

Palestine Polytechnic University

(PPU)



College of Engineering and Technology

Machine-Roomless Elevators (Gearless)

(MRL)

Prepared By
Nidal Mwas
Deeb Nimer
Jamal Tmizeh

Supervised By

Eng. JALAL SALAEMEH

Dr. SAMEER HANA KHADER

Dec 2007





Room-Less Elevators

TABLE OF CONTENTS

	<u>Page</u>
Table of contents.....	i
Table of Figures.....	iii
Acknowledgement.....	iv
Abstract	x
Ract.....	xi

Chapter 1 Introduction	1
1.1 Historical background	1
1.2 Kinds of elevators.....	3
1.2.1 Passenger elevator	3
1.2.2 Freight elevator	3
1.2.3 Vehicle elevator	4
1.3 Type of Elevators.....	4
1.3.1 Traction Elevator	5
1.3.2 Hydraulic Elevator	5
1.3.3 Claiming Elevator	7
1.3.4 Machine-Room-Less elevator	7
1.4.1 General	7
1.4.2 Benefits of the MRL Elevator	9
1.4.5 MRL cost.....	9
Chapter 2 Elevator design	11
2.1 Introduction	11
2.2 Building information.....	11
2.3 Elevator design.....	11
2.3.1 Waiting time	12
2.3.3 Elevator handing capacity	12

2.4	Selecting The Elevator	12
2.5	Communication process	16
	2.5.1 The hoistway	16
	2.5.2 load calculation	16
	2.5.3 Inner surface	17
	2.5.4 The pit floor	17
	2.5.5 lighting the hoistway	17
Chapter 3 Elevator Main Components		21
3.1	The car	21
	3.1.1 car frame	21
	3.1.2 Car construction.....	21
	3.1.3 Car ceiling.....	21
	3.1.4 Wall.....	21
	3.1.5 floor	21
	3.1.6 Hand rail.....	23
	3.1.7 Sill	23
	3.1.8 Apron.....	23
3.2	Operating panel.....	23
3.3	Doors	23
	3.3.1 Jambs.....	24
3.4	Machine Support	24
3.5	Out door hall button	25
3.6	Transom	25
3.7	Fireman switch	25
3.8	Counterweight.....	25
3.9	Guide rails.....	26
3.10	Hydraulic buffer for elevators	26
3.11	Bracket:.....	26
3.12	Ropes.....	26

3.13	Machine	29
3.14	speed governor	34
3.15	Rollers.....	34
3.16	Two electrical silence fans.....	34
3.17	Brakes.....	34
3.18	Elevator traveling cable	34
3.19	Control board	35
3.20	Door Mechanism	35
3.21	Hoistway Entrances.....	35
Chapter 4	Roped system.....	37
4.1	Elevator roping arrangement	37
4.2	Safety System.....	38
4.3	Speed Governor.....	38
4.4	incoder	40
4.5	Doors safeties.....	40
	4.5.1 - Light curtain protection.....	41
	4.5.2 - Monitoring of elevator door	41
	4.5.3 -Door reversal device.....	41
	4.5.4 -Automatic door open.....	41
	4.5.5 - door nudging	41
4.6	Limit switches.....	41
4.7	Final limit	42
4.8	Deceleration switches.....	42
4.9	switches	42
	4.9.1 speed governor micro switches	42
	4.9.2 -Over speed brake switch.....	42
	4.9.3 -Buffers switches.....	42
	4.9.4 - Landing doors lock switches.....	42
	4.9.5 -Car Door full open switch.....	42

4.19	Car door close switch.....	42
4.20	Door function.....	44
4.21	Hoistway car with emergency exit.....	44
4.22	Doorlock.....	44
4.23	Emergency return.....	44
4.24	Reset emergency service.....	44
4.25	Emergency car lighting.....	45
4.26	Car light & fan automatically shut off.....	45
4.27	Load weight measuring for an elevator car.....	45
4.28	OTIS Hall load bypass.....	45
4.29	OTIS Overload protection.....	45
4.30	Self-learnance function.....	45
4.31	Self-powered elevator button.....	46
4.32	Earthquake control operation system.....	46
4.33	VIP function.....	46
4.34	Full collective operation.....	46
4.35	Hoistway parameter self-learning.....	47
4.36	Automatically parking.....	47
4.37	Elevator locked.....	47
4.38	Running counter.....	47
4.39	Arrival gong.....	47
4.40	Self diagnosis of fault.....	47
4.41	Remote monitor and control.....	47
4.42	Elevator system leveling.....	48
4.43	Pre-open door.....	48
4.44	Re-level during open status.....	48
4.45	Dispatching as Group Control.....	48
4.46	Function for deformity.....	48
4.47	Emergency rescue device.....	49
4.48	Mistake car-call cancellation.....	49

4.9.6	-Car door close switch.....	42
4.10	Rescue function.....	44
4.11	Passenger car with emergency exit	44
4.12	Interphone.....	44
4.13	Fire emergency return.....	44
4.14	Fireman emergency service.....	44
4.15	Emergency car lighting.....	45
4.16	Car light & fans automatically shut off:.....	45
4.17	Load weight measuring for an elevator cart.....	45
	4.17.1 - Full - load bypass.....	45
	4.17.2 - Overload protection	45
4.18	Anti-nuisance function	45
4.19	Self-powered elevator button	46
4.20	Earthquake control operation system	46
4.21	VIP function.....	46
4.22	Full collective operation.....	46
4.23	Hoistway parameter self-learning.....	47
4.24	Automatically parking.....	47
4.25	Elevator locked.....	47
4.26	Running counter.....	47
4.27	Arrival gong	47
4.28	Self diagnosis of fault.....	47
4.29	Remote monitor and control.....	47
4.30	Elevator system leveling	48
4.31	Pre-open door.....	48
4.32	Re-level during open status.....	48
4.33	Dispatching as Group Control.....	48
4.34	Function for deformity.....	48
4.35	Emergency rescue device.....	49
4.36	Mistake car-call cancellation.....	49

Chapter 5	Electrical drive and Motor	50
5.1	Introduction	52
5.2	Adjust motor voltage	55
5.3	VvVF operator interface	55
5.4	Closed loop VVVF	56
5.5	Closed loop door operator	56
5.6	The VVVF Advantage	58
5.7	Electrical System Characteristic	58
5.8	Safety circuit	60
5.9	Circuit breaker elevator	63
5.10	Resistor Box	63
5.11	Elevator Motor	64
5.12	Gearless machines with zero maintenance	65
Chapter 6	Operation system of the elevator	63
6.1	Introduction	63
6.2	Control System	64
6.3	Logic Controller	64
6.5	Controller	65
6.6	Duplex selective collective operation	66
6.6.1	Use Case 1: Request Elevator	67
6.6.2	Case 2: Floor Selection Use Case	70
6.7	Elevator Door Control	72
6.8	Microcontroller	72
6.8.2	TYPES OF PIC's	73
6.8.3	Pic INSTRUCTIONS:	73
6.9	Description	76
6.10	Program to control elevator by C- language	78
	Conclusion	91

Appendix I93

References104

Table of Figures:

Content	Fig Number	Page Number
Hydraulic elevators	Fig. 1-1	6
Room-Less elevator	Fig. 1-2	8
Hoistway dimension	Fig. 2.1	17
suction for cabinet and counterweight	Fig. 2-2	18
shaft plane	Fig 2.3	19
Duplex elevators	Fig 2.4	20
Hoistway dimensions	Fig 3.1	22
Car operating panel	Fig 3.2	27
landing push-button	Fig 3.3	27
Guide rail and brackets	Fig 3.4	28
Buffers	Fig 3.5	28
Free Body Diagram	Fig 3.6	32

Speed /distance	Fig 3.8	33
Traveling cable	Fig 3.9	35
door entrance for last floor	Fig. 3.10	37
Entrance elevation for GL floor	Fig 3. 11	38
Elevator Roping	Fig. 4-1	41

Content	Fig Number	Page Number
limit switches	Fig4.2	45
Variable Voltage Variable Frequency controller	Fig. 5.1	53
Inverter's Pulse Width Modulation Output	Fig. 5.2	53
Block diagram for convert ac to ac	Fig. 5.3	54
Circuit diagram for rectification	Fig. 5.4	54
lower door vvvf	Fig55	57
Circuit diagram for elevator power circuit	Fig 5.6	59
inverter over current	Fig 5.7	60
DC link over voltage	Fig 5.8	60
inverter stack over heat	Fig 5.9	61
DC link under voltage	Fig 5.10	61

inverter charging trouble	Fig 5.11	61
inverter overload detection	Fig5.12	62
MRL machine	Fig. 5.13	66
Fixing of MRL	Fig 5.14	67
Flow of Events for Use Case 1	Fig. 6.1	74
State chart for User Activity	Fig 6.2	76
Pic 16f84	Fig. 6.3	79
Block diagram for controlling duplex elevator	Fig 64	81

Content	Table Number	Page Number
Duplex elevator cost	Table 1-1	9
Building information	Table 2-1	11
Car and door dimension	Table 3.1	21
Machine characteristics	Table 5.7	64

Abstract

The project which will be designed is duplex elevator for hotel of 5 floors, in this design a new technology which use gearless, roomless machine, controlled by microprocessor and using latest functions and options.

In the beginning this project text talks a little about the historical background and the development progress in the field of elevators. The types of elevators were briefly mentioned.

Two duplex elevators, 13 person capacity each at a speed of 90 m/min were selected to satisfy building needed. Selection method discussed and calculations done to insure the correct selection.

Communications process between owner, architecture and Construction Company, designer, manufacturers, Installation Company and local authorities mentioned and how flow of information and technical data goes between each party. Calculation done to determine the dimensions of hoistway, pit, over head, cabinet and openings. Bulk load needed in the construction and machine support determined. Mathematical methods to determine the counter weight, machine speed, acceleration, torque and electrical power and characteristics have been done.

Elevators components were listed and described. Safety systems components and operation functions were listed and described individually.

The electrical section discuss the VVVF technology, power rectification and inverting. Power and control circuit were described.

A sample of C program software for programming the ECU of the elevator added.

In the end MRI are highly recommended for such buildings.

Introduction & Literature Review

1.1 Historical background

An elevator or lift is a transport device used to move goods or people vertically. Elevators began as simple rope or chain hoists. An elevator is essentially a platform that is either pulled or pushed up by a mechanical means. A modern day elevator consists of a cab (also called a "cage" or "car") mounted on a platform within an enclosed space called a shaft, or in Commonwealth countries called a "hoistway". In the past, elevator drive mechanisms were powered by steam and water hydraulic pistons. In a "traction" elevator, cars are pulled up by means of rolling steel ropes over a deeply grooved pulley, commonly called a sheave in the industry. The weight of the car is balanced with a counterweight.

Hydraulic elevators use the principles of hydraulics to pressurize an above ground or in-ground piston to raise and lower the car. Roped Hydraulics use a combination of both ropes and hydraulic power to raise and lower cars. Recent innovations include permanent earth magnet motors, machine room-less rail mounted gearless machines, and microprocessor controls.

Hydraulic elevators are usually slower than traction elevators. The first reference about the elevator is located in the works of the Roman architect Vitruvius, who reported that Archimedes built his first lift or elevator, probably, in 236 B.C. In some literary sources of later historical period lifts were mentioned as cabs, on a rope and powered by hand or by animal's force. It is supposed that lifts of this type were installed in the Sinai monastery of Egypt. In the 17th century the prototypes of elevators were located in the palace buildings of England and France. In 1793 Ivan Kulibin created the elevator with the screw lifting mechanism for the Winter Palace of Saint Petersburg. In 1816 the elevator was established in the main building of sub Moscow village called Arkhangelskoye. In 1823, an "ascending room" made its debut

in London. Henry Waterman, of New York, invented the lift (elevator) in 1850. He intended it to transport barrels of flour.

In 1853, Elisha Otis introduced the safety elevator, which prevented the fall of the cab if the cable broke. The design of the Otis safety elevator is somewhat similar to one type still used today. A governor device engages knurled roller(s), locking the elevator to its guides should the elevator descend at excessive speed.

On March 23, 1857 the first Otis elevator was installed at 488 Broadway in New York City. The first elevator shaft preceded the first elevator by four years. Construction for Peter Cooper's Cooper Union building in New York began in 1853. An elevator shaft was included in the design for Cooper Union, because Cooper was confident that a safe passenger elevator would soon be invented. The shaft was circular because Cooper felt it was the most efficient design. Later Otis designed a special elevator for the school.

The development of elevators was led by the need for movement of raw materials including coal and lumber from hillsides. The technology developed by these industries and the introduction of steel beam construction worked together to provide the passenger and freight elevators in use today.

In 1874, J.W. Meaker patented a method which permitted elevator doors to open and close safely.

In 1929, Clarence Conrad Crispen, with Inclinator Company of America, created the first residential elevator. Crispen also invented the first inclined stairlift.

Hydraulic and roped elevators are the two main types of elevators in use today. Factors that govern elevator type and design include cost, speed, capacity requirements, safety, and reliability. There are risks involved in the use of elevators. Many factors must be taken into account in order to ensure that persons are not stuck in elevator for long periods of time, or worse that the elevator does not lose stability and plummet to the basement from a high floor. In the event of fire, elevators are not to be used. The engineers designing the system, as well as the construction company assigned to build the building and installing the elevator system are responsible for the safety and

Smooth operation of the elevator system. The building architects are responsible for providing space and structural support for the elevator. The engineers designing the elevator must ensure that the elevators will perform as specified in a safe manner (meeting all safety requirements and compliance standards). The engineers are also responsible for designing elevators that can be manufactured easily and feasibly and for designing systems that will work reliably and safely in the event that they are misused. The elevator users are responsible for operating the elevator according to the safety specifications laid out. The maximum capacity is not to be exceeded by users. The building owners are responsible for maintenance of the elevator and for assuring the elevator is compliant before use (via a certificate). The latter certificate is to be available to users so that they can be assured that the elevator is safe to use. The engineers are to communicate to the owners the specifications of the elevators and are to communicate to the builders the space and support that is needed for the elevator to function in its intended way. The architects and builders are to communicate with the elevator engineers to ensure that the structure and elevator are compatible.

1.2 kinds of elevators

The kind of elevators due to their function is:-

1.2.1 -passenger elevators

Passenger elevators may be specialized for the service they perform, including: Hospital emergency, front and rear entrances, double decker, and other uses. Cars may be ornate in their interior appearance, may have audio visual advertising, and may be provided with specialized recorded voice instructions.

An express elevator does not serve all floors. For example, it moves between the ground floor and a skylobby, or it moves from the ground floor or a skylobby to a range of floors, skipping floors in between.

1.2.2-Freight elevators (goods lift)

Freight elevator (or goods lift) is an elevator designed to carry goods, rather than passengers. Freight elevators are often exempt from some code requirements. Freight

elevators or service elevators (goods or service lifts) may be exempt from some of the requirements for fire service. However, new installations would likely be required to comply with these requirements. Freight elevators are generally required to display a written notice in the car that the use by passengers is prohibited, though certain freight elevators allow dual use through the use of an inconspicuous riser. Freight elevators are typically larger and capable of carrying heavier loads than a passenger elevator, generally from 2,300 to 4,500 kg. Freight Elevators may have manually operated doors, and often has rugged interior finishes to prevent damage while loading and unloading. Although hydraulic freight elevators exist, electric elevators are more energy efficient for the work of freight lifting.

1.2.3 -Vehicle elevators

A car lift is installed where ramps are considered space-inconservative for smaller buildings (usually in apartment buildings where frequent access is not an issue). The car platforms are raised and lowered by chained steel gears (resembling bicycle chains in appearance). In addition to the vertical motion, the platforms can rotate about its vertical axis (up to 180 degrees) to ease driver access and/or accommodate building plans. Most parking lots of this type are however unable to accommodate taller vehicle.

1.3 Type of elevator

1.3.1) Traction elevators (Geared and gearless traction elevators)

Geared Traction machines are driven by AC or DC electric motors. Geared machines use worm gears to control mechanical movement of elevator cars by "rolling" steel hoist ropes over a drive sheave which is attached to a gearbox driven by a high speed motor. These machines are generally the best option for basement or overhead traction use for speeds up to 500 ft/min (2.5 m/s). Gearless Traction machines are low speed (low RPM), high torque electric motors powered mainly by AC. In this case, the drive sheave is directly attached to the end of the motor. Gearless traction elevators can reach speeds of up to 2,000 ft/min.

Brake is mounted between the motor and drive sheave (or gearbox) to hold the elevator stationary at a floor. This brake is usually an external drum type and is actuated by spring force and held open electrically; a power failure will cause the brake to engage and prevent the elevator from falling (see inherent safety and safety engineering). In each case, cables are attached to a hitch plate on top of the cab or may be "underslung" below a cab, and then looped over the drive sheave to a counterweight attached to the opposite end of the cables which reduces the amount of power needed to move the cab. The counterweight is located in the hoist-way and rides a separate rail system; as the car goes up, the counterweight goes down, and vice versa. This action is powered by the traction machine which is directed by the controller, typically a relay logic or computerized device that directs starting, acceleration, deceleration and stopping of the elevator cab. The weight of the counterweight is typically equal to the weight of the elevator cab plus 40-50% of the capacity of the elevator. The grooves in the drive sheave are specially designed to prevent the cables from slipping. "Traction" is provided to the ropes by the grip of the grooves in the sheave, thereby the name. As the ropes age and the traction grooves wear, some traction is lost and the ropes must be replaced and the sheave repaired or replaced. Elevators with more than 100' of travel have a system called compensation. This is a separate set of cables or a chain attached to the bottom of the counterweight and the bottom of the elevator cab. This makes it easier to control the elevator, as it compensates for the differing weight of cable between the hoist and the cab. If the elevator cab is at the top of the hoist-way, there is a short length of hoist cable above the car and a long length of compensating cable below the car and vice versa for the counterweight. If the compensation system uses cables, there will be an additional sheave in the pit below the elevator, to guide the cables. If the compensation system uses chains, the chain is guided by a bar mounted between the counterweight rails.

11.2.2 - Hydraulic elevators

Conventional Hydraulic elevators were first developed by Dover Elevator (now ThyssenKrupp Elevator). They are quite common for low and medium rise buildings

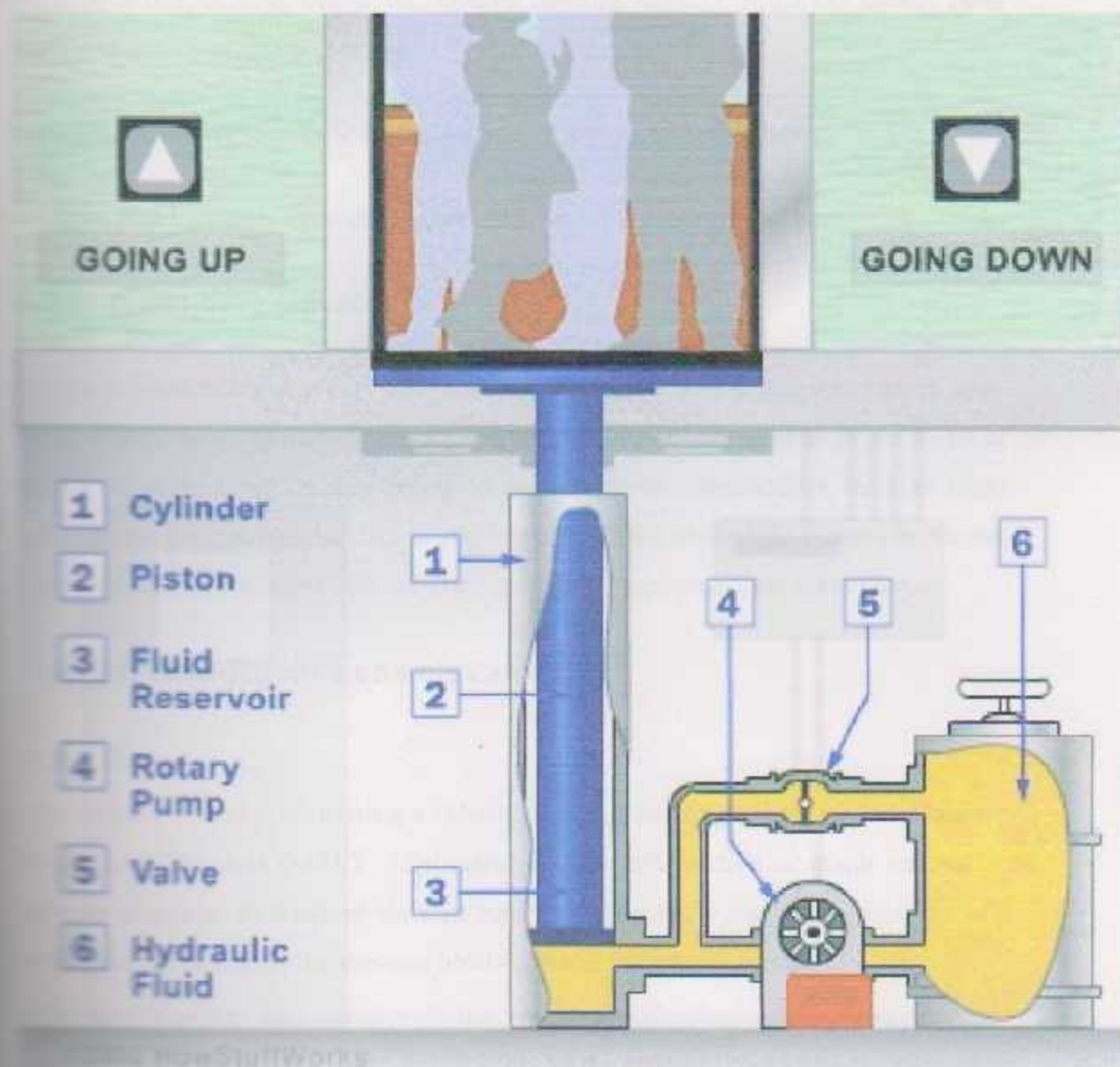


Fig 1.1 Hydraulic elevators

(2-8 floors) and use a hydraulically powered plunger to push the elevator upwards. On some, the hydraulic piston (plunger) consists of telescoping concentric tubes, allowing a shallow tube to contain the mechanism below the lowest floor. On others, the piston requires a deeper hole below the bottom landing, usually with PVC casing (also known as a caisson) for protection.

- Roped hydraulic elevators use a combination of ropes and hydraulics.
- *Twin post hydraulic provides higher travel with no underground hole

1.3.3 A climbing elevator

It is a self-ascending elevator with its own propulsion. The propulsion can be done by an electric or a combustion engine. Climbing elevators are used in guyed masts or towers, in order to make easy access to parts of these constructions, such as flight safety lamps for maintenance. An example would be the Moonlight Towers in Austin, Texas, where the elevator holds only one person and equipment for maintenance

1.4 Machine-Room-Less elevator

1.4.1 General

The elevator industry is offering a relatively new elevator product termed Machine Room-Less Elevators (MRL). Application in new construction or major renovation projects compared to standard elevator equipment is a fairly significant decision as it will affect the design of the elevator hoistways and equipment rooms.

The machine-room-less elevator is the result of technological advancements that allow a significant reduction in the size of the electric motors used with traction equipment. These newly designed permanent magnet motors (PMM) allow the manufacturers to locate the machines in the hoistway overhead, thus eliminating the need for a machine room over the hoistway. This design has been utilized outside the U.S. for at least 15 years and is becoming the standard product for low to low-mid rise buildings. It was first introduced to the U.S. market by KONE. Product acceptance was initially slow in the U.S. market because of its initial, limited applications, its inability to meet U.S. code requirements, and the limited number of manufacturers offering an equivalent product.



