Asian Journal of Convergence in Technology Volume 4 Issue III
ISSN No.:2350-1146, I.F-5.11

# A Review ON NEW ADVANCED SAFETY SYSTEMS FOR RESIDENTIAL ELEVATORS

Aniket A. Sakhare [1], Prof.Pruthviraj D. Patil[2] ,Nikhil R. Pawar[3], Gajanan R. Mohite [4], Shailesh R. Rashinkar[5]
[1]*Final year student, J.S.P.M'S. R.S.C.O.E., Mechanical Engg. Department, Pune.*
[2]*Assistant Professor J.S.P.M'S. R.S.C.O.E., Mechanical Engg. Department, Pune.*
[3]*Final year student, J.S.P.M'S. R.S.C.O.E., Mechanical Engg. Department, Pune.*
[4]*Final year student, J.S.P.M'S. R.S.C.O.E., Mechanical Engg. Department, Pune.*
[5]*Final year student, J.S.P.M'S. R.S.C.O.E., Mechanical Engg. Department, Pune.*

*Abstract*—**Safety of residential elevators is now a days prior requirement for any residential buildings. It causes serious injuries. This review paper is survey of accidental causes and latest advance system used to reduce and avoid accidents. Some of them are implemented and some of are the futures. Organizations such as the American Society of Mechanical Engineers (ASME) have set standards for the construction and maintenance of elevators and escalators and for their safe operation. The through study related to causes of accidents, factors creates accidents and new safety systems, needed for investigation of better safety systems for residential elevators**

**Keywords—*ASME, SPT, Electrocution***

**Introduction (*Heading 1*)**

There are two types of elevators that are used in common passenger travel. These include hydraulic elevators and cable elevators. Hydraulic elevators are not commonly seen in buildings more than a few stories tall due to the need to position the mechanics farther underground for each story the elevator will need to be raised. A non-compressible fluid is pump into a cylinder to raise a piston, and thus raise the elevator car. These elevators are more expensive in their energy use. They also have less safety equipment than cable elevators. Cable elevators are the much more common type of elevator in all over the world. All of the machinery is in a machine room at the top of the elevator shaft. The elevator is attached by cable to a sheave in the machine room. The sheave, which is similar to a pulley, is turned by an electric motor to raise or lower the elevator. A counterweight is attached to the cable opposite the side of the elevator car. The counterweight is equal to the elevator's weight at 40% load. This allows the elevator to be moved using very little energy, because the counterweight keeps the weight at the tipping point [1].

A common misconception is that elevator deaths occur from an elevator falling. However, in reality, improper maintenance can cause the counterweight to drop and launch the elevator car upwards. Improper maintenance can lead to a number of other injuries.

All cable elevators include a governor that controls the maximum speed of the descent. However, it is possible for the governor to fail due to improper maintenance. Additionally, they must include a level of shock absorption at the bottom of the elevator shaft. [5]

**Fig. 1 Elevator Cabinet**

## II. CAUSES OF ACCIDENTS OF ELEVATORS

### a) Various Defects and Malfunction

Even though elevator accidents are not so common, there are "more" common defects and malfunctions that can take place when they do occur. These defects can be very dangerous and fatal to users. They include the following:

- Pulley system malfunction
- Mechanical breakdown that causes the elevator to drop rapidly within the shaft
- Open shaft that carries a risk of fall
- Fall due to faulty doors or other failures to protect passengers from entering
- Faulty wiring, elevator control malfunction, or a risk of electrocution
- Incomplete repairs or maintenance
- Inspections by unqualified personnel
- Unbalanced leveling and failure of elevator lining up with floor
- Wiring malfunction or entrapment due to the heat from fire

Those killed working on or near elevators were involved in three types of activities, the deaths involving installation or repair of elevators.

**b) Installing and repairing elevators: Almost 70% of** these deaths involved elevator installers and repairers. The remainder included industrial machinery repairers, engineers, construction supervisors, electricians, janitors, and maintenance workers. At least 10 of the deaths involved workers who were unqualified not trained in elevator repair trying to fix jammed elevators.

***c) Sudden falls of elevators:*** Falls caused over one-quarter of the deaths of workers installing and repairing elevators; most of the fatal falls, however, were by workers who were not classified by the Bureau of Labor Statistics as elevator installers or repairers. "Caught in" deaths included being caught in elevator machinery (such as counterweights) or between two cars or between the elevator shaft or Door way and a car. Being struck by objects usually involved an elevator descending while someone was working in an elevator shaft. All but one of the electrocutions involved elevator installers and repairers.

