

ESCALATOR MODERNIZATION VERSUS REPLACEMENT

by Patrick J. Welch

Background

Transit systems across the country have been using escalators to move people between the street and train platforms for almost a century. In many ways, escalators have become a critical means of transportation within transit systems. Escalator codes have changed dramatically, as has the understanding of actual use and abuse to which transit escalators are subjected.

Currently, the American Public Transit Association's (APTA) Escalator Committee has developed a draft set of guidelines for new escalator installations. While already outdated, important strides were made in differentiating between "department store" commercial-type escalators and heavy-duty escalators. This article will contrast positive and negative aspects of escalator replacement strategy based on using APTA guidelines for the new escalators.

What is the difference?

It is critical to understand what a heavy-duty escalator is. Once that is understood, a better decision can be made with regard to your own escalator strategy. APTA borrows its philosophy from the European escalator code, EN 115. The key here is that EN 115 recognizes that there is a fundamental difference between commercial escalators and public-use escalators.

Public-use (heavy-duty for our discussion) escalators can be defined as any escalator in a public transportation facility that operates 20 hours a day, with a crush-load situation in any three-hour period. A crush load is defined as an escalator operating at full capacity for any 30 minutes in any three hour period.

There are other key differences between heavy-duty and commercial escalators that must be understood is shown in Table 1.

Note that many systems have modified the design load requirements as stated by APTA; 674 pounds can be considered excessive and is actually considered an error that should no longer be in the guidelines. A common design load in use in transit facilities is 450 pounds per 40-in. (1,000-mm) step. This is the same structural design load required by EN 115. Furthermore, it is becoming more common to use this design load for the motors and brakes as well.

Why is this important if you want to modernize?

It is critical to understand that APTA has developed excellent guidelines in conjunction with active transit authorities to develop these standards to improve

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APTA Heavy Duty	Feature	Commercial
>2,000 mm	Radius	1,000 mm standard
674 pounds	Design load-brakes	190 pounds
674 pounds	Design load machines	190 pounds
674 pounds	Design load truss	190 pounds
674 pounds	Design load machinery/chain	190 pounds
<1:1000 between supports	Truss deflection	no standard
100,000 hours	Engineered design life	25-30,000 hours
V-groove profile	Handrail construction	U groove
Galvanizing to ASTM123	Weatherproofing	Galvanized may warp lighter truss
3	Flat steps	2
3 mm	Track thickness	1.5 mm
high deck solid balustrade with 16 ga. stainless steel	Balustrade	Glass or 3/8 inch steel sandwich panel
waterproof, high insulation rating available	motors	varies
4 inches (100 mm)	Roller diameter	3 inches (75 mm)

Table 1: Heavy Duty vs. Commercial Duty Based on Escalators With a 40 inch (1,000 mm) Step

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equipment reliability and longevity. If you have escalators that are under-designed, you cannot turn them into a heavy-duty escalator by modernizing them.

Understanding what you are starting with and what you want to achieve are key objectives. It should also be understood that there are many escalators in use installed prior to the APTA guidelines. Many of them can be successfully modernized, but there are a significant number of them that may not be worth the investment.

How to decide whether to modernize or replace my transit escalators?

First, determine why you want to modernize or replace escalators in the first place. If the escalators are unreliable, take a very close look at the maintenance program in place. Preventive maintenance in transit facilities is traditionally very difficult to achieve.

Few systems permit unrestricted preventive maintenance during operating hours. Taking escalators out of service every week for preventive maintenance is often impossible. Consider off-hours maintenance or repairs. Many escalators need major repairs, not modernization.

It is critical to conduct a thorough study and inspection of any escalator you are considering to modernize. The best time to conduct this review is during the annual cleaning and inspection. Once all the steps are out and the unit is cleaned, you can perform a detailed inspection to determine what devices can be added in a modernization program.

What is the difference between modernizing and repairing escalators?

Simply put, repairs include the following work:

- a. Replace step chains;
- b. Replace handrails;
- c. Replace track sections or turnarounds;
- d. Replace steps;
- e. Major cleaning and lubricating;
- f. Replace floor plates, decking, balustrade panels;
- g. Drive repairs, including brake and drive chains; and
- h. Replace any existing safety device.

Modernization of an escalator can be done in certain increments and includes all of the above work, plus:

- a. Replace controller;
- b. Upgrade braking system;
- c. Upgrade motor;
- d. Change handrail drive system; and
- e. Addition of safety devices not included in original installations, such as

- i. Skirt deflector device (skirt brushes);
- ii. Comb impact device;
- iii. Skirt switches; and
- iv. Handrail speed monitors.

