Study on Urban Fire Station Planning based on Fire Risk Assessment and GIS Technology

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Abstract

This paper focuses on the planning of fire station in Lanshan District, Linyi City, Shandong Province. It mainly aims at the deficiency of the fire protection planning in Lanshan district and the new problems brought by the rapid development of the city. The fire risk of city buildings in Lanshan District was identified and evaluated. On the basis of fire risk assessment, GIS technology was introduced to solve the problem of site selection of those new fire stations and layout of old fire stations. The research results suggest that 4 new fire stations should be added, which are close to the great fire risk places. Meanwhile, the new fire stations are also required to be close to the main roads of the city as far as possible. The paper provides some scientific basis and suggestion for the layout optimization of fire stations in Linyi City by the comprehensive utilization of various methods.

Keywords: fire protection planning, fire station, fire risk assessment, GIS

Introduction

With the great improvement of economy during the latest 30 years, China has entered a rapid development period. The construction of city scale becomes much larger and more functional diversity. The number of population has increased dramatically and the traffic roads are more crisscross. Therefore, it can be said that the city is a very complex and dynamic system. In the city, urban construction and people's activities have a close connection with the city's geographical attributes and restricted by it. While the city development brings about economic growth, it also brings about the increase of fire risk. Urban buildings tend to have the new characteristics of larger volume, complex function, high crowd density and high fire risk [1-2]. At the same time, many places take up the fire passages in order to use the space more effectively. The fire prevention measures are insufficient and the fire hazards are quite big. Moreover, during the urban construction process, the old city, village in city and other products become more and more. The buildings in these areas are old and lack of fire protection capacity. At the same time, the buildings are closely adjacent to each other and easy to break out continuous fire accident. In addition, the internal circuit facilities of these buildings are aging severely, which are easy to cause fire and its fire extinguishing and rescue facilities are not complete. The roads are quite narrow and the fire engines are not easy to enter [3]. Besides, with the process of urban expansion, the buildings, which should not exist in residential or commercial areas, are often included, such as factories, warehouses and so on. These buildings are often the original source of fire and explosion [4-5]. Therefore, the old fire protection planning cannot meet the demand of the new cities, which are developing and growing all the while. The complicated layout of urban geography has laid many hidden fire hazards for the city and has

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put forward higher requirements for the layout of urban fire protection planning, which has brought difficulties to the layout design of urban fire protection.

GIS (Geographic Information System) is the product of the combination of geographic information technology and computer technology. By means of the cooperation of computer software and hardware, the geospatial information is processed to achieve the input and storage of information, the retrieval and operation analysis of information and the display and output of information [6]. Using the GIS technology to deal with the corresponding information about the building layout and the personnel distribution in urban fire protection planning, it can obviously improve the work efficiency and achieve satisfactory results. The GIS technology not only can accomplish the management of fire protection planning, but also can help the design of fire protection planning. The GIS technology should make adequate preparations before carrying out planning and design of urban fire protection. The main work is to creating a database of the related cities, including the detail information of the city, the fire key units of the location, the distribution of dangerous source, the distribution of fire facilities, road traffic arrangement and so on.

After setting up such a detailed database and combining relevant theoretical knowledge and calculation model, we can scientifically and rationally carry out accurate fire protection planning for the city and obtain credible results. However, the current work in this area is not perfect enough and the application of GIS in fire protection planning and design is not yet mature. There is great space for the development of fire protection facilities layout based on fire risk assessment and GIS technology, which can integrate the existing urban construction information and grasp the dynamics of urban development. This paper will combine the methods of fire risk assessment with GIS technology to solve the planning and optimizing issues of the fire station layout in Lanshan District, Linyi city. This method is not only suitable for Linyi City, but also has great practical value for most cities in China.

1. Main optimization process of fire station layout

Based on fire risk assessment and GIS technology, the optimization process of fire station layout is shown in Figure 1.

![Fig. 1. Optimization process of fire station layout based on fire risk](image-url)
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