

BUILDING TRANSPORTATION SYSTEM

BUILDING SERVICES

VOL.2

Nur Hidayah Bte Rosman | Shahrul Kamil Bin Yunus

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PREFACE.

This e-book is specially written for polytechnic students who are pursuing Diploma in Architecture.

The content is designed in line with the latest syllabus prescribed in Malaysian polytechnics, and covers the topic of the building transportation system. Each chapters begin with Learning Outcomes, brief explanation on related matters and quick check questions to improve understanding. This e-book includes guidelines, chart, diagrams and illustrations.

This book is organized into four main chapters. Chapter one briefly explain about what is building services and building transportation system. Chapter two gives an overview of the requirements of elevators design in relations to the Uniform Building by Laws, and Malaysian Standard. Chapter 3 explains the types of escalator design and it components. Chapter 4 describe on travelator design in a building.

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CHAPTER 1 INTRODUCTION

OBJECTIVE 01.

Apply knowledge of building transportation system into design-based task (people habitat/community building) in compliance with Uniform Building By Law (UBBL)



CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION TO BUILDING SERVICES

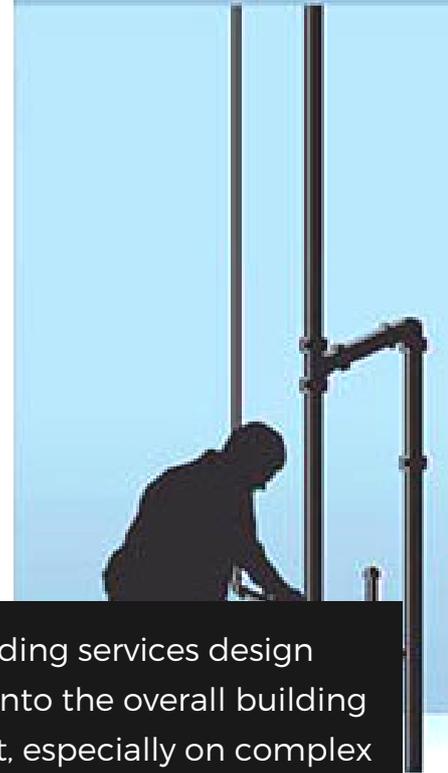
1.2 WHY BUILDING SERVICES IMPORTANT IN ARCHITECTURE?

1.3 WHAT IS BUILDING TRANSPORTATION?

1.4 FUNCTION OF BUILDING TRANSPORTATION SYSTEM

1.5 TYPES OF BUILDING TRANSPORTATION

1.1 INTRODUCTION TO BUILDING SERVICES



WHAT IS BUILDING SERVICES?

Building services are systems that are equipped in buildings to make them more **comfortable, workable, efficient, and safe.**

Building services play an important role in contributing to the design of a building, not only in terms of overall strategies and standards to be met, but also in **ensuring the architecturally building functions and is comfortable as a place for people to live and work.**

This means that building services design must be integrated into the overall building design from the start, especially on complex projects like hospitals. While an architect typically leads a building design team, a building services engineer may be appointed as the lead designer on buildings with extremely complex building services requirements. Some of the building services system that need to be integrated in a building design such as;

- 1. WATER, DRAINAGE AND PLUMBING**
- 2. HEATING, VENTILATION AND AIR CONDITIONING (HVAC)**
- 3. FIRE SAFETY, DETECTION AND PROTECTION**
- 4. ENERGY SUPPLY**
- 5. ESCALATORS AND LIFTS.**
- 6. SECURITY AND ALARM SYSTEMS.**

1.2 WHY BUILDING SERVICES IMPORTANT IN ARCHITECTURE?

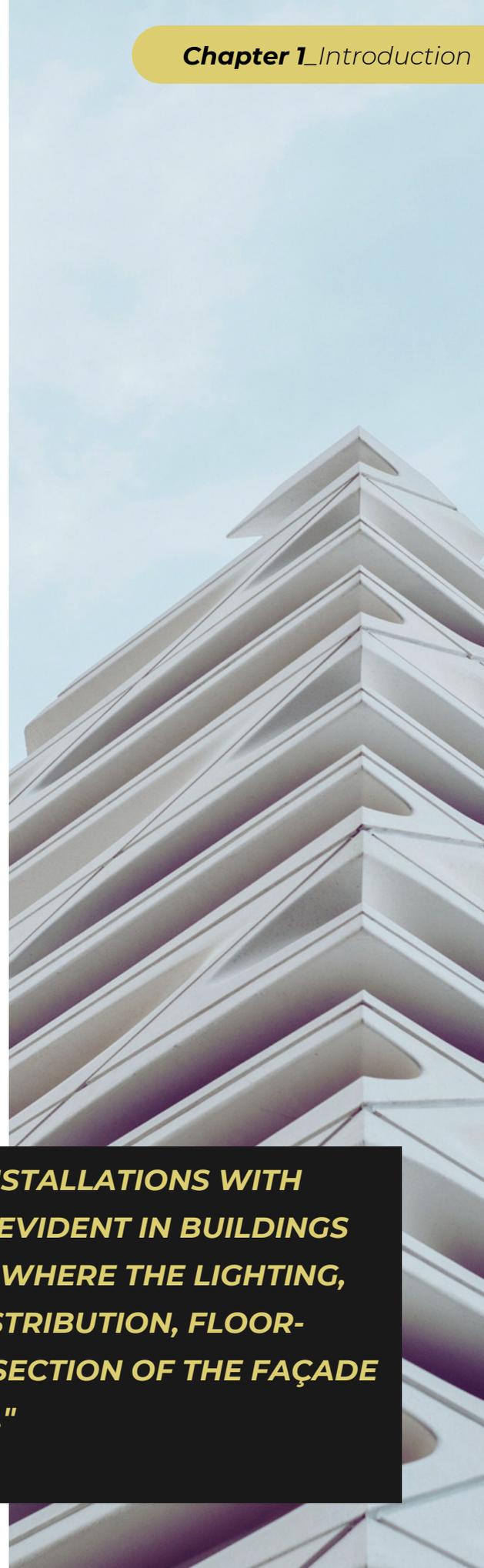
Building without services is analogous to driving a car without an engine. Services will be provided to complete and operationalize the structure.

Architects must deal with services early in the design process to ensure that the design complements technologies.

Consider yourself in the most magnificent structure on the planet. Remove the ventilation, lighting, and heating, the lift and escalators, the water supply and plumbing, the electricity and power supply, and so on. **What are your thoughts on the situation?** You're left with nothing but a cold, dark, and uninhabitable shell.

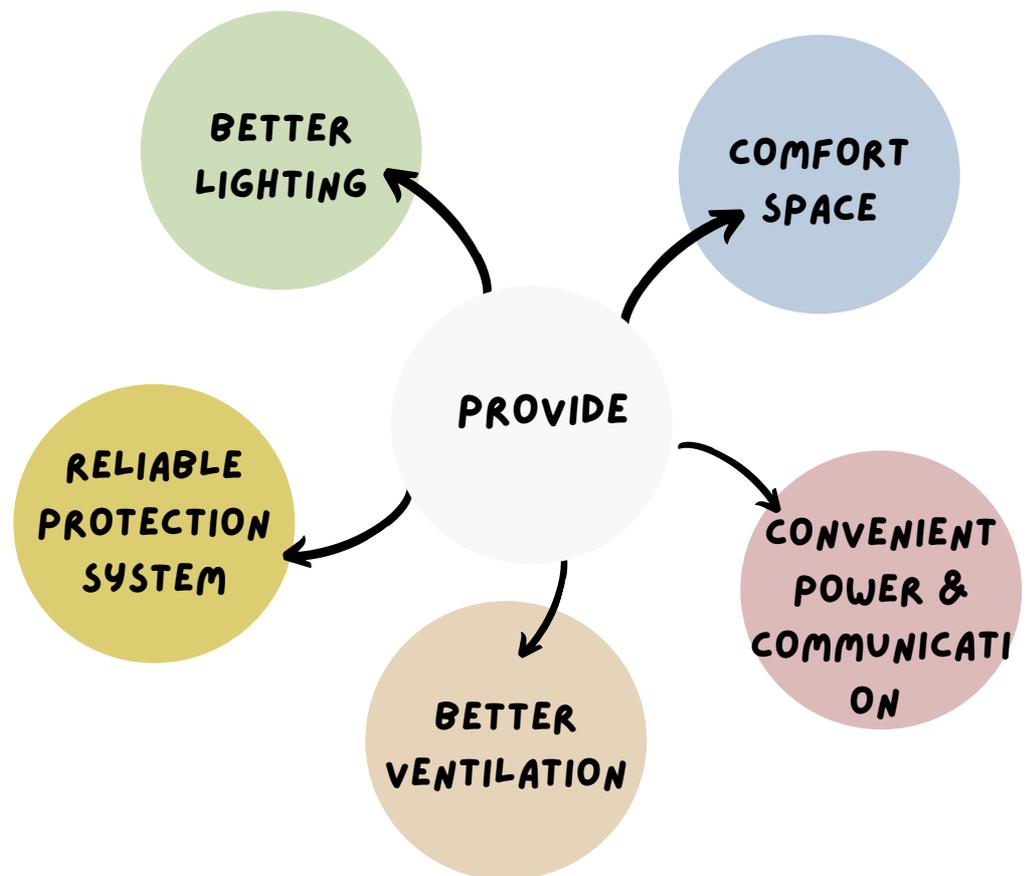
Building services include everything inside a building that makes it safe and comfortable to be in. A building must serve its purpose, which is to provide not only shelter but also an environment in which people can live, work, and play.

" THIS INTERDISCIPLINARY DESIGN OF INSTALLATIONS WITH OTHER ELEMENTS OF ARCHITECTURE IS EVIDENT IN BUILDINGS SUCH AS LLOYD'S BY RICHARD ROGERS, WHERE THE LIGHTING, AIR MOVEMENT, BUILDING SERVICES DISTRIBUTION, FLOOR-SLAB STRUCTURE, AND CONSTRUCTIVE SECTION OF THE FAÇADE ARE ALL DESIGNED COLLABORATIVELY..."
(CEASER & AMAIA; 2012)



1.2 DESIGN FEATURES FOR BUILDING SERVICES

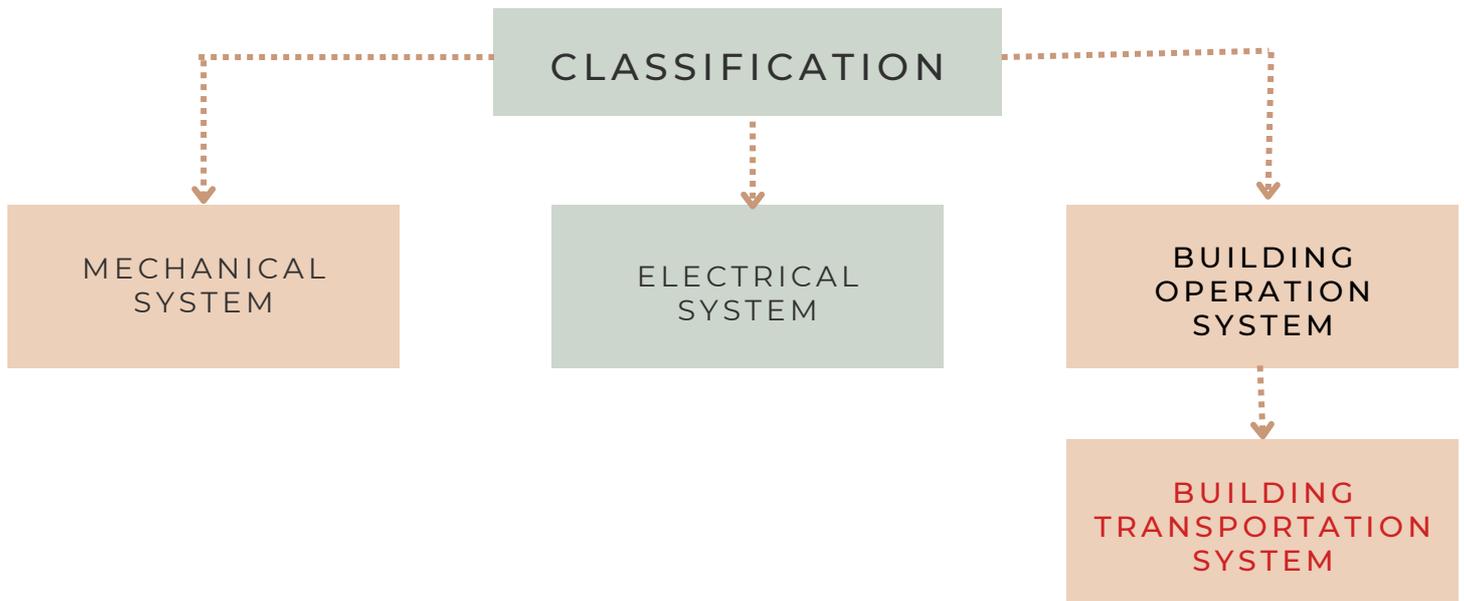
Modern structures are designed to provide **better, more consistent, and productive environments** in which to work and live. Building services must be designed with features in mind **such as**:



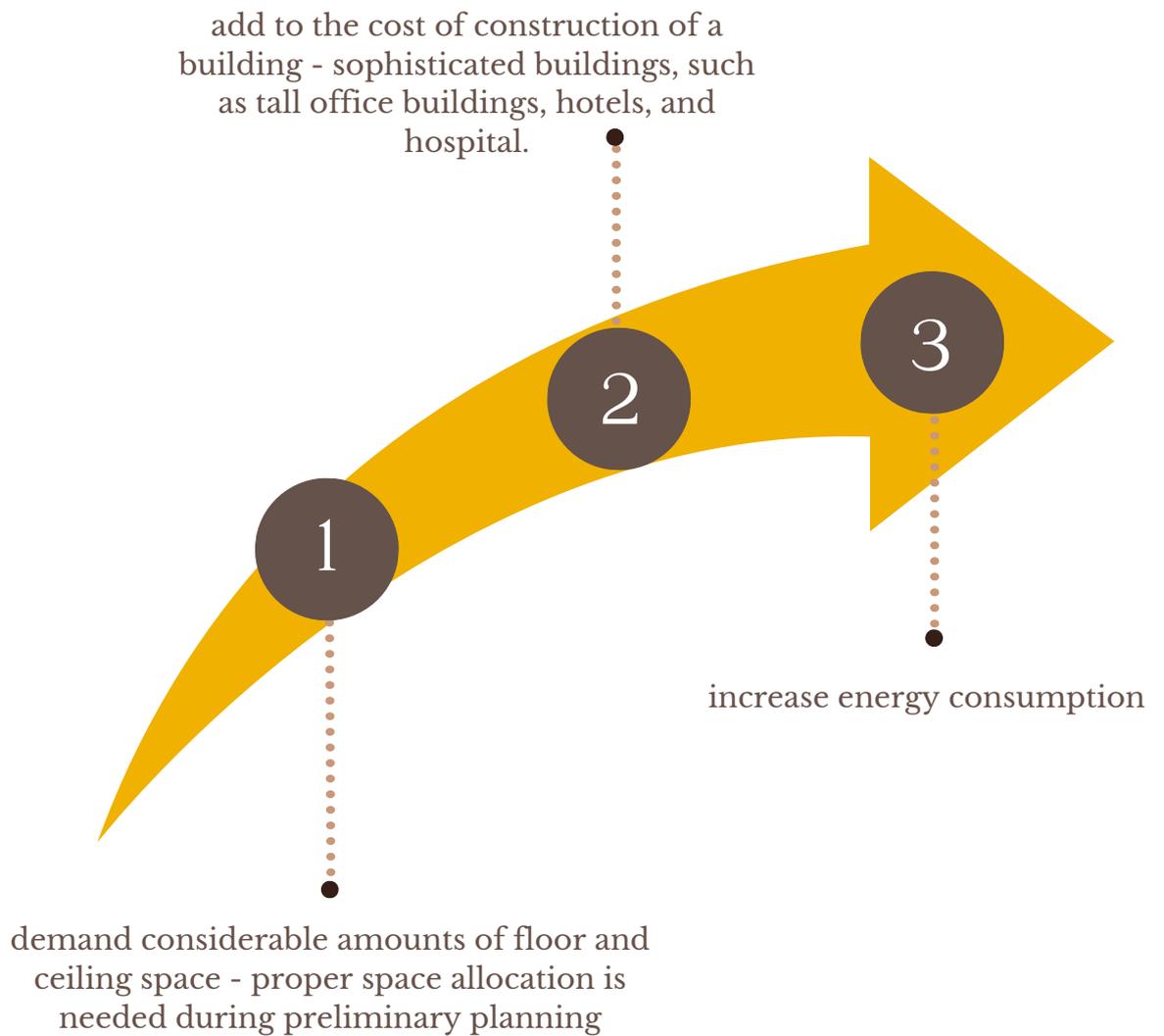
With advancements in building M&E system block-type buildings without windows, such as department stores, are completely reliant on electrical lighting, ventilation, and space conditioning. High-rise buildings must rely on high-speed vertical transportation and high-pressure water for drinking, cleaning, and fire protection. Diagram below to show **classification** of building transportation system:



M&E CLASSIFICATION



IMPACT M&E SYSTEM ON BUILDING



1.3 WHAT IS BUILDING TRANSPORTATION?

Building transportation systems are used to **transport people and goods within buildings**. These mechanical transports people and goods are an energy-consuming service that requires the designer's attention at the earliest stages of building design.

"THE DESIGN AND OPERATION OF BUILDING TRANSPORTATION SYSTEMS, SUCH AS ELEVATORS AND STAIRWELLS FOR OFFICES, HOTELS, AND APARTMENTS, ARE CRITICAL AND HAVE A SIGNIFICANT SOCIETAL IMPACT, SUCH AS IMPROVING EFFICIENCY, LOWERING COSTS, AND SAVING LIVES..."
(PETER B. LUH, LAURENT MICHE EL AL.: 2005)

These building transportation system include:

1 ELEVATOR

Vertical transportation system in transporting people and goods

2 ESCALATOR

A vertical staircase transportation

3 WALKALATOR

a horizontal transportation



1.4 FUNCTION OF BUILDING TRANSPORTATION

**' comfortable,
quick and efficient
manner'**

A building transportation system's overarching goal is to allow guests, employees, and goods to move or be moved in a **reasonably comfortable, quick, and efficient manner**. The building transportation system is, to some extent, a component of the building shell system: **space for halls and staircases**, for example, is an essential component of the physical facility..

A building shell can be completed without, say, its electrical system components (all wiring, transformers, fuse boxes, appliances, and so on), but not without a significant portion of the building transportation system. The hallways, staircases, and elevator shafts (but not the cars) must be present in a completed physical shell, including interior walls.

Much of the transportation problem will be solved if the points within the building from which people and goods commonly move are close to each other. Of course, in a large building, even excellent design can only go so far in minimising movement because nothing can be physically close to everything else.

