Topic 9
Vertical Transportation

INTRODUCTION

- **OF THE MANY DECISIONS THAT MOST BE** made by the designer of a multistory building, probably none is more important than the selection of the vertical transportation equipment-that is, the passenger, service, and freight elevators and the escalators.
- represent a major building expense, being in the case of a 25-story office building as much as 10'% of the construction cost.
- quality of elevator service is also an important factor in a tenant's choice of space in compet-ing buildings.

- The function of this chapter is to familiarise the architect and engineer with the nature and application of vertical transportation equipment in order to enable them to make preliminary design decisions and interact effectively with consultants.

For the general purpose traction elevator, the ideal performance provides

- minimum waiting time for a car at any floor level:
- comfortable acceleration:
- rapid transportation:
- smooth, rapid braking:
- accurate automatic leveling at landings:
- rapid loading and unloading at all stops.
- provide quick. quiet power operation of doors:
- good floor and travel direction indication, both in the cars and at landings:
- easily operated car and landing call buttons (or other devices):
- smooth, quiet, and safe operation of all mechanical equipment for all conditions of loading:
- comfortable lighting:
- reliable emergency and security equipment:
- a generally pleasant car atmosphere.

In addition to passenger-oriented service considerations, elevators have architectural impacts:

- Cars and shaftway doors must be treated in a manner consonant with the architectural unity of the building.
- shaftways are major space elements whose integration into the building is a prime factor in composition. as is the design of the elevator lobby.

ELEVATOR EQUIPMENT
PRINCIPAL COMPONENTS

- The car,
- cables,
- elevator machine,
- control equipment,
- counterweights,
- hoistway.
- rails.
- penthouse,
- and pit

are the principal parts of a traction elevator installation.

- The car is the only item with which the average passenger is familiar.
- some of a building's prestige depends upon proper design of the car.
- the car is a cage of some fire-resistant material supported on a structural frame. to the top member of which the lifting cables are fastened.
- By means of guide shoes on the side members, the car is guided in its vertical travel in the shaft.
- The car is provided with
  - safety doors,
  - operating- control equipment.
  - floor-level indicators,
  - illumina-tion.
  - emergency exits,
  - and ventilation.
- It is designed for long life, quiet operation. and low maintenance.

- Approximately 75'% of the energy expended in lifting a car is returned to the system by regen-eration when the car is lowered.
- Regeneration is the process in which the traction motor becomes a *generator* when the car is lowered and feeds power back into the electrical system.
- The lost energy appears as heat, primarily in the machine room.
- To compensate for the hoist rope weight, which becomes an important factor in high-rise elevators, cables are attached to the bottom of the car and the counterweight, thus equalizing loads re-gardless of the cab position.

- The elevator machine turns the sheave and lifts or lowers the car.
- It consists of
  - a heavy structural frame on which are mounted the sheave and driving motor,
  - the gears (if any), the brakes, the magnetic safety brake, and certain other auxiliaries.
- In many existing installations the elevator driving (traction) motor receives its energy from a separate motor-generator (m-g) set, which is in operation during the period that the particular elevator is available for handling traffic. This m-g set is properly considered a part of the elevator machine,
- In modern installations, solid-state power and control equipment replaces the m-g set,

- A governor, which limits the car to safe speeds, is mounted on or near the elevator machine.
- The control equipment is usually divided into three groups:
  - *Drive (motion) control* is concerned with the velocity, acceleration, position determination, and leveling of the car.
  - *Operating control* covers car door operation and functioning of car signals, including floor call buttons and all indicating devices.
  - *Supervisory control* is concerned with group operation of multiple-car installations.

