The Influence of Urbanization on Storm Runoff

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Abstract. With the development of economy society, urbanization process are accelerated, the tension of the urban land using leads that the cities develop to the low-lying parts, and even occupy river, landfill ditch pond, it makes perched water space of the city narrow, rainfall runoff coefficient increasing, the confluence time speeding up, it increases urban flood risk. Urbanization has changed the urban hydrologic cycle characteristics, so as to make the urban rain flood characteristics changing, it easily causes short duration rainstorm seep-waterlogging, so as to directly influence the urban residents' lives and causes great economic losses, even casualties. City is the political, economic and cultural center, once suffered from floods, it will cause great political influence and economic losses, so, it's necessary to analysis urban storm flood reason and put forward the corresponding countermeasures. This paper mainly discusses the urban waterlogging reason and influence on storm runoff, and discusses the countermeasures.

Keywords: Urbanization, storm runoff, urban waterlogging causes, countermeasures.

1. Introduction

In recent years, the problem of urban rainstorm and flood waterlogging has become increasingly prominent in China. Many cities have suffered from rainstorm in varying degrees, causing waterlogging disasters, seriously affecting the normal life of the city, and some even causing casualties and huge property losses. For example, the "7.18" rainstorm flood occurred in Jinan in 2007 [1]. The main characteristics of this flood are short duration, high intensity and concentrated rainfall. The rainstorm process only lasted for more than three hours. The average rainfall in the urban area has reached 146mm and the maximum point rainfall has reached 178mm. In 2010, Guangzhou was hit by several torrential rains, causing serious waterlogging in the urban area, the most serious of which was the "5.7" torrential rain, with more than 213mm in 12 hours, many underground parking lots were flooded, many trunk roads were seriously flooded, urban traffic was seriously blocked or even paralyzed, and the city's economic loss was about 540 million [2]; in 2012 Beijing's torrential rain
caused 78 people to die, resulting in 10660 houses collapsed, 1.602 million people were affected, and the economic loss was 11.64 billion yuan; on October 7, 2013, Yuyao, Zhejiang Province, was affected by typhoon fitter, resulting in 21 towns and streets in the city Daojun was affected by the disaster, with a population of 83.2870 thousand. A large area of the urban area was flooded, and the traffic in the main urban area was paralyzed. Most of the low-rise residential areas were flooded, and the water supply and power supply in the main urban area were cut off. In fact, these serious urban floods are not a case in point, but a common phenomenon in many cities in China.

City is the center of politics, economy and culture, with dense population, developed industry and commerce, and concentrated wealth. Once suffering from flood, it will cause political impact and economic losses. Therefore, it is very important to explore the causes and Countermeasures of urban rainstorm and flood waterlogging.

2. Influence of urbanization on Rainstorm and flood disaster and its cause analysis

2.1. Impact of urbanization on rainfall
With the increasing urbanization process in China, the urban population is becoming more and more concentrated, the traffic means are increasing rapidly, the building group is dense, asphalt pavement and cement pavement have been covered with streets and alleys of the whole city. Because of these factors, the temperature of the city is obviously higher than that of the suburbs, and the heat island effect is obvious. The urban heat island effect not only causes the temperature rise in the city and its surrounding areas, but also shows that the urban heat island effect may also affect the precipitation process in winter and summer through the effect of flow field [3-4]. In addition, the urban roughness is increased due to the different buildings in the city, which not only causes turbulence, but also hinders the steady and slow precipitation system, increases the retention time of rainfall in the urban area and increases the intensity of rainfall. At the same time, urbanization, with the development of industrialization, has produced air pollution to the environment, and the density of suspended particles in the air increases, which plays an important role in artificial rainfall to some extent, which leads to the increase of the probability and rainfall of rainstorm formation. Obviously, the urbanization effect will increase the rainfall in short time, which increases the possibility of urban flood disaster.

