BUILDING TRANSPORTATION SYSTEM

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PREFACE

The transportation system within a building is a critical aspect of modern architectural and engineering design. This e-book delves into the intricacies of building transportation systems, including elevators, escalators, moving walkways, and automated transit systems. As urbanization intensifies and buildings grow taller and more complex, the demand for efficient and reliable vertical and horizontal transportation becomes paramount. Our aim is to provide a comprehensive overview of the principles, technologies, and best practices that underpin these systems. We explore the evolution of building transportation, current innovations, and future trends, emphasizing the importance of sustainability, energy efficiency, and user comfort. This book serves as a valuable resource for students, professionals, and researchers in civil engineering, architecture, and building services engineering, offering insights and practical knowledge to design and manage effective transportation systems in buildings.

Redzuan Safri Bin Abdul Rahman
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ABSTRACT

Building transportation systems, comprising lifts, escalators, and moving walkways, are vital for efficient movement in multi-story buildings. Elevators, equipped with cabins, hoistways, and counterweights, enable vertical transport, while energy-efficient motors and regenerative braking systems enhance performance and sustainability. Escalators and moving walkways facilitate continuous movement along inclined or horizontal paths, featuring components like steps, chains, motors, and handrails. Safety measures are paramount, with elevators including emergency brakes, overload sensors, and communication systems, and escalators incorporating automatic stop functions, emergency stop buttons, and anti-slip surfaces.

Technological advancements have improved the reliability and efficiency of these systems, while sustainable designs and materials help reduce environmental impact. Building transportation systems are integral to modern architecture, enhancing accessibility, reducing travel time, and improving user convenience. This abstract highlights the components, safety measures, and importance of building transportation systems, emphasizing their role in meeting the demands of contemporary buildings through innovation and adherence to safety standards.

Keywords: building transportation systems, lifts, escalators, moving walkways, vertical transport, energy-efficient, safety measures, regular maintenance, technological advancements, sustainability.

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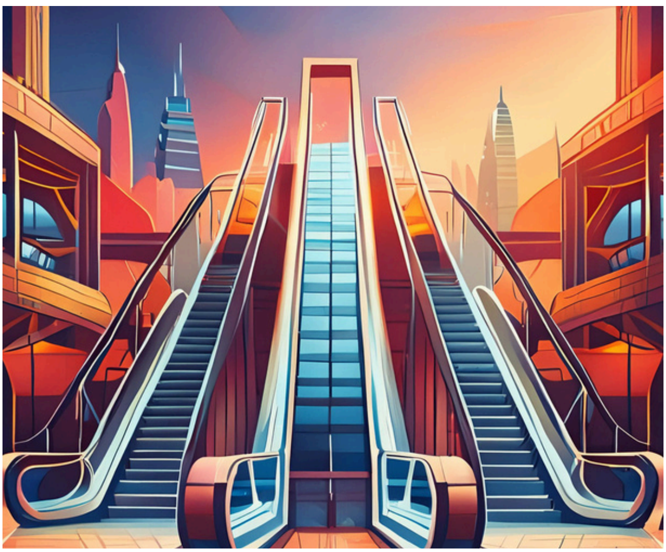
Chapter 1

Introduction to Building Transportation Systems



Introduction

Building transportation systems play a pivotal role in modern architecture and urban planning, facilitating vertical movement within buildings and structures. From residential skyscrapers to bustling commercial complexes, the efficiency, safety, and design of these systems significantly impact user experience and operational functionality. This chapter introduces the fundamental concepts and importance of building transportation systems, laying the foundation for understanding their complexities and considerations in contemporary construction.

Importance of Building Transportation Systems

Vertical transportation systems, primarily comprised of elevators and lifts, are essential for:

- Accessibility: Providing seamless access to different floors for people of all abilities, ensuring inclusivity within built environments.
- Efficiency: Streamlining movement and reducing congestion, especially in high-rise buildings where foot traffic can be substantial.
- Safety: Incorporating robust safety features to mitigate risks and ensure rapid evacuation during emergencies.
- Design Integration: Enhancing architectural aesthetics while maintaining functionality and usability.

Evolution of Elevator Technology

The history of building transportation systems traces back to ancient civilizations' rudimentary lifts powered by human or animal labor. However, the Industrial Revolution marked a significant leap forward with the introduction of steam-powered and later electric elevators. Since then, advancements in materials, control systems, and safety protocols have revolutionized vertical transportation.

Today, building transportation systems encompass a diverse range of technologies and designs, catering to various architectural and operational needs. From high-speed elevators in skyscrapers to specialized lifts for specific purposes like freight or accessibility, the evolution continues to drive innovation in urban development.

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Chapter 2

Principles of Designing Transportation Systems

Introduction

Designing efficient and effective transportation systems within buildings involves several key principles that ensure optimal performance, safety, accessibility, and user experience. These principles guide architects, engineers, and designers in creating vertical transportation solutions that seamlessly integrate with building architecture and meet the diverse needs of occupants. Here are the fundamental principles:

1) Traffic Analysis and Flow

- Understanding Traffic Patterns: Conduct thorough analysis to determine peak traffic times, destination preferences, and user demographics within the building.
- Zoning and Grouping: Group elevators/lifts based on traffic flow patterns and building zones (e.g., residential, office, retail) to minimize wait times and enhance efficiency.

2. Accessibility and Inclusivity

- Compliance with Regulations: Ensure adherence to accessibility standards such as ADA (Americans with Disabilities Act) to accommodate individuals with diverse mobility needs.
- Strategic Placement: Locate elevators/lifts centrally and near main entrances to provide equitable access for all users

3). Safety and Emergency Preparedness

- Fire Safety: Incorporate fire-rated materials, smoke detection systems, and emergency communication devices to ensure safe evacuation during emergencies.
- Emergency Procedures: Design systems that facilitate quick response and evacuation, including emergency power backup and clear evacuation routes.

4). Technological Integration

- Destination Control Systems: Implement advanced destination dispatching systems to optimize elevator/lift allocation based on user destinations, reducing wait times and energy consumption.
- Smart Technologies: Integrate IoT (Internet of Things) sensors for real-time monitoring, predictive maintenance, and performance optimization of transportation systems.

5). Architectural Harmony

- Aesthetic Integration: Design elevators/lifts to complement building aesthetics, using materials and finishes that blend with interior design themes.
- Spatial Planning: Ensure sufficient space for elevator equipment rooms, waiting areas, and circulation paths without compromising building aesthetics or functionality.

6). Operational Efficiency

- Energy Efficiency: Select energy-efficient elevator/lift systems and components to reduce operational costs and environmental impact.
- Maintenance Accessibility: Provide easy access for maintenance personnel to conduct routine inspections, repairs, and upgrades, ensuring minimal downtime and optimal performance.

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7). User Experience

- Comfort and Convenience: Design ergonomic cabin layouts, intuitive control interfaces, and comfortable waiting areas to enhance user experience and satisfaction.
- Wayfinding and Signage: Implement clear signage and wayfinding elements to guide users to elevators/lifts efficiently and inform them of floor destinations.

8). Future-Proofing and Adaptability

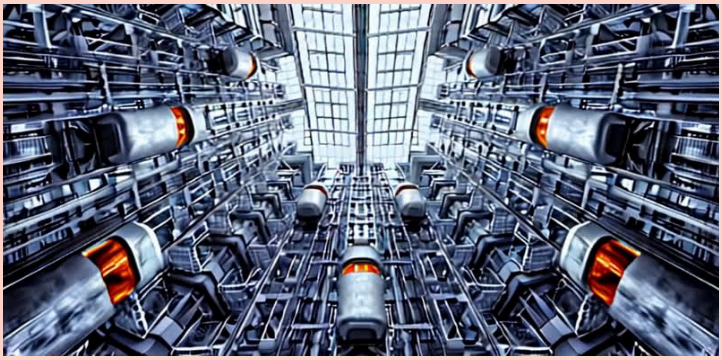
- Scalability: Plan for future growth and changes in building use by designing transportation systems that can accommodate increased traffic and technological advancements.
- Flexibility: Incorporate modular components and adaptable designs that allow for easy upgrades and modifications as building needs evolve.

9). Sustainability

- Green Design Practices: Integrate sustainable materials, energy-efficient systems, and eco-friendly technologies to minimize environmental impact and achieve green building certifications.
- Lifecycle Analysis: Consider the lifecycle costs and environmental footprint of transportation systems from design through operation and maintenance phases.
-

Conclusion

By adhering to these principles of designing transportation systems, stakeholders can create innovative, safe, and efficient vertical transportation solutions that enhance the overall functionality and user experience within buildings. Each principle contributes to a holistic approach that balances technological advancements, regulatory compliance, sustainability goals, and user-centric design to meet the evolving needs of modern urban environments.



QUIZ ACTIVITY 1

ANSWERS ALL QUESTION IN GOOGLE FORM

GOOGLE FORM LINK

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Chapter 3

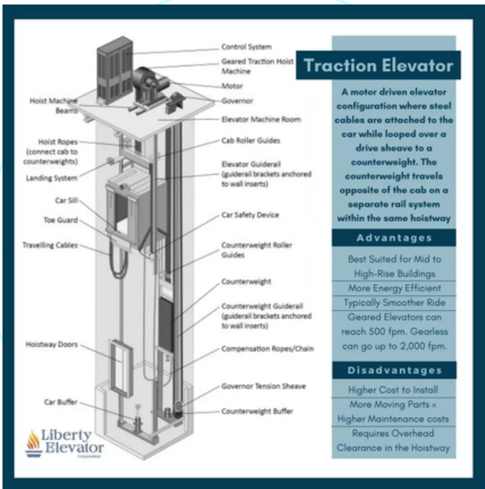
Types of Elevators and Lifts

3.0 TYPES OF ELEVATORS AND LIFTS

Elevators and lifts come in various types, each designed to meet specific architectural, functional, and operational requirements within buildings. Understanding these types helps architects, engineers, and building owners choose the most suitable vertical transportation solution based on factors such as building height, traffic flow, and user needs. Here are the main types of elevators and lifts commonly used in modern buildings:

1. Traction Elevators

- Description: Traction elevators operate using steel ropes or belts attached to a counterweight and driven by an electric motor. They are the most common type of elevator used in mid to high-rise buildings.
- Advantages:
  - Efficient for tall buildings.
  - Smooth and quiet operation.
  - Energy-efficient with regenerative braking systems.
- Applications: Skyscrapers, office buildings, residential towers.



