Briefly Discussion on Structural Test

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Abstract

The problems that can be solved in different structural tests and the four stages of test are explained. The static loading tests are emphatically introduced from the point of view of loading equipment, design of supports and specimens, test stand and reaction frame, working principle of strain gauges.

Keywords

Structural Test; Static Loading Test.

1. Problems Solved By Structural Test

According to the purpose of the test, the structural test can be divided into research test and production test. Research-based tests are mainly used in scientific research projects such as natural funds, and production-oriented tests usually have direct production objectives and specific engineering objects. Structural tests mainly solve the following problems:

(1)Verify the structural calculation theory or create a new one.

(2)Formulate engineering technical standards. In the formulation of various structural codes and standards, in addition to summing up the existing engineering experience and structural theory,we also need to do structural tests. Systematic structural tests and studies also provide reference for the safety, applicability and durability of structures.

(3)Check the quality of a structure or component.

(4)To determine the bearing capacity of a structure, especially when the calculation alone is not enough, a structural test is a must.

(5)Verify the safety reliability of the structure design. The object of this kind of structural test is usually the structural model of a small scale, such as the roof of a large span structure or the seismic test of some high-rise structures.

2. Experimental Design Principle

Structural test can be divided into four stages: experimental design, technical preparation, implementation process, data analysis and summary.

3. Static Loading Test

Static loading test is one of the general tests used in research and production tests. The instruments and equipment used in static loading test can be divided into loading equipment, measuring instruments, amplifiers and recorders,etc.The physical quantities observed in the static loading test are force, displacement, strain, crack width and distribution,failure form or unstable state, etc. The design of statically loaded equipment, supports and specimens, working principle of test stand and counterforce frame, strain gauge and instrumentation are described below.

Loading equipment. The loading methods can be divided into gravity loading, hydraulic loading, mechanical loading and pneumatic loading. Gravity loading is mainly used in long term test and field test. Generally speaking, the loading is very heavy and the safety is poor,so the failure test is not generally used. Hydraulic loading equipment is a kind of loading equipment used in structure test. Hydraulic loading equipment is generally composed of hydraulic pump source, hydraulic pipeline, control device and loading cylinder.Fluid pressure operated jacks is most used in loading, it is a small integrated hydraulic loading system. Hydraulic Jack is mainly used in static loading test of reaction beam, and it is mainly used in test. Manual hydraulic Jack, this manual hydraulic Jack without power,more convenient to use, therefore, more suitable for use in structural testing.

Support design. According to the purpose of the test, there are two different ideas to design the support of the test device. One idea is that the boundary condition of the tested structure or component is the same as the actual structure, which is a simulation experiment. Another idea is that the boundary conditions of the tested structures or members are as idealized as possible,the stress conditions are clear and consistent with the calculation schematics used in the structural design, and this setting method can make the structural performance analysis correctly. In the structural test, the design idea is generally the second.

The support can be designed as movable hinge support, fixed hinge support and column member hinge support. The movable hinge support can only provide a vertical bearing reaction force, which can not transfer bending moment or horizontal force. When the movable hinge support is designed, it is generally designed as a single axis hinge support. The member on the fixed hinge support can move freely, but can not rotate. In theory, the fixed hinge support can withstand the effect of horizontal force. In the static test of continuous beam, only one support is fixed hinge support, and the rest should be set as movable hinge support. In order to avoid errors in the manufacture of components or supports, in the manufacturing process of bearings the support should be made into a movable support that can adjust the height. The bearing of the column member is also a fixed hinge bearing, which requires high pressure in the test of the column. Therefore, the hinge support can be installed on the foot of the testing machine to form the column hinge support.