2.2. Impact of urbanization on stormwater runoff
With the process of urbanization and the change of land use in urban area, the original underlying surface has changed greatly, the number of buildings, road pavement and impervious area has increased, which directly changes the formation conditions of surface stormwater runoff and changes the natural hydrological situation. In addition, urban land is becoming increasingly tense, parks are gradually "marginalized", impervious area is gradually increasing, precipitation basically has no storage, stagnation, infiltration space, infiltration rainfall is basically zero. The surface runoff is produced quickly and the runoff coefficient is very large due to the ground hardening, which makes the rainwater falling to the urban area fill the depression quickly and then form surface runoff. The surface runoff formed by the same intensity rainstorm increases and the flood peak flow increases. When it exceeds the drainage capacity of the existing drainage system, the rainwater will accumulate in the ground area and form waterlogging.

2.3. Low drainage standard of urban rainwater pipe network
The standard of municipal drainage system adopted in Chinese cities is relatively low. According to GB 50014-2006 (code for design of outdoor drainage) [5], in general areas, the return period is generally 0.5-3 years; in important trunk roads, important areas or areas where short-term ponding can cause serious consequences, the return period is generally 3-5 years. However, in the actual design, the lower limit of the return period of drainage standard is often selected in most cities, such as Beijing, Shanghai and Guangzhou. The return period of drainage standard in most areas is once in a year, and that in key areas or particularly important areas is once in 3-5 years. Compared with the drainage
standard of 2-5 years commonly used in foreign cities [6], the drainage standard of Chinese cities is lower. Moreover, the municipal drainage system in some old urban areas has been used for decades, and some pipelines are aging, damaged or even blocked, resulting in the low drainage capacity of the whole drainage system.

2.4. On the connection of urban drainage system design standards and specifications

The urban drainage system consists of two parts, one is municipal rainwater pipeline system, which is mainly arranged in the main road and street and alley of the city, which is mainly used to exclude urban rainwater. However, some cities currently adopt the contract system of rainwater and sewage, and rainwater and sewage share one pipe. The design of municipal rainwater pipeline generally belongs to the design category of water supply and drainage specialty. The calculation of the non-calculated flow of the pipeline is calculated by the municipal formula, namely, the rainstorm intensity formula. The design standard adopts GB 50014-2006 ((code for outdoor drainage design); the other part is flood control and drainage projects set up from the perspective of water conservancy in urban areas, including the river, pumping station and sluice gate in urban areas, which belong to the scope of water conservancy design. The calculation of design flow generally adopts unit line method or reasoning formula method. At present, there is no special specification, mainly GB 50288-99 (standard for drainage of farmland in the code for design of irrigation and Drainage Engineering). The design of the two is complicated. Generally, the municipal rainwater pipeline is designed by the special municipal design unit, while some flood control and drainage projects are in the charge of the water conservancy design unit. Therefore, there will be two problems of professional connection and inconsistent standards.

2.5. The urban rainwater management system is not perfect

China's urban rainwater management system is not perfect, the construction of urban drainage facilities is not paid enough attention and investment is not enough, mainly in the construction of emergency flood control and disaster reduction facilities is not paid attention to; the comprehensive management of external flood and waterlogging is not enough; the level of flood prevention and early warning and emergency management is lagging behind; the drainage facilities are not maintained and repaired in time; the measures to deal with the super standard rainfall are not enough; the publicity is not enough Education is not enough, and there is no comprehensive disaster prevention and mitigation system with public participation.

3. Discussion on waterlogging Countermeasures of urban rainstorm and flood disaster

3.1. Engineering measures to reduce the impact of urbanization on Rainstorm

3.1.1. Utilization of rainwater and flood. There are three types of rainwater and flood utilization, namely, deep underground, storage and utilization and regulation of discharge. It mainly uses roads, green space, roofs, public infrastructure and other measures to collect rainwater. As road pouring, automobile washing, green land irrigation, community landscape, etc., or the ground pavement, permeable materials are selected, porous asphalt or porous concrete pavement is used, turf bricks are laid in sidewalks, squares or leisure areas to allow rainwater to penetrate into the ground smoothly.