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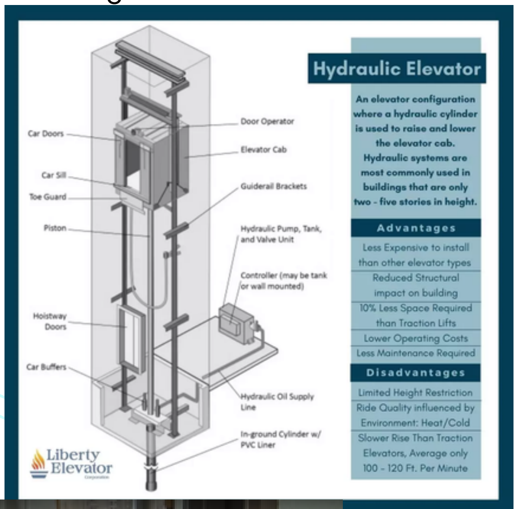
3.0 TYPES OF ELEVATORS AND LIFTS

2. Hydraulic Elevators

- Description: Hydraulic elevators use a hydraulic piston to lift the elevator car. They are typically slower than traction elevators but are suitable for low to mid-rise buildings where space for a machine room is limited.
- Advantages:
    - Cost-effective for low-rise buildings.
    - Require less overhead space.
    - Smoother ride compared to older models.
- Applications: Low-rise buildings, private residences, small commercial buildings.



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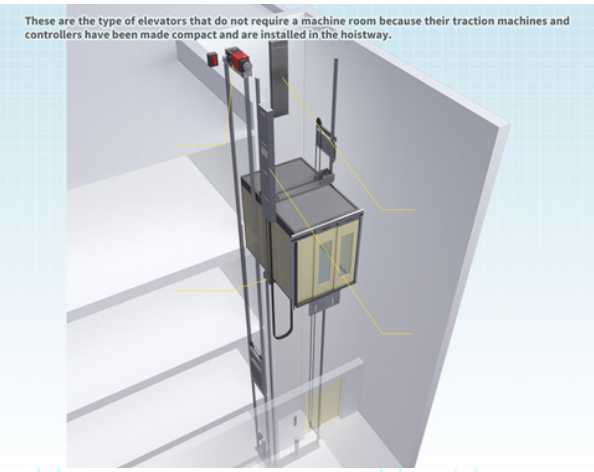
3.0 TYPES OF ELEVATORS AND LIFTS

3. Machine-Room-Less (MRL) Elevators

- Description: MRL elevators integrate the elevator machinery into the hoistway, eliminating the need for a separate machine room. They utilize compact gearless or gear traction systems.
- Advantages:
  - Space-saving design.
  - Lower installation and maintenance costs.
  - Energy-efficient operation.
- Applications: Residential buildings, hotels, mid-rise office buildings.



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3.0 TYPES OF ELEVATORS AND LIFTS

4. Scenic Elevators

- Description: Scenic elevators are designed with glass walls and provide panoramic views of the surrounding environment. They enhance aesthetic appeal and user experience by offering a unique perspective during vertical travel.
- Advantages:
  - Enhances architectural aesthetics.
  - Attracts users seeking scenic views.
  - Can be customized for themed environments.
- Applications: Tourist attractions, hotels, commercial centers with scenic views.

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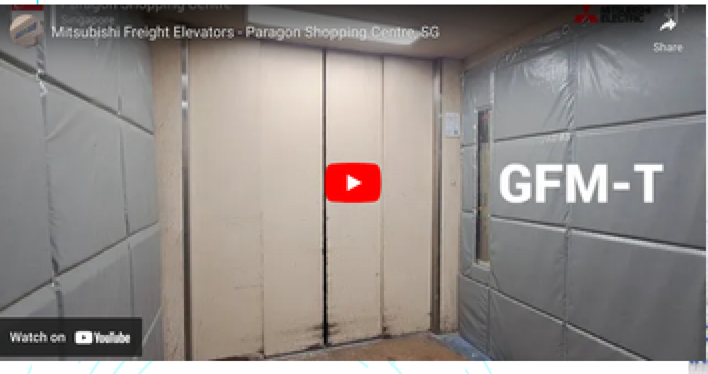
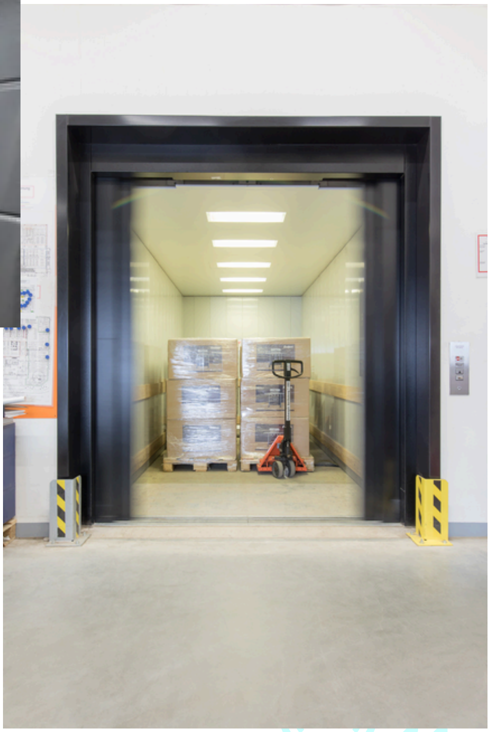
3.0 TYPES OF ELEVATORS AND LIFTS

5. Freight Elevators

- Description: Freight elevators are specifically designed to transport goods and materials rather than passengers. They feature robust construction and higher weight capacities to accommodate heavy loads.
- Advantages:
  - Heavy-duty performance.
  - Designed for frequent loading and unloading.
  - Enhanced safety features for cargo transport.
- Applications: Warehouses, industrial facilities, retail stores, hospitals.





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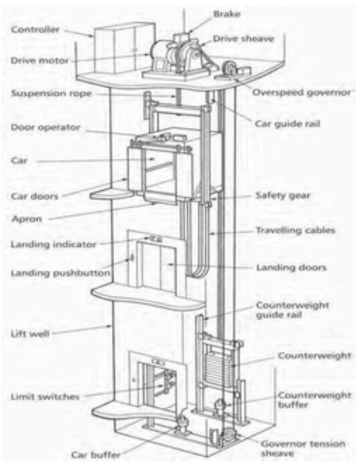
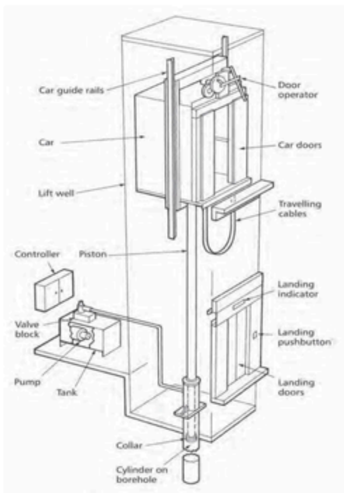
3.0 TYPES OF ELEVATORS AND LIFTS

Difference between **Traction & Hydraulic lifts**
(overview)

Traction (Machine)	Hydraulic
•lifted by ropes, which pass over a wheel attached to an electric motor above the elevator shaft.	•supported by a piston at the bottom of the elevator that pushes the elevator up as an electric motor forces oil or another hydraulic fluid into the piston.
•used for mid and high-rise applications. •Much higher travel speed than hydraulic.	•used for low-rise applications of 2-8 stories.
•*Principle* : see - saw	•*Principle* : Pascal's pressure principle
•*Components* : control system, sheave, motor, counterweight, guiding rail.	•*Components* : tank, motor, valve, actuator.
•The machine room is located at the upper most level, i.e., on the terrace.	•The machine room is located at the lowest level adjacent to the elevator shaft.



General arrangement of an electric traction passenger lift



General arrangement of a hydraulic passenger lift

Chapter 4

Location And Arrangement of Elavators

LOCATION AND ARRANGEMENT OF ELAVATORS

The strategic placement and arrangement of elevators/lifts within a building significantly impact functionality, efficiency, safety, and user experience. Architects and designers must carefully consider several factors to optimize vertical transportation systems effectively. Here’s a comprehensive guide to the location and arrangement of elevators/lifts:

1. Traffic Flow Analysis

- Understanding Peak Times: Analyze building usage patterns to identify peak times and traffic flows.
- Destination Analysis: Determine the most common destinations and travel routes within the building.
- User Demographics: Consider the diverse needs of occupants, including visitors, residents, and employees.

2. Strategic Placement

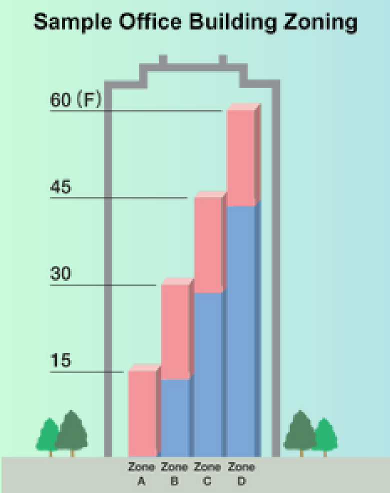
- Centralized Location: Position elevators/lifts centrally to minimize walking distances and serve as a focal point for easy navigation.
- Proximity to Main Entrances: Locate elevators/lifts near main entrances for convenient access and visibility.
- Traffic Separation: Separate elevator/lift banks for different building zones or functions (e.g., residential, office, retail) to optimize traffic flow.

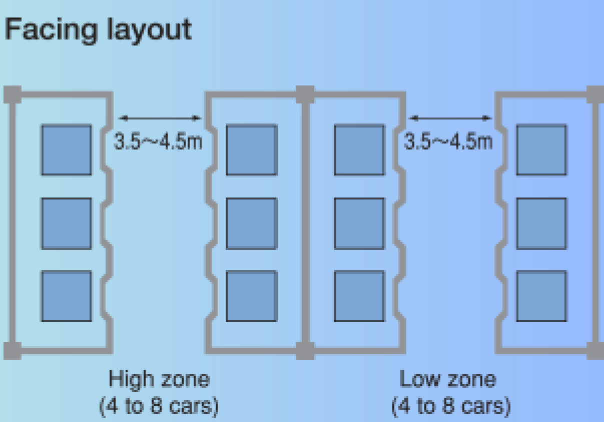
3. Grouping and Zoning

Grouping and zoning the location and arrangement of elevators or lifts in a building is crucial for efficient traffic handling and user convenience. Here are some key considerations and strategies for effective grouping and zoning:

Considerations for Grouping and Zoning:

- Traffic Analysis: Understand the building's traffic patterns, including peak usage times, floors with high traffic (e.g., ground floor, office floors), and any specific user needs (e.g., accessibility requirements).
- Building Size and Layout: Consider the size and layout of the building, including the number of floors, floor area, and the distribution of different functions (e.g., residential, commercial).
- User Profile: Know the building occupants' profiles (e.g., office workers, residents, visitors) to tailor elevator grouping to their specific needs.
- Speed and Capacity: Elevator speed and capacity influence grouping decisions. High-speed elevators might serve different purposes than slower ones, impacting zoning strategies.
- Emergency Access: Ensure appropriate zoning for emergency access and egress, complying with safety regulations.





