Design of portable recyclable drainboard set-up

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Abstract. For the traditional drainboard set-up device obvious disadvantages: the structure is bulky, loading complex, often need drainage plate body, affecting the drainage effect, almost impossible to recycle, poor environmental protection performance, due to the effect of deformation, late work and other devices have interference, the drainage itself difficult to regulate in the process of setting up. In order to achieve the light, automatic, non-destructive and recyclable of drainage plate, improve the obvious shortcomings mentioned above, a series of improvements are made to the drainage plate set-up device. Through the verification of laboratory experiments, the problems such as large, bulky, high vulnerability and low recovery rate are solved, and the laboratory simulation has no suitable equipment, which reduces the space occupancy rate, saves resources and so on, and greatly reduces the cost of experiments. In water engineering applications, this new type of drainboard discount ingress than the existing drainboard plug-in machine, can be a good substitute for improving the status quo of the project.

1. Introduction
With the rapid growth of national economic strength and the good development trend of coastal areas, the ports in the eastern coastal areas of China have become the hub of transportation and the window of opening to the outside world, thus the technology of offshore land creation has also been developed significantly [1]. In the fields of greening, municipalities, construction, water conservancy and transportation, drainage boards are widely used. Drainage slabs are also the most common measure in the process of improving marine engineering foundations. The method of laying drainage slabs for vacuum pre-pressure is commonly used in current foundation improvement projects, and this construction process has accumulated a wealth of experience in long-term engineering application practice[2-3]. In the construction process, there are problems with the placement of drainage slabs. The popular drainage board laying device at the project site of soft foundation treatment is the drainage board inserting machine, which is composed of the main frame, chassis and power system, of which the main frame often has a height of 20-30 metres. Such devices are large, bulky, fragile and have a low recovery rate; laboratory simulations simply do not have the right equipment, which affects the efficiency of the inserter and increases the cost of laboratory tests [4-7]. In this paper, a portable recyclable drainage board laying device is developed to achieve accurate, automatic, non-destructive and recyclable laying of drainage boards.
2. Drainage board laying working environment
With the rapid economic development in recent years and the saturation of terrestrial resources, land formation around the sea has become an important means of developing land resources in marine engineering foundation improvement. However, due to the high water content, high initial pore ratio, high compressibility, low initial ultimate shear strength and other physical and mechanical properties of the natural blow-fill materials, it is necessary to choose the correct consolidation and curing means to treat the initial foundation in the polder area \(^{[6-9]}\). The placement of drainage slabs for vacuum precompression is a common method used in foundation improvement projects. In a specific field implementation, the drainage slabs are laid inside the soft foundation, the sand bedding layer is laid on the surface of the soft foundation, followed by the geotextile and sealing membrane, which are successively covered and the sand bedding layer is isolated from the atmosphere by burying the sealing membrane in the sealing trench \(^{[10-11]}\). Finally, due to the principle of vacuuming, a local negative pressure source will be formed in the soil, which reduces the pore water pressure in the drainage board, and a pore pressure difference will be formed between the drainage board and the surrounding soil \(^{[12-13]}\). Large projects on site usually have machines for beating and setting drainage slabs, but such machines are obviously not suitable if simulation tests are carried out, so often people tie the drainage slabs to a rigid structure, and in order to insert the slabs in different positions, large frame rigid structures are also designed to tie the drainage slabs to them, this setup usually has a lot of disadvantages, in the process of vacuuming, through the pressure difference, the water and gas in the silt are extracted, but with the passage of time, the soil produces radial contraction, which can squeeze the drainage boards and also these structures, which is not conducive to secondary use, and placed in the soil, which may also damage the upper geomembrane due to settlement.

3. Design of the structure and parameters of a portable retrievable drainage board laying device
The disadvantages of traditional drainage board beating devices are obvious: bulky structure, complex loading; often need drainage board body, affecting the drainage effect; almost impossible to recycle, poor environmental protection; due to the impact of deformation, later with other devices have interference; beating process drainage board body is difficult to regulate.

3.1. Overall construction of the unit

![Figure 1. Overall structure of the unit.](image-url)
3. Device implementation and application

When implementing this portable and retrievable drainage board installation device, the reinforcement plate is fixedly attached to one side of said box-shaped drainage board; the swivel locking sleeve is fixedly attached to said reinforcement plate by means of bolts, orthogonal to the recess space; the installation shaft is cylindrical, one on each side, each shaft is equipped with two said swivel latches and two said circular limiting rings; the swivel latches and circular limiting rings are sized to match the swivel locking sleeve; the connecting rods are long and square in cross-section, connected to the two shafts by means of grooves in the mounting shafts, matching the grooves in size and limited by projections on the rods, the spacing between the two projections being the same as the spacing between the mounting shafts, with hooks fixed to the connecting rods.
For specific use, the design is described in conjunction with the accompanying drawings for ease of understanding. Before installation, the staff will pass the two mounting shafts through the rotating lock sleeve and rotate 90 degrees, the mounting shafts are limited in vertical displacement under the action of the rotating latch and circular limiting ring, then connect the two mounting shafts with the connecting rod, and complete the beating set by giving pressure to the connecting rod with other pressure equipment; after the beating set is completed, the connecting rod is recovered and the mounting shafts are rotated 90 degrees so that the rotating latch is facing the rotating lock sleeve, and under the action of tension, the rotating Under the pulling force, the latch is released from the rotating locking sleeve, thus separating the box-shaped drainage board from the installation equipment.

![Figure 4. B-B cutaway view.](image1)

![Figure 5. C-C cutaway view.](image2)

4. **Design Effectiveness Evaluation**

The beneficial effect of this device is that the connection and separation of the box-shaped drainage board from the beating equipment is cleverly achieved by using a mechanical structure, which is simple and convenient, occupies little space, saves resources and greatly reduces the cost of experimentation. The above description is only a preferred embodiment of the design and is not intended to limit the design, which is subject to various changes and variations for those skilled in the art. Any modifications, equivalent substitutions, improvements, etc. made within the spirit and principles of this design shall be included within the scope of protection of this design.

5. **Conclusions**

The design presented in this paper refers to a recyclable drainage board installation device, which achieves the connection and separation of the box-shaped drainage board and the beating installation equipment through the clearance fit of the rotating locking sleeve and the rotating latch, so as to achieve equipment recycling and reuse and save resources. It is a good solution to the problems of large, bulky, fragile and low recovery rate of the device; laboratory simulation is simply no suitable equipment, reducing the space occupation, saving resources and greatly reducing the cost of experiments.

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