VERTICAL TRANSPORTATION

B. Arch IV year

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What is vertical transportation?

- Vertical transportation is a phrase used to describe the various means of travelling between floors in a building. All buildings with more than one storey of course have at least one set of stairs and the provision of stairs is a very important consideration when designing buildings in order to ensure all the occupants of the building can escape safely in the event of a fire.

- In buildings with more than four storeys, a lift is desirable as there is a limit to how far people are willing to walk up stairs. In addition to this, stairs are unsuitable for infirm and mobility impaired persons so buildings with only two storeys are sometimes fitted with a lift.

- A third option is the escalator which is ideally suited for high volume applications such as shopping malls and airports but not practical for high rise buildings as they take up a lot of space.
Components of Lift

The car, cables, elevator machine, control equipment, counterweights, hoistway, rails, penthouse, and pit are the principle parts of a traction elevator installation.

THE CAR

The car is a cage of some fire-resistant material supported on a structural frame, to the top member of which the lifting cables are fastened. By means of guide shoes on the side members, car is guided in its vertical travel in the shaft.

The car is provided with safety doors, operating-control equipment, floor-level indicators, illumination, emergency exits, and ventilation.
CABLE
Four to eight cables, depending on the car speed and capacity, are placed in parallel; in general, each rope is capable of supporting the entire load.

The minimum factor of safety varies from 7.6 to 12.0 for passenger lifts and from 6.6 to 11.0 for freight lift.

The counter weight is made up of cut steel plates stacked in a frame attached to the opposite ends of the cables to which the car is fastened. Its weight equals that of the empty car plus 40% of the rated live load.

THE SHAFT
The shaft or hoist-way, is the vertical passageway for the car and counterweights. On the side walls are the car guide rails and certain mechanical and electrical auxiliaries of the control apparatus.
TYPES OF LIFTS

- TRACTION LIFTS
  GEARED & GEARLESS

Geared and Gearless Traction Elevators with Machine Room. Traction elevators are lifted by ropes, which pass over a wheel attached to an electric motor above the elevator shaft. They are used for mid and high-rise applications and have much higher travel speeds than hydraulic elevators.

- HYDRAULIC LIFTS

They use an underground hydraulic cylinder, are quite common for low level buildings with two to five floors (sometimes but seldom up to six to eight floors), and have speeds of up to 1 m/s (200 ft/min).
As architects continue to design taller and taller buildings, a certain limitation of elevators is going to become more of a problem – using traditional steel lifting cables, they can’t go farther than 500 meters (1,640 ft) in one vertical run.
TRACTION LIFT
GEARLESS TRACTION MACHINE

A gearless traction machine consists of a DC or AC motor, the shaft of which is directly connected to a brake wheel and driving sheave.

The elevator hoist ropes are placed around this sheave. The absence of gear means that the motor must run at the same relatively slow speed as the driving sheave, and these are generally used for high-speed lifts, i.e. speeds from 2.5 m/s to 10 m/s.

A gearless traction machine is superior to geared machines because it is more efficient and quieter in operation, requires less maintenance, and has longer life.

A sheave is just a pulley with a grooves around the circumference.
GEARED TRACTION LIFT

A geared traction machine has a worm and gear interposed between the driving motor and the hoisting sheave. The driving motor can therefore be smaller, cheaper, high-speed unit rather the large, low-speed unit required by a gearless installation.

These are used for car speeds up to 2.3 m/s and maximum rise of about 90 m.
ROPE ARRANGEMENTS

(a) Basic single-wrap rope arrangement. In (b) and (c), the rope passes over the traction sheave T and sheave S, doubles back over T, and then extends past S to the counterweight CW. This double-wrap arrangement provides additional traction at the drive sheave. (d) Roping arrangement for a basement machine room.
LIFT MACHINE ROOM

View of machine room

View of geared traction machine (for car speeds up to 0.8 m/s)

View of gearless traction machine (for high speed lifts, 1.75 m/s and over)
Main brake of an elevator is mounted directly on the shaft. The lift is first slowed by dynamic braking of the motor and the brake then operates to clamp the brake drum, thus holding the car still at floor.

A dual safety device is used to stop the car automatically in case of over-speed:

1. A centrifugal governor or an electronic speed control sensor cuts the power of the traction motor and set the brake in case of limited over-speed.

2. If over-speeding continues, governor actuates two safety rail clams, which are mounted at the bottom of the car and one either side.

Oil or spring buffers are usually placed in the pit, not the stop a falling car but to bring it to a somewhat cushioned stop if it over-travels the lower terminal.
HYDRAULIC PASSENGER LIFT

The **elevators** use a pump system to push a cylinder of fluid on a piston, lifting the cab. Energy used to lift the **elevator does not get** recovered on the trip going down, it is completely lost; this is because **hydraulic elevators do not use a counterweight** system.
The major advantage of hydraulic unit is the absence of an overhead machine room, a penthouse, and traction equipment.

Elevator load is carried by the ground not by the structure.

Hoist-way is smaller due to the absence of a counterweight and its guide rail.

Cars can be lowered manually by the operation of oil valves. Essentially there is no lifting limit.

Operating expensive is higher due to absence of counterweight. These are limited to low-rise, low-speed applications. Ride quality is also inferior.
HYDRAULIC JACK ARRANGEMENTS
LIFT DOORS

(a) Centre opening

(b) Two-speed side opening

(c) Two-speed centre opening

(d) Triple-speed side opening
Escalator: is a moving staircase – a conveyor transport device for carrying people between floors of a building.

The device consists of a motor-driven chain of individual, linked steps that move up or down on tracks, allowing the step treads to remain horizontal.

Step widths: 600, 800 & 1000 mm; min. step or tread length = 400mm
Inclination: usually at angle 30° if rise < 6 m & speed < 0.5 m/s
DRIVING SYSTEM

1- Step Drive System
2- Handrail Drive System.

The variation on how these two systems are combined is dependent upon the type of escalator. The Drive Machine used to drive the pinion gear or the main drive chain may directly or indirectly drive the Handrail Drive System.
Continuous operation is the optimal mode for the commercial sector in which customers are to be transported efficiently to the upper floors of the store. It continues to crawl along at 0.1 m/s in the absence of passengers.

Stop-&-go operation is recommended for the intermittent arrival of passengers or for sporadic use outside peak times. Typical applications include movie theaters, airports, subway stations and railway stations. The unit remains ready for operation when there are no passengers, as signaled by a direction indicator. The Schindler entrance monitoring system detects approaching passengers and sets the escalator/moving walk into motion whenever required.
Escalator speeds vary from about 90 feet per minute to 180 feet per minute (27 to 55 meters per minute). An escalator moving 145 feet (44 m) per minute can carry more than 10,000 people an hour -- many more people than a standard elevator.
**Rational Arrangements**

**SINGLE**
Such layout has the advantage of small covering area, flexible escalator arrangement. It can only fulfill one-way intermittent flow of the passengers. It is mostly suitable for small-size shopping places.

**SCISSORED**
Such layout is a bit larger than that from the irregular layout. It can fulfill one-way continuous flow of the passengers. It is mostly suitable for small and medium department stores.

**PARALLEL**
Such layout is mainly fit for large passenger flow shopping centers and public traffic areas. It can fulfill two-way continuous flow of large passenger flows. When one-way peak hour occurs in the passenger flow, we can adjust the travel direction of partial escalators in order to meet the requirements of rush-hour flows requirements. Without an internal retaining plate, such mode is quite economical.

**CROSS**
Such layout is mainly suitable for large-size department stores and public constructions. The conveying times between these floors shall be minimized as far as possible.
Escalator parts