4. Accessibility and Inclusivity

Ensuring accessibility and inclusivity in the location and arrangement of elevators/lifts is crucial for accommodating individuals with disabilities and elderly users. Here are key considerations and strategies to achieve accessibility and inclusivity:

- Regulatory Requirements: Familiarize yourself with local accessibility codes and regulations (e.g., SIRIM, JKR, Local authority or NIOSH) to ensure compliance in elevator design and placement.
- Universal Design Principles: Apply universal design principles to make elevators usable by the widest range of people possible, regardless of age, size, ability, or disability.
- User Input: Consult with disability advocates, accessibility experts, and potential users with disabilities to understand their needs and preferences.
- Location Proximity: Place elevators in central and easily accessible locations within the building, minimizing walking distances and obstacles.
- Clear Signage and Wayfinding: Ensure clear and visible signage directing users to elevators, especially from entrances and public areas. Use tactile signage for visually impaired users.
- Size and Interior Design: Design elevators with sufficient size to accommodate mobility aids such as wheelchairs, and ensure interiors have contrasting colors and adequate lighting for users with low vision.
- Emergency Features: Equip elevators with emergency communication devices accessible to all users, including those with hearing impairments or cognitive disabilities.

5. Emergency Procedures and Evacuation

Ensuring safety and effective emergency preparedness in the location and arrangement of elevators/lifts is critical to protect building occupants and facilitate swift response during emergencies. Here are key considerations and strategies to enhance safety and emergency preparedness:

Considerations for Safety and Emergency Preparedness:

1. Compliance with Regulations: Adhere to local building codes and safety regulations related to elevator installation, maintenance, and emergency procedures.
2. Emergency Power Supply: Ensure elevators are equipped with emergency power systems (e.g., generators or battery backups) to maintain operation during power outages, enabling safe evacuation.
3. Fire Safety Integration: Coordinate elevator design and placement with the building's fire safety systems to prevent fire spread and facilitate firefighter access.
4. Accessibility in Emergencies: Designate specific elevators as evacuation elevators or include features like fire-rated elevator lobbies to ensure safe evacuation routes for all building occupants, including those with disabilities.
5. Emergency Communication: Install reliable two-way communication devices in elevators (e.g., intercoms or emergency phones) to allow occupants to communicate with building management or emergency responders.
6. Emergency Procedures and Training: Develop and communicate clear emergency procedures for elevator use during fires, earthquakes, power failures, and other emergencies. Conduct regular training sessions for building staff and occupants on these procedures.
7. Seismic Considerations: In earthquake-prone regions, ensure elevators are seismically designed to withstand tremors and have appropriate emergency shutdown mechanisms.

6. Accessibility During Emergencies

- Priority Access: Designate elevators/lifts for priority use by emergency responders, individuals with disabilities, and elderly occupants during evacuations.
- Emergency Signage: Install clear signage indicating emergency evacuation routes, elevator/lift locations, and instructions for occupants during emergencies.

7. Maintenance and Inspections

- Routine Maintenance: Implement a regular maintenance schedule and inspections for elevators/lifts to ensure optimal performance and identify potential safety hazards.
- Emergency Maintenance Protocols: Establish protocols for immediate response to elevator/lift malfunctions or failures during normal operations and emergencies.

8. Technological Advancements

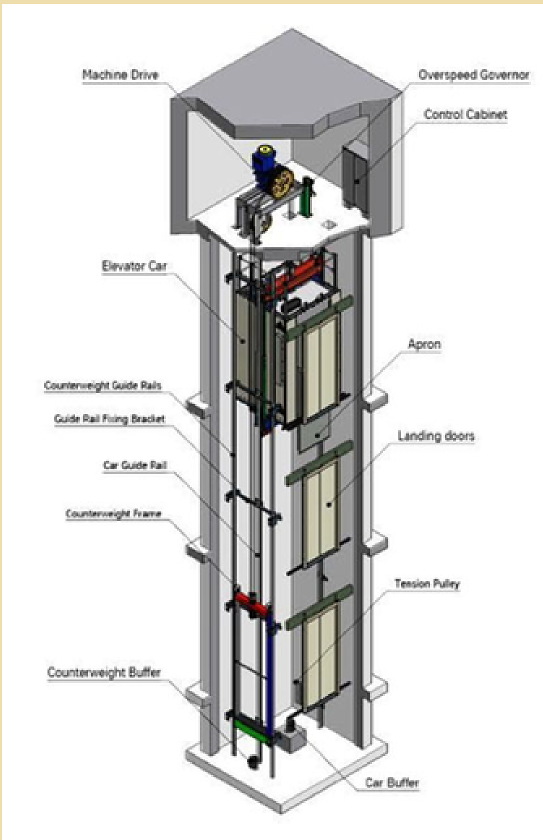
- Smart Technologies: Integrate IoT (Internet of Things) sensors for real-time monitoring of elevator/lift status, predictive maintenance, and early detection of issues that could compromise safety.
- Remote Monitoring: Utilize remote monitoring systems to monitor elevator/lift performance and receive alerts for maintenance or emergency situations.

Conclusion

Safety and emergency preparedness are critical aspects of elevator and lift systems within buildings. By implementing robust design practices, adhering to safety standards, installing emergency communication systems, ensuring fire safety measures, providing emergency power backup, developing clear evacuation procedures, and conducting regular maintenance and training, stakeholders can enhance the safety and reliability of vertical transportation systems. These measures not only protect building occupants but also contribute to overall building resilience and readiness to handle emergencies effectively.

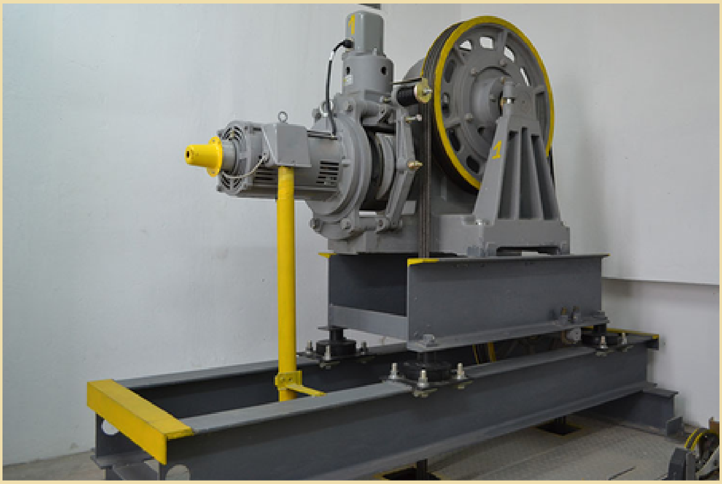
Chapter 5

Elayators Component/Equipment



Lift equipment refers to the various mechanical and electrical components that make up an elevator system, ensuring its safe and efficient operation. Here's an overview of the key lift equipment components:

1. **Hoisting Machinery:** This includes the motor, gearbox, and sheaves (pulleys) that move the elevator car by hoisting or lowering the ropes or cables attached to it. Modern elevators often use gearless traction machines that provide smoother operation and higher energy efficiency



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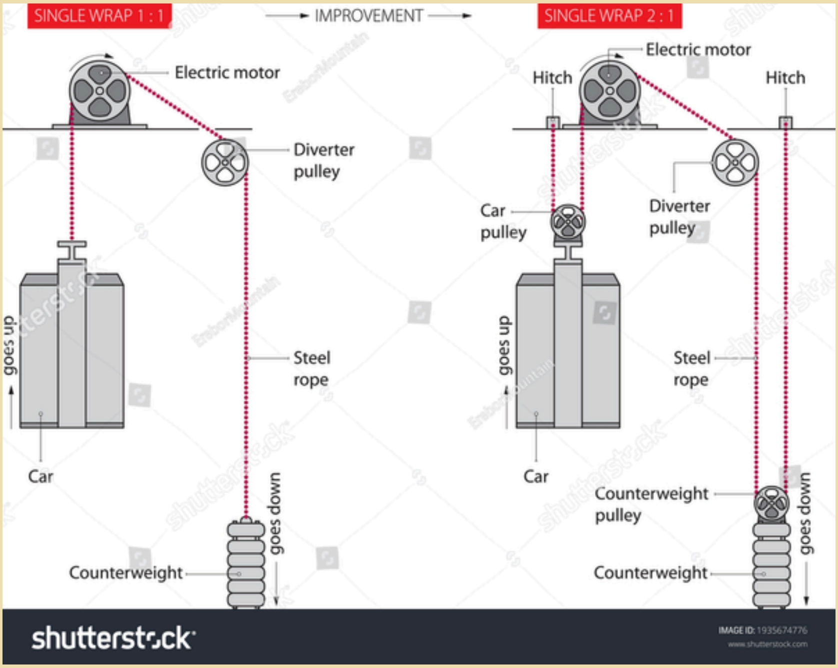
2. Counterweight: A counterweight balances the weight of the elevator car and its occupants, reducing the amount of energy needed to move the car up and down. It typically consists of a frame with concrete blocks or metal weights.



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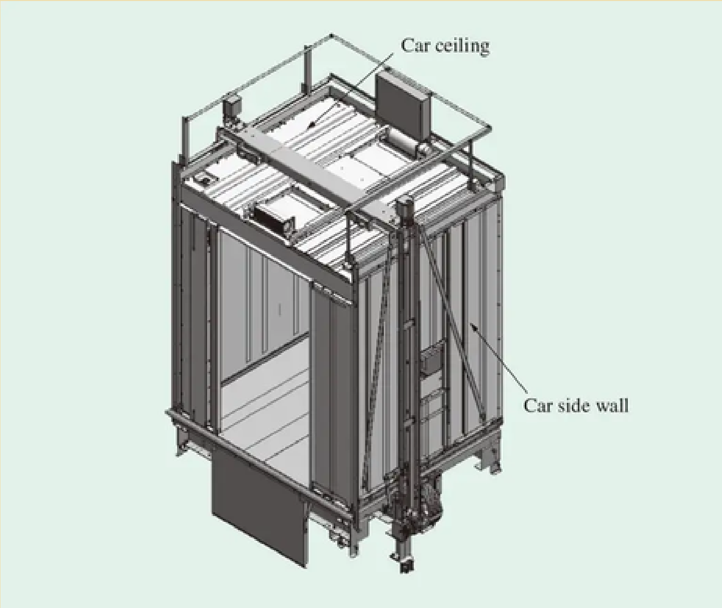
3.Elevator Car: The elevator car is the enclosed platform that transports passengers or goods between floors. It includes the car frame, walls, floor, ceiling, lighting, and operating panels (buttons or touchscreens) for users to select their desired floors.



