

OPTIMAL LOCATION SELECTION FOR FIRE STATION: A CASE STUDY OF WEST ZONE, RAJKOT CITY

¹Rushit D. Gohil, ²Prof. Himanshu J. Padhya,

¹M.Tech. (Town and Country Planning)

²Associate Professor & P.G. In charge, Faculty of Civil Engineering Department, Sarvajnik College of Engineering and Technology, Surat.

Abstract - In recent years, rapid urbanization has become rampant in India. Due to this rapid urbanization, emergency response services like fire service are needed to be planned systematically in order to reduce loss of life, loss of properties and mitigate damages. Response time is the main aspect for the planning of a new fire station. Proper planning or optimization of fire stations leads to better coverage. Response time mainly depends on travel time, road network and other factors. The main objective of this research is to analyses response time-based analysis of fire stations using Geographical Information System (GIS). This study carried out for critical zone of the Rajkot city.

Keywords - Emergency Fire Services, Response Time, Geographical Information System, Fire Safety Assessment, Fire Station Planning, Infrastructure Planning.

I. INTRODUCTION

Fire is one of the most ubiquitous risks in all areas of life around the world. It can occur at industries area, resident area, area of mass gathering, etc. Faulty electric wiring, short-circuit, Failure of equipment, leakage in hazardous material supply lines, over hitting electric appliances, etc are the major causes of fire hazards in urban area. Rapid urbanization scenario seen over the world so that pay attention, how to reduce the fire risk and reduce the loss of life, properties, etc.

In India many cities have face the problem regarding the fire. Many Indian cities have not to in a planned manner. Fire services is included in emergency response services in urban and rural area. Fire services is a basic need in a city. Fire services is most important service for cities safety. Emergency services are depending on a various factors like early response, preparedness, skill trained personnel, etc. Reducing the response time during fire hazards is a key factor in reducing property damage and saving lives.

FIRE INCIDENTS IN INDIA

The fire can be accrued ether by the man mad or natural. In both the cases, it can be deadly damaging people life as well as their properties. The below table shows the number of fire incidences in different building to the respective year in India. This data were collected from the official website of National Crime Record Bureau. In this study, the URDPFI guideline reference is used to identify the gap among the fire station. By comparing the existing fire station with the guideline, we get the gap of fire station. After performing gap identification, we can provide planning proposal of fire station at suitable location.

Table 1 Fire incident cases in different buildings in India.

Sr. NO.	Place of Fire incidents	Year 2016	Year 2017	Year 2018	Year 2019	Year 2021
1	Fire in School Buildings	19	3	7	28	3
2	Fire in Commercial Buildings	459	382	284	330	233
3	Fire in Residential/Dwelling Banglow	8478	7614	7208	6329	4240
4	Fire in Government Buildings	41	10	18	54	29
5	Fire in the Mines	28	26	14	2	7
6	Fire in Factory Manufacturing Combustible Materials	306	72	71	33	96

(Source: National Crime Records Bureau, 2020)

Table 2 Death due to fire incidents in India

Sr. NO.	Place of Fire incidents	Year 2016	Year 2017	Year 2018	Year 2019	Year 2021
1	Fire in School Buildings	19	3	7	28	3
2	Fire in Commercial Buildings	459	382	284	330	233
3	Fire in Residential/Dwelling Banglow	8478	7614	7208	6329	4240
4	Fire in Government Buildings	41	10	18	54	29
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(Source: National Crime Records Bureau, 2020)

II. LITERATURE REVIEW

This chapter includes a review of research papers, articles, guidelines, case studies, and methods for fire station location selection. Review of SFAC guideline and URDPFI guideline for response time-based fire station planning. Also, include the NIDM report for case studies of Rajkot.

III. INDIAN FIRE INFRASTRUCTURE SCENARIO

In India, fire infrastructure falls under municipality bodies. Fire Services, Civil Defence & Home Guards Ministry of Home Affairs Government of India report published in 2012 for state-wise gaps in the fire station, firefighter vehicles, fire-fighters equipment, and manpower in fire services. That gap is shown below tables. Overall shows a high deficiency in Gujarat state in fire services.

IV. INDIAN STANDARD FOR RESPONSE TIME

Emergency services accuracy depends on their response time. Every country provides a guideline for response time in fire services planning. Every country has a different response time. In India, response time guidelines are provided by the URDPFI guideline and SFAC guidelines.

