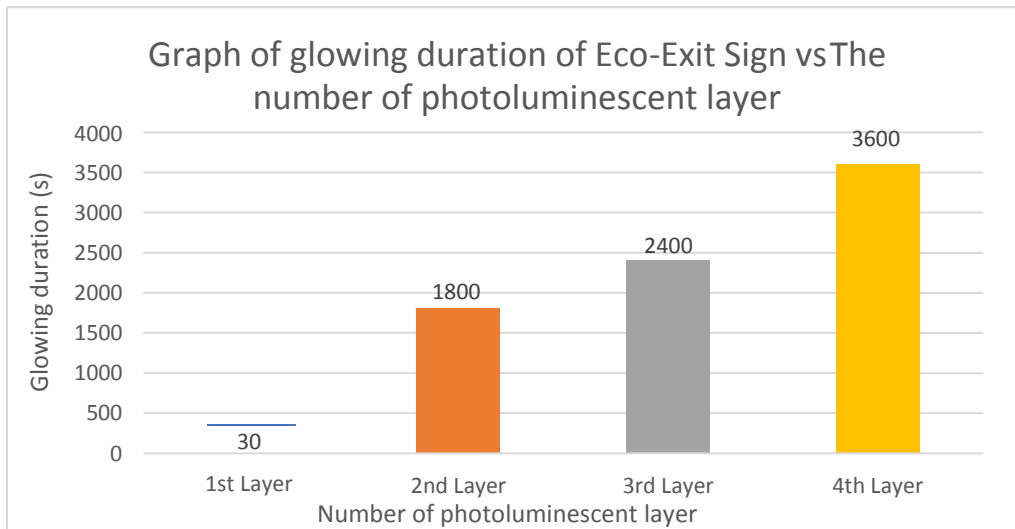


Figure Graph

4.2: of

glowing duration of Eco-Exit Sign vs the number of photoluminescent layer

4.3 Empirical Data & Analysis

Empirical research is research using empirical evidence. It is a way of gaining knowledge by means of direct and indirect observation or experience. The information acquired through experimentation and observation is called empirical data. For this project, there are four types of experiments carried out, which are:

4.3.1 Distance of visibility of Eco Exit Sign

After the brightness of Eco-Exit Sign reaches the satisfactory of the stated regulation, it was put into another experiment which is to test the distance of visibility. *“Exit sign should be visible from no more than 100 ft (30.48m)” OSHA Standards.* Based on the stated statement, a normal exit sign should be visible for more than 30.48m. Therefore, this experiment is carried out by placing the exit sign at a starting of 10 m until 30.5 m from the eye level or camera. The visibility of the signage is then observed. The photo below was taken during the experiment.