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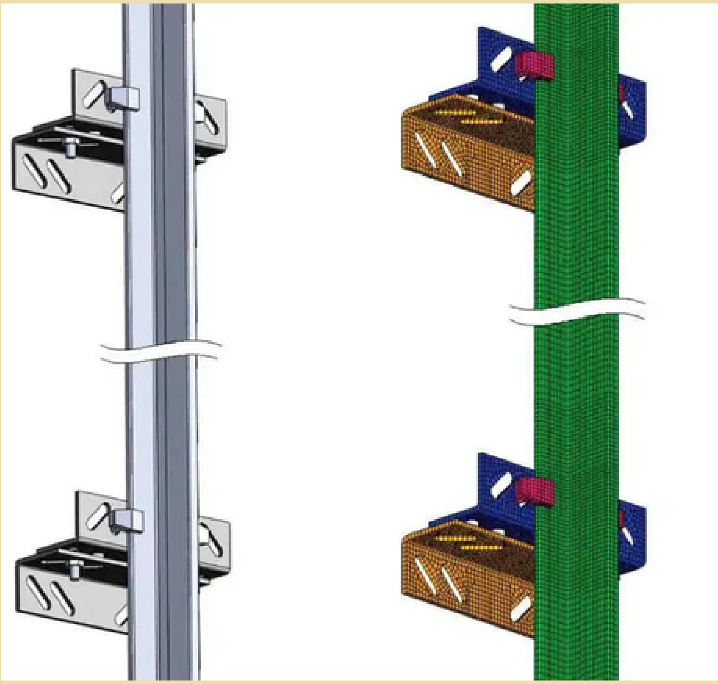
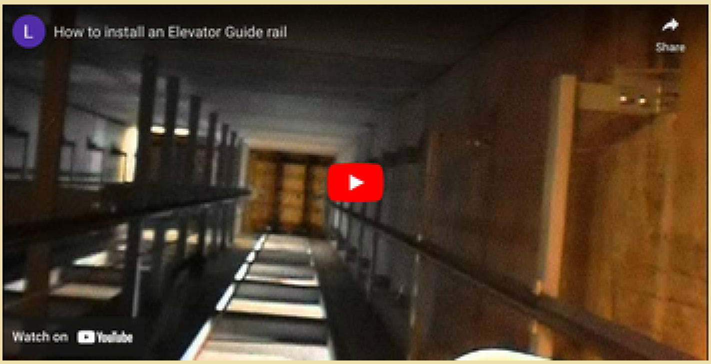
4. Guide Rails: Vertical guide rails are installed in the elevator shaft (hoistway) to guide the elevator car and ensure smooth and safe travel between floors. They help maintain the alignment of the car during movement





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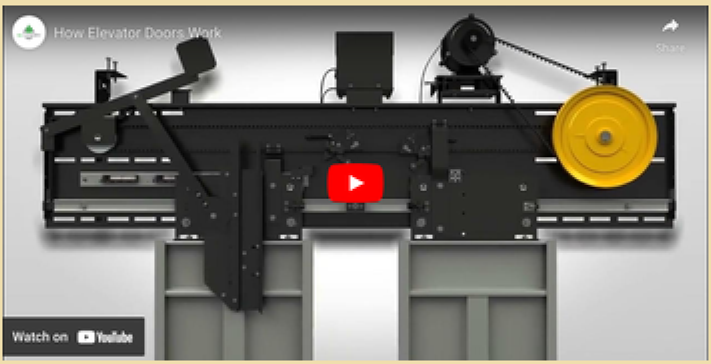
5. Elevator door system : Encompasses components such as the car door, floor door, door opener, door locking device, linkage mechanism, and more. The car door is positioned at the car's entrance, comprising the door itself and the door guide frame. Similarly, the floor door is situated at the entrance of each floor station. The door opener, located within the car, serves as the power source for both the car and the floor doors



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6. Elevator Control System: An elevator control system is an intricate mechanism designed to efficiently manage the movement of elevators in a building, ensuring the safe and timely transport of passengers and goods. This system can be quite complex, integrating various components and algorithms to handle multiple requests, optimize travel paths, and ensure safety. Here's a breakdown of the key components and functionality of a typical elevator control system:

Components of an Elevator Control System

1. Controllers:
    - Main Controller: Manages overall system operations, processes user inputs, and coordinates responses.
    - Car Controller: Each elevator car has its own controller to handle requests specific to that car.
2. Sensors:
    - Position Sensors: Detect the current position of the elevator.
    - Load Sensors: Measure the weight inside the elevator to prevent overloading.
    - Door Sensors: Ensure doors are open or closed correctly and safely.
3. Motors and Drives:
    - Responsible for moving the elevator up and down, as well as opening and closing doors.
4. User Interface:
    - Call Buttons: Located on each floor and inside the elevator car for users to request service.
    - Display Panels: Show information like current floor, direction of travel, and status messages.
5. Safety Systems:
    - Emergency Brakes: Activate in case of system failure to stop the elevator.
    - Alarm Systems: Allow passengers to signal for help in emergencies.

7. Elevator Safety System: An elevator safety system is a critical component designed to ensure the safety of passengers and the proper functioning of the elevator. This system includes various features and mechanisms to prevent accidents, respond to emergencies, and comply with safety standards. Here's an in-depth look at the components and functionality of an elevator safety system:

Key Components of an Elevator Safety System

E**mergency Brakes:**

- Safety Gear: Engages if the elevator moves too quickly, gripping the guide rails to stop the car.
- Overspeed Governor: Monitors the speed of the elevator. If the elevator exceeds a safe speed, it triggers the safety gear.

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Key Components of an Elevator Safety System

2. Buffer Systems:

- Installed at the bottom of the elevator shaft to absorb the impact if the elevator car descends too quickly or reaches the shaft bottom

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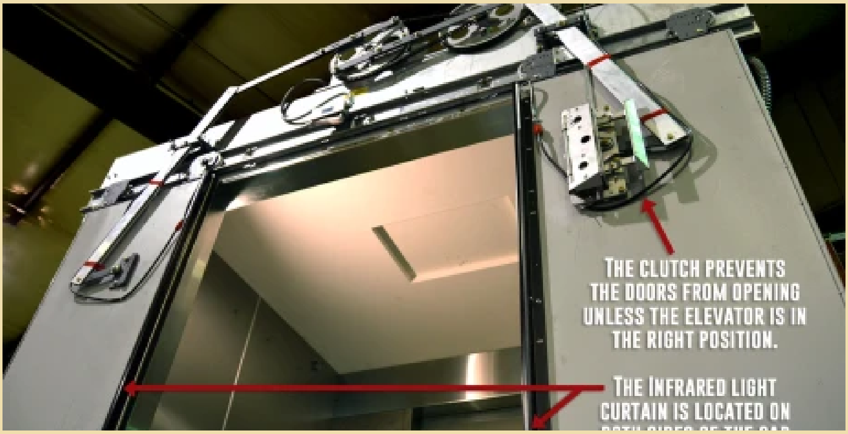
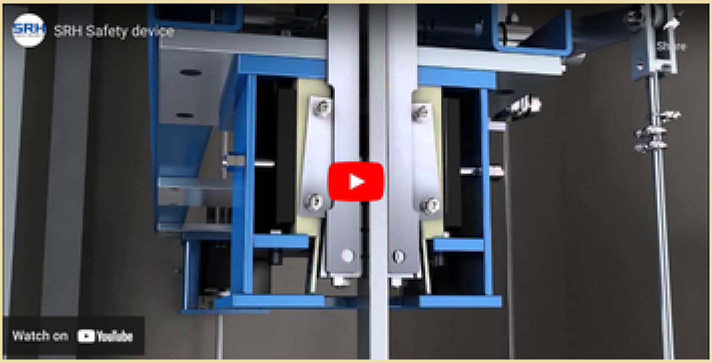
Key Components of an Elevator Safety System

3. Door Safety Devices:

- Interlocks: Prevent the elevator from moving if the doors are not fully closed and locked.
- Door Sensors: Detect obstacles in the door's path, preventing the doors from closing if something is detected.





Youtube Link

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Key Components of an Elevator Safety System

4. Load Weighing Devices:

- Measure the weight inside the elevator car to ensure it does not exceed the maximum capacity. If it does, the elevator will not move until the load is reduced.

5. Emergency Power Supply:

- Provides backup power to bring the elevator to the nearest floor and open the doors in case of a power failure.

6. Communication Systems:

- Alarm Buttons: Allow passengers to signal for help.
- Intercoms and Telephones: Enable communication with building security or emergency services.

7. Fire Emergency Systems:

- Fireman's Switch: Allows firefighters to take control of the elevators during a fire.
- Fire Detection Sensors: Automatically send the elevator to a designated floor and disable it to prevent use during a fire.

8. Control Systems:

- Microprocessor Control Units: Monitor and manage all safety features, ensuring they activate as needed.
- Monitoring Systems: Continuously check the status of the elevator and report issues.

An elevator safety system is an essential aspect of elevator design and operation, aimed at protecting passengers and ensuring the system operates reliably. These systems incorporate a range of mechanical, electrical, and electronic components, all working together to provide a safe and efficient vertical transportation solution. Regular maintenance, adherence to safety standards, and continuous monitoring are crucial to the effectiveness of these safety measures

QUIZ ACTIVITY 2

ANSWERS ALL QUESTION IN GOOGLE FORM

QUIZ 2 ACTIVITY

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* Indicates required question

1. Which type of elevator is typically used in low-rise buildings due to its lower cost and simpler installation? * 1 point

- Traction elevator
- Pneumatic elevator
- Hydraulic elevator
- Double-decker elevator

GOOGLE FORM LINK

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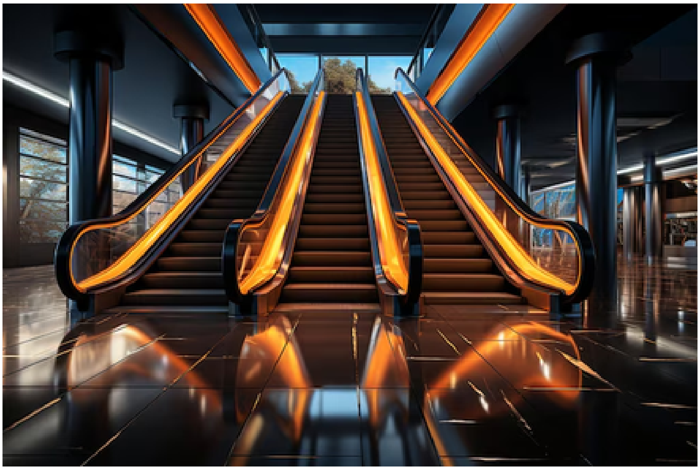
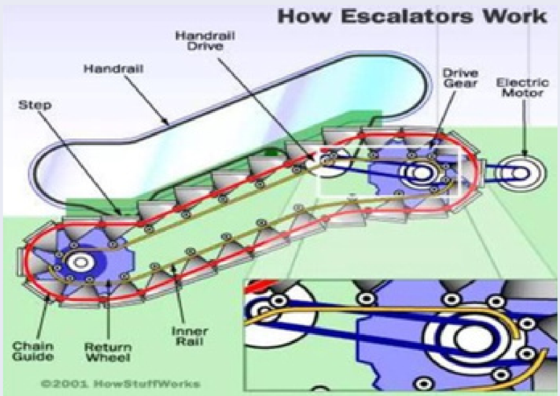
Chapter 6

