MODERN DOUBLE-DECK ELEVATOR APPLICATIONS AND THEORY

by James W. Fortune

Since their introduction in the 1930s, double-deck elevators have been applied in over 30 buildings throughout the world. The majority of the projects have been "pure double-deck applications," where all of the local lifts are double-deck units. Some very high-rise office towers utilize double-deck elevators for sky-lobby shuttles that then feed tenants and visitors to the single-deck, local lifts. With the advent of new, microprocessor-based, artificial intelligence-equipped dispatch controls, double-deck elevator applications are enjoying a renaissance – particularly in Asia, where very dense building populations, relatively small floor plates and high land costs make them a logical choice.

This paper explores the reasons for applying double-deck elevators in new high-rise office buildings and then reviews the design theory and dispatching algorithms that make these units attractive. A definition of elevator design terms – with particular emphasis on double-deck applications – and a listing of the world's current double-deck installations will be included in the appendix.

Introduction

In 1931, the first double-deck elevators (two tandem cars stacked one above the other and fixed in the same car frame) were installed in the 66-story Cities Service Building constructed at 60 Wall Street in New York City. This "pure" double-deck scheme was an attempt to increase the group-handling capacity of the high-rise zone lifts by having each car stop only at alternate levels during peak traffic periods. The cars then would simultaneously load and unload while serving two adjacent floors at each stop. The building was located above a subway stop, and it was envisioned that tenants desiring to go to odd-numbered upper floors would board the lower deck, while even-floor tenants would load onto the upper deck. This boarding characteristic created dual-loading lobbies at the basement and ground floors (Figure 1) that were interconnected by escalators so that during the morning up-peak, building tenants could sort themselves out by odd or even destination floors before they entered the elevators. The system was designed so that the elevators would operate as double-deck-enabled, odd/even units during the morning up-peak and evening down-peak traffic periods and then be switched to single-deck units, with only the top car operative, during the remainder of the day. The elevators were operated by attendants, had automatic signal control and were dispatched by starters from the main lobbies. A year after the building opened, the Great Depression hit, and the masses of tenants needed to fill the upper-floor rental areas never materialized. The double-deck operation was scrapped in order to save the employee cost for the excess elevator operators. Thereafter, the bottom car was counterbalanced with sandbags, sealed off and operated as single-deck elevators until the 1980s, when the cars were modernized to permanent single-deck operation.

Courtesy Otis Elevator Company

Continued ▶

MODERN DOUBLE-DECK ELEVATOR APPLICATIONS AND THEORY *Continued*

By designing a building with double-deck elevators, it was expected that each double-deck lift could provide service to more upper zone floors while reducing the required number of lifts (and shafts) compared to conventional, single-deck elevatoring required to provide a similar level of service in a given size building. To date, about 30 large office buildings have been constructed throughout the world utilizing double-deck solutions, and they seem to work quite well. The double- to single-deck ratio works out to about 70% – or an approximate 30% savings in the number of hoistways required. Surprisingly, the cost of the elevators – single-deck versus double-deck – is about the same, even though there are fewer double-deck units. However, the tremendous core savings for the double-deck solution makes the building more efficient by creating more rentable area. If this additional revenue is projected over the project's economic life, it usually results in a tremendous advantage favoring the double-deck approach for certain, selected projects.

Analysis

The old criteria for double-deck elevator applications in high-rise office buildings was to start looking at the viability of applying them when the building:

1. Contained over 93,000 gross m^2 of office space.
2. Had typical floor sizes in excess of 23,000 gross m^2 each.
3. Was to contain over 40 office floors with populations of at least 200 persons/floor.
4. Contained very dense, single-zone tenants with intense arrival queues and much interfloor traffic.
5. Was located in close proximity to a rapid transit station.

Utilizing these design requirements meant that double-deck installations were primarily reserved for monumental, headquarters-type, single-tenant buildings. The double-deck equipment required to satisfy these design parameters generally consisted of very large – 1800/1800 kg – cars, was very expensive to purchase and maintain, and required operation that was confusing to building tenants and visitors. The dispatching logic was relatively unsophisticated and based almost exclusively upon the functioning of a mechanical selector, with a morning up-peak, odd/even-restricted-floor – service algorithm and a trailing deck response strategy during nonpeak times. With masses of zone tenants constantly requiring one-way and two-way interfloor transport, it was almost a given that every time an elevator stopped, there would be simultaneous loading/unloading at each two-floor stop. These heavy zone populations also assured that almost every interfloor stop involved cancelling coincidental and/or congruent registered car and hall calls. In short, it was basically a people response dispatching strategy with little computing logic required.

