

Featured Articles I

Rapid, Low-cost Elevator and Escalator Modernization Services that Ensure Safety and Security

Tatsunori Takahashi
 Yasuhiro Takahashi
 Toshiaki Matsuo
 Takaaki Gunchi
 Hirobumi Utsunomiya
 Yoshiyasu Shibuki

OVERVIEW: While the market for new elevators and escalators in Japan is stagnant, the existing elevators and escalators installed during the construction boom of Japan's bubble years are now ready for overhauls. Even with proper maintenance, elevators and escalators generally require an overhaul after 20 to 25 years. Counting only the elevators and escalators made by Hitachi, there are now about 30,000 aging units in service in the market, and this number is expected to continue growing by about 5,000 units per year. In order to ensure the quality and safety of existing elevators, Hitachi will continue to provide elevator modernization services that meet a diverse range of customer needs, so that it can overhaul more elevators, even more rapidly.

INTRODUCTION

SERVING as the vertical mobility infrastructure of buildings, elevators and escalators remain in service around the clock from the time of delivery, resulting in a high risk of failure due to aging equipment. Ensuring the safety of old elevators and escalators installed over 20 years ago has become an area of public concern since these units no longer meet current regulations for safety or earthquake resistance, and it can be difficult to obtain parts for them.

One of the challenges of elevator and escalator overhauls is to find ways of minimizing the impact the work has on the business hours of office-building tenants, or on the mobility needs of daily users. Raising the money needed for refurbishing elevators and escalators can also be difficult for the owners or management associations of small- and medium-sized buildings.

The primary goal of an elevator or escalator overhaul is to ensure the continued safety and comfort of users. The work involves not only improving quality and safety, but also must consider making improvements in areas such as energy savings and convenience linked to overall building amenity.

This article presents Hitachi's modernization packages for elevators and escalators, which provide solutions to problems encountered by clients who need to overhaul aging elevators. It also discusses the earthquake resistance improvements Hitachi is making to existing escalators, and its three-dimensional

(3D) site survey system, which minimizes elevator downtime during the crucial site surveys needed for overhaul work.

MODERNIZATION PACKAGE FOR COMPLIANCE WITH NEW ELEVATOR REGULATIONS

Gearless Hoist Specialized for Elevator Modernization

Hitachi's modernization package for compliance with new elevator regulations includes a highly efficient gearless hoist specially created for modernizing elevators. The new hoist improves energy savings and provides advanced operation control that reduces machine room noise and elevator car vibration to improve ride comfort⁽¹⁾.

To meet the demand for improved safety, the hoist has—as standard features—two independent brakes (see Fig. 1), and an unintended car movement protection device that meets current safety regulations. If, by some chance, a failure in the drive system or control equipment results in the elevator moving while the door is open, these features can detect the problem immediately and stop the elevator automatically.

The modernization package for compliance with new elevator regulations consists of four options that allow the overhaul work to be apportioned to minimize the amount of continuous downtime. Depending on the type of building, the desired work duration, or the customer's budget, the customers are free to choose

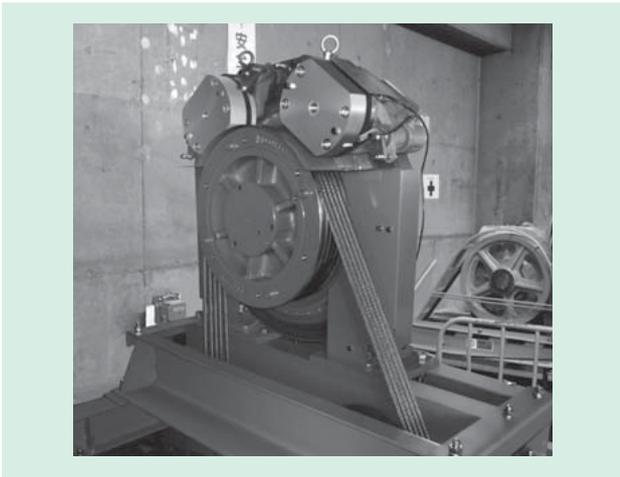


Fig. 1—Gearless Hoist for Elevator Modernization. The photo shows the new gearless hoist model, which has two independent brakes.

from a lineup of options consisting of safety functions (such as automatic landing devices triggered during power failures), LED lighting in cars, and upgraded features for universal access.