V. URDPFI GUIDELINES – 1, 2014

- Specifically, fire stations to be located on the corner plot giving direct access to sub- arterial roads.
- Sub fire station or fire post should be provided within a 3-4 km radius.
- Fire station should be provided for 2 lakh population or 5-7 km radius.
- Guidelines for locating fire stations and other firefighting facilities (As per Master Plan Delhi):
- Fire stations should be located so that the fire tenders are able to reach any disaster site within 3- 5 minutes.
- Fire stations should be located on corner plots as far as possible and on main roads with a minimum of two entries.
- In the new layouts, the concept of underground pipelines for fire hydrants other periphery exclusively for firefighting services should be considered.
- Necessary provisions for laying underground/ overground firefighting measures, water lines, hydrants, etc. may be kept wherever provision of the fire station is not possible.
- The concerned agencies shall take approval from the Fire department for firefighting measures while laying the services for an area.

VI. STUDY AREA PROFILE

Rajkot is the fourth-largest city in the Indian state of Gujarat after Ahmedabad, Vadodara, and Surat, and is in the center of the Saurashtra region of Gujarat. Rajkot is the 35th-largest metropolitan area in India, with a population of more than 2 million as of 2021. Rajkot is the 6th cleanest city of India, and it is the 7th fastest-growing city in the world as of March 2021. The city contains the administrative headquarters of the Rajkot District, 245 km from the state capital Gandhinagar, and is located on the banks of the Aji and Nyati rivers. Rajkot was the capital of the Saurashtra State from 15 April 1948 to 31 October 1956, before its merger with Bombay State on 1 November 1956. Rajkot was reincorporated into Gujarat State on 1 May 1960.

Table 3 Study area profile

Area	686.31 sq.km.
Population	15,35,109 (2011)
Density	397.8 Persons/Sq.Km.
Location	Latitude: <u>22.3</u> °N Longitude: 70.78°E

Rajkot is situated in the region called Saurashtra in the Gujarat state of India. The significance of Rajkot's location is owing to the fact that it is one of the prime industrial centers of Gujarat. Rajkot has a central location in the area called the Kathiawar peninsula. The city is located within the Rajkot district in Gujarat. Rajkot city is the administrative headquarters of the district of Rajkot. The district is surrounded by Bota in the east, and Surendra Nagar in the north, Junagadh and Amreli in the south, Morbi in the northwest and Jamnagar in the west and Porbandar in the southwest.

Rajkot is strategically located in the center of Suarashtra Region in the Aji basin. Rajkot is spread on both banks of Aji River which cuts through the city. The city is well connected not only to major towns within the state but also to neighboring states through strong transportation linkages all by rail, and road.

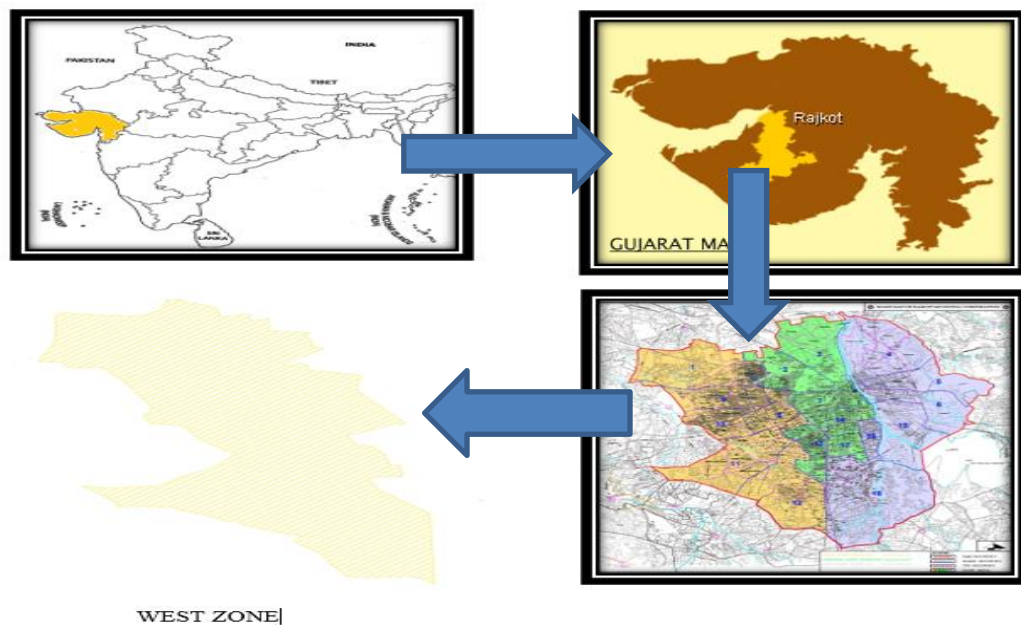


Figure 1 Location Map of West Zone, Rajkot City

VII. DATA ANALYSIS

This chapter consists the data analysis of fire safety infrastructure in study area. The existing situation of the fire safety is analyzed using the ArcGIS software. It is very helpful tool for the analysis of the fire station data.