Fig 1.2 Room-Less elevator

- The use of the MRL elevator will save a significant amount of energy (estimated at 70-80%) as compared to hydraulic elevators. The power feeders for the MRL are also significantly reduced due to the more efficient design and the counter-balancing provided with traction equipment

1.4.2 Benefits of the MRL Elevator

- 1- Reducing the building cost
- 2- No need for separate machine room
- 3- Reduce overhead and pit dimension
- 4- Saving energy by using permanent magnetic motor and vvvf technology control
- 5- Environment friend as guide roller require no oil and reduce the harmonic noise

MRL cost

The cost of all components of two duplex MRL elevators of 5 floors, with:-

a- 1000Kg (13 person).

b- 5 stops c- 1.5 m/s speed

Item	Description	Quantity	Price \$	Total \$
1-	Traction machine	2	5000	10000
2-	Cabinet and doors	2	6000	12000
3-	Door headers	2	2500	5000
4-	Counterweight load with frame	2	2000	4000
5-	Carbine rails and counterweight rails	2	2500	5000
6-	Rails Support packets	2	1500	3000
7-	Control board	2	4000	8000
8-	Duplex board	1	2000	2000
9-	Roping cables	2	2000	4000
10-	Traveling cable and wiring	2	2000	4000
11-	Landing doors panel and frame	2	3000	6000
12-	Buffers and switches	2	2000	4000
13-	Shipping	1	5000	5000
14-	Installation	1	6000	6000
15-	Commissioning and maintenance	1	8000	8000
Total without vat				86000

Table 1-1 Duplex elevator cost

As we can see in the total price for duplex MRL elevator is (86000 \$) witch mean that it's not much according to total cost of the hall building so we advice the owners to bayed this elevator.

2.1.2. Material selection

The elevator will consist of a hoistway, at least one car, and a machine room. The hoistway will be made of steel and the car will be made of steel and glass. The machine room will be made of steel and concrete.

The hoistway will be made of steel and the car will be made of steel and glass. The machine room will be made of steel and concrete.

The car will be made of steel and glass.

The machine room will be made of steel and concrete.

The hoistway will be made of steel and the car will be made of steel and glass.

2.2. Building Information

The building will be a new building and will be made of steel and concrete. The building will be made of steel and concrete.

Item	Unit	Quantity
Steel	m ³	100
Concrete	m ³	200
Brick	m ²	100
Window	m ²	100
Door	m ²	100
Roof	m ²	100
Foundation	m ²	100
Interior finish	m ²	100
Exterior finish	m ²	100

Table 2.1: Building Information

2.3. Elevator design

The elevator will be made of steel and glass.

The machine room will be made of steel and concrete.

The hoistway will be made of steel and the car will be made of steel and glass.

Chapter Two

Elevator Design

2.1 Introduction:

The elevators are enjoying a period of increased developing the quality of power, machine, car, all components and the control make it reliable, economic and improve the performance. The passengers have a safe, fast, and comfortable ride.

To select the suitable elevator for any building we must care with three important things in our consideration:

- 1) how can the elevator work in the right way
- 2) the price for the elevator and its working and maintenance
- 3) the good design for the hoistway architecture

2.2 Building information:

The building which the elevator need to be designed the elevator is a Movenpick Hotel of 5 floors in Ramallah City. From the architecture design, the flowing building information could be analyzed:

Floor	usage	heights
Ground floor	lobby	4 m
1 st floor	34 bedrooms	4m
2 nd floor	34 bedrooms	4m
3 rd floor	34 bedrooms	4m
4 th floor	34 bedrooms	4m
Number of service floors is	5 floors	
Travel distance	20 m	
Number of bedrooms	136 bedroom	

Table (2-1) Building information

2.3 Elevator design:

The assumption of population:

2 people in each bedroom

$$136 * 2 = 272 \text{ person}$$

To make the calculations two things should be known :

2.3.1 Waiting time

Time that an elevator user has to wait after pressing the call button before the elevator arrives. Waiting time is an important assessment criterion for elevators. In the planning phase of a building, elevator waiting time is calculated on the basis of simulations. The design of the elevators (e.g. size of cabs, number of elevators, the waiting time should be 30-60 sec. (appendix 4)

2.3.2 Elevator handling capacity:

The handling capacity measured by number of users in five minutes. (10%-25% of the population). (Appendix 4). It's better to choose the handling capacity about 25% as building is a luxury hotel.

$$HC = 25\% * Pt \dots\dots\dots (2.1)$$

Where HC: the handling capacity should.

Pt : the total population.

$$HC = 272 * 25 / 100 = 68 \text{ person every 5 minutes.}$$

2.4 Selecting the elevators:

Using tables (App. 4), a handling capacity 79 people in 39 sec waiting time.

* Number of lift we need is 2 lift (1000kg) which equal 13 people in each.

* Speed 90m/min. (App.4).

To prove the selection the following calculation should be done:

Numbers of stops expected is 50-60 %. (3).

It's better to take the 60%. (For luxury building).

* Number of stops:

$$Sn = Dn * Se \dots\dots\dots (2.2)$$

Where Sn: Number of stops

Dn: number of door

Se: numbers of stops expected

$$Sn = 5 * 60 / 100$$

$$= 3 \text{ stops}$$

* Average of running distance up or down (for one lift):

$$Da = Ht / Se \dots\dots\dots (2.3)$$

Where Da: Average of running distance (m).

Ht: total height (m).

Ht: total height (m).

Se: expected stops

$$Da = 20 / 3$$

$$= 6.67 \text{ m}$$

* Acceleration & deceleration distance:

$$Db = Dc + Dd \dots\dots\dots (2.4)$$

Where Db: Acceleration & deceleration distance (m)

Dc: accelerating distance (m).

Dd: deceleration distance (m)

$$Db = 0.6 + 2.70$$

$$= 3.3 \text{ m}$$

* Time of acceleration & deceleration (Ta):

$$Ta = 2.1 \text{ sec, (Appendix 3)}$$

* Driving time up:

$$Td = (Hs / V) + (Ta * N) \dots\dots\dots (2.5).$$

Where Td: driving time. (Sec).

Hs: total distance. (m)

V: rated speed. (M/sec)

Ta: time of acceleration & deceleration.(sec).

N: number of stop.

$$Td = 20 / 1.5 + 2.1 * 3$$

$$= 19.64 \text{ sec}$$

* Total door opening and closing time:

$$To = Tc * N \dots\dots\dots (2.6).$$

Where To: Total door opening and closing time. (Sec).

Tc: door opening and closing time in one stop. (Sec).

$$Tc = 2.3 \text{ sec, (appendix3).}$$

$$To = 2.3 * 3$$

$$= 6.9 \text{ sec}$$

*Total passenger entrance and exit time:

$$Te = Tp * N \dots\dots\dots (2.7).$$

Where T_e : total passenger entrance and exit time. (Sec)

T_p : Passenger entrance and exit time.

$T_p = 2.5 \text{ sec}$ (Appendix 3).

$= 7.5 \text{ sec}$

* Total door waiting time:

$$T_w = T_s * N \dots\dots\dots (2.8).$$

Where T_w : total door waiting time (sec).

$T_s = 3 \text{ sec}$ (adjustable).

T_s : door waiting time (sec).

$$T_w = 3 * 3$$

$$= 9 \text{ sec.}$$

* Trip time in one direction up or down:

$$T = T_a + T_d + T_o + T_e + T_w \dots\dots\dots (2.9).$$

Where T : Trip time in one direction. (Sec).

T_a : time of acceleration & deceleration. (Sec).

T_d : driving time. (Sec).

T_o : total door opening and closing time. (Sec).

T_e : passenger entrance and exit time. (Sec)

T_w : total door waiting time (sec).

$$T = 2.1 + 19.64 + 9.6 + 7.5 + 9$$

$$= 47.84 \text{ sec}$$

$$= 48 \text{ sec}$$

* Total time for the elevator up and down (T_t):

$$T_t = T * 2 \dots\dots\dots (2.10)$$

$$= 48 * 2$$

$$= 96 \text{ sec}$$

Waiting time for the duplex system (T_{wt}):

$$T_{wt} = T_t / 2 \dots\dots\dots (2.11)$$

$$= 96 / 2$$

$$= 48 \text{ sec.}$$

This means that the waiting time (48sec) is within the acceptable range (30 – 60 sec). (4)

2.5 Communication process

In the design, installation, and use of an elevator system much communication goes on between the design engineer, Construction Company, Elevators Manufacturers, Building Architects, Building owner and local authorities. The following instructions and information goes to the Building Architects, and Construction Company

2.5.1 The Hoistway:

The building design integrates the elevator shaft from the beginning, and the shaft grows as the building is erected. The walls of the shaft are poured concrete, and the shaft straightness should be acceptable. The building architecture are responsible for providing space and structured support for the elevator. Hoistway. Walls, floor and ceiling should be concrete and be able to handle all kinds of loads and the load created when operating the speed governor.

The engineer design the elevator should communicate the architecture provide them with the space required.

Referring to the Jordanian and local elevator codes, and the recommendation of manufacturing company the following dimension are recommended for hoistway:

Fit depth	1500 mm
Over head	4000 mm
Hoistway width	5100 mm (2450 mm for each +200 mm for separating wall)
Hoistway depth	2050 mm
Hoistway opening width	1200 mm
Hoistway opening height	2300 mm

Ventilation opening two 500 height, 700 width each in the top of the shaft.

2.5.2 Load Calculations:

The bulking force, F , shall be evaluated by using the following formula:

$$F = k * g * (M_c + M_b + L + M_m) \dots\dots\dots (2.12)$$

Where:

k : factor for using the speed governor.

$k = 2$ (Appendix 4)

g : standard acceleration of free fall.

Mc: car mass.

Mc = 1470 kg (3).

Mb: balance mass.

L: rated load.(kg).

L = 1000 kg.

Mm: machine mass

Mm = 425 kg (3).

MB = Mc + (50/100 * L) (2.13).

= 1470 + (50/100 * 1000)

= 1970 kg.

F = k * g * (Mc + Mb + L + Mm)

= 2 * 9.81 * (1470 + 1970 + 1000 + 425)

= 95451 Newton

2.5.3 Inner surface:

It should be smooth and continues with no cracks or excessive consultation materials and the surface finish strong enough to prevent dust and all material used should be fire resistance

2.5.4 The pit floor:

It should be able to handle load of 5 kn/m² (Appendix 4), with concrete base goes down to strong ground for the buffers also supplied with steel ladder. Treatment to prevent collecting water in the pit.

2.5.5 Lighting the hoistway:

Suitable light fixture with switch in the pit and light for the hoistway as well as with 200 lux. Power supply from a separate from the elevator. Emergency light is important.

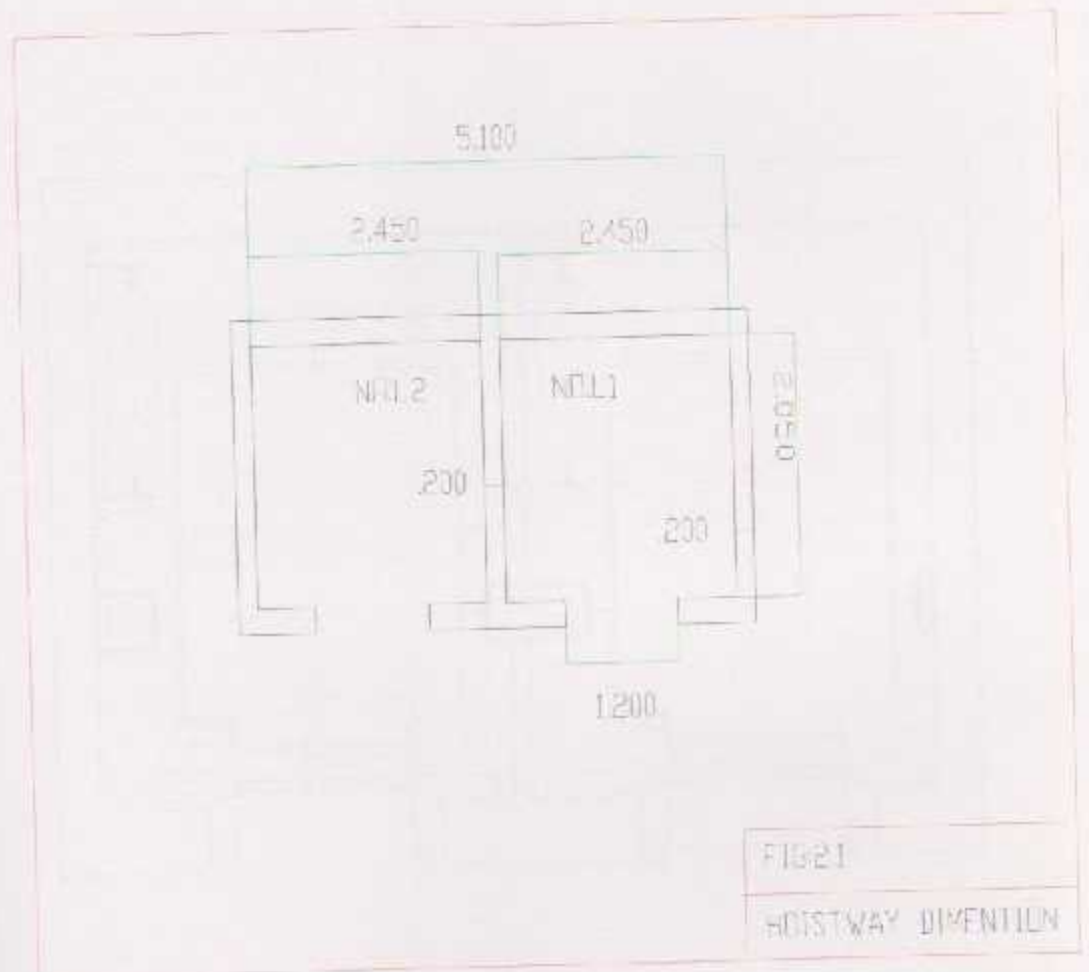


Fig 2.1 The Hoistway dimensions

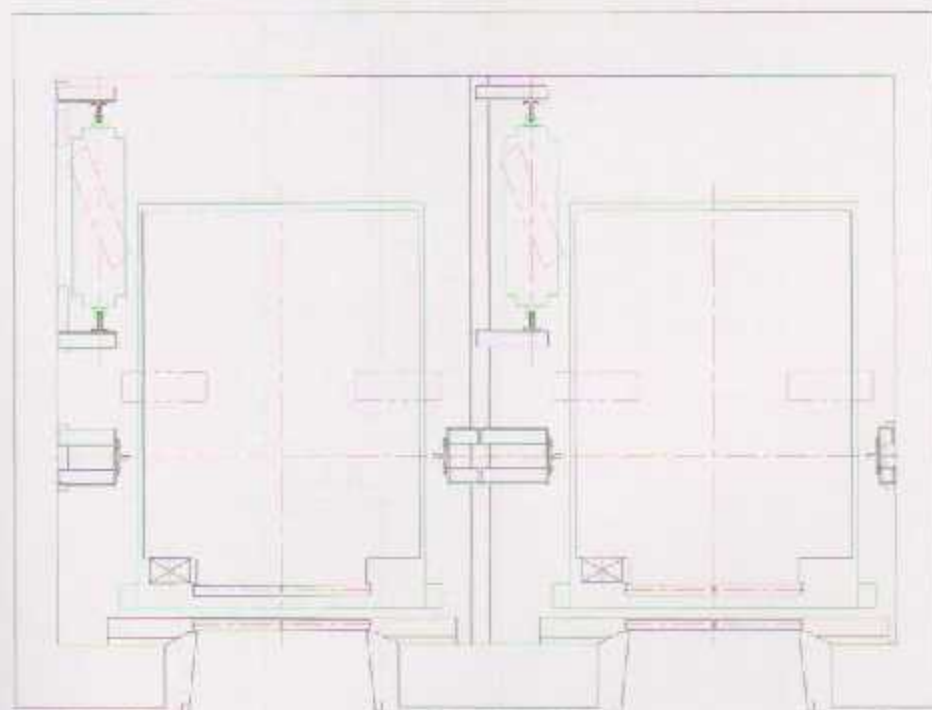
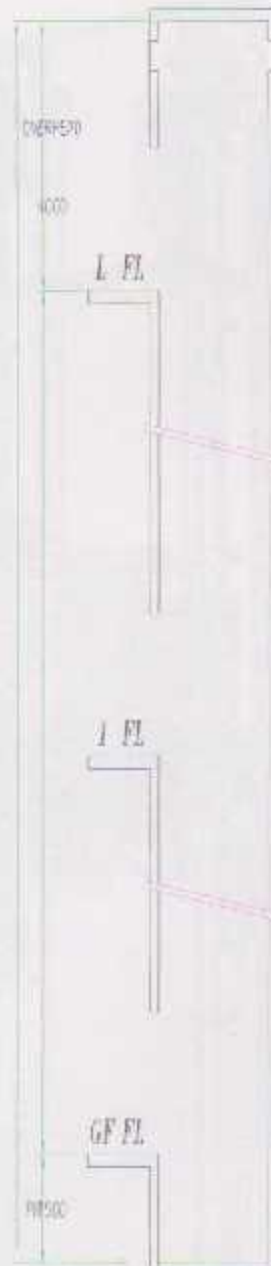


FIG: 22

SUCTION FOR CABINE AND
COUNTERWEIGHT

Fig 2.2. Section for carbine and counterweight



HOISTWAY SECTION (NO.11,12)

FLOOR NAME	GF FL	1 FL	2 FL	3 FL	OVERHEAD
SECTION SIZE	4000	4000	4000	4000	4000

FIG : 2.3

SHAFT PLANE

Fig 2.3 shaft plane

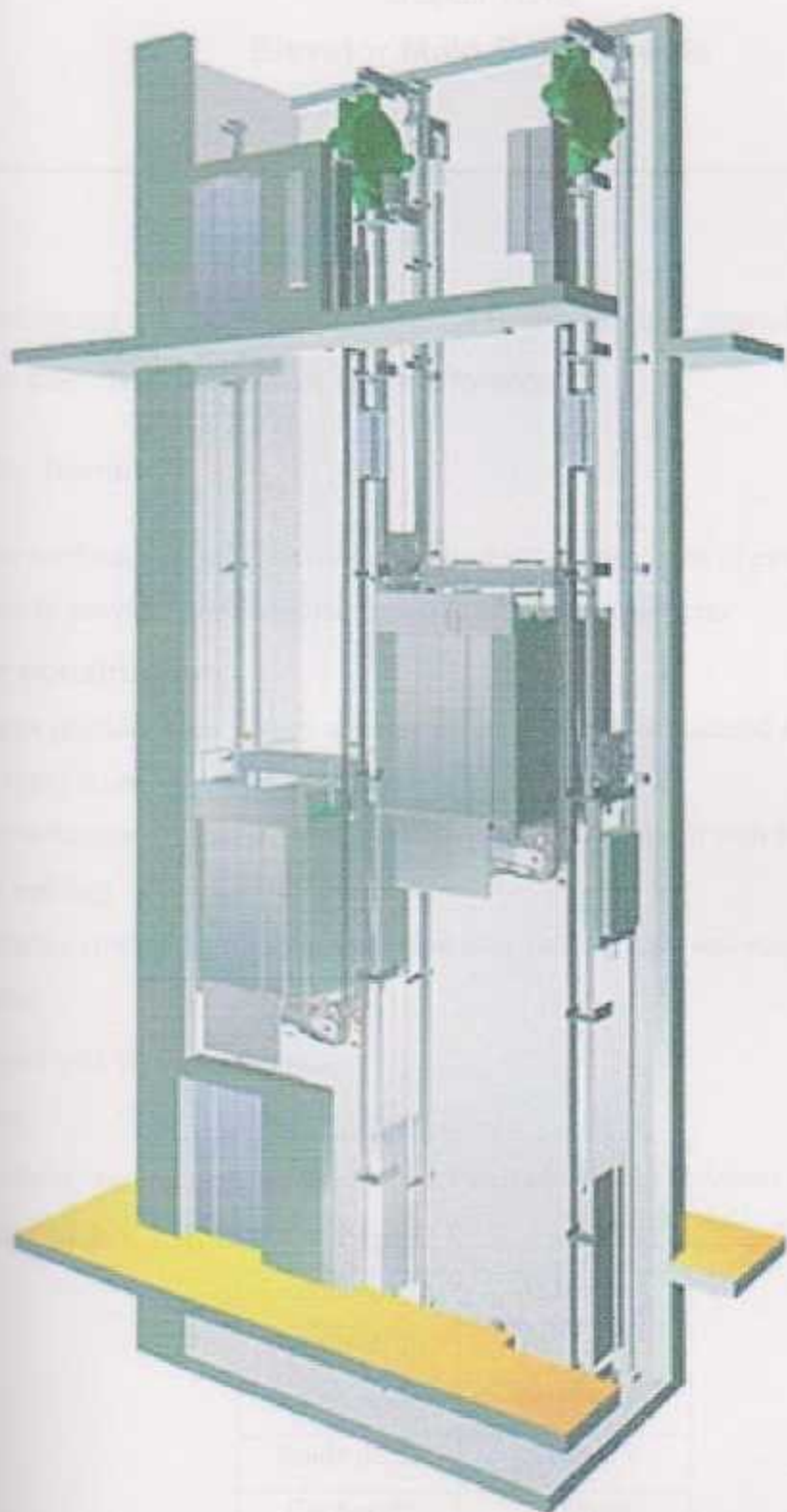


Fig 2.4 Duplex Elevators

Chapter Three

Elevator Main Components

The following information should go to the elevator manufacturer:

3.1 The car: The car consists of the followings:

3.1.1 Car frame:

A suitable car frame, constructed of formed steel structural shapes or extruded structural steel, shall be provided with adequate bracts to support the platform.

3.1.2 Car construction:

Manufacturers provide wide variety of construction material like painted steel or stainless steel with wide variety colors and decorates.

We choose antimagnetic stainless steel mirror with some etching fit with building decors..

3.1.3 Car ceiling:

Mainly stainless steel with grills for ventilation fans, indirect light and emergency light.

3.1.4 Walls:

Stainless steel with chosen etching.