- The shaft, or hoistway, is the vertical passage-way for the car and counterweights.
- On its sidewalls are the car guide rails and certain mechanical and electrical auxiliaries of the control apparatus.
- At the bottom of the shaft are the car and counter-weight buffers.
- At the top is the structural platform on which the elevator machine rests.
- The elevator machine room (which may occupy one or two levels) is usually directly above the hoistway.
- It contains the traction machine and the m-g set or solid-state control that supplies energy to the eleva-tor machine and control equipment.
- Machinery and control equipment are designed for quiet, vibra-tion-free operation

ARRANGEMENT OF ELEVATOR MACHINES, SHEAVES, AND ROPES

- The simplest method of arranging vertical travel of a car is to pass a rope over a sheave and counter-balance the weight of the car by a counterweight.
- Then by rotating the sheave, the car moves up or down and requires very little energy to do it.
- This is essentially the scheme that is used on a majority of high-speed passenger elevators, as illustrated in Fig. 31.3a.

- In types a, b, and c in Fig. 31.3 the elevator machines are located in a machine room penthouse at the top of the hoistway.
- If, for architectural or other reasons, it is desired to eliminate this pent-house, a basement machine room can be used with the roping shown in Fig. 31.3d.
- This arrangement uses geared traction equipment with speeds of up to 400 fpm. All the illustrated ropings are applicable to the full range of car capacities.

REQUIREMENTS FOR THE DISABLED

- The basic physical limitations addressed are those of ambulation, sight, and hearing.
- Thus, to ease access for passengers in wheelchairs (or with walking aids), requires
  - excellent car leveling, 36-in. minimum clear door opening (42-in. recommended),
  - delayed door closing, detection beams that reopen the door without contact on sensing a passenger.
  - inside car dimensions that permit turning a wheelchair,
  - buttons and emer-gency controls within easy reach, and appropriate car furnishings.

ELEVATOR CAR CONTROL

31.12 DRIVE CONTROL

The movement of an elevator car and all of its parts is controlled by three different systems that combine and interact to provide a unified control system.

- The supervisory system controls a bank of elevators as a group and dictates which car answers which call.
- The operational control system deter-mines when and where physical motion of a car and its doors should occur. It deals with the oper-ation of the car doors and the integration of car buttons, lanterns. and passenger-operated devices into the overall control and indicating system.
- Operating control passes its information about car and door control to the motion control system (also known as drive control). Motion control deter-mines the car's acceleration, velocity. braking, leveling, and regenerative braking, plus all aspects of door motion.

The speed control can be accomplished in a number of ways, all of which are in use in elevator installations. They are:

- Thyristor control of an asynchronous (squirrel cage) ac traction motor
- Thyristor control of a dc traction motor
- Motor-generator (m-g) set control of a dc traction motor (Ward-Leonard system or UMV unit multivoltage drive)
- Variable-voltage, variable-frequency (VVVF) control of an asynchronous ac traction motor

31.17 SYSTEM CONTROL REQUIREMENTS

- An operating system is one that provides the auto-matic response of a group of cars to calls for ser-vice.
- An effective system must take cognizance of all hall calls and car calls, car travel directions. and car position, in relation to each other and in rela-tion to the call requirements. plus the trends of traffic.
- The last is required in order that the system anticipate demand rather than react to it.
- Because traffic and calls are never static, the control system that can satisfy all these demands in a large eleva-tor system is necessarily an extremely sophisti-cated one.
- On small systems, the operating control is much simpler

31.18 SINGLE AUTOMATIC PUSHBUTTON CONTROL

- This system is the simplest of the passenger-operated automatic control schemes.
- It handles only one call at a time, providing an uninterrupted trip for each call.
- A single corridor button at each level can regis-ter a call only when the car is not in motion. This system is used only in private residences and for light-use freight elevators.

31.19 COLLECTIVE CONTROL

- Cars stop at each floor that registers a call irre-spective of direction, hence the term collective.
- This leads to slow and annoying service.
- As a result, this system is no longer used in new installations in the United States, although it is common in other countries.

