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Analysis of the upgrading and transformation of rain and sewage diversion in urban villages in Fujian province under the new situation--The example of a Sikouzun village

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Abstract: *In order to effectively improve the water environment quality of urban villages, meet the new requirements of water environment management under the new situation of environmental protection in China, and thoroughly realize the ideal goal of rain and pollution diversion from the source to the centralized discharge process. Therefore, with Sikouzun Village of rain pollution diversion improvement project, for example, in the common urban villages in China rain sewage network renovation problems, on the basis of the analysis of Sikouzun Village of rain sewage network renovation project transformation points, and combined with the problems existing in the project, put forward the corresponding solutions, hope can provide reference for other domestic urban villages rain sewage diversion management.*

Keywords: *Urban village rain and sewage diversion, Status quo transformation, Countermeasures and suggestions*

1. Introduction

Sewage treatment system is an important infrastructure for China's urbanization, directly related to urban drainage safety and waterlogging prevention level, but also affects the overall quality of China's water environment. In recent years, sewage treatment has been regarded by the environmental protection industry as the industry's "new" blue ocean, but so far, most sewage treatment projects are also focused on urban renovation governance scope.

And what is an urban village, which accounts for a significant proportion of modernised rural villages? Urban villages are villages that have lost or largely lost their arable land within the built-up areas of the city, but are still under villagers' autonomy and collective ownership, where the members of the rural collective have changed their status from that of farmers to that of residents and still live in the residential areas transformed from villages, also known as "villages in the city". Therefore, in order to promote the development of urban villages and to significantly improve the living standards of villagers, sewage treatment will also receive unprecedented attention.

2. Analysis of the current situation of sewage treatment in urban villages

According to incomplete data, urban village sewage treatment work, to the State Council in 2009, "on the implementation of the" prize to promote governance "to accelerate the implementation of the solution of outstanding environmental problems in urban villages" as a starting point, to now China's urban village sewage treatment has gone through more than 10 years, there are nearly 600,000 administrative villages and 2.6 million More than 2.6 million natural villages, urban villages occupy an important position in China's social and economic structure, but for a long time, village drainage and sewage treatment facilities are seriously inadequate, and the overall sewage treatment rate is low [1]. According to the National Bureau of Statistics 2021 China Statistical Yearbook, as of the end of 2020, the total population of the country is 1.412 billion, the proportion of rural population is 36.11%, so the number of rural residents is about 510 million people. [2] According to the "China Water Resources Bulletin 2021" issued by the Ministry of Water Resources, the per capita domestic water consumption of rural residents in 2020 is 100L/d. [3] The "Construction and Investment Guide for Rural Domestic

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Sewage Treatment Projects" issued by the Ministry of Environmental Protection in November 2013 points out that the rural domestic sewage discharge should be calculated according to 40%-90% of the total domestic water consumption, which should be combined with local economic conditions and The amount of domestic wastewater discharged in rural areas should be calculated on the basis of 40% to 90% of the total domestic water consumption. Therefore, in 2020, the per capita domestic sewage discharge in rural areas should be between 80-90L/d, while the per capita domestic sewage discharge in urban villages should be between rural and urban areas, with an average of 110L/d. Multiplying the number of residents in urban villages with the annual per capita domestic sewage in rural areas, we can calculate that the total domestic sewage in urban villages in 2020 is about 20.1 billion tons, so the sewage treatment in urban villages is The pressure to treat sewage in urban villages is enormous. Most of the water pollution in urban villages is related to the incomplete diversion of rainwater and sewage, which leads to the mixing of sewage into nearby water bodies, so I believe that good treatment in this area is an important element in improving the living environment in urban villages, which is of great importance for speeding up the construction of beautiful villages, improving the living conditions of villagers, making up for the shortcomings of rural construction and building a well-off society.

2.1. Current Status of Stormwater Diversion in Urban Villages

2.1.1. Poor design of the stormwater drainage treatment facilities

The design of rainwater and sewage treatment facilities in urban villages ignores the special characteristics of urban villages, resulting in most of the rainwater and sewage treatment facilities not really serving urban villages. On the one hand, due to the influence of population, topography and residential distribution, the quality and quantity of water, the collection ratio and the treatment process chosen for urban villages cannot be measured by the standards of towns. On the other hand, the rapid development of some urban villages in recent years, the site selection and construction mode of rainwater treatment facilities need to be synchronized with the planning of rural areas, especially in recent years, the rapid development of rural population to the town, resulting in a sharp decline in the number of rural population, many places to collect less than perfect.

