



DESIGN AND FABRICATION OFFIRE CART TO QUICK ASSIST ERT WITH EMERGENCY SITUATIONS

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Abstract: In introductory chapter discusses the complexities of relationship between humans and fire and the status of human efforts of control the disastrous effects of fire. A subsequent section examines characteristics and behavior of fire, with a special note on smoke movement in building the text covers these topics regarding fire hazard: Fire hazard of specific materials such as wood, fibers and explosives. Industrial and process fire hazard (e.g., solvent extraction) special fire protection and prevention issues regarding indoor and outdoor storage practices, material handling equipment's, electrostatics ignition sources, etc. Fire safety in building design and construction, with attention to high rise structures. Fire hazards in building services (e.g., air conditioning and electrical appliance system and the hazards of various types of occupied structure including residential business industrial and educational. The role and responsibilities of public fire departments and water supplies and facilities for fire protection are examined. Several sections offer detailed discussions of fire protection devices and systems including fire alarms, detection devices guard services, Extinguishing agents, water sprinklers, special systems and portable fire extinguishers. A chapter on fire hazards in rail rapid transit system is include.

The main aim of project is to develop unique range of equipment to assist ERT team in dealing with emergency situations in a safe and effective manner if they arise.

Keywords: Traffic lights, Emergency clinic, Vehicle signal.

1.INTRODUCTION

Firefighting is the act of extinguishing fires, A firefights fights fires to prevent loss of life, and/or destruction of property and the environment. Firefighting is highly technical skill that requires professionals who have spent years training in both general firefighting techniques and specialized areas of expertise.

1.2 DUTIES OF FIREFIGHTER

Firefighters' goals are to save lives, property and the environment. A fire can rapidly spread and endanger many lives; however, with modern firefighting techniques, catastrophe is usually, but not always, avoided. To prevent fires from starting, a firefighter's duties can include public education about fire safety and conducting fire inspections of locations for their adherence to local fire codes.

Because firefighters are often the first responders to people in critical conditions, firefighters may provide many other valuable services to the community they serve, such as:

1. Hazardous materials mitigation (HAZMAT);
2. Vehicle rescue/ extrication;
3. Search and rescue;
4. Community disaster support.
5. Fire risk assessments

Additionally, firefighters may also provide service in specialized fields, such as:

1. Wildland fire suppression;

2. Scarp yard fire suppression;
3. Production plant fire suppression;
4. High petroleum / Diesel storage tanks fire suppression;
5. Explosive chemical fire suppression.
6. LPG/ Kitchen fire suppression;
7. HT/LT Transformer, Panel and distribution line fire suppression;
8. Tool hoisting / High angle rope rescue;
9. Cold water/ UG Sump rescue;
10. Trench rescue;
11. Confined space rescue;
12. Building collapse rescue.

1.3SCIENCE OF EXTINGUISHMENT

Fire elements

There are four elements needed to start and sustain a fire and/or flame. These elements are classified in the "fire tetrahedron" and are:

1. Reducing agent (fuel)
2. Heat
3. Oxidizing agent (oxygen)
4. Chemical Reaction

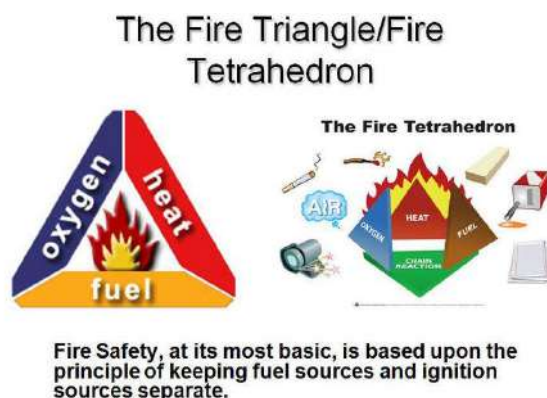


Figure 1.1 Fire triangle/ Fire tetrahedron

The reducing agent, or fuel, is the substance or material that is being oxidized or burned in the combustion process. The most common fuels contain carbon along with combinations of hydrogen and oxygen. Heat is the energy component of the fire tetrahedron. When heat comes into contact with a fuel, it provides the energy necessary for ignition, causes the continuous production and ignition of fuel vapours or gases so that the combustion reaction can continue, and causes the vaporization of solid and liquid fuels. The self-sustained chemical chain reaction is a complex reaction that requires a fuel, an oxidizer, and heat energy to come together in a very specific way. An oxidizing agent is a material or substance that when the proper conditions exist will release gases, including oxygen. This is crucial to the sustainment of a flame or fire.