31.20 SELECTIVE COLLECTIVE OPERATION

- is "selective" in that it is arranged to collect all waiting "up" calls on the trip up and all hall "down" calls on the trip down.
- The control system stores all calls until they are answered, and automatically reverses the direction of travel at the highest and lowest calls.
- when all calls have been cleared, the car will remain at the floor of its last stop awaiting the next call. Any hall button call will set the car into operation.
- Selective collective control is standard in locations where service requirements are moderate, such as in apartment houses, small offices, and pro-fessional buildings.
- Because these locations often require more than one car, a group control scheme for up to three cars
  – automatically assigns each hall call to the car best situated to answer it,
  – prevents more than one car from answering a call,
  – allows one car to be detached for freight duty,
  – and auto-matically parks cars at the ground floor *when* they are not required.

31.21 COMPUTERIZED SYSTEM CONTROL

Several algorithms with different emphasis for different functions, having the following characteristics:

- the anticipated service needs.
- Be reprogrammable to meet changes in building needs at nominal cost and with minimum shut-down time.
- Provide for
  - priority calls (based on landing wait-ing times),
  - statistical analysis of traffic in order to anticipate patterns,
  - adaptive (zoned) car parking to meet specific needs,
  - adjustable door timing based on the type of call (lobby, landing, car), backup dispatch means (in case of dispatch sys-tem failure),
  - and automatic call cutout for constant (stuck) signals.
- Provide means for lobby and management office viewing (monitor)

- Provide additional functions such as
  - emergency power elevator selection and control),
  - priority service,
  - selective hall/car call cutout,
  - swing (separate) car operation,
  - and hoist-way access controls for maintenance.
- Provide, where specifically required by the building's management.
  - a riot control feature (access limitation at entrance levels),
  - crossover floor operation in a zoned system.
  - convention service (intense short-time usage at selected levels),
  - and controlled access at given floors and for specific occupants.
- Be fully coordinated with the fire protection system in accordance with the local fire regulations (see Section 31.43).

- Provide additional functions such as
- Act in consonance with the elevator security equipment so that operation of security/alarm devices initiates automatic elevator motion con-trol procedures. This too must be coordinated with the local security authorities, and the auto-matic procedures must be subject to manual override (see Section 31.44).
- Proper operation of the system should also result in:
  – All floors getting equal service, including the basement. if required
  – Proper handling of multifloor tenants in office buildings to permit efficient interfloor traffic
  – Appropriate action in emergencies. such as gen-eral or local circuit power failure or any type of abnormal car to signal operation

31.23 LOBBY ELEVATOR PANEL

- The traditional lobby elevator control and information panel for each elevator bank that was usually wall-mounted adjacent to the related elevators has become one or more computer monitor screens positioned at a lobby desk (Fig. 31.12) and/or in the building maintenance office.
- In addition, an information-only screen is frequently wall-mounted adjacent to the related elevators for the waiting passengers.
- The information displayed on the screen includes car locations, movement direction, waiting corridor calls, and any special status data.

The con-trol functions available at the computer terminal permit intervention to establish special types of operation including:

- Car movement without operating the usual audible and visual signals *(*inconspicuous riser)
- One or more cars removed from supervisory control and operated manually (attendant or independent service)
- Cars elected for night or weekend service while the other cars are shut down
- Car(s) assigned to a particular floor on a fixed- or priority-basis call (convention feature or priority)
- control of emergency service, including the "fire-man's return" feature required by ANSI and many local fire codes (Section 31.43) and the controls related to switching of power between cars in the event that operation on emergency generator power is necessary (Section 31.42).
- In addition, means of two-way communication with each car and other selected locations are provided at the control center.

ELEVATOR SELECTION

31.25 GENERAL CONSIDERATIONS

The criteria usually used in determining elevator service quality are:

- Interval and average waiting time
- Handling capacity
- Travel time

31.26 DEFINITIONS

A clear definition of important terms, including variant usages. follows.

