Study on the Performance of Moving Walk Tread

Xiao Lianga*, Facai Renb, Hongjun Shic, Bo Wangd, Kuangye Niuë and Shaoyi Houf

Shanghai Institute of Special Equipment Inspection and Technical Research, Shanghai 200062, PR China

a*Corresponding author e-mail: liangxiao@ssei.cn
bemail: caifaren@163.com, cemail: hjshi@ssei.cn, demail: wangbo@ssei.cn, eemail: nkysmu@163.com, femail: housy@ssei.cn

Abstract. The performance of moving walk tread is very important for the overall quality and safety of moving walk. In this paper, static and dynamic load tests are carried out on integral and split moving walk treads. The analysis of the test results shows that the disturbance of the integral type is less than that of the split type. When the frequency is low, the curve of feedback force is basically consistent with that of applied force, indicating that the tread is doing normal reciprocating motion under the action of force wave.

1. Introduction

The moving walk is an open continuous automatic transportation tool, which is widely used in airports, subways, large supermarkets, stations, docks and other crowded places [1]. The ensuing safety accidents also showed a rapid upward trend. Tread is one of the most important components of the moving walk. It forms the moving walk together with truss, ladder guide rail, front and rear drive, traction chain, electrical control device and other components. Good rigidity and overall performance is one of the basic requirements for moving walk treads. Whether the tread structure is reasonable and the tread performance determines the overall quality of the moving walk. In terms of structure, the tread of moving walk is usually divided into integral type and split type. The integral tread is made of tread and support, which has the advantages of light weight, good rigidity and strength, convenient maintenance and so on. The split tread is composed of tread, bracket, connecting fastener, etc.

The research on the safety performance of key components of moving walk will help to reduce the incidence of accidents. Ruan et al. [2] designed and developed an anti-skid performance test device and applied it to the anti-skid performance test of escalator and moving walk step treads. The designed automation device can automatically test the anti-skid performance of escalator and moving walk steps and treads, comb support plate and floor plate surface. He et al. [3] conducted anti-skid performance test and safety risk assessment on 8 common types of step boards and treads. The test results show that the tread surface texture has a certain influence on the anti-skid performance. Jiang et al. [4] developed a high-precision and portable detection device for the safety protection device of escalator/moving walk comb plate. The device can detect the force and action displacement of the comb plate, so as to quantitatively evaluate the flexibility of the comb plate safety protection device. Wang et al. [5] designed photoelectric warning devices and anti-collision interlocking systems for escalators and moving walks, which can scientifically and effectively prevent passengers' limbs from entering the angle dangerous area. Han et al. [6] analyzed the movement of the comb plate of escalator and moving
walk under the horizontal and vertical force, and tested the breaking force of some comb plates. The test data analysis results show that on the premise of ensuring no misoperation, the smaller the action force in the horizontal direction of the comb plate, the better the protection.

From the above research, it can be seen that few people have studied the tread performance of moving walk. Therefore, this paper studies the performance of integral and split moving walks, and the results can provide a basis for their design and manufacture.

2. Material and experimental
In this experiment, six moving walk tread samples were selected, of which three were integral and three were split. First, use an electronic scale to measure the weight of the tread without accessories (shaft and roller). Conduct dynamic and static load tests on the tread, as shown in Fig. 1. The test method is to apply a vertical force to the center of the tread through a steel base plate. The width and length of the base plate are 0.2m and 0.3m respectively, and the thickness is 25mm. Static load test: after applying static load force on the test platform, test the disturbance through the displacement of the platform. The dynamic load test applies a pulsating load between 500N and 3000N with an undisturbed resonant force wave of any frequency between 5Hz and 20Hz. The test shall be conducted at each frequency between 20Hz and 5Hz at an interval of 1Hz.

![Figure 1. Test device.](image)

3. Results and discussions

3.1. Analysis on the influence of structural form on tread weight
Weight of moving walk treads is shown in Fig. 2. It can be seen from the weight measurement results that the weight of the split tread is between 16.12-16.24kg and the weight of the integral tread is between 10.09-10.12kg. Due to different structural forms, the split tread is heavier than the integral tread.
3.2. Analysis on the influence of structural form on the maximum static load deformation

Maximum deformation of moving walk treads is shown in Fig. 3. The maximum deformation of the split tread is between 1.58-1.66mm and the integral tread is between 0.71-0.74mm. The samples with integral structure are better than those with split structure in terms of disturbance. Because of the structural integrity of the integral tread, the deformation of the integral tread is relatively small when subjected to static load. Because the split tread is a combined structure and is assembled by multiple parts, unlike the integral casting, it has no integral structure stability and relatively large deformation when subjected to force and deformation.

3.3. Dynamic load analysis

Dynamic load tests were carried out on the moving walk tread. The output results of feedback force wave under the excitation frequencies of 5Hz, 6Hz, 10Hz, 15Hz, 18Hz and 20Hz are shown in Fig. 4. As can be seen from Fig. 4(a), when the excitation frequency of the moving walk tread sample is 5Hz, there is slight interference in the feedback force wave curve. As can be seen from Fig. 4(b), when the excitation frequency reaches 6Hz, the interference gradually increases. As can be seen from Fig. 4(c-e), after the excitation frequency reaches 10Hz, the feedback force wave does not meet the standard requirements in the range of 500N-3000N. Especially when the excitation frequency reaches 20Hz, as shown in Fig. 4(f), the amplitude of the feedback force wave has been seriously less than the range of 500N-3000N.
Figure 4. Typical feedback force wave curve.

4. Conclusion
In the static load test, the overall disturbance of the integral type is less than that of the split type. It can be seen from the curve of dynamic load test that when the frequency is small, the feedback of dynamic load test is relatively better, and the curve of feedback force can be basically consistent with the curve of applied force, which ensures that it is a resonant force wave, indicating that the tread is doing normal reciprocating motion under the action of force wave. When the frequency is increased, the curve of feedback force and the curve of applied force cannot be consistent.

Acknowledgments
The authors are grateful for the support by Shanghai Municipal Administration for Market Regulation Research Project (No. 2019-31).

References
[1] Yang L., Sun Z.Q., Chang G.Q.. (2020) Research on the protection device of main driving chain of escalators and moving walks. China Elevator, 31: 26-28.
[2] Ruan Y.H., Pei H., Deng S.H.. (2018) A testing device for the anti-slip properties of the tread surfaces of steps and pallets of escalators and moving walks. China Elevator, 29: 35-37.
[3] He W.S., Zhang J.Q., Gu X., Xiao J.H.. (2017) Research and tests of anti-slip properties of the tread surfaces of escalators and moving walks. China Elevator, 28: 36-39.
[4] Jiang R.H., Wang Y.L., Liu J., Jiang C.L.. (2019) Safety protection detecting device for escalator/automatic sidewalk comb plate. Machine Tool & Hydraulics, 47: 86-91.
[5] Wang S., Ding S.Q., Zhang S.R.. (2020) Research on safety protection device for intersection angle between escalators and moving walks. China Elevator, 31: 6-10.
[6] Han C., Wang H.G.. (2020) Analysis of the action of comb plate of escalators and moving walks. China Elevator, 31: 22-26.