If the tenant densities decrease or the arrival/departure queue intensities degrade due to tenant changes or more use of flex-time, the double-deck systems equipped with the old dispatching controls tend to break down because there are no longer enough people to push the buttons and heavily load the cars. Under these conditions, the waiting times for service at upper floors increase along with the number of "other deck loading" activations. These changes often lead to tenant frustrations with accompanying complaints to building management about poor service, which can generally only be alleviated by modernizing the elevators with new, microprocessor-based controls.

Modern, pure double-deck applications generally involve very tall, slender office towers with relatively small floor plates of about 1,400-1,850 gross m^2 each. The high land costs and relatively dense zone tenancies (10-12 m^2/person are not uncommon) associated with many Asian developments makes these types of projects a logical double-deck choice. These projects generally require much smaller car sizes – 1360/1360 kg or 1600/1600 kg – and are equipped with sophisticated graphics and signage directing tenants and visitors to the appropriate deck. The elevator motion, motor control and dispatching logic are generally microprocessor-based systems employing the latest double-deck application algorithms and advanced dispatching strategies that speed the elevator trip. These applications are more efficient than the older, people-based patch systems, because they continually scan the car and individual deck status and the number of car and hall calls registered, and then assign the best deck to service the call.

The following chart indicates the maximum car loads and zone populations that can be handled by a given size single-deck or double-deck lift.

Figure 1
ELEVATOR CAPACITIES/MAXIMUM ZONE POPULATIONS

ELEVATOR CAPACITY (KG)	FULL CAR LOAD (PERSONS)	NOMINAL CAR LOAD (PERSONS)	MAXIMUM ZONE POPULATION (PERSONS)	
			AVERAGE INTERVAL ≤ 30 SECONDS AND 12% HANDLING CAPACITY	AVERAGE INTERVAL ≤ 30 SECONDS AND 14% HANDLING CAPACITY
SINGLE-DECKS				
1360	20	16	1,333	1,143
1600	23	19	1,583	1,357
1800	27	22	1,833	1,571
2260	33	25	2,083	1,786
4530	66	50	4,166	3,571
DOUBLE-DECKS				
1360/1360	20/20	16/16	2,666	2,286
1600/1600	23/23	19/19	3,166	2,714
1800/1800	27/27	22/22	3,666	3,143
2260/2260	33/33	25/25	4,166	3,571

Double-Deck Design Advantages

Double-lift designs are unique, and some of their design advantages are listed below:

1. Fewer passenger elevators and groups of elevators are required when compared to a similar single-deck design.
2. Smaller-capacity elevators are required, compared to single-decks, because each car frame has two cabs.
3. Double-deck elevators generally do not require contract speeds as fast as single-deck units, because they serve more stops and generally do not have to express as far to reach their first local stop. Speed is used to partially overcome express-travel distances.
4. Each elevator carries more people (two cabs/unit) with fewer typical stops, due to two-floor jumps, en route to a rider's destination.
5. Each double-deck elevator zone typically contains 18-20 upper floor stops compared to no more than 15-16 stops for a single-deck zone arrangement.
6. During the up-peak condition, passengers generally reach their destination floor quicker than on comparable single-deck units, because the number of typical stops is halved.
7. Double-deck arrangements result in tremendous building elevator core savings (about 30%) when compared to a similar single-deck service scheme.
8. Taller buildings are possible for the same size building site – because the core area is reduced, each double-deck zone serves more floors, and the amount of rentable area is

increased. A typical 60-story office tower would require three zones of double-deck lifts (six to eight elevators per zone) or four zones of single-deck lifts. Figuring six elevators per zone, this works out to 18 double-decks versus 24 single-deck elevators (a 75% ratio), or 36 double cabs versus 24 single cabs.

9. They require smaller first floor elevator-loading lobbies and upper corridor widths because each car is normally smaller, and during peaks, the cars always stop at two-floor jumps.

10. Double-deck elevators require fewer entrances.

11. Double-deck elevators generally take less time to install because there are fewer of them.

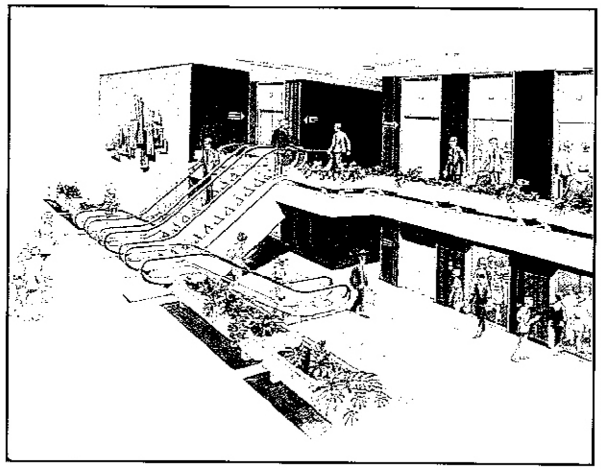
12. Double-deck elevator continuing maintenance costs are less than comparable single deck units because there are fewer of them.

