

Risk Prevention and Control, Monitoring and early warning Measures for Stereo Parking Equipment

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Abstract. This article comprehensively explores the risk prevention and control measures for equipment safety, ensuring the stability and safety of equipment operation. Firstly, a solution for the oxidation and aging issues of alloy materials is proposed, which involves surface treatment through electroplating metal and painting, with special attention paid to the protection of key components such as main and auxiliary steel and support columns. Secondly, the importance of connecting load-bearing components of the equipment was emphasized, and the stability and safety of the structure were improved through the use of high-strength bolts, nuts, and washers. In terms of maintenance of mechanical systems, regular lubrication of chains and sprockets, as well as scientific layout of electrical testing equipment, can ensure the safe operation of the equipment. The prevention, maintenance, monitoring, and early warning systems for improper personnel operation are very important and necessary.

Keywords: Stereo parking equipment; Comprehensive evaluation; Risk prevention and control.

1. Introduction

Now, in order to prevent the safety accidents of three-dimensional parking equipment, we need to strengthen the internal self-discipline of enterprises and fulfill the main responsibilities of enterprises [1]. At the same time, we also need to rely on government departments or third-party inspection agencies to provide legal inspection services for three-dimensional parking equipment [2]. Since April 2009, the detection of stereoscopic parking equipment has been included in the local statutory detection in China [3]. According to the relevant laws and regulations of our country, the detection of stereoscopic parking equipment is mainly divided into acceptance inspection (supervision and inspection) and regular inspection [4]. Therefore, the main risk points of stereoscopic parking equipment are summarized according to the data investigated [5]. In a large sense, it involves not only the environment and the equipment itself, but also the design, manufacture, installation and other links of the structure. The specific requirements correspond to the inspection specifications [6].

2. Risk prevention and control measures for equipment problems

Risk prevention and control measures for equipment problem is shown in Table 1. In general, the overall scheme should be designed reasonably in the design process. The engineering design drawings and structural strength calculation of the complete set of equipment shall meet the actual performance requirements of the product; However, the engineering design of the steel structure of the high-rise stereoscopic parking equipment requires the design and calculation of engineering technicians with relevant qualifications, which can only be constructed after being reviewed by the relevant national departments and meeting the requirements.

Table 1. Risk prevention measures of stereo parking equipment.

Risk points	Preventive measures
Steel frame structure	Carry out strict theoretical design and stability check calculation for steel frame structure; Rust removal (GB/T 8923), metal electroplating (GB2694), weld (NDT) in production pretreatment; High-strength bolts shall be used for connection of steel frame under stress (connection of support column and foundation, connection of support column and main and driven steel frame, etc.)
Operating mechanism	High-strength bolts shall be used to connect the lateral pull rod on the carrier basket and the connection stress at the suspension beam; Make anti-combustion materials for vehicle carrier plate; Regularly check the vehicle blocking device on the vehicle carrier; The lifting chain shall be subject to NDT or ultrasonic testing, and the parts with potential safety hazards shall be replaced in time
Electric control system	The fault prevention of the electrical control system can be carried out from two aspects: one is the troubleshooting between power supplies, and the other is the troubleshooting of the local short circuit of the control system. This requires the maintenance personnel to strengthen the troubleshooting of these two aspects and replace the aging parts found in time

(1) The surface of alloy materials such as main and auxiliary steel, support column, split beam, diagonal steel plate, intermediate pull rod, diagonal pull rod, support base plate, pulley guide groove, side pull rod, central cross shaft, suspension beam, carrier plate fixing frame, etc. shall be coated with electroplating metal and paint to prevent oxidation and weathering of the material itself.

(2) High-strength bolts, nuts and gaskets shall be used for the connection of equipment load-bearing parts. For example, the connection between the steel frame and the support column, the connection between the support column and the ground, the connection between the intermediate pull rod and the main and secondary steel frame, the connection between the diagonal pull rod and the diagonal steel plate, the connection between the diagonal pull rod and the diagonal pull rod adjustment device, and the connection between the lateral pull rod and the suspension beam.

