

Locating Fire Stations at the Most Convenient Location

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Key words: Emergency/Disaster management, Fire Stations, Location,

SUMMARY

Emergency response service providers such as fire-stations, hospitals, and other emergency response institutions play a key role in any country. Effective planning of emergency response services helps to avoid economic losses, such as reducing disability and mortality rates.

The determination of the correct locations will reduce the duration of the intervention in case of a possible emergency call. Selecting the best locations for facilities of emergency services, such as fire stations are among major goals of most municipalities or local government institutions.

Fires are the accidents which occur most frequently, whose causes are the most diverse and which require intervention methods and techniques adapted to the conditions and needs of each incident. As the population in cities increase the emergency calls will increase accordingly and new planning for renewing existing fire stations or opening of new stations will arise. In cities with high earthquake risk as well as rapid population growth and heavy traffic characteristics, the selection of locations of fire stations is very important to prevent life and property losses.

As Natural disasters (such as earthquake, flood, hurricanes, fire, etc.) and manmade disasters (such as wars, explosions, chemical spills, etc.) have increased in recent times, the value of emergency intervention is increasing significantly. Those emergency response institutions face several types of risk some of those are repeated risks that can be predicted by analyzing historical data, some are unpredictable risks that are catastrophic events. Although search and rescue operations may vary globally. Apart from national disaster and emergency situations, fire departments usually intervene in recurring disasters in both urban and rural areas. Fire departments perform various rescue operations from traffic accidents to as little as rescuing a pet or any other accidentally trapped animal. The basic requirement for the improvement of rescue operations is to determine the optimum place for fire department facilities.

Since Fire station buildings and materials can also be at risk during disasters, all preventive methods should be taken during location selection and building those stations. In this study, a multi-layer model based on the risk factors, environmental factors and infrastructure is suggested for the selection of fire station locations.

SUMMARY (optional summary in one other language in addition to English, e.g. your own language)

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1. INTRODUCTION

During an incident or a disaster whether this is a traffic accident or a catastrophic event, it requires accurate and urgent intervention. Various institutions may be engaged in this intervention like police, ambulances, fire brigades, civil/human aid organizations and many others. In most cases fire brigade equipment and vehicles are involved in rescue operations. Although search and rescue operations may vary globally. Apart from national disaster and emergency situations, fire departments usually intervene in recurring disasters in urban and rural areas. Fire departments perform various rescue operations from traffic accidents to as little as rescuing a pet or any other accidentally trapped animal. The basic requirement for the improvement of rescue operations is to determine the optimum place for fire department facilities to reach incident site before much damage has occurred.

Time is the critical element when an emergency is reported. Damage can grow enormously as the minutes pass.

2. MISSION OF FIRE SERVICES

The Fire service does not only respond to fire, but also to other emergencies as well as to less urgent incidents. These stations answer to more than fires, actually they respond to many incidents as such as:

1. Intervention: Firefighting, rescue in traffic accidents, rescue in natural disasters (earthquake flood), and intervention in catastrophic events and other rescue incidents.
2. Emergency services: First-Aid, Lifeguard services
3. Chimney Controls: Chimney inspection to prevent poisoning and chimney exacerbations
4. Providing Training: In-service training, Fire safety trainings for public, private institutions / organizations, Volunteering studies, Awareness raising activities for all sections of society especially for children and young people, Visual and written publications

3. IMPORTANCE OF TIME

There are separate forms of behavior and danger through, development and conclusion phases of the fire. Regardless of the speed of growth or length of burn time, all fires go through the same stages of growth. It is easy to extinguish the fire in the stage that starts with the ignition of the material. However, air-tube respirator protection must be used, in Flameover phase as half-burned gases and fumes are present. There is a very significant phase called Flashover when rising hot gases cover the fire area and raise all flammable materials to ignition

temperature, the explosions can occur. Measuring the time to flashover is a function of time and temperature.

To provide effective service, firefighters must have adequate resources to initiate fire fighting, rescue or emergency medical activities and to intervene as soon as possible after the incident is reported. In addition, correct planning of the fire brigade site will help ensure effective intervention by providing quick access. Prompt action minimizes the risk to occupants, property, and firefighters.

4. WHAT IF DAMAGE HAPPENS AT A FIRE STATION?

We always think that our rescuers as supermans but what if they are affected by the damage? Recently our world is coping with many problems and risks, Tornados, earth quakes, attacks, bombing, fire and many

A tornado tore through Hattiesburg in south Mississippi on Saturday, Jan. 21, 2017, killing four people and injuring dozens more. It also left the city without one of its fire stations the firefighters got a look at the damage to their station and saw that the roof over the apparatus bay was blown off. They took off on foot and got into the neighborhoods around the station to help the residents.