Double-Deck Lobby Designs

Typical double-deck loading-lobby arrangements are shown on Figure 2:

1. Because of their simultaneous loading characteristics, double-deck elevators create a dual-loading lobby situation where one loading lobby must be located on top of the other.

2. Most morning up-peak, double-deck applications require that the upper, odd-floor level tenants load on the bottom deck and that even, upper-floor tenants load on the top deck.



Courtesy Otis Elevator Company

3. There are four possible dual-loading lobby variations: a) a split-level lobby, b) a main lobby at the lower level, c) a main lobby at the upper level or d) a dual-entry/exit lobby at each level.

4. Up and down escalators are generally provided between each loading lobby in order to speed required elevator passenger entry/exiting level changes.

5. The split-level lobby is preferred from a visual and efficiency standpoint, but this arrangement requires the installation of more escalators than for the single-entry lobby schemes.

6. The space adjacent to the main, dual-loading lobbies or dual sky lobbies – created when using a double-deck shuttle scheme – are normally devoted to retail tenants. This commercial space can be utilized to create double floor-height atriums, food courts, retail stores or mini malls and lends itself to innovative architectural treatment.

7. During down travel, departing double-deck elevator passengers have no control over which elevator deck picks them up after down hall call registration on an upper floor. Upon arrival at the bottom terminal, passengers will exit at the bottom or upper-lobby landing and then sort out building exiting choice by use of the adjacent escalators.

Double-Deck, Special Building Design Requirements

Double-deck elevator installations do require some unique building requirements:

1. Dual-loading lobbies with up and down escalator interconnections are required.

2. Generally, all building levels served by the elevators must have the same floor-to-floor heights.

3. Special graphics and signage should be strategically placed at the building-entry points to direct people to the appropriate zone floors and the proper odd/even-loading lobby.

4. Double-deck elevators require slightly larger hoistway widths and depths due to the larger car frames, heavy duty rails and bigger counterweights.

5. Normal elevator over-travel requires the addition of one extra floor height if: a) the lower deck is to be capable of serving the top floor in the zone, or b) the zone has an odd number of floors, requiring the bottom deck to serve the top floor.

6. Machine room and pit reactions are slightly increased due to the larger hoist machine sizes and heavier suspended car loads (car frame and counterweights) and car capacities (two cars in each frame).

7. Lock-down-type rope compensation is required for all lifts.

8. If the building's parking shuttles do not serve both of the building's loading lobbies, a separate handicapped person shuttle elevator may be required to serve these floors. Alternately, special handicapped controls can be provided inside each car to permit a wheelchair-bound person to momentarily override the odd/even stopping pattern.

9. The size of the main building's lobby exits might have to be increased to avoid congestion created by the heavy down-peak traffic that can be discharged by the double-deck elevators at the main lobbies.

Continued ▶

Typical Double-Deck Dual-Loading Lobby Arrangements

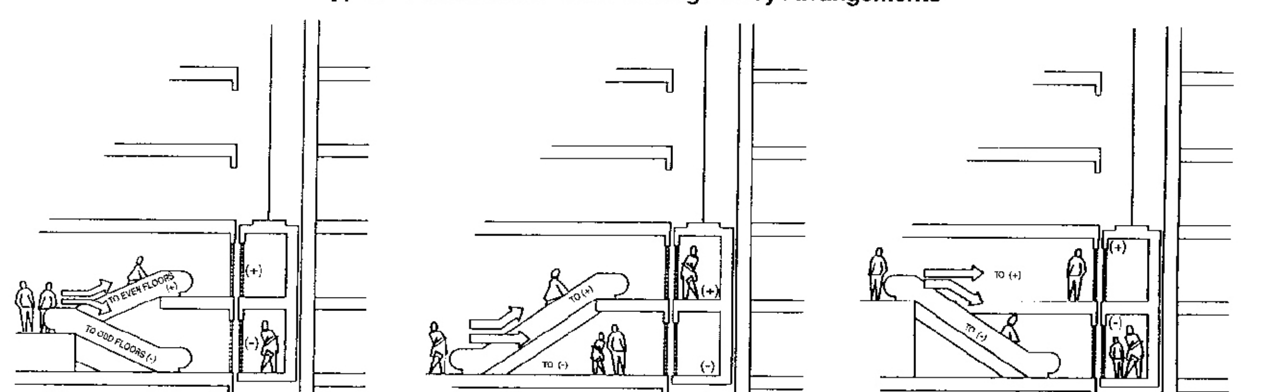


Figure 2 Split-Level Lobby | Main Lobby at Lower Level | Dual Main Lobbies or Main Lobby at Upper Level

MODERN DOUBLE-DECK ELEVATOR APPLICATIONS AND THEORY *Continued*

Double-Deck Problems

Double-deck elevators do present some problems in bidding, operation and application:

1. Most double-deck installations have been installed by Otis Elevator Company, so in the past, there has only been one viable bidder. The most recent double-deck projects have been bid by Otis; Schindler Elevator Corporation; Fujitec Co., Ltd.; Mitsubishi and KONE. Otis still claims they have a valid patent on the "trailing deck response," nonpeak-operation algorithm.