3.1.5 Floor:

On the platform natural granite same the front wall around the Elevators doors. The following table for car and door dimension:

Outside width	1650mm
Outside depth	1665 mm
Inside width	1600 mm
Inside depth	1500 mm
Car height	2300mm
Door width	900 mm
Door height	2100 mm

Table 3.1 Car and door dimension:

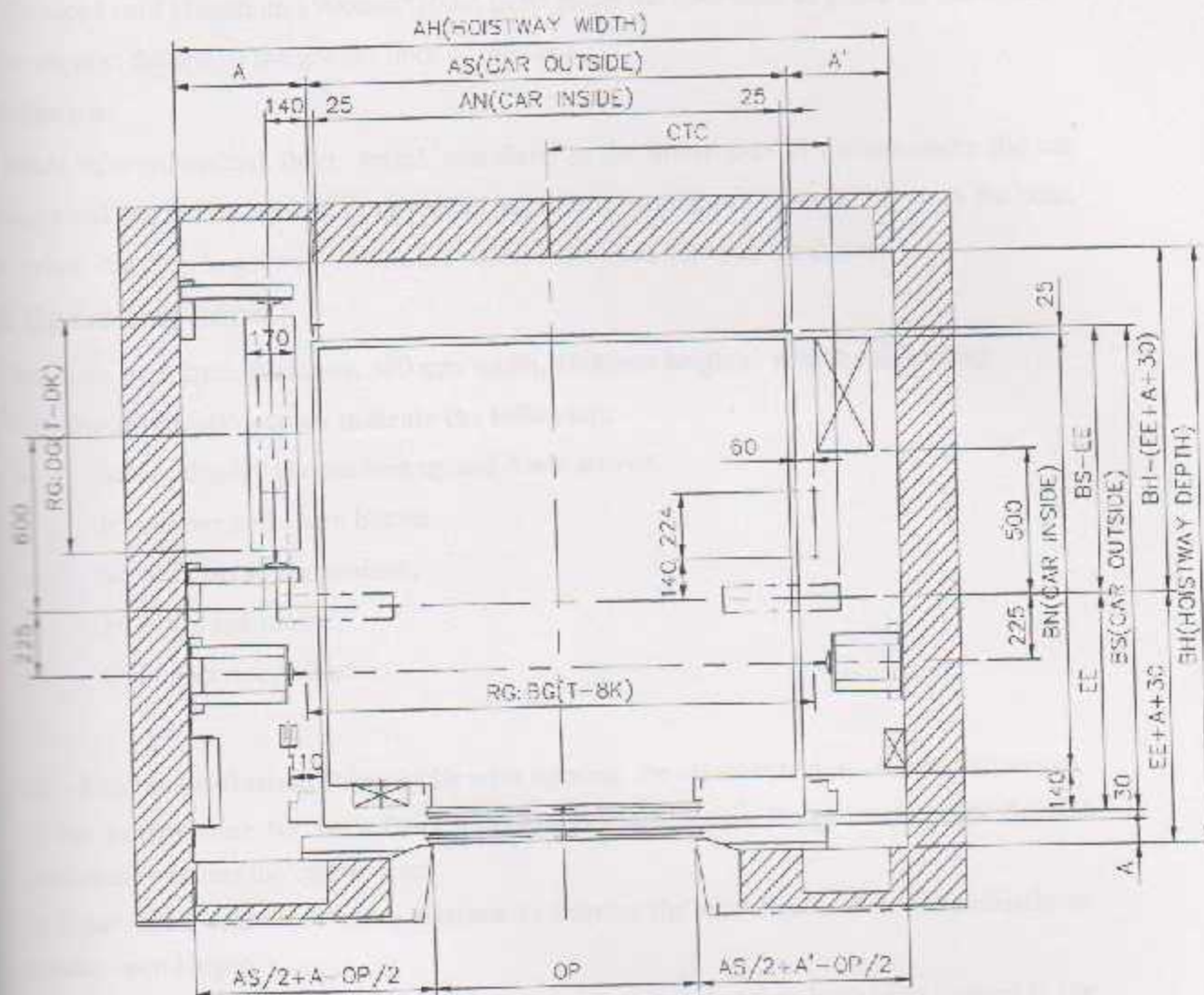


Fig 3.1 Car-Hoistway dimensions

2.1.6 Hand rail:

Stainless steel hand rail of 3.13cm diameter all the back, left and right walls.

2.1.7 Sill:

Extruded hard aluminum 1900mm*100mm fixed under the door used as guide for the doors and to support the end of the granite floor of the car.

2.1.8 Apron:

Made of a galvanized sheet metal, one fixed at the lower side of the car under the car entrance and one under each floor entrance, to prevent passengers from falling into the hoist way when they try to get out for the car when is stopped between the floors.

2.2 Operating panel:

Stainless steel 2mm thickness, 300 mm width, 1800mm heights with the following:

A) -Digital display screen indicate the following:

- a- Screen display the position up and down arrows.
- b- Interphone and alarm buzzer.
- c- Screen display the position.
- d- Full load indicator.
- e- Out of service indicator.

B) - Functional Button: Rectangular with lighting, the selected button for the following:

- 1) Six buttons one for each floor: possible to make certain floors inaccessible. Special card used to access the certain floor.
- 2) Door open and Door close buttons to instruct the elevator to close immediately or remain open longer.
- 3) An alarm button: which passengers can use to signal that they have been trapped in the elevator?
- 4) m An elevator telephone: which can be used (in addition to the alarm) by a trapped passenger to call for help.
- 5) A fireman's key switch: These places the elevator in a special operating mode designed to aid firefighters. .
- 6) Security controls: Elevators incorporate security features to control / prevent unauthorized floor access. To use card access in which call buttons don't register until an authorized card is detected.

- 7) **Cancel floor:** "double-clicking" a selected floor will de-select it.
- 8) **VIP Switch:** key operated switch. Gives the priority to the selected floor, and the elevator do not replay the floor calling, (but the other elevator replay).
- 9) **Fans on – off switch:** to operate or stop the ventilation fans.
- 10) **Inspection box:** Key opened door the following are inside:
 - 1) **An independent service switch,** which selects whether the elevator's operation will be coordinated with other elevators in an elevator bank.
 - 2) **Up and down buttons,** to move the car up and down without selecting a specific floor.

3.3 Doors:

Central open door stainless steel etched to fit the décor, for all landing doors and car door.

Complete with the following:

- A – Two mechanical safety edge.
- B – Safety ray curtain.
- C – Self closing mechanism.
- D – Hoistway door unlock device.
- E – Door lock with emergency opening key.
- F – Vvfv drives motor.
- G – Micro switches.

3.3.1 Jams: Stainless steel frame, wide kind to cover the entire concrete wall.

3.4 Machine Support:

It should be handle a load equal to the total mass of non moving material and double mass of the moving equipment of the elevator load included tolerance over the hoist way:

$$F = M_m * g + 2 * (M_c + L + M_b) * g \dots\dots\dots (3.1)$$

F: total load on the supporting beam

g: standard acceleration of free fall.

M_c: car mass.

M_c = 1470 kg (3).

M_b: balance mass.

L: rated load.(kg).

L = 1000 kg.

M_m: machine mass (3)

M_m = 425 kg (3).

$$\begin{aligned}
 F &= 425 * 9.81 + 2 * (1470 + 1000 + 1970) * 9.81 \\
 &= 91282 \text{ N}
 \end{aligned}$$

3.5 Out door hall button panel:

Stainless steel panel 2 mm thickness, 150 mm width, 250mm height, with two up and down calling button, the same as buttons in the car panel.

3.6 Transom:

Stainless steel panel, 2mm thickness, 300 mm height, 900 mm width, inside this

Plate (transom) the horizontal screen indicator showing the flowing indicator digitally:

- 1- Up down direction
- 2- Position digit
- 3- Full
- 4- Out of service
- 5- Fire mode.

3.7 Out door hall button Fireman key switch:

At the lobby outdoor at heights of 1600mm. Key operated switch in separate panel operated when using the elevator for evacuation.

3.8 Counterweight:

Most elevators use counterweights which equal the weight of the elevator plus 50% of its maximum rated load. This counterweight reduces the weight the motor must lift. Special frame filled with cast iron.

The counterweight should be 50 percent of the total load and the car weight. In other words, when the car is 50 percent full (an average amount), the counterweight and the car are perfectly balanced.

The purpose of this balance is to conserve energy. With equal loads on each side of the sheave, it only takes a little bit of force to tip the balance one way or the other.

$$M_c = M_c + (L * 50\%) \dots\dots\dots (3.2)$$

$$= 1470 + (50/100 * 1000)$$

$$= 1970 \text{ kg}$$

3.9 Guide rails:

"T" section guide rails, corrosion-proof, specially manufactured for elevators.

Two for the car and two for the counter weight, 22mm length each.

An apparatus for attaching a guide rail to a girder in an elevator shaft wall provides for vertical displacement of the guide rail relative to the walls of the elevator shaft. The apparatus includes a U-shaped intermediate plate of corrosion-proof metal positioned between the side surfaces of the flange of the guide rail and a U-shaped support bracket.

Steel guide rollers or guide shoes are attached to the top and bottom of the sling structure on each side to run along the guide rails. The guide rails are also steel and are attached to the interior walls of the elevator shaft which runs from the top of the building to the bottom.

3.10 Hydraulic buffer for elevators:

A hydraulic elevator buffer contains a piston (plunger) which is pushed down into a volume of hydraulic fluid. The buffer has no seals separating its interior from the atmosphere. As the piston is pushed down, the displaced fluid is forced through ports in the cylinder which gives rise to a restricting force. The displaced fluid escapes into a volume in which an airfluid mixture is produced. To reduce the collision shock and stop the car or counter weight safely in case of travels beyond the lower floor.

One for the car and one for the counter weight.

3.11 Bracket:

An elevator component mounting system includes two bracket-beam type structures that spans the vertical distance between successive floor slabs to provide a support bracket for elevator components in the absence of a vertical wall spanning the floor slabs, and for the counter weight.

3.12 Ropes:

The hoist ropes shall be made of steel with size and quantity to provide proper traction, safety factor, and elastic stretch of less than .07 inches per 150 lb. (App 2).

Governor ropes:

Shall be steel. All ropes shall consist of at least eight strands wound about a sisal core center



Fig 3.2 car operating panel

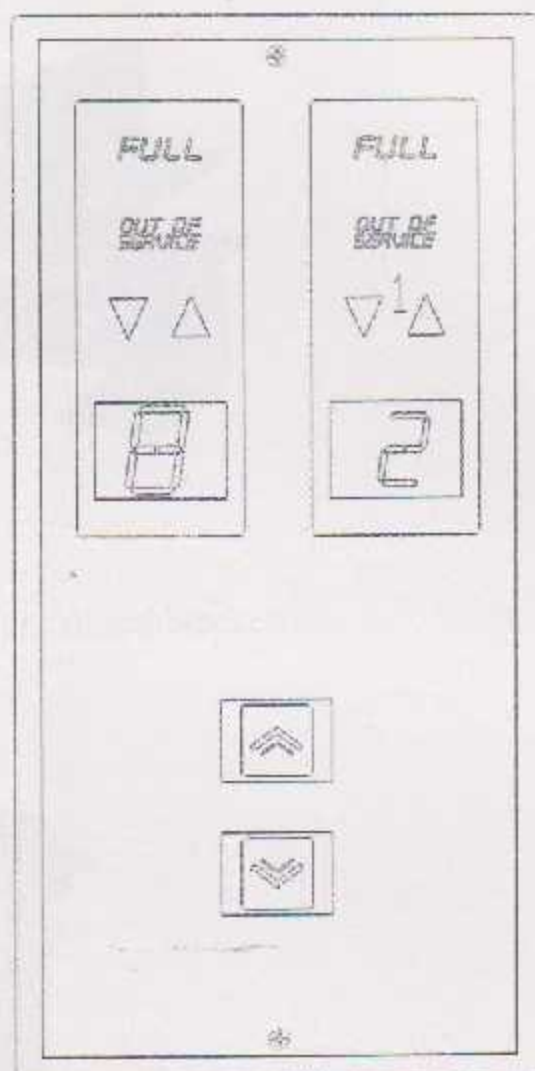


fig 3.3 landing push-button

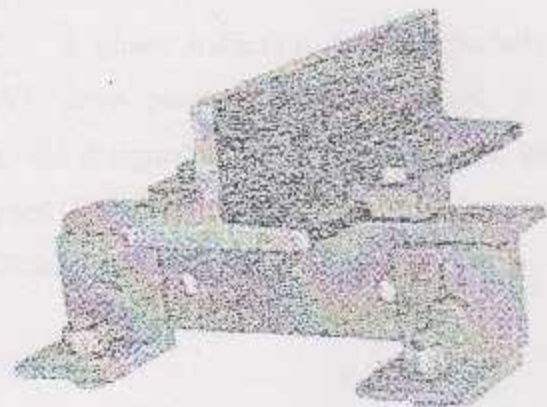


Fig 3.4 guide rail and brackets



Fig 3.5 buffers

3.13 Machine:

A single-spaced, AC – 3 phase induction motor, specially manufactured to compromise the VVVF drive power system. Its speed, positive or negative acceleration is exact to the designed elevator speed. Able to guide the elevator to reach the maximum speed (1.5m/s) in 600mm distance at less than 4 seconds.

Deceleration started 2700mm before the stopping point.

The motor could be:

Reversible.

Capable of operation in ambient temperate.

Be able to handle the load.

Rotate at the desired speed.

To calculate the machine torque, speed and power we can use the following formulas:

Motor speed:

$$N = V / C \dots\dots\dots (3.3).$$

Where N: motor speed (rpm).

V: elevator speed. (m/min).

C: pulley circumference. (m).

Designed speed (V) = 1.5 m/s

$$= 1.5 \text{ m/sec} * 60 \text{ sec/min}$$

$$= 90 \text{ m / min}$$

The pulley diameter (d) = 400mm. (appendix 3).

Therefore the circumference (C):

$$C = d * \pi \dots\dots\dots (3.4).$$

$$= 0.4 * 3.14$$

$$= 1.256 \text{ m}$$

Back to equation (3.3):

$$N = V / C$$

$$= 90 / 1.256$$

$$= 71.7 \text{ rpm} = 72 \text{ rpm}$$

The medium motor speed should double of the actual speed:

$$= 72 * 2$$

$$= 144 \text{ RPM}$$

Motor acceleration:

Moment of inertia:

$$I = 1/2 M * R^2 \dots\dots\dots (3.5)$$

Where I: moment of inertia. (kg. m²).

M: the mass. (Kg).

$$M = 1470 + 1000 - 1970$$

$$= 500 \text{ kg}$$

R: pulley radius. (m).

$$I = 1/2 M * R^2$$

$$= 1/2 * (500) * (0.2)^2$$

$$= 10 \text{ kg. m}^2$$

Torque:

$$T = F * R \dots\dots\dots (3.6)$$

Where T: torque (N m).

R: pulley radius (m)

F: force. (N).

$$F = M. g \dots\dots\dots (3.7)$$

$$= 500 * 9.81$$

$$= 4905 \text{ N.}$$

Back to equation (3.6):

$$T = F * R$$

$$= 4905 * 0.2$$

$$= 981 \text{ N m}$$

Since the angle is 90 and its sin= 1

$$\text{Then } T = I * \alpha \dots\dots\dots (3.8)$$

Where α : angular acceleration. (Rad/s²).

$$\alpha = T / I$$

$$= 981 / 10$$

$$= 98.1 \text{ rad /s}^2.$$

acceleration (a):

$$a = 2 * F / M \dots\dots\dots (3.9)$$

$$= 2 * 4905 / 500$$

$$= 19.62 \text{ m / sec}^2$$

Stall torque:

To choose a motor, more than 25% should be adding to the maximum torque.

$$= 4905 * 125 / 100$$

$$= 6131 \text{ N}$$

Motor Power:

Power = torque * angular speed

$$P = T * N \dots\dots\dots (3.10)$$

Where P: motor power (kW).

N: angular speed. (Rpm).

$$T = F * R \dots\dots\dots (3.11)$$

Where R: pulley radius (m)

$$= 4905 * 0.2 \text{m}$$

$$= 981 \text{ Nm}$$

$$P = T * 2 * \pi * N / 60000 \dots\dots\dots (3.12)$$

Where 60,000 come from 60 seconds per minute times 1000 Watts per kilowatt.

$$P = 981 * 2 * 3.14 * 72 / 60000$$

$$= 7.4 \text{ kW}$$

This means that the machine maximum power should be not less than 8.4 kW, we can add 40% as a safety factor, and we know that vvvf motors save energy.

$$P_a = P_t * 140\% \dots\dots\dots (3.13)$$

Where Pa: actual power.

Pt: theoretical power.

$$P_a = 7.4 * 140 / 100$$

$$= 10.4 \text{ kw}$$

Or 11 kW motor is suitable

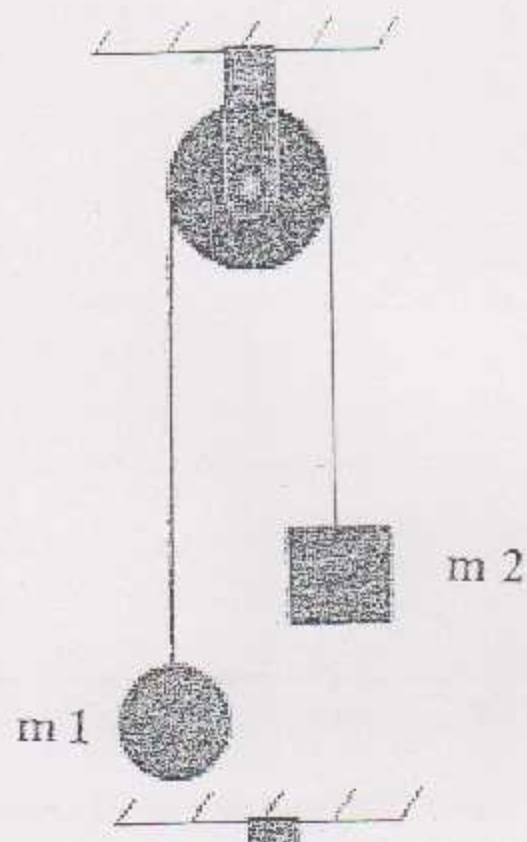


Fig 3.6 Free Body Diagram

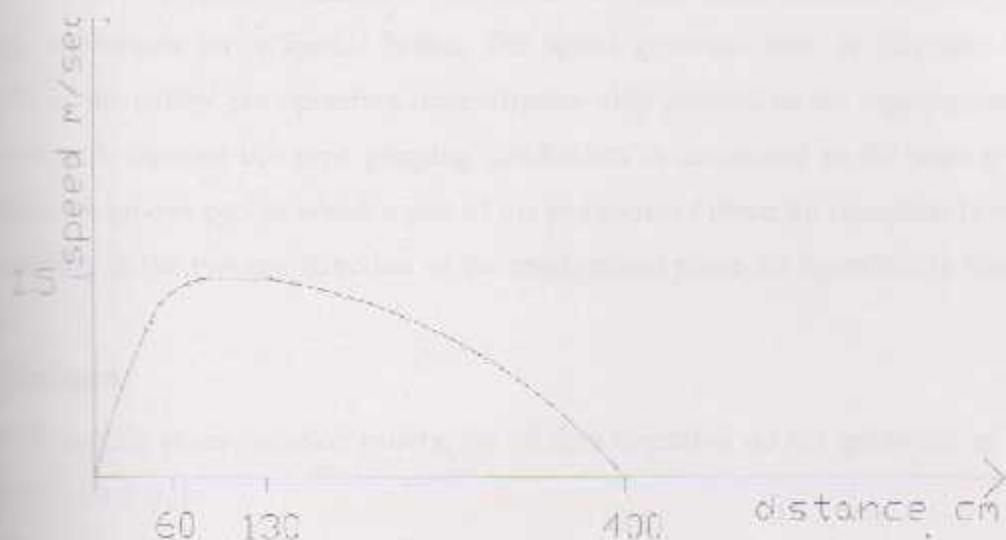


Fig 3.8 Velocity/Distance Jaigan

3.14 Speed Governor:

Where in a pulley around which a speed governor rope is wrapped is rotatably supported on a base. A latchet having an engagement piece for operation and rotatable about a pulley shaft for the pulley is supported on the base. The pulley comprises an engagement mechanism having a claw engaged with the ratchet when the rotational speed of the pulley reaches a set over speed and rotating the ratchet in the same direction as the pulley. A rope gripping mechanism for a special brake. The speed governor rope is disposed on the underside of the pulley. An operation lever displace ably pressed by the engagement piece for operation to operate the rope gripping mechanism is connected to the rope gripping mechanism. A groove part in which a part of the engagement piece for operation is inserted and extending in the moving direction of the engagement piece for operation is formed in the base.

3.15 Rollers:

Instead of guiding shoes, echelon rollers, for oil free operation on the guide rail of the car and the counter weight.

3.16 Two electrical silence fans:

in the car ceiling as supply fan and exhaust fan.

3.17 Brakes:

Prevent the elevator from moving when the car is stopping and there is no power applied to the machine.

A magnetic solenoid works against two springs pushing the fiber shoes of the brake , wound around a drum between the pulley and the motor. When a moving order and the motor attempt to start , a 90v power the solenoid which push the shoes out to release the pulley by the first micro switch, the second micro switch after while allow to give 45v power. The springs push the brake again after the machine stop immediately.

1.18 Elevator traveling cable:

An elevator system including an elevator car mounted for vertical movement in the hoistway of a building, and a plurality of traveling cables which interconnect the elevator car and a junction box in the hoistway. The pluralities of traveling cables are bundled to track as a single cable by a plurality of spaced retainer devices. Each retainer device includes a first portion which is tightly secured to one of the traveling cables, and a second portion which loosely encircles all of the traveling cab.

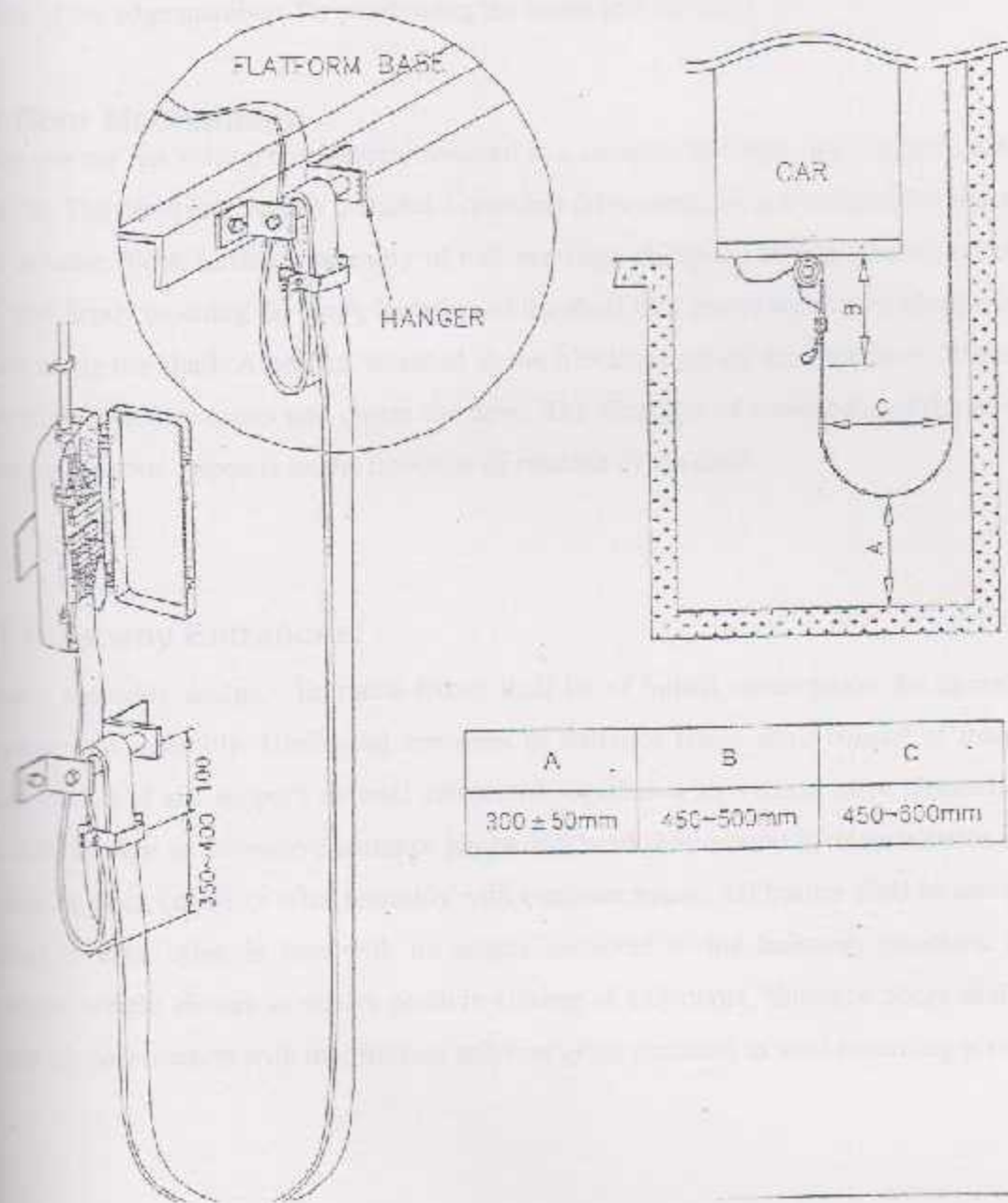


Fig 3.9 Traveling cable

3.19 Control board:

A control board for an elevator includes a pair of edge members each having a longitudinal slot. A number of boards and plates are engaged between the edge members for engaging with buttons and displayer and include side edges engaged in the slots of the edge members. The boards and the plates may be arranged or changed for fitting different buttons and displayer. Two panels are further engaged between the upper and the lower portions of the edge members for positioning the board and the plate.

