

Analysis of the Causes of Elevator Operation Resonance in Elevator Inspection

Yuzhe Jia

Guangzhou Academy of Special Equipment Inspection & Testing, Guangzhou, Guangdong, 511300, China

Abstract: Generally speaking, there are two reasons for elevator operation resonance to occur. One is because the quality of the hardware facilities is not up to standard, resulting in a mismatch between the operations of the various components in the elevator operation; the other is caused by irregular installation, use and maintenance of the elevator. The installation of each component between the elevators should cooperate with each other to perfectly cooperate to complete the operation of the elevator. If not, there will be big problems. While using the elevator to replace the traditional ladder, we must also understand the cause of the elevator operation resonance, and study the corresponding countermeasures to reduce the accident caused by the elevator operation resonance.

Keywords: *elevator operation resonance; traction machine*

Publication date: January, 2019

Publication online: 31 January, 2019

Corresponding Author: Yuzhe Jia, yygfo@sina.com

1 Introduction

In today's society, there are more and more high-rise buildings and various high-rise buildings are slowly appearing in people's vision. The emergence of high floors has made the rise of the elevator unstoppable. The elevator replaced the traditional staircase and, to a certain extent, gave the residents great convenience. The running resonance of the elevator is a common hidden danger of elevator operation safety, which seriously affects the running stability of the elevator and directly relates to the operational safety of the elevator. The 8.6th operation test of TSGT7001-2009 "Regulation for Lift Supervisory Inspection and Periodical Inspection-Traction and Positive Drive Lift" promulgated by

General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China(AQSIQ) stipulates that the car is empty and full, and runs at normal speed up and down, the signal system functions such as body and floor display are valid, the indication is correct, the movement is correct, the car is leveled well, and no abnormalities occur. Elevator operation is regulated by special equipment technical specifications, which shows the importance of elevator operation. Studying the resonance of the elevator plays an important role in the development of the elevator industry in China. It is beneficial to reduce operational failures and ensure operational safety, and to minimize the operational risk factor and accident rate.

2 Reasons for the resonance of elevator operation

In today's rapid economic development, elevators have been gradually integrated into people's lives, developed into an irreplaceable means of transport. As long as it is a mechanical device, failure will occur. In various dangerous cases of the elevator, running resonance is one of the most common accidents. Solving the elevator operation resonance can better guarantee the safety of the elevator and improve the safety factor of the elevator. Elevator operation resonance is mainly reflected in hardware facilities and human factors. Among them, the hardware is mainly the quality problem of elevator equipment and components; the human factors include the installation, use and maintenance of elevators^[1].

The specific analysis mainly has the following factors:

2.1 Traction machine

For the stable operation of the elevator, first of all,

there must be a good traction machine to ensure its power running output. The traction machine is one of the most important equipment for the elevator. The traction machine is the key hardware responsible for the stability of the elevator. The installation location must be in compliance with the relevant technical requirements. First of all, to ensure the verticality of the traction sheave, confirm that the traction sheave and the wire rope have a good wrap angle, in order to ensure good traction, in addition, should also adjust the good brake clearance and brake delay time. These will have a major impact on the stability of the elevator and the safety factor. In the long-term operation of the elevator, the aging and wear of the traction machine leads to the low efficiency of the traction machine, the wear of the traction wheel groove and the wear of the wire rope, which will cause the operation of the elevator to resonate. The daily maintenance of the traction machine is essential, and good maintenance is conducive to the long-term safe operation of the elevator. Studies have shown that good maintenance and maintenance can increase the life of the traction machine by about 40%^[2].

2.2 Guide rails and guide boots

If the train wants to run stably, it needs a good track. The elevator also has its own track, called the guide rail. If the installation of the guide rails and the guide shoes are not in accordance with the corresponding technical requirements, or the quality of the hardware is not up to standard and the level of the construction personnel is insufficient, the levelness and verticality of the guide rails and the guide shoes are not up to standard, and the guide rail distance is less than the design requirement, the elevator resonance problem cannot be avoided. In addition, many elevator companies have not corrected the horizontality and verticality of the guide rails of the elevators after the installation of the elevators, resulting in abnormal guide rail moments; The mounting degree of guide rails, guide shoes and elevators does not meet technical standards; After running for a long time, the guiding system is not well maintained, and the lubricating oil between the guide shoe and the guide rail is not replenished, resulting in a decrease in the degree of lubrication between the two and a high friction. This is one of the reasons why the elevator operates resonantly^[3].

2.3 Wire rope or steel strip

A wire rope or steel belt is like a drive shaft for a car.