Many fatal falls into elevator shafts occurred when an elevator call button was pushed and elevator doors opened – even though the elevator car was not at that floor. Interlocks are intended to prevent such occurrences, but clearly do not always work. Procedures are needed to quickly identify malfunctioning elevators (including elevator call buttons), to take steps to ensure that disabled elevators remain out of service, and ensure that warning signs and/or tape are placed on all elevator doors.[2]

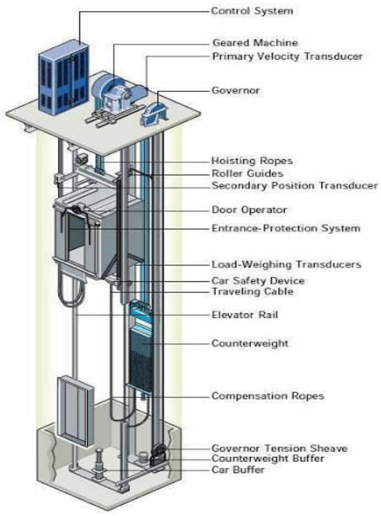


**Fig2: Layout of Elevator [3]**

**d) *Working in elevator shafts/cars:*** Deaths in this category involved retrieving keys and other objects that had dropped into a shaft, cleaning inside an elevator shaft, stuck elevators, and collapses of platforms over elevator shafts.

***e) Working near elevator shafts:*** Almost all of these deaths involved construction workers. Thirty-five of the deaths occurred during work next to unguarded or improperly guarded elevator shafts.[1]

**f) Use Adequate Lockout/Tag out Procedures:** More than half of the work-related elevator deaths, especially electrocutions and "caught in/between" and "struck by" deaths, were caused by failure to de-energize elevator electrical circuits or failure to ensure that elevator parts could not move while maintenance or repairs were under way. These causes resulted also in four of the seven work-related escalator deaths.

**g) Ensure Adequate Fall Protection:** Forty-nine percent of the deaths during work on or near elevators resulted from lack of fall protection. Provision of adequate fall protection – scaffolding, guardrails in front of open shafts, or personal fall protection systems – could have prevented these deaths.

**h) Treat Elevator Shafts as Confined Spaces:** Over one-quarter of the work-related deaths occurred when workers entered elevator shafts to repair or maintain elevators, or to perform activities such as cleaning, welding, and retrieving fallen objects.

**Fig 3. During Maintenance of Elevators**

**i) Malfunctioning defect:** Malfunctioning escalators were also a cause of deaths or injuries. Several instances of multiple injuries were caused when an escalator suddenly sped up or reversed its direction of movement (Armstrong 1996a, annex

j) **Hands and feet of trapping:** The high number of injuries involving trapping the hands and feet of children and the trapping of clothing of adults at the bottom or top of an escalator and in the gap between moving stairs and sidewalls raises the question of whether escalators are adjusted or designed properly[3]

**Fig 4. Feet trapped in elevator**

## III. ADVANCED SAFETY SYSTEMS IN ELEVATORS

### i )Buffers

**A Buffer** is a device designed to stop a descending car or counterweight beyond its normal limit and to soften the force with which the elevator runs into the pit during an emergency. They may be of polyurethane or oil type in respect of the rated speed.

**There are two principal types of buffers in existence:**

**A- Energy accumulation**: accumulate the kinetic energy of the car or counterweight.

**B- Energy dissipation**: dissipate the kinetic energy of the car or counterweight. Polyurethane buffers which are energy accumulation type with non-linear characteristics are used for our lifts that have rated speed not more than 1 m/sec. Polyurethane buffers have three shapes as shown in the below image


**Fig.5 Main Types of Elevator Buffers[12]**

**a- A Spring Buffer** is one type of buffer most commonly found on hydraulic elevators or used for elevators with speeds less than 200 feet per minute. These devices are used to cushion the elevator and are most always located in the elevator pit.

