Elevator 101

Introduction to Elevator Technology

Acknowledgements

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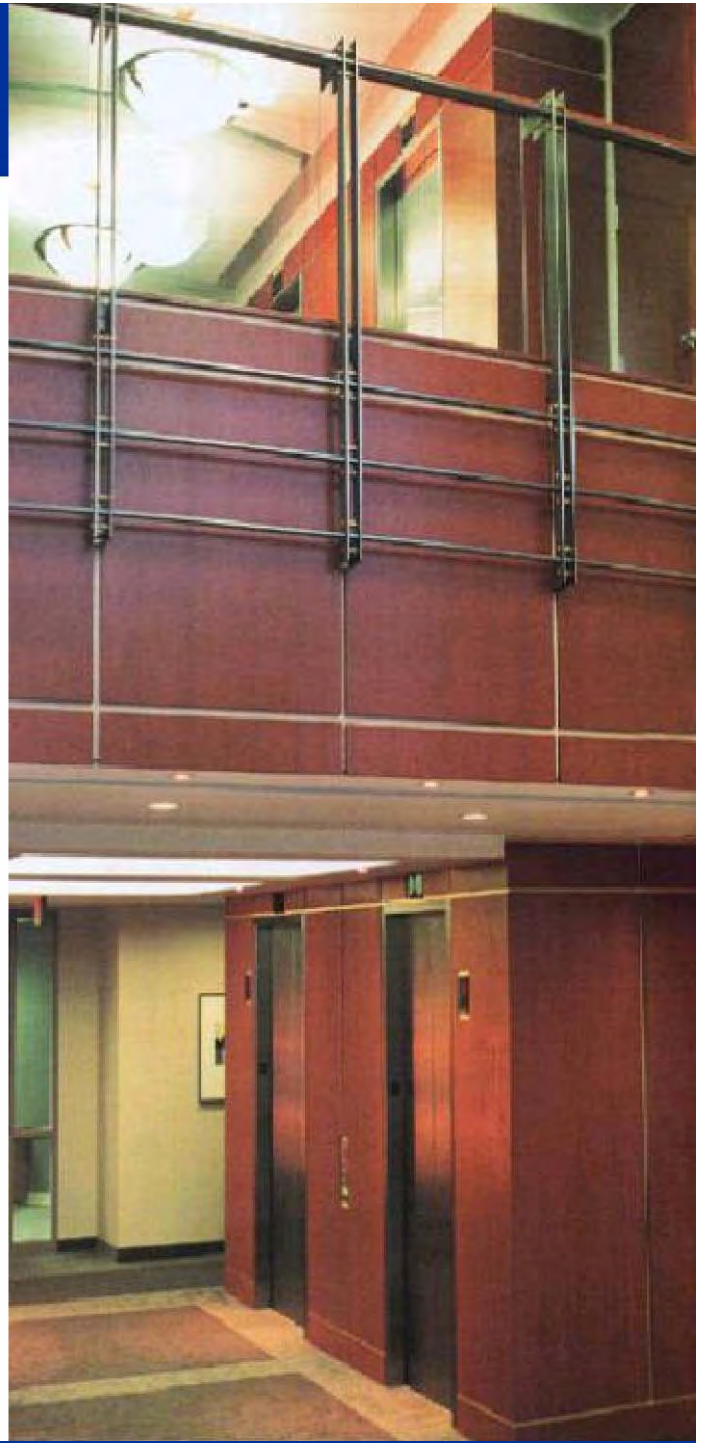
What we're going to cover

- Elevator history
- Types of elevators
- Elevator components
- Key design and planning considerations



Learning objectives

- To understand:
  - common types of elevators
  - elevator components
  - key design and planning criteria

History

1852	Safety brake invented by Elisha Graves Otis
1878	First hydraulic passenger elevator
1950	First elevator operated without attendant
1979	First fully-integrated microcomputer system
2000	Machine room-less elevator system that uses coated-steel belts instead of ropes introduced