There are three main **function** of building transportation in a building;



1.5 TYPES OF BUILDING TRANSPORTATION

Nowadays, mechanical transportation may be found in modern buildings and developments such as;

+ Lift / Elevator

Lifts are elevators that transport passengers and goods vertically. These are enclosed vehicles made of lightweight metal. Lifts are required for a four-story building.

+ Escalator

A conveyor conveyance mechanism called an escalator is made up of a staircase with steps that move up and down on tracks that keep the surfaces of the individual steps horizontal.

+ Travelator

When compared to walking, using a travelator can move individuals across longer horizontal distances more swiftly and easily.



ELEVATOR

Vertically transportation system



ESCALATOR

Vertically staircase movement



TRAVELATOR

Horizontally transportation system



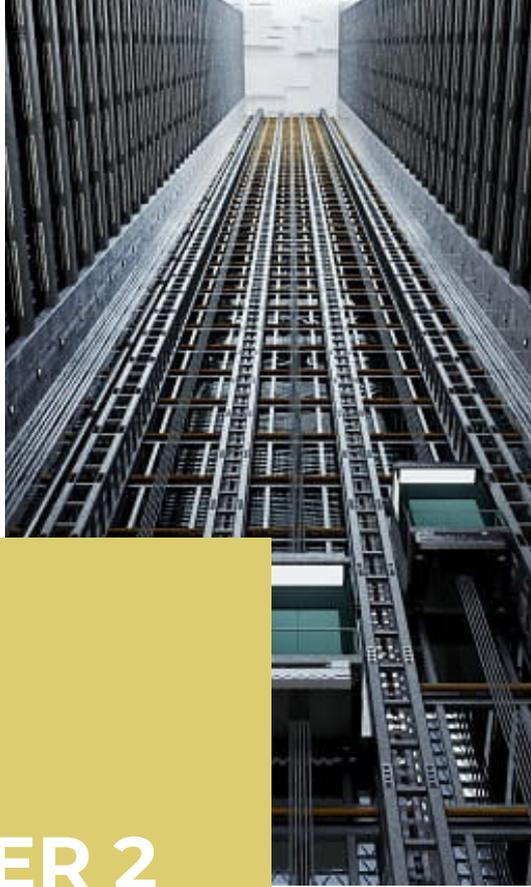
CHAPTER 2 ELEVATOR/ LIFT

OBJECTIVE 01.

Apply knowledge of building transportation system into design-based task (people habitat/ community building) in compliance with Uniform Building By Law (UBBL)

OBJECTIVE 02.

Analyze building transportation system's facilities in relation to architectural design



CHAPTER 2 ELEVATOR

2.1 INTRODUCTION TO
ELEVATOR

2.2 HISTORY OF ELEVATOR

2.3 GENERAL REQUIREMENTS

2.4 LOCATION AND
ARRANGEMENT OF
ELEVATOR

2.5 IMPORTANCE OF ELEVATOR

2.6 ELEVATOR SELECTION
FACTORS

2.7 TYPES OF ELEVATOR

2.8 CATEGORIES OF
ELEVATOR

2.9 ELECTRIC VS HYDRAULIC

2.1 INTRODUCTION TO ELEVATOR

Nowadays, elevator or lift used rapidly as one of important building transportation. An elevator is a transport device used to move goods or people vertically. In workplaces, public buildings, and other multi-story structures, a lift (or elevator) is a means of vertical transit between building floors, levels, or decks.

Lifts can be important for providing vertical circulation, especially in tall buildings, for wheelchair and other non-ambulant building users, and for vertical transporting goods. There are 3 types of lift/elevator operating mechanism;

- 1 TRACTION/ELECTRIC**
- 2 HYDRAULIC**
- 3 ROPED HYDRAULICS, OR HYBRID LIFTS**
- 4 CLIMBING LIFTS**

WHAT IS ELEVATOR?

The Lifts Regulations 1997 define a 'lift' as:

...a lifting device with a car that travels along permanent or rigid guides and is inclined at an angle of greater than 15 degrees to the horizontal, designed to transport:

- People
- People and goods
- Goods alone, if a person can enter easily and controls are installed inside the car or within reach of a person inside.

2.2 HISTORY



**ELISHA
GRAVES
OTIS**

BORN AUGUST 3, 1811,
HALIFAX, VERMONT,
U.S.

DIED APRIL 8, 1861,
YONKERS, NEW YORK.

AMERICAN INVENTOR
OF THE SAFETY
ELEVATOR.

INNOVATION

According to the Roman architect Vitruvius, Archimedes constructed the first elevator in 236 BC. It was mentioned that elevators were cabs on a hemp rope propelled by people or animals.

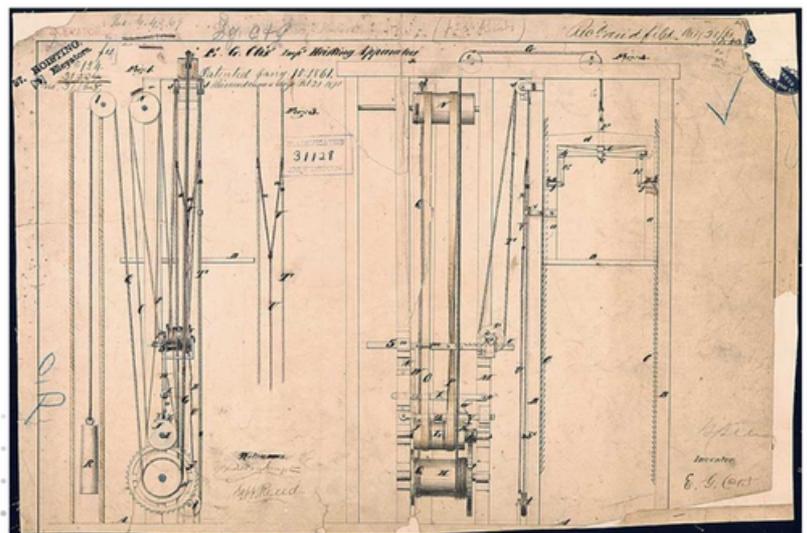
THE FIRST SAFETY ELEVATOR

Elisha Otis invented the safety elevator in 1852 to stop the cab from falling to the ground in the event that the cable broke. The Otis safety elevator shares some similarities with a current design.

PASSENGER ELEVATOR

The first Otis passenger elevator was set up at 488 Broadway in New York City on March 23, 1857.

other than that, Equitable Life Building, was the first office building with passenger elevators located at New York City, which was finished in 1870.



Picture 2.2.1; Elevator patent drawing by Elisha Otis', 15 January 1861

2.3 GENERAL REQUIREMENTS

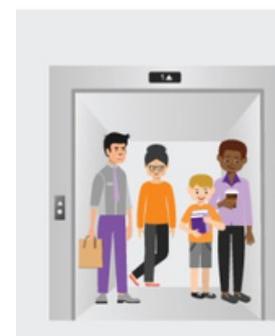
THE ELEVATOR REQUIREMENTS;

- For all **non-residential buildings exceeding 4 storeys above** or below the main access level at least **one lift shall be provided. (UBBL-Clause 124)**
- Considered a requirement in all buildings over three storeys
- Minimum standard of service is **one lift for every four storeys.** Maximum distance of **45 m** to the lift lobby
- Floor space estimates and car capacity can be based on an area of **0.2 m² per person**
- Elevator powered by **electric motor and transport** by traction cable and **counterweight systems** like a hydraulic pump or hoist.



Picture 2.3.1: High-rise Elevator

How many people can your elevator hold?



1 16 people maximum under any condition

2100 lbs
5'-8" X 4'-3"



2 26 people maximum under any condition

3500 lbs
6'-8" x 5'-5"

3 35 people maximum under any condition

5000 lbs
5'-8" X 8'-5"

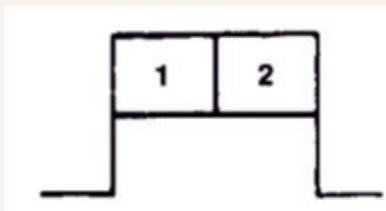
Picture 2.3.2: Passenger's capacity

2.4 LOCATION AND ARRANGEMENTS OF ELEVATOR

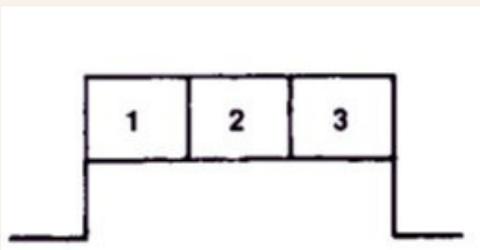
- A lift should be at locations which provide easy means of access for all building users at central entrance lobby of offices building, apartments, hotel etc.
- Lifts need to be grouping and it is essential for user convenience

Lift grouping arrangements :

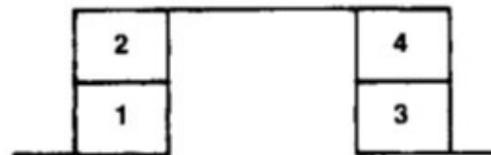
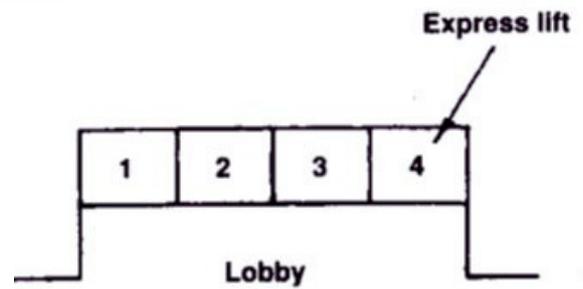
2 lifts



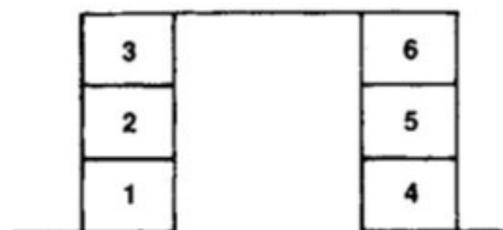
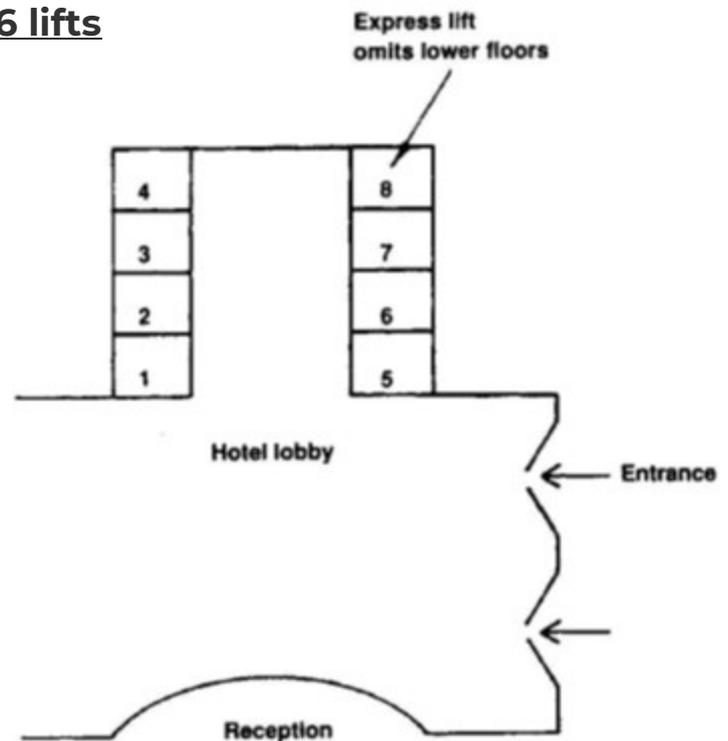
3 lifts



4 lifts



6 lifts



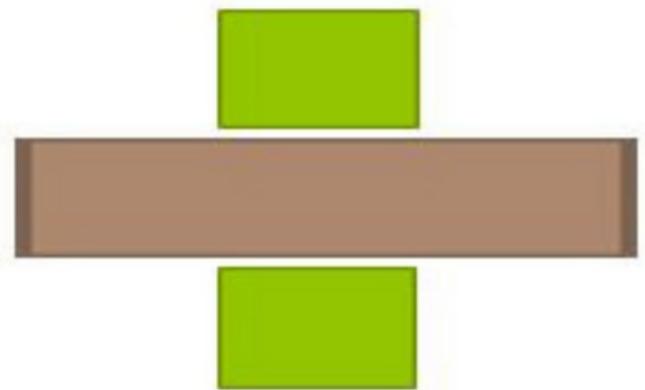
ARRANGEMENTS OF ELEVATOR

- To ensure there is no interference between passengers who wish to get into the lift.
- Should be carefully planned so can easily get into lobby and travel distance is reasonable.
- Maximum travel distance 150 - 200ft
- System layout depends on the number of elevator cars that use the elevator
- Normally the elevator is set in the layout or zoned.

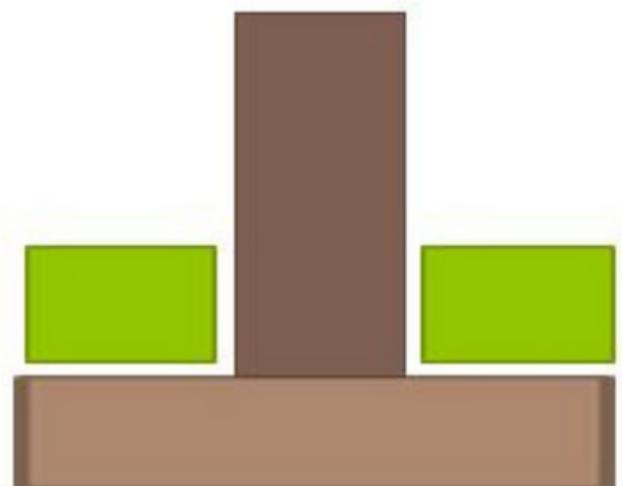
ARRANGEMENT FOR 2 CARS



Side by side arrangement - width of corridor = width of car lift



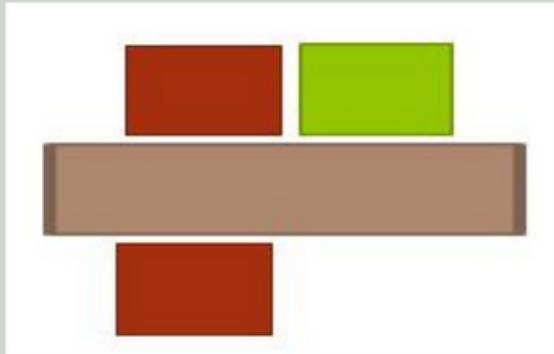
Opposite arrangement of corridor = width of car lift ment - width of corridor = width of car lift



Not good arrangement

ARRANGEMENTS OF THE ELEVATOR

ARRANGEMENT FOR 3 CARS

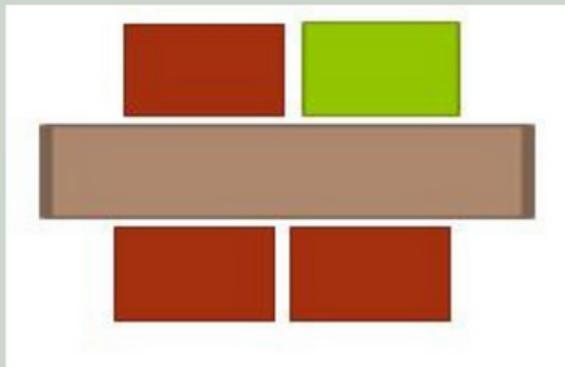


Opposite arrangement - width of corridor = $1.5 - 2A$, where A is width of lift

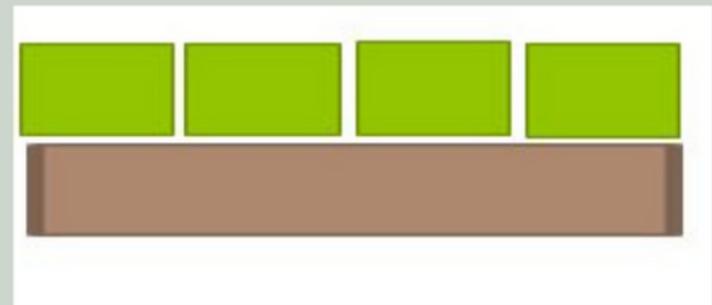


Side by side arrangement -width of corridor = $1.5A$, where A is width of lift

ARRANGEMENT FOR 4 CARS



Opposite arrangement - width of corridor = $1.5 - 2A$, where A is width of lift

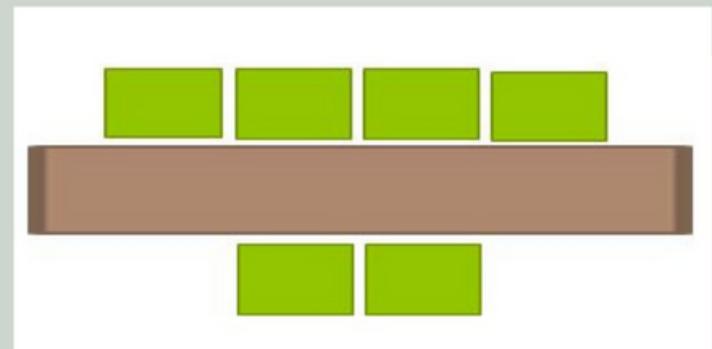


Side by side arrangement -width of corridor = $1.5A$, where A is width of lift

ARRANGEMENT FOR 6 CARS



Opposite arrangement - width of corridor = $1.75 - 2A$, where A is width of lift



Side by side arrangement -width of corridor = $2A$, where A is width of lift

ARRANGEMENTS OF THE ELEVATOR

ARRANGEMENT FOR 6 CARS



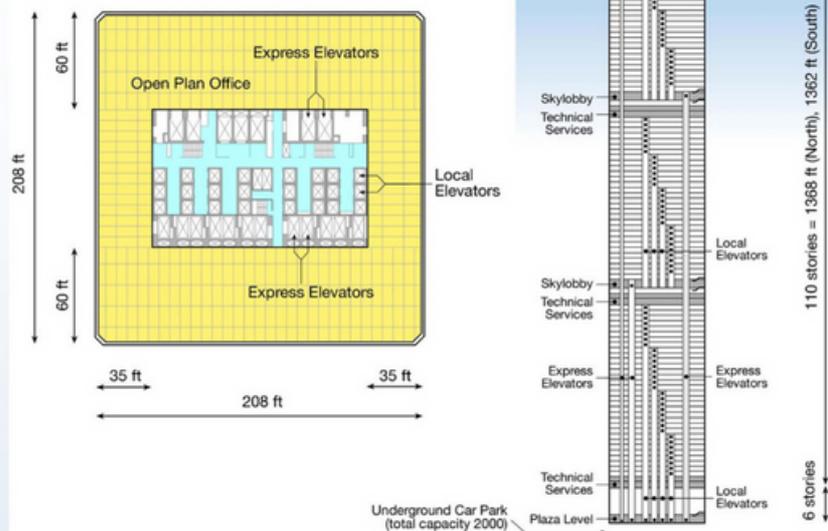
Weak arrangement for 6 car lift

ARRANGEMENT FOR 8 CARS



Opposite arrangement - width of corridor = $2A$, where A is width of lift

System Design Concept



Picture 2.4.1: The former World Trade Center's twin towers used skylobbies, located on the 44th and 78th floors of each tower.