2.1.2. Poor design of the stormwater drainage treatment facilities

According to the results of the survey of the supporting collection pipe network of the urban village sewage treatment facilities in the area: only a very small number of villages or new villages have a more complete supporting pipe network for rainwater treatment facilities, the implementation of rainwater and sewage diversion; other villages where the random discharge of sewage is affected by factors such as topography and housing distribution, the investment amount, volume of work and construction difficulties of the rural sewage network are far greater than the construction of sewage treatment facilities. Many local implementation of urban village rainwater treatment projects due to pipe network laying or management and maintenance is not in place, there is either not collected sewage, or rainwater and surface water carrying a large amount of sediment infiltration, resulting in rainwater treatment facilities blockage, rainwater treatment facilities can not function.

2.2. Problems with the current rainwater diversion facilities in urban villages

Urban villages give the current situation of rainwater and sewage diversion facilities and the problems that exist in urban villages are mainly distributed around the city, which were not included in the city at the early stage of urban planning, and were gradually incorporated into the city and became urban residential areas as the city continued to expand. The urban villages were initially built according to rural standards, without integrated consideration from the perspective of urban planning and development, so that many problems have arisen. The original rainwater and sewage diversion facilities in the urban villages have outstanding problems such as substandard water quality from their own water sources, small pipe diameters, poor pipe quality, insufficient water supply, waterlogging in rainy days and poor drainage. [4]

2.3. The Need for Stormwater Diversion in Urban Villages

Into the "14th Five-Year Plan" period, China is facing the comprehensive construction of a socialist modernization country, after achieving the first hundred-year goal, to enhance the construction of beautiful villages and rapid urbanization of the special national conditions, with the country's environmental management of urban villages increased, governments at all levels have been vigorously

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promoting urban village sewage treatment. The proportion of administrative villages dealing with sewage nationwide has increased year by year, and the Party Central Committee and the State Council attach great importance to the treatment of domestic sewage in urban villages. Based on the background of the new era, new urban communities have taken rainwater and sewage diversion and other supporting facilities, the face of urban villages, especially some older areas, are still using combined flow system, did not achieve rainwater and sewage diversion, mixed connection, private connection and other phenomena are common, the water quality of the downstream waters and the environment caused a great hidden danger, based on this, urban villages for rainwater and sewage diversion project transformation, to achieve rainwater and sewage Effective diversion not only reduces water pollution and protects the natural environment, but also promotes a friendly relationship between people and nature,[5] so the renovation of rainwater and sewage diversion is necessary.

3. Overview of Sikouzun Village and current status of sewage diversion

3.1. Overview of Sikou Shenzhen Village

Sikouzun Village is located at the intersection of Su Song Avenue, Sikouzun Road, Sikouzun Second Road and Tongji North Road in Tongan District, backed by the Tongan Industrial Concentration Area, 5 km from Tongan City and 28 km from the city centre. The village covers an area of 42.72 hectares, with a household population of 1,853 and a permanent population of 20,096. The climate of Sikouzun Village belongs to the subtropical monsoonal island climate, and the community has no agricultural land, forest land, barren hills and other primary industrial land, and the direction of development is manufacturing and other tertiary industries. According to statistics, the total number of buildings in Sikouzun Village is 751, of which 90% are commercial and rental households and 10% are villagers' own houses. The village's houses are mainly built by the villagers themselves, with single-family houses and shops ranging from 1 to 3 storeys in height, while rental houses are basically above 4 storeys and up to 8 storeys.

As a typical urban village, the water consumption index is 120L/person-d, and the sewage volume is about 2412m3/d. The current drainage system of Sikouzun Village is not a complete diversion system, mostly combined flow, with partial diversion. There is a relatively complete sewage collection system on the current main road in Sikouzun Village, with pipes of polyethylene double-walled corrugated pipes, DN200~DN300 in diameter, and the sewage terminal enters the 1000m3/d integrated pumping station and then lifts to the DN600 pipe on Susong Avenue. Main road rainwater mainly to side ditch (cover type), and a small part of the original rainwater trunk pipe, pipe diameter for DN500 ~ DN1000 between, rainwater system by each street lane collection into the main road culvert finally into the Wuzi Creek.