3.20 Door Mechanism:

An elevator car has a drive mechanism mounted in a compact housing on the upper surface of the car. The drive mechanism includes a rotatable drive shaft, around which is mounted a linear actuator block having a plurality of ball bearings, obliquely arranged relative to the shaft, and firmly touching the shaft. Rotation of the shaft by a motor makes the block move linearly along the shaft. A bracket attached to the block carries an elevator door. Rotation of the shaft therefore opens and closes the door. The direction of movement of the block, and hence the door, depends on the direction of rotation of the shaft.

3.21 Hoistway Entrances:

Entrance assembly design: Entrance frame shall be of bolted construction for complete one-piece unit assembly. Horizontal members of entrance frame shall consist of integral header track and sill support channel connected together with vertical strut channels on each side. Design of decorative entrance jambs and head shall permit their installation into entrance opening before or after assembly with entrance frame. All frames shall be securely fastened to each other in line with tie angles anchored to the hoistway structure. Use suspended weight closers to ensure positive closing of hall doors. Entrance doors shall be of open rib construction with low friction polymer gibes mounted to steel mounting plates.

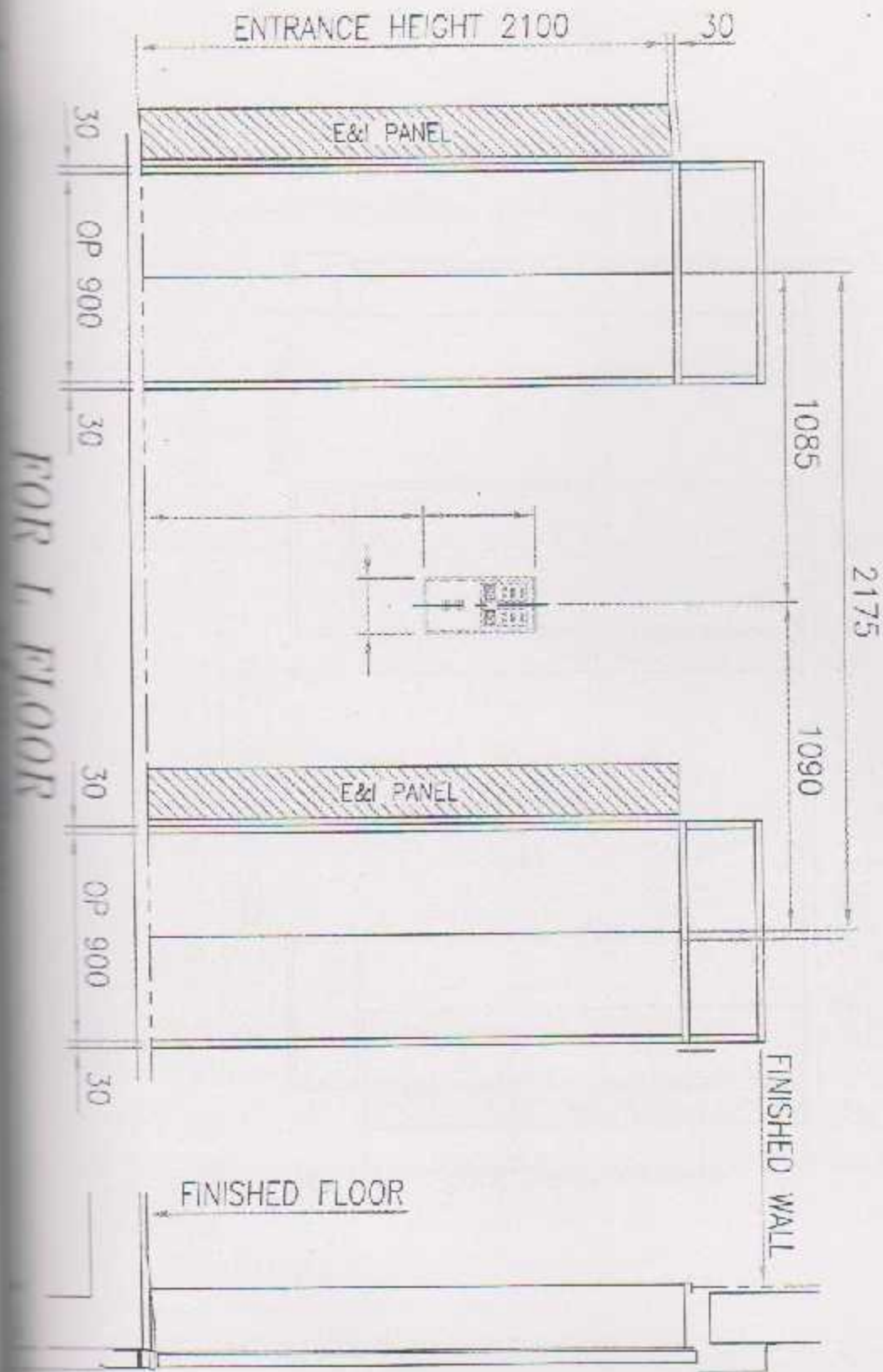


Fig 3.10 door entrance for last floor

Chapter Four

Roping, Safety system and Functions

Introduction

Helically around a core. The strands of a wire rope, or cable, consist of a number of individual Wire rope is metal in its strongest form. It consists of a group of strands laid wires laid about a central wire.

4.1 Elevator roping arrangement

An elevator installation includes an elevator car located in a hoistway and having a floor, and a rear wall extending upward from the floor. A counterweight is located in the hoistway adjacent to the rear wall of the elevator car. A drive machine is mounted in the upper portion of the hoistway, and a drive sheave operatively engages the drive machine and is located above the counterweight, with the drive sheave having a front edge. A deflector sheave is also mounted in the upper part of the hoistway generally below the drive sheave and has a rear edge that vertically overlaps with the front edge of the drive sheave. A first rope and a second rope each have a first end attached to one of a first and a second dead end hitch in the upper portion of the hoistway, with the underslung sheave assembly operatively engaging the first and second ropes to support the elevator car and the counterweight operatively engaging the first and second ropes as the first and second ropes extend from the drive sheave to the counterweight, and with the first and second ropes extending from the under slung sheave assembly around the rear edge of the deflector sheave and the front edge of the drive sheave such that the first and second ropes wrap around the drive sheave greater than 180 degrees. In roped elevators, the car is raised and lowered by traction steel ropes rather than pushed from below.

The ropes are attached to the elevator car, and looped around a sheave). A sheave is just a pulley with grooves around the circumference. The sheave grips the hoist ropes, so when you rotate the sheave, the ropes move too.

In gearless elevators, the motor rotates the sheaves directly. In geared elevators, the motor turns a gear train that rotates the sheave.

Both the elevator car and the counterweight ride on guide rails along the sides of the elevator shaft. The rails keep the car and counterweight from swaying back and forth, and they also work with the safety system to stop the car in an emergency.

Roped elevators are much more versatile than hydraulic elevators, as well as more efficient. Typically, they also have more safety systems.

4.2 Safety Systems:

Elevators are built with several redundant safety systems that keep them in position. The first line of defense is the rope system itself. Each elevator rope is made from several lengths of steel material wound around one another. With this sturdy structure, one rope can support the weight of the elevator car and the counterweight on its own. But elevators are built with multiple ropes (between four and eight, typically). In the unlikely event that one of the ropes snaps, the rest will hold the elevator up.

4.3 Speed Governor:

If all of the ropes were to break, or the sheave system was to release them, it is unlikely that an elevator car would fall to the bottom of the shaft. Roped elevator cars have built-in braking systems, or safeties, that grab onto the rail when the car moves too fast.

Safeties are activated by a governor when the elevator moves too quickly. Typically it works when the elevator moves at a speed of 15% faster. Most governor systems are built around a sheave positioned at the top of the elevator shaft. The governor rope is looped around the governor sheave and another weighted sheave at the bottom of the shaft. The rope is also connected to the elevator car, so it moves when the car goes up or down. As the car speeds up, so does the governor.

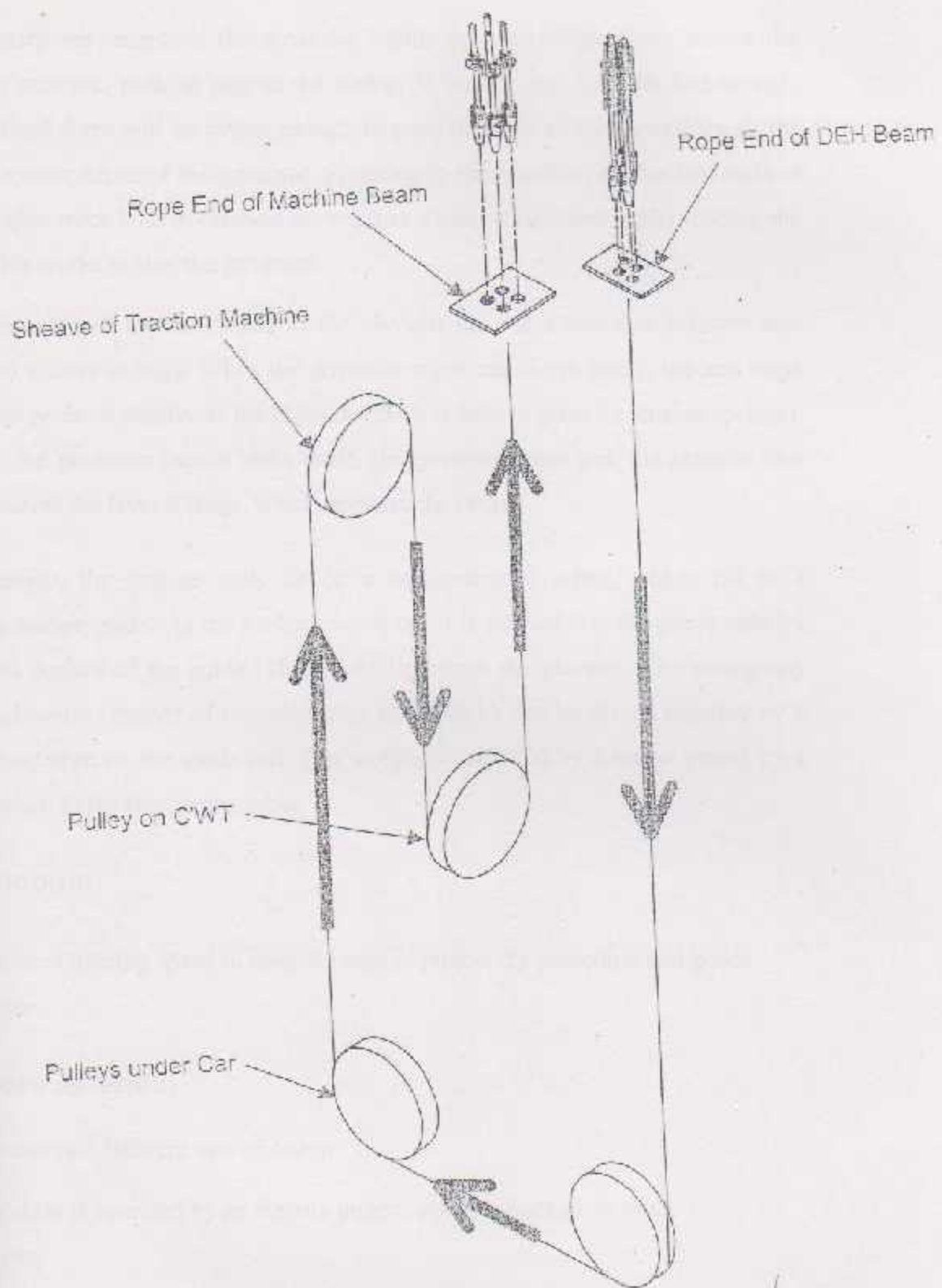


Fig 4.1 Elevator Ropping

As the rotary movement of the governor builds up, centrifugal force moves the flyweights outward, pushing against the spring. If the elevator car falls fast enough, the centrifugal force will be strong enough to push the ends of the flyweights all the way to the outer edges of the governor. Spinning in this position, the hooked ends of the flyweights catch hold of ratchets mounted to a stationary cylinder surrounding the sheave. This works to stop the governor.

The governor ropes are connected to the elevator car via a movable actuator arm attached to a lever linkage. When the governor ropes can move freely, the arm stays in the same position relative to the elevator car (it is held in place by tension springs). But when the governor sheave locks itself, the governor ropes jerk the actuator arm up. This moves the lever linkage, which operates the brakes.

In this design, the linkage pulls up on a wedge-shaped safety, which sits in a stationary wedge guide. As the wedge moves up, it is pushed into the guide rails by the slanted surface of the guide. This gradually brings the elevator. The emergency brake mechanism consists of two clamping faces which can be driven together by a wedge to squeeze on the guide rail. The wedge is activated by a screw turned by a drum attached to the emergency cable.

4.4 Encoder:

Insure the car's running speed in normal range to protect the passenger and goods from danger.

4.5 Doors safeties:

Elevators use two different sets of doors:

- 1) Cars door is operated by an electric motor, which is hooked up to the elevator
- 2) Landing doors is opening into the elevator shaft.

4.5.1 Light curtain protection:

A door safety device of an elevator, where in detection light is emitted from a platform side light emitting device to the platform side of a door at a platform. The detection light emitted from the platform side light emitting device is received by a platform side light receiving device. A control device controls the opening/closing of the door of a car and the door at the platform according to information from the platform side light receiving device. The platform side light emitting device and the platform side light receiving device are mounted on the car.

4.5.2 - Monitoring of elevator door reversal data:

An elevator displaying device for displaying, in addition to the car position of the elevator, operating conditions, such as opening and closing states, of the car door to alert passengers who are about to get on the car of possible dangers resulting from the operation of the door. Detectors are provided for detecting the operating conditions of the car door.

4.5.3 -Door reversal device:

Cause the car door and hall door to reopen, if an obstruction encountered when the doors are closing.

At the telescopic door, two micro switches located on the two parts of the door with lever 2 cm width and the door height.

One of them canceled 10cm before closing by a signal of a switch and a cam at the top of the door.

4.5.4 -Automatic door open and close time adjustment:

To increase the operation efficiency, the ECU automatically adjust the door open and close time, depending on whether the call is a hall or a car call.

4.5.5 Door nudging:

If the door remains open for more than the fixed time (20 sec), the door reduces closing speed with buzzer sound.

4.6 - Limit switches:

Limit Switches are the most numerous input devices in an elevator. They tell the system the position of gates, doors, turn heads, or distributors, and the alignment of belts. A switch can only tell whether an object is present or absent at a certain location. A pair of switches can tell if a gate is completely closed or fully open, but

not where the gate is if it is somewhere between those two limits. A limit switch can be operated by mechanical contact, by breaking a beam of light, or by detecting the disturbance of a magnetic field caused by a metal object. The following diagram shows a mechanical limit switch wired to a pair of indicator lights. It has an actuator arm which operates the switch contacts when it is moved slightly by contact with a piece of equipment such as a slide gate. The arm is spring-loaded, so it returns from its actuated position to its normal position when the equipment moves away.

4.7 -Final limit switch:

Independent of the limit switches, cause power to be remove from the drive motor, in cause the elevator passes any of the limit switches. Located 20 cm next to the limit switches up and down, and it should be manually reset.

4.8 -Deceleration switches:

Installed at 270 cm before the limit switches, to inform the ECU to start deceleration before stopping level. Up and down.

4.9 Miro-switchs:

4.9.1 Speed governor micro switches:

Operated by a centrifugal lever at the speed governor's pulley, factory adjustable at about 115%of the rated speed, put to power off, manually reset.

4.9.2 -Over speed brake switch:

Operated when over speed brake brakes the car put the power of, manually reset.

4.9.3 -Buffers switches:

Located at the car buffer and counter weight buffer, put the power off, when the car or counter weight pushes on the buffer.

4.9.4 - Landing doors lock switches:

Operated by its weight and a cam on the door, inform the control system about door open or close.

4.9.5 -Car Door full open switch:

To inform the control unit on the car to stop the door motor.

4.9.6 -Car door close switch:

To inform the door control unit when fully close and deactivate the right hand door safety edge switch 10 cm before closing.

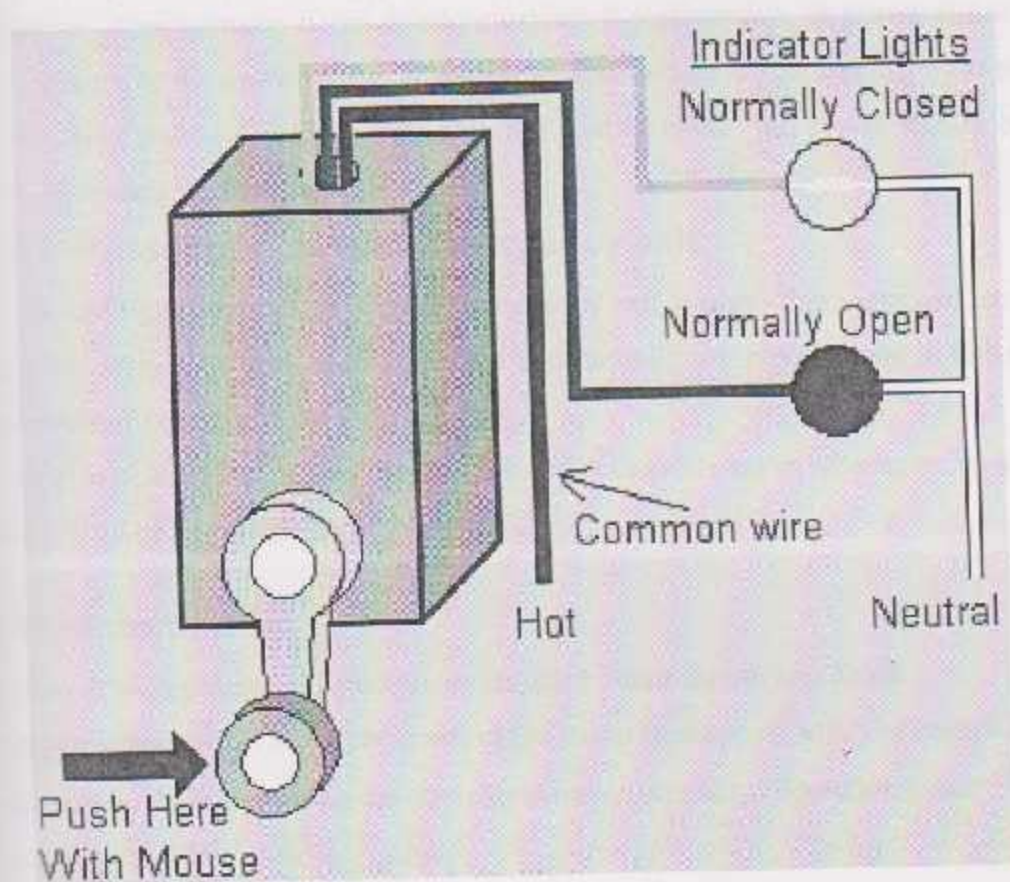


Fig 4.2 limit -switches

4.9.7 - Brake switches:

Two micro switches, operated by the brake solenoid rods, inform the control unit about brake solenoid piston position to determine the power to the solenoid.

4.10 -Rescue function:

When car stops between floors due to mechanical malfunction, or power failure, the car descends to the nearest floor, by a rechargeable battery which supply power pulses to the brake solenoid using a switch in the control board, the power should be off when operating the function.

4.11 -Passenger car with emergency exit:

An elevated passenger car having an emergency exit feature. The passenger car is of the type supported such that there are substantially no obstructions between the underside of the car and the ground below it.

A door unlock device to open the door, provides access to assist passengers within the car in event of an emergency or power failure.

4.12 -Interphone:

In case of emergencies, the interphone installed inside the car can direct communication with rescue personnel in the motor room or car top. The interphone is activated by simply pressing the interphone button on the car operation panel.

4.13 - Fire emergency return:

When the building's fire or smoke detectors are activated, all calls are cancelled and all the elevators will immediately travel to the main lobby and park there with the door fully open. It remains parked until the detection devices are deactivated.

4.14 - Fireman emergency service:

The fireman's switch is usually installed at the elevator main lobby. When it is activated, all car and hall calls are automatically cancelled and all elevators in the same bank will return immediately to the main lobby. The doors will open to allow passengers to disembark. Subsequently, the fireman's elevator responds only to car calls, the purpose of this mode of operation is to facilitate fire rescue and fire fighting operation.

4.15 - Emergency car lighting:

An emergency ceiling light switch on automatically in the event of a power failure, providing illumination within the car. The emergency light will allow any passengers inside the car and utilize the Interphone or the alarm bell to alert the superintendent of elevator.

4.16 - Car light & fans automatically shut off:

Elevators can be installed with an energy saving feature that automatically switches off the car internal lighting and ventilation fans when no calls are registered after a predetermined period of time.

4.17 - Load weight measuring:

If a load weight potentiometer for an elevator car, the purpose of this control is to provide meaningful feedback pertaining to the ECU, with the following functions:

4.17.1 - Full - load bypass:

If the car load has exceeded 80% of the rated load or capacity of the elevator, the elevator will automatically ignore all the hall calls in the direction of service and respond car calls only. The hall calls remain registered and will be served on the next trip (single car), or by another elevator (group).

4.17.2 - Overload protection:

When the car load exceeds the capacity or rated load of the elevator (110%), the elevator will stop operation with the doors fully opened on that floor and a buzzer is activated. The buzzer will stop when a sufficient number of passengers have entered the car load is less than the rated load.

4.18 - Anti-nuisance function:

Hall calls are automatically cancelled to avoid unnecessary stops caused by registration nuisance car calls registered do not correlate with the car load.

4.19 - Self-powered elevator button:

Elevator hall call device inductively receives an electrical signal from an interlock wiring circuit by means of a coupling device. The elevator hall call device comprises

a capacitive device which stores electrical charge based on the electrical signal received from the interlock wiring circuit by means of the coupling device. Hall call circuitry sends and receives signaling information to the elevator controller over the interlock wiring circuit, where the hall call circuitry is coupled to the capacitive device for receiving electrical power based on the stored electrical charge in the capacitive device.

4.20 - Earthquake control operation system:

When the sensor detects an earthquake, the car stops at the a safe floor, (the lobby) with the door open. It remains stop until a reset done or fireman key functioned to evacuate.

The earthquake control operation system for an elevator includes: an earthquake information delivering device for calculating a predicted arrival hour of earthquake waves in accordance with a position of a registered building based on an emergency earthquake bulletin including at least a seismic center of an earthquake and an hour of occurrence of the earthquake; an earthquake information receiving device for receiving the predicted arrival hour through an Internet and calculating an earthquake arrival need time as a time required for the earthquake waves to reach the building based on the predicted arrival hour; and an elevator control panel for performing an operation of stopping an elevator car at a safety floor when the elevator car is traveling toward the safety floor, a car call for the safety floor is registered, and a stop time at the safety floor is shorter than the earthquake arrival need time.