2. LITERATURE SURVEY- DESIGNING OF FIRE HYDRANT SYSTEM

Aside from the general purpose of delivering water for fire fighting, the hydrant design selected must be based on a number of operational elements. Some issues to consider include:

How much water (GPM or L/min) is needed for fire fighting. How many and what size hose connections are required.

The established hose sizes and coupling threads in the region. Current (and future) configuration of fire apparatus.

Issues of clearance and visibility. Operating characteristics of the hydrants.

Amount of head (static pressure) that is present in the system. Climatic conditions in the area.

Generally speaking, water supply systems in industrial area should be designed to deliver no less than 3000 GPM (11000 L/min) at each individual hydrant. In commercial and multi-story apartment zones, this volume should increase based on the required fire flows of the buildings being protected. If the required fire flows are several thousand GPM, the required flow will usually have to be met by two or more hydrants flowing simultaneously.



The operations of the fire department or fire brigade must be taken into consideration. In instances where new hydrant systems are replacing poor or nonexistent systems, new fire fighting approaches need to be developed to make proper use of the new system. Hydrant designs should capably and easily provide necessary water to fire engines currently in service as well as more modern fire engines which may be purchased in the future. For example, a fire brigade may have smaller engines equipped with medium diameter hose and 750 GPM (2850 L/min) pumps, however with a suitable water supply system, the brigade may upgrade to engines equipped with large diameter hose and pumps with a capacity of 1250 GPM (4732 L/min) or greater. Accordingly it may be appropriate to specify fire hydrants which have medium diameter hose outlets as well as a large diameter pumper outlet.

In the event of a major emergency, fire companies may be requested from multiple jurisdictions. Hydrant outlet threads should meet the regional standard for compatibility among all fire engines, regardless of origin. If no large diameter outlet size and thread has been established, we recommend the 5" Storz configuration.

Hydrants need to be readily recognizable and accessible. Placement and installation considerations should take into account the shape of the hydrant as well as the positions of valves and outlets. Specific suggestions regarding hydrant placement are presented later in this feature.

Hydrants must be simple and reliable to connect to and to operate. Operating nuts should be pentagonal or triangular in design to reduce tampering by unauthorized persons.

Discharge valves should be specified to open by turning counter-clockwise and close clockwise. (Underground valves on water mains and on the hydrant branch line should operate according to local or regional standards.)

Hydrant designs must be appropriate for the amount of head (static pressure) that is applied to them. The minimum working pressure rating of any fire hydrant should be 150 p.s.i. Hydrants installed in higher pressure installations should be rated appropriately. All fire hydrants should be static tested at twice the rated working pressure.

In temperate climates where hard freezing is not an issue, the most efficient hydrant design is the "wet barrel" hydrant where valves are located above ground and can be independently controlled. In colder climates, dry barrel hydrants will be required which use a single operating valve that is located below ground in the base of the riser and which charge all outlets simultaneously when turned on.

3. EXISTING FIREFIGHTING SYSTEM

Firefighting system

A firefighting system is an activity of prevention during a fire spread in building, home or warehouse with the use of proper fire safety equipment like extinguisher, hose reels, fire monitors, nozzles and hose pipes

There are many types of firefighting systems and some important types of firefighting systems are following.

1. Fire Hydrant System
2. Fire Sprinkler System
3. Fire Alarm System
4. Deluge System
5. Foam Top pourer System
6. Vesda System (Very early smoke detection apparatus)
7. FM 200 System
8. CO2 Gas Suppression System
9. Wet chemical powder Suppression system (Kitchen Fire)
10. Fire Extinguisher system

3.1 FIRE HYDRANT SYSTEM

In spite of all chemical developments in the field of firefighting, water still remains the most economical and dependable fire extinguishing medium, due to no-cost factor and continuity of supply. A proper fire hydrant system ensures an adequate, un-interrupted water supply, under sufficient pressure, at all strategic points of a building/factory in such a way that fire can be attacked immediately, with minimum loss of time and with maximum efficiency.



Figure 3.2 Fire pumps Control Panels



Figure 3.3 Hydrant point & Hose Box



Figure 3.4 Fire pumps- Main (Diesel), Electrical, Jockey pumps



4. PROBLEM IDENTIFICATION

- Response time for the fire incident is more than 4:00 Minutes, It will create more difficulty for fire suppression
- No vehicle for transportation of ERT Members to a fire incident scene.
- Availability of all emergency tools and equipment's not in one area.
- Only 55% area was covered by fire hydrant points.
- Operating of Fire hydrant requires 3+ Trained, Well Experienced ERT Members required.
- Pressure of discharge water is not more enough for high range fire targets.
- Handling of water discharge gun is difficult at 360 Degree of firefighting.