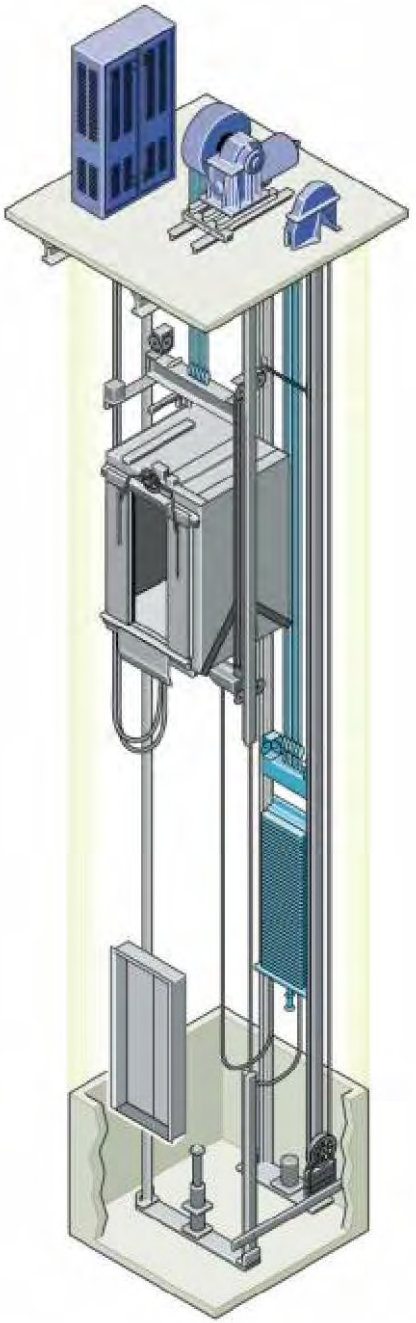
How elevators work

Push vs. Pull

- Push = Hydraulic
- Pull = Traction

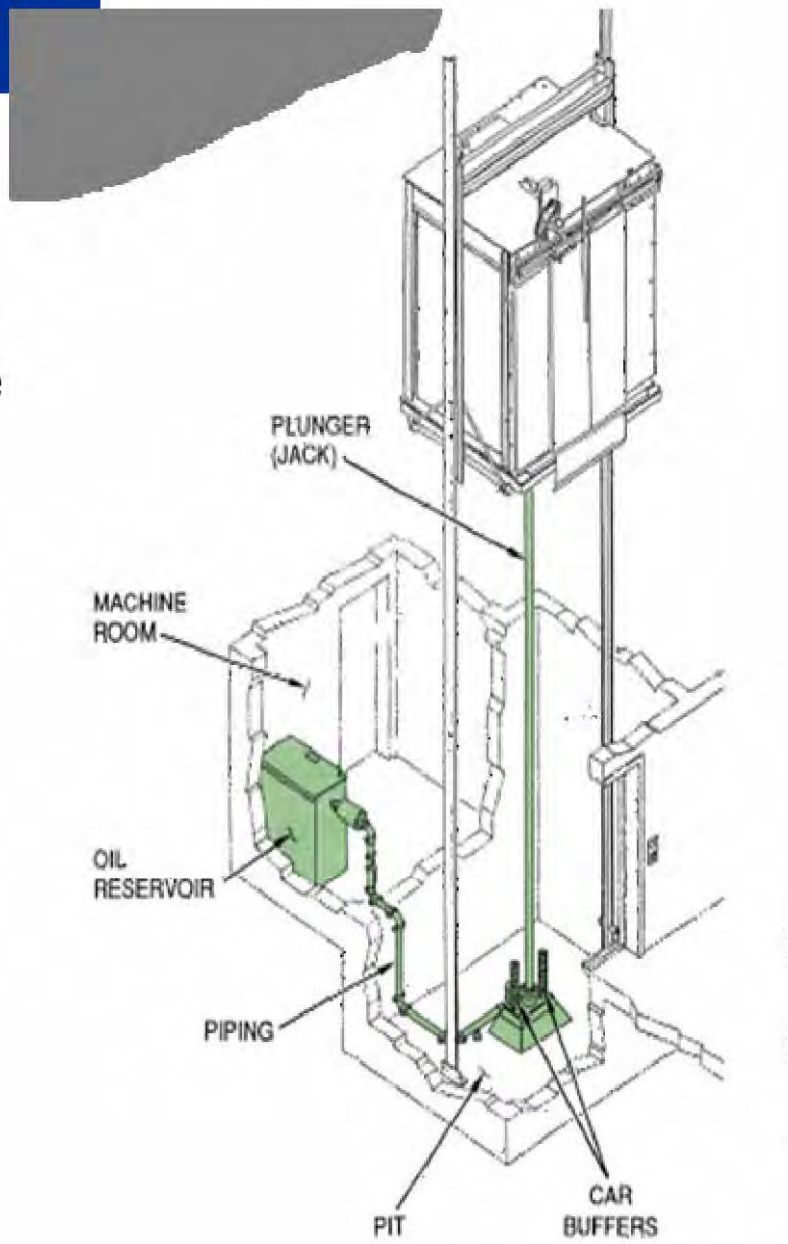
Basic elevator components

- Car
- Hoistway
- Machine/drive system
- Control system
- Safety systems



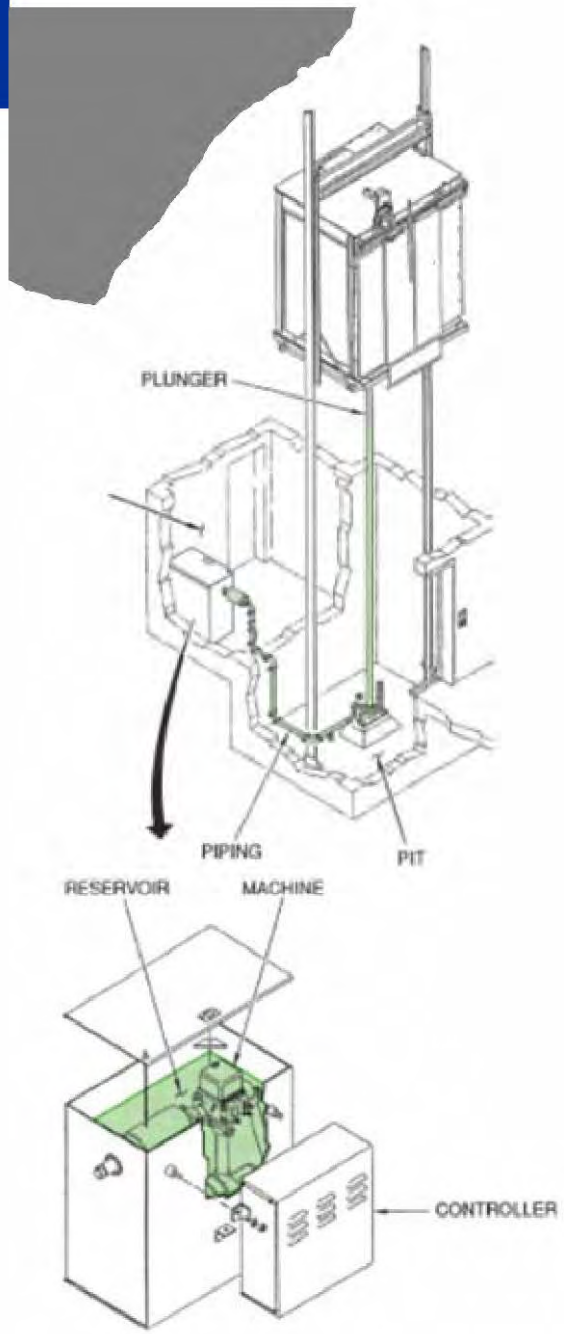
Hydraulic system

- Elevator car pushed from below
- Operating system positioned below and adjacent to hoistway in machine room
- 100, 125, 150 fpm
- Low- and medium-rise
  - Max. 60 ft.
  - Max. 7 stops