4.21 - VIP function:

A key or card operated function, when operating the VIP service, all operation orders will be cancelled and all running of elevator are controlled by attendant.

4.22 - Full collective operation:

Up/down hall call button are set to head off the elevator in the same direction. Local door open and open/close automatically is the basic function.

4.23 - Hoistway parameter self-learning:

Controller can learn the parameter of hoistway by automatically running. The information comprises total floor, floors height, rise etc.

4.24 - Automatically parking:

During off-peak hours, after the elevator cars have been dormant with door closed for a predetermined amount of time, the system disperse each car to a designated location (base floor or main floor), thus allowing more efficient service to future hall calls.

4.25 - Elevator locked:

Switch off the two position key switch which mainly located at base floor, then car will run to appointed floor with door-open status and cancel all registered calls. If the elevator is in group control status, those calls will transfer to other elevators. After the stopping time the door will close.

4.26 - Running counter:

For convenient maintenance, there is a counter in the operation board of controller used to count the amount of running time.

4.27 - Arrival gong:

An electronic chime provides an audio signal to inform waiting passengers of the arrival of the elevator car at each floor. The chime can be mounted on the top or bottom of the car, or at each floor if required.

4.28 - Self diagnosis of fault:

Last 10 times of fault information (fault code, time, and floor) and last 1 times detailed fault information (fault code, time, floor, current, voltage etc) will be recorded. in order to eliminate them quickly and restart running.

4.29 - Remote monitor and control:

By modem and phone, the elevator can be remotely controlled and monitored, in order to find the running condition of each elevator for manufacturer and service team.



4.30 - Elevator system leveling safeguard control and method:

An elevator control system with a local area network on the traveling cable and distributed control circuit safeguard for loss of remote microprocessor control with a car door open when floor releveled distance exceeds the landing zone limit. The elevator control circuit is interactive with the car driving apparatus and with the car door circuit so that when the driving apparatus for the car is leveling the car for passenger load weight gain or loss, the car door is signaled to remain open in the zone of the target floor as long as the distance that the car moves is within the elevator safety code requirements. A time delay relay interfaced with an output channel circuit of the microprocessor times out to stop car driving apparatus if the distance limit is exceeded.

4.31 - Pre-open door:

When elevator runs to level range, the door can be open in advance to improve the efficiency.

4.32 - Re-level during open status:

When elevator stops at the level, many people or goods enter it. As the distortion of steel wire rope and rubber, the level of elevator fluctuate and it is not convenient to people and goods. The system permits the elevator slowly run to level in door-open

4.33 - Dispatching as Group Control

The group control system for two or more elevators employs artificial intelligence and fuzzy logic. The big-best refined knowledge and experience harnessed in the field of group control have been incorporated into the microprocessors, allowing car assignments to the most used location, and thereby providing superb elevator efficiency and optimum service.

4.34- Function for deformity:

It is special for those people who are handicapped, which include additional special operation panel with Braille button, handrail, back mirror and sound player etc.

4.35- Emergency rescue device:

During normal power failure, the automatic rescue device converts stored energy from a bank of rechargeable batteries to drive the elevator car to the nearest floor and opens the elevator doors to let the passengers out. (Could be used when there is no emergency power supply for the building).

4.36- Mistake car-call cancellation:

Allows cancellation of an incorrectly registered car call. If you push a wrong floor button in the car, you can cancel it by pressing the floor button twice consecutively.

5.1 Introduction

The drive system for DC motors was invented in 1893 and rapidly became the drive of choice for lift systems. One hundred years later (give or take a year or two) the variable-voltage, variable-frequency drive system for AC motors appeared. A variable-frequency drive is a system for controlling the rotational speed of an alternating current (AC) electric motor by controlling the frequency of the electrical power supplied to the motor. A variable frequency drive is a specific type of adjustable-speed drive. Variable-frequency drives are also known as adjustable-frequency drives, AC drives, microdrives or inverter drives. Since the voltage is varied along with frequency, these are also called VVVF (variable voltage variable frequency) drives.

The technology has improved greatly over the years. The most recent high-tech products are dubbed Vector Control for induction motors or are designed to work with Permanent Magnet Synchronous motors, a type. The reason that their use is limited to low speed elevator applications is not the drive, or the lack of technology to make the application work at higher speeds, but simply the lack of a low rpm AC motor driven elevator machine suitable to work with a gearless traction system.

- **Rectifier stage:** A full-wave, solid-state rectifier converts three-phase 60 Hz power from a AC supply to either fixed or adjustable DC voltage. The system may include transformers if higher supply voltages are used.
- **Inverter stage:** Electronic switches - power transistors or thyristors - switch the rectified DC on and off, and produce a current or voltage waveform at the desired new frequency. The amount of distortion depends on the design of the inverter and filter.

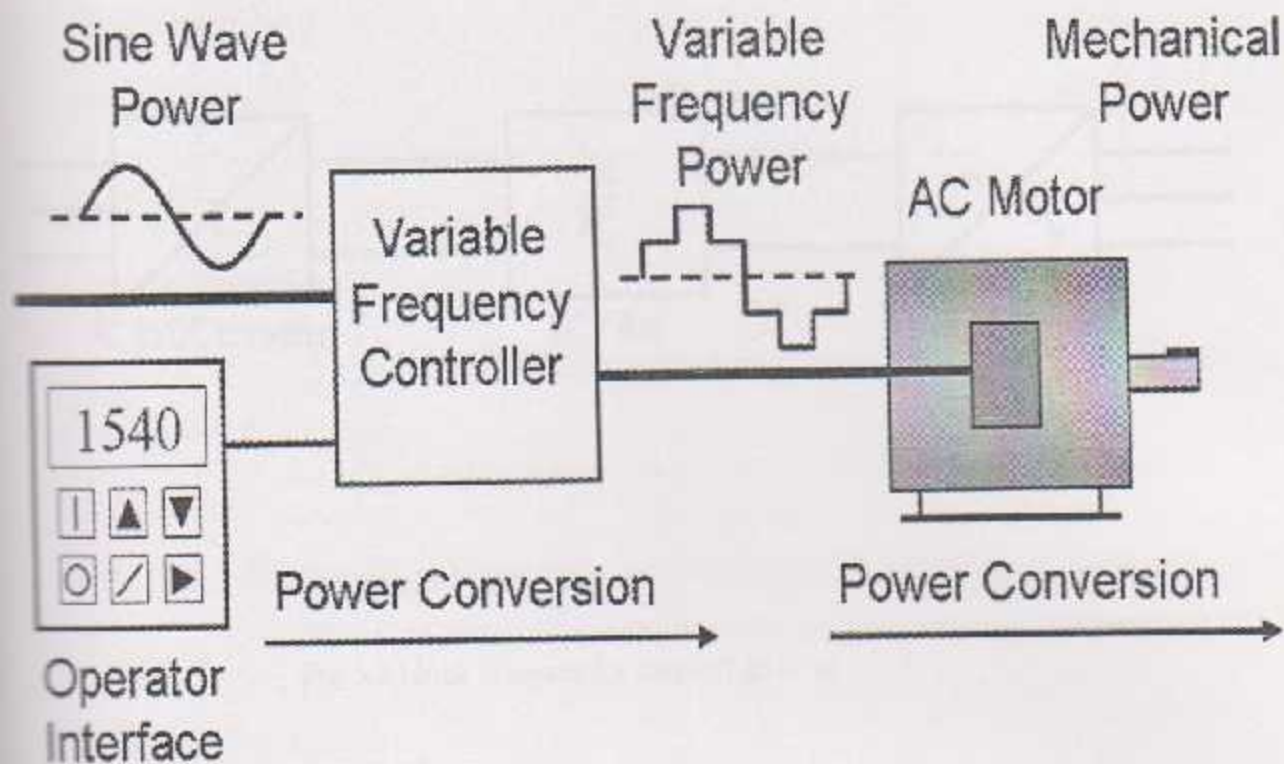


Fig 5.1 Variable Voltage Variable Frequency controller

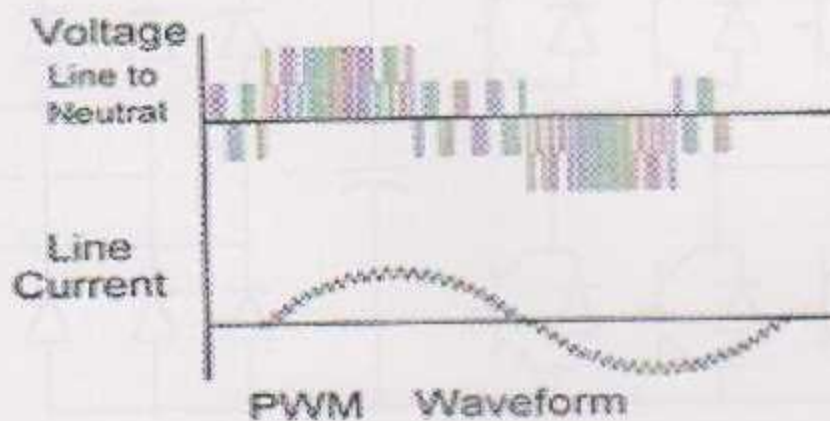


Figure 5.2 Inverter's Pulse Width Modulation Output

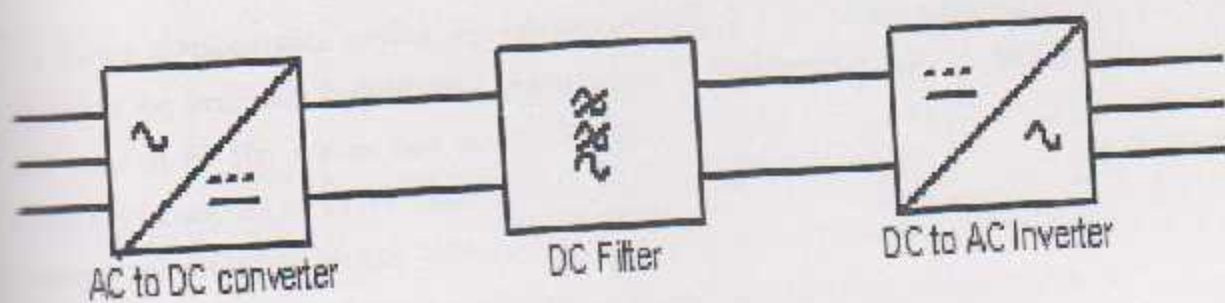


Fig 5.3 block diagram for convert ac to ac

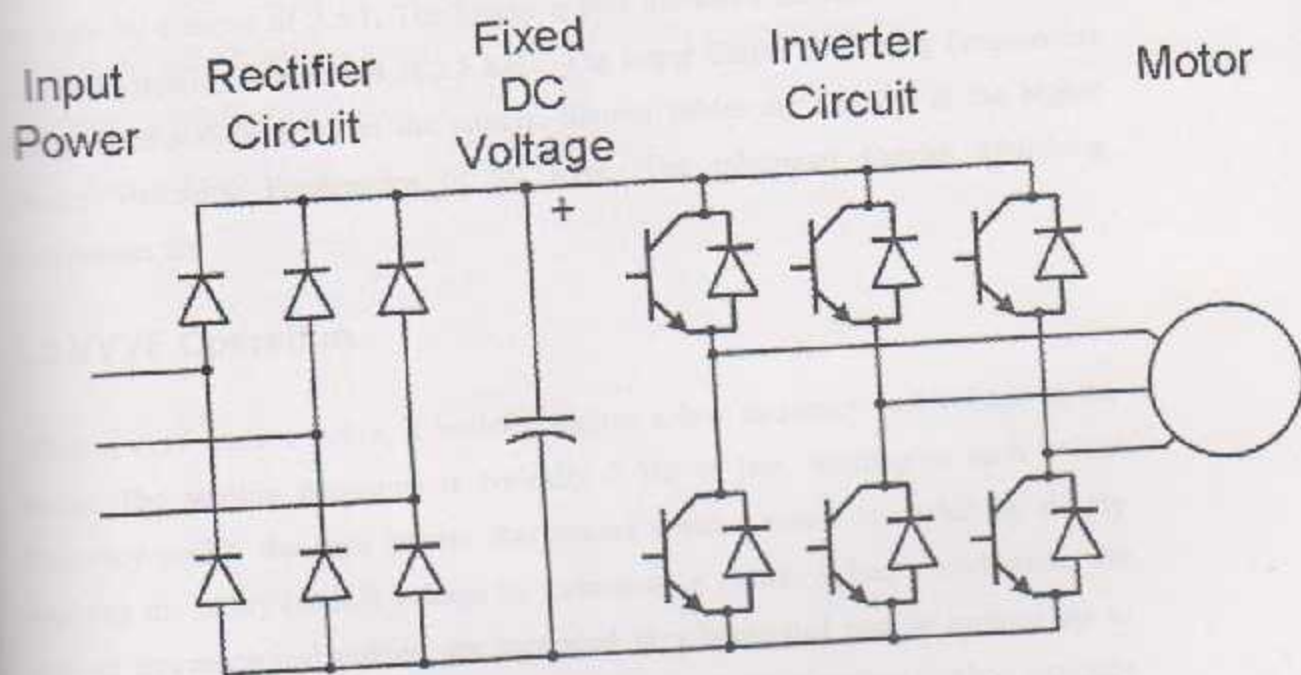


Fig 5.4 circuit diagram for rectification and inverting voltage

5.2 Adjust motor voltage

AC motor characteristics require the applied voltage to be proportionally adjusted whenever the frequency is changed. For example, if a motor is designed to operate at 460 volts at 60 Hz, the applied voltage must be reduced to 230 volts when the frequency is reduced to 30 Hz. Thus the ratio of volts per hertz must be regulated to a constant value ($460/60 = 7.67 \text{ V/Hz}$ in this case). For optimum performance, some further voltage adjustment may be necessary, but nominally constant volts per hertz is the general rule.

An embedded microprocessor governs the overall operation of the Vvuf controller. The main microprocessor programming is in firmware that is inaccessible to the vuvf user. However, some degree of configuration programming and parameter adjustment is usually provided so that the user can customize the vuvf controller to suit specific motor and driven equipment requirements.

At 460 Volts, the maximum recommended cable distances between Vvuf and motors can vary by a factor of 2.5:1. The longer cables distances are allowed at the lower Carrier Switching Frequencies of 2.5 KHz. The lower Carrier Switching Frequencies can produce audible noise at the motors. Shorter cables are allowed at the higher Carrier Switching Frequencies of 20 KHz. The minimum Carrier Switching Frequencies for

5.3 VVVF Operation

When a vuvf starts a motor, it initially applies a low frequency and voltage to the motor. The starting frequency is typically 2 Hz or less. Starting at such a low frequency avoids the high current that occurs when a motor is started by simply applying the utility (mains) voltage by turning on a switch. When a vuvf starts, the applied frequency and voltage are increased at a controlled rate or ramped up to accelerate the load without drawing excessive current. This starting method typically allows a motor to develop 150% of its rated torque while drawing only 50% of its rated current. When a motor is simply switched on at full voltage, it initially draws at least 300% of its rated current while producing less than 50% of its rated torque. As the load accelerates, the available torque usually drops a little and then rises to a peak

while the current remains very high until the motor approaches full speed. A Vvvf can be adjusted to produce a steady 150% starting torque from standstill right up to full speed while drawing only 50% current.

With a Vvvf, the stopping sequence is just the opposite as the starting sequence. The frequency and voltage applied to the motor are ramped down at a controlled rate. When the frequency approaches zero, the motor is shut off. A small amount of braking torque is available to help decelerate the load a little faster than it would stop if the motor were simply switched off and allowed to coast. Additional braking torque can be obtained by adding a braking circuit to dissipate the braking energy or return it to the power source.

In lift applications, VVVF control regulates input voltage and frequency to the motor. The figures below illustrate the variation of electrical current drawn by different lift motor during the whole journey of a lift car. The speed of the lift increases (accelerates) and decreases (decelerates) gradually at the beginning and ending respectively as shown in the top graph. When compared with AC 2 speed drive (middle graph) and ACVV drive (bottom graph), VVVF drive draw much less current during acceleration and deceleration.

5.5 Closed loop door operator

The door operator is critical to the elevator door system and performance time. Closed loop operators are now very common and reliable. Although not all are created equal, they are still much better than the open loop system because the closed loop operator can control the closing pressure to compensate for building stacking effect and dirt in the sill. Closed loop systems mean more accurate stopping and ride comfort all the time.

◆ Inverter Door (VVVF)

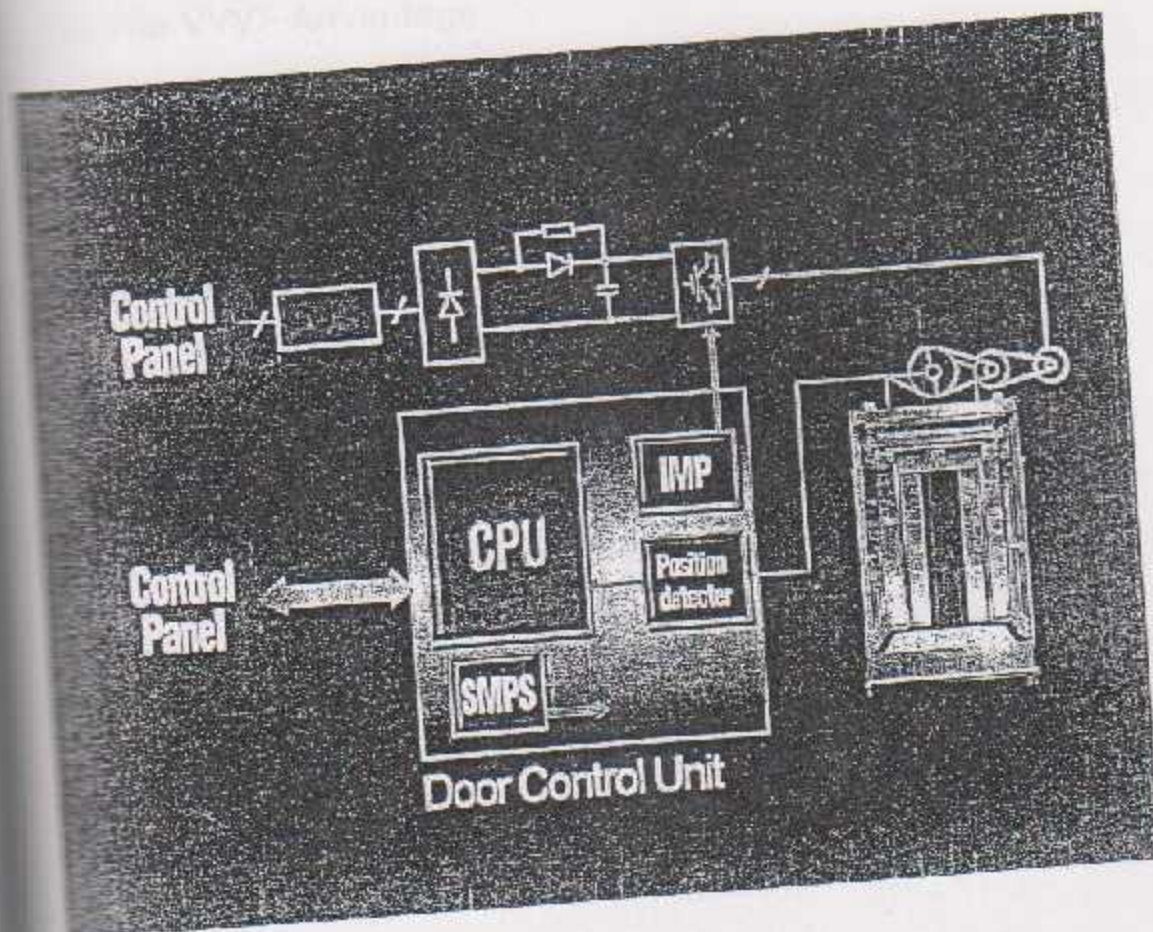


Fig 5.5 inverter door - vvvf

5.6 The VVVF Advantage

- 1) Quickly installed, easily maintained and 100% factory tested
- 2) Suited for use with single or two speed, three phase, AC induction motors
- 3) Delivers level floor stops bringing your AC elevator up to accepted leveling standards
- 4) Provides zero-speed brake stops, which will reduce wear on the elevator machine and brake
- 5) Existing motor may be reused in modernization's
- 6) Excellent ride quality and dependable operations

5.7 Electrical System Characteristic

- 1- INPUT Voltage 3 -phase 380 V,50 HZ

This input voltage will be change by inverters and rectifier and we got many kind of voltage to operate all system:

- 307 AC voltage with 56 HZ for machine and machine door
- 220V AC 50 HZ Single phase for lighting
- 110 DC voltage for control switches and break
- 110V AC voltage for control system
- 48V DC for relay's

- 2- Variable voltage variable frequency system (vvvf) for soft start

- 3- Equipment wiring system for all elevator component and lighting

5.8 Safety circuit

5.8.1 Inverter over current

when current in the electric motor exceeds limit value , if over current occurs ,stop switching in order to prevent damage on motor and inverter device as we can see in fig 5.7.