2. Building tenants can cheat the morning up-peak odd/even dispatching strategy by boarding the wrong deck and then: a) waiting for the restricted odd/even car calls to become unbridled after either deck stops in response to a hall call; b) waiting for the car to make its first stop, momentarily jumping out and quickly registering an up hall call and then reboarding the elevator; or c) riding the wrong deck until the car reverses. After any of these three scenarios occurs, the car calls become unbridled, and the inscrutable elevator rider can then immediately register his real destination car call.

3. For the double-deck strategy to be effective, there must be an adequate number of zone tenants and visitors present. A minimum number of people are required to register calls and load both decks in order to take advantage of the system's ability to provide: a) simultaneous loading/unloading characteristics at each two-floor jump, b) adjacent or congruent hall call stop cancellation, and 3) coincidental stop car and hall call cancellations.

Double-Deck Operation

General

With a double-deck elevator system, two elevator cabs are connected in tandem (one on top of another) to the same car frame and share the same hoistway. Each elevator then can serve two adjacent floors simultaneously.

At the lower loading building lobbies, zone tenants and visitors board the elevators from two different levels, depending upon whether their upper-level destination is an odd- or even-numbered floor. When first entering the building, they must identify whether they should board a lower level (-) deck or upper level (+) deck. The two loading lobbies are interconnected by adjacent escalators, and elevator passengers are directed by prominent signage to the appropriate loading lobby.

ELEVATOR DESIGNS – A GLOSSARY OF DOUBLE-DECK ELEVATOR TERMS

ELEVATOR ARRANGEMENT TERMS	
TERMINAL FLOOR	A MAIN ELEVATOR DISPATCHING ENTRY/EXIT FLOORS
SKY LOBBY	A TERMINAL FLOOR(S) LOCATED IN SOME UPPER PORTION OF A BUILDING WHERE PASSENGER CAN TRANSFER BETWEEN THE SHUTTLE ELEVATORS AND LOCAL ELEVATORS
TOP/DOWN ELEVATOR APPROACH	LOCAL ELEVATORS BEING DISPATCHED UP AND DOWN FROM A TERMINAL FLOOR(S)
SHUTTLE ELEVATOR	LARGE ELEVATORS THAT ARE UTILIZED TO TRANSPORT PERSONS BETWEEN TERMINAL FLOORS; NORMALLY USED BETWEEN GROUND FLOOR TERMINAL(S) AND UPPER FLOOR SKY LOBBY(IES)
LOCAL-ZONE ELEVATORS	A GROUP OF ELEVATORS THAT ARE DISPATCHED FROM A TERMINAL FLOOR(S); CAN BE A SKY LOBBY
SINGLE-DECK ELEVATOR	A SINGLE ELEVATOR CAR IN A SINGLE FRAME
DOUBLE-DECK ELEVATOR	TWO ELEVATOR CARS RIGIDLY ATTACHED, ONE ON TOP OF ANOTHER AND LOCATED IN THE SAME ELEVATOR FRAME
ELEVATOR ANALYSIS TERMS	
ROUND-TRIP TIME (RTT)	THE TIME IT TAKES A SINGLE ELEVATOR TO COMPLETE ITS TRIP WITH A FULL LOAD WHEN LEAVING THE TERMINAL FLOOR AND THEN RETURNING (READY FOR ANOTHER LOAD)
AVERAGE INTERVAL (AI)	THE FREQUENCY OF DEPARTURES (IN SECONDS) OF ELEVATORS BEING DISPATCHED FROM A MAIN LOADING TERMINAL(S) DURING A PEAK TRAFFIC CONDITION
INDIVIDUAL CAR LOAD (ICL)	THE NUMBER OF PERSONS LOADED IN AN INDIVIDUAL ELEVATOR CAR (USUALLY COUNTED DURING A PEAK TRAFFIC CONDITION)
GROUP HANDLING CAPACITY (HC)	THE NUMBER OF PERSONS OR PERCENTAGE OF THE ZONE POPULATION MOVED BY AN ELEVATOR (GROUP) DURING PEAK PERIODS
INDIVIDUAL (SINGLE) WAITING TIME (WT) OR (SWT)	THE TIME A PROSPECTIVE ELEVATOR RIDER WAITS AT THE ELEVATOR LOBBY AFTER HIS HALL CALL REGISTRATION UNTIL THE APPROPRIATE ELEVATOR RESPONDS AND ITS DOORS ARE OPENED READY FOR BOARDING
AVERAGE WAITING TIME (AWT)	THE AVERAGE OF ALL PROSPECTIVE ELEVATOR RIDER INDIVIDUAL WAITING TIMES AT THE ELEVATOR LOBBY AFTER THE HALL CALL REGISTRATION UNTIL THE APPROPRIATE ELEVATOR RESPONDS AND ITS DOORS ARE OPENED READY FOR BOARDING
SYSTEM REGISTRATION (RESPONSE) TIME (SRT)	SIMILAR TO AVERAGE WAITING TIME EXCEPT IT IS THE TIME FROM ALL CALL REGISTRATION UNTIL THE CALL IS EXTINGUISHED (USUALLY ABOUT FOUR SECONDS BEFORE THE DOORS OPEN)