2.5 IMPORTANCE OF AN ELEVATOR

RAPID DEVELOPMENT

Buildings design nowadays built vertically /higher because of high land cost'

FIRE REQUIREMENTS

Provide fire lift to be used during fire

BASIC NEEDS

To bring building user from one level to higher level in building

IMPORTANCE

UNIFORM BUILDING BY-LAWS

The building with more than 4 storey must provide lifts system

COMFORT NEEDS

Working efficiency for office building or large organization



video time!



HOW DO ELEVATOR WORKS?

<https://www.youtube.com/watch?v=CvY-G2FTbGM>



TYPES OF ELEVATORS

<https://www.youtube.com/watch?v=1eNGQnJ6d20>

2.6 ELEVATOR SELECTION FACTORS

GENERAL REQUIREMENTS

UTILITY

The function must be identified whether for commercial, office or hospital.

CAPACITY & NUMBER OF LIFTS

Depends on the access building pattern and building size.

SPEED

Depends on the number of stops, numbers of user and transport cost.

SPETYPE & SIZE OF LIFT GATEED

Depends on the use or function.

PHYSICAL REQUIREMENTS

SIZE OF LIFT SHAFT

Depends on lift cargo capacity

DEPTH OF LIFT SHAFT

Depends on the speed of elevator

AREA OF SPACE IN LIFT

Depends on the number of stops, numbers of user and transport cost.

MECHANICAL ROOM SIZE

Depends on type and size of the lift equipment

2.7 TYPES OF ELEVATOR



1- ELECTRIC/ROPE/CABLE LIFT

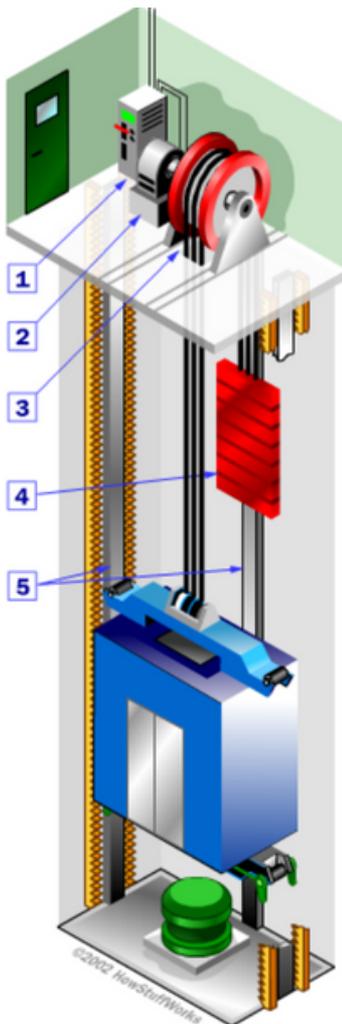


Figure 2.7.1: Electric lift component

ELECTRIC/ROPED/CABLE

The cable/roped elevator is **generated by an electric motor** to power a sheave, or pulley turning. Depending on which way the sheave is turned, it will either move the elevator car vertically up or down. The sheave grips hoist ropes or cables that are connected to the elevator car on one end and a counterweight on the opposite end.

THE COMPONENTS

In these elevators, the car is raised and lowered by traction steel ropes rather than pushed from below. Its components:



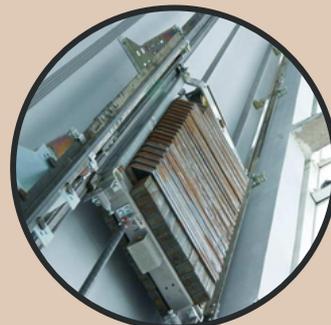
1 - Control system



2 - Electric motor



3 - Sheave



4 - Counterweight



5 - Guide rails

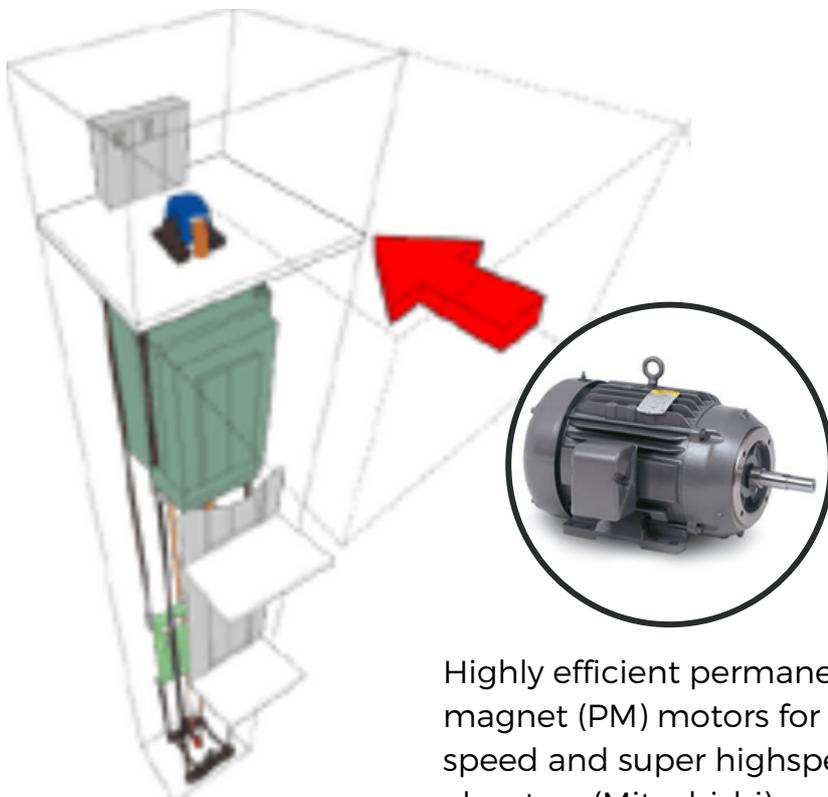
THE COMPONENTS

ELECTRIC MOTOR

- Located in lift motor room
- On anti-vibrations mountings



MOTOR



Highly efficient permanent magnet (PM) motors for high-speed and super highspeed elevators (Mitsubishi)

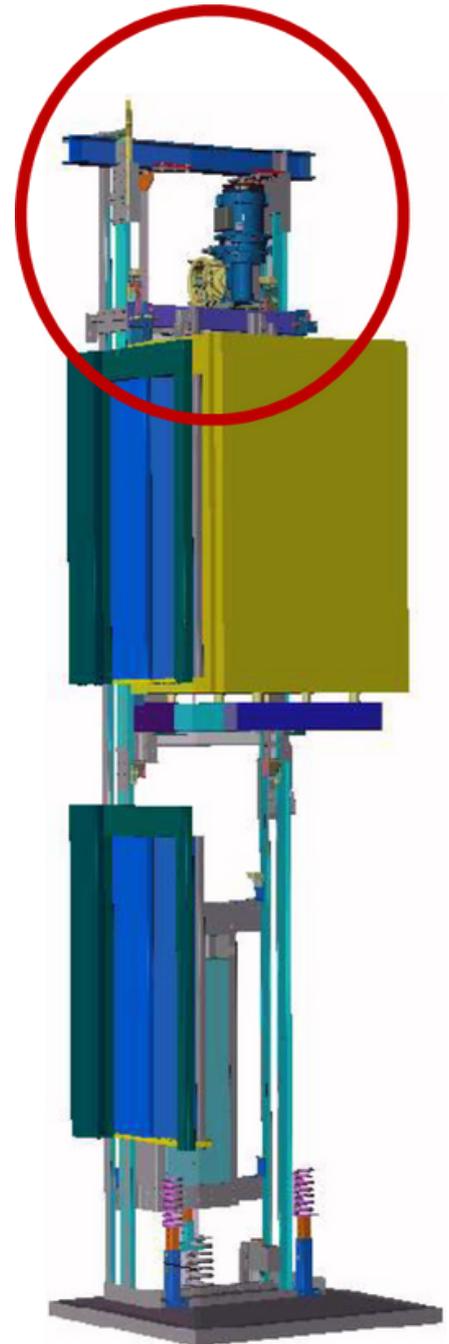


Figure 2.7.2: Location of motor

2.7.1 PLAN, SECTION OF ELECTRIC LIFT



MOTOR ROOM

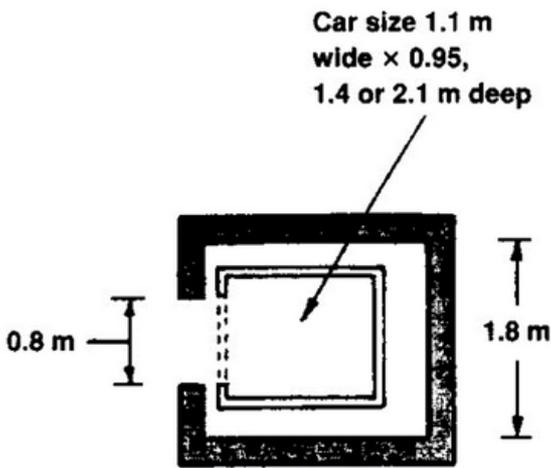


FIGURE 2.7.3: PLAN VIEW NTS



LIFT PIT

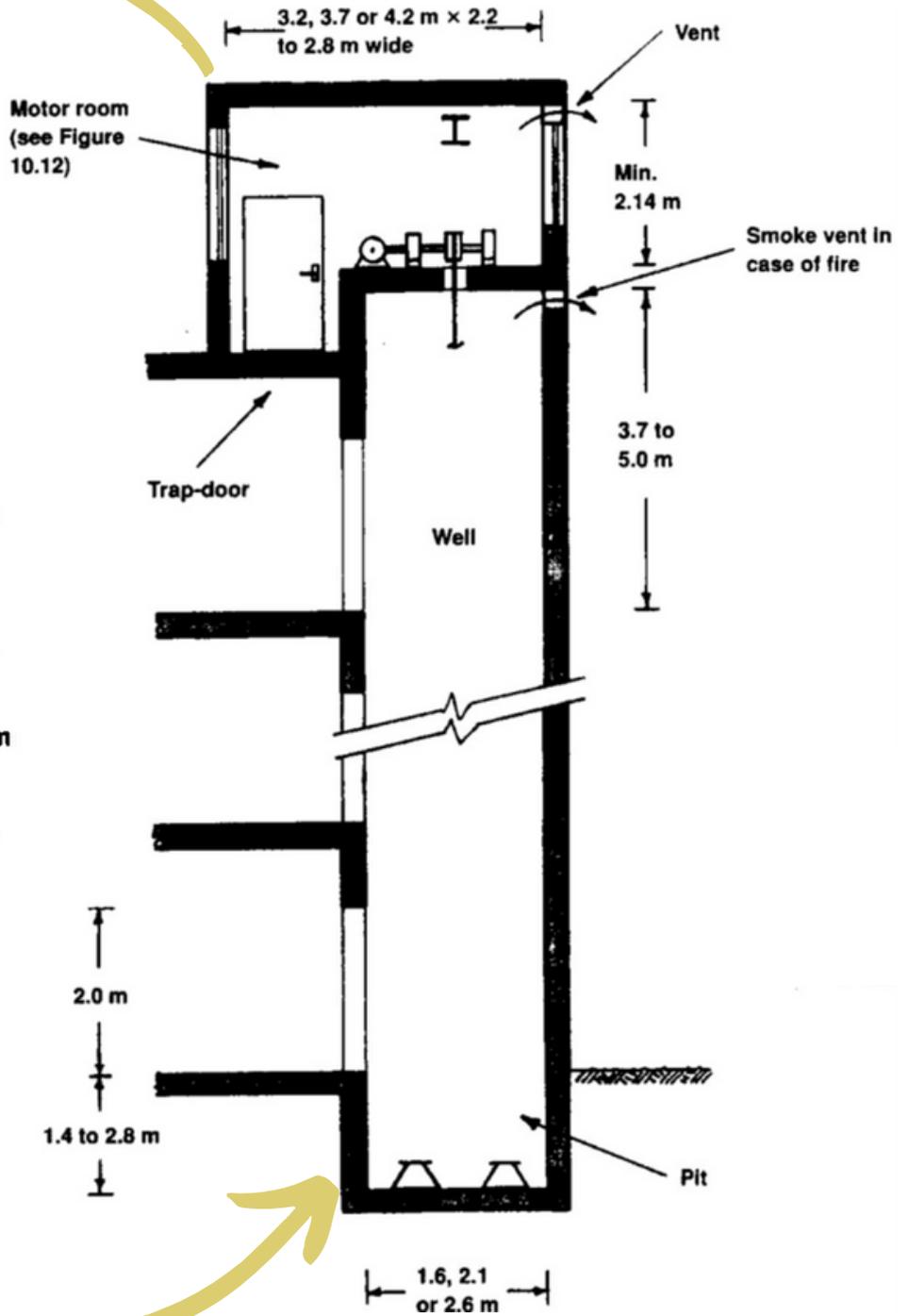


FIGURE 2.7.4: SECTION VIEW NTS

MACHINE/ MOTOR ROOM



MOTOR ROOM

- Noise from motors and winding gear must be contained with **adequate insulation and absorbent bedding** for machinery
- An overhead universal beam for raising and lowering equipment and parts during maintenance is essential
- **Adequate daylighting** and supplementary artificial light
- **Fan** assisted ventilation to remove excess heat from electric plant
- A **locked door** (key with security staff) provides the only access to the machine room, except for a trap-door over the landing area – this is specifically for raising and lowering items of machinery

MACHINE/MOTOR ROOM

Normally located above the well, containing:

- winding gear
- traction sheave
- control panel
- over speed governor, and other components

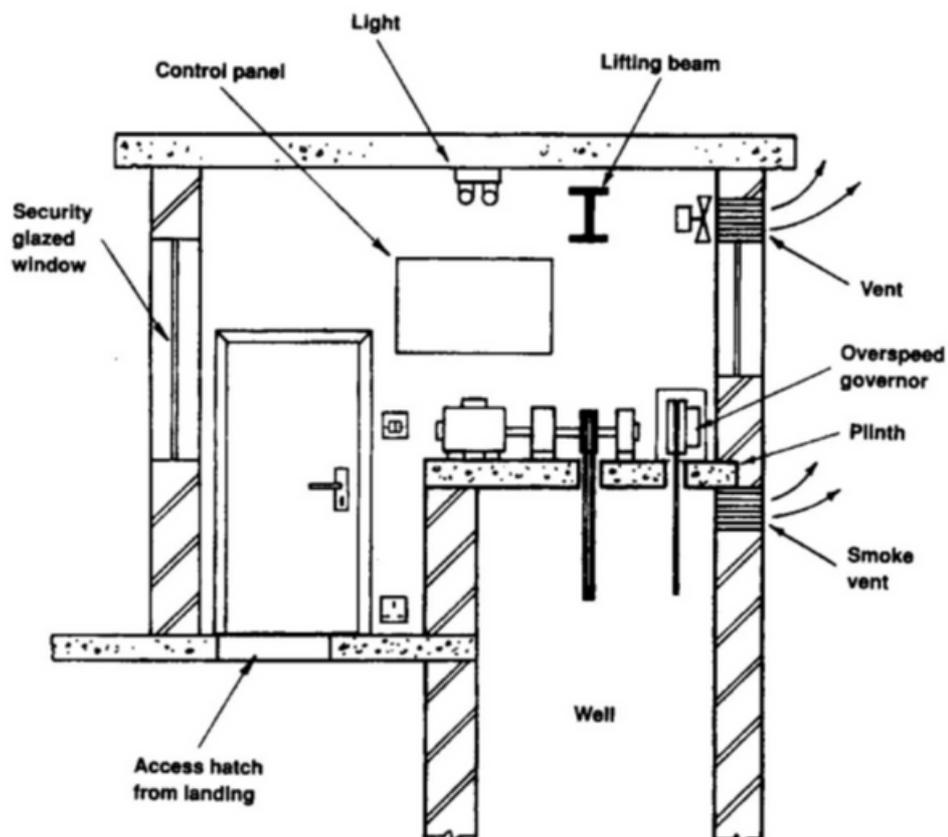


Figure 2.7.5 : Motor room's component

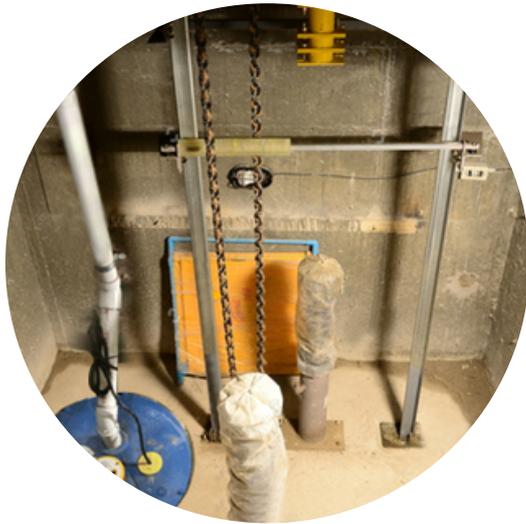


control panel



Overspeed governor

LIFT PIT



LIFT PIT

LIFT PIT

- Located below the lowest landing level, containing buffers
- For slower lifts - spring-type buffers
- For higher-speed lifts - oil loaded buffers
- **Depth** of pit varies from **1.4 to 2.8 m**, depending on lift specification

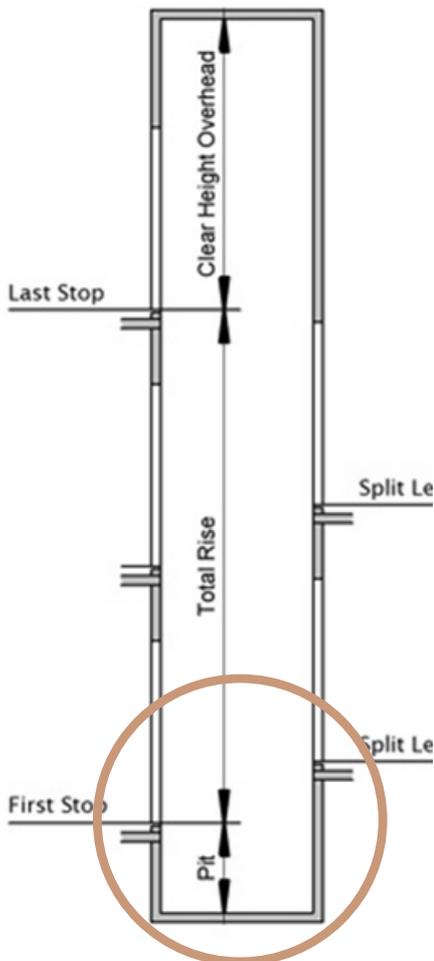
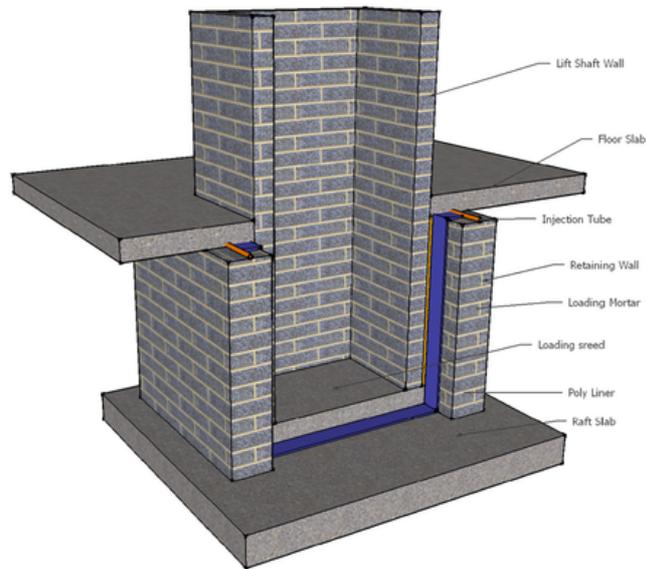


