Single-Speed Elevators

Time to Retire

By Dave Balmer

Current codes require that elevators stop no more than one-half inch above or below the floor level. It can be difficult for older single-speed elevators to meet that requirement.

Up until the early eighties, arguably the most common elevator installed into the low-rise residential buildings of the time continued to be the traction or cable-drive single-speed passenger elevator. This elevator was, at that time and still is, a slow-speed, low-capacity passenger conveyance intended to service buildings in the two to eight floor range. At times these non-compulsory limits were exceeded by builders and developers who were more interested in saving money than in providing proper "elevatoring" to a building and its tenants.

As the eighties flowed into the nineties, population growth created the need for buildings to increase in height and numbers of floors. That called for increased elevator capacity and speed. It became impossible to continue to install the old technology that these slow-speed elevators represented; with their erratic and inconsistent levelling at floors.

Concurrently with this growth, awareness of the needs of the disabled created changes to the building and elevator codes. One of the major changes to the codes consisted of rules referencing accurate elevator car and landing alignment and levelling. The current elevator code requires that elevators, when arriving at a floor, must stop accurately and consistently within a finite limit of only one-half inch (13mm) above or below the floor level! This is reflected in the following excerpt from the current edition of the North American Harmonized Elevator code the CSA B44/ASME A17.1 and the National Building Code of Canada.

Elevators that stop out of level are a tripping hazard to everyone and are especially hazardous to the elderly. Wheelchair users and other mobility impaired persons may find it extremely difficult to negotiate the level difference caused by the misalignment. Thus your building is NOT accessible under the Building Code and Barrier Free Access requirements.

Note that it is important for the reader to understand that the catalyst for this code change originated with the single-speed elevator. And the reason?

The sequence of operation to stop a single-speed elevator is as follows: While it is travelling at full speed toward a selected floor, it will receive a signal from the controller

E-3 Operation and Levelling

Elevator operation shall be automatic. Each car shall be equipped with a self-levelling feature that will automatically bring and maintain the car at floor landing within a tolerance of 13mm (0.5 in.) under rated loading to zero loading conditions.

to stop when it approaches to within a set distance of the floor. The machine brake will be released and the two brake shoes will close onto the brake drum which is rotating at the full speed necessary to operate the car at its rated speed—typically about 100 feet per minute (fpm). The brake shoes will clamp onto the brake drum and quickly bring the car to a full stop. This all sounds quite easy and simple, however, there are problems! It is extremely difficult to consistently bring the car to a stop in the same spot where it is level with the floor! There are several reasons for this inconsistency. These are listed below in no particular order of precedence.

Is the car empty, partially loaded or fully loaded? Varying load conditions affect the ability of the brake to stop consistently level. The brake tension springs have been set for a "typical" loading condition and then set to stop the car level with the floor. A heavier load will cause the car to slide a little further (travel past the floor) when it stops and a lighter load will cause the car to stop a little sooner (stop prior to floor level). The counterweight is always about 40% to 45% heavier than the empty car, thus an empty car will have a different stopping condition than a fully loaded car.

What is the weather? Is it humid, cold, warm or rainy? All of these weather conditions can affect the ability of the brake to stop the car consistently level. The brake drum can easily become wet in a warm, moist atmosphere and this acts as a lubricant on the brake shoes and the linings. The brake can easily slide a little causing the car to stop out of level until the moisture is "burnt off". (Have you ever driven your car through a deep puddle and then tried to stop quickly. If you have then you will understand!)

What is the condition of the brake linings? They can also absorb moisture and swell or alternatively they can become brittle and dry. This can occur in a changing atmosphere where the machine room is not air conditioned and humidity levels controlled. Each condition affects the ability of the car to stop consistently level.

What is the age of the elevator? What is the condition of the brake drum and the brake shoes? They all are factors in the ability of the elevator to stop consistently at or near the floor level.

What level of elevator maintenance have you purchased from your maintenance company? A simple Inspect, Oil and Grease (IOG) contract will not permit the maintenance company to automatically keep your brakes in top condition and do their best to keep the elevator stopping reasonably level.

NOTE: Some elevator maintenance companies will say that the best they can sometimes guarantee floor levels is within two inches (50mm) above or below the floor—and even that may be qualified!

In order to get a better understanding of the problems faced by your elevator maintenance company I offer the following analogy. Consider that you are driving down a dry street on a bright sunny day in your car, which you have done many times, and approach a stop sign. From experience you know that if you press your brakes "just so" at a "certain" distance from the stop sign you will stop consistently and comfortably at the intersection. However, let's suppose it is snowing. If you press your brakes "just so" as you are used to doing and at that "same certain" distance are you going to stop in the same spot as consistently as on the bright sunny day? I think not! It will be necessary to adjust your speed, press or pump your brakes slightly to bring the car down to a lower speed so your brakes can stop the car without sliding through the intersection.

If you have comfortably and safely stopped your car on a snowy day it is because you have created some human interaction between you and your brakes. You have slowed down the car a further distance from the intersection than when it is dry and pumped or lightly pressed the brakes to bring you safely to a stop at the intersection. Very nice! Except that your single-speed elevator cannot do the same! Whether the weather is moist or dry, the load heavy or light, the brake conditions good or bad, the brakes will always be applied with the same force and speed! If you did the same in your car under varying load and weather condition you know you would slide right through the intersection, or stop ten feet short!

Because of these problems, many innovations have been tried with control systems, braking and motor types. The modern elevator today does not even use the brakes to stop the car as we did in the past and yet the control systems will consistently stop the elevator, under almost any loading condition, absolutely level at the floor with hardly a variation. One-eight inch (3mm) is easily achievable and some consultants would not even accept that variation!

Without getting too technical, let's just say that modern elevator control designs take complete control of the movement and speed of the elevator. Under varying load conditions the "brains" of the elevator (micro-processor) will electronically monitor and control the motor rotation to ensure that as the elevator approaches the floor level it will initiate slow down and accurately and consistently level the car and align it to the landing. It will then momentarily stop the car exactly at the floor level while the brake is still open! At the moment that the car stops, it is the "brain's" electrical control of the motor that is holding it at the floor, not the brake! The brake will only actuate once the car is stopped and level! Thus the brake is only used as a holding device to maintain the car level with the floor, it really does not stop it! The result is absolute accuracy of car and landing alignment 100% of the time, if properly adjusted initially! There is minimal wear on the linings and the original brake linings will last many years.

To avoid costly lawsuits caused by the tripping of tenants and other users due to car and landing misalignment AND to add considerable value to your building, retire your old single-speed elevator machine and controls and upgrade to a modern variable-voltage variable-frequency (VVVF) drive system. Your tenants will thank you! CAM

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