<http://www.firehouse.com/news/12297952/hattiesburg-fire-station-2-destroyed-by-deadly-tornado-firefighter-news>



The Butler County Rural Fire District 5 station caught fire recently on 6th of February 2018. The fire destroyed a truck, and the garage that housed it.

<http://www.kwch.com/content/news/Local-volunteer-fire-department-damaged-by-fire-473046563.html>

Fire stations are vulnerable to damages as any other buildings. So when we decide on a location we must also think of how to select the best secure site location for those institutions.

5. THE IMPORTANCE OF EARTHQUAKE AND DISASTER RISK DATA IN DETERMINING THE BEST LOCATION

In natural disaster areas such as Earthquake, Hurricane and Flood, the responsibilities of the firefighters are doubled. These natural disasters are multiplying the damage to infrastructure, private and public property. In such regions, it is wrong to handle only the fire damage events alone. Considering that Fire Stations are also affected by natural disasters, it is necessary to consider all factors in the selection of fire station location.

When we look at the world's natural catastrophe risk map, we can see that the regions that are economically most vulnerable are the regions where there are major fault lines, or flood areas, and Tusunami disasters or the areas where the urban development percentage is higher.

In such case, using shortest route, the size of allocated land, demography data etc is not enough data to be handled to determine the location.

In addition to these data, we also consider the necessity of including earthquake zones and flood data. Because a damaged station can not contribute to rescue operations in the neighborhood. The risk factor of the regions is very important in determining the locations of the fire stations.

6. DISTANCE TO RISKY AREAS FACTOR

The proximity of a building to a petrol station, a natural gas main valve, a hazardous material deposit, etc. makes the location of a building risky. This also applies to the fire brigade. After a location for a fire station is detected, there may still be more than one option for the exact location. One of the common things to consider when choosing an area is that it is resistant to floods or other conditions caused by weather and weather conditions. GIS can provide very detailed information about terrain features and optimum field location. GIS can analyze and display ground types, earthquake faults, elevations and slopes, flood-prone locations, and other features important for a convenient fire Station site.

7. A SIMPLE MODEL FOR FIRE STATION LOCATION DETERMINATION

The most powerful aspect of GIS is its comprehensive analysis capabilities. GIS shows the real road network of the area being analyzed. A high degree of accuracy can also be ensured by using actual travel distances, traffic, time delays due to weather and terrain. All other data can also be obtained from various institutions to be viewed and analyzed in GIS.

As mentioned above, in addition to proximity to fire zones, and travel times, fire brigade stations should proceed in the process of determining the location, considering the extent to which the station location can be in a safe zone and the extent to which the station is affected by natural disasters and other disasters.

8. CONCLUSION

The fire fighter's primary responsibility is to provide fire and rescue services. The volume of fire can increase greatly every minute; for this reason, the time becomes critical when the firefighter intervenes in an emergency. This applies also to other incidents. Timely delivery of services depends largely on the location of the fire stations. For this reason, when planning where to place fire stations, it is necessary to improve the standards of fire response according to the country and global standards. These standards are based on an analysis of the types of services to be delivered, the extent of a reasonable access period, the size of the service area, the available resources and the acceptable risk level. Once the intervention standard has been established, land, infrastructure, natural disaster and human-induced risk data can be used with more accuracy with GIS to determine the location of the fire station. GIS is a good tool to improve the performance of fire stations as well during fire detection phase, transportation within the shortest time to incident location and event analysis for future investment plans.

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BIOGRAPHICAL NOTES

Sevda Gul ERTURK works in Universal Software Inc. since 2009 as Senior GIS Consultant with a demonstrated history of working in the spatial information technology since 1984 and survey services industry since 1980. Skilled in GIS Business Processes, ArcGIS, Management, and Data Collection. Part of Spatial Informatics Initiative of Turkey. Strong engineering professional with a BSc in Engineering from University of Baghdad. Led the first underground utility inventory and mapping in Baghdad “Base map of Baghdad at scale 1:500 and 1:1000 with inventory of underground utilities”.

Selda ERDOĞAN works in Universal Software Inc. Since 2014 as GIS specialist. Graduated from İzmir Institute of Technology and ranked second among students graduated from the department of city and regional planning in 2013. She is skilled in management of spatial data using ArcGIS. She worked as urban planner before joining universal and has contributed to Universal with her city planning knowledge. She has interest in Geodesign.

Murat DEMIRCAN works in Universal since 2015 as GIS specialist as well as continuing his MSc study in Istanbul Technical University on Geomatics Engineering. He also had an Erasmus experience in VILNIUS GEDIMINAS Tech. Univ. Regarding ArcGIS. He is mainly interested in GIS analysis and LIS, also has interest in some programming languages like Javascript, C## and XML.

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