Research on Acceleration Test Method of Amusement Facilities

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Abstract: The analysis of the current test level of entertainment facilities, the test of entertainment facilities in driving state should solve the urgent problem, pointed out that the test system of entertainment facilities in driving state as the core, accelerated test, test speed, stress-strain test decision. Combined with the working characteristics of entertainment facilities, three core testing technologies are studied from the aspects of theoretical analysis, equipment selection and testing methods. The test case shows that the operation state detection system of entertainment facilities based on the above technology test is feasible and will provide strong technical support for the detection of entertainment facilities.

1. Introduction

In recent years, with the rapid development of society and the improvement of living standards, the entertainment industry has achieved rapid development[1]. China's large-scale amusement park construction is changing every day. Foreign large-scale entertainment facilities are pouring in, and domestic manufacturers are also introducing new things. Entertainment facilities have evolved from simply imitating overseas machines to produce small and medium-sized devices. For example, the highest speed of domestic roller coaster is more than 100km / h, and the height of observation car reaches 168m. The world's first 208m observation car is also in the process of design. The development direction of entertainment facilities is as follows: faster, faster, more advanced technology and more complex sports forms. As a result, the risk is also increasing exponentially. With the rapid development of entertainment facilities, the safety accidents of entertainment facilities occur from time to time, resulting in a very bad social impact. Entertainment facilities test system is an important guarantee to test the performance of entertainment facilities and determine whether it is safe and reliable. At present, the testing system at home and abroad will carry out static index tests such as whether the safety device is sound, whether various structural components have cracks or other defects, whether mechanical and electrical products have been modified. When the height of entertainment equipment reaches tens of meters and the speed exceeds 100km / h, the testing system at home and abroad gradually focuses on the testing research of dynamic indicators. This type of large-scale entertainment facilities is safe when its dynamic and static indicators meet the safety standards[2]. For this purpose, master the key operation state parameters of entertainment facilities, and construct the detection technology, monitoring system and other related fields from the train test system. And make corresponding changes to establish a scientific and reasonable equipment set compatible with the development of entertainment facilities. Motion state test system

2. Amusement Facilities Operation State Test System

2.1. Amusement Park Test System Status

The inspection of existing entertainment facilities inherits the idea of inspecting special devices, and the inspection methods and experimental devices focus on specific indicators and non-destructive tests of subsystems or components of devices[3]. However, the overall performance indicators of entertainment facilities have not been fully concerned. General use of entertainment

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equipment test device, the idea of this check, low speed is suitable for the initial small-scale entertainment equipment. Today's large-scale entertainment facilities have faster operation, greater influence and more complex sports forms[4]. The original test tool could not meet the inspection requirements. For example, it is difficult to test the travel speed of a device with multiple degrees of freedom, such as a speed windmill. Flying island can easily lift more than 100 tourists, but it can't accurately test the strength of arms. In addition, in the 2008 amazing safety specification 6, the concept and limit range of acceleration are introduced, and there is no special device for acceleration test. Therefore, in order to meet the needs of safety inspection and supervision, it is necessary to develop a complete entertainment facility test system as early as possible.

2.2. Setting of Inspection System for Operation of Entertainment Facilities

In large-scale entertainment facilities, designers usually carry out dynamic analysis of design plan and calculate load spectrum of specific components in order to obtain theoretical acceleration curve and speed curve. In this way, through the detailed design of each component and the analysis of limited components, the stress nephogram of components can be obtained, and the maximum stress of components can be obtained[5]. Therefore, the theory of working state test system is constructed. The system can analyze the theoretical data of design and analysis, the measurement data of test system, the safety specifications and specifications, reflect the actual operation conditions of the device, and find the potential problems of the equipment. In addition, speed reflects the overall operation of the machine from a macro perspective, acceleration reflects the impact problem in operation from a micro perspective, and the pressure of key components is tested by pressure and distortion. The above three tests basically cover the main aspects of operation state.

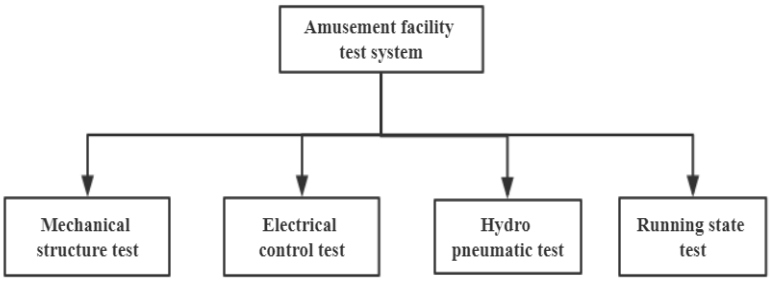

Figure 1 Inspection equipment of common amusement facilities

2.3. Research Status of Key Indicators

Between vehicles, the acceleration acting on passengers must be limited to a specific range. For example, EU, US and Australian standards specify this[6]. Then, the passenger's detention device is designated. It must be set according to the acceleration. The acceleration requirements of China's entertainment facilities specification GB 8408 in 2000 are blank. In the new version of entertainment facilities safety rules in 2008, the regulation of EU acceleration department was directly introduced into China's standard system. The work of design, manufacturing and safety inspection has played a great role in the progress, but the matching test device and test method are still lacking[7]. This has led to the embarrassing situation that the inspection agency has standards and is unable to achieve them. Therefore, it is necessary to develop the accelerated test device and research method for entertainment facilities as soon as possible.