Escalator System



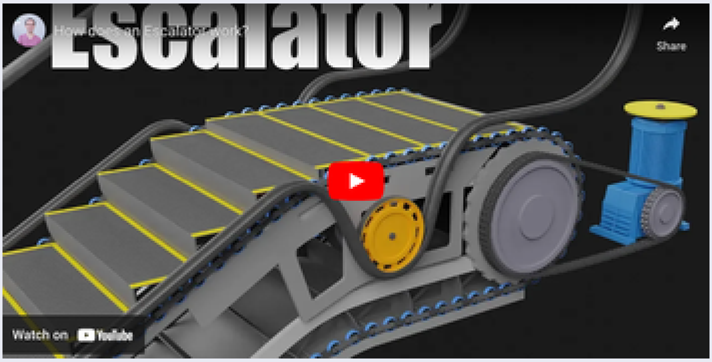
INTRODUCTION

An escalator is a conveyor transport device for transporting people, consisting of a staircase whose steps move up or down on tracks that keep the surfaces of the individual steps horizontal. Principal areas of usage include shopping centres, airports, transit systems, trade centres, hotels, and public buildings. Escalators are designed for both convenience and efficiency, allowing large numbers of people to move smoothly and quickly between floors without the need for physical exertion. They are commonly used in urban environments to facilitate the flow of pedestrian traffic, especially in areas with high foot traffic. The invention of the escalator is credited to Jesse W. Reno, who patented his design in 1892. However, it was Charles Seeberger who refined and popularized the modern escalator, introducing safety features like comb plates at the ends of the steps to prevent tripping and handrails for stability. Escalators are an integral part of modern infrastructure, offering a practical solution for vertical transportation within buildings and contributing to the efficiency of public spaces.



How does and escalator work?

An escalator is a continuously moving staircase. Each stair has a pair of wheels on each side, one at the front of the step and one at the rear. The wheels run on two rails. At the top and bottom of the escalator, the inner rail dips beneath the outer rail, so that the bottom of the stair flattens, making it easier for riders to get on and off.



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The requirements (persons per hour) of an escalator need to consider the following parameters:

- Type of building (offices, shopping centre, movie theatre, subway station, airport; one-way traffic, two-way traffic; single- or multi-purpose building).
- Peak traffic times (office opening and closing
- Population factor based on net usable area
- Customer turnover rate per floor in department stores
- Level of travelling comfort required on the unit (uncrowned, convenient, crowded)

The advantages of using escalators:

- Escalators are public transport facilities to move from one level to another level with fast and convenient, especially when there are many people who need to be transported.
- It is capable of transporting a load of 12,000 persons per hour.
- Degradation rate is low.
- Security rate is high with the various safety switches that act quickly to prevent serious accidents, especially in elderly and children.
- Escalators have the capacity to move large numbers of people.
- It can be placed in the same physical space as stairs would be.
- They have no waiting interval, except during very heavy traffic.

The disadvantages of using escalators:

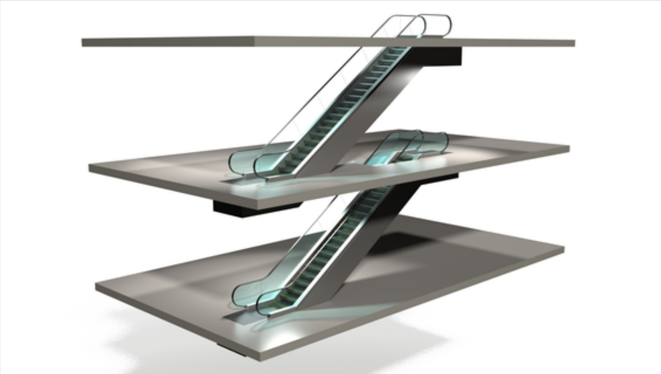
- The cost of an escalator is very high and the cost of maintenance and repair services and is also costly because it needs qualified specialist to repair.
- If there is any damage, it needs time to be improved and this would interfere with the internal circulation system of the building.
- Spare parts are an important factor because it is very expensive and must be obtained from abroad.
- It cannot operate in the event of power failure.
- There is still a minor accident such as tools or safety switch does not work as expected.

Arrangement of escalators

Escalators have five typical configuration options:

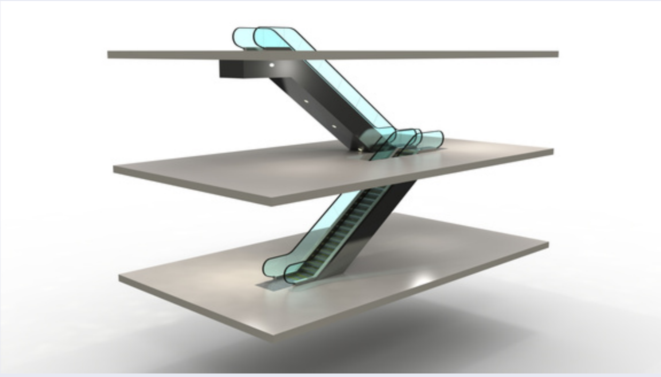
a. Single unit/A single escalator

The single unit is used to connect two levels. It is suitable for buildings with passenger traffic flowing mainly in one direction. Flexible adjustment to traffic flow (e.g., up in the morning and down in the evening) is possible.



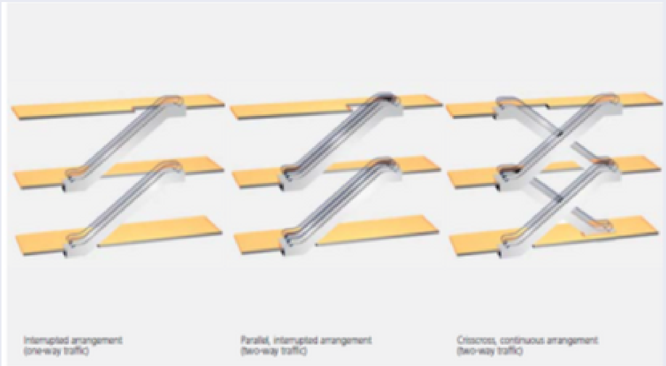
b. Continuous arrangement (one-way traffic)/Escalator in one travel direction

This arrangement is used mainly in smaller department stores to link three sales levels. It requires more space than the interrupted arrangement.



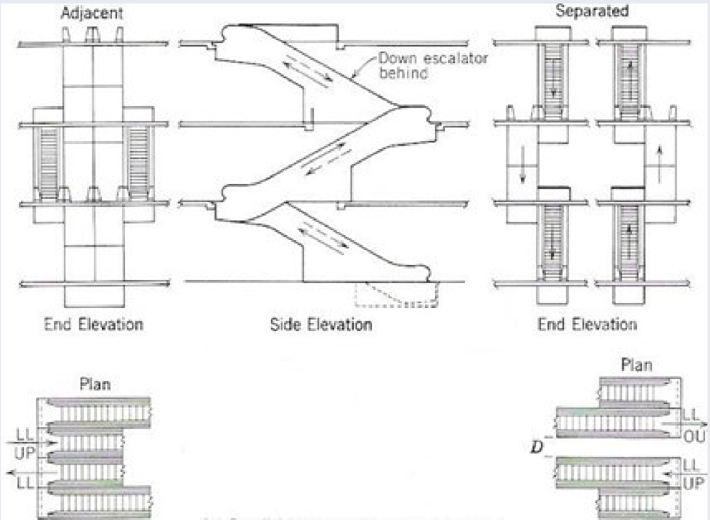
c. Interrupted arrangement (one-way traffic)/Escalator in one travel direction (arrangement-parallel)

While relatively inconvenient for the user, for the owner of the department store it provides the advantage that due to the spatial separation of the upward and downward directions, customers have to walk past specially placed merchandise displays.



d. Parallel, interrupted arrangement (two-way traffic)

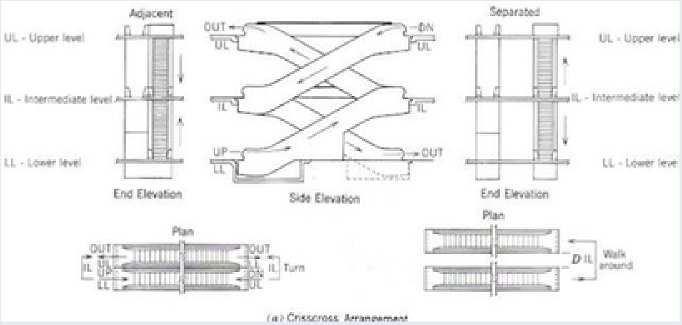
This arrangement is primarily used in department stores and public transportation buildings with high traffic volumes. It involves having three or more escalators or moving walkways that can reverse direction based on traffic flow. The escalators can be positioned side by side, separated by a distance, or overlap for up to two building levels. Users need to walk around to reach the next escalator to go up or down. This setup encourages visitors to move through the entire premises, potentially increasing purchases, especially during low-cost sales events.



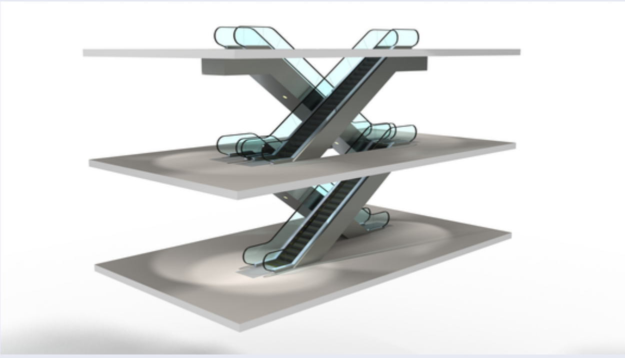
(c) Parallel Arrangement (no walkaround)

e. Crisscross, continuous arrangement (two-way traffic)

This installation type is commonly used in various establishments, particularly in department stores and shopping centers, to facilitate quick and efficient travel between floors with minimal waiting time. By strategically positioning the escalators, it enhances the visibility of the shop floor, attracting customers to displayed goods. The arrangement typically involves crisscrossed escalators separated by horizontal distance, optimizing structural space by stacking escalators in one direction. This setup minimizes congestion as there's only one boarding and exit point, leading to smoother user experience. Moreover, it's a cost-effective solution in terms of building space compared to parallel arrangements.