(3) In order to prevent the hidden fire caused by oil leakage, the vehicle carrier plate must be made of anti-combustion material and can prevent the downward leakage.

(4) As the key device to stop the vehicle and prevent the vehicle from sliding, the vehicle carrier plate should be strictly inspected and maintained, and the parts that may be dangerous in the production process should be replaced in time.

(5) The selection of the motor drive part shall comply with the national standards. Select the special motor for lifting machinery with a large starting torque multiple. The working level shall comply with the M5 level in GB/3811, and the motor contact duration shall not be less than 25%.

(6) For the chain and sprocket parts, all chains and sprockets shall be lubricated regularly in the reverse direction, and the safety factor of the lifting chain shall not be less than 7, and the accuracy of the drive chain shall meet the requirements of GB/T 1243.

(7) For the safety warning system, it is required that all electrical detection equipment, such as temperature sensor, infrared detector, emergency stop switch, travel switch, top impact protection switch, protective fence, safety hook status detection switch, ultra-long, ultra-wide, ultra-high photoelectric detection device, pedestrian and vehicle misentry detection device, etc., should be scientifically and reasonably set and arranged.

3. Prevention and control of improper operation of personnel and maintenance guarantee measures

In terms of personnel operation, strengthen the training and supervision of equipment operators, enhance safety awareness and self-protection awareness, do well in safety education and training, and implement various systems. For the equipment inspector, enter the information of the staff into the operating system, which allows only qualified staff to enter the equipment operation area and play a monitoring function for the equipment operator, so as to prevent the occurrence of safety accidents

caused by the illegal operation of other staff; For the majority of drivers and users, they are required to have basic driving knowledge, such as parking, handbrake, flameout, and so on. At the same time, they are required to increase the publicity of the use of three-dimensional parking equipment, so that they have a basic understanding of different types of parking equipment.

The maintenance service of the stereoscopic parking equipment should be improved. The maintenance department should provide special maintenance technical training and education courses for the maintenance technicians to make them have a necessary understanding of the working principle of the stereoscopic parking equipment, and also make them have a better understanding of its mechanical structure and Dinage equipment. When relevant new employees initially enter this position, they need to know the previous maintenance records of this type of equipment in a timely manner. The record contains the analysis of the internal causes of the failure of the stereoscopic parking facilities, and the corresponding solutions should also be listed. After the employees master it, it will be more convenient for the management and maintenance of relevant equipment in the later stage, so as to be handier and greatly reduce the accident rate. The best thing is to identify the risks in advance and eliminate them directly.

In addition, the maintenance unit should appoint a person in charge of each parking equipment and keep records. The person in charge needs to check the safety performance of the equipment at a fixed point on a regular basis, report and deal with the possible dangers in a timely manner, and communicate with the management in a timely manner for the equipment that is not suitable for continuous operation, stop the operation of the equipment and prevent the occurrence of safety accidents.

In addition, in order to better build and improve the long-term mechanism of the risk prevention and control system, it needs the cooperation between government functional departments, three-dimensional parking equipment manufacturing companies, three-dimensional parking equipment maintenance management organizations and driver users. The government departments shall formulate and improve relevant regulations and strictly control the overall operation process of three-dimensional parking equipment; The company shall strictly abide by its own internal laws and regulations, and comprehensively do a good job in product design, manufacturing and construction in accordance with relevant national regulations; The management personnel and maintenance support should improve the service quality and risk prevention awareness, and do a good job in quality management, maintenance and other related work; The majority of drivers and users of stereoscopic parking equipment need to enhance their safety awareness and master the basic operation process of the stereoscopic parking equipment.

4. Monitoring and early warning system

Establish a three-dimensional parking equipment safety system for monitoring and warning, which can detect and deal with problems as soon as possible in case of safety abnormalities of three-dimensional parking equipment, so as to avoid casualties or property losses; Be able to observe the storage status of the vehicle in real time, and operate stably and conveniently; It is convenient for the staff to monitor and maintain the stereoscopic parking equipment in real time, as shown in Figure 1.

