

# Analysis of Fire Station Infrastructure using GIS and Planning Proposal: A Case of Surat City

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**Abstract:** Infrastructure is very important in development of the country which includes education, transportation, health care, fire safety, etc. Fire safety is important in life of people because a small ignorance of fire can cause a big incident. Fire impact people, property and the environment in all countries, around the world. In some cases, there are major losses causing hundreds of deaths, widespread damage to property and significant impact on the environment. More often, fire may cause a single casualty or affect a single home, through the effect are still highly significant to those affected and collectively are substantial. This project focuses on analysis of standard data of fire accidents and requirements of fire stations at different locations according to fire safety guidelines particular for Surat city. Proximity analysis will be conducted for data of fire station using GIS software. This process will help in finding the need of fire stations in the city and find locations according to TP schemes to establish fire station at those locations. This work may enhance the infrastructure of whole city if executed. Suggestions can be given to local authorities to provide better infrastructure, which will enhance execution of fire station authority during fire outbreak.

**Keywords:** GIS, planning, infrastructure.

## 1. Introduction

Fire is defined as any instance of uncontrolled burning, including combustion explosions and flammable/combustible material is exposed to a source of warmth unitedly with a sufficient quantity of oxygen. Fire will be natural or manmade. Fire is produced by combination of three elements i.e., Oxygen, Heat and Fuel which forms fire triangle. Fire will be extinguished by removing anyone of the weather of the hearth triangle.

Fire service is one among the foremost important emergency response services. Fire services come under the 12th schedule of constitution handling municipal functions. These lines about fire scenes, quoted from a daily newspaper, depicts on of the foremost frequently seen problem about fire events and fire intervention in India.

“With 27,027 deaths, every fifth fire-related death within the world in 2017 passed off in India. Around 9 million fire incidents and 1.2 lakh deaths were recorded across the world that year. Of those incidents, India recorded 1.6 million fires and 27,027 deaths. Indian deaths were 2.5 times the figures in China, where 10,836 people died in fire in 2017. India, together with seven countries, including Pakistan, accounted for over

half the death thanks to fire”

According to the 2017 edition of the India Risk Survey, fire accidents recorded a jump from the 8th position in 2016 to the 5th position in 2017, which shows the vulnerability of India to fireplace accidents.

In the case study of Surat city, the adequacy of fireside stations has to be checked. Variety of fireplace incidents within the past highlights the vulnerability of the security of infrastructure a well because the safety of individuals. One among the tragic incident in Surat city was the Takshashila tragedy which caused 22 fatalities.

Based on population distribution, emergency latency and coverage area, assessment of existing fire stations are often applied using GIS. This can also help to find if new fire stations must be proposed or not.

### A. Aim

The aim is to:

- Find the factors of fireside stations spatial requirements looking on interval of fireside vehicles at the urban scales.
- Analyze the present station spatial coverage with relevance time interval.
- Find this site selection and style process of fireplace station in Surat.
- Explore suitable sites where new fire stations is proposed considering the spatial requirement.
- Draft plan for one among the proposed sites of fireplace station considering the requirements of fireplace services department.

### B. Objectives

The main objective of this project is to research existing firehouse in Surat city using the quality provision data given by the local, state and central authorities.

In addition, lack of fireplace station is identified supported latent period of fireside services and suitable location are proposed to ascertain new fire stations. A concept is drafted for one in all the proposed firehouse with standard requirements.

## 2. Data Analysis

The spatial exposure of current fire stations are often crosschecked by the spatial analysis with the rules. Spatial

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analysis is completed using ArcGIS software. The situation coordinates of existing fire stations are wont to accurately locate data on the map.

### 3. Tools and Techniques

The data per the current study were collected from various sources. The road network considered as a chief source for the study was import from [www.geofabrik.de](http://www.geofabrik.de) within the kind of shape file after geo-referenced by with corresponding SOI topographic sheets. Using GPS, the hearth station co-ordinates were collected and fed into GIS environment. After the preparation of layers for fire station location and road network, the topographic point dataset for every firehouse has been created with impedance of various period of time using Network Analyst tool in ArcGIS. Finally, inference drawn to spot optimal locations for locating new fire service stations.

### 4. Proximity Analysis

Proximity Analysis is an analytical technique want to determine the connection between a particular point and its neighbors. It's wont to determine area covered by particular point or feature surrounding that time or feature.

There two forms of analysis:

1. Buffer Analysis
2. Network Analysis

#### 1) Buffer Analysis

Buffer is one amongst the simplest tools to know and one in every of the foremost commonly used. It's a fast and straightforward thanks to determine both if and the way much/many features are found within a specific distance of another feature. As an example, if you were trying to work out what quantity area covered by particular station. The Buffer tool works with an input layer and an outlined "buffer distance", measuring aloof from each feature.

As mentioned in SFAC guidelines, there must be one station in every 10 km<sup>2</sup> area in geographical area. Therefore, a map is generated with a buffer of 1.78 km. radius from the hearth stations.

#### 2) Need for Network Analysis (Drive time based)

The place analysis usually attempted by creation of buffer zone form a specific point. But it doesn't meet the wants of network topographic point, because accessibility always must be determined by road length not a line from the purpose. The Figure clearly depict the difference between buffer zone-based spot and network-based place. Further, the network spot analysis by taking the account of road length alone wouldn't provide good accuracy of results, because some roads have higher carrying capacity and a few other don't. During this regard, a drive time-based place provides a stronger result. To cater such variety of analysis, ArcGIS Network Analyst tool helps in enormous way.

#### 3) Network Analysis (Drive time based)

A network spot may be a region that encompasses all accessible streets (that is, streets that are within specified impedance). These service areas help us to gauge accessibility from the fireplace station in numerous directions. To spot the

hearth service station's spot, time period zones i.e., within 1, 2, 3, 4, 5 minutes were defined by adopting assumed drive time as impedance. Basis of assumption at peak hours, i.e., 60 km/hour for highways and 30 km/hour for other street roads

### 5. Conclusion

The past incidents of fire outbreak in Surat city highlights the essence of fire safety for the people as well as the infrastructure. Specially, these incidents reveal the possibility of allocation of fire station in the areas where fire emergency services cannot respond in time being.

This case study shows the risk associated with the current fire service infrastructure and suggests addition of new fire service infrastructure which can reduce the impact of fire incidents. The number and location of fire stations significantly influence the efficiency of emergency response during fire accidents.

The plan drafted for Variyav can be set as a standard plan for taking key notes on the selection of location as well as setting the requirements of a fire station.

Moreover, this study represents many possibilities of solving a problem using GIS. Analysis of data depending on spatial distribution can be optimized using ArcGIS. Furthermore, the overall study also serves as a base for approaching assessment and allocation of emergency-based infrastructures like hospitals, rescue services and fire services in different cities.

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