3.2. Status of sewage diversion in Sikouzun Village

3.2.1 Heavy mixing in the home

Some of the single-family homes on the lower floors lack washing pools and directly wash clothes and vegetables with external taps, resulting in wastewater being discharged directly onto the ground or into nearby rainwater grates and gutters, causing a mix of rain and sewage. The mixing of standpipes in high-rise rental buildings is also very serious, as landlords directly connect the kitchen and bathroom of upstairs tenants to the rainwater standpipes around their houses for convenience. After investigation, the proportion of mixed standpipes of high-rise rental households in the whole village reached more than 80%, resulting in a large amount of sewage being discharged into the storm drains causing serious pollution to the surrounding water bodies.

3.2.2. Heavy mixing of pipe sidings

After researching the actual main road part of the original stormwater grate directly into the main sewage pipe, resulting in a large amount of rainwater mixed into the trunk sewage pipe on rainy days. Due to the existence of rainwater side ditches lead to the main road along the street merchants, households sewage connection pipe elevation can not meet the requirements of households, but also lead to shops, households generated by domestic sewage directly into the rainwater side ditches. Most of the streets and lanes are not covered by the sewage network, and the domestic sewage from the buildings on both sides of the streets and lanes is basically discharged into the stormwater side drains of the small streets and lanes. As a result of a large amount of sewage mixed into the stormwater side

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drains led to the stormwater terminal Wuzi Creek overall water quality pollution is serious.

As a typical urban village, Sikouzun Village has a large population flow, which also leads to frequent changes in the commercial properties of the shops along the main road in the village, and due to the changes in commercial properties the number and location of the shops' sewage outlets will also change, leading to the sewage produced by the new shops having nowhere to be connected, and then directly connected to the roadside stormwater grates leading to combined rain and sewage flow. In addition, the Sikouzun Village night market has a well-developed economy and there will be a large number of mobile stalls on the main road at night, mainly catering, and the wastewater generated is discharged directly to the surrounding stormwater grates or stormwater drains via the ground.The current status of sewage discharge in Sikouzun Village is shown in Figure 1.

Figure 1: Current status of sewage collection in Sikouzun Village.

4. Sikouzun Village rainwater and sewage diversion renovation and solutions to major problems

4.1. Sikouzun Village rainwater and sewage diversion renovation

4.1.1. In-house rainwater and sewerage diversions

The current drainage system in Sikouzun Village is in disarray. In order to completely separate rainwater and sewage, it is necessary to start at the source, that is, the drainage system in the household. The first thing to do is to ensure that all drainage facilities in the lower floors are connected to the sewerage network (generally household washing tanks, kitchen grease traps, bathroom septic tanks, special drainage households such as restaurants and hairdressers need to set up pre-treatment facilities), and new sewerage connection pipes should be built to ensure that domestic sewage is connected. Then is the high-rise rental building standpipe mixing problem, due to the complex internal structure of the rental building is difficult to figure out all the domestic sewage discharge, so now the original combined standpipe transformation as a sewage standpipe, and then the new rainwater standpipe. The specific transformation plan is as follows: the existing combined standpipe is transformed, the combined standpipe connecting the roof rainwater hopper is cut off from the top of the building and connected to the new rainwater standpipe, and the new vent is built in the external wall of the building after the cut off building standpipe, which is used as a sewage standpipe. After the standpipe conversion is completed, the standpipe types are marked for ease of differentiation. After the renovation, the roof rainwater flows from the new rainwater riser into the rainwater gutter or grate around the house, while the sewage flows from the original sewage riser into the sewage branch pipe.The building riser modifications are shown in Figure 2.