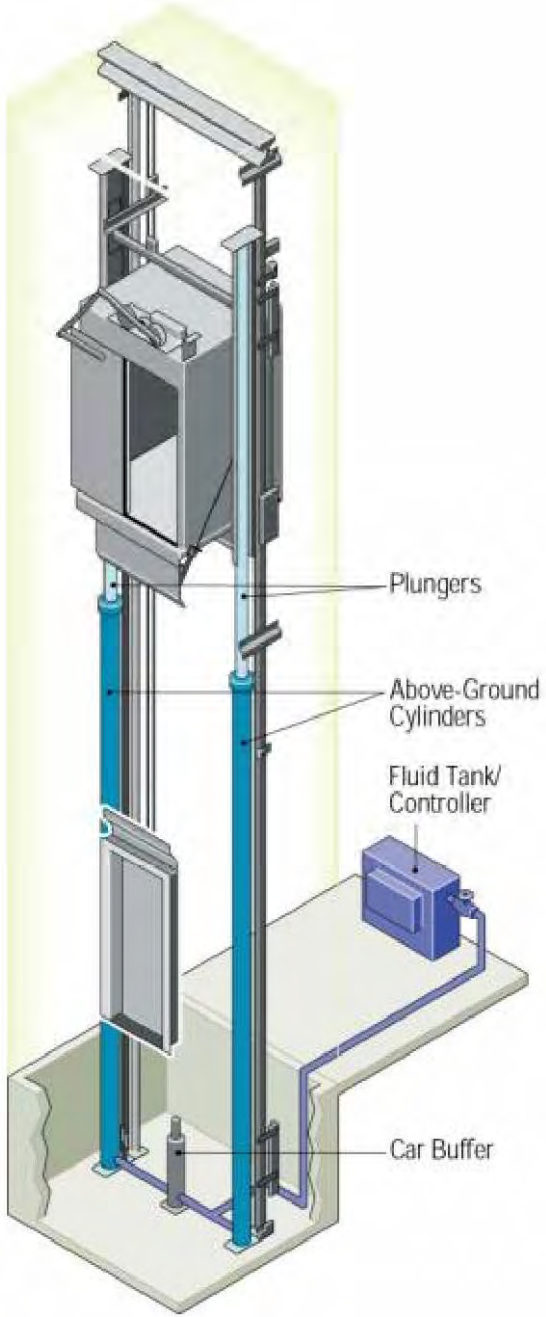
Hydraulic elevators — how they work

- Piston and cylinder
- Hydraulic oil reservoir
- Pump and piping
- Control system



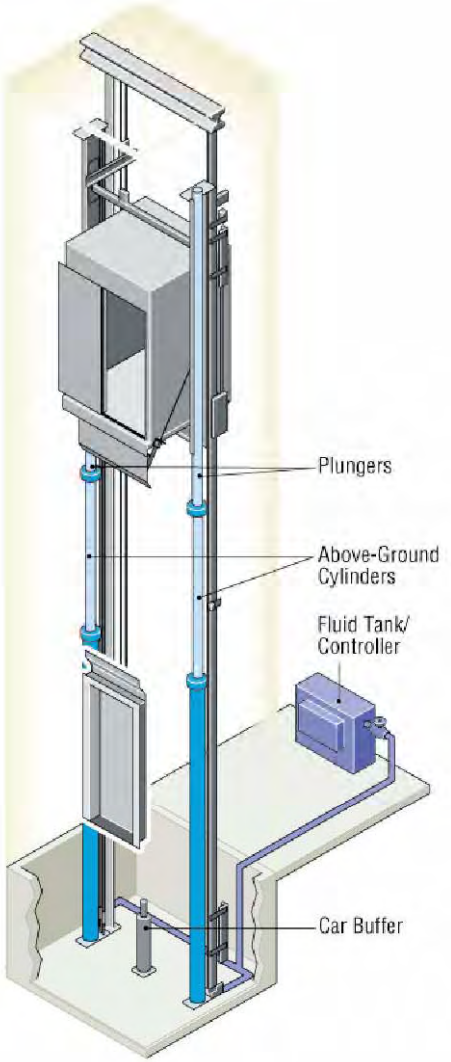
Holeless (single-stage) hydraulic elevator

- Rise to about 14' – 20'
- Maximum 2 to 3 stops
- No need for in-ground well hole for cylinder



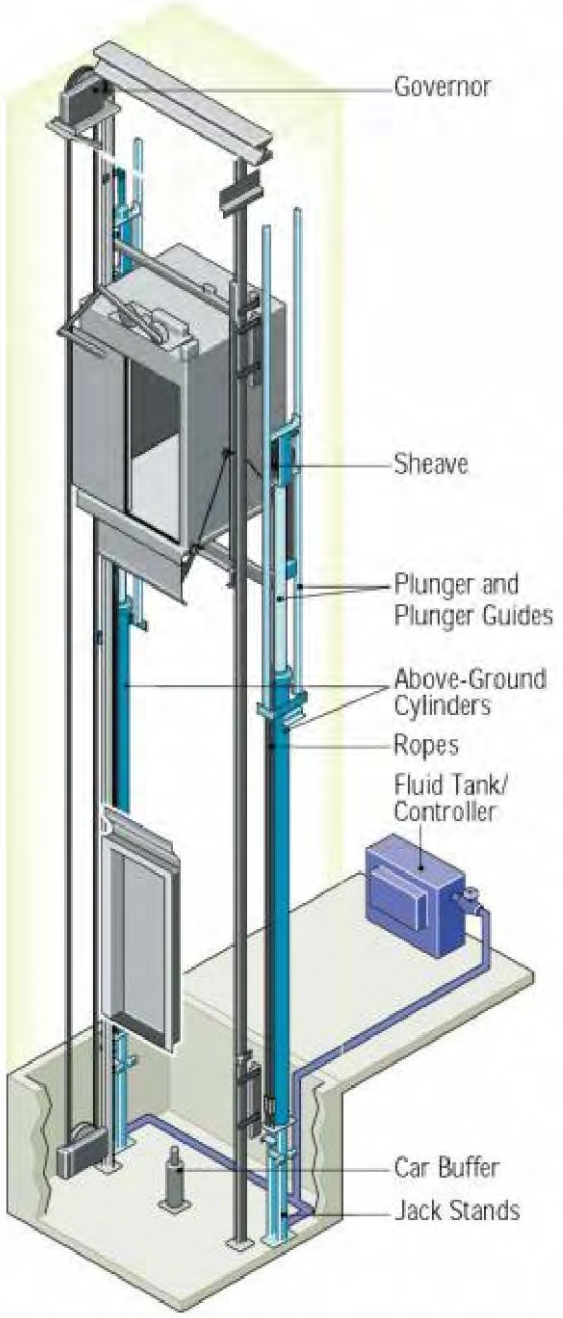
Telescopic holeless hydraulic elevator

- Rise to 27' to 44'
- Maximum 4 stops
- 2- or 3-piece telescoping pistons
- No need for in-ground well hole for cylinder