**b- An Oil Buffer** is another type of buffer more commonly found on traction elevators with speeds higher than 200 feet per minute. This type of buffer uses a combination of oil and springs to cushion a descending car or counterweight and are most commonly located in the elevator pit, because of their location in the pit buffers have a tendency to be exposed to water and flooding. They require routine cleaning and painting to assure they maintain their proper performance specifications. Oil buffers also need there oil checked and changed if exposed to flooding.[12]

### ii) **Hoistway Door Interlock**

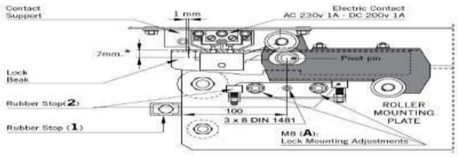


**Fig. 6 Device for locking landing doors[12]**

- It shall not be possible in normal operation to open the landing door (or any of the panels in the case of a multi-panel door) unless the car has stopped, or is on the point of stopping, in the unlocking zone of the door.
- The unlocking zone shall not extend more than 0.2 meter above and below the landing level.
- The hoistway door locking mechanism provides a means to mechanically lock each hoistway door and the elevator cannot leave a landing unless the doors are fully closed and secured.

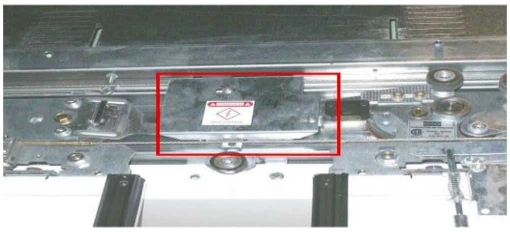

**Fig. 7 Hoistway Door Interlock[12]**

- They are also interconnected electrically to prevent operation of the elevator if any of the elevator's hoistway doors are open. Should the doors be forced open, the interlock circuit will be broken, causing the elevator to immediately stop.
- Each landing door shall be provided with a locking device satisfying the previous conditions. This device shall be protected against deliberate misuse.

Landing doors shall be capable of being unlocked from the outside with the aid of key , which fit the unlocking triangle (Hoistway Emergency Door Keys

### iii) Hoistway Emergency Door Keys

**Fig.8 Hoistway Emergency Door Keys[12]**

Hoistway Emergency Door Keys permit the unlocking of the hoistway door interlock.

**iv) Escutcheon Tube**

**Fig.9 Escutcheon Tube[12]**

- The keyhole on the upper portion of a hoistway door that accepts a hoistway emergency door key and permits unlocking of the hoistway door locking mechanism.
- These keyholes are usually located at the bottom and top floors, but may also be on other selected floors or all floors.
- You may find a lock covering these keyholes on some new elevator installations. Locate these keys during pre-fires.[12]

**iv) Progressive safety gear**

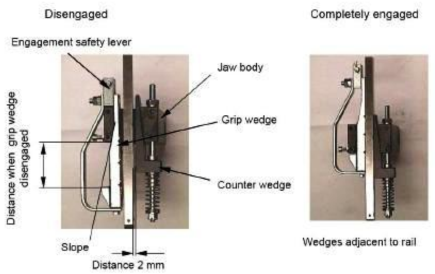


**Fig. 10. Progressive safety gear[12]**

- **Safety gear** is a mechanical device for stopping the car (or counterweight) by gripping the guide rails in the event of car speed attaining a pre-determined value in a downward direction of travel, irrespective what the reason for the increase in speed may be.
- Progressive safety gear retardation is affected by a breaking action on the guide rails and for which special provisions are made so as to limit the forces on the car, counterweight o balancing weight to a permissible value.

Pair of safety gears is mounted in the lower part of car sling and operated simultaneously by a linkage mechanism that actuated by overspeed governor[12]

***Conclusion***

From the above review, two conclusions can be obtained. First is that if the material is not used again, then the incremental hole drilling method is preferred because it gives an accurate result since the stress is measured with the help of the amount of strain that is received when a hole is drilled. Second is that if the material need not to be used again, since it is one of the widely used techniques and it gives an accurate result based on the time. The sources of errors will be estimated precisely and parametric study on sizes causing residual stresses.

**Acknowledgment**

We wish to thanks Konstantinos Stamatopoulos,G. Montay,O.Sicot, X.-L Gong, A.Cherouat,J. Lu, Göran Fernlund, Anoush Poursartip, Graham Twigg, Carolyne Albert, for the provision of the research papers studied in related topics. The authors are grateful for technical support that helps to identify stresses and techniques by supporting emerging research.

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