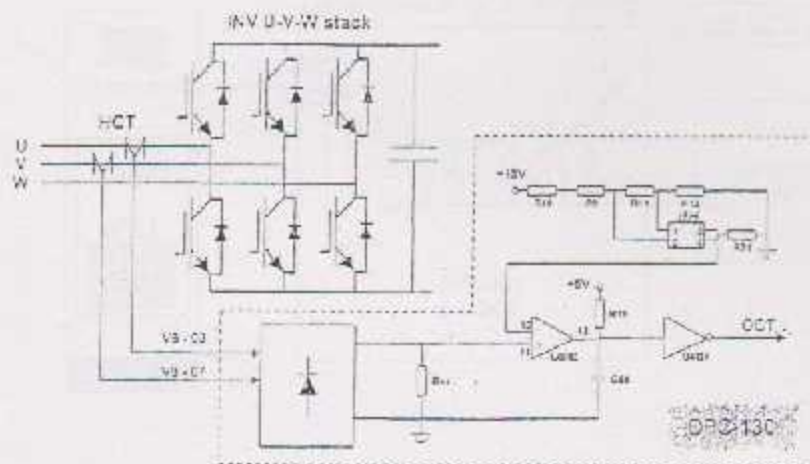


Fig 5.7 inverter over current

5.8.2 Dc link over voltage

When DC link voltage is 770 V or more is detected, stop switching to prevent condenser from damage as we can see in fig 5.8

Over voltage detection circuit

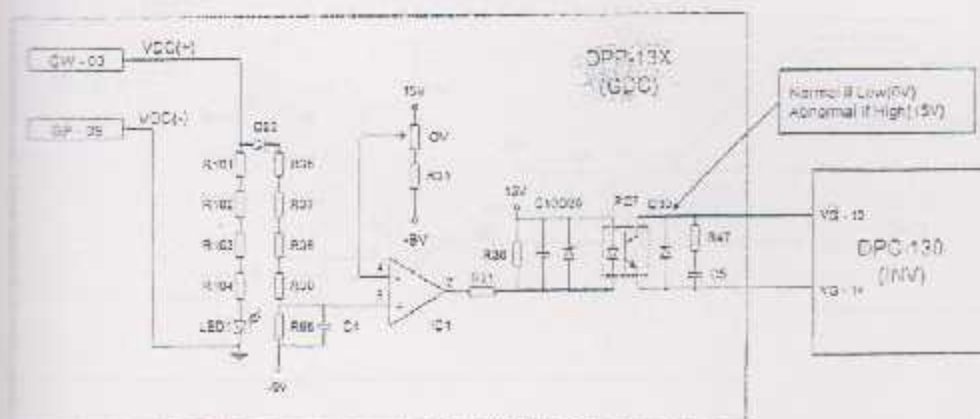


Fig 5.8 DC link over voltage

5.8.3 Inverter stack over heat

When the thermal switch on radiating plate activate in order to prevent the damaged by overheating 85 c or more as we can see in fig 5.9

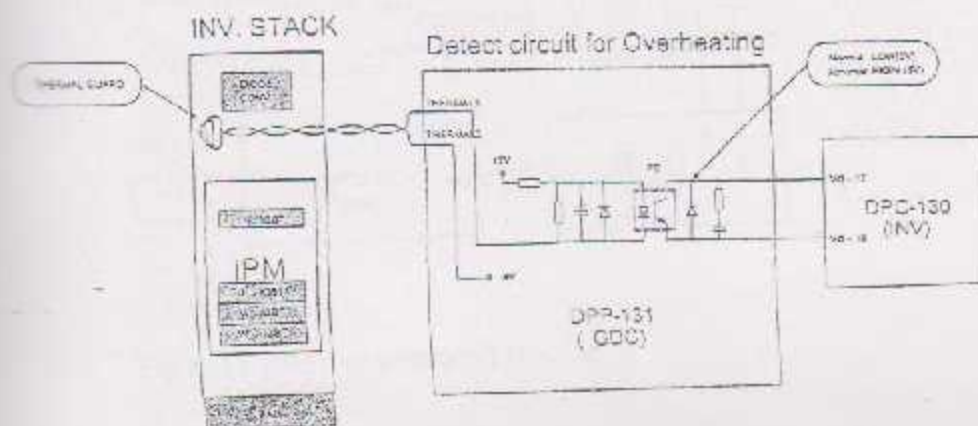


Fig 5.9 inverter stack over heat

5.8.3 DC link under voltage

When the voltage of dc link is 330 V or less we used the voltage drop detecting circuit as in fig 5.10

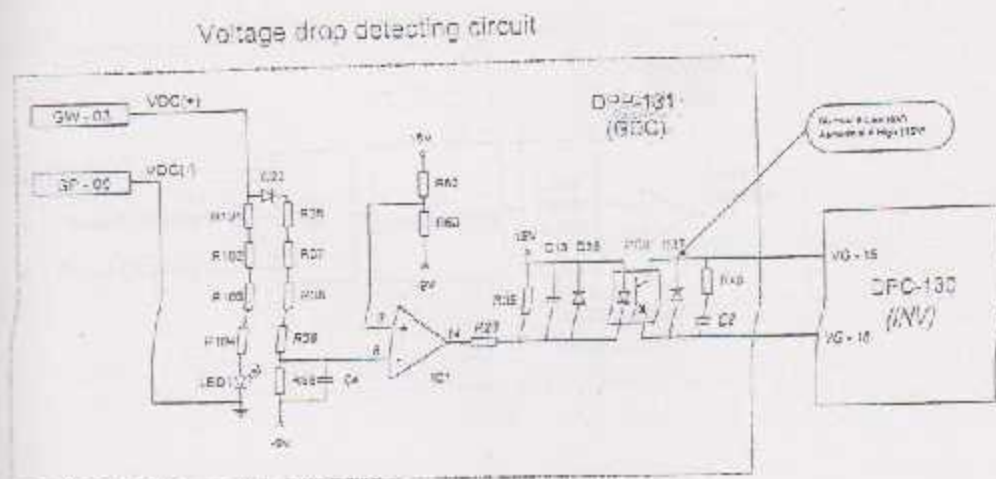


Fig 5.10 DC link under voltage

when failure occurs in the charging circuit which protect the condensers and power derive by damping current on initial charging of DC line end as in fig 5.11

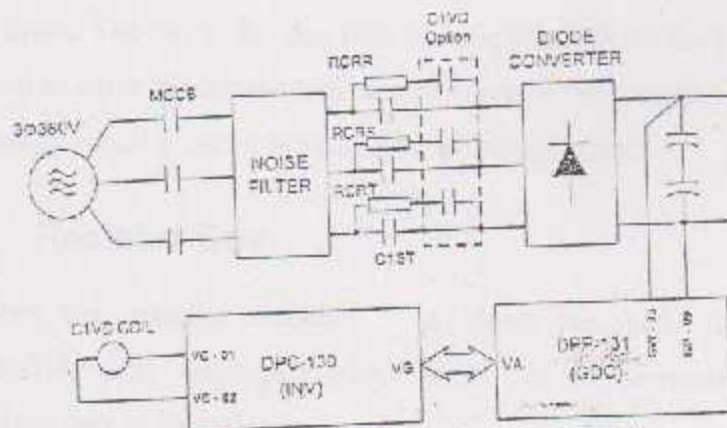


Fig 5.11 inverter charging trouble

5.8.5 Inverter overload detection

When the current detected on motor exceeds general motor capacity continuously this error is detected when the motors U,V, and W phase value that have been radio-rectified, converted into A/D values and gone through low pass filter exceed 150% of rated and the error is detected when tatted value over 1 second)

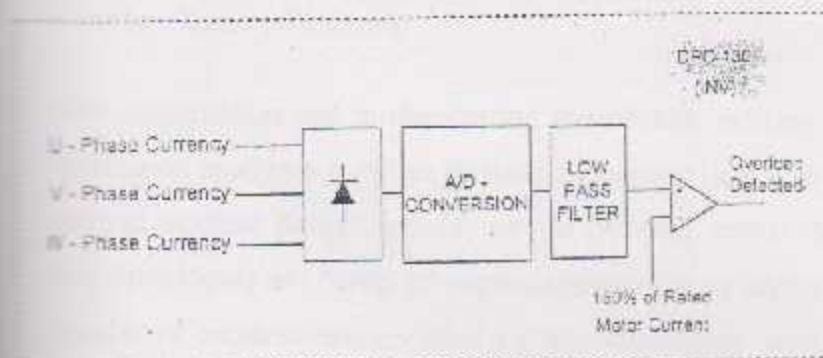


Fig5.12 Inverter overloads detection

5.9 Circuit breaker elevator

A collapsible metal frame is attachable to the front of a switchboard assembly and allows a circuit breaker to be withdrawn from one of a plurality of vertically stacked compartments and deposited on a pan carried between the open compartment and the metal frame. The circuit breaker may then be lifted above the pan, and the pan removed to allow the circuit breaker to be dropped to ground level. This procedure is reversed to install a circuit breaker into the compartment.

5.10 Resistor Box

When the traction machine go down the shaft the machine became as Generator and produce voltage back so we connected the motor to 3 big resistor box to limit this voltage

5.11 Elevator Motor

Elevator motor provide power to raise and lower platform, there is a lot of kind of electrical motor AC induction, squirrel cage elevator motors with variable speed (VVVF). Traditionally a DC machine, AC variable frequency is today's state of the art prime mover for most elevators. Low slip, closed loop vector duty motors are available from 5 to 200 horsepower 4, 6, 8 or 10 pole. Rutland's unique electrical and mechanical designs are ideally suited for the demanding low noise levels and positioning

New construction and modernization (retrofitting existing old DC installations) of traction machines is where Rutland's expertise lies. Many older DC machines utilized special flange mount, single bearing motor designs and Rutland has developed a/c "drop-in" replacements for all styles and manufacturer's machines requirements required for this application such as Westinghouse, Titan, Northern, Armor, and Dover or bolt-up designs eliminate the need for costly adapters and modifications to standard flange mount motors

As we make the analyses of the machine characteristic which needed for the elevator and according to Jordanian code and the experience, the following table 5.7 for characteristic the machine :

Model		WIN3000
Rated Speed		1.5, m/s
Shaft Load		3,000kg
Power Capacity		11kW
Weight		425 kg approx.
Angular velocity		144 rpm
Sheave Diameter		400mm
Motor rating	Voltage	307V
	Current	26.7A
	Pole	40P
	Frequency	56Hz

Table 5.7 machine characteristic

5.12 Gearless machines with zero maintenance

"Most lift companies consider gearless machines as only suitable for use in machine-room-less lifts. However, they are in fact the perfect solution for any type of installation

Gearless machines range from 300 kg up to 2,500 kg and from 0.63 to 2.5 m/s.

"Within this range, It is a highly compact gearless machine that enables an

installation in direct draw with a piggyback type of frame, cutting down assembly time significantly.

~~Since these machines do not have a gearbox, they do not require any type of idling.~~

Thanks to the AC drive control, brake wear is virtually nonexistent. Add to this the fact that most of the units in use today are machine-room-less, and the benefits are extraordinary. Companies that rely on this type of technology start making a profit from the moment they install the lift.



Fig 5.13 MRL machine

Direction system of the stage

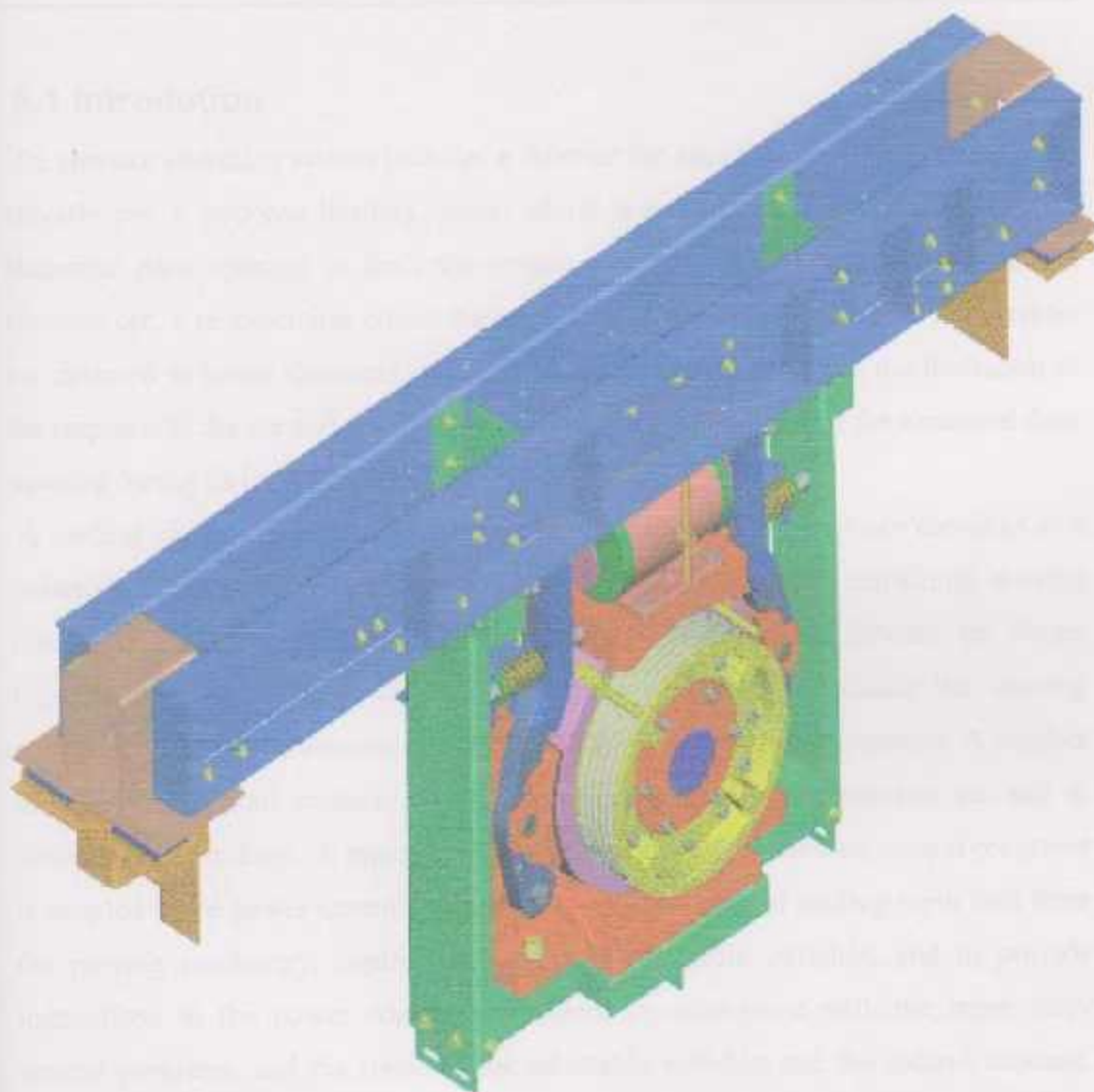


Fig 5.14 fixing of MRL

Operation system of the elevator

6.1 Introduction

An elevator operating system includes a detector for detecting an door opening of an elevator car, a response limiting circuit which is responsive to the detection of the abnormal door opening to limit the response to car calls and floor calls for the elevator car, a re-execution circuit for re-executing the door opening of the elevator car detected as being abnormal, and a releasing circuit for releasing the limitation of the response to the car and floor calls in response to no detection of the abnormal door opening during its re-execution.

A method and apparatus for controlling the movement of one or more elevators in a hoistway. The apparatus includes a power control sub-system containing moving machinery for imparting motion to the elevator car and to the elevator car doors, together with a plurality of control contacts operating to actuate the moving machinery to urge the elevator car and the doors in appropriate directions. A number of selectable control contacts or switches are provided in the elevator car and at elevator floor landings. A supervisory control sub-system containing control programs is coupled to the power control sub-system for the purpose of reading input data from the moving machinery, control contacts, and selectable switches, and to provide instructions to the power control sub-system in accordance with the supervisory control programs, and the status of the selectable switches and the control contacts. The supervisory control sub-system includes a data memory for storing the input data, a program memory for providing ones of a plurality of predetermined program instructions, and a data processor serially storing data, addressing the program memory, reading the instructions, fetching stored data, and providing output control signals to the power control sub-system. The elevator car and door motion is controlled in accordance with the output control signals.

Our elevators is controls by microprocessor system with full option to arrange the registration of the calls respect to the priorities and direction of the car our elevator is Duplex full Collective Operation Using a microprocessor-based controller,

6.4 Scheduling Elevator Operations

Logic controllers must have some way to determine in what order riders should be picked up and dropped off. Many elevator systems will move in one direction (e.g., upward) and only pick up riders that are also signaling to go in that direction (e.g., upward). When the final floor that has been requested in that direction (e.g., upward) is reached the elevator will turn around and pick up all riders signaling the opposite direction (e.g., downward). Of course, the elevator car also stops at all floors for which riders, already inside the car, have input a requested. A more sophisticated system, often used in hotels and other large buildings with a lot of foot traffic, involves the traffic patterns that reoccur. These systems have logic controllers that are programmed with information about the demand on each floor with respect to the time of day and they route the elevator cars accordingly so as to minimize the wait for all riders. When there are multiple elevator cars, the logic controller bases the movement on each car on that of the others. Often, the elevator car is equipped with a load sensor so that if the elevator is full to capacity it sends a signal to the control system and the logic controller signals the car not to pick up any more passengers until the load is lowered.

6.5 Controller:

The elevator control system shall be microprocessor based and software oriented and be linked together for purposes of communication by a serial communications link.

Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons are pressed. Each landing call shall be canceled when answered.

2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the

a direction shall not intercept the travel unless the stop for that floor has been entered by a car button or unless the up call is the lowest for which any button has been pressed.

When the car has responded to its highest or lowest call, and calls are registered for opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be acted upon at the stopping of the car at the landing.

Microprocessor and car controller are located in the last floor near the car frame.

Microprocessor door operator shall reside in the door operator and control all functions of the elevator door(s).

Electronic selector shall reside on the car top and contain Hall Effect transducers that detect magnetic fields. Magnets, corresponding to floor positions and top/bottom of hoistway are mounted on a perforated metal tape that runs the length of the hoistway.

6 Duplex selective collective operation:

With two cars in service and no calls, registered one car park at lobby and becomes home car.

- 1- Other car parks where last used and becomes free car.
- 2- Registrations of hall call away from home car call in free cases free car to respond
- 3- After car has started, respond to call registered for direction of travel in order in which floors are reached
- 4- Once direction of travel has been established, car will not reverse direction of travel, have been answered
- 5- Car slows down and stops automatically at floors corresponding to registered calls, in order in which they are approached in each direction of travel.

- 6- As slow down is initiated for hall call, call is automatically canceled and hall button for direction of travel remains ineffective until elevator leaves floor
- 7- Car calls are similarly canceled
- 8- Car remains at arrived floor with predetermined time interval sufficient to allow passenger transfer, timing feature must be adjustable
- 9- Car answers calls corresponding to direction in which car is traveling, except car may answer call in opposite direction if call is highest or lowest call registered
- 10- when free car is clearing calls home car responds to:
 - a-call registered in home car buttons
 - b-up hall call registered below free car while free car is traveling up
 - c-up or down call registered and free car is delayed its normal operation for predetermined period
 - d- Hall all registered and free car is delayed in its normal operation for predetermined period
- 11- when both cars are clearing call, only one car stops in response to registered hall call
- 12- first car to clear calls returns and becomes home car

3.6.1 Use Case 1: Request Elevator

- **Primary Actor(s):** Elevator User, Elevator Logic Controller
Description: The Elevator User uses the Elevator Request System (ERS) to request an elevator.
Preconditions: An Elevator User is at a floor and desires to use the elevator.
Flow of Events : The Elevator User arrives at the ERS panel on their floor :
 1. User presses "Up" or "Down" button on ERS panel.

2. The ERS sends a signal to the ELC, detailing which floor the user is on.
3. The request is added to a list of floors to visit.
4. The ELC determines which direction to move to service the next request.
5. The doors are closed, if open, and the elevator begins to move towards the requested floor.
6. The ELC checks whether to stop as the elevator approaches a floor.
7. The elevator stops at requested floors that are along the route to the original destination floor.
8. The ELC opens the elevator door when it comes to a stop.
9. The elevator arrives to service the request of the user.

Postconditions: The elevator has arrived in response to a request.

Alternative Flow of Events: None.

Assumptions: None.

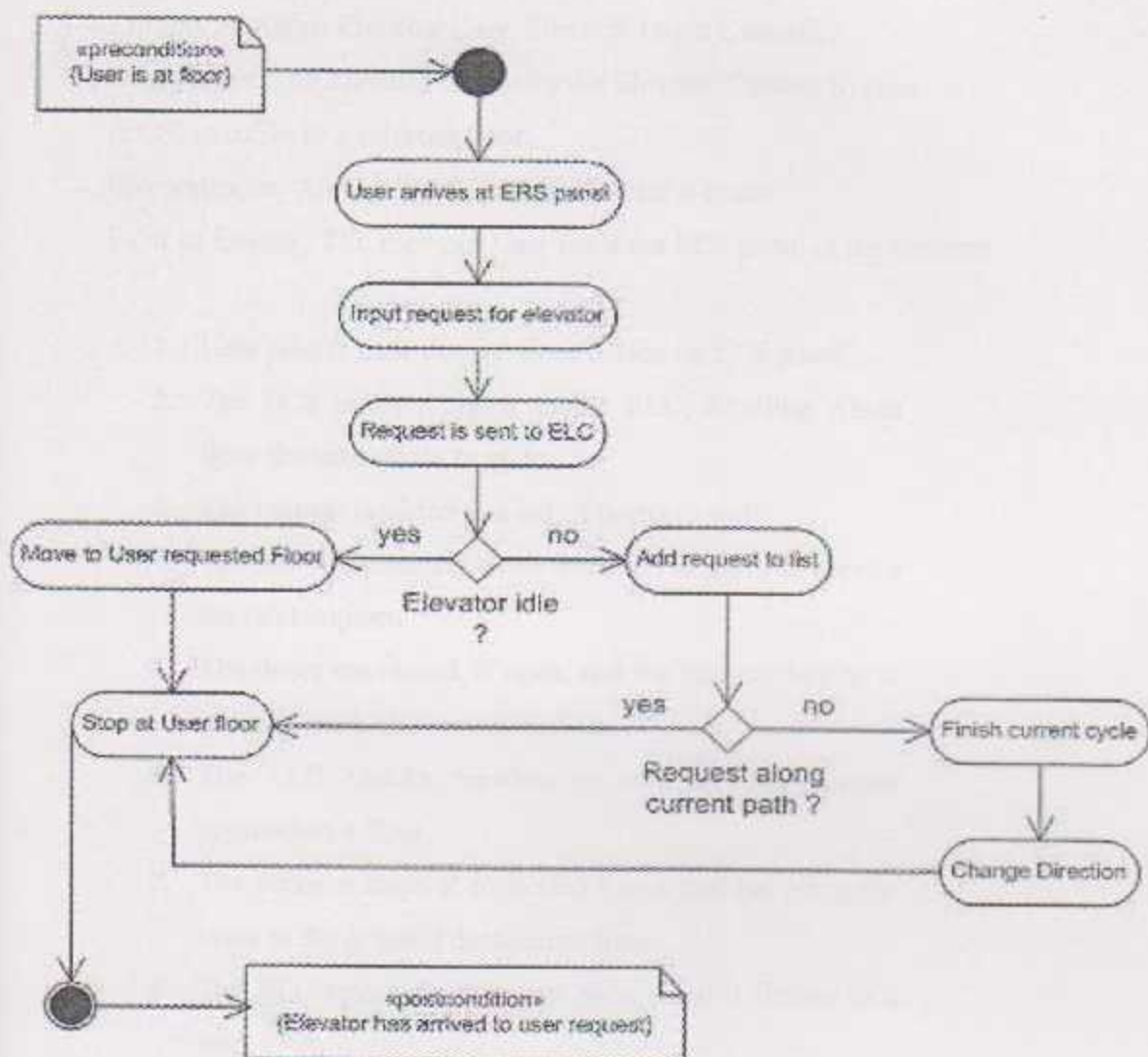


Fig. 6.1 Flow of Events for Use Case 1.

6.6.2 Case 2: Floor Selection Use Case

- Primary Actor(s): Elevator User, Elevator Logic Controller

Description: The Elevator User uses the Elevator Control System (ECS) to move to a selected floor.

Preconditions: An Elevator User is inside the elevator.

Flow of Events : The Elevator User finds the ECS panel in the elevator :

1. User selects their desired floor button on ECS panel.
2. The ECS sends a signal to the ELC, detailing which floor the user wants to go to.
3. The request is added to a list of floors to visit.
4. The ELC determines which direction to move to service the next request.
5. The doors are closed, if open, and the elevator begins to move towards the requested floor.
6. The ELC checks whether to stop as the elevator approaches a floor.
7. The elevator stops at requested floors that are along the route to the original destination floor.
8. The ELC opens the elevator door when it comes to a stop.
9. The elevator arrives to service the selection of the user.