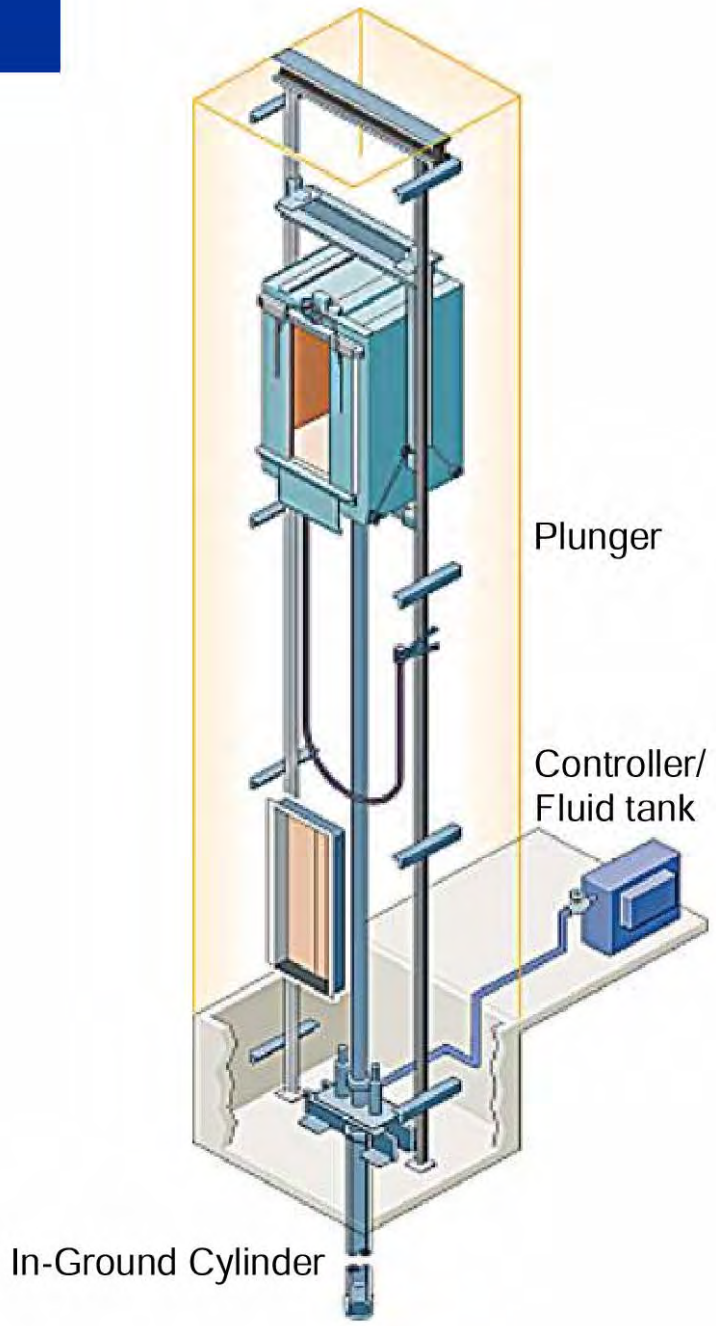
Roped holeless hydraulic elevator

- Rise to 60'
- Maximum 7 stops
- No need for in-ground well hole for cylinder
- Available up to 3,500 lbs.



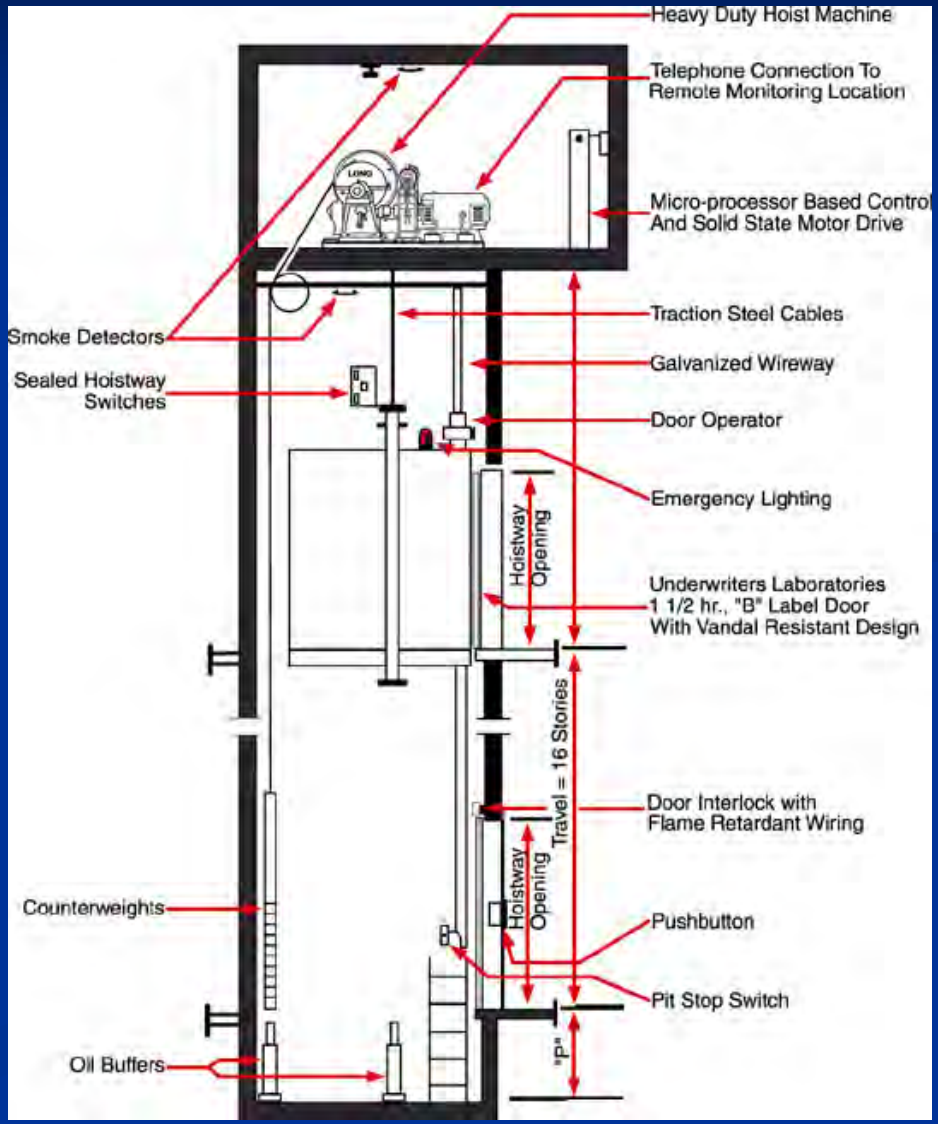
Holed hydraulic elevator

- Rise to 60'
- 7 stops
- Requires deep well hole for burying cylinder underground