New Hoistway Lifting Method

The overhaul work performed in the modernization package for compliance with new elevator regulations has been designed with a more efficient method of lifting the hoist up to the existing top-floor machine room.

The lifting done to deliver equipment by crane or stairs in the past has been often restricted by the conditions of the building. Hitachi’s new hoistway lifting method involves setting up a stage in the top-floor hoistway, and pulling up the hoist from an access port created in the machine room floor (see Fig. 2). This method is not affected by the building conditions, so it enables standardized lift plans and lowers lifting costs.

Five-day Continuous Downtime Method

The basic option in the modernization package for compliance with new elevator regulations required a standard construction period with seven days of continuous downtime. This long period of downtime created a problem whereby single-elevator tenant-occupied office buildings generated clusters of work requests targeting extended holidays, such as the New Year and Golden Week holidays, which made it impossible to set construction periods at the earliest possible convenience. Many apartment building management associations and lodging facilities also wanted to have their elevators remain in service on weekends.

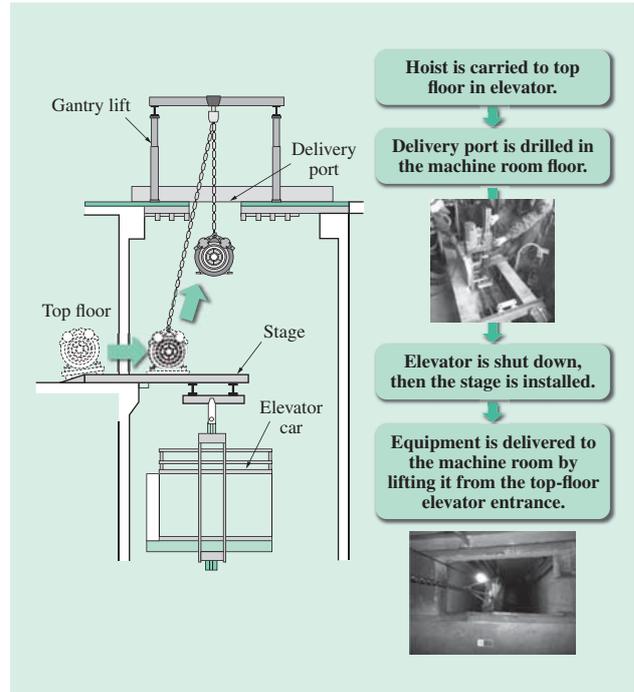


Fig. 2—Method Used for Hoistway Lifting in the Modernization Package for Compliance with New Elevator Regulations. This method enables elevator installers to lift heavy objects under any building conditions.

Hitachi responded by adopting a new work method that reduced the period of continuous downtime to five days. Work time was significantly reduced by increasing the work team from three members to four, and by eliminating waste and overburden from the work procedures. The following three measures also contributed to achieving this (see Fig. 3):

- (1) Improving product packaging

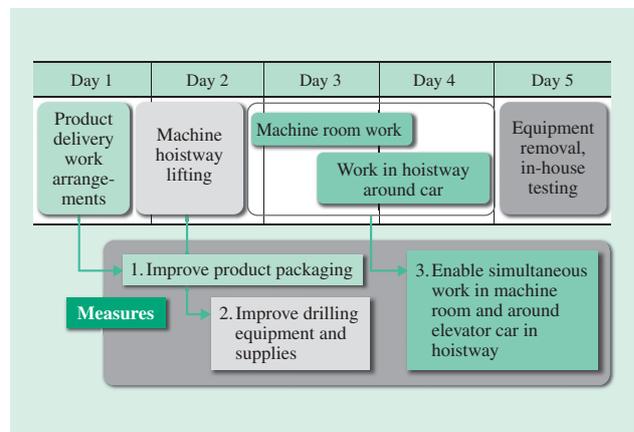


Fig. 3—Modernization Package for Compliance with New Elevator Regulations Five-day Work Method. This method reduces the amount of continuous elevator downtime from seven to five days.

