ELEVATOR 101

• ALMOST EVERYTHING YOU NEED TO KNOW ABOUT ELEVATORS AND ESCALATORS AND THE FUTURE OF THE VERTICAL TRANSPORTATION INDUSTRY
– Elevator History

– Conventional elevator technology

– Technological advances

– MRL cost & space savings, and sustainability benefits

– Future trends
Early Elevators
Early Elevators
Elisha Otis Demonstrates his “Safe” Freight/Passenger Elevator in 1853
The High-rise Building is Born
The first moving stairway; the escalator was actually a ride
In 1891, Jesse Reno patented a moving stairway – actually a moving ramp – that was known as the "inclined elevator." In 1896, Reno installed his version of an escalator at the Old Iron Pier at Coney Island. The amusement park ride, which transported riders on a conveyor belt built at a 25-degree angle, was considered a novelty by the 75,000 people who rode it during its two-week Coney Island exhibition. The Otis Elevator Company bought the patent, and ultimately merged two separate designs to create the escalator that is commonly used today.
Early Escalators
Modern Escalators
Early “Modern” Elevator Machines
Early Elevator Machines
CURRENT ELEVATOR TECHNOLOGY
Elevator Technology

Hydraulic Applications

Three configurations:

1) Direct Plunger
   - Holed

2) Roped Plunger
   - Roped
   - Under slung

3) Holeless

Direct Plunger
Roped
Twin Jack Holeless
Elevator Technology

Traction Applications

Traction configurations:
1) Overhead
2) Basement
3) Underslung

Overhead Application
Basement Application 1:1 Roping
Underslung Application 2:1 Roping
Gearless Elevator Machine
Elevator Technology

Advantages
• Costs less to install
• Shorter lead times
• No reactions at the top of the structure

Drawbacks
• Higher noise level
• Slow speeds
• High energy consumption
• Environmental concerns
Elevator Technology

Advantages
• Higher speeds
• Greater rise
• Smoother ride quality

Drawbacks
• Higher installation cost
• Longer lead times
• Significant load on top of structure
• Penthouse requirements
• Critical path
Elevator Technology: 1996 – Today

- **Hydraulic Elevators**
- **Gearless Traction Elevators**
- **Geared Traction Elevators**
- **Machine Room-Less Elevators**

The diagram compares different elevator technologies with their respective vertical ranges:
- **Holeless**
- **Roped**
- **Holed**
- **Gearless MRL**
- **Gearead**
- **Gearless**
Permanent Magnet Synchronous Motor (PMSM)

- Reduces motor size & weight
- Saves significant energy
- Reduces building’s carbon footprint
- Eliminates traditional machine room
- Eliminates hydraulic oil
- Simplifies installation
- Sustainable ownership
Elevator Technology

- **AC Gearless PMSM Technology**
  - +93% efficient
  - 50-70% less energy than traditional traction or hydraulic machine technology
  - 6.7 hp vs. 40-60 hp

- **Reduced Starting Current Demand**
  - 30-40% less energy than traditional hydraulic or traction
Elevator Technology

PMSM Technology enabled Machine Room-Less (MRL) elevators

- Money saved by eliminating a machine room can be used to build additional rental space
- Give architects more creative freedom of design
Eliminating Oil

Elevator Technology

- Oil in traditional elevator technology
  - Lubricate machine
  - Hydraulic motion

- The average hydraulic elevator uses approximately 300 gallons of oil over its lifetime.

Direct Plunger  
Basement Application  
Underslung Type

1:1 Roping  
2:4 Roping

* Based on a 3-landing in-ground, 20’ of travel
Elevator Technology

- Buildings account for 40% of the world’s energy consumption
- Elevators account for 2-10% of the total building’s energy consumption
- Over a lifetime of a new elevator the energy savings can amount to more than the initial cost of the equipment
- In high traffic applications, up to 30% of energy consumed can be recovered through regenerative systems
- In low traffic applications, the energy used while sitting idle (standby energy) can amount up to 70-80% of the total energy consumed
Elevator Technology

Architects are increasingly turning to MRL’s as hydraulic elevators continue to disappear.

- Saves energy
- Saves space
- Eliminate hydraulic oil
- Simplifies installation
- Sustainable ownership
Today and Tomorrow’s Escalators
Technology Advances

Elevator Technology

- Regeneration
- Sleeping Elevators
- Solar Powered Elevators
“Anytime you can put in a traction product in place of a hydraulic...that’s a no brainer! We foresee in the coming year (and that’s not too far off!), that machine room-less will replace hydraulics.”

-David Mirch, Elevator Consultant, President of DMT, LLC