- **Average lobby time or average lobby waiting time.**
  - Average time spent by a passenger between arriving in the lobby and leaving the lobby in a car.
- **Handling capacity (HC).**
  - Figure of merit for an elevator system, indicating the maximum number of passengers that can be handled in a given period-usually 5 minutes, thus the term 5-minute *handling capacity.* When expressed as a percentage of the building's population, it is called *percent handling capacity* (PHC).
- Interval (I) or lobby **dispatch time.**
  - Average time between departure of cars from the lobby.

- **Registration time.**
  - Waiting time at an upper floor after registering a call.
- **Round-trip time (RT).**
  - Average time required for a car to make a round trip, starting from the lower terminal and returning to it. The time includes a statistically determined number of upper-floor stops in one direction and, when *cal*culating *elevator requirements based on up-peak traffic,* an express return trip.
- **Travel time or average trip time (AVTRP).**
  - Aver-age time spent by passengers from the moment they arrive in the lobby to the moment they leave the car at an upper floor.
- Zone.
  - Group of floors in a building that is con-sidered as a unit with respect to elevator ser-vice. It may consist of a physical entity-a group of upper floors above and below which are blind shafts-or it may be a product of the elevator group control system. changing with system needs.

31.27 INTERVAL OR LOBBY DISPATCH TIME AND AVERAGE LOBBY WAITING TIME

In an ideal installationa car would be waiting at the lower terminal on the rider's arrival or would be available after a short wait. Because cars leave the lobby separated in time by the interval (I) and passengers arrive at the lobby in random fashion, the average waiting time in the lobby should be half (50%) the interval. Field measurements show, how-ever, that it is actually longer than this. The figure most often used in the industry is 60%-that is:

– average lobby waiting time = 0.6 x I

TABLE 31.4 Recommended Elevator Intervals and Related(a) Lobby Waiting Time

Facility Type		
	Interval I (sec)	Waiting Time
	OFFICE BUILDINGS	
Excellent service	15-24	9-14
Good service	25-29	15-17
Fair service	30-39	18-23
Poor service	40-49	24-29
Unacceptable service	50+	30+
	RESIDENTIAL	
Prestige apartments	50-70	30-42
Middle-income apartments	60-80	36-48
Low-income apartments	80-120	48-72
Dormitories	60-80	36-48
Hotels-first quality	30-50	18-30
Hotels-second quality	50-70	30-42

TABLE 31.5 Car Passenger Capacity (p)

Elevator Capacity (lb)	Maximum Passenger Capacity	Normal Passenger' Load per Trip
2000	12	10
2500	17	13
3000	20	16
3500	23	19
4000	28	22

'The number of passengers carried on a trip during peak conditions is approximately 80% of the car capacity.

TABLE 31.6 Minimum Percent Handling Capacities (PHC)

Facility		Percent of Population to Be Carried in 5 Minutes
	OFFICE BUILDINGS	
Center city		12-14
Investment		11.5-13
Single-purpose		14-16
	RESIDENT AL	
Prestige		5-7
Other		6-8a
Dormitories		10-11
Hotels-first quality		12-15
Hotels-second quality		10-12

TABLE 31.7 Population of Typical Buildings for Estimating Elevator and Escalator Requirements

Building Type	Net Area
OFFICE BUILDINGS	Square feet per person
Diversified (multiple tenancy) Normal Prestige Single tenancy Normal Prestige	110-130' 150-250 90-110 130-200
HOTELS	Persons per sleeping room
Normal use Conventions	1.3 1.9
HOSPITALS	Visito s and s aff per bed(b)
General private General public (large wards)	3 3-4
APARTMENT HOUSES	Persons per bed corn
High-rental housing Moderate-rental housing Low-cost housing	1 5 2.0 2.5-3.0

TABLE 31.8 Office Building Efficiency

Building Height	Net Usable Area as Percentage of Gross Area
0-10 floors	Approximately 80%
0-20 floors	Floors 1-10 approximately 75% 11-20 approximately 80%
0-30 floors	Floors 1-10 approximately 70% 11-20 approximately 75% 21-30 approximately 80%
0-40 floors	Floors 1-10 approximately 70% 11-20 approximately 75% 21-30 approximately 80% 31-40 approximately 85%

Source: Reprinted from G.R. Strakosch, *Vertical Transportation, Elevators and Escalators,* 2nd ed. Wiley, New York, 1983.
Note: Applicable to buildings with 15,000 to 20,000 gross square feet per floor.