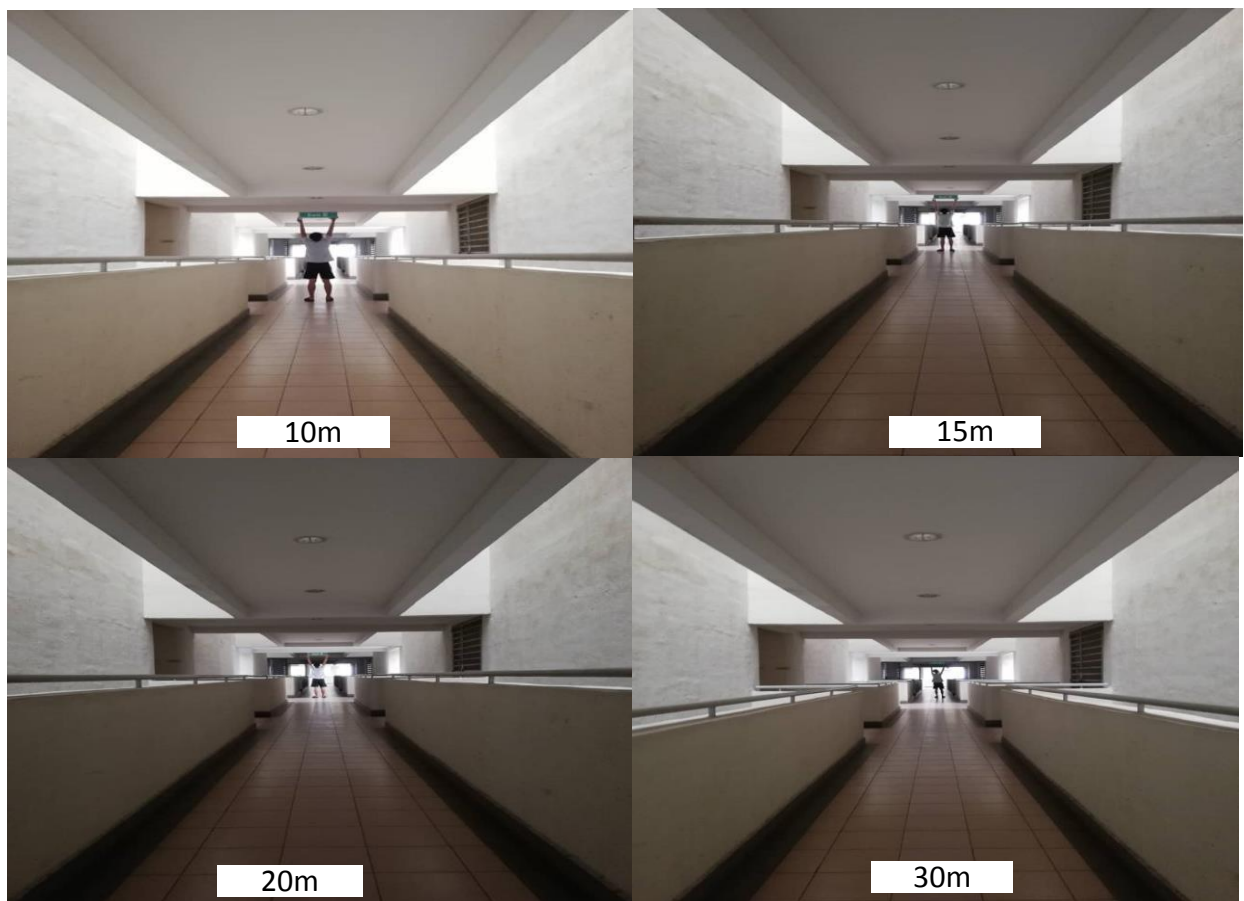


Figure 4.3: The visibility of Eco-Exit Sign at 10m, 15m, 20m, and 30m

4.3.2 The effect of fire towards the body of Eco-Exit Sign

In this experiment, the researchers take a sample of the same material of the body of the Eco-Exit Sign is made off as the object to be burnt at about 300°C at about 15 minutes. The sample of pinewood is sprayed with Hi-Temp Samurai Paint before it is burnt. Hi-Temp Samurai Paint is a fire resistance spray that can withstand a standard fire resistance test. Figures below shows the effect of heat towards the pinewood with and without the Hi-Temp Samurai Paint. The test shows that the surface of pinewood without the fire resistance paint burnt more easily. Meanwhile, the one with the protection of fire resistance spray can withstand the heat better than that of pinewood without fire resistance paint. Other than that, the surface of pinewood that is sprayed with fire resistance spray is not easily damaged by fire.



Figure 4.4 Without fire resistance paint

Figure 4.4: Without fire resistance paint

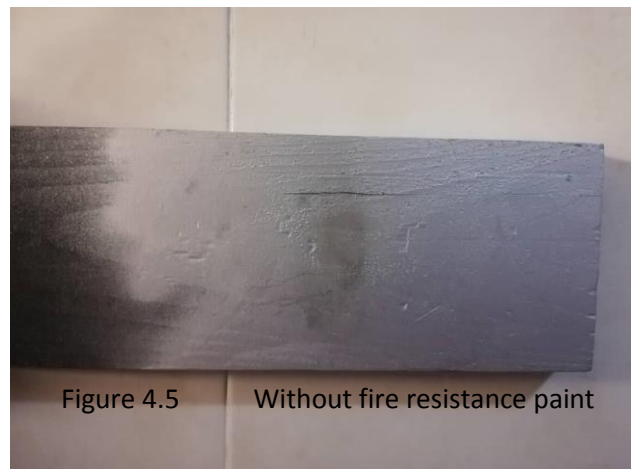


Figure 4.5 Without fire resistance paint

Figure 4.5: With fire resistance paint

4.3.3 Interview with Fire Department Officer

The researchers went to Ibu Pejabat Bomba Negeri Selangor for an interview session with Mr. Zahiran. Based on Mr. Zahiran, this project research is great as an innovation product as the researchers invested their time, money and creativeness in order to come out with this project. He also agreed that this project can help to save environment and building electrical and maintenance cost as it does not required electricity to operate. For an innovation project, as long as the project does not lose its originality and its main function, it can be acceptable. Nevertheless, in order to make this research as a new and official safety product, it requires further research and the approval of SIRIM. Figure below shows the photography session of

the researchers and *Mr.Zahiran Bin Abdul Ghafor, Cawangan Kesedaran Awam of Ibu Pejabat Balai Bomba Negeri Selangor.*