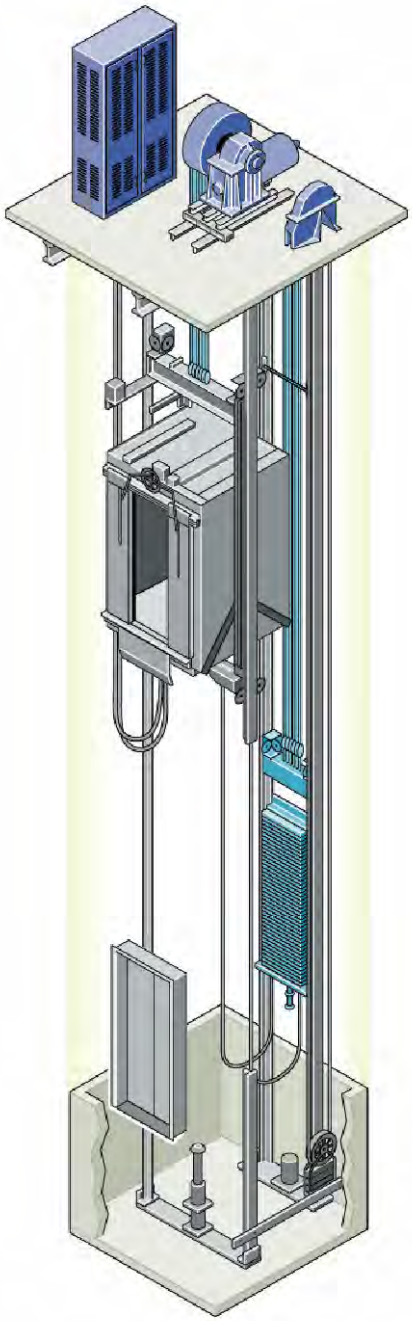
Traction System

- Elevator pulled above by wire hoist ropes
- Operating machinery positioned above elevator hoistway
- Moderate to high speed
- Medium and high-rise



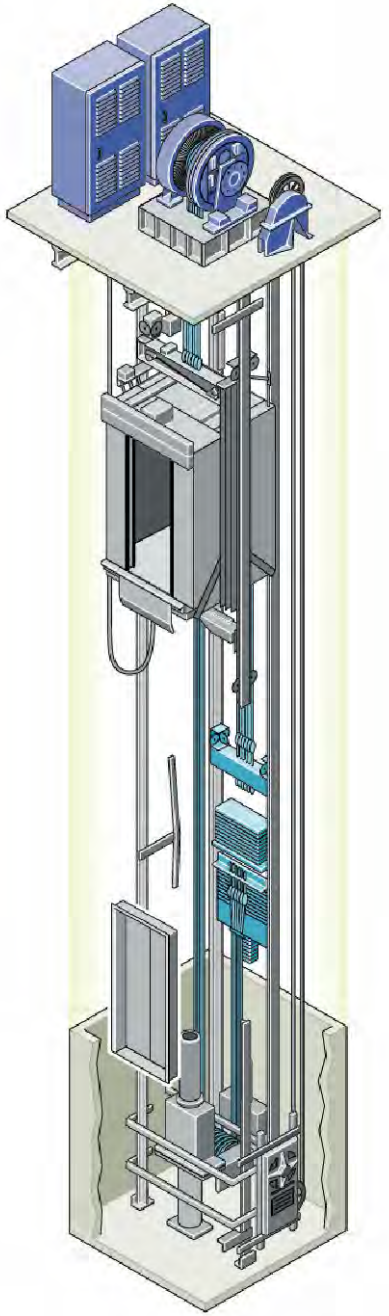
Geared traction

- Motor drives gear assembly, which rotates drive sheave
- Mid-rise up to 300ft at speeds up to 500 feet per minute



Gearless traction

- Motor directly rotates drive sheave
- High-rise above 20 stories and speeds of 500 feet per minute or above
- Available for passenger and service duties



Elevator Pits

- Safe and convenient access shall be provided to all pits.
- Pits shall be accessible only to authorized persons
- A permanent lighting fixture shall be provided in all pits and the bulb shall be guarded

Elevator Operating

Equipment

Door Protection

Elevators are protected by a several types of door reopening devices:

- Infrared Safety Curtains – These devices scan the areas adjacent to the elevator door(s) and automatically reopen the door(s) when the presence of an object is detected. This is the most modern means of door protection.
- Electronic Photo-eyes – These devices send out two (2) or more fixed beams that cause reopening when someone or something breaks the beam. These are used in conjunction with mechanical safety edges.
- Mechanical Edges – These devices must make physical contact with a person or object to trigger reopening.

Door Safety

If someone is moving towards the elevator, utilize the door open button on the car control panel to wait for them. The door reopening devices are designed to turn off during the last 2 to 4 inches of travel therefore someone should never stick an object or limb in the path of a closing door.

Elevator Leveling

- Elevators are required to stop at each floor within plus or minus ½" of the floor landing.
- A simple method of assessing that your elevator is approaching the maximum ½" tolerance allowed by code is to draw the sole of your shoe across the landing sill.
- Caution should be advised to anyone wearing bi-focal glasses.

Emergency Communication

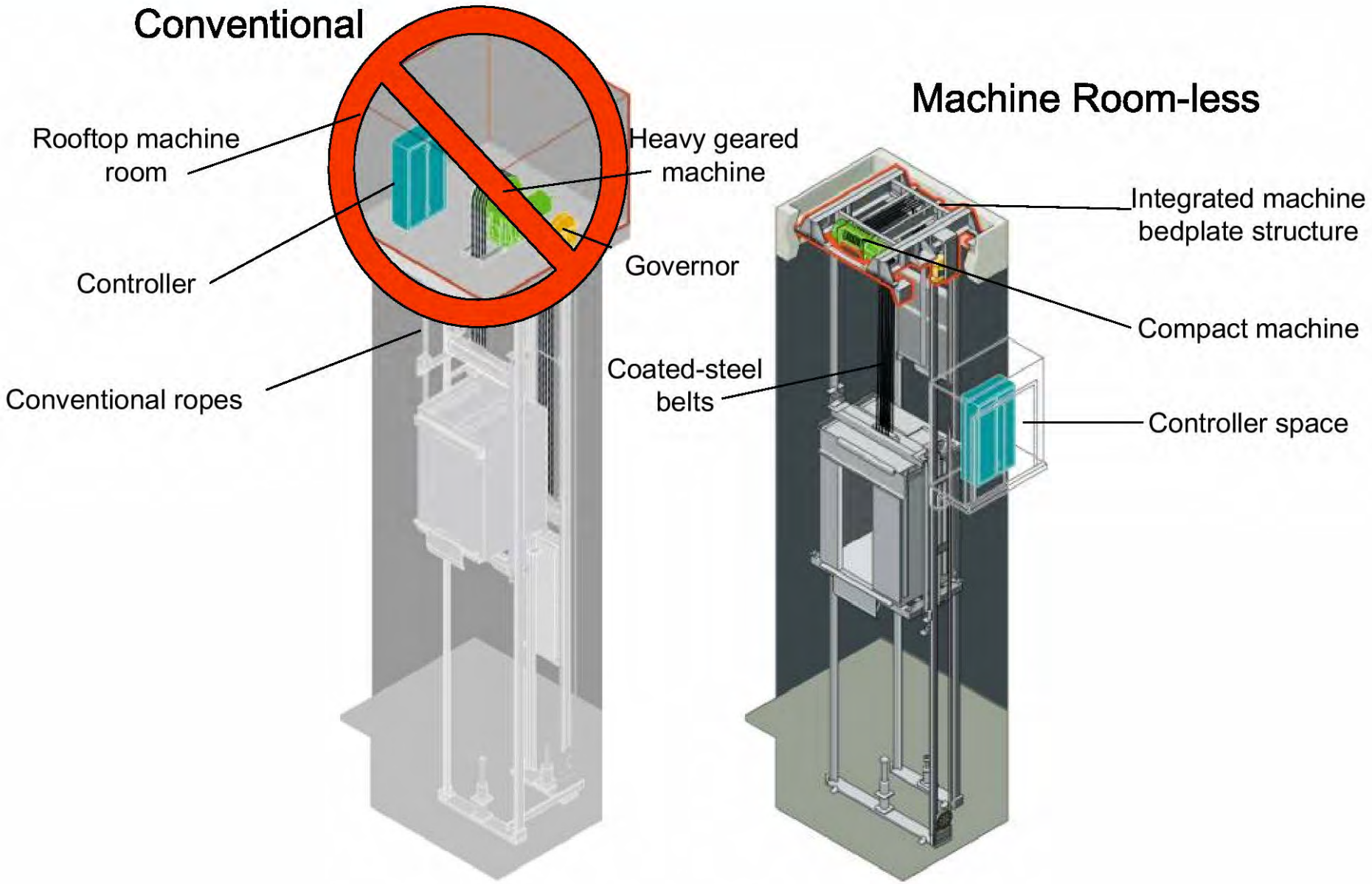
- Most elevators have an Alarm Bell and Telephone or Intercom.