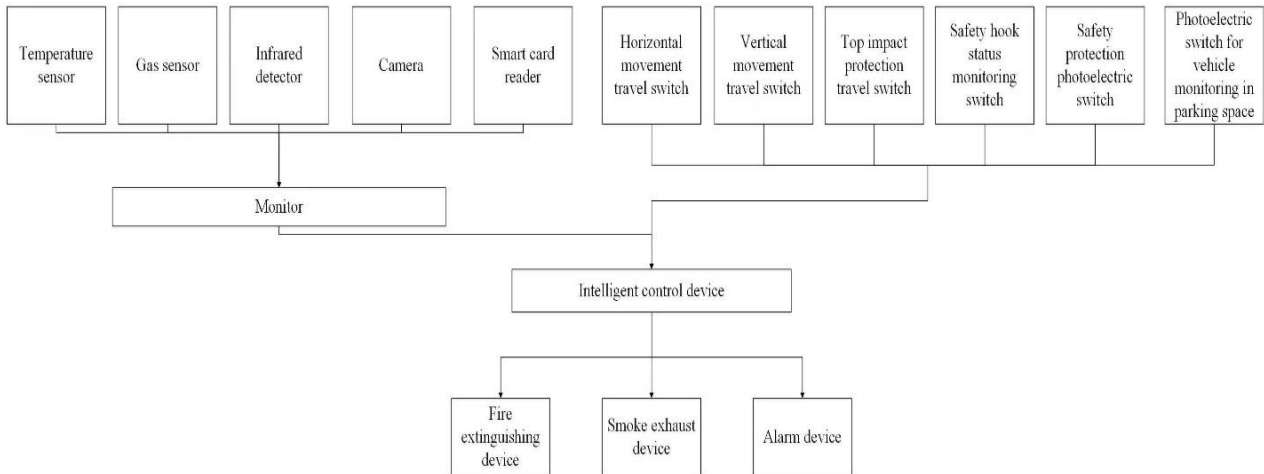


Fig 1. Stereo parking equipment detection and early warning system.

The intelligent alarm control system of the stereoscopic parking equipment includes temperature sensor, gas sensor, infrared detector, horizontal movement travel switch, vertical movement travel switch, overhead protection travel switch, safety hook status detection switch, safety protection photoelectric switch, parking space detection photoelectric switch, multi-dimensional camera, intelligent card reader, intelligent control device, display, fire control device, alarm device (buzzer) Smoke exhaust control device.

The input end of the display is connected with temperature sensor, gas sensor, infrared detector, multi-dimensional camera and smart card reader respectively; The horizontal movement travel switch, vertical movement travel switch, top impact protection travel switch, safety hook status detection switch, safety protection photoelectric switch, parking position detection photoelectric switch and display output end are connected with the input end of the intelligent control device; The output end of the intelligent control device is connected with the input end of the fire extinguishing control device, alarm device, buzzer and smoke exhaust control device.

The function of the temperature sensor is to monitor the temperature in the stereoscopic parking equipment. If the temperature exceeds the initial setting range, for example, if a fire occurs in a certain place in the stereoscopic parking equipment, the intelligent control device will start through the alarm device and remind the staff. At the same time, the intelligent control device will start the fire extinguishing control device to carry out firefighting. When the temperature is lower than the initial setting range, it will return to the normal state; the function of the gas sensor is to monitor whether there is oil or gas leakage in the stereoscopic parking equipment. When the detection value of the gas sensor exceeds the initial set value, the intelligent control device starts the alarm device, informs the staff, and uses the intelligent control device to start the smoke exhaust device at the oil leakage to realize the evacuation of oil smoke. When the detection value of the gas sensor is lower than the initial set value, the intelligent control device closes the smoke exhaust control device, Restore the normal state; The function of the horizontal movement travel switch is to monitor whether the left and right limit positions of the car are in place. It is installed at both ends of the horizontal direction of each parking space. When the horizontal movement travel switch of one of the parking spaces does not have a signal of being in place, the abnormal parking status of the horizontal parking space can be diagnosed. At this time, through the intelligent control device, the alarm device starts, and the system sends the abnormal status information to the user interface equipment and monitoring equipment, The status message is specific to the parking position where the fault occurs, so as to facilitate rapid troubleshooting; The vertical movement travel switch is installed at the upper and lower ends of each parking space to monitor whether the lifting of the parking space is in place. When the vertical movement travel switch of a parking space is not in place, it can diagnose the abnormal parking status of the lifting parking space. At this time, through the intelligent control device, the alarm device is activated, and the system sends abnormal information to the user interface equipment and monitoring equipment, The status message is specific to the parking position where the fault