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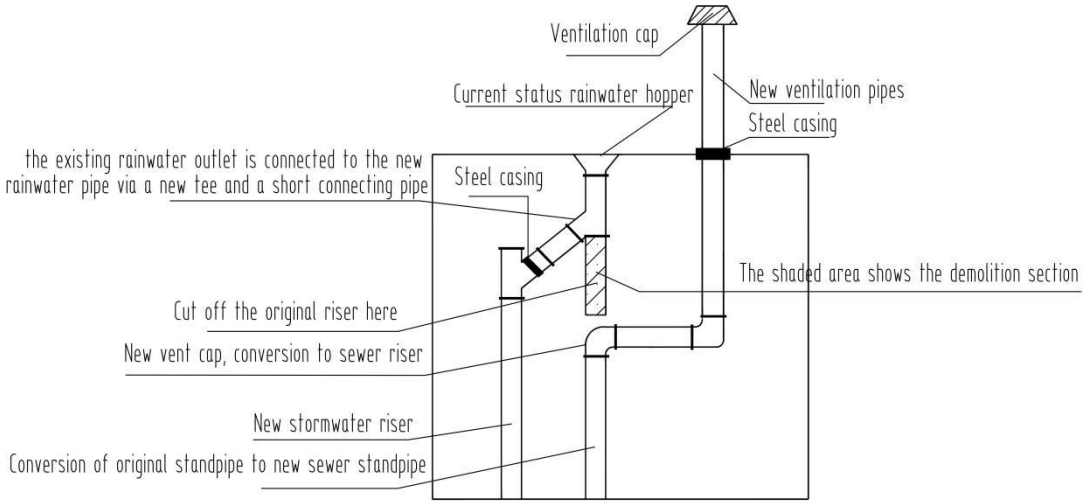

Figure 2: High rise riser retrofit programme.

4.1.2. Main road storm sewer diversion

The original merging trunk pipe on the main road of Sikouzun Village is retained as the main sewage pipe (through retrospective investigation, the original pipe has structural functional defects or the elevation does not meet the need to renovate the surrounding sewage branch access), and on this basis, a new DN300 main sewage pipe is built, and the sewage terminal enters the DN600 municipal pipe on Susong Avenue via the current sewage lifting pump station and the new river crossing pipe network respectively. In terms of rainwater, a new DN600~DN1200 rainwater trunk pipe will be built on the main road and additional rainwater grates and other rapid collection systems will be installed, and the rainwater terminals will be merged into Wulizi Creek via the two trunk pipes.

4.1.3. Separation of rainwater and sewage from side ditches

The main part of the village ditch is divided into a main road ditch and a small street ditch. After the main road was renovated, there was a trunk sewer and a new trunk storm water pipe, so the main road side ditch was filled and abandoned. Due to the high density of houses in Sikouzun Village, it is difficult to build rainwater and sewage branches at the same time because of the narrow roads in the small streets and lanes, so this renovation of new DN200 sewage branch pipes in the small lanes and then the original combined side ditches will be retained, and then the original combined ditches will be closed to domestic sewage discharge to ensure that only rainwater will be left in the side ditches after the renovation, and sewage will be connected from the end of the standpipe into the sewage branch pipes in the lanes. The systematic rainwater and sewage diversions in Sikouzun Village are shown in Figure 3.

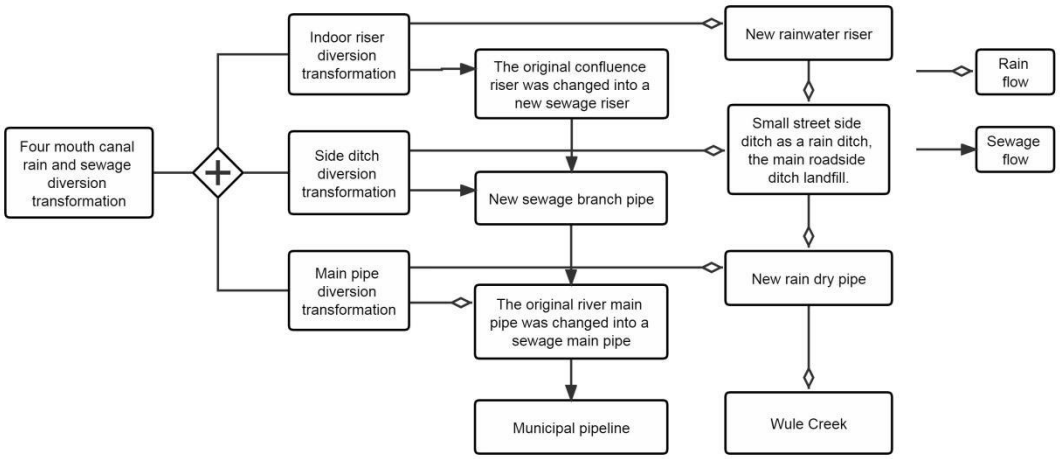

Figure 3: Diagram of rainwater sewerage diversion conversion.