The traction machine passes the wire rope or the steel belt to drive the elevator car and the counterweight to move up and down. The quality of the wire rope and steel strip directly affects the operational safety of the elevator. China's "Safety Rules for the Construction and Installation of Electric Lifts-GB 7588" has detailed regulations for steel wire ropes and steel strips for elevators^[4]. The elevator is used as a vertical transport, and the connection state of the wire rope or steel strip is very important. When installing the elevator, the tension of the wire rope plays a decisive role in the elevator resonance problem. The tension between each wire rope must be corrected to ensure that the tension of each wire rope (or steel belt) is kept uniform. The uneven tension will reduce the service life of the wire rope and the traction sheave. The uneven tension will also lead to the reduction of the traction capacity of the elevator, which will cause uneven force on the four corners of the elevator car and the counterweight. The force is affected, causing the elevator to produce severe vibrations and resonance phenomena, which endanger the safe operation of the elevator^[5]. During the daily operation, due to the continuous change of the car's load and temperature, the wire rope will have different degrees of wear or elongation and shortening, which will lead to uneven tension of the wire rope, and then the elevator operation resonance^[6].

2.4 Cars

The car is a passenger and cargo tool, and is also an important part of the resonance of the elevator. When designing the elevator, it is necessary to ensure that the car is evenly stressed during operation and there is no center of gravity offset. Otherwise, the elevator's traction machine center and the car cannot form a unified operating mechanism, and even the elevator operation resonance phenomenon. The car of the elevator is assembled from various parts. At the time of installation, the construction personnel must conform to the standard for the mutual fitting between the parts. If the installation process is too simple or cut corners, the car will be unevenly stressed during the operation. The lighter may only be deformed and unable to operate; the heavy car will be disintegrated directly^[7]. When designing the elevator car, the spacing between the main and secondary rails and the shoe lining is also a key factor affecting the operation of the elevator. If the distance between the main and auxiliary rails and the shoe lining is too small, the friction between the car and the guide rail will become larger, which will accelerate

the wear speed of the equipment and cause the elevator to operate at resonance; if the clearance is too large, during operation there will be horizontal shaking, which seriously affects the stability of the elevator.

Finally, during the annual overhaul of the elevator, the repair and maintenance of the elevator car must ensure that the center of gravity of the traction machine and the car cannot be offset. The two must be synchronized to ensure stable operation of the elevator^[8].

2.5 Shockproof device

The anti-shock device of the elevator is called “anti-mechanical resonance device”, that can effectively prevent the elevator from operating in the elevator operation resonance, and is an after-sale guarantee for the elevator. The anti-mechanical resonance device acts as a self-mechanism for the anti-operation resonance of the elevator, and can mainly alleviate the cooperation between various hardware of the elevator to a certain extent in the system. The anti-mechanical resonance device provides a guarantee for the safe operation of the elevator and improves the ride comfort of the elevator. Therefore, in the annual inspection of the elevator, the maintenance of the anti-mechanical resonance device is also essential. The anti-mechanical resonance device works physically, and the physical hardware facilities will wear out under time, which will affect the operating efficiency of the elevator, which will not effectively suppress the occurrence of resonance phenomenon. Therefore, when the elevator is overhauled, the anti-mechanical Resonance device is one of the key points that must be viewed^[9].

2.6 Wind resistance

The elevator shaft ensures the independence of the elevator operation, but also increases the wind resistance of the elevator operation. As the speed of the elevator accelerates, the influence of wind resistance on the operation of the elevator will become more and more serious. The wind resistance during the operation of the elevator is another factor of elevator resonance and must be controlled. The difference between the shape of the car top and the shape of the car bottom determines the size of the windshield area and determines the size of the wind resistance. The design of the air outlet of the hoistway also affects the wind resistance during the operation of the elevator. Elevator resonance caused by hoistway wind resistance has become another important factor in the operational safety of elevators^[10].

2.7 Impact of cyclical operations

In addition to the quality of the above hardware and the installation, use, and maintenance issues, there is an impact that is easily overlooked. After the elevator runs all the year round, all parts of the elevator have a certain loss and aging, and its own hardware will generate vibration frequencies of different amplitudes. This is the characteristic of the hardware itself, and when the vibration frequency of the hardware is different, the effect is produced. The force will also be correspondingly different. When these forces gradually accumulate in the elevator, the elevator's own operating system will not be able to digest these forces, and the force will be mutual. The force will have little effect on the elevator in the early stage. However, after accumulating and forming, it will act against the elevator itself, resulting in the phenomenon of elevator operation resonance^[11].

3 How to effectively deal with the operating resonance phenomenon of the elevator

3.1 Stringent controlling the elevator installation details

The installation of the elevator is a very demanding task for the staff. For each elevator installation company, training for the company's internal staff is essential. Every installer should be responsible for his or her work and treat the work with a serious, careful, and rigorous work attitude. Only when the installation is strictly in accordance with the technical specifications can the installation of the elevator be more reasonable and perfect, and the installation accuracy of the elevator can be effectively ensured, thereby avoiding the unexpected system malfunction of the elevator. Strict installation specifications allow the elevator to operate more smoothly and reduce the incidence of accidents. Elevator is the crystallization of human wisdom. We must be careful to treat every part of it with perfection. Only by repairing it from all aspects it can provide better service to us. As a small-scale means of transport, elevators are an important tool for transporting against gravity. Elevator installation as a key step to ensure efficient operation of the elevator, we should start from the details and eliminate all unfavorable factors, so as to ensure the quality of the installation, and thus ensure the quality of the elevator and confirm the safe and stable operation of the elevator^[12].

