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Study on the Construction of Ecological Drainage Pipe with Critter Crossing Function

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Abstract Critter passage can to a large extent ensure the safety of living things crossing the road and reduce the traffic mortality of living things arising from crossing the road. Outdoor drainage pipes can eliminate accumulated surface water, alleviate the drainage pressure of urban roads, and reduce the phenomenon of urban stagnant water. At present, there are many studies on the construction methods of drainage pipes, and there are also many studies on critter passage, but there is little research on the organic combination of critter passage and drainage pipes. Taking the drainage pipe as the research object, in accordance with the basic requirements of critter passage, this paper studies the construction methods of ecological drainage pipe with critter passage function, in order to solve the problem of single function of drainage pipe at present. It can provide a reference for related research in the future.

Key words Critter crossing, Ecological type, Drainage pipe, Construction

1 Introduction

With the continuous development of the level of urbanization, the urban hard ground area is also increasing, and the crisscross urban roads will separate the urban green space piece by piece. This leads to the continuous separation of living space for living things, and the source of food, the number of populations, necessary activities or migration are all limited^[1].

In the past 30 or 40 years, the number of wildlife killed by traffic around the world has exceeded that caused by hunting. Protecting the safety of living things crossing the road is a problem that must be considered in road construction, and at present the most effective method is to design the critter passage^[2]. Up to now, there are many researches on the construction methods of drainage pipes, and there are also many studies on critter passage. However, there is little research on the organic combination of critter passage and drainage pipe. In the title search on CNKI, the relevant literature on the integration of critter passage and drainage pipe has not been found.

Taking the drainage pipe as the research object, in accordance with the basic requirements of critter passage, this paper studies the construction methods of ecological drainage pipe with critter passage function, in order to solve the problem of single function of drainage pipe at present. It can provide a reference for related research in the future.

2 Problems to be solved

2.1 Function collaboration

The functional coordination re-

ferred to in this paper is the coordination of drainage function and critter crossing function, and the stagnant water on the ground is removed from the drainage pipe. Critter crossing refers to living things coming in from one end of the critter passage and then going out from the other end. Critter passage can be divided into two types: up-crossing type and down-crossing type. The upper-crossing passage is to build an "overpass" over the road, and creatures pass over the road. The down-crossing passage is to build a passage under the road, and living things pass under the road, mainly in the form of viaducts, small bridges, culverts, pipes, etc.^[3]. Because the outdoor drainage pipe is buried underground, it can be structurally connected with the down-crossing critter passage across the road.

How to form an ecological drainage pipeline with critter crossing function, make critter crossing unable to affect drainage, and critter crossing feasible in the process of drainage, is a difficult problem that needs to be solved.

2.2 Maintenance and management

Drainage means that the stagnant water on the road flows into the inspection well through the top cover of the inspection well and then into the drainage pipe. The organic combination of drainage pipe and sunken critter passage has the dual functions of drainage and critter crossing, but it is prone to problems such as sediment blockage, and biological nesting. With the accumulation of water on the surface, the surface sediment may flow into wells and pipes, and debris attached to the critter body may also fall into the critter passage. Biological nesting means that living things build nests where they stay and rest in the critter passage. In order to ensure the effective play of biological crossing and drainage function, it is very important to reduce sediment blockage, biological

nesting, and make maintenance and management simple and convenient.

How to make a reasonable design from the structure to give full play to the role of ecological drainage pipe with critter crossing function is a difficult problem that must be solved.

3 Structural design

The specific construction practice of the ecological drainage pipe with critter crossing function studied in this paper is shown in Fig. 1. It consists of outdoor green space, roads, sidewalks, critter passage, inspection wells, drainage pipes and other parts. Among them, the critter passage is composed of entrance and exit, slope and cave body, which is mainly for smaller animals such as snakes, frogs, sewer rats, feral cats, hedgehogs and so on. The top cover of the inspection well is top cover with a cave, and the sidewall of the inspection well comes with a drainage pipe with a filter cover and connected with the municipal drainage pipe. The bottom of the drainage pipe is on the same horizontal plane as the bottom of the critter passage cave.

3.1 Critter passage construction practice

3.1.1 Entrance and exit structure. The down-crossing animal passage is mainly aimed at the crossing of smaller creatures. In order to prevent rain water, dust and garbage from falling into the critter passage, the roof and wall 2 made of concrete with intensity great than C20 are installed at the entrance and exit 1. The upper part and the surrounding soil are planted to make it in harmony with the surrounding environment^[4]. Vegetation can contract from inside to outside into a funnel shape, inducing animals to the passage and stimulating them to cross the road^[5]. The vertical distance between the roof and ground at entrance and exit 1 is greater than 1 000 mm. Paving bricks are used at the connection between the entrance and exit 1 and the ground. The ground of the entrance and exit 1 of the critter passage is 100 mm above the outdoor green space to prevent the green space rain water and mud from flowing into the slope 2 of the critter passage. The edges and corners of the inner surface of the entrance and exit 1 are polished to prevent damage when animals pass through the entrance and exit.

3.1.2 Slope structure. In order to make the living things better adapt to the environment in the passage, according to the living habits of the creatures, the net width of the section of slope 3 of the designed passage is 400 – 800 mm and the net height is 600 – 1 000 mm. It is made of cast-in-place or precast reinforced concrete, and the strength grade of concrete is greater than C20. The slope has a gradient of 1:2, and the slope should be skid-proof.