Speed is one of the basic performance indexes of vehicles. There are more detailed rules about the speed of ride standard vehicles. In addition, with regard to the roller car, the speed of each part of the truck can be correctly tested, and the running state of the device can be known by detecting the coordination between the vehicle and the truck, the performance of the braking system and the performance of the lifting mechanism[8]. The current test method is radar speed measurement. Radar testing is a mature technology, the most appropriate price, convenient benefits, but roller coaster like complex motion equipment, its orbit is standardized, speed changes significantly, will lead to radar speed measurement. Because of the large error, it is an urgent task to study the velocity measuring device suitable for amusement equipment.

The forms and supporting conditions of entertainment facilities are complex, with high load. In order to calculate the stress, after applying the finite element method or other numerical calculation methods, the stress distortion test verifies the correctness of the assumptions and assumptions in the calculation, analyzes the calculation results and confirms them[9]. This method can also analyze the damage reason of the machine structure, find the weak link and find the improvement method. For example, American standards pay special attention to stress testing in entertainment facilities, and stipulate that the impact coefficient in the design can be selected within a certain range according to the test results. China's entertainment standards need stress testing, but they lack specific testing equipment and methods. Although the pressure and distortion of a complete set of test equipment and methods, as soon as possible, their actual safety factors meet the standard conditions, in order to confirm the pressure test, high-risk equipment in order to guide and super large equipment suggestions are necessary.

3. Key Technology Research

According to the needs of the above amusement facilities operation state test system, combined with the characteristics of amusement facilities, the following key technologies are studied.

3.1. Acceleration Test

Accelerometers are inertial sensors (accelerometers and gyroscopes) that are attached directly to a vehicle (such as a roller coaster). According to the acceleration and angular velocity output of the inertial sensor, the system estimates the instantaneous acceleration, velocity, position and attitude of the payload relative to the earth. The peak acceleration of large-scale entertainment facilities may occur in places with small curvature of motion track such as roller coaster and liner, so it is necessary to pay attention to the maximum angular velocity and bandwidth of accelerometer[10]. Therefore, from the comprehensive investigation of the weight, volume, cost, maximum measurement angular velocity and bandwidth of the device, the piezoelectric resistance acceleration sensor with built-in signal regulator is selected.

GPS receiver has high performance and high data collection frequency. The advanced mathematical model in the machine can ensure that the long baseline can correctly solve the unknown whole week. The data link performance is good, the transmission distance is long, and the data of the reference station can be accurately transmitted to the rover. Move with a fixed GPS mobile station. The antenna of the mobile station shall point to the sky as much as possible during the movement. The reference station must have a wide field of vision and an angle of cut-off height of more than 15 degrees. In order to reduce the multipath interference, there should be no signal reflector around the wide area such as tap water, large buildings and so on. In order to broadcast the differential correction signal, the base station should be set at the relative height as much as possible. In addition, there is no strong electromagnetic interference in the working area. Please put that away from the equipment room and control cabinet.

3.2. Test Process and Precautions

Determine site selection. It shall be determined according to the key components calculated in the design document identification. Pay special attention to key components with lower security factors. In addition, during manufacturing and installation, pressure and distortion tests must be performed on the components found in the field, which is quite different from the original design. In order to make the test results unaffected by the temperature effect, the half bridge and double arm connection can be used to remove the temperature effect. Then, to protect against moisture, use protective adhesive. According to the conditions of full load, eccentric load and no load, the distortion value of each point is measured.

4. Conclusion

This paper analyzes the current situation of entertainment facilities test system, and points out

that in order to ensure the safety of entertainment facilities, it is urgent to establish a comprehensive entertainment facilities operation test system. In addition, as the main technology of entertainment facility operation state test system, acceleration, speed, stress and distortion tests are determined. According to the characteristics of entertainment facilities, the equipment selection, test methods and evaluation standards of acceleration, velocity and stress distortion test are studied. The corresponding test example shows that the above devices and methods are feasible and can be applied to the operation state test of entertainment facilities. The inspection system of entertainment facilities is a long-term research object of the inspection authorities. Due to the increase of large-scale lifting device, vibration test will become the focus of further research. In addition, how to combine multiple test results to find deep machine problems is the focus of future research.

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