Response and reacting time for fire incident.

Fire and emergency services, across the country, though trained to respond at the earliest, suffer from restricted access, encroachments and traffic congestion. This often causes a delay in response, leading to loss of life and assets. The delay in response to fire outbreaks by the authorities is a major issue as the inability to rescue within the golden hour increases the casualties. The norms of the Standing Fire Advisory Council (SFAC) stipulate response time between 3-7 minutes based on the risk category

- At 0:30 minutes, the fire starts and rapidly grows.
- At 1:04 minutes, the fire spreads from the initial flame, and the room begins to fill with smoke.
- At 2:30 minutes, the temperature in the source room climbs above 400°F.
- At 3:03 minutes, the temperature in where the fire began will reach over 500°F. No human can survive that kind of heat.
- At 3:20 minutes, escaping will be very challenging, with the upstairs halls filled with smoke.
- At 3:41 minutes, a "flashover" occurs. Everything in the room where the fire originated will ignite, with the temperature exceeding 1,400°F.
- At 4:33 minutes, flames will have engulfed the home's exterior. Rescue is no longer possible.

It takes less than five minutes for a fire to completely engulf most area. There is not much time to decide what to do. Fire waits for no man. It is critical to make a plan in advance.

4.1 CRITICALITY OF THE PROBLEM

- Delay in response time leads to more property damage and risk of life for occupants.
- Increased direct & indirect cost of accidents
- Affecting our company Hi 5 metrics

5. PROPOSED WORK – FIRE CART

A fire cart is a vehicle designed primarily for firefighting operations. The terms "firefighting cart" and "fire Cart" are often used interchangeably.

5.1 SCOPE OF THE PROJECT

This project scope to support the ERT team by increasing the firefighting ability to more than 30% with the existing set up at M/s Lucas TVS Pvt. Ltd, Thirubuvanai.

This project is taken for improvement mainly too

- The primary purposes of a fire cart are to quickly extinguish the fire and including transport of ERT member to an incident scene.
- Fire cart is a vehicle can use in New Building construction there is no fire protection system expect fire extinguisher.
- Provide a fast and effective first response to fighting fires, on our shop floor and other peripherals of NPM premises. It consists of all aspect of emergency equipment and accessories and supports the ERT team within the first few minutes of any unfortunate incident...
- The modern Fire cart is easily operated by one person and cart utilises the nearest water supply (i.e.) it can be attached to a nearest fire hydrant point to extinguish the fire.
- Also, the Fire Cart carries other special apparatus, firefighting equipment required by ERT team to fight against the hazardous materials mitigation and technical rescue.
- A typical modern fire cart will carry tools for a wide range of firefighting tasks, with common equipment mention below.

**5.2 COMPONENTS OF FIRE CART**

SI.NO.	ITEMS	QTY
1	Fire Monitor	1 Nos
2	Hose reel drum	1 Nos
3	2 Way fire brigade	1 Nos
4	Fire extinguisher	
	Co2 - 4.5 kg	1 Nos
	Foam - 9 liters	1 Nos
	ABC - 4 Kg	1 Nos
	ABC - 2 Kg	2 Nos
5	Nozzle (SS)	2 Nos
6	Hose with female and male coupling (SS)	2 Nos
7	Barrier rope	2 Nos
8	Nylon rope	1 Nos
9	Mega phone	1 Nos
10	Fire blanket	1 Nos
11	Gum boot	2 Pair
12	Stretcher	1 Nos
13	Helmet (RED)	3 Nos
14	Fire axe	1 Nos
15	Reflective jacket	5 Nos
16	Kevlar gloves	1 Pair
17	Face shield	1 Nos
18	Mask	3 Nos
19	Goggles	3 Nos
20	Hand Gloves	3Pair
21	HT Gloves	1 Pair
22	Hand siren	1 Nos
23	Tool box	1 Nos
24	4Inch pipe with MS - C class	20 mtr
25	4Inch pipe L Bow with MS - C class	2Nos
26	Fire ball	2 Nos
27	First aid Box	1 Nos
28	Hammer	1 Nos
29	Tarpaulin	1Nos
30	Full body harness	1Nos
31	Fall rescue kit	1Nos
32	Self containing breathing apparatus	1Nos
33	Chemical spill kit	1Nos
34	Oil spill kit	1Nos