Test stand and counterforce frame. In the static loading test, the steel beam in the lower part of the test stand and the cross beam on the loading frame form a balance system. The reaction force of loading Jack is transmitted to the lower steel beam through the pulling rod of the loading steel frame, so that the support of the steel beam exerts downward force on the steel beam. Forming a system of force balance. This kind of load test support is mainly used in small mechanism test. The counterforce frame also works with the test stand, which is generally made up of closed steel frames. Generally speaking, the ground trough counterforce pedestal and the spiral counterforce pedestal are used in the structural test. The ground trough counterforce pedestal is designed as a whole cast-in-place reinforced concrete thick slab with a thick slab on which the site for structural test is designed. The longitudinal channel is called a geosyncline. Anchor bolts are arranged inside the groove to fasten the loaded counterforce steel frame. At work, the anchor bolt can move along the geosyncline so that the position of the counterforce steel frame can be adjusted according to different tests. The counterforce steel frame is mainly composed of columns and beams. The columns of table supports are helical bars, and the columns on plate pedestal are mostly shaped steel with I-shaped section. In order to avoid excessive bending moment, the connection between column and beam can be hinged. The design of test stand, counterforce steel frame and counterforce wall should not only meet the requirements of bearing capacity, but also meet the requirement of rigidity; Fatigue strength requirements under repeated loads.

Working principle of strain gauge. The strain gauge in static loading test can be divided into concrete strain gauge and steel bar strain gauge. Both kinds of strain gauges are resistive strain gauges, but the sizes of the two gauges are different. The strain gauges used to measure concrete are longer, because when the concrete cracks, the cracks develop in the form of dendrites, and each crack involves a wider

range of cracks than the ones produced by the steel bar. Therefore, a longer strain gauge is needed to accurately measure the deformation of the concrete surface. Although these two strain gauges have different forms, they all work in the same way, and when subjected to external loads, the surface of the members The mechanical deformation of the strain gauge will change the resistance value of the strain gauge, and the change of the resistance value in the galvanometer can be reflected as the change of the current. In the process of data collection, the change of component physical quantity can be measured by the transformation of resistance value.

Specimen design. In the design of static loading test members, the components which are consistent with the original structural specimens can be used, or the model of reducing the scale can be adopted. The design of component mainly includes the shape of component, the size and quantity of component, and the design of structure. The selection of specimen size should take into account the cost of the test, the capacity of the equipment and the influence of the size on the performance of the specimen. When the size of the specimen is the same as that of the actual structure, it is called the true specimen, and the size of the specimen is smaller than that of the actual structure, so it is called the model specimen. For example, in the experimental study of crack span of reinforced concrete flexural members, the size of the members is involved in many influencing factors. The size of the main steel bar diameter, spacing and thickness of the protective layer, and so on.

Instruments for testing. The purpose of the structural test is to understand the static behavior and failure characteristics of the structure. Therefore, effective and reliable data must be obtained by means of reasonable measurement and data collection. The data of structural test mainly include two parts, one is the function of structure, such as load, bearing reaction force and so on. The other part is the response of the structure under load, such as displacement, strain, crack and so on. In order to obtain accurate test data, electronic measurement system can be used to collect data. The measurement system consists of three parts: sensing part, amplifier part and display part. The sensing part is mainly the sensing original or the sensor, in large part, amplifies the signal, and the display part passes the mechanical or electronic signal through the pointer, and the disk is recorded to facilitate the reading. In order to obtain accurate data, we must fully understand the performance of the instrument, such as the range, sensitivity, resolution, accuracy, linearity, offset and so on.

4. Summary

Structural testing is very important in both production and research. Whether in production or research, under the premise of definite test purpose, the similar theory research method can be used to design the support and specimen size or directly test the actual structural member according to the requirements of the test model. Design reasonable loading scheme and observation plan, after all the preparation work before the test, carry on the structure research type or the production type test, and adopt the scientific and reasonable measuring instrument to collect the accurate data, Then, according to the data, the mechanical and deformation properties of the structural members are analyzed, and the failure patterns of the members are studied, and then the bearing capacity or the serviceability of the members is studied. Can make the evaluation, so as to achieve the purpose of the structural test.

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