ELEVATOR ANALYSIS TERMS *Continued*	
AVERAGE TIME TO DESTINATION	AFTER BOARDING, THE TIME IT TAKES AN ELEVATOR RIDER TO ARRIVE AT THE MIDPOINT OF THE ELEVATOR'S LOCAL STOP TRAVEL
TOTAL TRANSIT TIME	THE TIME A RIDER SPENDS TRAVELING IN THE ELEVATOR FROM BOARDING TO ARRIVAL AT HIS DESTINATION FLOOR
DOUBLE-DECK TERMS	
PURE DOUBLE-DECK SYSTEM	AN ELEVATOR SYSTEM WHERE ALL OF THE GROUP ELEVATORS ARE DOUBLE-DECK UNITS
SKY LOBBY DOUBLE-DECKS	DOUBLE-DECK SHUTTLES SERVING BETWEEN LOWER TERMINAL FLOORS AND UPPER SKY LOBBY FLOORS
ODD/EVEN* DISPATCHING STRATEGY	DURING UP TRAVEL, THE BUILDING (ZONE) SERVICE IS RESTRICTED SO THAT ODD-FLOOR TENANTS ARE DIRECTED TO BOARD THE LOWER ELEVATOR DECK WHILE THE EVEN-FLOOR TENANTS ARE DIRECTED TOWARDS THE UPPER DECK
SKIP/STOP SERVICE	THE BOTTOM DECK STOPS AT ODD FLOORS AND THE TOP DECK STOPS AT EVEN FLOORS BOTH DECKS UNLOADING AND LOADING SIMULTANEOUSLY
RESTRICTED DECK SERVICE	ODD FLOOR CAR BUTTONS ON THE EVEN DECK AND EVEN FLOOR CAR BUTTONS IN THE ODD DECK CANNOT BE ACTIVATED DURING UP TRAVEL
TRAILING DECK RESPONSE	A DISPATCHING STRATEGY WHERE THE TRAILING DECK (BOTTOM DECK IN THE UP DIRECTION, TOP DECK IN THE DOWN DIRECTION) STOPS IN RESPONSE TO A REGISTERED HALL CALL
UNBRIDLED CAR CALLS	AS SOON AS EITHER DECK ANSWERS A REGISTERED HALL CALL, BOTH DECKS BECAME UNRESTRICTED AND ALL AVAILABLE CAR CALLS CAN BE REGISTERED IN EITHER DECK; I.E., EITHER DECK CAN THEN RESPOND TO BOTH ODD OR EVEN CAR CALLS
CONTIGUOUS OR CONGRUENT HALL CALLS	REGISTERED HALL CALLS AT ADJACENT LANDINGS THAT CAN BE SIMULTANEOUSLY ANSWERED BY BOTH DECKS DURING A SINGLE ELEVATOR STOP
COINCIDENTAL CAR AND HALL CALLS	A DISPATCHING STRATEGY WHICH CAUSES A DECK TO STOP IN RESPONSE TO REGISTERED CAR AND HALL CALLS FOR THE SAME LEVEL IN A SINGLE STOP
COINCIDENT STOPS	A MORNING, UP-PEAK CONDITION WHEN BOTH CABS LOAD AND/OR UNLOAD AT THE SAME TIME
NONCOINCIDENT STOPS	A MORNING, UP-PEAK CONDITION WHEN ONE CAB OF A DOUBLE DECK CAR STOPS TO UNLOAD WITHOUT A SIMULTANEOUS STOP FOR THE OTHER CAB – "OTHER DECK LOADING SIGN" IS ACTIVATED IN THE NONLOADING DECK WHILE THE CAR DOORS REMAIN CLOSED

*CAN BE EVEN OR ODD

The Restricted Up-peak Condition

During the morning up-peak condition, when incoming tenants and visitors arrive at the building, they board the appropriate odd or even elevator deck. When selected for dispatch, both decks of a single unit have their doors open simultaneously for loading, and elevator riders select their in-cab destination floor by registering car calls as they enter the cab. During this condition, the odd or even cab will only accept the appropriate floor registrations, even though all cabs are equipped with all-zone floor buttons.