Crisscross, continuous arrangement (two-way traffic)



Differences between types of arrangement escalator system

Single Unit

- Used to connect two levels.
- Direction can be adjusted to suit traffic flow.

Continuous Arrangement

- One way traffic.
- Mainly used in department stores to link sales levels.

Interrupted Arrangement

- One way traffic.
- Separation of the upward and downward escalators means that customers have to walk past strategically placed merchandise displays.

Parallel

- Two way traffic.
- Used mainly in department stores and public transportation buildings with heavy traffic flow.

Crisscross

- Two way traffic.
- This arrangement allows customers to travel quickly to upper floors without any waiting time.

Location of an escalator

Escalator is moving conveyor transport device and is a part of the internal circulation facilities building. It must be placed in the main routes in the circulation system of the building. This is different with thelift service where it canbe placed in group. It should be located in areas that directly give services to the user going to the next level and should also provide at the dominant view. This allows users:

- Tracking escalator immediately.
- Identifying individual destinations quickly each of the escalator.
- Allows the user to move towards the escalator with ease.

Separation of between two escalators

Separation between the escalators at a level which raises two problems:

- Reduction of floor space necessary for the circulation of consumers and this resulted in congestion, pushing each other's and a waste of time.
- Reducing number of lift in the building will force users to move a lot riding escalator in a building. If it exceeds 3 storeys and this will waste of time users.

Design and layout considerations

In choosing the escalator, there are a number of factors affect escalator designs. There including physical requirements, location, traffic patterns, safety considerations, and aesthetic preferences.

- Physical requirements

Physical factors like the vertical and horizontal distance to be spanned must be considered. These factors will determine the pitch of the escalator and its actual length. The ability of the building infrastructure to support the heavy components is also a critical physical concern.

- Location

Location is important because escalators should be situated where they can be easily seen by the general public. In department stores, customers should be able to view the merchandise easily. Furthermore, up and down escalator traffic should be physically separated and should not lead into confined spaces.

- Traffic patterns

Traffic patterns must also be anticipated in escalator design. In some buildings, the objective is simply to move people from one floor to another, but in others there may be a more specific requirement, such as funnelling visitors towards a main exit or exhibit. The number of passengers is important because escalators are designed to carry a certain maximum number of people. For example, a single-width escalator travelling at about 1.5 feet (0.46 m) per second can move an estimated 170 persons per five-minute period. The carrying capacity of an escalator system must match the expected peak traffic demand, presuming that passengers ride single file. This is crucial for applications in which there are sudden increases in the number of riders. For example, escalators at stations must be designed to cater for the peak traffic flow discharged from a train, without causing excessive bunching at the escalator entrance.

In this regard, escalators help in controlling traffic flow of people. For example, an escalator to an exit effectively discourages most people from using it as an entrance, and may reduce security concerns. Similarly, escalators often are used as the exit of airport security checkpoints. Such an egress point would generally be staffed to prevent its use as an entrance, as well.
It is preferred that staircases be located adjacent to the escalator if the escalator is the primary means of transport between floors. It may also be necessary to provide an elevator lift adjacent to an escalator for wheelchairs and disabled persons.

- Safety

Safety is also major concern in escalator design. Fire protection of an escalator floor- opening may be provided by adding automatic sprinklers or fireproof shutters to the opening, or by installing the escalator in an enclosed fire-protected hall. To limit the danger of overheating, adequate ventilation for the spaces that contain the motors and gears must be provided. It is preferred that a traditional staircase be located adjacent to the escalator if the escalator is the primary means of transport between floors. It may also be necessary to provide an elevator lift adjacent to an escalator for wheelchairs and disabled persons.

- Aesthetic

Consideration should be given to the aesthetics of the escalator. The architects and designers can choose from a wide range of styles and colours for the handrails and balustrades.

- Carrying capacity

The carrying capacity of an escalator system must match the expected peak traffic demand, presuming that passengers ride single escalator. This is crucial for applications in which there are sudden increases in the number of riders.

Components of escalator

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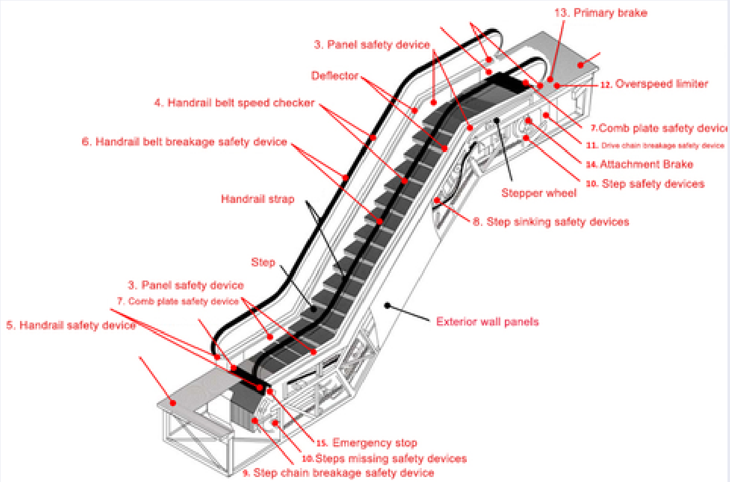
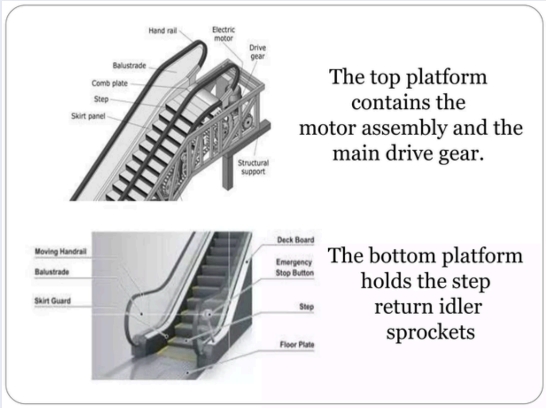


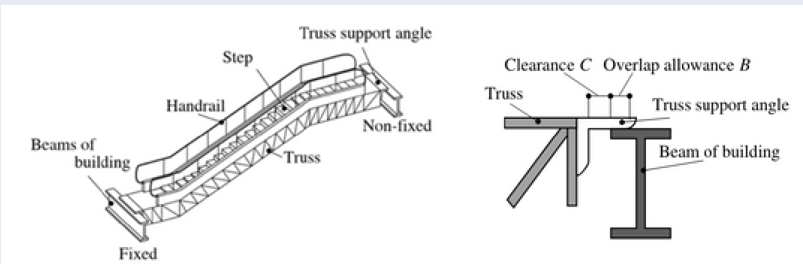
a) Top and Bottom Landing Platforms

The escalator system comprises two platforms housing curved track sections, gears, and motors. The top platform contains the motor assembly and the main drive gear, while the bottom platform holds the step return idler sprockets. These platforms also serve as anchors for the escalator truss. Additionally, they feature a floor plate and a comb plate. The floor plate provides a standing area for passengers before they step onto the moving stairs, typically flush with the finished floor and designed for easy access to machinery below. The comb plate, positioned between the stationary floor plate and the moving steps, features cleats resembling a comb's teeth. These cleats mesh with corresponding ones on the steps, minimizing the gap between the stairs and the landing to prevent objects from getting caught.



b) The Truss/supporting beams

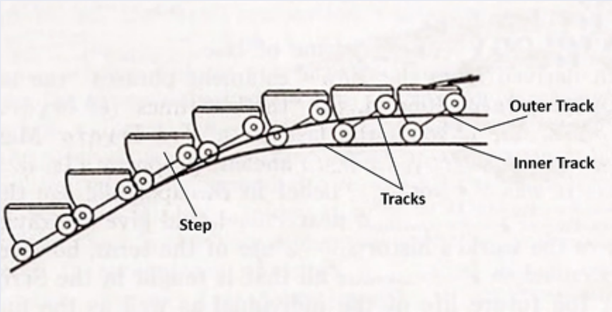
The truss or supporting beam is a hollow metal structure that bridges the lower and upper landings. It is composed of two side sections joined together with cross braces across the bottom and just below the top. The ends of the truss are attached to the top and bottom landing platforms via steel or concrete supports. The truss carries all the straight track sections connecting the upper and lower sections.



c) The tracks

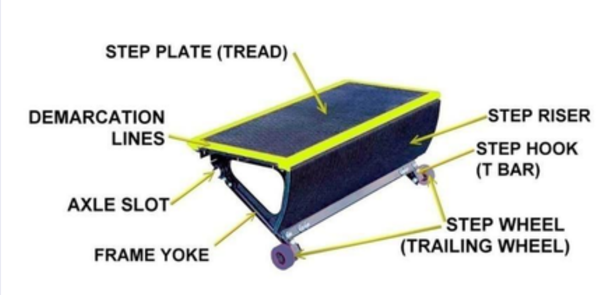
The track system is built into the truss to guide the steps. There are actually two tracks: one for the front wheels of the steps and one for the back wheels of the steps.

The relative positions of these tracks cause the steps to form a staircase as they move out from under the comb plate. On the inclined portion of the escalators, the step track is positioned to create a staircase configuration at the steps. Then, as the steps transition at the top and bottom of the escalator, the two tracks separate to allow the steps to "flatten out" at the floor plate.



d) Steps

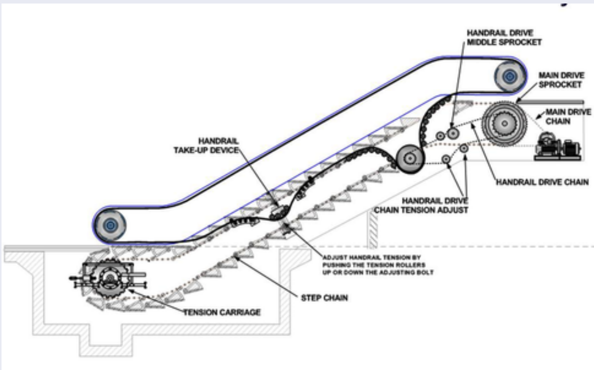
The manufacturers of the steps are in three widths: 24-in, 32-in and 40-in wide. The depth of any step tread in the direction of travel shall not be less than 400mm (15.75in) and the rise between treads shall not be more than 220mm (8.5in). Most steps today are fabricated from cast aluminum, which is stronger and lighter than older escalator step construction.



