Rails and Ropes – A Service Perspective

by T.K. Purushothaman

I was in the construction department for about one-and-a-half years after I joined Otis Elevator Co. During my training period on one of the construction sites, the first day's work was to carry three collapsible gates to each floor. There were three lifts in the building. The second day's work was to carry the cast-iron filler weights to the top floor. Later, my work was a little easier, as I started the actual lift erection – the template setting, taking bracket readings, and marking pockets for bolts, etc.

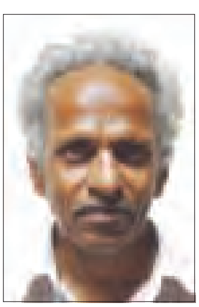
After the guide rails were hoisted and aligned, I noticed that they were not touching the buffer channel in the pit. There was about a 25- to 30-mm gap from the channel. Also, there was about a 50- to 75-mm gap on the top of the rail between the rail and machine-room slab. When I asked the erector why, he told me that it is the tolerance kept for the linear expansion. It was not difficult for me to believe. I have seen the joints of railway tracks with a gap of about 6-8 mm.

Years later, I experienced the problem of linear expansion on governor ropes in high-rise buildings. New rope stretches very fast in the first six to 12 months, after which the stretching ceases. But every summer the rope will stretch again, resulting in the tension pulley coming down. In the winter, the rope returns to normal condition, and the tension pulley goes up. So, every summer I used to take the tension pulley down, and in the winter, I used to take it up. This was a good example of linear expansion. This problem used to happen only in tall buildings with 25 to 30 stops or more with collapsible gates (not with sheetmetal doors). It is likely that the outside temperature does not easily reach the shaft with sheet metal doors.

I encountered a similar problem in a small building with eight stories. I was erecting a new lift, and the governor roping was done on the last day of summer. The next day, a monsoon started, and it rained for three or four days. It was not a densely populated area, and there were trees all over, so the atmosphere quickly became cold. On the fourth day, the governor rope had contracted, and it pulled the tension pulley upwards.

After a few years, I came across another example of linear expansion/contraction. A concrete structure started sinking/shrinking, and the machine-room slab touched the rails. It was difficult for me to believe, but I could see it happening over a period of time.

One such incident began with a complaint from one of the buildings in the suburbs. The customer complained that there was a lot of noise when the lift moved, so I sent a technician with some lubricant. Usually, the noise comes when there is no oil in the bushing, or if the rail is dry, so the technician applied oil to the rail. The next day, the customer met me and reported that the problem had not been solved. When I went to the building and took a run on the car top, I found that the counterweight rails were bent. When the lift moved, the counterweight was touching the cabinet, creating noise. When I took a closer look, I found that the rails were touching the top slab. I cut both the counterweight rails and removed a 6-inch piece. As soon as the piece



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came out, the rail straightened on its own with a loud noise, and the cabinet had sufficient space to travel. After this, the noise stopped completely. I discovered that concrete structures can really sink/shrink.

A few months later, I heard about a similar problem in a nearby building maintained by another contractor. Since the contractor couldn't find the exact fault, the company removed one or two rails and replaced them with new ones, and the problem was solved.

Another interesting thing is slippage between the rope and m/c sheave when the rope is dirty. This happened in a lift maintained by another local contractor. The customer approached me to replace the rope. The main rope was in very bad condition and due for replacement. I gave a quote for replacement, which was accepted and I arranged to carry out the work.

When I visited the site, I found that the rope could break into two pieces at any time. It looked more like a rod than a rope, since it had accumulated dirt and lubricants. The people were afraid to use the lift, and only two or three people could travel in it at a time. Even with a lighter load, the lift would overtravel and hit the buffer because of the dirt on the rope. Whenever the lift overtraveled and hit the buffer, passengers in the lift would press the up button to move up then stop it by opening the car door when it was at the desired level. The ropes were replaced, and the lift was handed over to the owner with a verbal warning to rectify the faults before an accident occurred. The next day the security staff was informed that the lift was once again on the buffer and not working, and all ropes were loose.

Some time back, I saw a cartoon in which a person asked what the most important part of an automobile is. The person said nuts, which keep the wheels in position. In the same way, some think the rope is the main or most important part in an elevator. In this instance, once the ropes were changed, the people started crowding in the lift, and it went down on the buffer. Since the final limit was bypassed, the lift didn't stop, and the counterweight frame overtraveled up to the thimble, touching the machine-room slab. Since the ropes were new and there was no dirt, the traction on the sheave increased, and it took the counterweight frame up. This provides a lesson on the importance of keeping the rope clean.

The other thing to note, apart from the slip on the rope, is rope tension. Usually, the rope tension is checked keeping the lift mid way. Keep the gauge near the thimble and check the value on each rope and note the reading. Repeat the same on the counterweight side. Depending on the value, tightening or loosening the nut on the thimble equalizes the tension. After running the lift up and down two or three times, check the value again, and

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make necessary adjustments. Even after doing all of this, however, rope tension may not be correct. This is because the rope tension might differ when the lift is on the top or bottom floor.