Figure 4.6: Photography session with Mr.Zahiran

4.3.4 Questionnaire

The researcher prepared several questions to be asked to the Fire Department Officers and the public about the Eco-Exit Sign. The researcher prepared several questions to be asked to the Fire Department Officers and the public about the Eco-Exit Sign. The questionnaire consists of 5 close ended questions and 1 open ended question. The questionnaire was divided into 5 questions, i.e. question 1, to acknowledge the awareness of respondent on service provided by an exit sign. Question 2 and 3, to acknowledge the impression of respondents towards Eco-Exit Sign. Question 4, to acknowledge the awareness of the respondents towards the environmental issues that earth is facing and how efficient can Eco-Exit Sign play the role in saving the environment. Last but not least, question 5, to acknowledge the satisfaction level of respondent towards Eco-Exit Sign. In the other hand open ended questions was grossly incomplete due to the lack of comments from the respondents. Below shows the sample of questionnaire given to the respondents.

Product name: Eco Exit Sign



Eco Exit Sign is an eco-friendly and yet a high-quality function as the common exit sign. It plays an important role during emergency. Eco Exit Sign does not require any electricity in order to function properly and yet reduce usage of power. It only needs to be dusted every once a while in order to maintain the brightness of the sign

1.	Do you know Exit sign board?	YES / NO
2.	Do you think Eco Exit Sign is more convenient than the previous exit sign?	YES / NO
3.	Do you think Eco Exit Sign can reduce the regular requirement of maintenance?	YES / NO
4.	Due to the environment issues that our earth is facing nowadays, do you think that Eco Exit Sign can help to reduce the pollutions and global warming? As it does not use any electrical power and is made up of eco-friendly material.	YES / NO
5.	How innovative is the product?	POOR AVERAGE GOOD

Do you have any other comments about how we can improve our product?

JOB	

Figure 4.7: Questionnaire sample

4.4 Conclusion

Based on the research and testing we did; the Eco Exit Sign will do it's best to comply to the standard of a emergency exit light. Besides that. This chapter is used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data Or we may measure a large number of people on any measure. The Eco Exit Sign has a lot room for improvement. We will do our best to comply to the standard of an emergency exit light in order to enter the potential markets.

CHAPTER 5 CONCLUSION

5.1 Introduction

This chapter reviews the research that has been carried out. First, a brief review of the project research is presented. In this part, all issues such as the research objectives, problem statement and methodology are briefly discussed.

Subsequently, the major findings of the study are discussed. In this section, the findings from the empirical test derived from data analysis are presented. Then, the implications of the current study are discussed. Next, the contributions of the study are presented. Finally, the discussion on the limitations and direction for future research are presented.

5.2 Discussion

Generally, the main objectives of this project is to improve the electrical powered exit sign that has been highly used in Malaysia. At the same time, reducing the pollution and protecting the environment of the earth. Due to the highly polluted environment the earth is facing nowadays, photoluminescent, a non-toxic self-luminous powder is used to replace the LED or any electrical powered exit sign to indicate the nearest exit in any building. This helps to save not only the cost of electricity of a building, it also saves the reliable sources that are used to produce electricity such as nuclear energy, fossil energy, oil, coal and natural gas which are classified as the non-renewable source of energy. In order to obtain these non-renewable sources, the earth must be drilled or mined. All of these activities will lead to unwanted impact to the earth. Other than that, all the materials used on this project are eco-friendly. Therefore, we can say that the innovation of this project supports the 3R concept and is not harmful to the environment.

One of the research instruments was putting the project into a number of tests and observation. This project has gone through several types of experiment in order for it to completely comply to the safety regulations. For instant, the test of the Eco-Exit Sign towards the brightness, distance of visibility, effect of fire and the glowing duration. From the result obtained, we can say that this project has pass most of the tests that were carried out on it. Within the process of the tests were carried out, this project has passed 3 of the tests. There is one test that it is unable to pass due to the limitations itself which will be discussed furthermore. Besides that, questionnaire and interview session are carried out in order to know the impression of the industry. The questionnaire consists

of 5 close ended questions and 1 open ended question. The questionnaire was divided into 5 questions, i.e. question 1, to acknowledge the awareness of respondent on service provided by an exit sign. Question 2 and 3, to acknowledge the impression of respondents towards Eco-Exit Sign. Question 4, to acknowledge the awareness of the respondents towards the environmental issues that earth is facing and how efficient can Eco-Exit Sign play the role in saving the environment. Last but not least, question 5, to acknowledge the satisfaction level of respondent towards Eco-Exit Sign. In the other hand open ended questions was grossly incomplete due to the lack of comments from the respondents.

Therefore, the data from those responses were excluded.

5.3 Conclusion

This project research has given a chance to save electricity, the buildings, the occupants, the environment and the earth. From identifying the problem faced by the building maintenance to solving it with a green technology known as Eco-Exit Sign. This research is not completely perfect as it needs to be improved in several aspect which will be discussed further. The research instrument questionnaire proves that, this new innovation has been accepted in the industry. With more improvements of this product, the researchers believe that it will bring a huge impact to the industry world, nations and countries in a positive way.