ESCALATOR STEP

e)Handrail

The handrail provides a convenient handhold for passengers while they are riding the escalator. Handrails should be provided on both sides of the stairs. In an escalator, the handrail is pulled along its track by a chain that is connected to the main drive gear by a series of pulleys. It is designed with fabric-rubber railings.



f) Safety device

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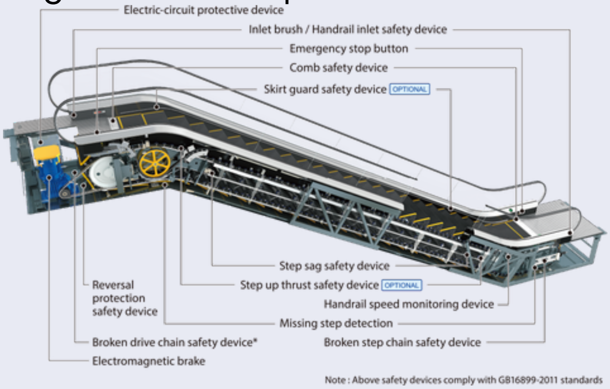
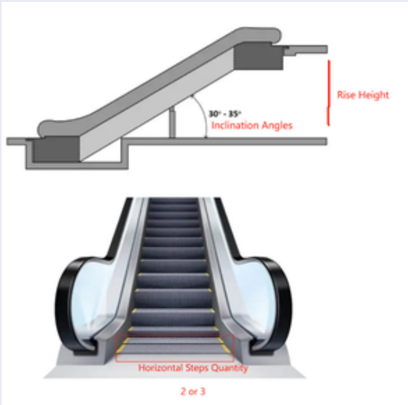


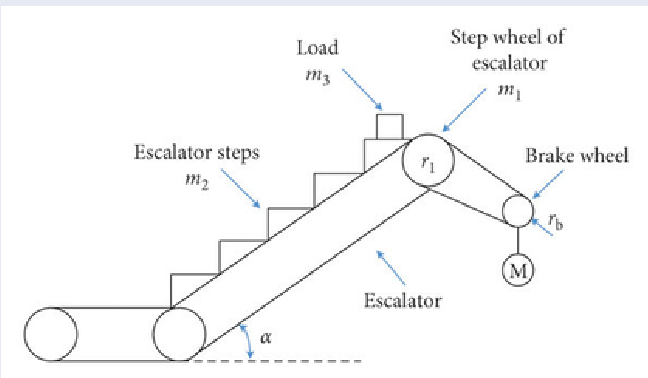
g) Rise

Standard rise of the escalator is up to about 60 feet (18m) with angle of inclination to the horizontal floor level is 30 degrees. Typical escalator step rise is 8½ in (maximum).



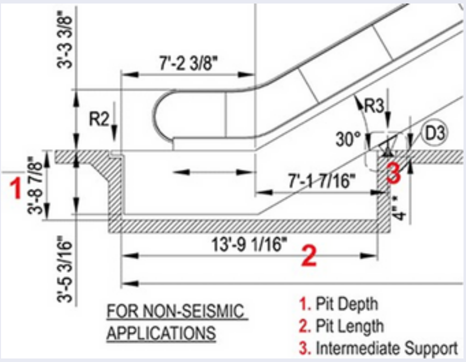
h) Rope system

The rope system of the escalator is consists of electric motor, driver gear, return wheel, chain guide and inner rail.



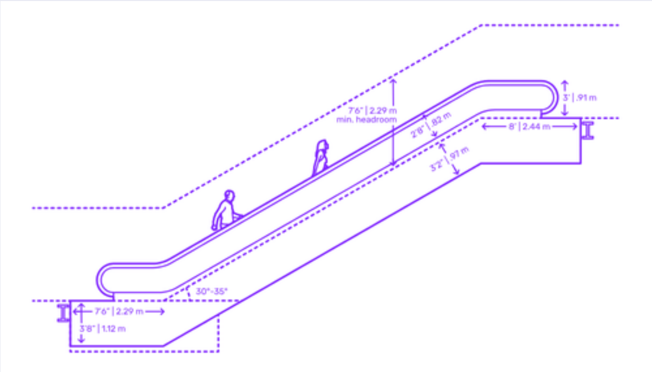
i) Escalator pit

The escalator pit is required at the back of the escalator. The depth and length of the pit is depending upon the rise of the escalator and width of the steps.



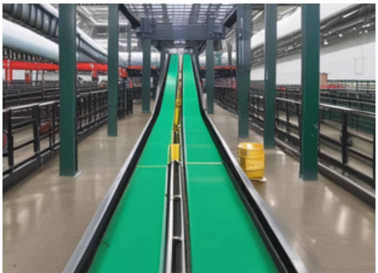
j) Headroom

Headroom of the escalator is measure from the level of floor or platform to the ceiling. If the headroom on the underside of the escalators is less than 2200mm, this area must be guarded to avoid hazard. The provision such as railings or solid wall is some means of meeting this requirement.



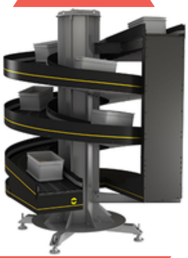
Chapter 7

Other Building Transportation



Conveyor

Travellator



Spiral Lift

Dumbwaiter

Stair Lift

Gondola/Standing Glider

Paternoster Lift

CONVEYOR

Conveyors are mechanical devices used to transport materials, products, and goods efficiently from one location to another within a facility or between different points in a process. They are widely used in various industries, including manufacturing, mining, packaging, and distribution, due to their ability to handle large volumes of items quickly and reliably. Conveyors help streamline operations, reduce manual labor, and improve productivity.

Youtube Link:
bit.ly/3KJ8DM4

Advantages & Disadvantages

Advantages

- Inclination of allow materials (big and small) to be moved from one elevation to another easily.
- Unlimited opportunities to continuously load and unload items over a long period of time.
- To transport materials across levels with almost no limitation of heights.
- Can move in both directions.
- Allow careful control of the speed which materials are moving.
- It can load the materials automatically and eliminating manual unloading.
- No time is wasted in monitoring the material unloads.

Disadvantages

- Hard to have a maintenance.
- A separate arrangement for material handling is required.
- Hot material cannot be transported by the conveyor.
- Vertical transport cannot be done by the conveyor like the materials cannot be carried to the high rise building.

Types of conveyor

Live Roller Conveyor

- Used for transport of totes and cartons on a horizantal plane in straight lines.
- Often used to convey heavier products.
- Consists of series of rollers linked together to sprocket that is attached to a motor powers the rollers.

Youtube Link:
bit.ly/3KIHgSE

Belt Conveyor

- Used to transport items through changes in elevations and around curves.
- Highly cost effective conveyor that can handle item even it is too small and maintains product orientation through curves.
- Consists of a belt made of fabric, rubber, plastic or leather which is supported by frames.

Youtube Link:
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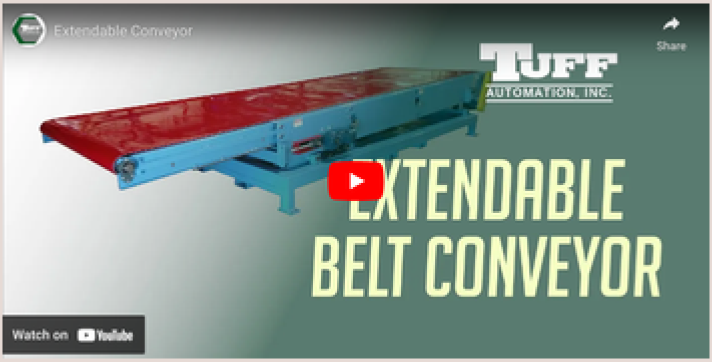
EXTENDABLE CONVEYOR

- Generally used in shipping and receiving for the unloading and loading of truck trailer.
- The unit in this conveyor is motorised enabling items to move properly and keep its position.



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Benefits

Efficiency:

- Reduces the time and labor required for loading and unloading, enhancing productivity.

Ergonomics:

- Reduces the need for workers to carry heavy loads over long distances, minimizing the risk of injuries.

Versatility:

- Suitable for various industries including warehousing, logistics, manufacturing, and distribution centers.

Cost-Effectiveness:

- By improving loading and unloading times, it can lead to significant cost savings over time.

Applications:

- Loading Docks: Efficiently moves goods in and out of trucks and trailers.

Warehouses:

- Facilitates the movement of products within the facility.

Retail Distribution:

- Enhances the distribution process by speeding up the transfer of goods.

Overall, extendable conveyors are valuable tools for any operation that requires the frequent and flexible movement of materials, providing both practical and economic advantages.

TRAVELLATOR

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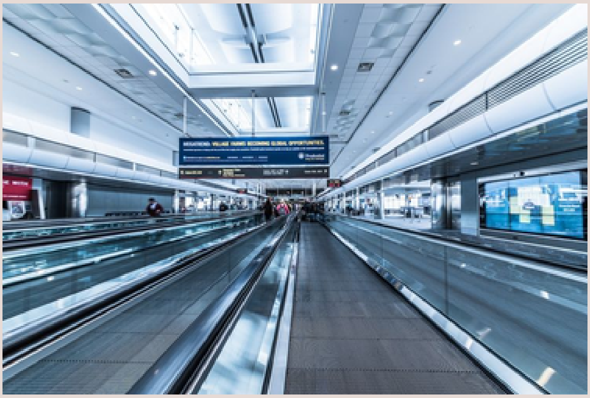


The basic operation of travellator

- Travellator is also known as a moving walk.
- A travellator or moving walk is defined as a moving device on which passengers stand or walk on it. Its passenger-carrying surface remains parallel to its direction of motion and is un-interrupted.
- Travellator / moving walk may be installed at an incline between two floors.
- The same fire prevention features described for escalator apply to moving walk.
- Qualified travellator inspectors / expertise are necessary to perform inspections.

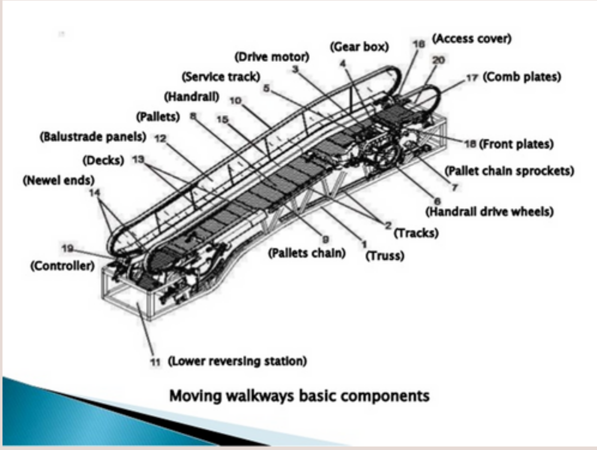
Type of Travellator

Pallet type

- A continuous series of flat metal plates join together to form a walkway.
- Effectively identical to escalators in their construction.
- Most have a metal surface, though some models have a rubber surface for extra traction.