3.1.3 Cave structure. While ensuring the safety of critter crossing, the structural strength requirements of cave 4 of critter passage and drainage measures should also be fully considered.

A 2% drainage slope is arranged at the bottom of the cave body 4 to prevent the accumulated rain water in the slope 3 of the critter passage from entering into the cave 4 of the critter passage. The net width of the section of cave 4 of the critter passage is 400 – 800 mm and the net height is 600 – 1 000 mm. It is made of cast-in-place or precast reinforced concrete, and the strength grade of concrete is greater than C20.

3.2 Drainage construction The drainage facilities include inspection well 5 and drainage pipe 11. Inspection well 5 with a filter cover arranged at the edge of the road or in the sidewalk is connected with the critter passage. The bottom plate 8 of the inspection well is 120 mm lower than the bottom plate of the cave 4 of the critter passage. A large-sized pebble layer 10 with a thickness of 100 mm is placed at the bottom. This is beneficial for living things to pass through the caves of critter passage. A plurality of inspection wells 5 may be arranged according to the actual situation and in the present case, the number of inspection wells 5 is two. The drainage pipe 11, the pebble layer 10, the base plate 8 and the cushion layer 9 are arranged accordingly.

In order to prevent the living things in the critter passage from entering the drainage pipe, the well end of the drainage pipe is equipped with a filter cover plate.

4 Use and maintenance

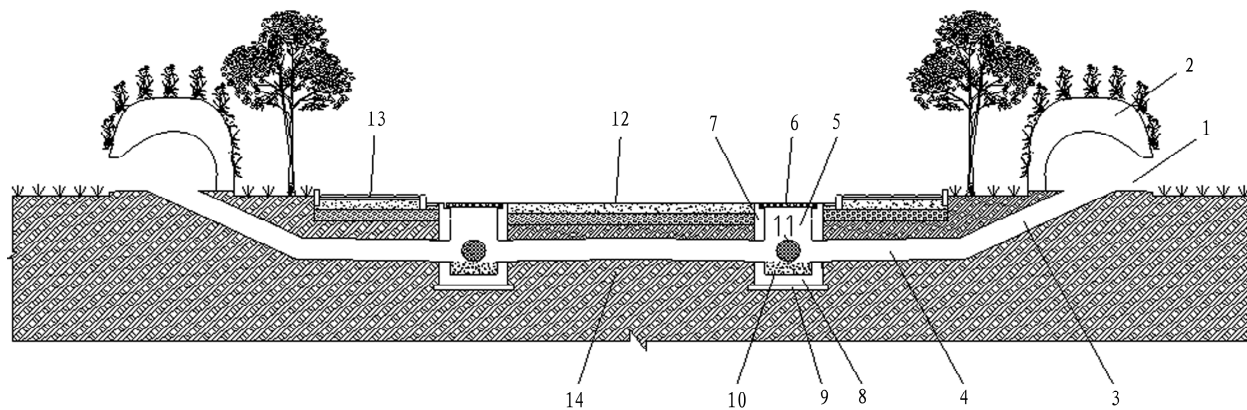
When in use, the creatures in the green space on both sides of the road pass through the entrance and exit 1 of the critter passage, and enter the cave 4 of the critter passage containing a plurality of inspection well 5 through the slope 3 of the critter passage. After passing, they enter another critter passage slope 3 and reach another critter passage entrance and exit 1.

When it rains, the rain water on the road flows into inspection well 5 through the top cover of the inspection well 6, and the rain water will be discharged into the municipal drainage pipe through drainage pipe 11 with a filter cover.

There is a slope at the bottom of the critter passage slope 3 and cave 4, pointing to inspection well 5. If the rain water enters through the entrance and exit 1 of the critter passage, this part of rain water can also flow along the slope into the inspection well 5 and discharge into the urban sewer through the drainage pipe 11.

When the cave 4 of the critter passage contains silt or other debris or the drainage pipe 11 with a filter cover is blocked, we can open the inspection well top cover 6 for manual cleaning. In order to prevent living things in the critter passage from entering the drain pipe 11, the well end of the drainage pipe 11 comes with a filter cover plate.

If there are animals building nests in the cave, manual inspection and removal can be carried out through entrance and exit 1 of the critter passage and inspection well 5. It can be cleared with water or manual cleaning can be carried out (Fig. 1).



Note: 1-entrance and exit of critter passage; 2-the top cover and wall body of the entrance and exit; 3-the slope of the critter passage; 4-the cave body of the critter passage; 5-inspection well; 6-inspection well top cover; 7-inspection well sidewall; 8-inspection well bottom plate; 9-inspection well cushion; 10-pebble layer; 11-drainage pipe with filter cover; 12-road; 13-sidewalk; 14-tamping the soil.

Fig. 1 Schematic diagram of ecological drainage pipe with critter crossing function

5 Conclusion

As we can see from the above, the ecological drainage pipe with critter crossing function studied in this paper organically combines the drainage pipe with the critter passage, and has the dual functions of critter crossing and eliminating surface stagnant water. It has the advantages of simple structure, low cost and convenient construction. It can not only eliminate the stagnant water on the surface, but also connect the green space, farmland and mountains on both sides of the road. This reduces the impact of urban roads on critter crossing in the green space on both sides, which is conducive to the protection of the ecological environment.

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