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4.2. Solutions to the major problems of rainwater and sewage diversion in Sikou Shenzhen Village

4.2.1. Pre-connection of sewage from shops and mobile stalls

In order to ensure that the waste water generated by the shops and mobile stalls is not mixed into the storm water system at a later stage, the facilities need to be reserved in advance. Therefore, for the shops and mobile stalls along the main road, a new DN160 sub-pipe was laid close to the shops in the original abandoned combined ditch and connected to the trunk sewer in separate sections. Due to the shallow depth of the pipeline in the trench, it is proposed that the pipeline be encapsulated. At the same time, in order to prevent the road from becoming too dense with main wells, a sweeping opening will be made in front of each shop. New sewage sub-pipe in front of each shop to add a stainless steel closed floor drain about 5cm above the ground, so that not only can the main road mobile stalls generated by the wastewater through the floor drain into the sewage system, but also to prevent the late shops along the street due to changes in commercial properties new sewage points can not be connected, but also to prevent rainwater through the floor drain mixed into the sewage system, so as to ensure that the renovation of the late diversion system is perfect.

4.2.2. Construction work programme at housing densities

Sikouzun Village belongs to an urban village with relatively high building density. Due to the lack of reasonable planning during the construction of the village in the early stage, the current situation of Sikouzun Village has led to irregular village roads such as small streets and lanes in addition to the main road, and crowded houses. Therefore, during the actual construction process, the buildings were too dense, the lanes were too narrow and the foundations of the villagers' self-built buildings were too shallow, which posed a huge risk to the excavation of the foundation pits and directly led to the inability to carry out excavation works.

Therefore, to address this issue, we will give priority to the safety identification and protection of the houses, and carry out piling support excavation if conditions permit. However, as the piling process may cause damage to the surrounding building foundations due to vibration, if the excavation conditions really do not allow, we can also consider non-excavation construction, for the four mouths of the village, part of the location can not be excavated to consider the pipe jacking construction, but the pipe jacking construction requirements for the terrain is high, the minimum working diameter of the mechanical pipe jacking receiving well is DN800, so due to topographical restrictions pipe jacking work well installation will be limited. The installation of pipe jacking wells will be restricted due to topographical constraints. If the construction section is relatively flat and there are no other pipelines underneath (power grid, water supply pipe, etc.), the traction pipe construction scheme can be considered.

5. Conclusions

In general, the rainwater and sewage diversion renovation in urban villages is a simple but complex process [6]. Through the rainwater and sewage diversion transformation of Sikouzun Village, it is found that the rainwater and sewage diversion transformation of urban villages is very different from urban rainwater and sewage diversion transformation. For the renovation of rainwater and sewage diversion in urban villages, preliminary mapping and research is very important. It is necessary to understand the general situation of the urban village, the drainage system and the current diversion characteristics, etc. Only in this way can we target the renovation process and thoroughly realise rainwater and sewage diversion from the source to the terminal. Through the analysis of the important and difficult problems that arise in the process of rainwater and sewage diversion in Sikouzun Village, the difficulties of urban village diversion transformation are clarified, such as the difficulties of excavation due to dense buildings and narrow lanes in the village, and the sewage reservation for mobile stalls in the night market. Of course the most ideal solution is still to rain and sewage diversion facilities, from the very beginning to be able to plan and build at the same time, and in accordance with the standard volume of rain and sewage diversion projects to regulate construction, in order to ensure the quality of the project, and there are plans to work out a more complete set of guidance and supervision norms for use jointly with the local government, as well as a relatively complete post-operation and maintenance programme, for the future of China's urban villages to carry out comprehensive construction to thoroughly realise rain and sewage This will lay a solid foundation for the complete implementation of rainwater and sewage diversion in urban villages in China in the future.

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