

## George Washington Bridge Bus Station *by Dharam Pal, PE and Cheng Chang, PE*

As a public agency, the Port Authority of New York and New Jersey manages and maintains the George Washington Bridge Bus Station, an essential transportation facility for Upper Manhattan in New York City. The station has three levels: the main concourse with shops and ticket sales, the lower level with local bus and subway stops, and bus platforms on the upper level. To facilitate the movement of people between each level, 14 Otis Type R escalators were installed. These escalators have been in service since the station was opened in 1963.

Located in the Washington Heights area, the station occupies a two-block site at 4211 Broadway between 178th and 179th streets, and Fort Washington and Wadsworth avenues. It has served as a vital link to the regional transportation network for approximately 20,000 daily commuters, and is located directly above the 12-lane Trans-Manhattan Expressway.

Due to their age (more than 40 years of heavy use), the lack of availability of spare parts and equipment malfunctions, these escalators are periodically taken out of service. Furthermore, safety codes for escalators have also changed over all these years. It became a challenging task to reduce escalator downtime and ensure customer safety and reliability of the vertical-transportation system. Two alternatives, rehabilitation and replacement, were evaluated. The evaluation revealed that each alternative has its technical challenges.

Rehabilitation involved removing major components of an escalator, replacing them with new or reconditioned parts, and reconditioning the driving machine — keeping only the original outer shell and truss. Since the existing escalators were of a 1960 design, the replacement parts were difficult to obtain. Some were no longer available from the original manufacturer



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and could only be replaced with refurbished aftermarket parts. The controller (providing all the required monitoring circuits and fault findings) was difficult to obtain and costly. Additionally, the brake system could only be overhauled. Furthermore, the inclusion of all safety devices required by the current codes was not feasible.

The alternative to replacement had its own challenges. The heavy-duty transit-type escalators would require substantially more space than standard commercial-type units. Due to the working point of the existing escalator trusses being closer to the edge of the existing structural supports and the inclined portion of the existing trusses being positioned directly above the building's steel beams that pass under the escalators, the existing structural supports and pits would have to be modified to enlarge the well-ways and accommodate the replacement escalators. The space under the inclined portion of the escalator trusses was less than the required dimensions; therefore, the existing soffit and structural supports had to be modified. Staging and rigging of the escalators would have to be coordinated to ensure that the disruption of station services was minimized and that station structures were protected.

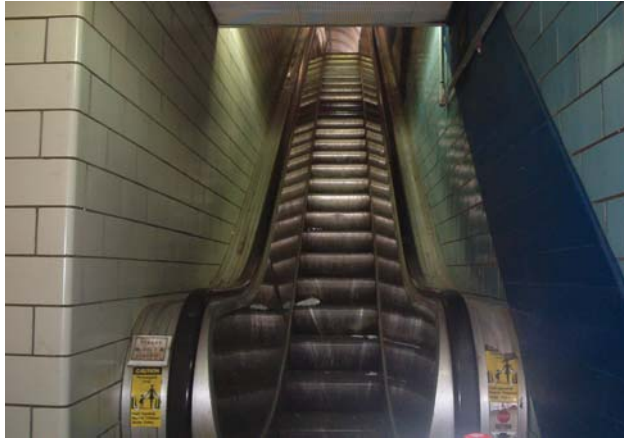
As the options were being reviewed, two escalators serving platforms No. 21 and 24 were shut down due to the failures of essential components. As these two platforms were very active, time was of the essence and a major decision had to be made: how best to restore these two escalators and reopen bus platforms.

While exploring each option and its approach to remedy these escalators, a modernization package developed by KONE was identified. The advantages over expensive and disruptive truss removal and component replacement were obviously numerous. This solution involved nothing short of installing an entirely new escalator in the existing truss. The package provided a systematic way to replace all existing escalator components with new

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Above (l-r):

- Escalator No. 21 prior to modernization
- Escalator No. 21 after modernization



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components and technology while avoiding significant disruptions and construction costs associated with conventional escalator replacement. The modernization system was comprised of new modular components that were custom-engineered to fit inside the existing escalator truss.

Since time was of the essence, KONE was contacted to obtain additional details on modernization processes, schedule and budget pricing. Preliminary investigations were performed to verify if the modernization could meet all code requirements and fit into the existing truss without significant structural modifications. Based on the comparison of scope,

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Opposite page (top to bottom, l-r):

- Escalator No. 24 prior to modernization
- The preparation work of the existing truss
- Delivery of preassembled module for upper truss
- Preassembled module for lower truss
- Escalator No. 24 after modernization

This page (top to bottom, l-r):

- Work in progress – Escalator No. 24
- Work in progress – Escalator No. 21
- Escalator controller and interface panel for interfacing with fire alarm and building management systems

schedule and budget pricing for these three options (rehabilitation, replacement and modernization), the modernization approach was selected. Two escalators were selected as a pilot project.

After extensive field measurements, the vendor custom-designed and manufactured the required escalator's components. As this was the first time such modernization had been done on this type of escalator, extensive factory testing was performed to ensure its safe operation. The KONE EcoMod' included preassembled modules, which

were manufactured in the factory and shipped to the site for installation. Once the existing components were removed from the truss and the truss was prepared for the installation of new components, these modules were attached to the existing truss frame. All other components were then installed in a sequential process, similar to the one used in the construction of new escalators. The EcoMod included new technology designed for reliability and performance far superior to traditional rebuilding or replacement options, enhanced safety that meets ASME code requirements and lower energy consumption and operating costs.

Reusing the trusses at the station offered many advantages, such as cleaner and less-disruptive installation compared to ripping out the existing trusses from the facility and bringing new escalators into this location. This also eliminated the need for costly structural modifications to the existing facility.

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No major rigging, hoisting or crane requirements were necessary. Additionally, its design offers enhanced safety, improved operating performance, greater reliability, lower energy consumption and reduced operating costs.

In the end, all original components of the 16-foot, 8-inch rise Otis Type R escalators were removed and new EcoMod escalator components were installed inside the existing trusses. There were no modifications to the existing structural steel and no lane closures at the Trans-Manhattan Expressway. Portable hoists were used to deliver and install each module and key components. The new microprocessor-based controller constantly monitors speed, direction, safety status and other key operating parameters. Furthermore, the units were designed and constructed in compliance with ASME and New York City building codes.

Both escalators have been successfully modernized. There were no service interruptions. Additionally, the replacement newels, decking and skirt panels with stainless-steel finish enhance the appearance of the station.

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Above (top to bottom):

- Safety devices being tested by the Port Authority inspector
- Skirt/step performance index of the escalator being tested

## Credits

**Owner:** The Port Authority of New York and New Jersey

**Planner:** The Port Authority of New York and New Jersey, Engineering Department

**Consultant:** Vertical Transportation Excellence

**Vertical-transportation system contractor, equipment manufacturer and components supplier:** KONE, Inc.