Study of a prefabricated structure perforated paving inlaid brick grid mat

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Abstract. In this paper, a prefabricated structure perforated paving inlaid brick grid mat is proposed, which is laid on the leveling layer and embedded in the brick block. The position of the brick is fixed by the positioning pile to ensure the gap between the bricks. Through the above manner, it is possible to directly use the bricks of common specifications to complete the permeable paving, simplify the paving operation, facilitate replacement and maintenance.

1. Introduction
China is in a critical period of building a well-off society in an all-round way, with unprecedented construction speed and unprecedented scale. Squares and roads play an important role in urban planning and construction. Under the background of rapid urbanization, the impervious surface area of roads, plazas and parking lots is increasing, and the infiltration of rainwater can lead to an increase in surface runoff, resulting in runoff pollution and urban stagnation. And so on, the problem is getting worse [1, 2].

At present, in the process of building sponge cities in China, the use of permeable pavement to solve the contradiction between ground hardening demand and rainwater seepage demand has become a common way. In the sidewalks, squares, parking lots and other grounds that use bricks to use permeable pavement, usually using permeable bricks and structural permeable water, although these two ways can achieve good results, are also commonly used in engineering, but the following problems still exist:

(1) The permeable bricks are expensive and easy to block, and the maintenance and management are inconvenient [3].
(2) The structural gap permeable form usually requires special shaped bricks, and the side bulges are used to ensure the spacing between the bricks, thereby increasing the cost [3].
(3) In order to ensure the gap structure, the protrusion of the structural permeable brick is usually small and easily damaged [4].
(4) After the completion of the laying, when the individual bricks are damaged, the replacement and maintenance are inconvenient [4].

In order to solve the above technical problems, this paper proposes a prefabricated structure with a perforated paving inlaid brick grid mat, which has the advantages of low cost, convenient maintenance and good water permeability [5].
2. Permeable paving technology

According to the geological structure, soil type and underground engineering conditions of the pavement, there are two types of permeable pavement: drainage pavement and permeable pavement.

The paving material of the drainage type pavement is water permeable, but the mat or the base layer is a water impermeable layer. This means that the rainwater passes through the permeable pavement and cannot continue to infiltrate into the basement. Instead, it is discharged along the basement to both sides of the roadway, then discharged to the basement well, and finally discharged to the urban rainwater pipe network. Therefore, some scholars call it the For "semi-permeable paving". Drainage pavement is mainly suitable for floors above underground spaces (such as garages) [6].

The permeable pavement is provided with a permeable mat or a bonding layer, and the rainwater can penetrate into the subgrade soil and be stored inside the soil. However, the permeable pavement is less strong than the general paving or drainage paving, and is suitable for sidewalks and garden paving. As the local settlement of rainwater is realized, the pressure of drainage is reduced, and groundwater can be replenished, which is worth promoting. It is also a paving method that conforms to the concept of sponge city construction. Due to its porous structure, permeable pavement not only enables rapid infiltration of rainwater but also purifies rainwater, so the environmental benefits of permeable pavement are significant. In general, the environmental and social benefits of permeable pavement are outstanding, and the promotion and application prospects are good [6].

There are two types of permeable paving surface materials [7]:

1) The overall permeable paving surface. Through the special grading of materials, the surface layer has a porous structure that communicates with each other, providing a channel for rainwater infiltration and evaporation of the underlying layer, but due to the porous structure, the joint strength of the aggregate is reduced, thereby reducing the strength and durability of the pavement. In view of this, additives are often used to improve the strength of the top layer bonding material.

2) Block type permeable paving surface layer. Its water permeability is mainly achieved in two ways, namely, a porous water-permeable structure and a water-permeable passage for paving indirect slits. The permeable paving base material is used as a base material for permeable paving, and in addition to having appropriate strength, it must have good water permeability. The base material is generally made of a graded gravel with good water permeability. When using graded macadam as the base layer, the maximum particle diameter of the gravel should be less than 0.7 times the thickness of the base layer and should not exceed 53 mm. At the same time, for engineering application, the base material is used as the aggregate commonly used in engineering, that is, continuous graded gravel with a particle size of 5~25mm, and the porosity is 46%.

According to the thickness of the base layer, the overflow and the drainage method, the permeable pavement can be divided into the following structures [7]:

1) A permeable base layer with a small water storage capacity. The pavement base layer mainly consists of a leveling layer and a water permeable base layer. The water permeable base layer has a large void ratio, but the thickness is not large, so the water permeability is strong. It is applicable to areas with less precipitation, strong cushioning ability and high bearing capacity. It is mainly used in sidewalks, non-motor vehicle lanes, plazas, parking lots and pedestrian streets.