TRAVEL TIME OR AVERAGE TRIP TIME

- The average trip time or time to destination is the sum of the lobby waiting time plus travel time to the median floor stop.

ROUND-TRIP TIME

- The figure for round-trip time during up-peak traffic conditions, used for calculating elevator requirements, is composed of the sum of four factors: (1) time to accelerate and decelerate; (2) time to open and close doors at all stops; (3) time to load and unload; and (4) running time (Figs. 31.16, 31.18).
- Physically, round-trip time is the time from door opening at the lower terminal to door opening at the same terminal at the end of a round trip.

TABLE 31.9 Elevator Equipment Recommendations

Building	*Car Capacity(a)*	Rise		*Minimum Car Speed*
Type	lb kg	ft	m	fpmm/s
		0-125	0-40	350-4002.0
Office	25001250	126-225	41-70	500-6002..5
building	30001250	226-275	71-85	7003.15
	35001600	276-375	86-115	8004.0
		Above 375	>115	10005.0
Hotel	25001250 13000	As above		As above
	1250			
		0-60	0-20	1500.63
		61-100	21-30	200-2501.0
Hospital	350016001	101-125	31-40	250-3001.6
	1400*2000*	126	41-55	350 4002..0
		176-250	56-75	500-6003.15
		>250	>75	7004.0
		0-75	0-25	1000.63
Apartments	20001000	76-125	26-40	2001.0
	125001250	126-200	41-60	250-3001.6
		>200	>60	350-4002..0
	3 5001600	0-100	0-30	2001.0
Stores	40002000	101-150	31-45	250-3001.6
	50002500	151-200	46-60	350-4002.0
		>200	>60	5002.5

31.31 SYSTEM RELATIONSHIPS

The symbols that used in all elevator calculations are:

- p: individual car capacity, equal to 80% of the maximum during peak hours
- h: 5-minute capacity of a single car
- N: number of cars in a system
- HC: system 5-minute handling capacity, expressed in number of
- RT: round-trip time, in seconds
- AVTR: average trip time, in seconds
- I: interval, in seconds
- D: population density, in square feet per person
- PHC: percent of the population to be moved in 5 minutes, expressed as a percentage

and

CAR SPEED

- The selection of the car speed to be used is a matter of trial and error, the final selection being that required to give an RT (round trip time) that in turn gives an acceptable interval. Although car size can be selected at any value, it has been shown that for certain facility types, specific-size cars are indicated. These recommendations are given in Table 31.9.

TABLE 31.9 Elevator Equipment Recommendations

Building	Car Capacity(a)		Rise		Minimum Car Speed
Type	lb	kg	ft	m	fpmm/s
			0-125	0-40	350-4002.0
Office 25001250			126-225	41-70	500-6002..5
building 30001250			226-275	71-85	7003.15
35001600			276-375	86-115	8004.0
			Above 375	>115	10005.0
Hotel 25001250 13000			As above		As above
1250					
			0-60	0-20	15000.63
			61-100	21-30	200-2501.0
Hospital 350016001			101-125	31-40	250-3001.6
140002000			126	41-55	350 4002..0
			176-250	56-75	500-6003.15
			>250	>75	7004.0
			0-75	0-25	1000.63
Apartments 20001000			76-125	26-40	2001.0
125001250			126-200	41-60	250-3001.6
			>200	>60	350-4002..0
	35001600		0-100	0-30	2001.0
Stores	40002000		101-150	31-45	250-3001.6
	50002500		151-200	46-60	350-4002.0
			>200	>60	5002.5

"Car capacity is determined by building size, and car speed by rise.