(2) Reviewing the equipment and supplies used to drill holes in machine room floors for hoistway lifting, and switching to more easily operated general-purpose equipment

(3) Optimizing the team member allocation to enable simultaneous work in machine room and around the elevator car in the hoistway

ESCALATOR CONTROL MODERNIZATION

Energy-saving Inverter Control Method

Overhauls of aging escalators have been lagging due to obstacles such as securing delivery routes during building business hours and extended periods of downtime.

Hitachi's control modernization package is a major escalator modernization package with basic options that cover replacement of control panels, drive systems, and safety devices with the latest models. This work results in energy-saving performance and safety performance equivalent to that of modern escalators⁽²⁾.

The control modernization package's greatest benefit is the improvement in drive efficiency it gains by executing a rapid, partial overhaul that upgrades the operation control equipment to an inverter control system, and replaces the worm reduction gearbox with a helical reduction gearbox in the drive equipment.

The control modernization package also has an eco-mode operation function that reduces energy consumption by 13 to 20% compared with before. It works by inferring user numbers from inverter load information and imperceptibly reducing the escalator's speed (from 30 to 25 m/min) when the number of users is low.

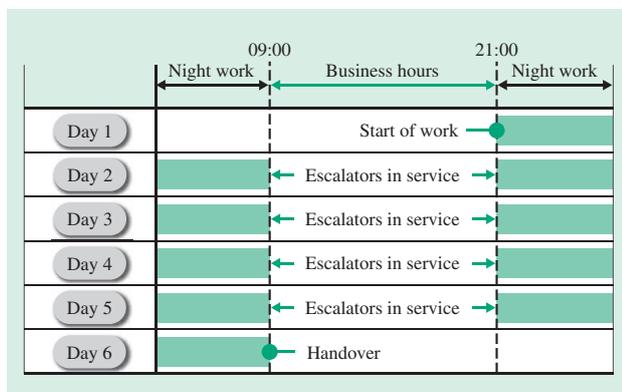


Fig. 4—Example Control Modernization Work Schedule. The work schedule keeps escalators in service during the business hours of commercial building tenants.

Improving User Safety

The standard control modernization package includes the following safety features designed to reduce falling or tripping accidents:

(1) Soft stop function

When an emergency stop is triggered by a safety device, the escalator stops by inverter-controlled constant deceleration instead of stopping instantly.

(2) Variable speed operation system

This system provides a key switch that can reduce the operation speed from 30 to 20 m/min to enable safer use by the elderly.

Night-only Work Method that Does Not Hinder Business Hours

About 70% of escalators are installed in commercial facilities, where equipment shutdowns during daytime business hours are a hindrance to business.

Hitachi's night-only work method is designed to meet the needs of these customers. Overhaul work is done at night after businesses have closed and before they open the following morning, enabling escalator use during business hours (see Fig. 4). Safety devices are upgraded by Day 3, the control panel is replaced on Day 4 (at night), and a special temporary tool used to drive the escalator with the new inverter control panel and existing drive mechanism is installed by Day 5 (during the day).

This work method has been well-received by commercial facility customers. Nearly all customers choose the night-only work method option to prevent hindrances during business hours.