6.2 Elevator Door Control

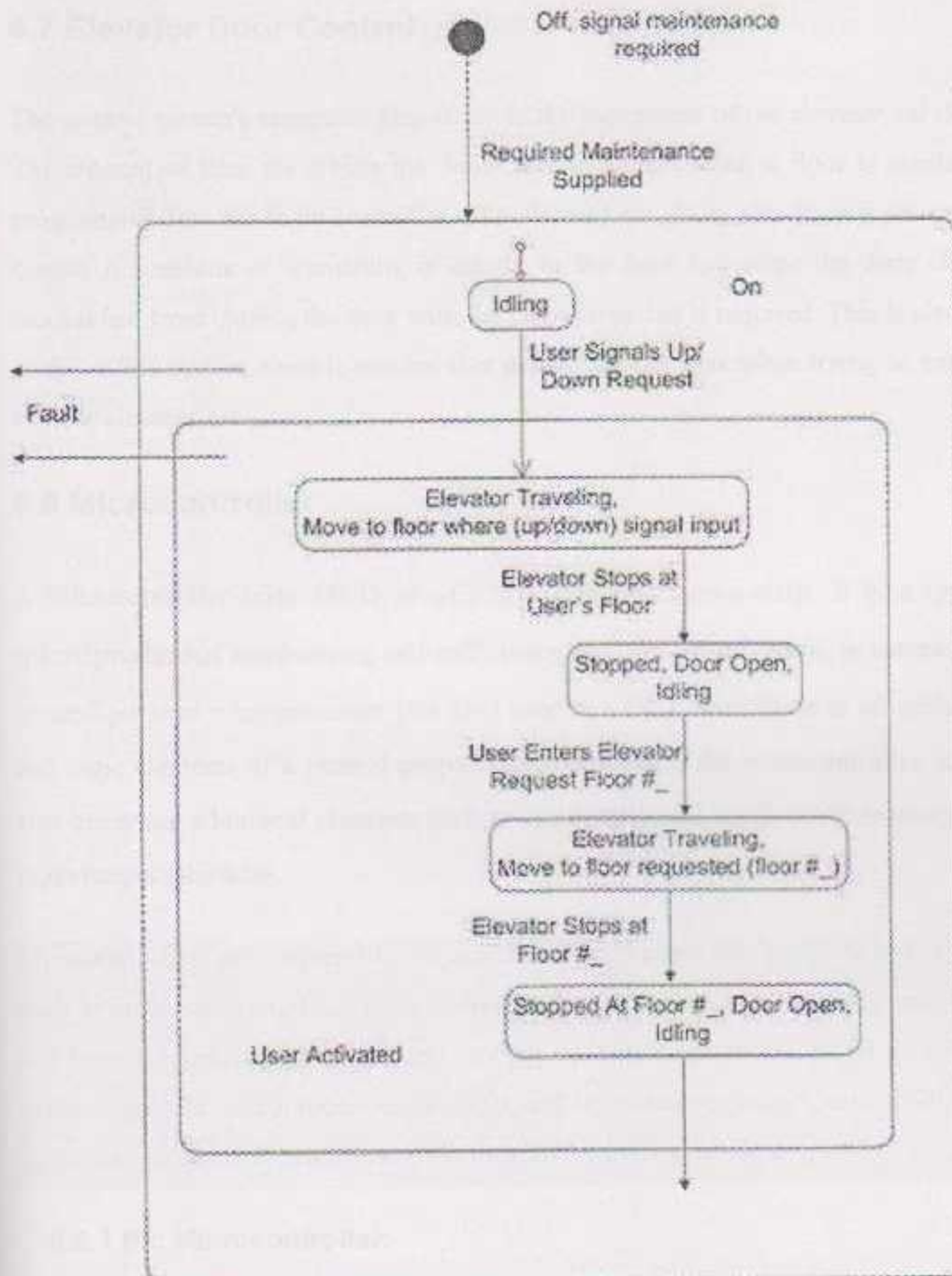


Fig. 6.2 Statechart for User Activity

6.7 Elevator Door Control

The control system's computer also controls the movement of the elevator car doors. The amount of time for which the doors are held open when a floor is reached is programmed into the logic controller. The elevator car doors also have a sensor that detects if someone or something is caught in the door and stops the door closing mechanism from closing the door with the large force that is required. This is also part of the safety system since it ensures that people are not hurt when trying to enter or exit the elevator car.

6.8 Microcontroller

A microcontroller (also MCU or μC) is a computer-on-a-chip. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor (the kind used in a PC). In addition to all arithmetic and logic elements of a general purpose microprocessor, the microcontroller usually also integrates additional elements such as read-only and read-write memory, and input/output interfaces.

Microcontrollers are frequently used in automatically controlled products and devices, such as automobile engine control systems, office machines, appliances, power tools, and toys. By reducing the size, cost, and power consumption compared to a design using a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to electronically control many more processes.

6.8.1 Pic Microcontroller:

When studying the PIC series of microcontrollers, the first thing to realize is that the architecture is completely different from anything you are probably used to. This makes understanding the PIC quite confusing at first. You are probably familiar with the spinal cord type of computer with memory, cpu and peripheral chips hooked in parallel to the same data and address bus. The PIC chips have two separate 'data' busses, one for instructions and one for everything else. Instructions are essentially in ROM and dedicate the microcontroller to doing one task. There is

very little RAM, a few dozen bytes, and this is reserved for variables operated on by the program. There is also very little 'data' storage, again a few dozen bytes, and this is in EEPROM which is slow and clumsy to change.

6.8.2 TYPES OF PIC's:

There are a dozen or so I/O pins on the PIC which can be configured as inputs or outputs. When outputs, they have to strength to drive LED's directly. A couple of the I/O pins are used to program the internal ROM serially with an external programmer. These are the OTP, (One Time Programmable), chips. There are also similar chips with UV erasable EPROM's used for prototyping at about three times the price. Then there is one series that is of special interest to the hobbyist, the 16F84, (C84,83), chips which have electrically reprogrammable EEPROM memory for instructions. These can be reprogrammed hundreds of times. There have been many programmers designed for this series, one of the simplest appeared in the Sept. '98 issue of 'Electronic Now'.

6.8.3 Pic INSTRUCTIONS:

The small instruction set, (37 instructions), and the 14 bit size of instructions lead to a number of compromises. For one thing you can't have two registers specified in a single instruction. Each register takes 7 bits to specify its address, but you also have to specify the instruction number and what to do. The solution is to run almost everything through 'W' or working register which is internal to the processor and doesn't have an address. A register to register transfer would take two instructions. Suppose you had a pattern of LED segments to be lit in the variable PATTERN and want to move it to PORTB to light the segments

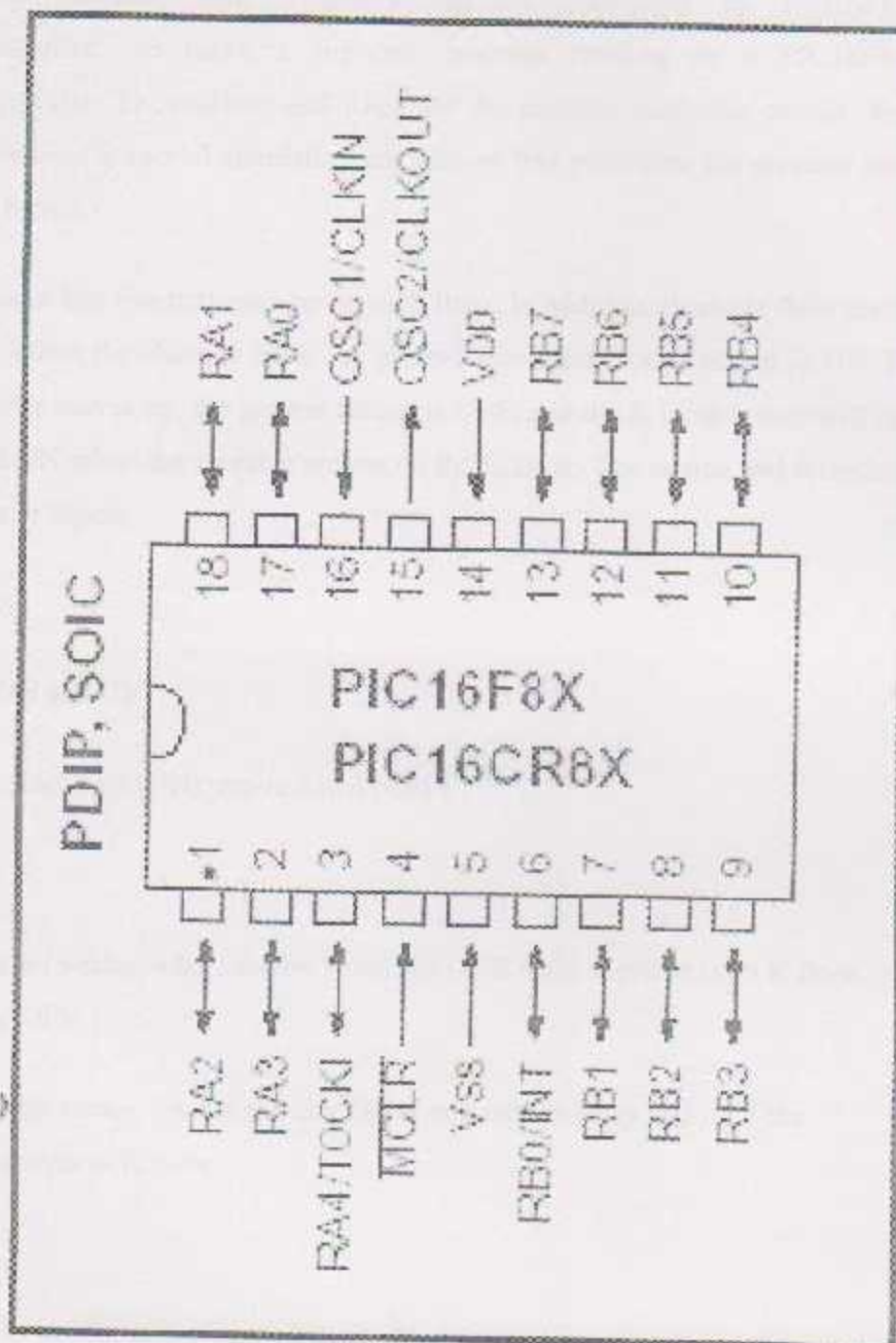


Fig 6.3 pic 16f84

6.9 Description

Our elevator with 5 floors can be controlled by PIC16F84 microcontroller; we make a software program running on a PIC16F84 microcontroller. To motivate and illustrate the elevator controller design, the applet contains a special simulation component that visualizes the elevator and its floor button..

The elevator has five buttons, one on each floor. In addition, there are floor level sensors. When the elevator is on the ground floor, the ground sensor is ON. If the elevator moves up, the ground sensor is OFF, and the K level sensor will be switched ON when the elevator arrives on the K floor. The engine and direction are elevator inputs.

Inputs:

engine: ON and OFF

direction: move up (ON), move down (OFF)

Outputs:

Sensor: 5-bit vector, where the bit K will be ONE if the elevator is on K floor, otherwise OFF

Button: 5-bit vector, Switch the bitk ON if pressed, and stay ON until the elevator arrives at K floor.

6.10 Program to control elevator by C- language

To control our 5 floors elevator we need to program our microcontroller (Pic 16f84) by using C language for programming the chip to have all function for controlling the moving of the elevator car between the floors

```
// this program using to control the elevator with 5 floors //
```

```
// Elevator controller (5 floors) with PIC16F84
```

```
// Also demonstrates how to implement state-machines as C  
Programs.
```

```
// the push-buttons that request the elevator target floor
```

```
// we map BUTTON_0=RA4 etc. to keep the schematics simple..
```

```
#define BUTTON_0 RA4
```

```
#define BUTTON_1 RA3
```

```
#define BUTTON_2 RA2
```

```
#define BUTTON_3 RA1
```

```
#define BUTTON_4 RA0
```

```
// the sensors that indicate which floor the elevator car
```

```
// has reached. Again we map 0-4 1-3 etc. to avoid signal
```

```
// crossing in the schematics.
```

```
#define SENSOR_0 RB4
```

```
#define SENSOR_1 RB3
```

```
#define SENSOR_2 RB2
```

```
#define SENSOR_3 RB1
```

```
#define SENSOR_4 RB0
```

```
// two output ports used to control the elevator motor
```

```
// (on/off) and motor direction (up/down).
```

```
#define MOTOR_ON RB6
```

```

#define UP_NDOWN RB7

// the elevator states: parked means waiting (at floor < i >),
// up_to and down_to imply moving to the corresponding floor.
// We force an encoding that allows you to watch the state
// during the simulation (upper nibble=1/2/4: parked/up/down),
// lower nibble=floor index, 0xff=error
//
enum elevator_state {
    PARKED_0 = 0x10,
    PARKED_1 = 0x11,
    PARKED_2 = 0x12,
    PARKED_3 = 0x13,
    PARKED_4 = 0x14,

    UP_TO_1 = 0x21,
    UP_TO_2 = 0x22,
    UP_TO_3 = 0x23,
    UP_TO_4 = 0x24,

    DOWN_TO_3 = 0x43,
    DOWN_TO_2 = 0x42,
    DOWN_TO_1 = 0x41,
    DOWN_TO_0 = 0x40,

    UNKNOWN = 0xff,
};

enum motor_state {
    STOP = 0x00,
    MOVE_UP = 0xc0,
    MOVE_DOWN = 0x80,
};

```

the operation shall be automatic by means of the car and hall buttons. In the absence of system activity, one car can be made to park at the pre-selected main landing. The other (free) car shall remain at the last landing served. Only one car shall respond to a hall call. If either car is removed from service, the other car shall immediately answer all hall calls,

6.2 Control System

Every elevator system must be equipped with a control system that will receive the rider input and translate that into a signal that will control the actual elevator hardware.

6.3 Logic Controller

These systems include a logic controller that takes the rider input and translates it into meaningful actions. According to company of elevators, the logic controller's central processing unit (CPU) must be given at least three critical pieces of information, namely:

- Where people want to go?
- Where each floor is?
- Where the elevator car is?

The first input comes directly from the riders. The user pushes the floor number inside the elevator car signaling their final destination. When the floor buttons are pushed the logic controller receives the signal and registers the user's request.

The second input "where each floor is" can often be determined by the addition of holes located on a long vertical tape inside the elevator shaft. The elevator car is equipped with a light or magnetic sensor that reads the number of and which holes are being passed by the elevator car as it ascends and descends. The computer is equipped with a means of varying the speed of electric motor (connected to either of the following system designs) so it can slow down the car when it is approaching a floor at which it is to stop.

```
// global variables for state-machine state and motor control
```

```
//
```

```
unsigned char state = PARKED_0;
```

```
unsigned char motor = STOP;
```

```
// indicate an error by lighting the LED on port B.5
```

```
// (note that RB5 is also used to reset the SR-flipflops,
```

```
// but the short strobes should not be visible on a real LED.
```

```
void
```

```
error(void)
```

```
{
```

```
    motor = STOP;
```

```
    for(;;) {
```

```
        RB5 = 1;
```

```
    }
```

```
}
```

```
void
```

```
main(void)
```

```
{
```

```
    GIE = 0; // disable interrupts
```

```
    TRISA = 0x1f; // all inputs
```

```
    TRISB = 0x1f; // RB7..RB5 outputs, RB4..RB0 inputs
```

```
    for(;;) {
```

```
        switch(state) {
```

```
            case PARKED_0:
```

```
                if(BUTTON_1 | BUTTON_2 | BUTTON_3 | BUTTON_4) {
```

```

        state = UP_TO_1;
        motor = MOVE_UP;
    }
    else {
        motor = STOP;
    }
    break;

case PARKED_1:
    if (BUTTON_2 | BUTTON_3 | BUTTON_4) {
        state = UP_TO_2;
        motor = MOVE_UP;
    }
    else if (BUTTON_0) {
        state = DOWN_TO_0;
        motor = MOVE_DOWN;
    }
    else {
        motor = STOP;
    }
    break;

case PARKED_2:
    if (BUTTON_3 | BUTTON_4) {
        state = UP_TO_3;
        motor = MOVE_UP;
    }
    else if (BUTTON_0 | BUTTON_1) {
        state = DOWN_TO_1;
        motor = MOVE_DOWN;
    }
    else {
        motor = STOP;
    }

```

```

    break;

case PARKED_3:
    if (BUTTON_4) {
        state = UP_TO_4;
        motor = MOVE_UP;
    }
    else if (BUTTON_0 | BUTTON_1 | BUTTON_2) {
        state = DOWN_TO_2;
        motor = MOVE_DOWN;
    }
    else {
        motor = STOP;
    }
    break;

case PARKED_4:
    if (BUTTON_0 | BUTTON_1 | BUTTON_2 | BUTTON_3) {
        state = DOWN_TO_3;
        motor = MOVE_DOWN;
    }
    else {
        motor = STOP;
    }
    break;

case UP_TO_1:
    if (SENSOR_2 | SENSOR_3 | SENSOR_4) {
        error ();
    }
    if (BUTTON_2 | BUTTON_3 | BUTTON_4) {
        state = UP_TO_2;
        motor = MOVE_UP;
    }

```

```
else if (SENSOR_1) {  
    state = PARKED_1;  
    motor = STOP;  
}
```

```
else {  
    motor = MOVE_UP;  
}  
break;
```

```
case UP_TO_2:
```

```
if (BUTTON_3 | BUTTON_4) {  
    state = UP_TO_3;  
    motor = MOVE_UP;  
}
```

```
else if (SENSOR_2) {  
    state = PARKED_2;  
    motor = STOP;  
}
```

```
else {  
    motor = MOVE_UP;  
}  
break;
```

```
case UP_TO_3:
```

```
if (BUTTON_4) {  
    state = UP_TO_4;  
    motor = MOVE_UP;  
}
```

```
else if (SENSOR_3) {  
    state = PARKED_3;  
    motor = STOP;  
}
```

```
else {  
    motor = MOVE_UP;
```

```

    }
    break;

case UP_TO_4:
    if (SENSOR_4) {
        state = PARKED_4;
        motor = STOP;
    }
    else {
        motor = MOVE_UP;
    }
    break;

case DOWN_TO_3:
    if (BUTTON_2 | BUTTON_1 | BUTTON_0) {
        state = DOWN_TO_2;
        motor = MOVE_DOWN;
    }
    else if (SENSOR_3) {
        state = PARKED_3;
        motor = STOP;
    }
    else {
        motor = MOVE_DOWN;
    }
    break;

case DOWN_TO_2:
    if (BUTTON_1 | BUTTON_0) {
        state = DOWN_TO_1;
        motor = MOVE_DOWN;
    }
    else if (SENSOR_2) {
        state = PARKED_2;

```

```

        motor = STOP;
    }
    else {
        motor = MOVE_DOWN;
    }
    break;

case DOWN_TO_1:
    if (BUTTON_0) {
        state = DOWN_TO_0;
        motor = MOVE_DOWN;
    }
    else if (SENSOR_1) {
        state = PARKED_1;
        motor = STOP;
    }
    else {
        motor = MOVE_DOWN;
    }
    break;

case DOWN_TO_0:
    if (SENSOR_0) {
        state = PARKED_0;
        motor = STOP;
    }
    else {
        motor = MOVE_DOWN;
    }
    break;

default:
    error ();

```

```

} // end switch(state)

// a variant of the elevator circuit uses extra SR-flipflops
// to make sure that the (short) pulses generated by the
// floor-sensors are picked up by this program loop.
// To reset the flipflops, we generate a short-pulse on RB5
// now. We can do this here, because we have just handled
// one iteration of the state-machine state update.
// The single pulse is too short to make the error LED
// light up visibly.
RB5 = 1;
RB5 = 0;

// now activate the motor corresponding to the current
// state. We just need RB7 and RB6, but the other bits
// are inputs anyway.
PORTB = motor;

// finally, reset the watchdog timer.
CLRWDTO;
}

}

// we don't use interrupts in this program.
//
static void interrupt
ISR(void)
{
    if(TOIF) { // timer interrupt
        error();
    }
    else if(INTF) {
        error();
    }
}

```

Conclusion

MRL using the latest technology in the field of elevators, where the laws of science used for the benefit of man kind.

Time saving: every function, waiting time, machine speed and door opening and closing time are designed to perform as fast as possible.

Safe: elevators are the most safe transportation device. Great safety system used.

Comfortable ride: by applying computerize and vvvf control with nice design make it comfortable ride.

Reliable: high quality materials, latest technology, self diagnosis make it reliable equipment.

Environment- friend: the clean hoistway as adopting guide roller for car & counterweight require no oil. Low noise by using no gear.

Energy saving: adopt gearless machine with permanent magnet synchronous motor, vvvf control with intelligent module.

Space saving: no need for a separate machine room, no visual pollution on the roof, improved net leasable space, reduce overhead and pit dimension.

Construction cost saving: no machine room to build saves construction work and materials, reducing the total building cost.

Safe, reliable, low noise and comfortable ride are the MRL elevators.