31.35 OTHER ELEVATOR SELECTION RECOMMENDATIONS

(a) Office Buildings

- All necessary design criteria can be selected from Tables 31.4 to 31.7.
- Supervisory group control is normally microprocessor-based.
- Approximately 1 service car per 10 passenger cars should be pro-vided or, alternatively, one car for every 300.000 ft' of net area.
- Service cars should be 5000 lb or larger without a dropped ceiling and, if also used for passenger service, equipped with wall pads.
- An oversized door (e.g.. 4 ft. 0 in. or 4 ft, 6 in.) is particularly useful in handling furniture.
- Service elevators should have a shaftway door at every level plus easy access to the truck dock or other freight entrance as well as the lobby.
- These cars operate as service cars normally but can serve as passenger cars in peak periods to reduce congestion and delay.

(b) Apartment Buildings

- Studies indicate that apartment building traffic depends not only on the population but also on the location and type of tenant.
- Buildings with many children experience a school-hour peak;
- buildings in midtown with predominantly adult tenancy exhibit evening peaks due to the home-coming working group and outgoing dinner traffic.
- Where two cars are required, the second car should function both as a service car and as a passenger car.
- The cars may be banked or separated as desired. If a single car is used, it should be service elevator size.
- Self-service collective control is the general choice, with provision for attendant control in prestigious buildings.

- With small cars and a short rise, a swing-type manual corridor door is acceptable: in larger installations, both the car and the corridor door should be the power-operated sliding type.
- Service elevators must be large enough to han-dle bulky furniture and should therefore be at least 4000 lb, with a 48-in. door and a high ceiling.
- Hoistways must be isolated from sleeping rooms by lobbies or other space.
- Similarly, machine rooms must be isolated because the starting and stopping of motors and other machine room noises are a detriment to sound sleep.

(c) Hospitals

- As mentioned in Table 31.6. the governing factor in the determination of elevator requirements may be either normal hospital traffic or visitor traffic, depending on the visiting-hour schedule.
- Due to the large volume of vehicular traffic such as stretcher carts, wheelchairs, beds, linen carts, and laundry trucks, the elevator cars are much deeper than the normal passenger type.
- This type of car, when used for passenger service, holds more than 20 persons and therefore gives slow service. For this reason, it is occasionally advisable to utilize some normal passenger cars in addition to hospital-size cars, particu-larly in large hospitals.
- The use of tray and bulk carts in food service imposes a considerable load on the elevators before, during, and after meals, and passenger service is seriously disrupted.

- To reduce this congestion and delay, many architects and hospital administrators prefer the use of dumbwaiter cars or another of the many types of materials-handling systems that can handle a 15 1/2 x 20-in. food tray. These systems can also be used for transporting pharmaceuticals and other items.
- Elevators should be grouped centrally, although separated by type of use. Car control is normally self- service collective.
- The population of the hospital may be esti-mated from Table 31.7. Experience has shown that a carrying capacity of 45 passengers in a 5-minute period is adequate (estimating each vehicle as equiv-alent to 9 passengers).
- Intervals should not exceed 1 minute. All recommendations for service to the handicapped should be adopted (see Section 31.11).

(d) Retail Stores

- Retail stores present a unique problem in vertical transportation in as much as the objective is partially to transport persons to specific levels and partially to expose the passengers to displayed merchandise.
- For this reason, modern stores rely heavily on escalators, with one or two elevators intended for use by staff and handicapped persons.
- When, for some reason, it is desired to equip a store with elevators, use the recommendations shown in Table 31.9, calculated for a load of 10% to 20%, of the store's population.
- Control should be automatic, selective collective. Cars are arranged in a straight line to facilitate loading and waiting.