3.2 Maintenance work of the elevator

Any mechanical equipment is aging and wearable, and elevators are no exception, which requires maintenance. On-time and timely maintenance is extremely important for the long-term use of the elevator. In the daily use process, the friction between the various hardware of the elevator will bring loss to the hardware, and after the loss, the function of the hardware itself will be affected to some extent, and in the whole system of the elevator, if there is a problem in one link then other links will inevitably be affected. During the daily inspection process, we should apply lubricant to the guide rails and guide shoes on time, check the tension of the wire rope, the wear of the wire rope, and replace the hardware equipment with serious wear and tear in time. Do a good job in the maintenance of the elevator in time, prohibit the elevator from running with the disease, is the key to ensure the safe and effective operation of the elevator^[13].

3.3 Reasonable control of periodic vibration

For the impact of the hardware's own characteristics, we must first select good performance materials, high quality products, improve the quality of the elevator's own products, increase its service life; and then rationally design the elevator room and hoistway to make the layout more reasonable, more perfect, to ensure the quality of civil works, thereby reducing installation errors, improve the installation quality of elevators, thereby extending the service life of elevators, reducing periodic problems; finally strengthening the technology and ability to detect period vibration and eliminate it on time. Immediately after discovering the problem, contact the relevant personnel to replace and repair the hardware, so that the system can run more stably.

However, while providing convenience, there are also many safety hazards. The elevator running resonance is an important safety hazard that cannot be ignored during elevator operation.

3.4 Establishment and improvement of elevator maintenance system

According to the operating period of the elevator, the maintenance time is reasonably set, the stability of the elevator operation is regularly checked, the aging degree of the electrical equipment is checked, the wear of the mechanical parts is detected, and the loosen elevator parts are detected. A warning sign is posted on

the car, prompting people to safely take the elevator as a civilized passenger and encounter dangerous solutions. The stability of the elevator operation depends not only on regular maintenance and overhaul, but also on the awareness of the passengers themselves^[14].

4 Conclusion

The popularity of elevators provides a lot of convenience for people to live and travel. We must reduce the resonance of elevator operation through inspection and maintenance and ensure the quality of elevator operation. Among them, the elevator operators can reduce the elevator operation resonance problem by strictly controlling the elevator installation details, doing the elevator maintenance work, controlling the cycle vibration reasonably, establishing a sound elevator maintenance system, etc., so as to reduce or even eliminate the safety hazard and ensure the safe operation of the elevator.

References

- [1] Guoliang Lou, Jie Chen. Causes and Solutions of Elevator Operation Resonance in Elevator Inspection[J]. Urban Construction Theory Research, 2018(29):174.
- [2] Hongfeng Zhu. Analysis of the Elevator Operation Resonance in Elevator Inspection[J]. Plant Maintenance Engineering. 2018(19):29-30.
- [3] Yanling Wei. Discuss of the Causes of Elevator Operation Resonance in Elevator Inspection[J]. Home, 2018(26):251-252.
- [4] Yingfei Wu. Causes and Solutions of Elevator Operation Resonance in Elevator Inspection[J]. Shandong Industrial Technology, 2018(18) :222.
- [5] Na Lai. Simply Analysis of the Causes of Elevator Operation Resonance in Elevator Inspection[J]. Science and Technology & innovation, 2018(10):74-75.
- [6] Cheng Yu. Analysis of Causes of Elevator Operation Resonance in Elevator Inspection[J]. New Technologies and New Products of China, 2018(03):138-139.
- [7] Kaijian Jiang. Explore and Analysis of the Cause of Elevator Operation Resonance in Elevator Inspection[J]. Safety Technology of Special Equipment. 2017 (06):43-44.
- [8] Zhou Zhu, Zengguang Wang. Principle Analysis of Elevator Operation Resonance in Elevator Inspection[J]. Science and Technology Innovation Herald, 2017, 14(30):19+21.
- [9] Hui Ding. Causes and Solutions of Elevator Operation Resonance in Elevator Inspection[J]. Urban Construction Theory Research, 2017(27):2.
- [10] Hairong Zhang. Analysis of the Causes of Resonance in Elevator Inspection[J]. Technology and Economic Guid, 2017(26):93.
- [11] Ke Li, Lin Zhang, Cheng Zhang. Causes and Solutions of Elevator Operation Resonance in Elevator Inspection[J].

- Building Materials and Decoration, 2017(32):210-211.
- [12] Peile Li. Analysis of the Causes of Resonance in Elevator Inspection[J]. Technology and Innovation, 2017(11):127+130.
- [13] Jinbiao Yu. Analysis of the Causes of Resonance in Elevator Inspection[J]. Technology Innovation and Application, 2017(06):149.
- [14] Yue Zhang. Discuss of the Causes of Resonance in Elevator Inspection[J]. Low-carbon World, 2016(31):241-242.