Figure 2.7.6 : Section of lift shaft

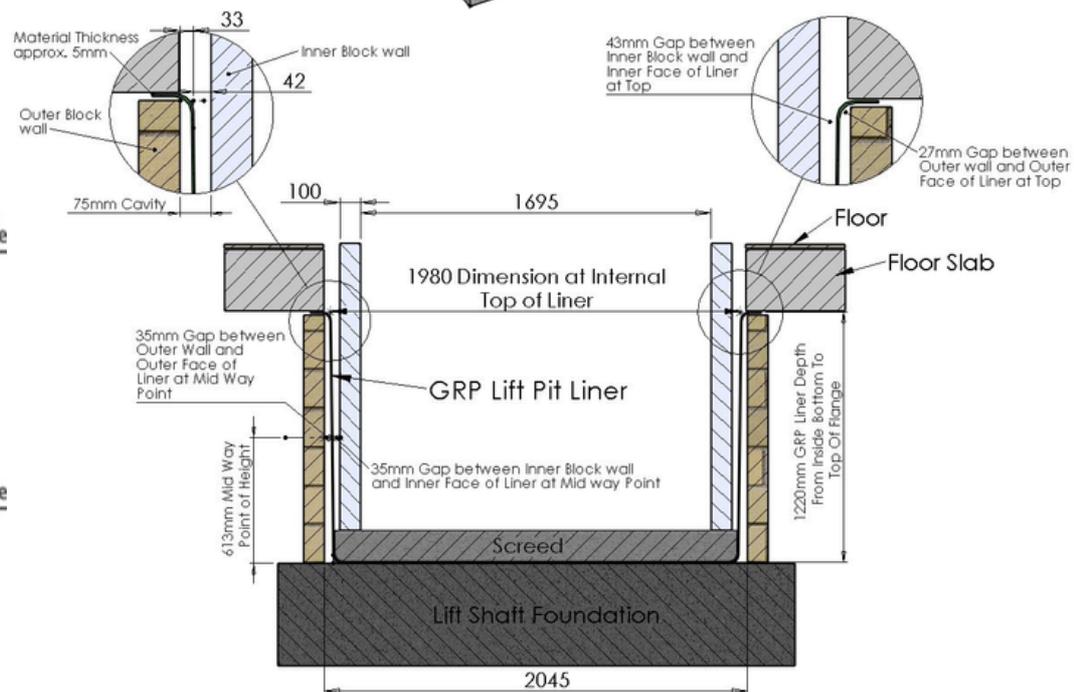


Figure 2.7.7 : Detail section of lift pit

LIFT SHAFT



LIFT SHAFT

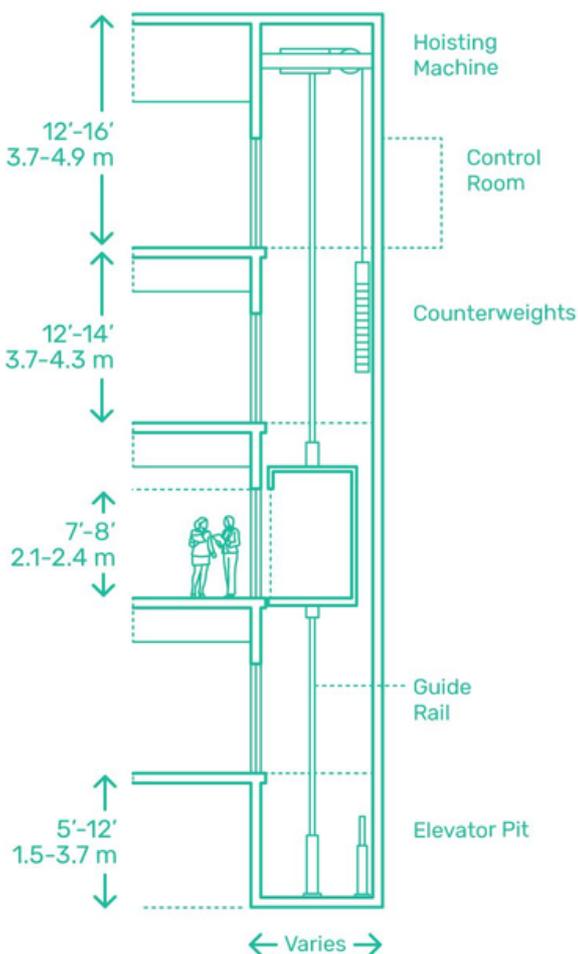


Figure 2.7.8 : Lift shaft section

LIFT SHAFT

A lift shaft should incorporate the following features:

- A Water tightness
- Means of drainage
- A Plumb, vertical sides
- A Smooth painted finish
- A Ventilation void for emission of smoke
- A Permanent inspection lights
- Have no other services except those necessary for operation of lif

✓ Correct GFA Plan Presentation For Lift Shaft

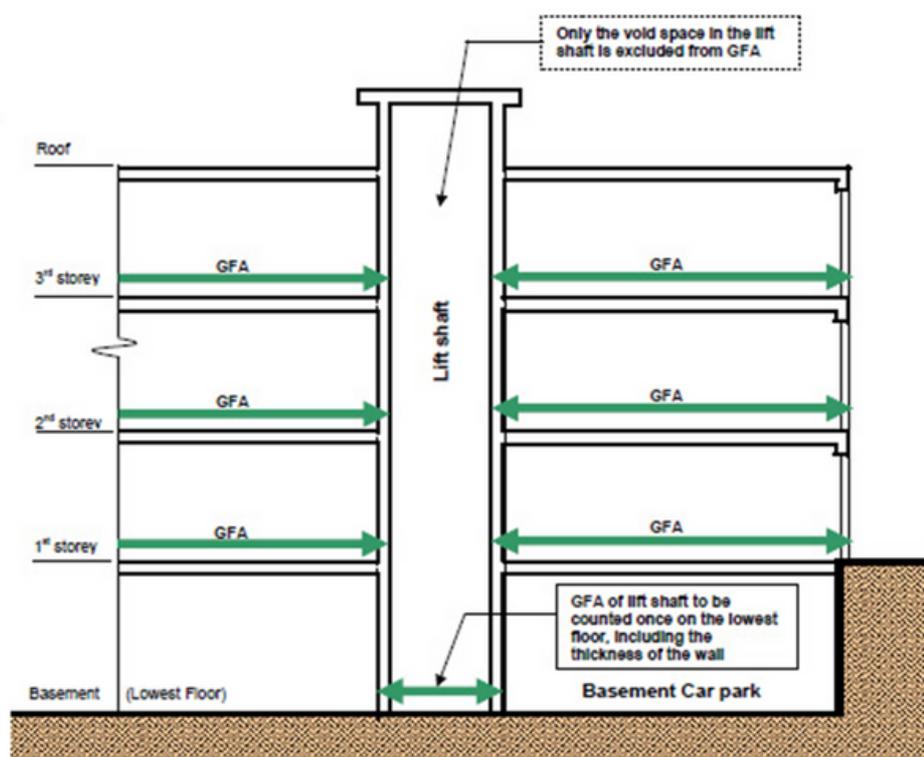


Figure 2.7.9 : Gross floor area calculation

2.7 TYPES OF ELEVATOR



2- HYDRAULIC LIFT

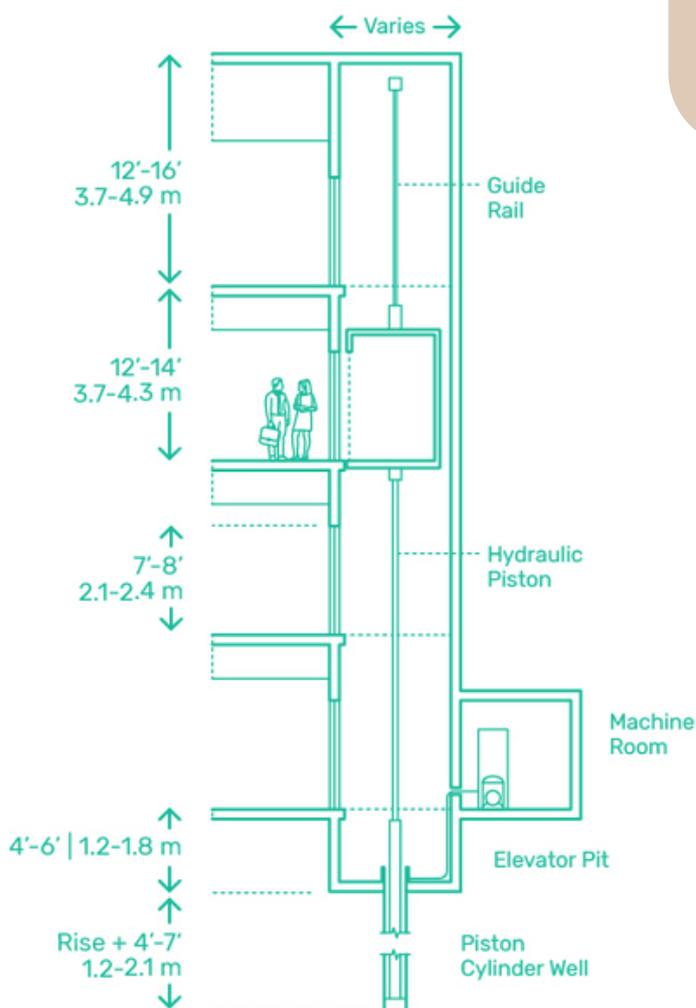


Figure 2.7.10 : Section of Hydraulic lift

HYDRAULIC

Hydraulic lift/elevator systems lift a car using a hydraulic ram, a fluid driven piston mounted inside a cylinder. Normally for low-rise buildings.

ADVANTAGES

- Capacity for very heavy loads
- Accuracy in floor levelling
- Smooth ride characteristics
- Low-level plant room
- No structural loads from winding gear
- Pump room can be located up to 10 m from the shaft

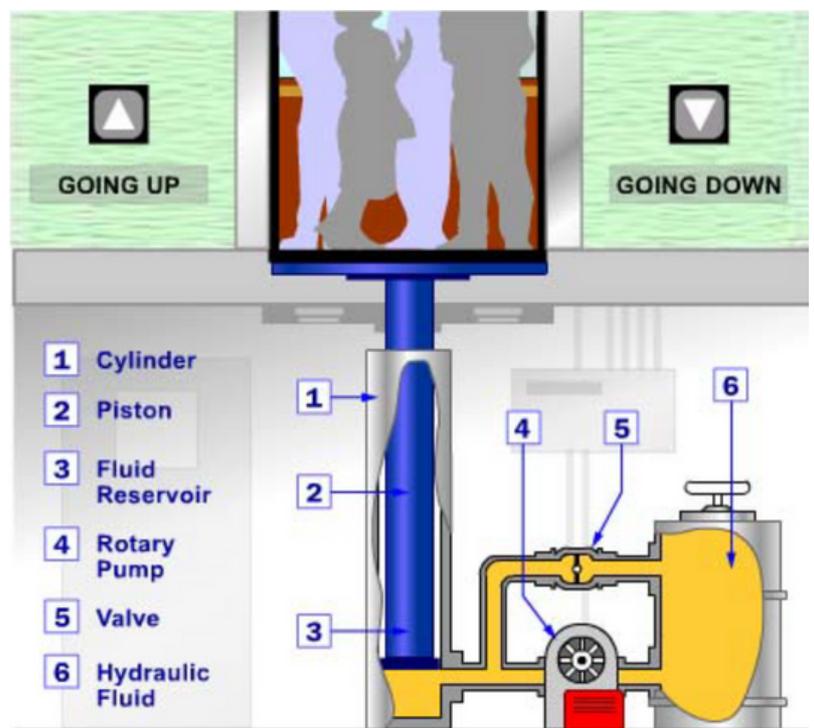


Figure 2.7.11 : Hydraulic lift components

2.7 TYPES OF ELEVATOR



3- FIRE-FIGHTING LIFT

Requires specific provisions:

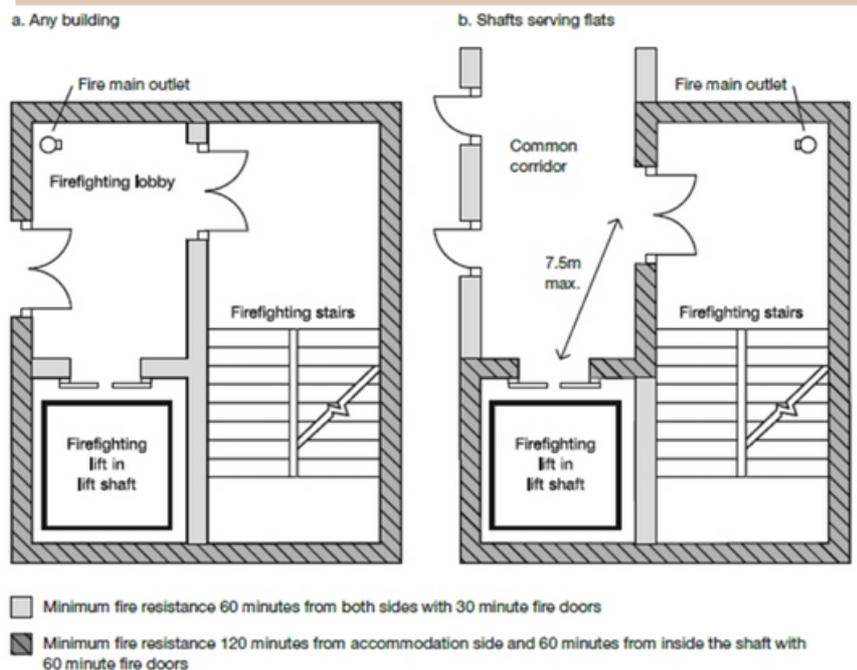
- **630 kg minimum** duty load to accommodate fire-fighting equipment
- Minimum internal dimensions of **1100 mm width, 1400 mm depth and 2000 mm height**
- An emergency hatch in the car roof
- Manufactured from non-combustible material
- A two-way intercom
- **1 hour fire-resisting doors** of 800 mm minimum width x 2 m height
- A maximum of 60 s capability to run the full building height
- Dual power supplies, one direct mains and the other an emergency generator

FIRE-FIGHTING ELEVATOR

This type of elevator for rapid emergency access. The original concept was a variation within conventional passenger lift, which contained a priority **break-glass** key switch. This elevator was normally at the ground floor, and when activated it brought the lift to that floor immediately. Independent fire-fighting lifts are required in offices, shops and other commercial premises exceeding 18 m in height. Shared shaft fire-fighting lift – the lift must be marked for that purpose only.



TYPICAL LAYOUT



Notes:

1. Outlets from a fire main should be located in the firefighting lobby or, in the case of a shaft serving flats, in the firefighting stairway (see Diagram b).
2. Smoke control should be provided in accordance with BS 5588-5:2004 or, where the shaft only serves flats, the provisions for smoke control given in paragraph 2.25 may be followed instead.
3. A firefighting lift is required if the building has a floor more than 18m above, or more than 10m below, fire service vehicle access level.
4. This Diagram is only to illustrate the basic components and is not meant to represent the only acceptable layout. The shaft should be constructed generally in accordance with clauses 7 and 8 of BS 5588-5:2004.

Figure 2.7.12: Typical fire-fighting accommodation in a shaft located no more than 60 m from any part of that floor level

2.8 CATEGORIES OF ESCALATOR

PASSENGER ELEVATOR

All types of passenger lifts with varying capacities and speeds. The most recent passenger lifts are equipped with a VVVF Close loop microprocessor Controller, a sophisticated steel cage, and cutting-edge electronic components for easy maintenance and low power consumption.



OBSERVATION/PANORAMIC/ SCENIC LIFTS

The glass-walled cars serve as a point of interest for passers-by, as well as a level of security for occupants, a mobile observation platform, and floor access for the user. Very common in atrium malls, where it complements the glass architecture. These lightweight structures lend themselves to hydraulic lifts, releasing building designers from the burden of superimposed motor room loadings.



STAIR LIFT

A mode of vertical transportation used in nursing homes, hospitals, and traditional homes with physically disabled residents. Designed for easy application to domestic chairs. The chair moves at about 0.15 ms^{-1} up an inclined rail parallel to the stair gradient, powered by a 230 V AC electric motor.



DOUBLE-DECK ELEVATORS

They are elevators with two elevator cars attached one on top of the other. This allows passengers on two consecutive floors to use the elevator at the same time, significantly increasing an elevator shaft's passenger capacity. Such a scheme could be useful in buildings where the volume of traffic would normally necessitate a single elevator stopping at each floor.



2.8 CATEGORIES OF ESCALATOR

PLATFORM ELEVATOR

A Platform Elevator is designed primarily to provide affordable access to those who have difficulty using a staircase. A fully enclosed shaft (normally rectangular tube) with relatively smooth internal walls is provided on Platform Elevators that serve between two or more floor levels.



DUMPWAITER

A dumbwaiter is a small freight elevator or lift that transports food. Dumbwaiters are frequently found connecting multiple floors in modern structures, including commercial, public, and private buildings. (wikipedia)

AUTOMOBILE ELEVATOR

Automobile Elevators are designed for moving cars in condominiums, car showrooms, garages, homes, and other locations. Our car elevators offer compact, simple basement or rooftop parking solutions for cities.



GOODS ELEVATOR

Goods elevators are used to lift heavy goods and items in a variety of industries. These goods elevators are precisely designed to have a high lifting capacity and a low-maintenance working mechanism. Its competitive pricing ensures that work orders for these goods lifts are completed in the shortest amount of time.

2.9 ELECTRIC VS HYDRAULIC LIFT

ELECTRICAL LIFT

BUILDING HEIGHT

Suitable for highrise building

MOTOR ROOM

Used electric and rope to run the lift car. Motor room located above the lift shaft

CAPACITY

Can carry medium loads.

WINDING GEAR

Winding gear to support loads from motor

SPEED

Can go fast and suitable for high-rise building

HYDRAULIC LIFT

BUILDING HEIGHT

Suitable for low-rise building

MOTOR ROOM

Used hydraulic piston to run the lift car. Motor room located below the shaft

CAPACITY

Can carry very heavy loads

WINDING GEAR

No structural loads from winding gear

SPEED

Not really fast but more accurate

TUTORIAL 1



QUESTION:

(a) With the aid of sketches, **design a suitable lift car arrangement** for the **15-storey apartment building** that can accommodate 300 pax occupants. Your sketch must **include one fire lift, lift lobby and any related dimensions**.