A very important issue to understand is that a modern escalator has more safety devices than an escalator installed prior to 1987. What this means is that the old escalator may shut down more often than it did prior to the modernization. What is critical to understand is that unlike an elevator, or even a bus or a train, when an escalator shuts down, it is usually because something worked correctly.

An example of this is when a child gets a shoelace caught between the step and skirt and it sets off either the skirt switch or the comb impact devices (both post 1987 code requirements). The escalator will shut down, but it is not a malfunction. What has happened is that an incident involving a patron has been avoided or significantly reduced in severity.

Take a careful look at your escalator system to make sure your maintenance is as complete and thorough as possible. If necessary, invest in increased maintenance and repair before making a final decision to determine if the improved maintenance gets you the results you were looking for.

It is important to understand that not all escalators can be upgraded to the same degree. Space limitations or design may not permit certain upgrades you may desire. "Look before you leap" is very good advice when considering escalator modernization!

Table 2 illustrates some of the pluses and minuses of escalator modernization.

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Positive +	Negative -
Minimal building work required	Cannot increase number of flat steps
Less downtime once work starts	Cannot increase radius
More bidders available	Cannot replace rusted truss
More flexible scope of work	Building supports may be bad
Less expensive than new heavy-duty escalators	Cannot increase design load on all devices
No major rigging issues in delivery of parts	Cannot make a department store escalator a true heavy-duty escalator
Significant improvement in safety and reliability	Structural integrity of escalator steps may be below standard for new equipment.

Table 2: Decision Factors in Modernization of Escalators

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New escalator steps must be stringent engineering type tested, including a step fatigue certification test. Escalator step frames are subject to vibration, rain, salt, uneven wear and abuse (such as newspaper vendors using heavy handcarts on escalators) that can lead to undetected fatigue in an escalator step.

Your author has witnessed informal testing of new steps versus steps over 25 years old. The new steps had an ultimate breaking strength of close to 1,700 pounds, a truly solid and excellent design. When an older step in seemingly good condition was subjected to the same test, it failed at only 700 pounds! While still within U.S. code standards, this is certainly an alarming result.

There is currently no requirement by any code or standard to re-test escalator steps at any interval. It is our recommendation to either sample test existing steps in the system or supply new steps in any escalator modernization in which step fatigue is a concern.

It is also possible to submit sample steps to a new step fatigue certification test. However, it is no longer valid as a type test, since each individual step will have been subject to different stresses in the many years of service in the transit system.

Table 3 examines the pluses and minuses of a new installation.

Summary

New escalators look nice and, if properly specified for your application, can last up to 20 years or more with focused maintenance. However, be prepared often to perform structural modifications to structural supports, add drains, canopies and increase electrical power.

If you are prepared to make that investment, your escalator will have an increased factor of safety with

spare parts that are currently available. New escalators will require preventive maintenance of at least twice per month, and in certain circumstances, weekly maintenance will be required. What will not be required for several years are large major repairs. This will permit transit facilities to spread their often thin preventive maintenance resources toward equipment that has yet to be replaced or upgraded.

Modernizing escalators has the singular advantage of flexibility. There are significant safety devices that can be added into existing escalator systems without the time and expense of a full modernization. You can improve the safety and reliability of your escalators in increments that may suit your budget, if you cannot yet afford a full replacement or upgrade.

Of particular note, the comb-impact device has been added to many escalators in transit systems without a full modernization being completed on the escalators. This device shuts the escalator down if an object becomes trapped between the step and the combplate in the vertical or horizontal plane.

An entire article could be written on the advantage of this single safety device. This article will simply recommend adding this device wherever possible on any escalator that does not have this device installed, regardless of any other capital plans you may have for your escalators.

Modernizing escalators is not as straightforward as modernizing elevators. Be wary of modernizations that solve all problems in your escalator system. It has many advantages as outlined here, but there will be instances where modernization is not worth the effort, or is simply not possible.

Know your option; study your equipment, and you will understand the best choices for your system.

Positive +	Negative -
Can get increased radius	Much more expensive (2-3 times the price of modernization)
Can increase number of flat steps	More building work is required, for structural changes, increase in electrical demand, etc.
New truss, higher tensile strength	More downtime for removal of old escalator
Increased design load	Only 3 bidders meet Buy America
Modern parts available	Rigging in existing installation often requires transit station shut down
Longest life expectancy	

Table 3: Decision Factors in Installations of Transit Escalators

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