5.3 ELECTRIC VEHICLE

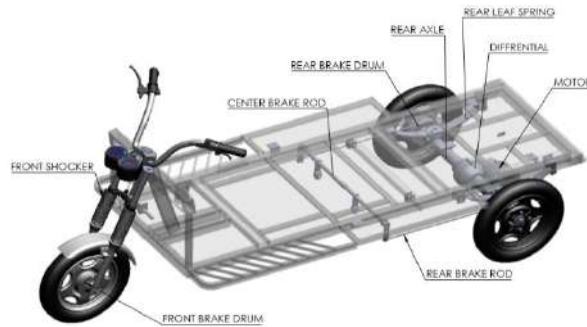


Figure 4.5 Design and Transmission of Electric vehicle

5.3.1 BILL OF QUANTITY ELECTRIC VEHICLE

Si.no.	Descriptions and specifications	QTY
1.	Seamless 15mm Square tube	50 Mtr
2.	Tyre with wheel	3 Nos.
3.	Hydraulic Drum brake front and rear	3 Nos.
4.	Helical spring and hydraulic shock absorber with anti-drive link front suspension	1 Nos.
5.	Rear leaf spring suspension	2 Nos.
6.	Differential gear, axle with Motor 48v, 10 kw BLDC type	1 Nos.
7.	Electric vehicle 48v Controller box.	1 Nos.
8.	Handle bar, brake sets, throttle, Horn front and reverse, Head light and break lights.	1 Nos.
9.	Battery charger 48V 20 amps and Battery 100 Ah * 4	1 Nos.



Figure 5.6 Fabrication of Electric vehicle

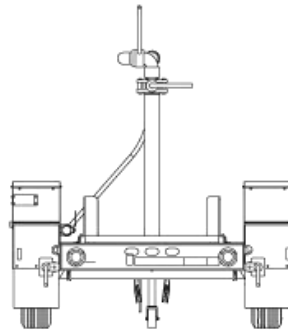
4.4. FIRE MONITOR

Fire Monitors are industrial monitor devices used to deliver large water flows for firefighting purposes in high risk or hazardous industries.

**Figure 5.7 Fire monitor**

5.4.1 STANDARD DESIGNING OF FIRE MONITOR

The designing of fire hydrant system as per NFPA 14.

**Figure 5.8 Design of fire monitor in fire cart.**

The information of designing regarding the external hydrant system consist in NFPA 14 & NFPA 22 for water storage tank, NFPA 20 for pump.

The major points of designing are as follows.

1. General

Aside from the general purpose of delivering water for firefighting, the hydrant design selected must be based on a number of operational elements.

2. Pressure Limitation.

Amount of head (static pressure) that is present in the system. Climatic conditions in the area.

Generally speaking, water supply systems in industrial area should be designed to deliver no less than 3000 GPM (11000 L/min) at each individual hydrant

3. Location of Hose Connections

How much water (GPM or L/min) is needed for firefighting. How many and what size hose connections are required.

The established hose sizes and coupling threads in the region. Current (and future) configuration of fire apparatus.

4. Number of stand pipes

Fire hydrants, namely, stand post type, and underground type conforming to IS 909: 1975 should be provided. Standpipes are portable hydrants designed to be connected to a fire hydrant in a water main to gain access to bulk water. All standpipes used in our area of operations must be metered and hired from us.

The pipe laid in soil shall be protected as specified. 1.8. 7 The yard hydrants shall be placed at a regular spacing of 45m centre to centre

5. Interconnection of standpipes.

Standpipe systems are a series of pipes which connect a water supply to hose connections, basically an extension of the fire hydrant system. They are designed to provide a pre-piped water system for building occupants or the fire department

6. Minimum sizes for standpipes and branch lines

The minimum size for a branch line is 2-1/2 inches. The standpipe minimum size for Class I and III is 4 inches, with a combined system minimum of 6 inches. The size of the branch lines for a hydraulically calculated system is based on the flow, pipe size and length, with the minimum dimension of 2-1/2 inches.



7. System design and sizing of pipe for delivery of system demand

The minimum size pipe for Class I and III standpipes is 4 in. (100 mm). If the standpipe is part of a combined sprinkler system in a partially sprinklered building, that is increased to 6 inches (150 mm). If the building is protected with an automatic sprinkler system, then the minimum combined standpipe size can be 4 in. (100 mm) if hydraulically calculated. The branch lines of the standpipe system are to be sized hydraulically but cannot be smaller than 2 -1/2 in. (65 mm).