After cleaning, oiling and checking the lift during routine maintenance, I checked the rope tension from the m/c room. The lift had a deflector, so I pressed the ropes with my thumb, one by one, and found the tension to be different when the lift was in a different position. For example, when a lift is on the top floor, rope one has more tension, rope two has a little less, rope three has even less, and rope four has minimal tension. When the lift is on the bottom floor, the condition is reversed, meaning that rope four has maximum tension, rope three has less, rope two has even less, and rope one has minimal tension.

I didn't immediately know the reason, but after thinking for a while, I assumed that it was due to the indifferent depth of machine sheave grooves. How are improper cutting of machine sheave groove depth and rope tension related?

Suppose the machine sheave has a diameter of 500 mm. The circumference will be 1,571.43 mm, the rise of the building is 75 m and the roping is 1:1. On every rotation of the sheave, the rope moves 1,571.43 mm. The machine sheave will rotate about 47 times, when the lift moves from the ground floor to the top floor. See Figure 1, assuming one of the groove depths is less by 0.1 mm.

The circumference of the sheave groove becomes -1,572.05 mm. So in one rotation, the rope in the groove, which has less depth, moves faster by 0.62 mm. The number of sheave rotations is 47, so the total difference in rope length is 29.14 mm. Here, the difference in groove depth is 0.1 mm. The building height is 75 m, roping is 1:1, and the difference in rope length is still 29.14 mm. If the roping is 2:1, the difference will be 58.28 mm. This also gives more pressure on the guide rails.

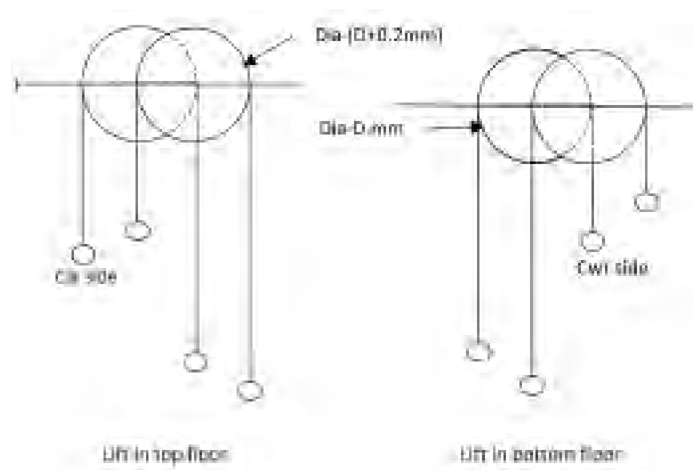

Figure 1

Another important issue in elevator maintenance is rail alignment. Both car rails should be in one straight line and equidistant throughout the lift run. The same applies to counterweight rails, as well. Tolerance allowed is <0.5 mm. If the brackets are in two pieces, affix the wall bracket firmly to the wall and place the rail bracket so it is 90° with the rail center line, and same time distance shall be maintained before welding them. If the brackets have slots, they can be nut bolted to be kept in position. Suppose the bracket position came in a curved surface ("A" in Figure 2).

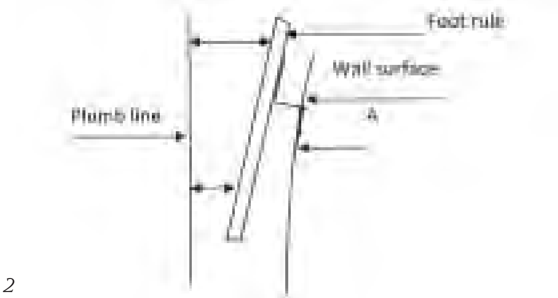

Figure 2

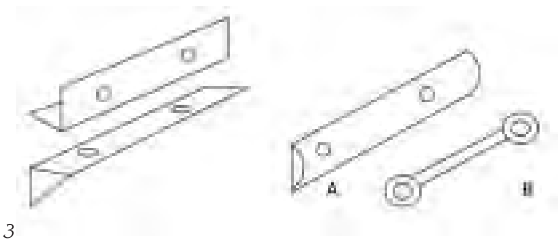

Figure 3

Assume that the bracket is fitted at section "A" in Figure 2. At the center of the bracket, the distance can be maintained, but at the top and bottom, the distance will vary. If you hold a steel scale on the bracket, you can clearly see the slanting. This can be rectified by putting shims between brackets, but most erectors don't put much effort in rectifying this problem and leave the bracket after removing the horizontal twist. By using a spacer 5 to 6 mm thick, like "A" or "B" the vertical slant can be automatically removed. The spacer should be kept between the bracket and rail, past the bolt, which is fixing the rail clip, through the holes of the spacer and bracket.

After completing the rail alignment, it should be re checked again, because when hitting the upper bracket with a hammer while aligning the same, the down bracket, which was already aligned, may shift its position slightly. The distance between the guide rails at joints are seldom checked. The distance can be increased or decreased by putting shims between the fishplate and rails, but the fishplate must be strong enough.

Ultimately, it is the individual who installs and maintains the elevator that is responsible for pointing out and suggesting improvements.