(b) Based on your sketches in Question (a), **illustrate a section of a lift car**. **Label and explain the function** of all components used in this type of lift.

ANSWER

PASSENGER ELEVATOR

a .According to capacity of occupants, the building needs **4 lift cars** to serve them. The arrangement that can be proposed are:

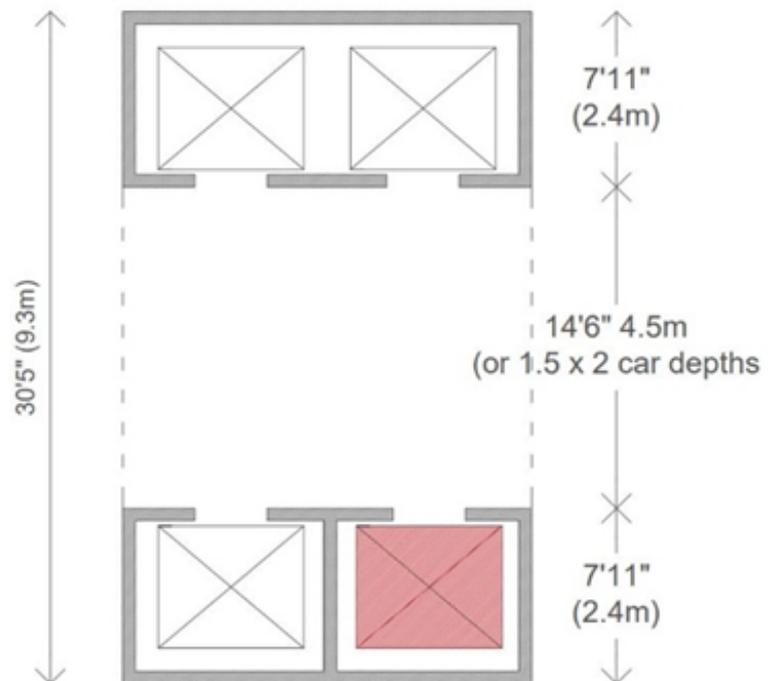
- i. **Opposite arrangement.**
- ii. **Side by side arrangement.**

Marks:

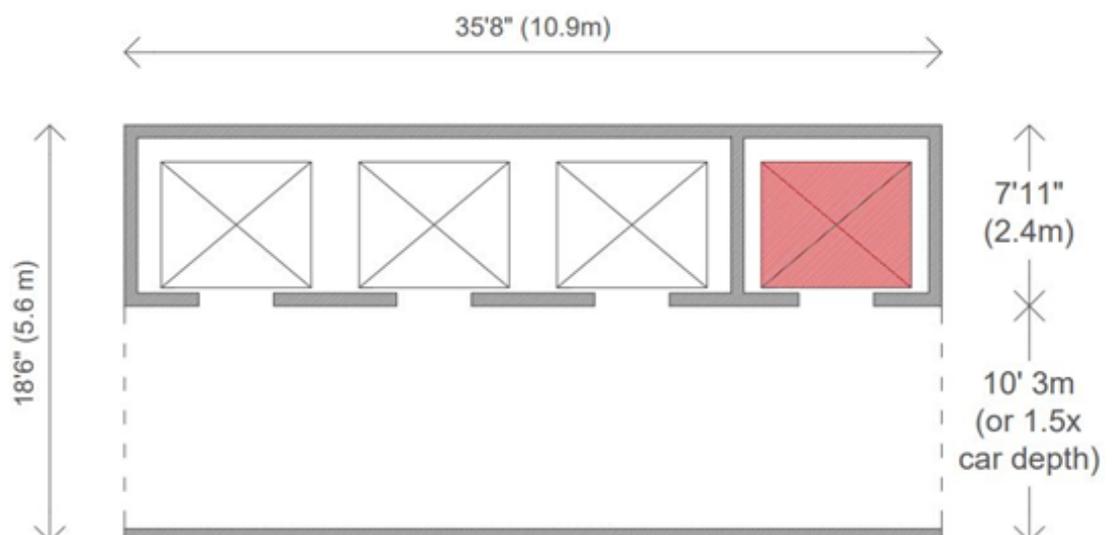
Complete sketch and labelling = 2 marks

Correct dimension = 3 marks

Total = 5 marks



Opposite arrangement.
Width of corridor = $1.5 \times 2A$;
where A is a width of lift



Side by side arrangement.
Width of corridor = $1.5A$;
where A is a width of lift

ANSWER

b. The section drawings

Marks:

Draw correct section - 2 marks

State correct equipment - 2 marks

State correct dimension - 2 mark

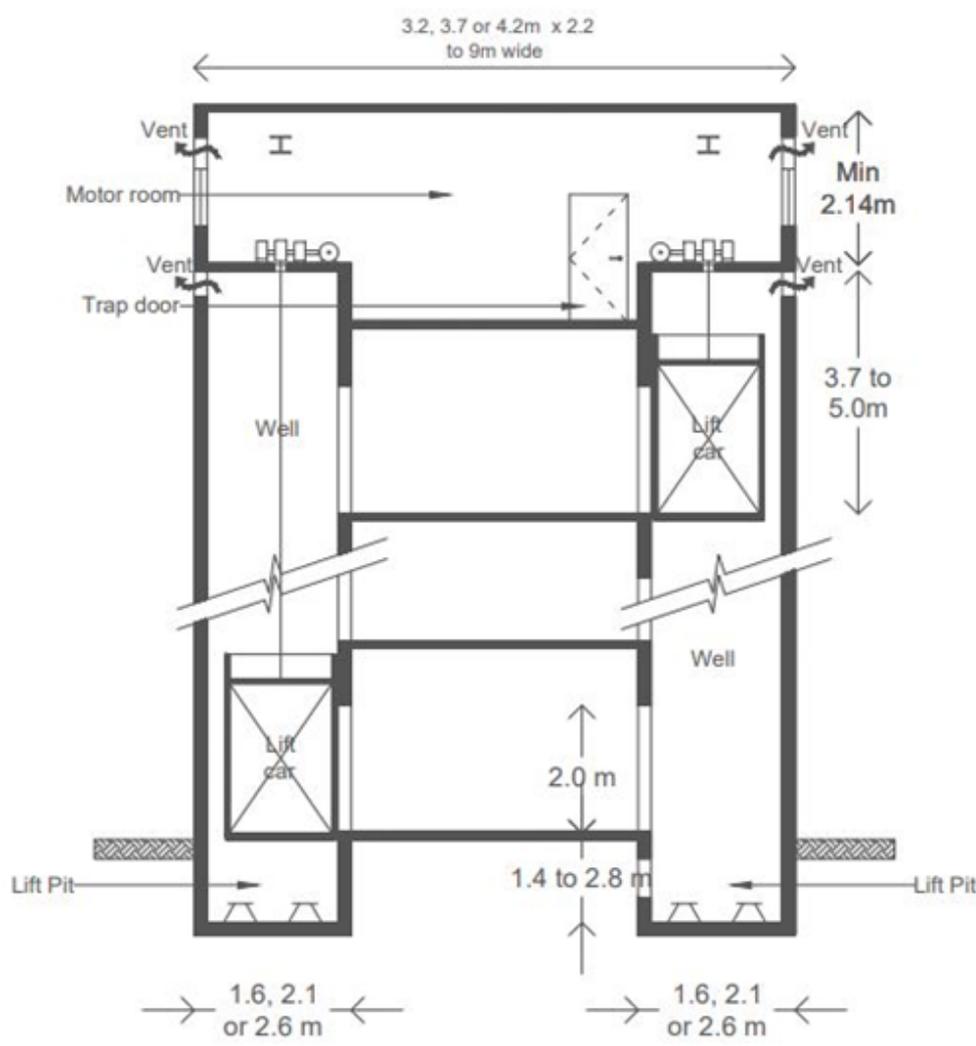
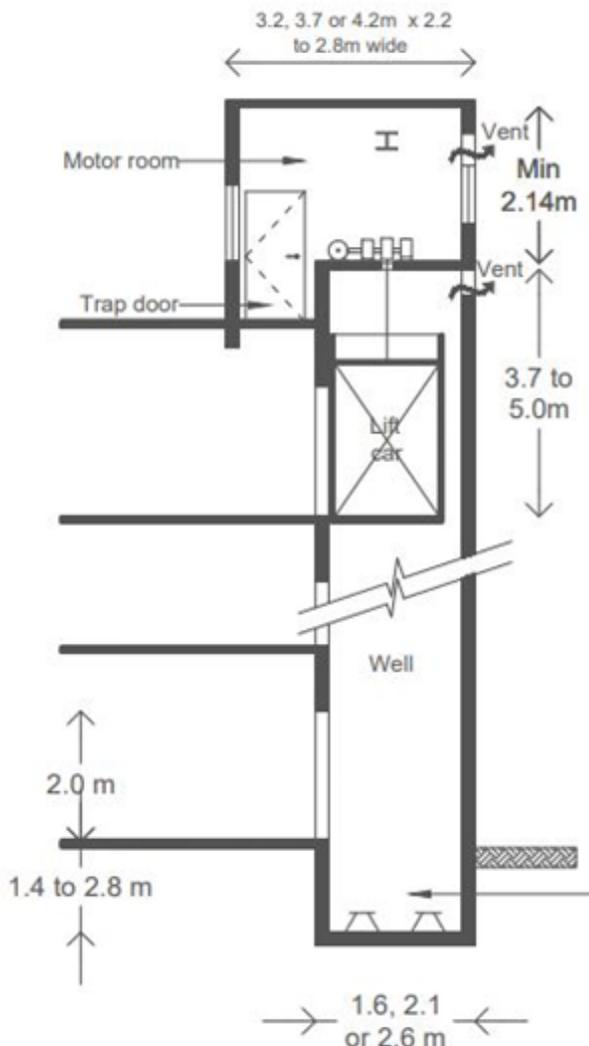
Function of the equipment's:

a) Lift Shaft/Well : To carry the lift car.
 b) Motor room : Motor room purposely to locate motor and for maintenance wise. Normally located above the well, containing: winding gear, traction sheave control panel, over speed governor and other components.

c) Lift pit: Located below the lowest landing level, containing buffers. - For slower lifts - spring-type buffers - For higher-speed lifts - oil loaded buffers
 Any 1 point carry 2 marks.

3 points x 2 marks = 6 marks

Total = **12 marks**





CHAPTER 3 ESCALATOR

OBJECTIVE 01.

Apply knowledge of building transportation system into design-based task (people habitat/ community building) in compliance with Uniform Building By Law (UBBL)

OBJECTIVE 02.

Analyze building transportation system's facilities in relation to architectural design



CHAPTER 3 ESCALATOR

3.1

INTRODUCTION TO
ESCALATOR

3.2

DESIGN & ARRANGEMENT
CONSIDERATION

3.3

FACTOR EFFECTS
ESCALATOR DESIGN

3.4

TYPE OF ESCALATOR &
COMPONENT

3.5

TYPE OF ESCALATOR &
COMPONENT

3.6

SPREAD OF FIRE / UBBL
REQUIREMENTS

3.7

ADVANTAGES &
DISADVANTAGE

3.1 INTRODUCTION TO ESCALATOR

An escalator is a type of conveyor transport device that consists of a staircase with steps that move up and down on tracks that keep the surfaces of the individual steps horizontal.

There will be a need for multiple escalators where huge crowds of people are expected, such as in airports, train stations, department shops, and shopping centres. These escalators can be organised in various ways to fit the needs of the building.

? *did you know?*

• That the word Escalator comes from the Latin word "**scala**" meaning steps, and Latin word "**elevatus**" meaning rise.

WHAT IS ESCALATOR?

Merriam Webmaster define escalator as;

- a power-driven set of stairs arranged like an endless belt that ascend or descend continuously or an upward course suggestive of an escalator
- an upward course suggestive of an escalator

source:

<https://www.merriam-webster.com/dictionary/escalator>

3.1 HISTORY OF ESCALATOR

During the construction of the great pyramids of Giza in ancient Egypt, escalators were used for the first time. To transport stone cubes to construction sites, a crude track made of tree trunks was used.

Nathan Ames of Massachusetts received the first escalator patent in the United States in 1859 for his "Revolving Stairs." Ames was an inventor who received several other patents. This creation was mostly speculative. His patent details reveal that he was vaguely unspecific about his invention's potential use or construction materials. His idea was never realised, and no working prototype of his revolving stairs was ever built.

" MY INVENTION CONSISTS IN ARRANGING STEPS, OR STAIRS, ON AN INCLINED ENDLESS BELT, CHAINS, OR ROPES, OR IN ATTACHING THE STAIRS OR STEPS TOGETHER BY LINKS OR JOINTS TO FORM AN ENDLESS INCLINED FLIGHT OF STEPS OR STAIRS, WHICH ARE PLACED ON, OVER, OR AROUND ROLLERS, SO THAT THE STAIRS OR STEPS SERVE AS ELEVATORS WHEN MOTION IS TRANSMITTED TO THE ROLLERS..."
(NATHAN)

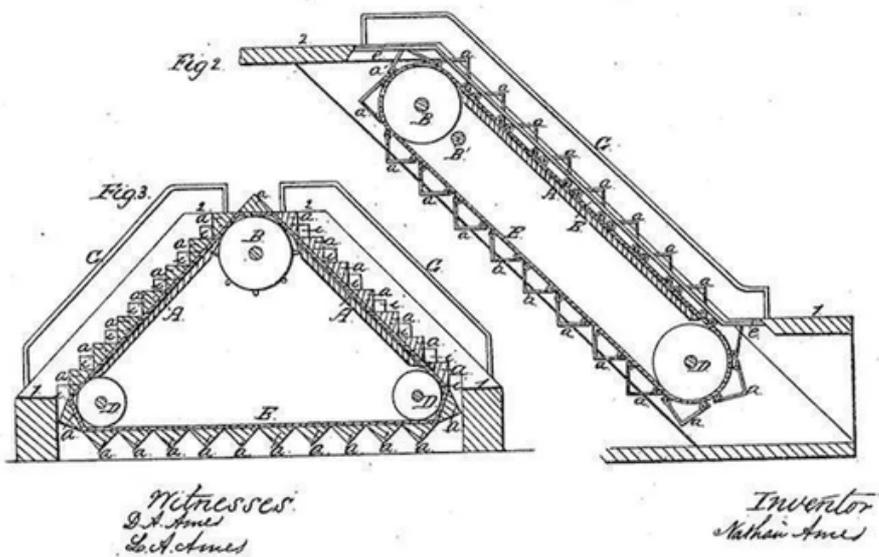
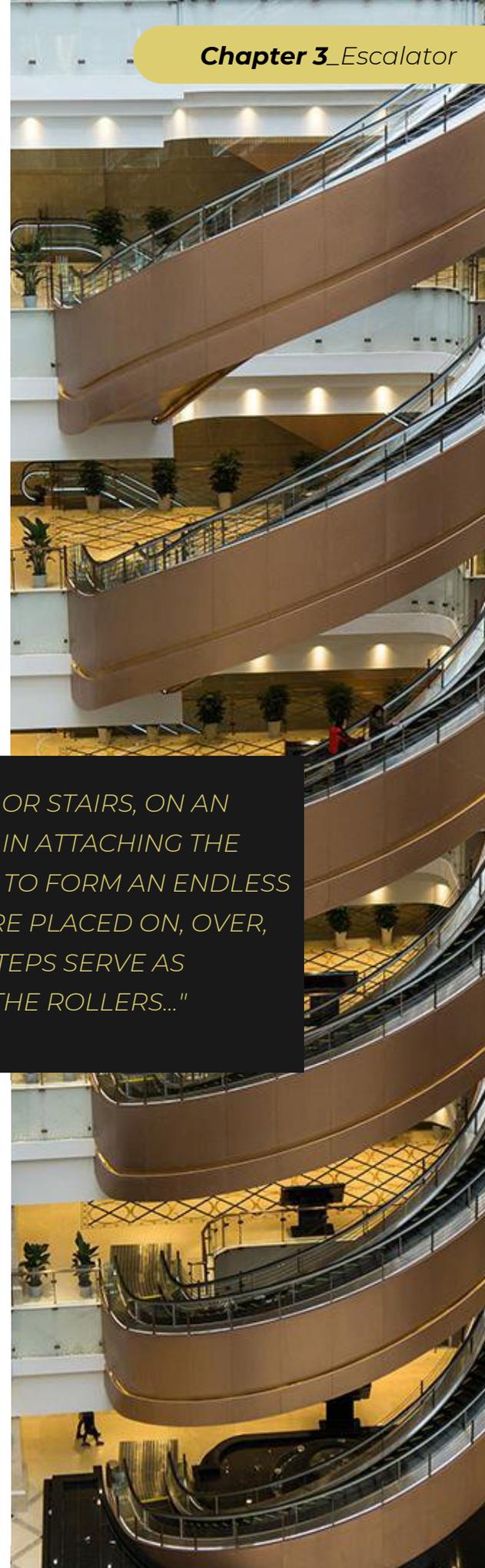


Figure 3.1.1 : Nathan's patent detail



3.2 DESIGN CONSIDERATION

Similar to moving sidewalks, escalators frequently use constant-speed alternating current motors to propel them forward at a pace of **1-2 feet (0.3-0.6 m) per second**. An escalator typically slopes to the horizontal floor level at an **angle of 30 degrees**, with a typical **rise of up to 60 feet (18 m)**.