2) A permeable base layer with a large water storage capacity. Generally, it consists of a screed layer, a water storage base layer, and a geotextile. The thickness of the water storage layer is large and the void ratio is small. When the rainfall is large and cannot be discharged in time, part of the rainwater is stored in the base layer to avoid water in the road area. This base layer is suitable for areas with large rainfall, water storage and drainage. Below the aquifer is a geotextile whose function is to maintain the bearing capacity of the cushion.

3) The surrounding overflow structure is permeable to the road surface. The surrounding overflow structure has been widely used in parking lots. Therefore, this permeable road surface is required to have a certain load capacity. However, when the strength is increased, the water permeability is reduced. When the amount of rain water is large, the rainwater cannot be drained in time, and the road area water is easily caused. Therefore, the peripheral overflow structure is adopted. The specific method is to use...
a certain thickness to open the graded gravel as the surface layer. The bottom layer is directly supported by the cushion with a certain slope. The cushion layer has geotextile on top, and the whole base layer is like a reservoir. In this way, when the rainfall is large, the rainwater can overflow directly from the periphery into the base reservoir and then drain out. Overflow structure of non-permeable pavement: traditional pavement does not have water permeability. The overflow structure adopts permeable paving brick as the surface layer and has the same design elevation as non-permeable pavement. It is not only beautiful, but also has the ability to withstand light loads, but cannot withstand heavy loads. Traffic, this structure is similar to the side ditch and has a very good drainage capacity. With the acceleration of urbanization, the problem of urban ecologicalization is becoming more and more serious, and the ecological nature of permeable pavement has solved this contradiction well, so that the city can get better comprehensive benefits and achieve the purpose of urban ecological construction. The construction of the sponge city continues to deepen, I believe we will see more and more applications of permeable pavement in urban construction.

3. Permeable paving inlaid brick grid mat paving method

The prefabricated structure of the perforated pavement inlaid brick grid mat proposed in this paper is composed of a positioning pile and a connecting strip, and the brick is fixed by the positioning pile to ensure the gap between the bricks, thereby realizing the rain and water seepage. No special requirements, you can directly use the bricks of common specifications, use the positioning pile on the grid mat to block the bricks, simplify the paving operation, and facilitate replacement and maintenance.

As shown in Fig. 1 and Fig. 2, a prefabricated structure of a perforated paving inlaid brick grid mat includes a main part of a positioning pile 1 and a connecting strip 2, and the connecting strip is mainly used for connecting the positioning pile. Reduce the area as much as possible to prevent adverse effects on runoff infiltration. After the underground cushion is completed, it can be laid on the initially completed leveling layer and fixed, and then the brick 3 is embedded between the positioning piles 1, and then a proper amount of fine sand 4 is filled between the brick joints to assist the fixed bricks, auxiliary fixing bricks, leveling pavement. Finally check the overall flatness and fine-tune it.

**Figure 1.** Schematic plan view of prefabricated structure perforated paving inlaid brick grid mat
The markings of the components in Fig. 1 and Fig. 2 are as follows: 1. Positioning pile; 2. Connecting strip; 3. Brick; 4. Fine sand.

The grid mat is composed of a positioning pile and a connecting strip, and the rainwater seepage is realized by ensuring the gap between the bricks. The method has no special requirements on the bricks, and can directly use the bricks of common specifications, and uses the positioning piles on the grid mats to fix the position of the bricks, ensure the spacing of the bricks, simplify the paving operation, and facilitate replacement and maintenance. The grid mat is made of environmentally-friendly coils, and its specifications can be mass-produced according to several sizes of common bricks. The connecting strip occupies a small area and has little effect on rainwater seepage. The shape of the positioning pile is unified into a cylinder, and its height is 1/3 to 1/2 of the thickness of the brick. In addition, the bricks do not have to be permeable bricks.

4. Conclusion

By adding brick grid mats to ensure the interval between bricks and maintaining the gap-permeable structure; the positioning pile proposed in this paper replaces the irregular protrusions of the traditional structure permeable bricks, so that the use of ordinary bricks can also achieve permeable pavement, which is conducive to promoting permeable pavement the popularity of this method. This method of laying bricks realizes the assembly laying. It only need to embed the bricks into the mesh mats, eliminating the steps of positioning the wires and fixing the bricks one by one, improving work efficiency, reducing labor costs, and speeding up the progress of the project. The method has the advantages of simple structure and easy production. After mass production according to several specifications, the cost is not high, and the construction cost is reduced as a whole. The bricks are fixed by the method of the present invention, and when individual or part of the bricks are damaged, it is easy to take out and replace. Specific bricks do not affect the surrounding bricks, which facilitates later maintenance.

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