Moving belt

- These are generally built with mesh metal belts or rubber walking surfaces over , metal rollers.
- The walking surface may have a solid feel or a “bouncy” feel.



Location of moving travellator

- Airport
- Museum
- Zoo
- Theme park
- Public transport
- Urban areas
- Skiing
- Supermarkets

SPIRAL-LIFT

- Elevators that used to transport goods.
- Goods transported by moving round/ spiral from top to bottom or bottom to top.
- This lift is usually used at low height buildings.
- Usually installed at factories, restaurant and shopping complex.
- Less noise and power consumption of electrical energy low.
- The spiral lift requires relative low-power electric motor drives thanks to its very high mechanical efficiency.
- Spiral lift unit can be configured easily in modular designs to suit any platform geometry and building architecture.
- Multiple units can be linked to the same drive train and fully synchronized.
- Entry/Exit Orientation-Clockwise (Right-hand) Counter-Clockwise (Left-hand).

SPIRAL-LIFT APPLICATION

- Airport baggage handing
- Medical devices
- Food processing facilities
- Beverages
- Printing plant/newspaper

MAIN FEATURES

- Space Efficiency:

Compact Design: The spiral configuration allows for a vertical lift in a limited floor space, making it ideal for facilities with space constraints.
High Throughput: Capable of handling high volumes of products within a small footprint.

- Continuous Flow:

Seamless Transport: Provides continuous and smooth transport of goods, reducing bottlenecks and improving overall efficiency.
Constant Speed: Typically operates at a consistent speed to ensure a steady flow of products.

- Versatility:

Multiple Applications: Suitable for a variety of products including cartons, bottles, totes, and individual items.
Flexible Configurations: Can be customized to handle different sizes and types of products, and can be integrated into existing conveyor systems.

- Construction and Materials:

Robust Build: Made from durable materials such as stainless steel, aluminum, or coated steel to withstand heavy use and harsh environments.
Hygienic Design: Often designed with easy-to-clean surfaces, making them suitable for food and pharmaceutical industries.

- Load Handling:

Varied Load Capacities: Can be designed to handle light to heavy loads, depending on the application requirements.
Stable Conveyance: Designed to maintain product stability and integrity during vertical transport.

- Energy Efficiency:

Low Power Consumption: Efficient motor designs reduce energy usage, contributing to lower operating costs.

- Regenerative Drives:

Some models feature regenerative drives that recover and reuse energy, enhancing efficiency.

- Safety Features:

Safety Guards and Covers: Equipped with protective guards and covers to prevent accidents and ensure operator safety.
Emergency Stop Mechanisms: Includes emergency stop buttons for immediate halt in case of an emergency.

- Customizability:

Variable Heights: Can be designed to reach different vertical heights as needed.
Entry and Exit Points: Multiple infeed and outfeed points can be configured to fit specific layout requirements.

- Ease of Maintenance:

Accessible Components: Designed for easy access to components for routine maintenance and repairs.
Minimal Downtime: Built to minimize downtime, with durable components that require less frequent maintenance.

- Smooth Transition:

Gentle Handling: Ensures smooth and gentle handling of products to prevent damage, especially important for delicate items.

DUMBWAITER

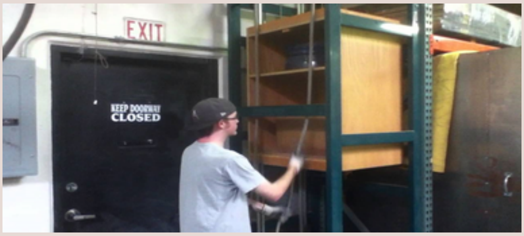
A dumbwaiter is a small freight elevator or lift designed primarily for transporting objects rather than people. They are commonly found in settings such as restaurants, hotels, hospitals, and private homes, serving as a practical solution for moving items like food, laundry, books, and dishes between different floors.

Youtube Link:
bit.ly/3XjLJCA

TYPE OF DUMBWAITER

Manual Dumbwaiter:

- Pulley System: Operated manually by pulling ropes or chains, suitable for light loads and occasional use in homes or small businesses.
- Counterweight System: Features a counterweight to balance the load, making it easier to operate manually.



Electric Dumbwaiter:

- Cable-Driven: Uses cables and an electric motor to move the car, commonly used in restaurants, hotels, and hospitals for transporting food, laundry, or supplies.
- Chain-Driven: Utilizes chains for movement, offering durability and suitability for heavier loads.
- Belt-Driven: Employs belts for operation, providing quieter and smoother performance, often used in environments where noise reduction is essential.

TYPE OF DUMBWAITER

Hydraulic Dumbwaiter:

- Powered by a hydraulic system, capable of handling heavier loads and offering smooth and reliable operation, typically used in industrial settings.

Traction Dumbwaiter:

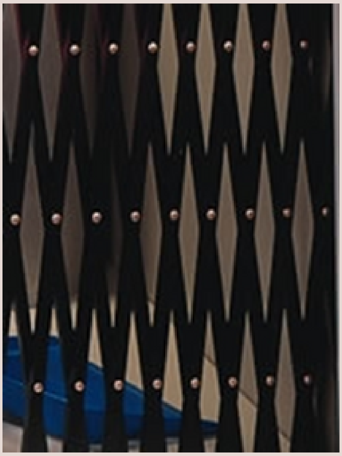
- Uses a system of ropes, sheaves (pulleys), and a counterweight, similar to traction elevators, efficient for taller buildings and capable of handling varying loads.

TYPE OF DUMBWAITER DOOR

SLIDE-UP DOOR

BI-PARTING DOOR

SWING DOOR



COLLAPSIBLE GATES

STAIR LIFT

A stair lift is a mechanical device designed to help people with mobility issues ascend and descend stairs. Here are the key components and features of a stair lift:

- Rail: A track or rail is mounted along the side of the staircase. The rail can be straight or curved, depending on the shape of the stairs.

- Chair or Platform: The lift typically includes a seat or platform that the user sits or stands on. For wheelchair users, there are platform stair lifts that can accommodate a wheelchair.

- Motor: An electric motor powers the stair lift, allowing it to move up and down the rail. The motor can be battery-powered or connected to the home's electrical system.

- Controls: The stair lift has controls, usually located on the armrest of the chair or on a remote control, allowing the user to operate the lift easily. There are also call/send buttons at the top and bottom of the stairs.

- Safety Features: Stair lifts come with various safety features, including:

- Seat Belt: To secure the user while in motion.
- Swivel Seat: The seat can swivel at the top and bottom of the stairs to allow for safe and easy dismounting.
- Footrest Sensors: To stop the lift if an obstacle is detected on the stairs.
- Emergency Stop: A button to halt the lift immediately in case of an emergency.

Types of Stair Lifts:

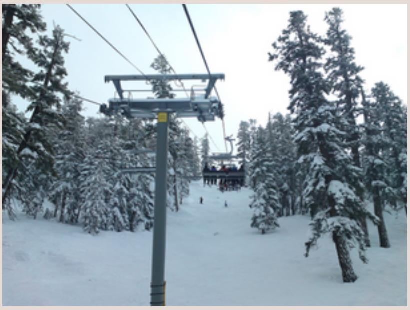
- Straight Stair Lifts: Designed for staircases that go straight up without any curves or landings.
- Curved Stair Lifts: Custom-built to fit staircases with curves, turns, or intermediate landings.
- Outdoor Stair Lifts: Made with weather-resistant materials for use on outdoor staircases.
- Standing Stair Lifts: Designed for users who have difficulty bending their knees and prefer to stand while using the lift.

Stair lifts are a practical solution for enhancing mobility and independence for individuals with disabilities or those who find it challenging to navigate stairs due to age or health conditions. They allow users to safely and comfortably access different levels of their homes without needing to remodel or move to a single-story residence.

Youtube Link:
bit.ly/45lSXbk

GONDOLA/STANDING GLIDER

A gondola lift, as opposed to a cable car, is a means of cable transport and type of aerial lift which is supported and propelled by cables from above. It consists of a loop of steel cable that is strung between two stations, sometimes over intermediate supporting towers. The cable is driven by a bullwheel in a terminal, which is typically connected to an engine or electric motor. They are often considered continuous systems since they feature a haul rope which continuously moves and circulates around two terminal stations.Depending on the combination of cables used for support and/or haulage and the type of grip (detachable grip vs. fixed grip), the capacity, cost, and functionality of a gondola lift will differ dramatically.



Youtube Link:
bit.ly/3Vouuxf

PATERNOSTER LIFT

A Paternoster lift is a type of passenger elevator which consists of a chain of open compartments that move slowly in a loop up and down inside a building without stopping. It allows passengers to step on or off at any floor they wish. Here's a detailed description of its features and operation:

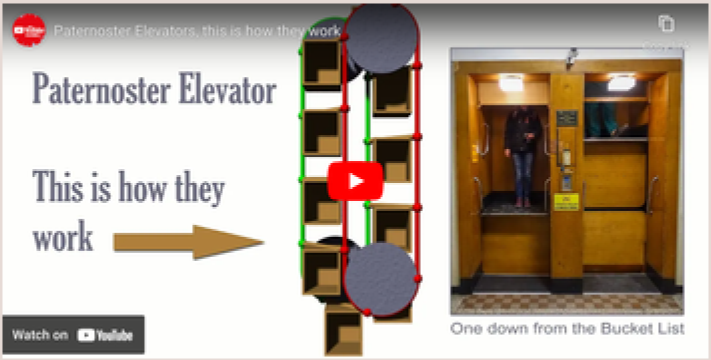
- Continuous Movement: Unlike conventional elevators that stop at each floor, a Paternoster lift moves continuously in a loop. It moves at a slow speed, allowing passengers to step on and off safely.

- Open Compartments: The compartments in a Paternoster lift are open and do not have doors. This design facilitates the easy entry and exit of passengers as the lift moves.

- Up and Down Movement: The lift operates in a continuous loop, with one side of the compartments moving upwards and the other side moving downwards. Passengers can get on from any floor and travel either up or down.

- No Stops: Since the lift doesn't stop at each floor, passengers need to be attentive and step on or off the moving compartments quickly and carefully.

- Safety Considerations: Due to its continuous movement and open design, the Paternoster lift poses more safety risks compared to conventional elevators. Many countries have stopped installing new Paternoster lifts due to safety concerns, although some older installations are still in use.
- Historical Use: Paternoster lifts were popular in Europe during the early to mid-20th century, particularly in office buildings, universities, and government buildings. Their name comes from the resemblance of the continuous chain of compartments to rosary beads used in the Pater Noster (Our Father) prayer.
- Modern Regulations: Modern safety standards and regulations have limited the use of Paternoster lifts. Existing installations are often retrofitted with safety features or are decommissioned.



Youtube Link:
bit.ly/4eeWE6J

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