8. Minimum and Maximum pressure limits

The pressure in the hydrant pipe work shall be kept constant at 6 Kg/cm². In the event of fire when any of the hydrant valve in the network is opened, the resultant fall in header pressure shall start the AC motor driven fire pump through pressure switches automatically.

9. Stand pipes system zones

The standpipe extends into the building to supply fire fighting water to the interior of the structure via hose outlets, often located between each pair of floors in stairwells in high rise buildings.

10. Flow rates

All fire hydrants have a required minimum outlet flow rate of 10 litres per second (L/s)

CLASS AA	1,500 gpm or greater
CLASS A	1,000 gpm or greater
CLASS B	500 to 1,000 gpm
CLASS C	<500 gpm

11. Drains And Testriser

Drain Valves are to be provided at all low points in the system for draining the water. These shall be 40mm dia full way ball valve fixed on 40mm dia black steel pipe **I.S.1239**.

12. Fire Department connection

Fire department connection or Fire Brigade allow firefighters to supplement, or fully supply, the standpipe water flow from an external water source, such as a hydrant or pond, through a pumper apparatus to the structure.

5.5 FIRE HOSE REEL

A fire hose reel is a first attack piece of fire-fighting equipment. It is designed to be used as a quick-response method by any member of the general public for fighting fires in their early stages. Hose Reels are suitable for Class A fires: Paper, Textiles, Wood, Most Plastics and Rubber.

Do NOT use on electrical fires, remember water conducts electricity, so using a fire hose reel on it could lead to electrocution!

Fire Hose Reels are easy to use and provide a virtually unlimited supply of water, as they are connected to the mains water supply, and should extend for approximately 35 metres.

Fire Hose reels consist of a length of non-kinking tubing. They are permanently connected to a water supply and consist of a main turn on/off valve, a hose guide, and a hose with a nozzle. The control nozzle attached to the end of the hose enables the operator to control the direction and flow of water to the fire.

Hose reels provided for firefighting purposes must not be used for cleaning purposes, this can lead to fines.

**Figure 5.8 Fire hose reel**

All Hose Reels require inspection & testing every 6 months in accordance with Australian Standards. This testing is to ensure that the hose reel is operational in the event of an emergency. During this testing inspectors will check the hose for many things, whether or not there is water at the nozzle, if the hose is leaking, that it is free from dust and debris that can wear away at the hose and that it is operating to its full capacity.

6. RESULT

The fire fighting cart was designed, fabricated and training was given to ERT Members.

- This cart supports the ERT team by increasing the fire fighting ability to more than 30% with the existing set up.
- Reacting and response time was decreased to 90 sec. - The Speciality of this cart is quickly manoeuvred into position.
- The pressure and flow rate of water was increased. The Fire Cart delivers high pressure water at high volume of 1750 litres per minute, three times the volume of a standard fire hose reel.
- Less ERT members required to fire fighting at 360° fire suppression.
- Area coverage of fire fighting was increased 55% to 86%.
- Availability all type of extinguisher and emergency equipment at a time.

**Figure 6.9 Fire Cart**

6.1 Comparison:

Description	Existing Facility	Modified Facility
	Fire hydrant Point	Fire hydrant Point + Fire Fighting Cart
Area Coverage in mtr	30	60
Area Coverage in %	55	86
ERT Members Required	4 Persons	2 Persons
Availability of Extinguisher	Water Type	Water, Foam, Co2, ABC
Availability	Availability	All Type of Incidents can be prevented (Minor become Major)
Time for Response (Sec)	180	90

5.3 Main Components of fire cart



1. Fire Monitor with brigade.
2. Fire Hose Reel and "F" Rod.
3. Fire Extinguisher (Co₂, Foam and ABC)
4. Fire Ball.
5. Emergency Stretcher



6. Fire ERT Suit with Helmet.
7. Tool Box, Hammer, Axe, Tarpaulin and Rope.
8. PPE's and Walky-talky..
9. Mega Phone, Hand siren , Emergency Light
10. First Aid Box

Figure 5.8 Fire Cart Main Components



Figure.5.9 Result

7. FUTURE WORK

Installing wireless alarm devices in fire cart with integration of fire alarm control panel for alerting ERT members in emergency situation.

ACKNOWLEDGEMENT

I would like to thank **Mr S.Gopinath**, Safety officer- TVS Lucas for supporting the project and our sincere thanks to Excel College of Engineering.

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