occurs, so as to facilitate rapid troubleshooting; The impact protection travel switch is used for redundant lifting protection. It is installed at the maximum safety limit of each upper parking space; the function of the safety hook status detection switch is to monitor the opening/closing status of the safety hook. It is installed at the rear of the safety hook pulling mechanism. When the detected safety hook position is "untrusted" and cannot be used as the basis for determining the conditions of parking space movement, the system will notify the staff through the intelligent control device and the alarm device, and the system will send abnormal information to the user interface equipment and monitoring equipment, The status message is specific to the parking position where the fault occurs, so as to facilitate rapid troubleshooting; The safety protection photoelectric switch is used to prevent the entry of outsiders when the stereoscopic parking equipment is working, and has the safety protection function. It is installed on the columns at both sides of the entrance and exit of the stereoscopic parking equipment; the photoelectric switch for detecting the presence of vehicles in the parking space is used to monitor the presence of vehicles in the parking space. It is installed at the front wheel position of vehicles in the parking space; The infrared detector is set at the exit of the stereo parking equipment, and a multi-dimensional camera is required to be installed at the exit for monitoring; The smart card reader is installed in front of the entrance door of the stereoscopic parking equipment, and the car owner pays the parking fee through the parking card.

The arrangement of various sensors used to detect the operation and status of the garage is shown in Table 2. The detection system can monitor the overall situation of the three-dimensional parking equipment and give an emergency warning in case of an accident, effectively ensuring the parking safety in the garage and facilitating the management of the garage.

Table 2. Installation position and function of sensor.

Sensor name	Installation position	function
Temperature sensor	Installed on the tray of each parking space	The temperature of the garage can be monitored at any time. When the temperature is higher than a certain set value, the alarm device will be started;
Gas sensor	Installed at the bottom of the survey library	It can monitor the oil and gas leakage in the garage and give an alarm in time;
Smart card reader	Installed in front of the garage entrance	Provide parking cards to calculate parking fees;
Horizontal movement travel	Installed at both ends of horizontal direction of each parking space	Monitor whether the left and right limits of the vehicle reach the safety condition
Vertical movement travel switch	Installed at the upper and lower ends of each parking space	Monitor whether the vehicle lifting position is in place
Top impact protection travel switch	Installed at the maximum safety limit position of each parking space on the upper side	It plays a redundant lifting protection role;
Safety hook status detection switch	Installed behind the safety hook pulling mechanism	Monitor the opening/closing status of safety hook
Safety protection photoelectric switch	Installed at the columns on both sides of the vehicle inlet and outlet	It is safe to prevent the entry of outsiders when the stereoscopic parking equipment is in operation
Photoelectric switch for vehicle detection in parking space	Installed at the front wheel of the vehicle in the parking space	Monitor whether there are vehicles parked in the parking space

5. Conclusion

This paper first establishes a risk prevention and control mechanism for stereo parking equipment, including environment, design, manufacturing, personnel operation, maintenance and other links. Based on the main risk points of stereo parking equipment summarized above, the paper gives safety precautions in terms of equipment risks, improper personnel operation, after-sales maintenance and other aspects. Then a monitoring and early warning system is established. The stereo parking equipment intelligent alarm control system, including intelligent control device, display, temperature sensor, gas sensor, infrared detector, horizontal movement travel switch, vertical movement travel switch, top protection travel switch, safety hook status detection switch, safety protection photoelectric switch, parking space vehicle detection photoelectric switch, etc., is used to monitor the garage operation and status, The safety testing system can monitor the overall situation of the stereo parking equipment and give an emergency warning in case of an accident, effectively ensuring the parking safety in the garage and facilitating the management of the garage.

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