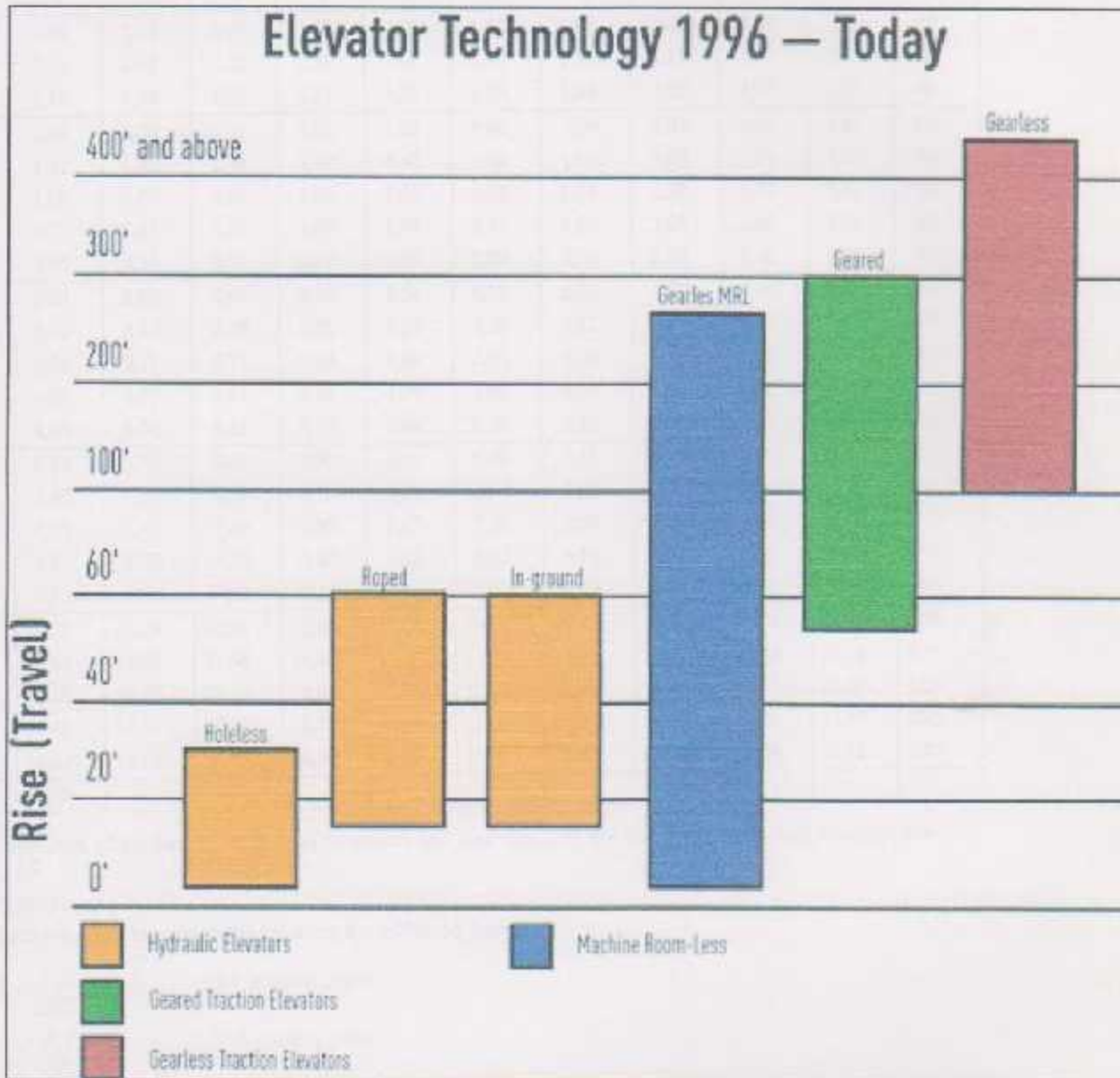


Table 1.3 Elevator Technologies

Appendix (1)

A- EN81-1:1998

Table G.4 — "Omega"-value ω related to λ for steel with tensile stress of 520 N/mm²

λ	0	1	2	3	4	5	6	7	8	9	λ
0	1,06	1,06	1,07	1,07	1,08	1,08	1,09	1,09	1,10	1,11	20
10	1,11	1,12	1,12	1,13	1,14	1,15	1,15	1,16	1,17	1,18	30
20	1,19	1,19	1,20	1,21	1,22	1,23	1,24	1,25	1,26	1,27	40
30	1,28	1,30	1,31	1,32	1,33	1,35	1,36	1,37	1,39	1,40	50
40	1,41	1,43	1,44	1,46	1,48	1,49	1,51	1,53	1,54	1,56	60
50	1,58	1,60	1,62	1,64	1,66	1,68	1,70	1,72	1,74	1,77	70
60	1,79	1,81	1,83	1,86	1,88	1,91	1,93	1,96	1,98	2,01	80
70	2,05	2,10	2,10	2,18	2,24	2,29	2,33	2,38	2,43	2,48	90
80	2,53	2,58	2,64	2,66	2,74	2,79	2,86	2,90	2,96	3,01	100
90	3,06	3,12	3,18	3,23	3,29	3,35	3,41	3,47	3,53	3,59	110
100	3,65	3,71	3,77	3,83	3,89	3,95	4,02	4,09	4,15	4,22	120
110	4,28	4,35	4,41	4,48	4,55	4,62	4,69	4,75	4,82	4,89	130
120	4,96	5,04	5,11	5,18	5,25	5,33	5,40	5,47	5,55	5,62	140
130	5,70	5,78	5,85	5,93	6,01	6,09	6,16	6,24	6,32	6,40	150
140	6,48	6,57	6,65	6,73	6,81	6,90	6,98	7,06	7,15	7,23	160
150	7,32	7,41	7,49	7,58	7,67	7,75	7,85	7,94	8,03	8,12	170
160	8,21	8,30	8,39	8,48	8,58	8,67	8,76	8,86	8,95	9,05	180
170	9,14	9,24	9,34	9,44	9,53	9,63	9,73	9,83	9,93	10,03	190
180	10,13	10,23	10,34	10,44	10,54	10,65	10,75	10,85	10,96	11,06	200
190	11,17	11,28	11,38	11,48	11,60	11,71	11,82	11,93	12,04	12,15	210
200	12,26	12,37	12,48	12,60	12,71	12,82	12,94	13,05	13,17	13,28	220
210	13,40	13,52	13,63	13,75	13,87	13,99	14,11	14,23	14,35	14,47	230
220	14,59	14,71	14,83	14,95	15,08	15,20	15,33	15,45	15,58	15,71	240
230	15,83										

5.6 Examples of guidance, suspension situations and load cases of the car and the relevant formulae are given in G.7.

5.7 Deflections

The deflections shall be calculated by using the following formulae:

$$\delta_y = 0,7 \frac{F_y l^3}{48EI_x} \quad \text{Y-Y guiding plane}$$

$$\delta_x = 0,7 \frac{F_x l^3}{48EI_y} \quad \text{X-X guiding plane}$$

where

δ_x = deflection in the X-axis in millimetres;

δ_y = deflection in the Y-axis in millimetres;

F_x = supporting force in the X-axis in newtons;

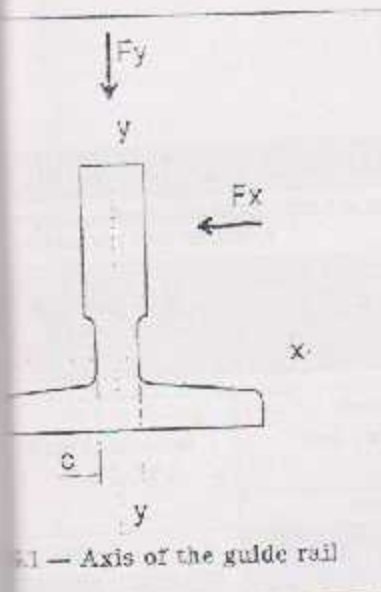
F_y = supporting force in the Y-axis in newtons;

l = maximum distance between guide brackets in millimetres;

E = modulus of elasticity in newtons per square millimetre;

I_x = second moment of area in the X-axis in fourth power millimetres;

I_y = second moment of area in the Y-axis in fourth power millimetres.



6.3 — "Omega"-value ω related to λ for steel with tensile stress of 370 N/mm²

	1	2	3	4	5	6	7	8	9	λ
	1.04	1.01	1.00	1.05	1.06	1.06	1.07	1.07	1.08	20
	1.09	1.06	1.10	1.10	1.11	1.11	1.12	1.13	1.13	30
	1.14	1.15	1.18	1.18	1.17	1.18	1.19	1.19	1.20	40
	1.22	1.23	1.23	1.24	1.25	1.26	1.27	1.28	1.29	50
	1.31	1.32	1.33	1.34	1.35	1.36	1.37	1.38	1.40	60
	1.42	1.44	1.46	1.46	1.48	1.49	1.50	1.52	1.53	70
	1.56	1.58	1.59	1.61	1.62	1.64	1.66	1.68	1.69	80
	1.73	1.74	1.75	1.78	1.80	1.82	1.84	1.86	1.88	90
	1.92	1.94	1.96	1.98	2.00	2.02	2.05	2.07	2.09	100
	2.14	2.16	2.18	2.21	2.23	2.27	2.31	2.36	2.36	110
	2.47	2.51	2.55	2.60	2.64	2.68	2.72	2.77	2.81	120
	2.90	2.94	2.99	3.03	3.08	3.12	3.17	3.22	3.26	130
	3.38	3.41	3.45	3.50	3.55	3.60	3.65	3.70	3.75	140
	3.86	3.90	3.95	4.00	4.06	4.11	4.16	4.22	4.27	150
	4.38	4.43	4.49	4.54	4.60	4.66	4.71	4.77	4.82	160
	4.94	5.00	5.06	5.11	5.17	5.22	5.29	5.36	5.41	170
	5.55	5.59	5.66	5.72	5.78	5.84	5.91	5.97	6.03	180
	6.16	6.23	6.29	6.36	6.42	6.49	6.55	6.62	6.68	190
	6.82	6.89	6.96	7.03	7.10	7.17	7.24	7.31	7.38	200
	7.52	7.59	7.66	7.73	7.81	7.88	7.96	8.03	8.10	210
	8.26	8.32	8.40	8.47	8.55	8.62	8.70	8.78	8.86	220
	9.01	9.09	9.17	9.25	9.33	9.41	9.49	9.57	9.66	230
	9.81	9.89	9.97	10.05	10.14	10.22	10.30	10.39	10.47	240

B- Hoistway ropes

PFEIFER DRAKO

DRAKO 300 T 9-strand steel core rope for traction drive elevators

Strand construction of DRAKO 300 T is dependent on the rope diameter to optimize fatigue bending performance and wear resistance

Characteristics:	preformed, prefinished (premium bright (galvanized on request, in some diameters ex-stock) right hand (left hand on request) ordinary lay,
Twist grades:	15/3
Rope diameter tolerance:	see page 6

Rope construction DRAKO 300 T	Nom. Rope diameter	Minimum breaking force F_{min} 1570	Nominal length mass approx.	Metallic area approx.
	mm	kN	kg/100 m	mm ²
 9S-1WRC	35	42.1	26.1	30.9
	40	53.3	33.1	39.2
	45	68.4	46.8	49.3
 12F-1WRC	50	66.0	52.5	49.7
	55	79.8	61.2	60.1
	62	95.1	71.6	71.6
	70	111.6	83.3	84.2
 15F-1WRC	75	133	84	93.6
	80	153	96	110.9
	85	163	103	116.4
	90	174	110	126.2
	95	206	121	151.0
	100	220	129	159.7
	105	245	134	178.0
	110	262	141	197.2
 20F-1WRC	125	331	215	243.5

For further diameters, see rope standard EN 12305 - 6, stranded ropes for lifts and ISO 6054:2004.

To make correct rope installation easier, especially on highrise installations, DRAKO 300 T ropes are produced with a single blue line along the rope. If the ropes have untwisted whilst being installed, the blue line enables to correct it.

For hoistway ropes will be supplied with servings on both ends, if not specified otherwise.

DRAKO 300 TX 9-strand steel core rope for super high rise traction drive elevators

Rope construction of DRAKO 300 TX is dependant on the rope diameter to optimize fatigue bending performance and wear resistance.

Characteristics:	pretensioned, pretensioned (medium), bright, right hand, ordinary lay
Steel grades available:	1955
Diameter tolerance:	maximum: unloaded +3 % minimum, loaded with 0.5 % σ_{br} -1 %

Rope construction DRAKO 300 TX	Num. Rope diameter	Minimum breaking force F_{min} 1955	Nominal length mass approx.	Metallic area approx.
	mm	kN	kg/100 m	mm ²
 13 - IWRC	5	18.2	9.0	1.7
	8	27.4	14.5	2.8
	8*	49.0	25.5	5.0
	9	61.8	32.2	5.8
 16 IWRC	10*	58.8	42.3	13.7
	13*	136	72.3	31
	16*	208	110	46
	22*	333	154	78
 22 WS - WRC	22*	338	214	248

*Standard diameter, see rope standard EN 12586 - 5, stranded ropes for lifts and ISO/DIS 4344.

To make correct rope installation easier, especially on highrise installations, DRAKO 300 TX ropes are produced with a marking line along the rope. If the ropes have untwisted whilst being installed, the blue line enables, to correct it.

For elevator ropes will be supplied with servings on both ends, if not specified otherwise.

Appendix (3)

C- Sigma Elevator Company

Machine Roomless

(Main Power : 380V)

Supply Plan

Supply Plan											Heat Output (kcal / H)	Starting Power (KVA/Set)
Capacity		Motor Capi. (kW)	MCCB Capacity of Building(A)		Power Supply Capacity(KVA)		Lead-in Wire Size(mm)		Earth Wire Size(mm)			
Person	Load(kg)		Simplex	Duplex	Simplex	Duplex	Simplex	Duplex	Simplex	Duplex	Simplex	Duplex
8	550	3.7	20	30	6.5	12.92	3.5	8.0	3.5	5.5	800	10.92
9	600	3.7	20	30	6.9	13.9	3.5	8.0			900	11.69
10	650	4.5	20	40	7.2	14.38	3.5	8.0			1020	11.78
11	750	4.8	20	40	7.5	15.25	3.5	8.0			1130	12.46
13	900	5.2	25	40	8.8	17.69	3.5	14.0			1350	14.24
15	1000	6.2	25	50	9.7	19.4	3.5	14.0			1500	15.59
8	550	5.6	25	50	9.5	17.08	3.5	14.0			1240	17.24
9	600	5.6	25	50	9.2	18.43	3.5	14.0			1350	18.46
10	680	6.8	35	60	10.0	20.03	5.5	14.0	1530		19.7	
11	750	6.9	35	60	10.3	21.3	5.5	14.0	1630		20.57	
13	900	9.2	40	75	12.3	24.59	5.5	22.0	2030		23.5	
15	1000	9.2	40	75	13.5	27.07	5.5	22.0	2250		25.73	
8	550	6.5	35	60	9.7	19.31	5.5	14.0	1450		23.56	
9	600	6.5	35	60	10.4	20.9	5.5	14.0	1580		22.02	
10	680	8.1	35	60	11.4	22.73	5.5	22.0	1780		23.52	
11	750	8.1	40	75	12.1	24.22	5.5	22.0	1970		24.91	
13	900	11	40	75	14.0	28.01	5.5	22.0	2370		28.05	
15	1000	11	50	100	15.4	30.58	8.0	22.0	2630		30.7	

Head Height, Pit Depth

Speed(m/min)	Entrance Height(mm)	Overhead(mm)	Pit Depth(mm)	Type of Buffer
1.0m/sec	2100	3750	1300	Spring(Standard)
		3500	1500	Hydraulic(Optional)
1.5m/sec		3850	1500	Hydraulic
1.75m/sec		4000	1750	Hydraulic

or Wide Car

(Unit: mm)

Standard

Standard			Opening Type	Entrance Opening (mm)	Car Size		Hoistway Size				Top Beam Reaction Load(kg)				Pit Reaction Load(kg)	
Speed (m/min)	Capacity				Inside	Outside	Simplex		Duplex		R1	R2	R3	R4	R5	R6
	Persons	Load (kg)					AN x BN	AS x BS	AM	BM						
60	8	550	2-Fane Center opening	800	1350 x 1100	1400 x 1265	2100	1750	4350	1750	2650	3900	1500	1150	5500	5200
	9	800		800	1400 x 1100	1450 x 1265	2150	1750	4450	1750	2750	4000	1550	1200	5600	5400
	10	650		800	1400 x 1250	1450 x 1415	2250	1800	4600	1800	2850	4200	1600	1250	5700	5500
	11	750		800	1400 x 1350	1450 x 1515	2250	1900	4600	1900	3100	4300	1700	1350	5900	5700
	13	900		900	1500 x 1350	1550 x 1515	2450	1900	5000	1900	3350	4700	1800	1500	6200	6000
	15	1000		900	1600 x 1500	1650 x 1655	2450	2050	5000	2050	3600	4900	1900	1600	6500	6300
80	8	550		800	1350 x 1100	1400 x 1265	2100	1750	4350	1750	2650	3900	1500	1150	5500	5200
	9	800		800	1400 x 1100	1450 x 1265	2150	1750	4450	1750	2750	4000	1550	1200	5600	5400
	10	650		800	1400 x 1250	1450 x 1415	2250	1800	4600	1800	2850	4200	1600	1250	5700	5500
	11	750		800	1400 x 1350	1450 x 1515	2250	1900	4600	1900	3100	4300	1700	1350	5900	5700
	13	900		900	1500 x 1350	1550 x 1515	2450	1900	5000	1900	3350	4700	1800	1500	6200	6000
	15	1000		900	1600 x 1500	1650 x 1655	2450	2050	5000	2050	3600	4900	1900	1600	6500	6300
105	8	550		800	1350 x 1100	1400 x 1265	2100	1750	4350	1750	2650	3900	1500	1150	5500	5200
	9	800		800	1400 x 1100	1450 x 1265	2150	1750	4450	1750	2750	4000	1550	1200	5600	5400
	10	650		800	1400 x 1250	1450 x 1415	2250	1800	4600	1800	2850	4200	1600	1250	5700	5500
	11	750		800	1400 x 1350	1450 x 1515	2250	1900	4600	1900	3100	4300	1700	1350	5900	5700
	13	900		900	1500 x 1350	1550 x 1515	2450	1900	5000	1900	3350	4700	1800	1500	6200	6000
	15	1000		900	1600 x 1500	1650 x 1655	2450	2050	5000	2050	3600	4900	1900	1600	6500	6300

(Unit: mm)

EN Code

EN Code				Entrance Opening (mm)	Car Size		Hoistway Size				Top Beam Reaction Load(kg)				Pit Reaction Load(kg)	
Speed (m/min)	Capacity		Opening Type		Inside	Outside	Simplex		Duplex		R1	R2	R3	R4	R5	R6
	Persons	Load (kg)			AN x BN	AS x BS	AM	BM	AM	BM						
60	8	550	2-Fane Center opening	800	1350 x 1100	1400 x 1265	2100	1750	4350	1750	2650	3900	1500	1150	5500	5200
	9	800		800	1400 x 1100	1450 x 1265	2150	1750	4450	1750	2750	4000	1550	1200	5600	5400
	10	675		800	1400 x 1250	1450 x 1415	2250	1800	4600	1800	2850	4200	1600	1250	5700	5500
	12	750		800	1400 x 1350	1450 x 1515	2250	1900	4600	1900	3100	4300	1700	1350	5900	5700
	13	900		900	1500 x 1350	1550 x 1515	2450	1900	5000	1900	3350	4700	1800	1500	6200	6000
	15	1000		900	1600 x 1500	1650 x 1655	2450	2050	5000	2050	3600	4900	1900	1600	6500	6300
80	8	550		800	1350 x 1100	1400 x 1265	2100	1750	4350	1750	2650	3900	1500	1150	5500	5200
	9	800		800	1400 x 1100	1450 x 1265	2150	1750	4450	1750	2750	4000	1550	1200	5600	5400
	10	675		800	1400 x 1250	1450 x 1415	2250	1800	4600	1800	2850	4200	1600	1250	5700	5500
	12	750		800	1400 x 1350	1450 x 1515	2250	1900	4600	1900	3100	4300	1700	1350	5900	5700
	13	900		900	1500 x 1350	1550 x 1515	2450	1900	5000	1900	3350	4700	1800	1500	6200	6000
	15	1000		900	1600 x 1500	1650 x 1655	2450	2050	5000	2050	3600	4900	1900	1600	6500	6300
105	8	550		800	1350 x 1100	1400 x 1265	2100	1750	4350	1750	2650	3900	1500	1150	5500	5200
	9	800		800	1400 x 1100	1450 x 1265	2150	1750	4450	1750	2750	4000	1550	1200	5600	5400
	10	675		800	1400 x 1250	1450 x 1415	2250	1800	4600	1800	2850	4200	1600	1250	5700	5500
	12	750		800	1400 x 1350	1450 x 1515	2250	1900	4600	1900	3100	4300	1700	1350	5900	5700
	13	900		900	1500 x 1350	1550 x 1515	2450	1900	5000	1900	3350	4700	1800	1500	6200	6000
	15	1000		900	1600 x 1500	1650 x 1655	2450	2050	5000	2050	3600	4900	1900	1600	6500	6300

ك.ب.أ (٢٨/٩٠)

كودات البناء الوطني الأردني

كودة المصاعد



مجلس البناء
الوطني الأردني

الطبعة الأولى
١٩٩٠

الجدول رقم (2)
الملاحة الموضحة بها مدى سرعة المعدد المقررة وشروط الرحلة

الحد الاعلى الموضى به بشروط رحلة المعدد للاستعمال التحويلي المبين (متر)					الرجوع : الباب الثالث من صلا الكودة		تصنيف المعدد	السرعة المقررة متر/ثانية	رقم الجدول او رقم الشكل	مصابي مكبنة	مكاتب وفنادق كبيرة البح	مكاتب وفنادق كبيرة البح	مستشفيات ومكاتب ممرات ومسارات مكبنة	مصابيح مصابيح مصابيح مصابيح
-	-	-	-	10	2	0.63 , 0.50 1.00 1.00	مصابيح الركاب للاستعمالات العفوية							
-	-	-	20	20										
-	-	-	30	35										
-	-	-	-	15	3	0.63 , 0.50 1.00	مصابيح الركاب المكبنة							
-	-	-	-	20										
-	-	20	20	-	4	1.00 1.60	مصابيح الركاب للاستعمالات العامية							
-	-	30	30	-										
-	-	45	-	-	5	2.50 3.50	مصابيح الركاب للمساحات الكثيفة							
-	-	60	-	-										
-	12	-	-	-	6	0.63 , 0.50 1.00 1.60	مصابيح الركاب والمرور							
-	25	-	-	-										
-	40	-	-	-										
8	-	-	-	-	7	0.25 0.63 , 0.50 1.00	مصابيح البيئات للاستعمالات العامية							
15	-	-	-	-										
25	-	-	-	-										
10	-	-	-	-	8	0.25 0.63 , 0.50 1.00	مصابيح البيئات للمساحات الكثيفة							
20	-	-	-	-										
30	-	-	-	-										

$\frac{1}{2} \left(\frac{1}{2} \right) = \frac{1}{4}$

[illegible]

هذه هي الطريقة التي يجب أن نتبعها في كل وقت.

الجدول رقم (٩)

أسماء الشركات المساهمة: الأشخاص الطبيعيين والمعنويين

نظرات موضوعية : ثمرات بحران الاحساس في العراق والمطالب المعنوية الخ
والعباسي السكينة (القدس الحداد) ورقه (٣) -

السهم الواحد : تحصيل : القدرة ذاتها مع اعين قديم من الوسط : ارباب مملوطة
البركات القياسية : النظر العلائقية : هذه البركات كما يلي :

1) احادي السرعة = 0.50 م/ث

$\Delta t_p(1.00) = \Delta t_p(0.63) =$

(ج) سرءء مقبوءة $\Rightarrow \left(\begin{matrix} 1.00 \\ 1.60 \end{matrix} \right) \leq \left(\begin{matrix} 1.00 \\ 1.60 \end{matrix} \right) \leq \left(\begin{matrix} 1.00 \\ 1.60 \end{matrix} \right)$

[illegible]

ملاحظة 1 : الإبقاء المعمود في هذا الجدول، مالمحة للمؤسسات الأقل من الأسماء المذكورة أيضا

ملحقه ٢ : اختصار الاستعداد لكل من Rd و Ru

(١) التي تكون مساوية للأبعاد الموصولة في هذا الجدول أو أكبر أيضا

أيضا التي جعلت حرية مساواة مساحة المساواة الرموز (H) أو التي جعلت

الجدول رقم (٤)
معلومات الأداء لمعايير الركاب
عدد الطوابق من (10) إلى (18) طبق

عدد الطوابق *	عدد العربات	السرعة المقصورة	13 راكب 1000 كغم		13 راكب 1250 كغم		21 راكب 1600 كغم	
			الفترة (ثانية)	المنطقة المقل (ثانية)	الفترة (ثانية)	المنطقة المقل (ثانية)	الفترة (ثانية)	المنطقة المقل (ثانية)
10	3	1.6	35	86	38	97	44	113
	3	2.5	32	98	34	106	40	124
	4	2.5	24	126	26	141	29	165
11	3	1.6	37	83	40	91	-	-
	3	2.5	34	92	36	100	43	118
	4	2.5	25	123	27	132	32	137
12	3	2.5	35	88	38	95	44	112
	4	2.5	26	117	29	126	35	149
	3	3.5	-	-	37	98	45	115
	4	3.5	-	-	27	130	32	132
13	3	2.5	36	84	40	91	46	106
	4	2.5	27	113	30	121	34	142
	4	3.5	-	-	29	123	34	145
	5	3.5	-	-	23	156	27	162
14	3	2.5	38	81	41	87	-	-
	4	2.5	28	109	31	116	36	135
	4	3.5	-	-	30	120	35	140
	5	3.5	-	-	24	151	28	173

References

- [1] Mechanical and Electrical equipment for Building by: William
- [2] المصاعد الكهربائية : المهندس صلاح الدين بكري ١٩٨٨
- [3] Otis –LG catalogs
- [4] Jordanian code for elevator 1990
- [5] http://www.keyscan.ca/English/PDFs/EC2000_Layout.pdf
- [6] <http://lams-www.informatik.uni-hamburg.de/applets/hades/webdemos/95-dpi/pic16f84-elevator5/elevator.html>
- [7] <http://www.freepatentsonline.com/4505360.html>
- [8] <http://navago.tradeindia.com/>
- [9] <http://www.patentstorm.us/patents/5869794-description.html>
- [10] <http://www2.isye.gatech.edu>
- [11]. <http://www.freepatentsonline.com>
- [12] <http://www.liveboards.com>
- [13] <http://en.wikipedia.org/wiki/Elevator>
- [14] <http://www.konc.com>