

The design of research experiment about cohesive soil piping failure under the action of unsteady head

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Abstract. At present, many scholars at home and abroad having been studying the action of the unsteady under water head. For example, on the basis of the unsteady seepage piping test, Mao Chang xi conduct an experiment of the stable seepage piping according to the test of the sine type flood tidal flow and theoretical analysis. However, no significant achievements were obtained. On the one hand, the interaction between the unsteady head such as the flood and soil is more complex. On the other hand, because of the complexity of the development of the piping, pore filling of fine grained soil is taken away by the seepage force, which has great randomness in the coarse grained soil. Based on the research unsteady under the head piping, a suitable method for unsteady head under the action of sand piping test may be found through a variety of experimental scheme comparison. What's more, under the action of the flood and other unstable head, sand damage characteristics of piping were analyzed.

1. Introduction

For reducing flood and other unstable water pressure piping failure, some scholars studied by experimental simulation. But due to the complexity of the internal movement of soil, the inherent characteristics of most existing research not deep into the piping failure. In the past research, Nanjing Hydraulic Research Institute Wu Liangji ^[1] and other scholars analysis of single particle force, and considering the interaction of soil and water, the practical formula of many critical head, some formula has become the national standard (GB50287-99) formula recommended by ; Lu Peiyan^[2] according to the actual engineering problems, are deduced in the embankment of river, deep excavation and excavation of the subway mining method evaluation formula for seepage piping under three kinds of situations; Mao Changxi ^[3] mechanism of concentrated leakage passage on the embankment seepage occurred are analyzed by finite element simulation; Yin Jianhua ^[4] that the change of seepage field in the process of the development of piping is very important. Based on the research on the role of head stability of piping, Liu Wu ^[5] studied Signorini type boundary conditions of unsteady seepage problem; Mao Changxi ^[6] was the peak of flood and tidal amplitude process dike piping unsteady seepage model test, discussed the calculation scale law and time similar model test model that gives the piping development time reference. Hu ran ^[7] by giving a Signorini containing complementary condition parabolic variational inequality method, the Signorini type inequality method from the steady seepage analysis method to unsteady seepage analysis; Duan Xiangbao ^[8] in sand tank model laboratory simulation of slope silt, fine sand, clay and other materials of the non landing the physical process in the process of stable seepage in water, analyzes the characteristics of seepage drawdown of upstream slope field in the process; Based on the model test, Tao Tongkang ^[9] analyzed the physical mechanics of impervious unsteady seepage in homogeneous earth dam foundation of earth dam foundation; As the water level on the unsteady flow calculation program were decreased Chen Ping ^[10] , therefore



unsteady seepage program for reservoir water level rise and fall; Based on local piping phenomenon of earth dam in flood season, Wei Jianfei^[11] pointed out that the peak Under the action of soil piping time lag. Chen Liang^[12] through theoretical analysis and laboratory tests, the development laws of soil piping head conditions of different properties under.

2. Piping test device design

Using the design of model test apparatus (test device diagram as shown in figure 1) Simulates the phenomenon of the cohesive soil undertaking the lower load under water. In order to prevent the soil particles from blocking the bottom layer under the action of downward flow, the permeation test of the direction of the flow direction is adopted. The main body diameter of the model is 150mm, and the height is 550mm. The material of the model device is a 8mm thick organic glass cylinder. It is divided into four layers from top to bottom, Which makes it possible to observe the trajectories of the particles in the test process. The side wall of the cylinder is arranged from down to top and 8 pressure tubes are arranged in turn. Its spacing is 50mm, which is used to monitor the change of the water level of the piezometer during the test. In order to produce a permeable flow, blast-hole and delivery port are intercalated. and the water discharged as soon as possible without affecting the development of piping in the process of test coming up. As the outlet of the pipe is larger, when the pressure is larger, the flow of water will produce a concentrated seepage force in the process of rising, which affects the result of the test. Therefore, a certain thickness of the flow buffer is laid with a coarser soil sample, and the flow of water at the inlet and outlet can be controlled by the valve at the bottom of the model device. A brief diagram of the structure of the instrument is shown in figure 1 below.