If an elevator rider tries to register a call for an even floor in the odd deck or vice versa, the car call will simply not register. Thus, the car calls are restricted at the loading lobbies during this condition. Once the elevator is dispatched, the doors close, and the car expresses to the first typical floor stop, where both car doors open and the passengers discharge simultaneously, two floors at a time. If a car call is not registered for one deck, while the other deck is unloading, the doors for the nonresponding decks remain closed, and a back-lighted sign that displays "Serving Other Deck" illuminates inside the cab.

Unrestricted Up-peak Travel

As soon as an up hall call is registered, the bottom, trailing deck of the selected elevator ascending in the up direction will normally stop in response to this call. The car call buttons for both decks then become "unbridled"; passengers entering either deck can now enter car calls for any floors above them, and either deck can stop at any upper floor it serves. This trailing deck response strategy is designed to promote two-floor runs and permit simultaneous loading of the upper deck if it picks up a congruent hall call.

Two-Way Interfloor Service

During nonpeak times (majority of the day), the elevators are: a) parked where they answered their last call, b) placed into zones, or c) moved to strategic positions within the zone. To answer a down hall call, the upper, trailing deck normally responds, forcing the lower, lead deck to respond to any adjacent hall calls. Similarly, a response to a registered up hall call is normally answered by the lower trailing deck, which leaves the upper, lead deck available to answer other calls. If the group supervisory control determines that a trailing deck is full or that the lead deck has registered coincidental car and hall calls for a particular floor, it may instead select that deck to respond. The important point to remember with nonpeak, two-way traffic is that the efficiency of the double-deck interfloor service depends upon the frequency of adjacent (congruent) hall stops and coincident car and hall call responses, i.e., heavy interfloor traffic volume creates more coincidental and congruent stops, thus increasing system efficiency.

Down Travel

If no passenger boards either deck during the local stop up travel, the in-cab car call odd-even restriction is removed upon car reversal, and both decks become "unbridled" during down travel. An elevator traveling down will normally answer a registered corridor call with it trailing (now the top) deck. Again, the lower, leading deck is free to pick up congruent hall calls. During down travel, the cars do not follow the restricted odd/even pattern but search for "congruent" and "coincident" calls at adjacent landings. By searching for congruent hall calls and coincident car and hall calls, the supervisory control system is attempting to minimize the number of required stops, maximizing the number of passengers served and reducing the typical elevator round-trip times, while increasing the group-handling capacity. A down-traveling passenger has no control over which deck will pick him up, has no clue as to whether the upper or lower deck picked him up (since all cabs look the same) and

Continued ▶

MODERN DOUBLE-DECK ELEVATOR APPLICATIONS AND THEORY *Continued*

doesn't know which loading lobby he will exit at until the car arrives at the lower loading lobbies and the cab doors open.

Car Load Weighing Operations

Each deck is equipped with an electronic device for determining the number of people loaded in each car. The group supervisory control system utilizes this information to: a) initiate selected dispatching patterns, b) dispatch a car in advance of its normal rotation, c) bypass registered hall calls if either deck becomes full, d) select the alternate deck if the normally selected trailing deck is too full to respond to registered hall calls and e) pretorque a hoist motor to prevent "rollback" if the car loads exceed the weight of the counterweight.

Modern Dispatching Improvements

Newer forms of microprocessor-based group dispatching for double-deck lifts, such as Otis Elevonic 411 or Schindler Miconic 10™, are more efficient in assigning calls to decks, particularly during nonpeak times. With their increased scanning speed, large computer storage memories and advanced dispatching or artificial intelligence capabilities, these microprocessor controls are capable of more closely matching the available elevator service (decks) to the traffic demands, while significantly reducing the system-response times. These systems continually update the status of each car and scan all registered car and hall calls to select the most efficient deck to respond to the demands.

Conclusions

The introduction of microprocessor-based controls with advanced dispatching capabilities has expanded the market for pure double-deck applications in high-rise office buildings. This increased computing power has made double-deck lifts more efficient during nonpeak times, as the "trailing deck response" to registered hall calls is no longer required. Instead, modern dispatch systems make it possible to assign the best deck to answer a particular call.