Dimensions

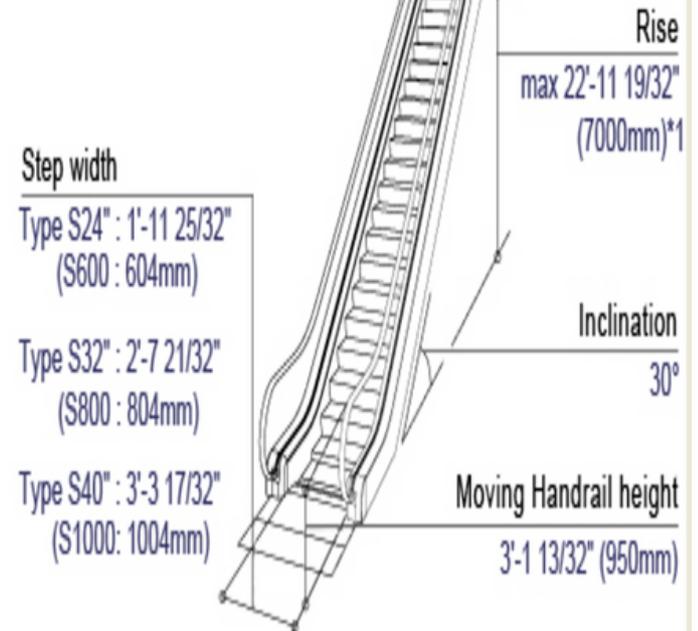


Figure 3.2.1: Detail dimension of escalator

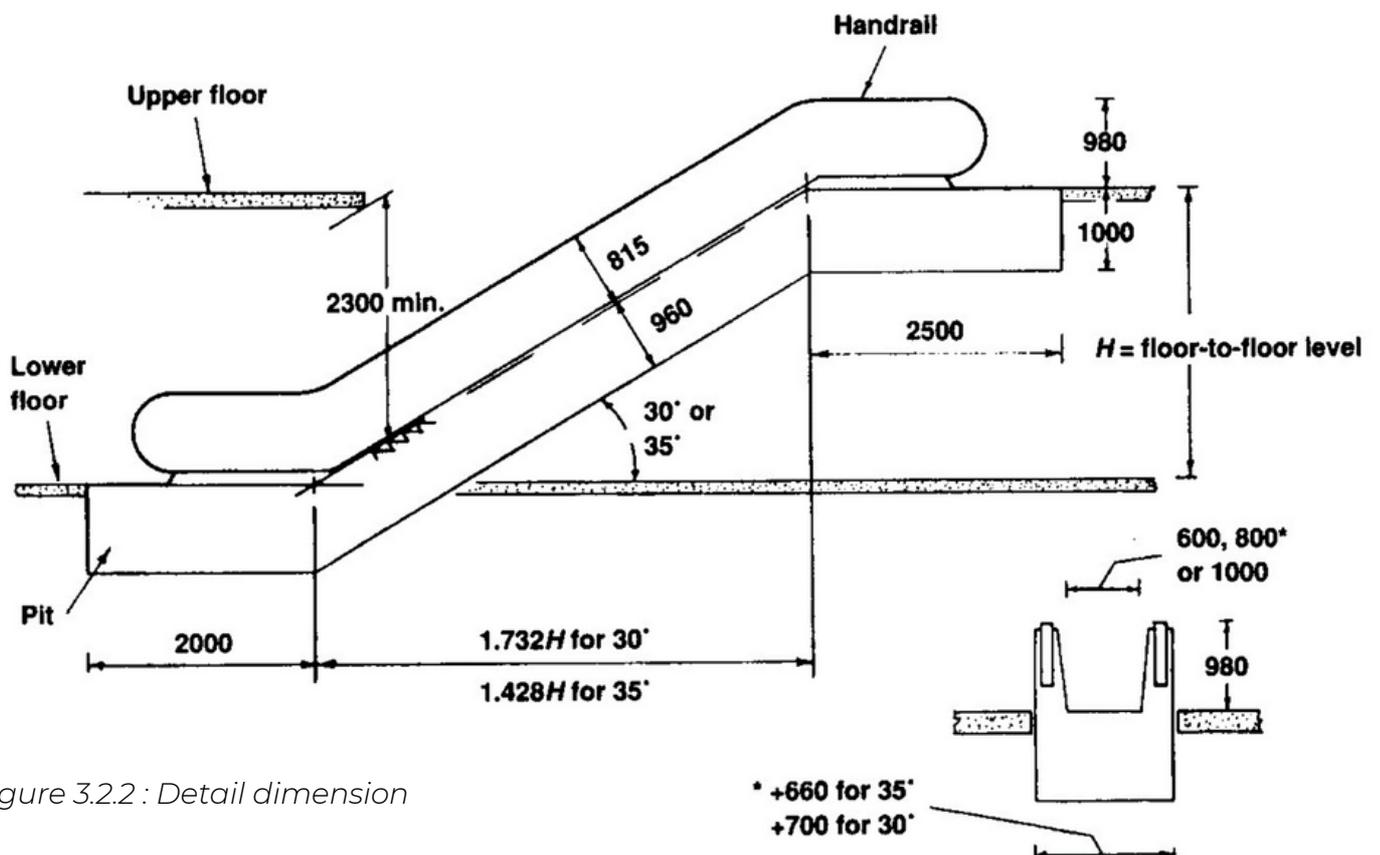
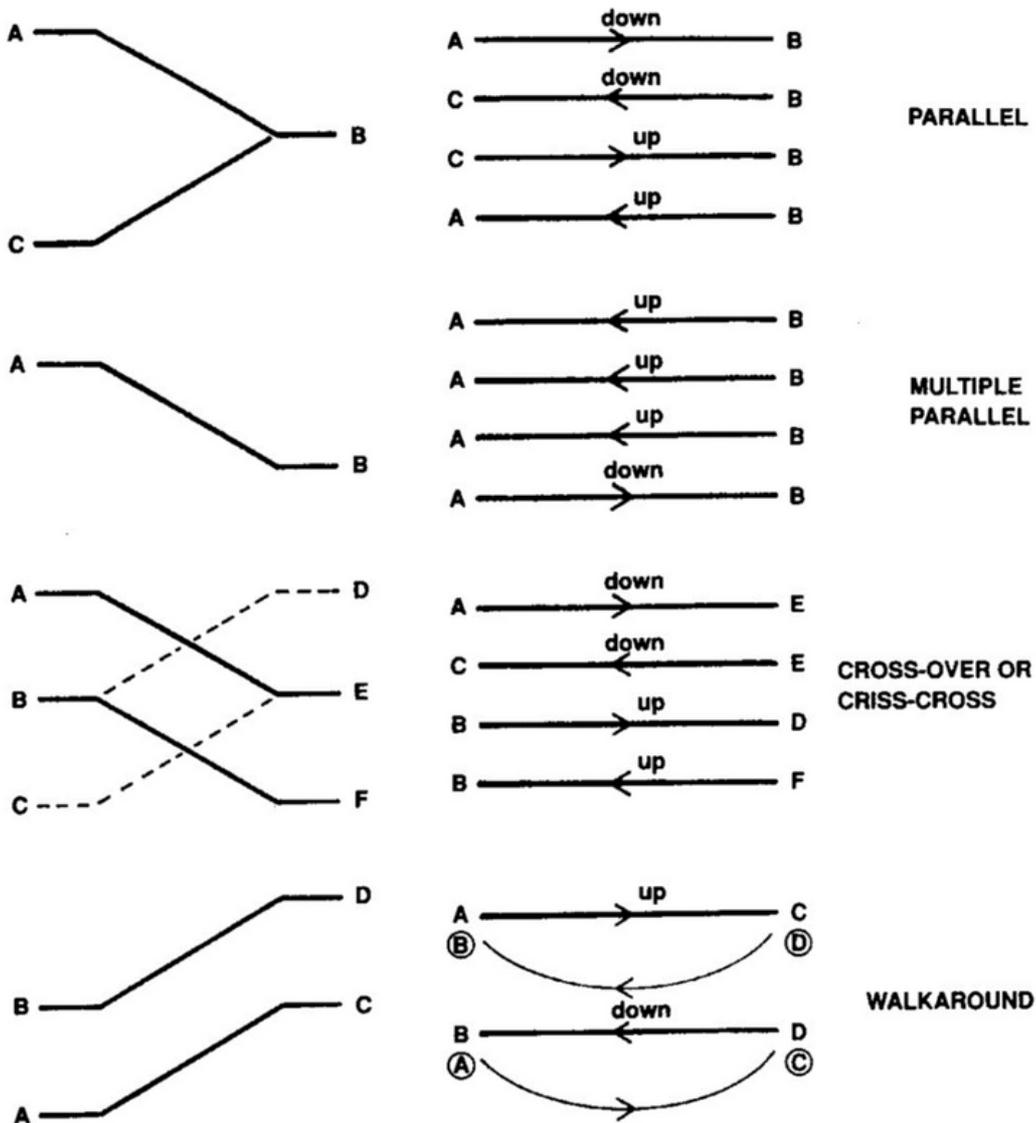


Figure 3.2.2: Detail dimension

3.2 ESCALATOR ARRANGEMENT



did you know?

UMEDA SKY BUILDING: THE WORLD'S HIGHEST ESCALATOR

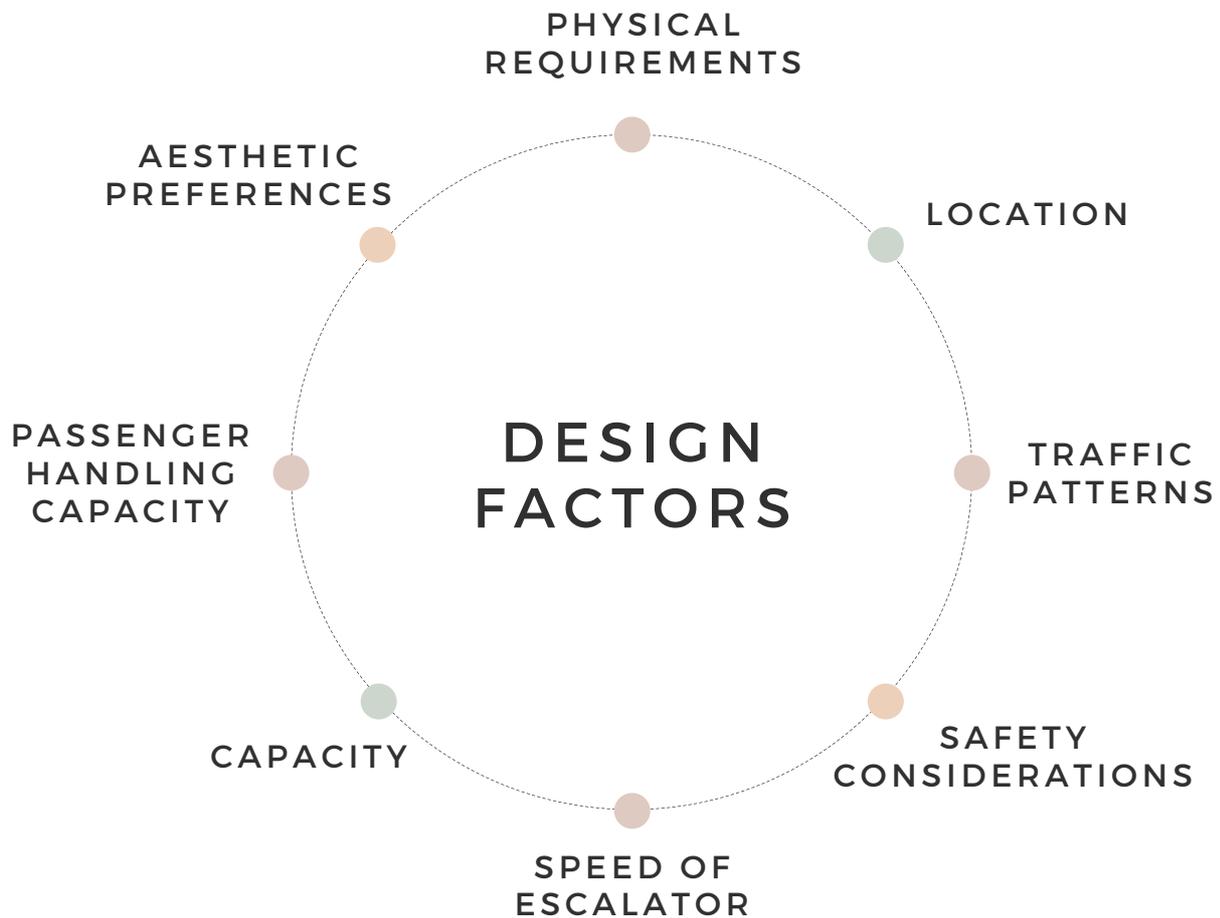
The Umeda Sky Building was designed by Hiroshi Hara and constructed by Takenaka Corporation. The 173 meter high structure has 2 escalators located at the top floor to connect the 2 buildings



<https://www.youtube.com/watch?v=jv-UYMjOKqc>



3.3 FACTORS EFFECT ESCALATOR DESIGN



video time!



LET'S SEE JAPAN ESCALATOR DESIGN!

<https://www.youtube.com/watch?v=P6pKmlSsUTo>



WACKIEST & WEIRD ESCALATORS

<https://www.youtube.com/watch?v=kWWSHiD-eBU>

3.4 TYPE OF ESCALATOR AND DESIGN



PARALLEL

Parallel escalator acers always face the same way. This type of escalator always takes up more floor space and looks great. This type of elevator is both more expensive and inefficient. Parallel escalators are frequently used for spiritual arrangements. This type of elevator can easily move from one floor to another.



MULTI PARALLEL

Multiple Parallel Escalator is a type of escalator that always moves in the same direction. Its primary function is to travel in a single direction. In order to keep up with the movement of the steps, an escalator must have a moving handrail. The primary function is to transport people and goods from one location to another. It saves time because it covers a large area.



CRISS -CROSS

Crisscross escalators are the most common type of escalator arrangement, with the upper and lower ends at opposite ends of the escalator. This type of escalator requires very little money to install. It also requires very little floor space and has the smallest structural requirements.



SPIRAL

This escalator is ideal for long distances. It requires the user to walk correctly and over long distances. Users can easily access without difficulty. This type of escalator will always be ideal in places like the mall, stations, and metro.

3.5 COMPONENTS OF ESCALATOR

Landing platform: The curved sections of the tracks, as well as the gears and motors that power the stairs, are housed on these two platforms. The motor assembly and main drive gear are located on the top platform, while the step return idler sprockets are located on the bottom.

Floor plate: It gives passengers a place to stand before stepping onto the moving stairs. This plate is flush with the finished floor and can be hinged or removed to provide easy access to the machinery below.

Deck board: These are used to prevent clothing from becoming entangled and other similar issues.

Balustrade: The escalator's side that extends above the step, including the interior panel, skirt guard, deck board, and moving handrails

Track: The truss incorporates a track system to give a reference the step chain, which the step continuously pulls from the bottom platform to the top in an endless loop.

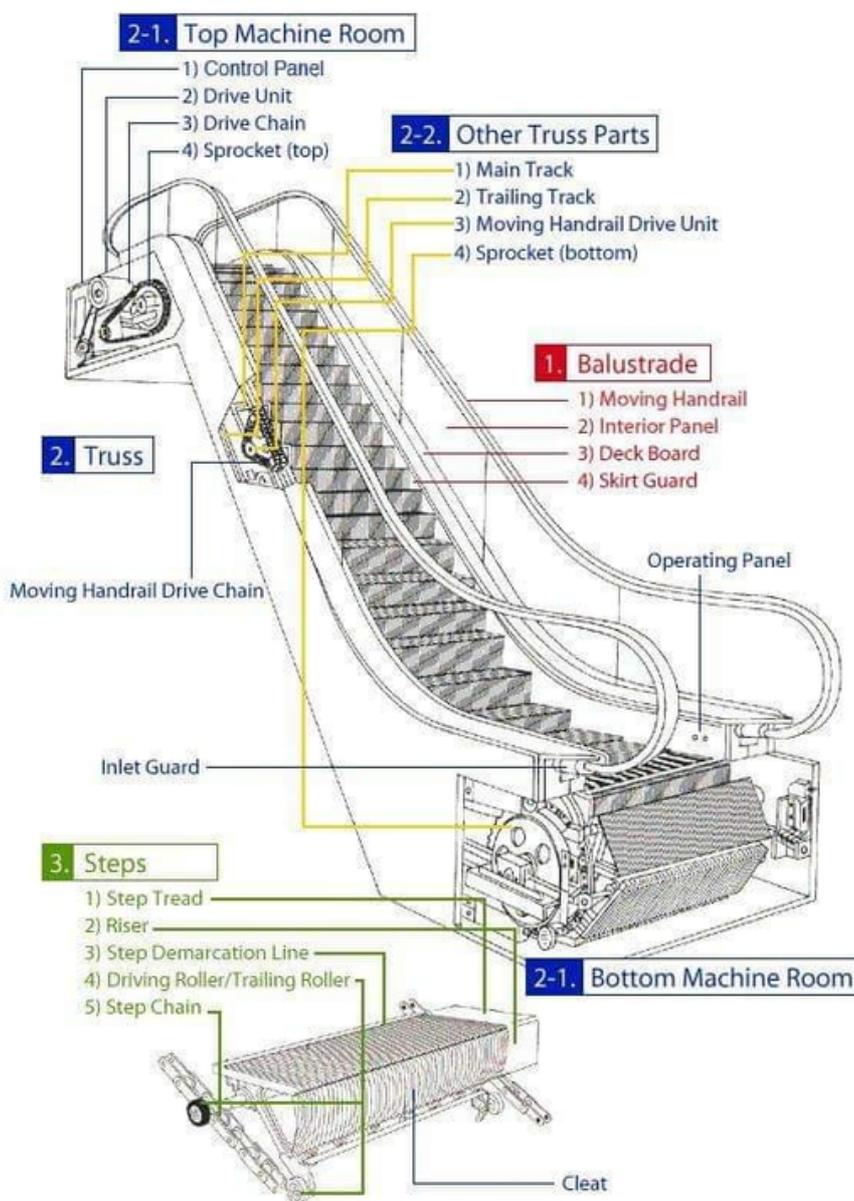


Figure 3.5.1: Escalator components

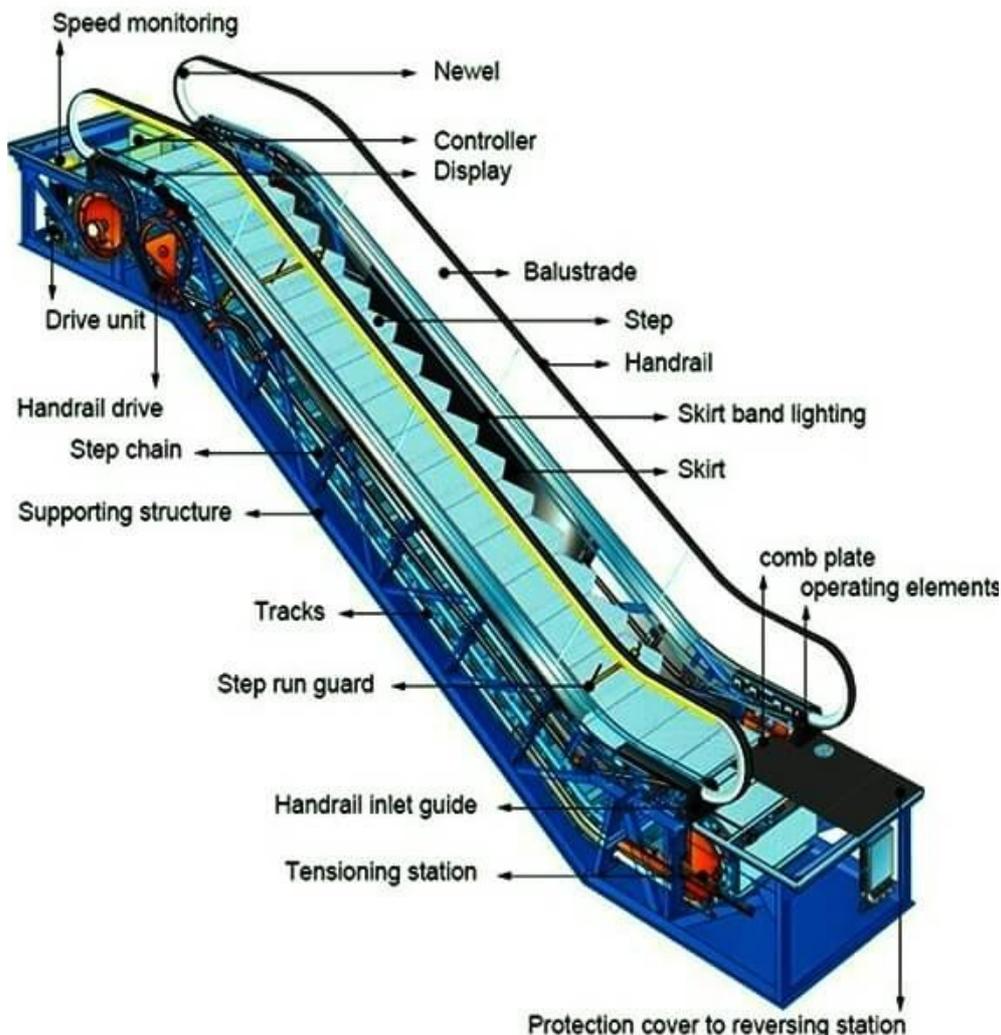


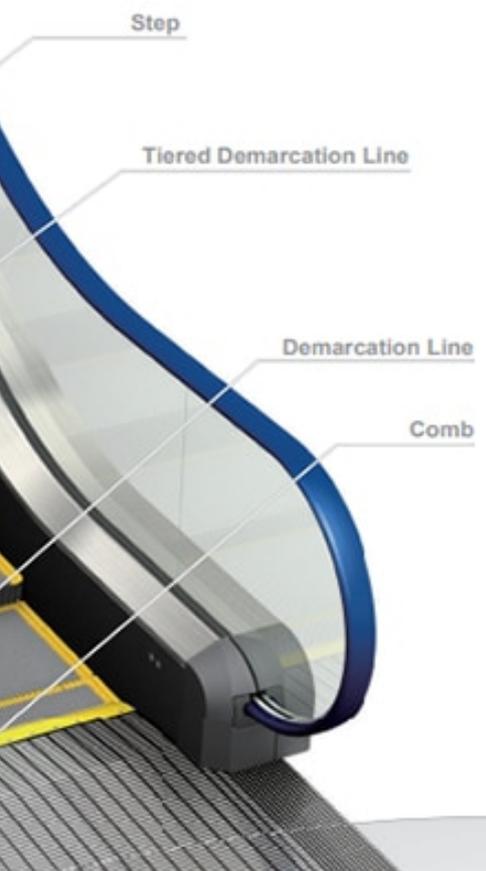
Figure 3.5.2: Escalator components

Modern escalators have single-piece aluminum or stainless steel steps that move on a system of tracks in a continuous loop.