VIII. FIRE CASES IN RAJKOT FROM THE YEAR 2001 TO 2022

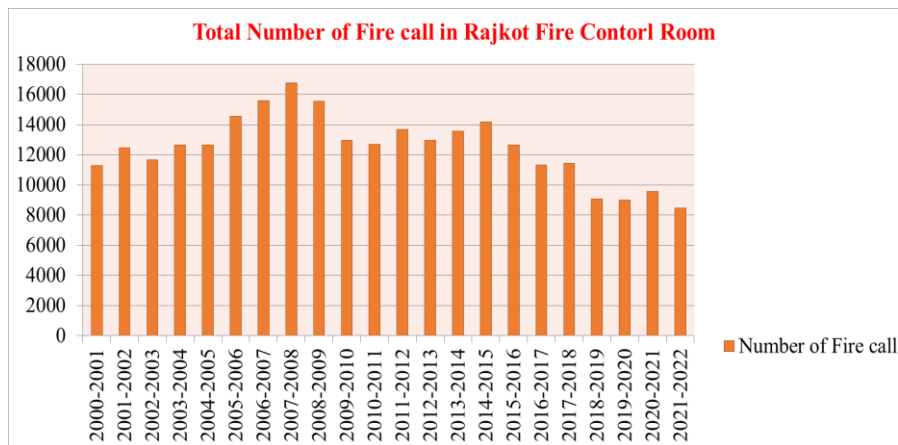


Chart 1 Fire calls in Rajkot from 2001-2022.

IX. BUFFER ANALYSIS OF EXISTING FIRE STATION USING GOOGLE EARTH PRO

The GIS is very helpful software for the different types of analysis. In this study the buffer analysis tool of Google Earth Pro is used for the analysis. As per the URDPFI guideline the converge area of fire station should be 5-7 km. The converge area of 5-7 km radius fire station is prepared using Google Earth Pro Buffer Analysis tool

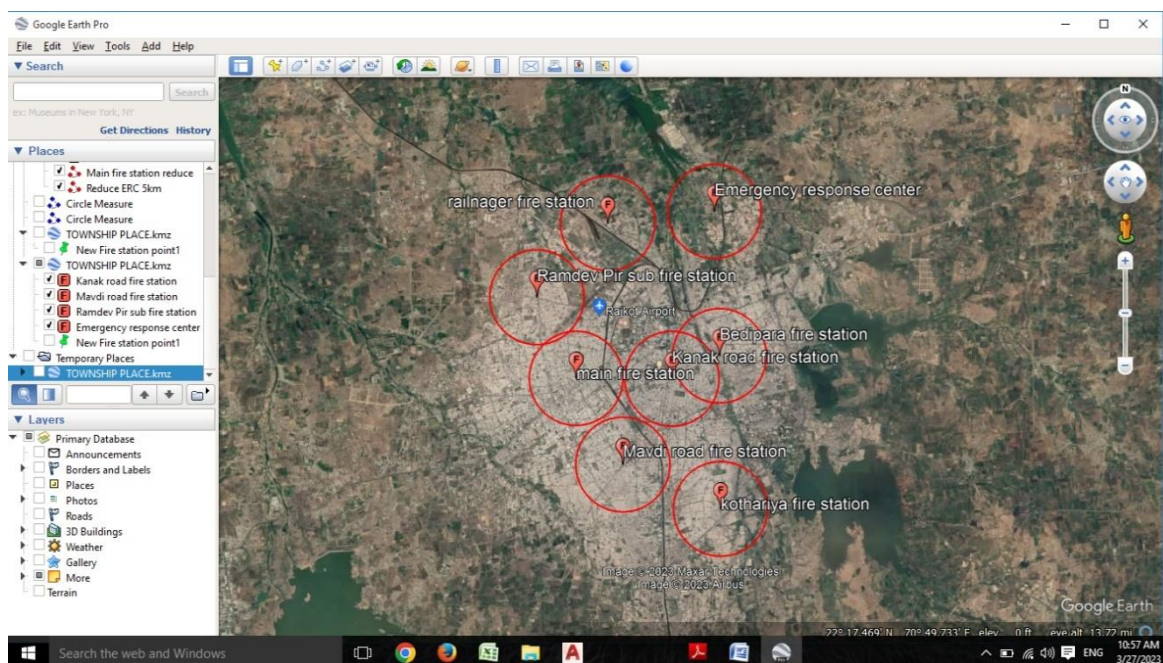


Figure 2 Buffer Analysis of Existing Fire Station

X. CONCLUSION REMARK

- The URDPFI guideline suggest that there should be one fire station withing the coverage area of the 5-7 km radius.
- The coverage area of all fire station in Surat is measured using buffer analysis tool in ArcGIS. The map generated through GIS is clearly indicates that there is lacking area in West zone.

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