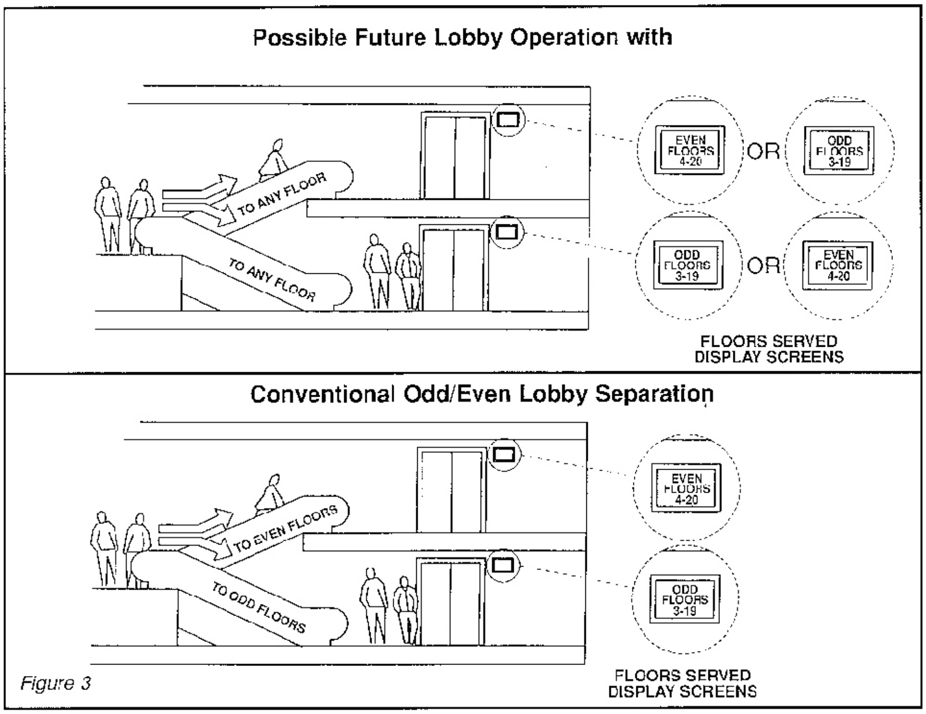


Figure 3

With the introduction of electroluminescent or active dot matrix display screens located at the dual-loading lobby floors (Figure 3), coupled to rotational sectoring (channeling) or destination encoding operations, it may even be possible to eliminate the odd/even-restrictive dispatching that causes so much consternation among conventional double-deck riders. Under this scenario, an elevator rider could enter either elevator loading lobby and wait until the dispatching system selected the appropriate odd/even car or deck that will stop at the selected floor.

Double-deck installations are no longer confined to monumental, high-rise buildings and are being considered in many modern 30- to 50-story office building applications. Is there a double-deck installation in your future?

This paper was presented at Elevcon '95 in Hong Kong and is reprinted with permission from the International Association of Elevator Engineers (IAEE).

– ABOUT THE AUTHOR –

James W. Fortune *graduated from Pasadena City College with a degree in Architecture and from California State Polytechnic University with majors in Architecture and Industrial Technology. After a stint in the U.S. Navy, he served with Westinghouse Elevator Division in Los Angeles for three years, then joined Lerch, Bates & Associates – Denver Headquarters – in 1971 as a staff engineer. He later became project manager and regional vice president. In 1979, he relocated to Los Angeles as the consulting firm's vice president and West Coast zone manager, and in 1985, became the company's East Coast and West Coast vice president while relocating to the Denver Headquarters office. He obtained his MBA degree from the University of Denver in 1989 and was elected president of Lerch, Bates & Associates, Inc. in 1994.*

BUILDINGS WITH SKY LOBBY DOUBLE-DECK SHUTTLES – METRIC UNITS

YEAR COMPLETED	BUILDING AND LOCATION	NUMBER OF STORIES	GROUPS OF ELEVATORS
	OTIS		
1992	U.O.B. PLAZA 1 SINGAPORE	66	(6) 1800/1800 kg at 300 mpm TOP/DOWN SKY LOBBY AT 37/38
	SCHINDLER (WESTINGHOUSE)		
1974	SEARS TOWER CHICAGO, ILLINOIS	110	(8) 2250/2250 kg at 420 mpm SKY LOBBIES at 33/34 (6) 2250/2250 kg at 480 mpm SKY LOBBIES at 66/67
1984	FIRST INTERSTATE BANK (ALLIED TOWER) HOUSTON, TEXAS	72	(5) 1600/1600 kg at 300 mpm TOP/DOWN SKY LOBBY AT 34/35 (6) 1600/1600 kg at 300 mpm TOP/DOWN SKY LOBBIES AT 53/59
	ELEVATORS PTY. LTD. (KONE)		
1981	CENTER POINT TOWER SYDNEY, AUSTRALIA	65	(3) 1150/1150 kg at 420 mpm

BUILDINGS WITH DOUBLE-DECK ELEVATORS COMPLETED OR UNDER CONSTRUCTION
PURE DOUBLE-DECKS (LOCAL ZONE SERVICE) – METRIC UNITS – JANUARY 12, 1995