Truss: The truss is a hollow metal structure that connects the bottom and top landings. It is made up of two side sections that are connected by cross braces across the bottom and just below the top. Steel or concrete supports connect the truss ends to the top and bottom landing platforms. The truss supports the entire straight track.

Steps: The steps are solid, one-piece die-cast aluminium or steel construction. A continuous metal chain that forms a closed loop connects the steps. The steps' front and back edges are each connected to two wheels. To fit into the wider back track, the rear wheels are set further apart, while the front wheels have shorter axles to fit into the narrower front track. These are essentially moving platforms that escalator passengers ride on.

Handrail: The handrail provides passengers with a convenient handhold while riding the escalator. The handrail on an escalator is pulled along the track by a chain that is connected to the main drive gear via a series of pulleys.



3.6 SAFETY, FIRE SPREAD & UBBL

FIRE SAFETY

The void containing the escalators may encourage fire to spread quickly throughout the building. As a result, the following precautions could be taken:

- **Sprinklers** were installed to create a continuous stream of water down the escalator void.
- **Fusible link or smoke** relay releases fire curtains or shutter mechanism to seal the top of the escalator shaft.
- **Escalator compartmentalization** or separation into a well- or fire-protected enclosure

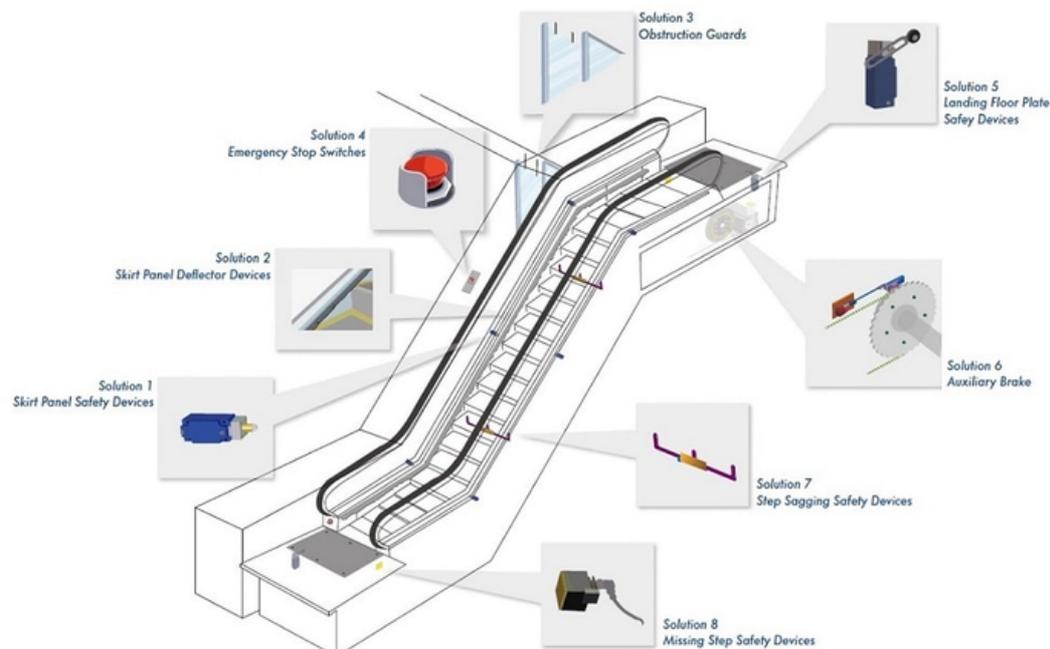


Figure 3.6.1: Escalator curtain compartment

Figure 3.6.2: Escalator safety elements

3.6 SAFETY ISSUES

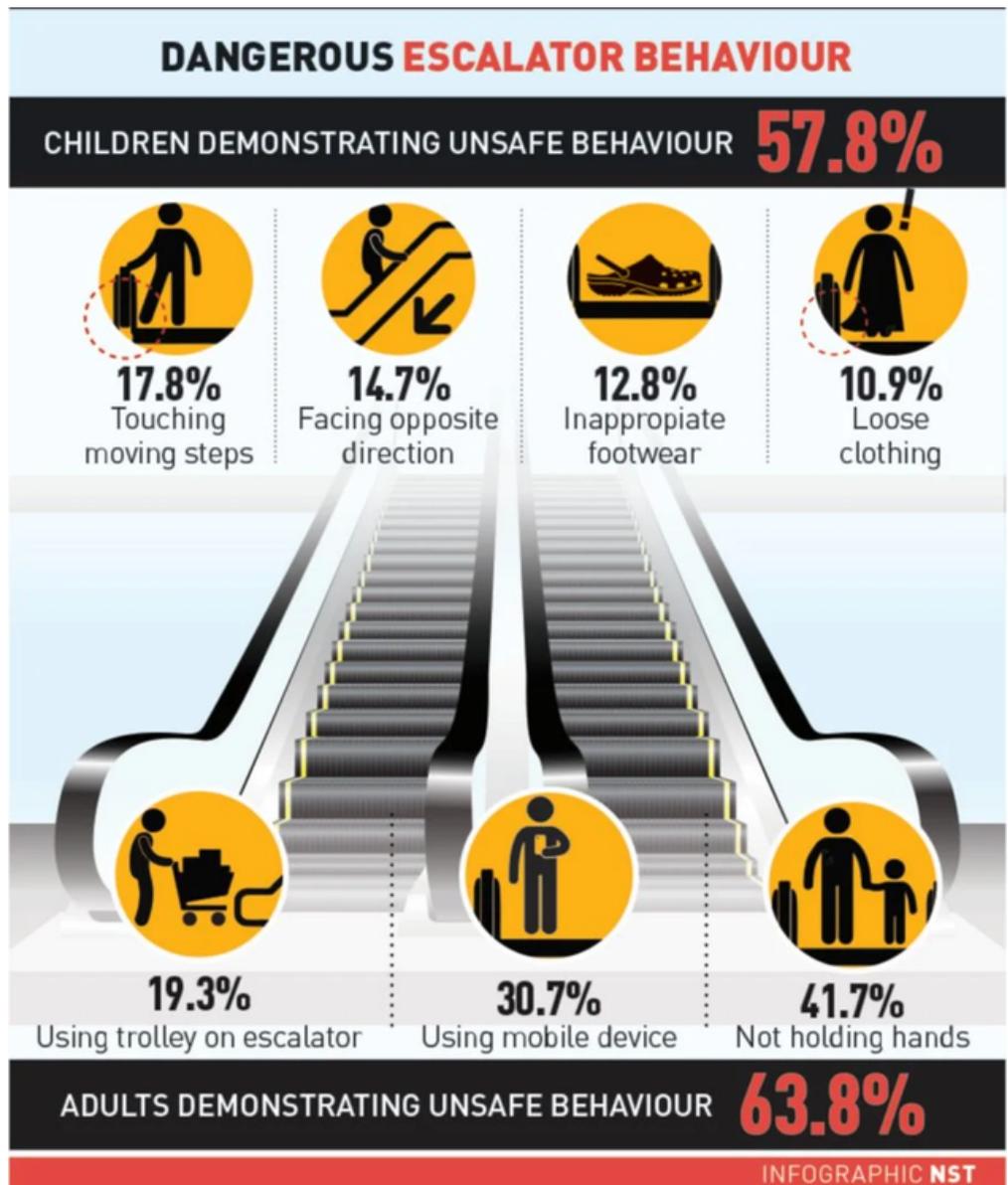
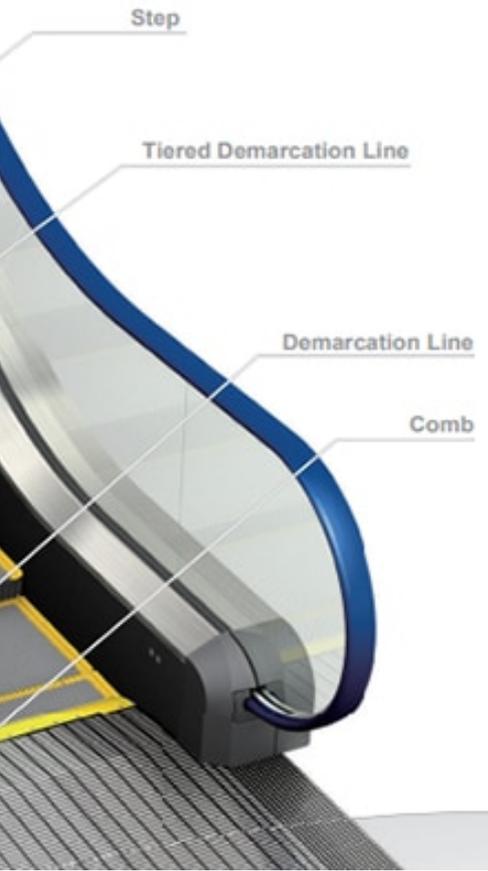


Figure 3.6.3 : Dangerous escalator behaviour
 (www.nst.com.my/opinion/letters/2017/07/253508/escalators-safety-tips)



ESCALATOR ACCIDENT IN MALAYSIA.

In Malaysia, deaths and permanent physical disabilities accounted for **14% of the 85 elevator- and escalator-related injuries**. One of the leading causes of these accidents was the wrongful use of the elevator and escalator.

WATCH this ESCALATOR SAFETY TIPS:

 <https://www.youtube.com/watch?v=3WKnSWpP1AA>

CAUTION
 Passengers Only



Hold Handrail
Attend Children
Avoid Sides

3.7 ADVANTAGES & DISADVANTAGES

ADVANTAGES

HELPS A LARGE
NO. OF PEOPLE
IN MOVING

HELPFUL FOR THE
PEOPLE THAT
HAVE PAIN

MEAN OF GUIDANCE
AND CIRCULATION

SPEED CAN BE
ADJUSTED

WHEN TURNED
OFF THEY CAN BE
USED A
STAIRCASE

WASTE OF ENERGY
WHEN NOT IN USE

POSSIBLE INJURIES
WHEN STOPPED
SUDDENLY

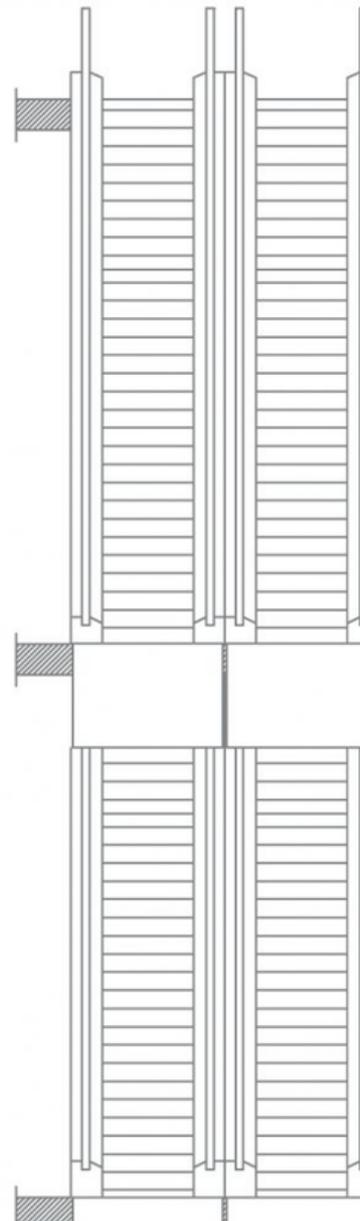
SOURCE OF FEAR
FOR SMALL
CHILDREN

DISADVANTAGES

TUTORIAL 2



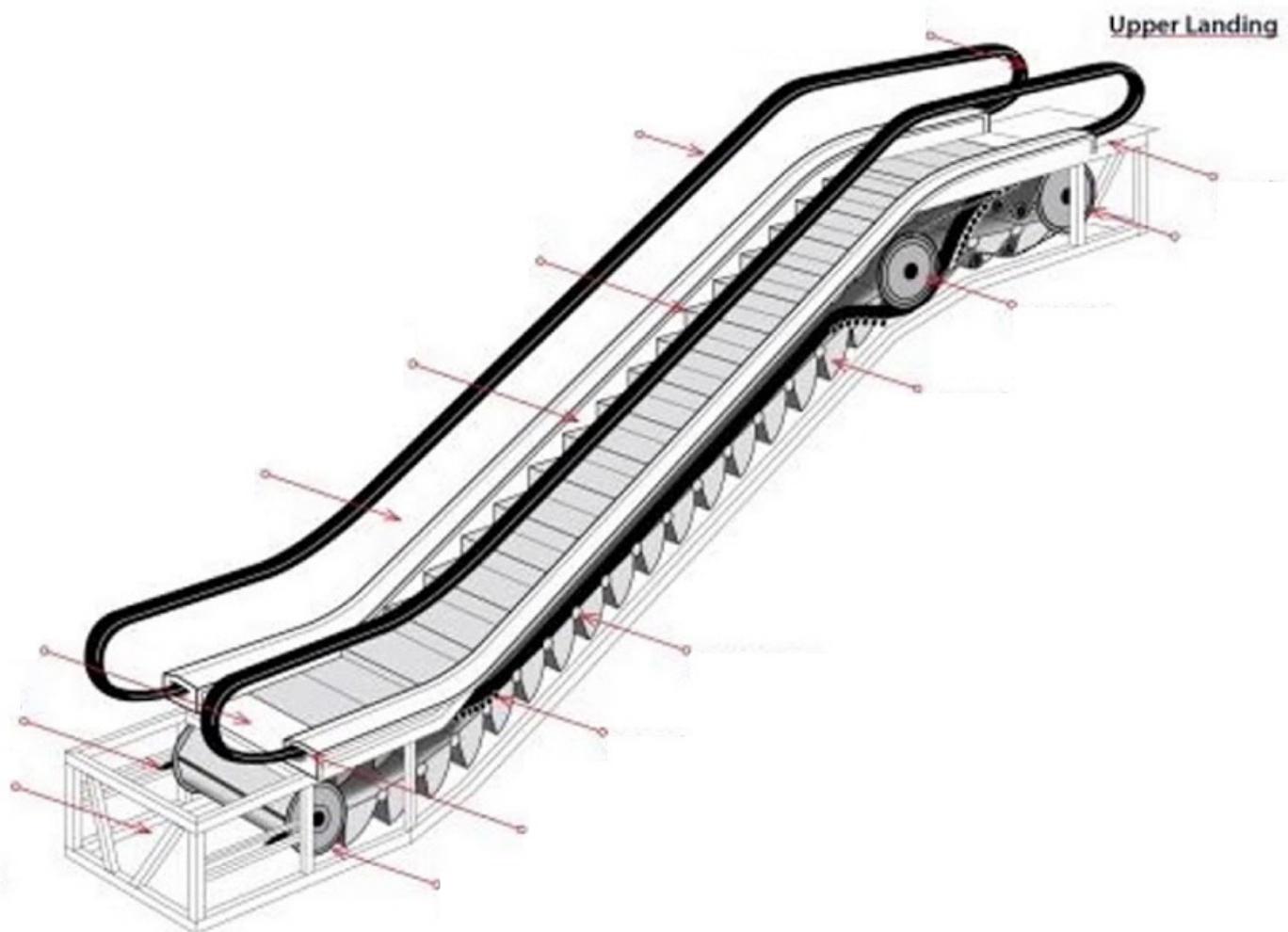
"Let's do some exercise!
Fill in the components!"