3.1.2. Rational planning of land use and reduction of hardened area in urban planning and design stage. Flood control and drainage must be paid attention to in the stage of urban planning and construction. Systematic planning of drainage facilities, combining water conservancy with municipal planning and design, compiling planning of rainwater control and utilization of storage facilities from the source, and reasonably planning construction land. For the existing river channels, ditches, ponds and other areas with flood storage and drainage capacity, do not fill and occupy them at will, properly arrange some gardens, sports grounds, parking lots, and temporarily store or discharge flood water, in
the road design to minimize the hardening area of the ground, more use of infiltration type pavement, increase the green area, not only beautify the environment, but also can increase the infiltration and implication of rainwater.

3.1.3. Improve the connection of drainage system standard and Standard Specification. Combined with the current situation of drainage system in China, it is an inevitable trend to gradually improve the design standard of drainage facilities. In the future design, different return periods should be adopted in different areas. In some important areas such as main roads and urban centers, the design return period of rainwater pipes should be increased, and the upper limit of the standard should be taken as far as possible to meet the international standards. If the built drainage facilities are transformed, it should be considered according to the new design. At the same time, the drainage standard of the central city should also be improved, and the standard of 20-year return period, which is often used in the design of super flood, can not meet the requirements. We should not only improve the standard of drainage system, but also pay attention to the connection of standards and strengthen the design communication and coordination among different specialties. In addition, how to unify the municipal norms and standards with the water conservancy standards, instead of considering the problems from their respective professional fields, it needs the relevant departments to conduct in-depth discussion and research in this aspect, and formulate a unified standard.

3.1.4. Improve urban rainwater management system. (1) Maintenance and repair of drainage facilities. (2) Actively publicize urban flood control and disaster reduction, and establish the public awareness of flood risk. (3) Using foreign experience for reference and adopting urban flood control risk management method. (4) Strengthening the basic work of urban flood control.

3.1.5. Adopt advanced technology to deal with super flood. Using advanced technology to provide a scientific basis for the planning and design of new urban drainage system, and provide a scientific forecast for the old city to take measures to deal with sudden rainstorm. The database and mathematical model of the drainage system in the whole urban area are established to simulate the dynamic changes of the whole system by computer. The position and depth of ponding in case of excessive rainfall are timely predicted, which provides scientific basis for timely emergency measures. At present, there are many mature commercial software abroad, which can be applied according to the actual situation of our country.

3.2. Non engineering measures to reduce the impact of urbanization on Rainstorm
(1) From the government level, it is necessary to legislate. For example, some cities in the United States legislate that "when building buildings, corresponding water demand equipment must be built at the same time, and the principle is not to increase the surface runoff of blocks".

(2) From the technical level, we must improve the drainage standards of urban rainstorm, revise the corresponding norms, so that the rainstorm can be discharged in time to avoid the occurrence of urban waterlogging.

(3) The urban master plan should fully consider the requirements of quiet development and improvement of living standards, not only water supply, but also drainage and the treatment and standard of drainage water quality.

4. Conclusions and suggestions
The extreme bad weather brought by the continuous urbanization and the continuous deterioration of the earth's environment, especially in recent years, the probability of rainstorm and extraordinarily heavy rain is increasing, resulting in serious waterlogging in many cities. This paper analyzes the causes of urban rainstorm and flood waterlogging, and discusses some measures to deal with urban waterlogging according to some relevant researches at home and abroad.
It is suggested that the rainwater system planning and design system and key technologies should be further improved, and the rainwater system model construction and its application in planning should be strengthened. At the same time, it is necessary to strengthen and improve the legislation of relevant departments, so as to greatly reduce the impact of urbanization on storm runoff and reduce the loss caused by urban waterlogging.

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