- It is also important to have a functioning emergency light in the elevator to avoid leaving a trapped passenger in the dark as they wait for assistance.

New Elevator Technology

- Machine Room Less Elevators
- Coated Steel Elevator Belts
- Gearless Machines

Machine room-less gearless traction



Coated steel belts

Innovative, durable

- Zinc-plated steel wires minimize corrosion
- Tough polyurethane coating avoids metal-to-metal contact – reduces noise and vibration
- Belt comprises high-tensile strength steel wires
- No lubrication required

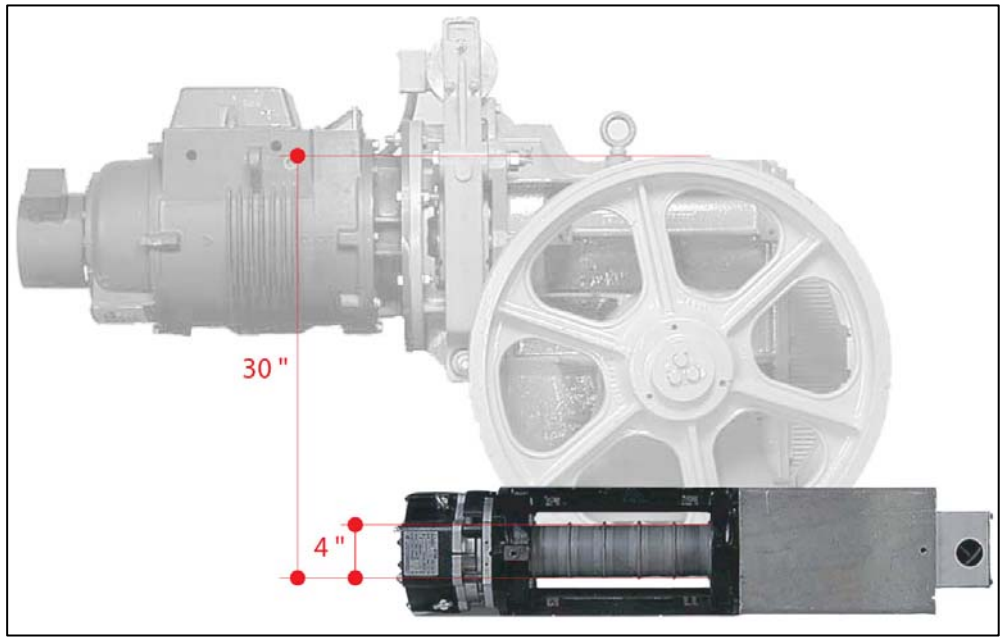
LASTS 2-3 TIMES LONGER THAN CONVENTIONAL STEEL ROPES

12 smaller cords and flat arrangement provide better flexibility than conventional ropes.

Gearless machine

Compact and efficient

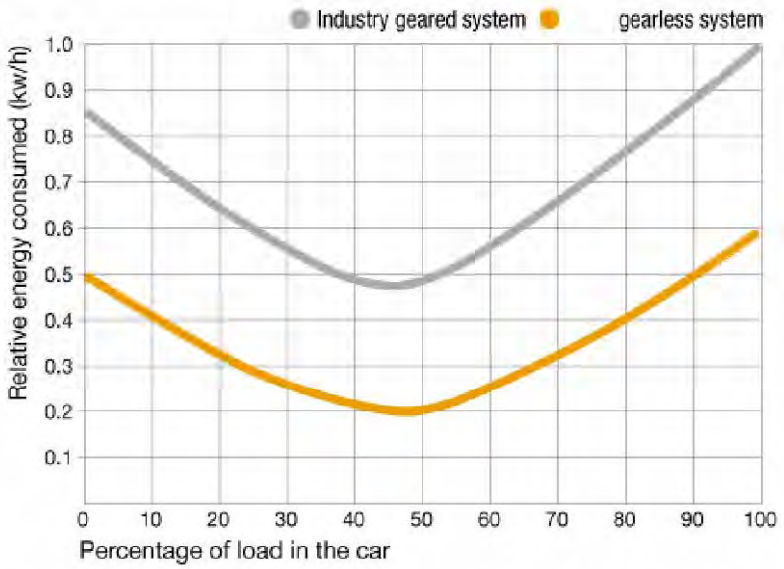
- AC gearless machine tucks away at the top of the hoistway – 70 % smaller
- Compact synchronous permanent-magnet motor
- Up to 50% more efficient than conventional geared machines



Environment-friendly

Up to 50 percent more energy-efficient than conventional geared and hydraulic elevators.

- The new, permanent-magnet machine reduces power consumption
- The smaller sheave turns at a faster, more efficient speed
- The gearless design eliminates the energy loss of geared systems
- The coated-steel belts improve sheave traction



Based on 3500 lb. system at 350 feet per minute at 180 starts per hour.