Instruction:

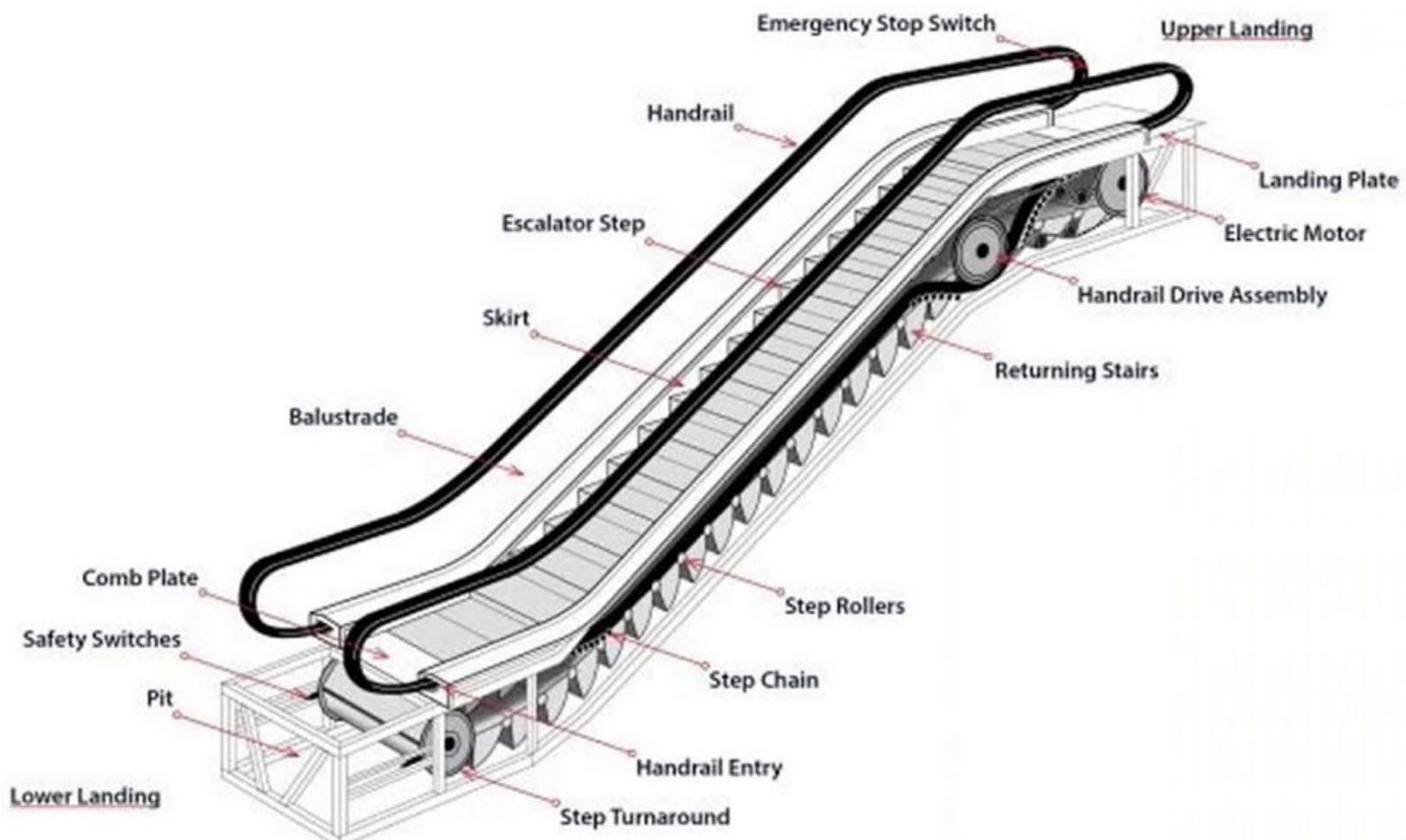
Based on this diagram,
NAME all the required
components

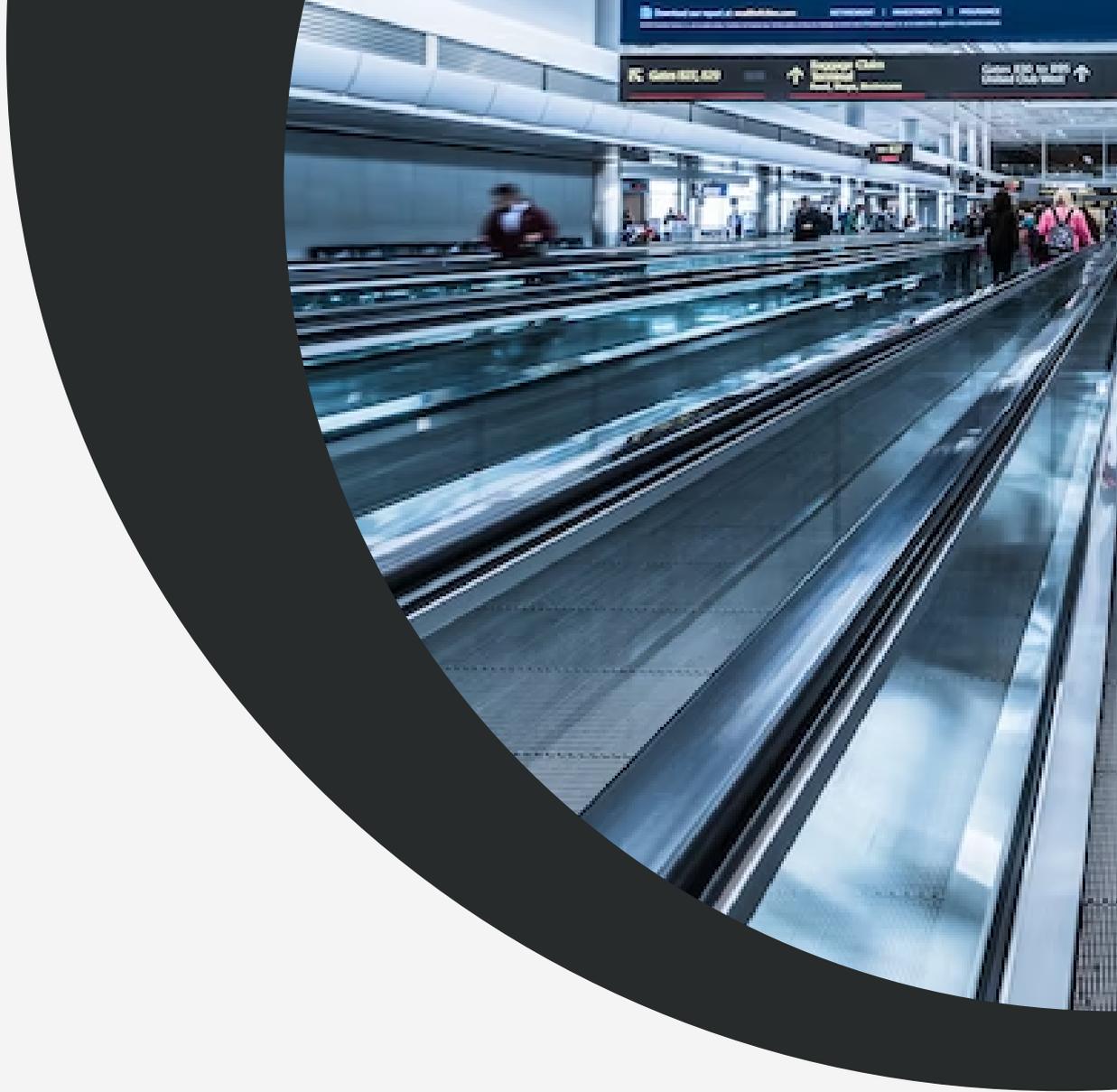
Parts of an escalator



Answer of the tutorial

Parts of an escalator





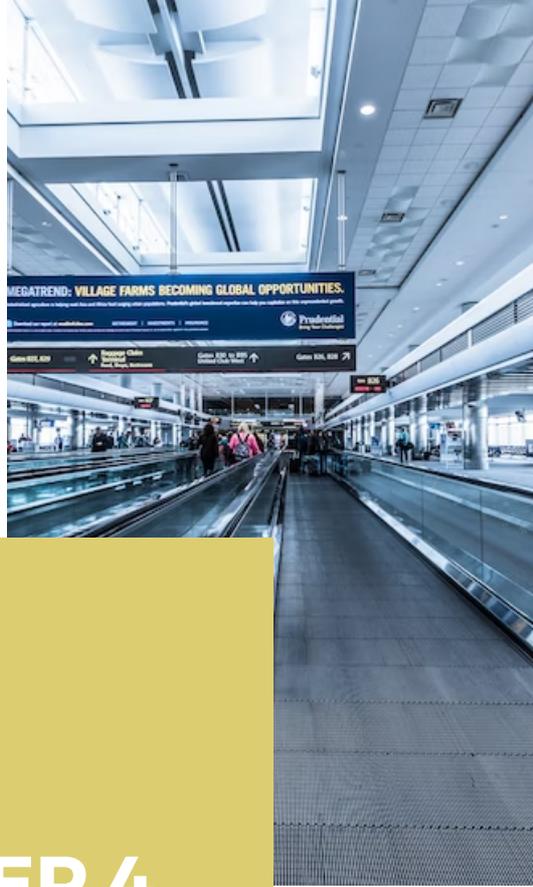
CHAPTER 4 TRAVELATOR

OBJECTIVE 01.

Apply knowledge of building transportation system into design-based task (people habitat/ community building) in compliance with Uniform Building By Law (UBBL)

OBJECTIVE 02.

Analyze building transportation system's facilities in relation to architectural design



CHAPTER 4 TRAVELATOR

4.1 INTRODUCTION TO TRAVELATOR

4.2 TRAVELATOR TYPE & DESIGN

4.3 TRAVELATOR SYSTEM

4.4 ADVANTAGES & DISADVANTAGES

4.1 INTRODUCTION TO TRAVELATOR

A travelator is a conveyor-type device that transports people over longer horizontal distances more quickly and easily than walking. A moving sidewalk, autowalk, or moving walkway is another name for a travelator.

A travelator (also spelled travolator or travellator) is a type of escalator that transports people horizontally rather than diagonally from floor to floor.

These moving walkways are commonly found in airports, where walking distances, particularly between concourses or terminals, can be quite long. As with an escalator, a person can step onto the autowalk and simply stand, allowing the travelator to transport the passenger from one end to the other. If not, the person on the moving sidewalk may continue to move forward, effectively doubling their speed and enabling them to get to the end more quickly.

WHAT IS TRAVELATOR?

Oxford Dictionary stated that a travelator **is a moving path, especially at an airport.**

(<https://www.oxfordlearnersdictionaries.com/definition/english/travelator>)

While Collins Dictionary state the same meaning, travelator is a **moving pavement for transporting pedestrians, as in a shopping precinct or an airport**

(<https://www.collinsdictionary.com/dictionary/english/travelator>)

4.2 TYPE AND DESIGN

A moving walkway, moving sidewalk, or travelator is a slow conveyor belt that transports people horizontally up to the practical limitations of about **300 m**. There are several type of travelator design;

- + Horizontal moving walk
- + Ramped horizontal moving walk
- + Incline moving walk
- + Criss-cross



Side view.

Horizontal moving walk.



Side view.

Ramped horizontal moving walks: Where no continuous pit is possible. The inclination of the ramp can be up to 12° [maximum 4° when pallet width exceeds 40" (1000 mm)].

***Source:**

Escalators and moving walks planning guide
(TyssenKrupp;2011)



HORIZONTAL

Horizontal travelator at Incheon Airport, Korea



HORIZONTAL

Vertically staircase movement



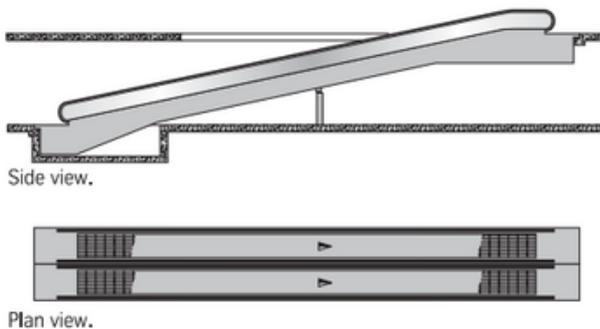
RAMPED HORIZONTAL

Horizontally transportation system

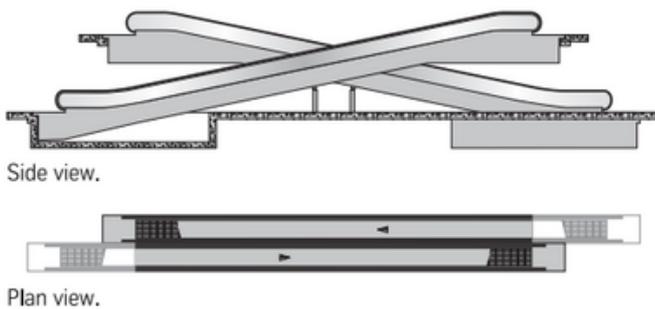
4.2 TYPE AND DESIGN

They are especially useful in large railway and airport terminals, as well as shopping malls, and can be inclined up to about **15 degrees** where there are level differentials.

Moving Walks:



Inclined moving walks in parallel.



Criss-cross arrangement: Moving walks with top and bottom transition curve in criss-cross arrangement.

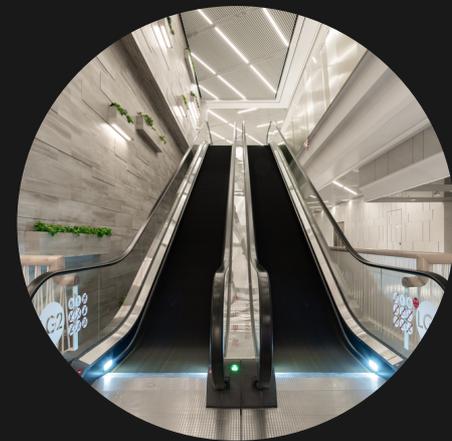
*Additional notes:

- Upper well ventilation is not required for escalators and moving walks.
- A lower pit-floor cut-out is required to house the oil-water separator for outdoor applications.



INCLINED MOVING

Inclined moving in supermarket



INCLINED MOVING

Incline moving used to connect one floor to another floor vertically

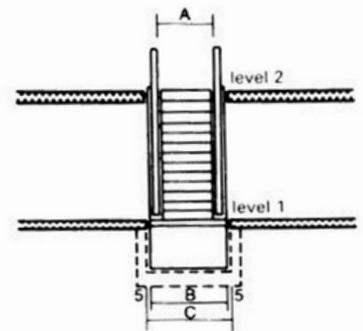
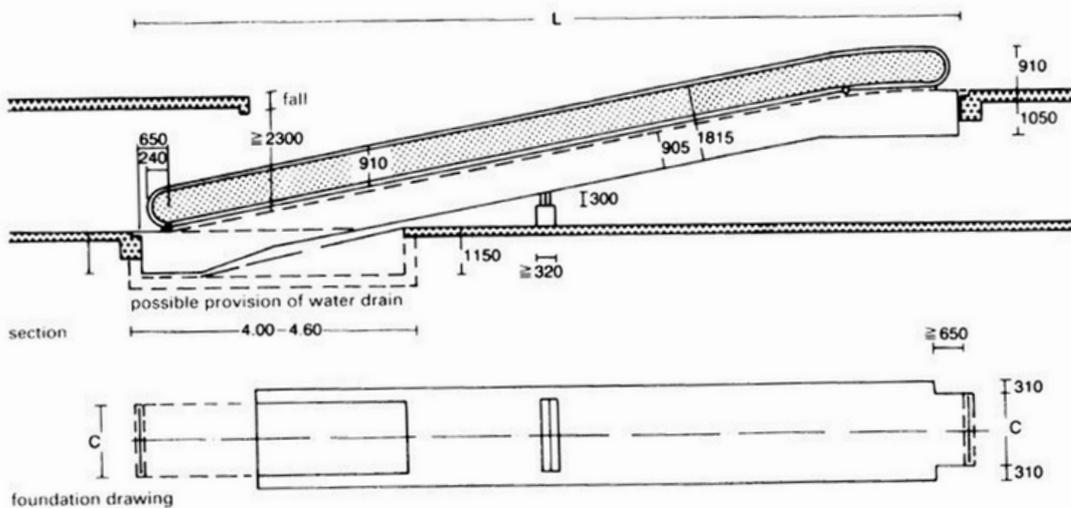


CRISS-CROSS

Horizontally transportation system

4.3 TRAVELATOR SYSTEM

"Transports people horizontally up to the practical limitations of about 300 m"



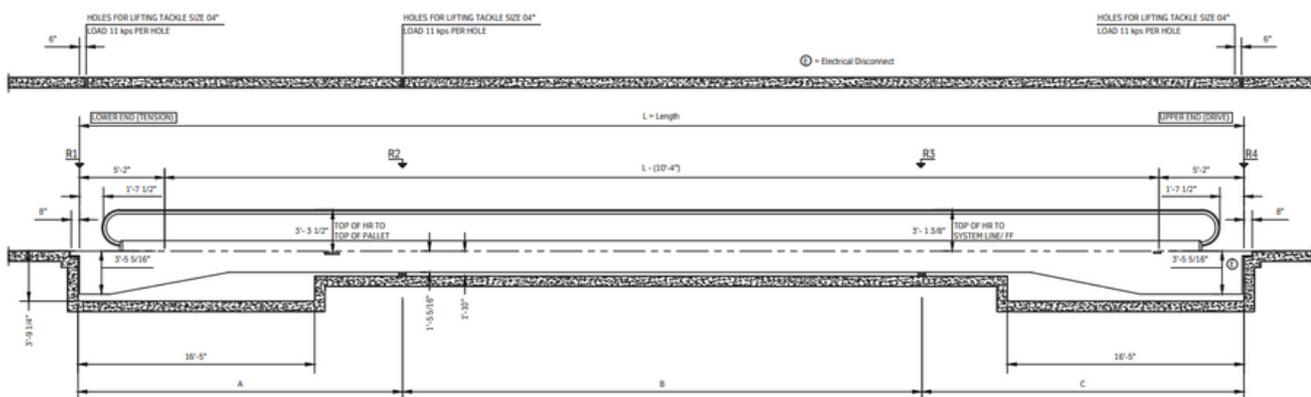
② Cross-section → ①

① Travelator, cross-section and foundation diagram

type	60	80	100
A	600	800	1000
B	1220	1420	1620
C	1300	1500	1700

③ Dimensions → ① - ②

Moving Walk Section View



Moving Walk Dimensions

K	L	M	N	A	B	C
40"	5' - 0 1/4"	10' - 3"	4' - 1"	< 39' - 8"	< 39' - 8"	< 39' - 8"
48"	5' - 8 1/4"	11' - 7"	4' - 9"	< 42' - 3"	< 42' - 3"	< 42' - 3"
56"	6' - 4 1/4"	12' - 11"	5' - 5"	< 45' - 3"	< 45' - 3"	< 45' - 3"
64"	7' - 1/4"	14' - 3"	6' - 1"	< 48' - 3"	< 48' - 3"	< 48' - 3"



4.4 ADVANTAGES & DISADVANTAGES

ADVANTAGES

HELPS AN
ELDERLY/DISABLE
PEOPLE

HELPFUL TO
TRANSPORT
HEAVY GOODS
USING TROLLEY

MEAN OF
GUIDANCE AND
CIRCULATION

SUITABLE FOR
RESTING WHILE
WALKING

USED FOR
LARGE
BUILDING EG,
AIRPORTS

LONG AND SLOW
CONVEYOR

SOURCE OF FEAR
FOR SMALL
CHILDREN

DISADVANTAGES

TUTORIAL 3



State **FOUR (4)** differences
between **ESCALATOR &**
TRAVELATOR?



**ANSWER:
ESCALATOR VS
TRAVELATOR**

ESCALATOR

MOVING
VERTICALLY

STEP STAIRCASE
LIKE

CONNECT TO ONE
FLOOR TO
ANOTHR FLOOR

TRANSPORT
PEOPLE ONLY

VS

MOVING
HORIZONTALLY

FLAT MOVING
WALKWAYS

CONNECT SPACE
HORIZONTALLY/
VERTICALLY

CAN TRANSPORT
PEOPLE AND
HEAVY GOODS
USING TROLLEY

TRAVELATOR

QUIZ TIME



scan me



Let's test your understanding!





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THANK YOU!

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