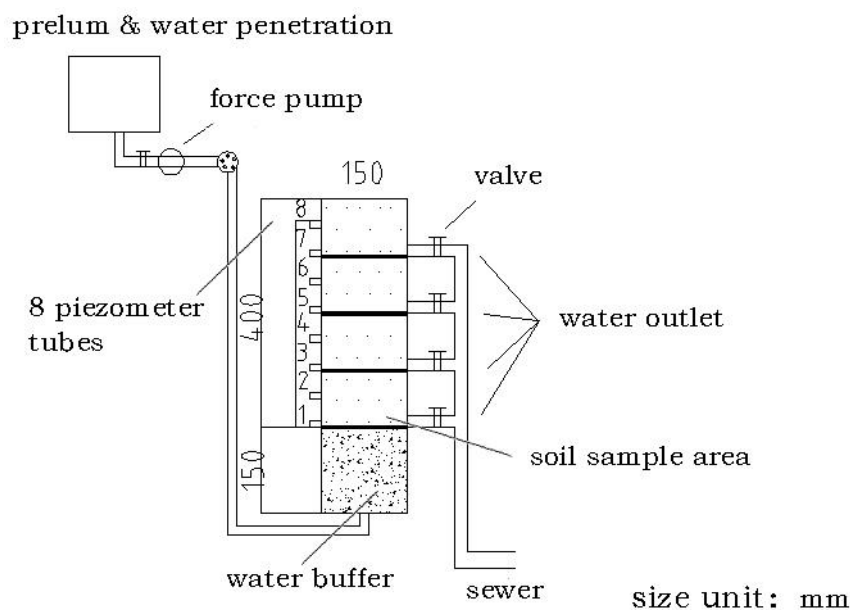


Fig. 1. The experimental instrument piping structure map

3. Test of piping materials

Fine particle clay with particle size range from 0.01mm to 0.03mm, from 0.03mm to 0.05mm, from 0.05mm to 0.07mm and boulder quartz sand size range from 5mm to 10mm are determined to be test materials. According to the regulation of any two of the first three respectively in the round and quartz sand soil according to soil mechanics types with different porosity, Test materials are classified and the sand piping mode is formed. Through the model test on the stability of non cohesive soils head failure law Chung and the analysis of the influencing factors under the unsteady water piping failure, Some dates can be obtained by using the control variable method (such as nature) to test.

4. feasibility analysis

The theoretical analysis of this design is to establish the extension and reasoning on the basis of previous studies, the experimental data by the team under the guidance of instructors do, and learn from other experts and other data as a reference, the experimental data and experimental theory, true and reliable, the experts and scholars of theory and experiment confirm each other.

Numerical simulation technology and mathematical statistics analysis technology are relatively perfect for current advanced technology. They are widely applied in surgical research and other fields in China. This provides a theoretical and simulation basis for this experiment, which greatly increases the possibility of design completion. On the one hand, the design can prevent the harm of piping engineering design, and it is good for the development of space; on the other hand, it can greatly improve the service life of engineering experiment, the engineering cost can be reduced, and the disaster prevention and mitigation of dam engineering has a very good role in promoting.

Finally, from the perspective of national policy, China implements sustainable development strategy, advocates saving and encouraging technological innovation, and the purpose of this project is to find more effective ways to improve the sustainability of the project, which is in line with national policies.

Comprehensive analysis of theory, technology, team, policy and economic environment, this design is feasible.

5. The characteristics and innovation of this experiment

(1) low standard. The piping failure contains a complex mechanism, this project will focus on simplifying complex one, the number and fuzzy piping development can be a relatively simple performance.

(2) combine with the local reality. The experts and scholars in the research object of piping failure more widely, and this project combined with the local, the emphasis of the study of cohesive soil.

(3) the environment of the test is the effect of unsteady head. Stable head under the action of piping failure there have been many professional scholars, but in a non stable head under the action of piping failure few scholars pay attention, this project aims to the unstable head under the action of the failure mechanism of piping is studied.

(4) the test instrument is small but the five viscera are full. Combination of pressurized water inlet device and a flow buffer can form stable environment non head good; 8 piezometers can measure during the test of real-time data; the soil sample area from top to bottom, the average is divided into 4 layers, can be observed movement of soil particles in a water outlet; under the control of the valve can make the test process of water penetration test according to the required speed discharged without affecting the piping development.

6. Concluding remarks

Through the sand piping model experiment, find out the rules of piping failure in different head and different size soil tests and research in flood and other unstable head of sand piping failure mechanism. So it is necessary to study the problem of flood and other non stable Piping under the action of the head. Through the sand piping model experiment, find out the rules of piping failure in different head and different size soil tests and research in flood and other unstable head of sand piping failure mechanism.

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