5.4 Recommendation for future research

There are several aspects that can be improved in order to make future research on this topic more accurate and more meaningful to represent the evolution on exit sign:

5.4.1 Visibility of Eco-Exit Sign

Based on the present test that was carried out related to the visibility of Eco-Exit Sign, it has shown that it needs some improvement in order for the building occupants to notice it easier especially during the emergency. It may have passed the test, but the height and width of the wordings can be enlarged so that I can be read from afar. This can be convenient for the building occupants to identify the nearest exit.

5.4.2 Glowing duration of photoluminescent.

This experiment involves the time taken for the glowing of photoluminescent to fade and out of sight. The variable that was taken into account was the number of layers of photoluminescent. The Eco-Exit Sign is unable to pass the experiment due to the lack of depth of the wordings on the acrylic plate where the word "EXIT" is engraved on. Therefore,

recommendation of using a thicker acrylic plate may be helpful so that there is more area for the word to be engraved. The deeper the engraves of the word, the more layer of photoluminescent mixture can be put on it, hence enhancing the brightness and the glowing duration of the Eco-Exit Sign. The researchers were unable to correct this due to the budget limitations.

5.4.3 The weight of Eco-Exit Sign

Eco-Exit Sign is made up of pine wood, a high-quality wood which is also very healthy. The researchers chose pinewood because it has high rate of fire resistant. The weight can be reduced by designing a more compact and light weighted design. The current Eco-Exit Sign looks bulky and heavy, with a more compact design, the industry might extend their interest on this project due to its compatibility and aesthetic look.

5.5 Summary

It is hoped that this research and new innovation has given a clearer view for the industries and public towards the green technology which at the same time can help in saving the earth. Specially, it is hoped that the current study gives a clear view of awareness, satisfactions and benefits of the new innovation Eco-Exit Sign. With this green technology, the industries can develop more effective and attractive new ideas of green technology that can help in saving money and the planet. Therefore, the Eco-Exit Sign can help the nation to improve the economic condition and contribute to the achievement of the target of becoming a developed, healthy and green country in the future.

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ATTACHMENT

I. Gantt Chart

II. Questionnaire

Product name: **Eco Exit Sign**



Eco Exit Sign is an eco-friendly and yet a high-quality function as the common exit sign. It plays an important role during emergency. Eco Exit Sign does not require any electricity in order to function properly and yet reduce usage of power. It only needs to be dusted every once a while in order to maintain the brightness of the sign

1.	Do you know Exit sign board?	YES / NO
2.	Do you think Eco Exit Sign is more convenient than the previous exit sign?	YES / NO
3.	Do you think Eco Exit Sign can reduce the regular requirement of maintenance?	YES / NO
4.	Due to the environment issues that our earth is facing nowadays, do you think that Eco Exit Sign can help to reduce the pollutions and global warming? As it does not use any electrical power and is made up of eco-friendly material.	YES / NO
5.	How innovative is the product?	POOR AVERAGE GOOD

Do you have any other comments about how we can improve our product?

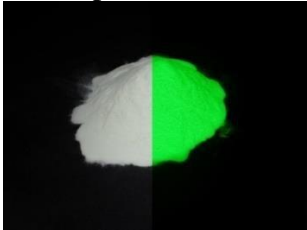



JOB	



Figure 4.7: Questionnaire sample

III. Project Costing

No.	Materials	Quantity	Price per unit	Overall price
1	Photoluminescence powder	100g	RM90/100g	RM90
2	Clear premier	500ml	RM40/500ml	RM40
3	Fire resistance wood (12x600x1200) mm	4	RM75	RM300
4	Acrylic glass	2	RM15	RM30
5	Nuts and screw 35mm	4	RM5	RM5
	Exit sign plate	3	RM130	RM390
	Reflective paper	1	RM25	RM25
	Fire resistant spray	1	RM25	RM25
	Steel rod	2	RM20	RM40
Total amount			RM945	

IV. Components List

Material	Description
<p>Photoluminescence powder</p> 	<p>Photoluminescent is a self-luminous powder</p>
<p>Reflective Sticker</p> 	<p>Bounce the light, making it appear as if the sticker or decal is glowing.</p>
<p>Acrylic</p> 	<p>Acrylic is a transparent plastic</p>
<p>Fire Resistance Spray</p> 	<p>Fire Resistance paint helps to protect any surface from fire damage.</p>

<p>Clear Primer</p> 	<p>Clear primer ensures better adhesion of paint to the surface</p>
<p>Pinewood</p> 	<p>Act as the body of Eco-Exit Sign</p>