ANTISEISMIC REINFORCEMENT STRUCTURE FOR EXISTING ESCALATORS

The Building Standards Law Enforcement Order concerning measures to prevent escalators from falling became effective in April 2014. As a result, an increasing number of building owners began planning to retroactively upgrade existing facilities and add antiseismic reinforcement as part of their expansion or remodeling work. The new regulations call for an increase in the overlap allowance of existing escalators, which requires work on building beams. Minimizing the time and scope of this work is the goal for commercial buildings.

This section presents Hitachi's extension beam structure and extension plate structure, which minimize building renovation work⁽³⁾.

While previous site surveys for standard elevators took about 90 minutes, Hitachi's 3D site survey system can reduce the time needed to about 30 minutes. Since it has also automated processes ranging from checking the site survey dimensions to creating the study drawings, it has greatly reduced the lead time needed for design or work estimates from 4 hours to 30 minutes or less.

CONCLUSIONS

This article has presented Hitachi's leading modernization packages, the modernization package for compliance with new elevator regulations, and the control modernization package for escalators. It has also looked at structures for improving earthquake resistance in existing escalators that can be installed with less construction work, and a 3D site survey system designed to grow Hitachi's overhaul business by drawing on the latest technology.

There are many different types of existing elevators and escalators in the domestic Japanese market, and clients are increasingly demanding rapid, low-cost overhaul options for these elevators and escalators. Overhaul work done to bring existing elevators and escalators into compliance with the latest safety and

earthquake resistance regulations needs to be promoted by developing simpler and more convenient overhaul options tailored to existing models.

Hitachi intends to continue to provide safe and comfortable environments for all building users through its elevator and escalator modernization packages.

REFERENCES

- (1) Hitachi Building Systems News Release, "Hitachi Launches Its Modernization Package for Compliance with New Elevator Regulations," (Dec. 2012), <http://www.hbs.co.jp/news/2012/121212.html> in Japanese.
- (2) Hitachi Building Systems News Release, "Hitachi's 'Controlled Modernization' of Escalators Significantly Reduced Construction Time and Costs while Updating the Control Panel and Drive System to the Latest Inverter Control System," (Mar. 2010), <http://www.hbs.co.jp/news/2010/100323.html> in Japanese.
- (3) Hitachi Building Systems News Release, "Hitachi Develops Seismically Resilient Structure for Existing Escalators that Minimizes Building Remodeling Work," (Jul. 2016), http://www.hbs.co.jp/news/2016/160706_01.html in Japanese.
- (4) Hitachi Building Systems News Release, "Hitachi Develops and Starts Operation of a '3D Site Survey System' that Automatically Generates Hoistway Installation Drawings from 3D Measurement Data," (Jun. 2015), <http://www.hbs.co.jp/news/2015/150609.html> in Japanese.

ABOUT THE AUTHORS



Tatsunori Takahashi

Business Planning Department, Business Planning Division, Global Elevator & Escalator Division, Hitachi Building Systems Co., Ltd. He is currently engaged in drafting business plans and consolidating business performance results for the elevator and escalator business.



Yasuhiro Takahashi

Installation Development Department, Installation Management Division, Global Elevator & Escalator Division, Hitachi Building Systems Co., Ltd. He is currently engaged in the development of construction methods for elevator and escalator modernization.



Toshiaki Matsuo

Escalator Development & Design Department, Mito Production Division, Global Elevator & Escalator Division, Hitachi Building Systems Co., Ltd. He is currently engaged in the design and commercialization of escalators.



Takaaki Gunchi

Escalator Development & Design Department, Mito Production Division, Global Elevator & Escalator Division, Building Systems Business Unit, Hitachi, Ltd. He is currently engaged in the development of escalators.



Hirobumi Utsunomiya

Escalator Development & Design Department, Mito Production Division, Global Elevator & Escalator Division, Building Systems Business Unit, Hitachi, Ltd. He is currently engaged in the development of escalators.



Yoshiyasu Shibuki

Global Sales Engineering Department, Installation Management Division, Global Elevator & Escalator Division, Hitachi Building Systems Co., Ltd. He is currently engaged in the development of 3D measuring technologies.