31.36 SHAFTS AND LOBBIES

- The elevator lobby on each floor is the focal point from which the corridors radiate for access to all rooms, stairways, service rooms, and so forth.
- The ground-floor elevator lobby (also called the *lower terminal)* must be conveniently located with respect to the main entrances. The equipment within or adjacent to this area should include public telephones, a building directory, elevator indicators, and possibly a control desk
- All lobbies should be adequate in area for the peak-load gathering of passengers to ensure rapid and comfortable service to all. The number of people contributing to the period of peak load (15- to 20-minute peak) determines the required lobby area on the floor.

- Not less than 5 ft' (0.5 m') of floor space per person should be provided at peak periods for waiting passengers at a given elevator or bank of elevators.
- The hallways leading to such lobbies should also provide at least 5 ft^2 (0.5 m^2) per person, approaching the lobby. Under self-adjusting relaxed conditions, density is about 7 ft^2 (0.65 m^2) per person. However, in peak periods crowding occurs, reducing this amount 3 to 4 ft^2 per person (3-4 persons/m^2). An acceptable compromise is 5 ft^2 (0.5 m^2) per person.

Carsize	speed	DEPTH	WIDTH
kg	m/s	mm	
1000	*2.5*	*2200*	*2400*
1250	*2.5*	*2200*	*2600*
1600	*2.5*	*2500*	*2600*
2000	*2.5*	*2500*	*2600*
1000	*4.0*	*2200*	*2400*
1250	*4.0*	*2200*	*2600*
1600	*4.0*	*2500*	*2600*
1250	*6.0*	*2250*	*2500*

fig.31.20 Rough hoistway dimensional data for use in schematic design) SI elevator sizes and dimensions.

Energy Conservation

A reduction in energy consumption can be accomplished by implementing the following recom-mendations:

FOR EXISTING ELEVATORS

- Increase the interval during nonpeak hours
- Replace m-g sets with a solid-state dc power supply or ac traction motors with a VVVF power supply. This conserves energy not only due to the higher efficiency of the power supply. but also because energy consumption of idling machines is eliminated.
- Recycle machine room waste heat.
- Shut down some units completely during off hours.

FOR A BUILDING IN THE PLANNING STAGE

- Base the design on the maximum recommended trip time.
- Use the lowest speeds possible within a type-that is geared or gearless.
- Use gearless equipment whenever possible.
- After construction, implement the recommendations for existing elevators previously detailed.

31.43 FIRE SAFETY

Most fire codes specify the procedures that the ele-vator control equipment must implement once a fire emergency has been initiated :

I . All cars close their doors and return nonstop to the lobby or another designated floor, where they park with the doors open. Thereafter. they are operable in manual mode only, by use of the fire fighter's key in the car panel.

2. All car and hall calls are canceled, and call-registered lights and directional arrows extinguished.

3. The fire emergency light or message panel in each car is activated to inform passengers of the nature of the alert and that cars are return-ing to a designated terminal.

4. Door sensors and in-car emergency stop switches are deactivated.

5. Traveling cars stop at the next landing without opening their doors and then proceed to the designated terminal.

The cars can then be used by trained personnel to transport fire personnel and equipment and for evacuation.

Elevator security has two aspects: physical security of riders and consideration of the elevator as a por-tal in a building-access security system.

(a) Rider Security

- elevators are equipped with alarm buttons that alert residents and security personnel,
- Every elevator, by code, must be equipped with communication equipment.
- When a closed-circuit TV monitor is added, utilizing a wide-angle camera in each car (Fig. 31.28), the security problem will have been addressed to a considerable extent
- Handling of the alarm is problematic because an automatically locked door can be forced open manually. Furthermore, the advisability of locking a violent person in an elevator with potential victims is questionable.

(b) Access Control

- This is often a matter of restricting access to (and from) a floor or car. This can be accomplished by pushbutton combination locks or coded cards, the proper use of which permits access.
- However, if a second person happens to accompany the authorized person, the effectiveness of this type of access barrier is seriously compromised.
- In sum, the most effective security system is a combi-nation of automatic monitoring and access devices coupled with continuous supervision by persons who know the appropriate action to take in an emergency.