Common design questions

- Determine number/capacity of elevators
- Layout of elevator groups
- Machine room size & location
- Custom cab interiors
- Hoisting beams
- Rail fastenings
- Sump pumps/pit equipment

Code/ADA requirements

- ADA = 2000 lb. 5'-8" x 4'-3"
- Local municipal requirements
  - Stretcher requirement
    - No center opening doors on 2500 lb car
    - Side opening door or hospital car arrangement on at least one elevator

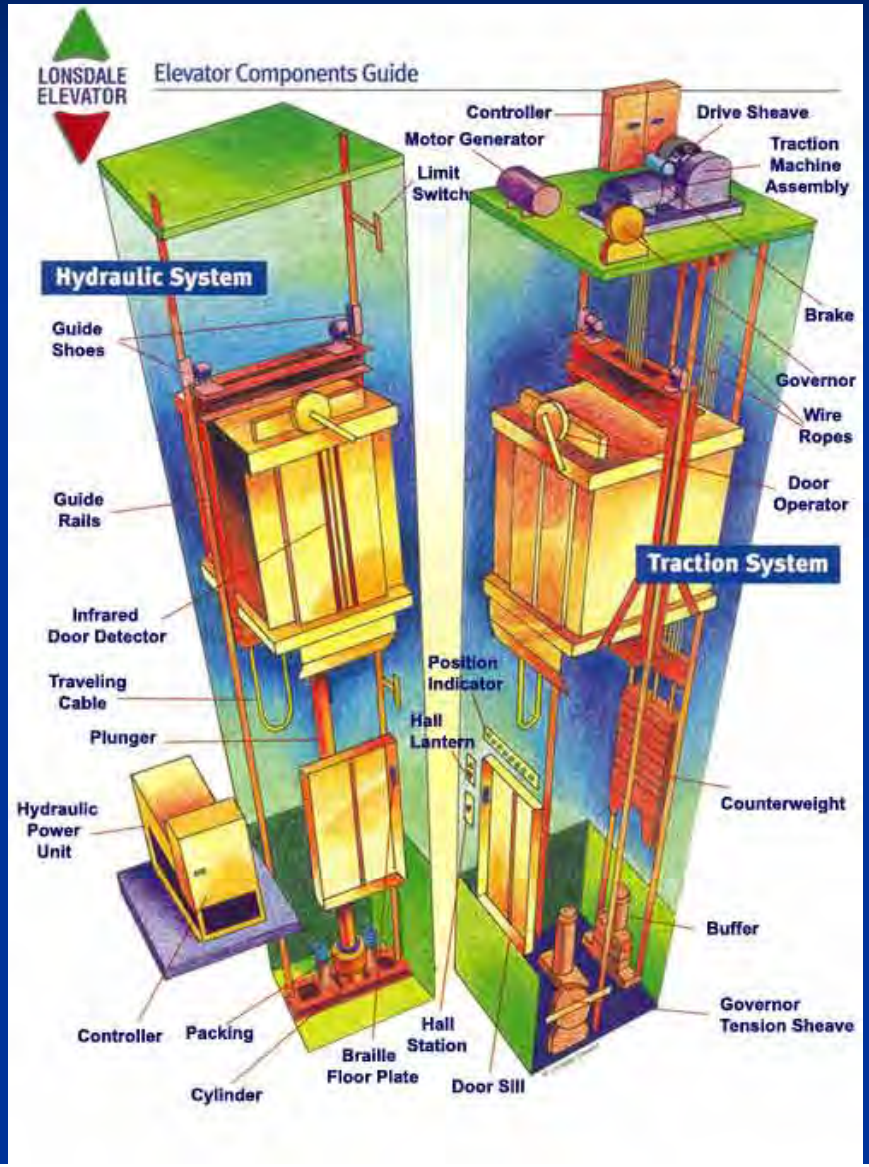
Summary

- Hydraulic systems
  - More energy needed to move
  - Cost effective in low-rise applications
  - Commonly used in 2 to 7 story buildings
- Conventional traction systems
  - Less energy needed than hydraulic
  - Better ride comfort than hydraulic
  - Commonly used in 4 to 30 story buildings
- Gearless, machine room-less technology
  - Save Space – Save $$
  - Less energy than conventional traction - environmentally friendly
  - Improved ride comfort over conventional traction
  - Commonly used in 4-story and above applications

Glossary

The remaining slides in this presentation contain a glossary of common elevator parts and terms

Glossary of Elevator Terms



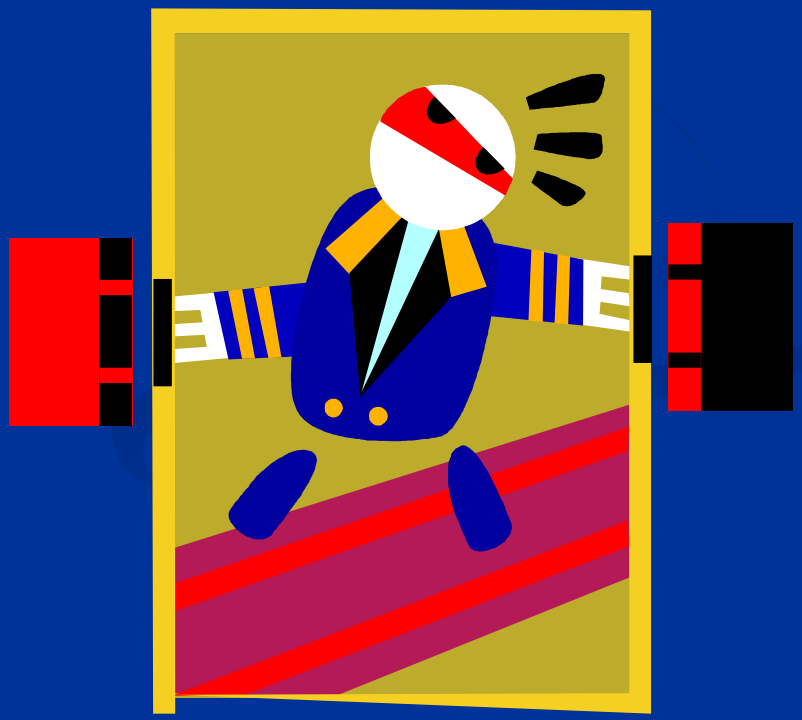
Glossary of Elevator Terms

- **Cable (Rope)** - Usually 4 to 6 in number, it is used to support the car and (passing over the drive sheave to the counterweight) pull the car.
- **Car Counterweight** - A set of weights roped directly to the elevator car of a winding-drum type installation. In practice, this weight is equal to approximately 70 percent of the car weight.
- **Car Operating Panel/Station** - A panel mounted in the car containing the car operating controls, such as call register buttons, door open and close, alarm, emergency stop and whatever other buttons or key switches are required for operating.

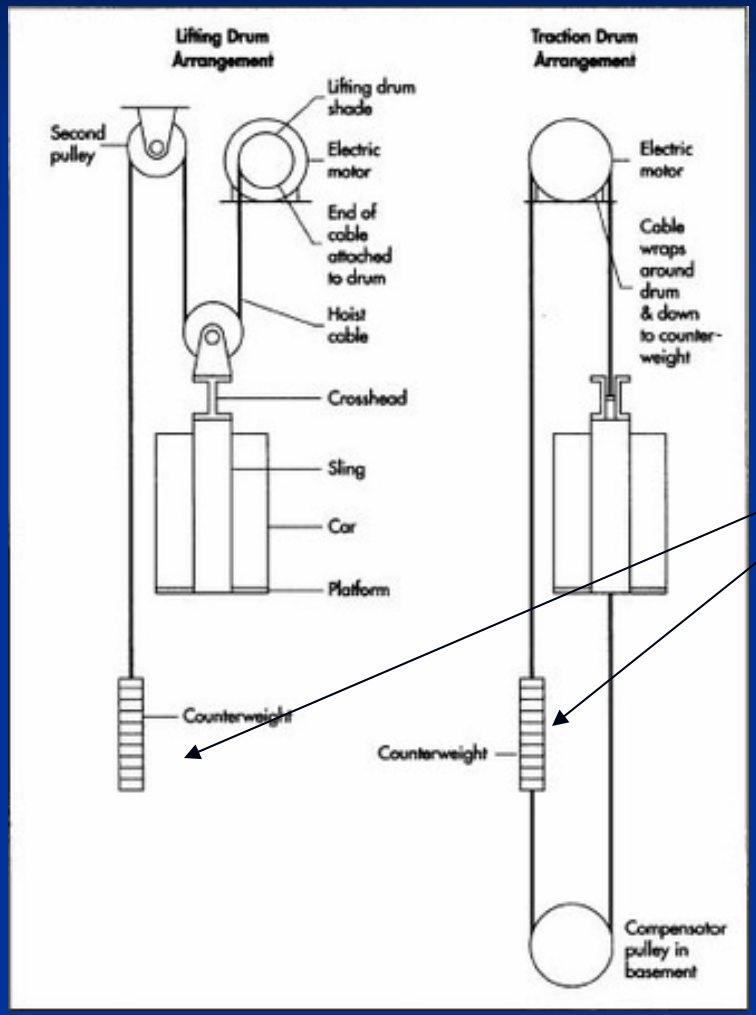
Glossary of Elevator Terms

- **Clutch** - A device used in elevator power door operation to engage the car door to the landing door by a grasping and holding movement.

- **Compensating Chain** - A welded-link chain used for hoist rope weight compensation.
  One end of the chain is attached to the underside of the elevator car, and the other end is fastened to the counterweight or stationary fastening in the hoistway.



Glossary of Elevator Terms



- **Compounding Sheave** - A pulley located on the car, and on the counterweight, under which the hoist cables run to double the capacity and reduce the speed of an elevator.
- **Counterweight** - A weight which counterbalances the weight of an elevator car plus approximately 40% of the capacity load.
- **Cylinder** - The outermost lining of a hydraulic jack.

Glossary of Elevator Terms

- **Door Gibs** - Devices at the bottom of horizontal sliding door panels, which stick into sill grooves and eliminate door panels swinging in or out.

- **Door Hanger** - A rolling assembly fastened to the top of a door panel which supports and allows horizontal sliding movement of the door panel. The door track on which the hanger rolls is part of the door hanger assembly.

Glossary of Elevator Terms

- **Door Protective Device** - Any type of device used with automatic power operated doors that detects obstructions to the normal closing of the elevator doors and either causes the doors to reopen or go into some other mode of operation, such as nudging. A safe edge, a safety astragal, a photoelectric device (safe ray), and electrostatic field device are examples of door protective devices.
- **Door Sill** - The threshold of a door opening with grooves to guide the bottom of the car door.

Glossary of Elevator Terms

- **Governor** - (1) A mechanical speed control mechanism. For elevator, it is a wire rope driven centrifugal device used to stop and hold the movement of its driving rope. This initiates the activation of the car safety device. It opens a switch, which cuts off power to the drive motor and brake if the car travels at a preset overspeed in the down direction. Some types of governors will also open the governor switch and cut off power to the drive motor and brake if the car overspeeds in the up direction. (2)

Glossary of Elevator Terms

- **Guide Rails** - Steel T-, round, or formed sections with guiding surfaces installed vertically in a hoistway to guide and direct the course of travel of an elevator car and elevator counterweights.
- **Guide Shoes** - (1) Devices used mainly to guide the car and counterweight along the path of the guide rails. They also assure that the lateral motion of the car and counterweight is kept at a minimum as they travel along the guide rails. (2) Guiding projections mounted on the bottom edge of horizontally sliding doors or gates, or on the sides of vertically sliding doors or gates to guide them.

Glossary of Elevator Terms

- **Hoistway** - The space enclosed by fireproof walls and elevator doors for the travel of one or more elevators, dumbwaiters or material lifts. It includes the pit and terminates at the underside of the overhead machinery space floor or grating, or at the underside of the roof where the hoistway does not penetrate the roof. (Hoistway is sometimes called "hatchway" or "hatch".)
- **Oil Buffer** - One type of buffer (for elevators with speeds of more than 200 feet per minute), which uses a combination of oil and spring to cushion the elevator. It is located in the elevator pit.

Glossary of Elevator Terms

- **Pickup Rollers** - Devices on the hoistway door which mate with the clutch on the car door to allow the hoistway doors to be pulled open and closed.
- **Platform** - The entire floor assembly of an elevator on which passengers stand or the load is carried.
- **Roller Guides** - Guide shoes which use rollers that rotate on guide rails rather than sliding on the rails.
- **Safety** - A large clamp that anchors the car to the building to keep the elevator from falling.

Glossary of Elevator Terms

- **Shackle** - Threaded rods to which the hoist cables are socketed and which bolt to the hitch plate and the counterweight.
- **Sling** - The basic structural frame, which consists of two stiles, a crosshead and a bolster or safety plant, which supports the platform and cab of an elevator.
- **Spring Buffer** - One type of buffer, for elevators with speeds less then 200 feet per minute, which cushions the elevator. It is located in the elevator pit.

Glossary of Elevator Terms

- **Strike Column** - Column located inside the car, which extends the full height of the elevator door opening. This is the column against which the sliding door closes.

- **Traveling Cable** - A cable made up of electric conductors, which provides electrical connection between an elevator or dumbwaiter car, or material lift, and a fixed outlet in the hoistway or machine room.