YEAR COMPLETED	BUILDING AND LOCATION	NUMBER OF STORIES	GROUPS OF ELEVATORS DOUBLE-DECK (DD)
	MITSUBISHI		
1972	OBAYASHI BUILDING OSAKA, JAPAN (skip-stop operation)	32	4-1350/1350 kg at 150 mpm 4-1350/1350 kg at 240 mpm
1983	PEMEX (NATIONAL OIL COMPANY) MEXICO CITY, MEXICO (skip-stop operation)	51	6-1350/1350 kg at 150 mpm 6-1350/1350 kg at 240 mpm 6-1350/1350 kg at 300 mpm
1994	RIVERSIDE SUMIDA TOKYO, JAPAN	16	5-1600/1600 kg at 180 mpm
	OTIS		
1970	TIME-LIFE BUILDING CHICAGO, IL	30	2 GROUPS WITH 12 DD ELEVS.* 6-1800/1800 kg at 180 mpm 6-1500/1500 kg at 240 mpm * presently running as single-deck units due to low population density
1972	COMMERCE COURT TOWER (C.I.B.C.) TORONTO, CANADA	57	1 GROUP WITH 5 DD ELEVS. (LOW-RISE GROUP ONLY) 5-1500/1500 kg at 240 mpm CONVENTIONAL ELEVATORS SERVE ALL FLOORS ABOVE THE LOW-RISE GROUP.
1973	AMOCO (STANDARD OIL) OF INDIANA CHICAGO, IL	80	5 GROUPS WITH 40 DD ELEVS. 8-1600/1600 kg at 240 mpm 8-1600/1600 kg at 300 mpm 8-1600/1600 kg at 420 mpm 8-1600/1600 kg at 420 mpm 8-1600/1600 kg at 480 mpm
1974	JOHN HANCOCK BUILDING BOSTON, MA	60	5 GROUPS WITH 30 DD ELEVS. 6-1800/1800 kg at 210 mpm 6-1800/1800 kg at 240 mpm 6-1800/1800 kg at 360 mpm 6-1800/1800 kg at 420 mpm 6-1800/1800 kg at 450 mpm
1976	CITICORP BUILDING NEW YORK, NY * 46 occupied floors	56 *	3 GROUPS WITH 20 DD ELEVS.* 8-1350/1350 kg at 210 mpm 6-1350/1350 kg at 360 mpm 6-1350/1350 kg at 420 mpm * upper level is "odd" service
1976	NATIONWIDE INSURANCE COLUMBUS, OH	40	2 GROUPS WITH 12 DD ELEVS. 6-1600/1600 kg at 210 mpm 6-1600/1600 kg at 300 mpm
1977	FIRST CANADIAN PLACE TORONTO, CANADA	70	4 GROUPS WITH 29 DD ELEVS. 8-1600/1600 kg at 240 mpm 7-1600/1600 kg at 300 mpm 7-1600/1600 kg at 300 mpm 7-1350/1350 kg at 300 mpm
1977	C.E. HOWE (TREASURER BUILDING 5) OTTAWA, CANADA	14	2 GROUPS WITH 10 DD ELEVS. (GLASS CABS IN ATRIUM) 5-1600/1600 kg at 150 mpm 5-1600/1600 kg at 150 mpm NOTE: 2 GROUPS SERVE THE SAME FLOORS ON EITHER END OF THE BUILDING.
1982	NORTHWEST BELL TELEPHONE OMAHA, NE	17	6-1800/1800 kg at 180 mpm
1982	PHILIP MORRIS BUILDING NEW YORK, NY	26	7-1800/1800 kg at 210 mpm
1984	REPUBLIC PLAZA DENVER, CO	54	3 GROUPS WITH 22 DD ELEVS.* 7-1600/1600 kg at 150 mpm 7-1600/1600 kg at 240 mpm 8-1600/1600 kg at 300 mpm * upper deck is "odd" service
1985	NATIONSBANK PLAZA DALLAS, TX	73	6-1350/1350 kg at 150 mpm 6-1350/1350 kg at 240 mpm 6-1350/1350 kg at 300 mpm 5-1350/1350 kg at 360 mpm
1985	INTERFIRST BANK (NATIONS BUILDING) DALLAS, TX	70	4 GROUPS WITH 23 DD ELEVS. 6-1350/1350 kg at 150 mpm 6-1350/1350 kg at 240 mpm 6-1350/1350 kg at 300 mpm 5-1350/1350 kg at 360 mpm
	OTIS *Continued*		
1985	SOUTHWEST BELL TELEPHONE COMPANY ST. LOUIS, MO	48	3 GROUPS WITH 18 DD ELEVS. 6-1600/1600 kg at 210 mpm 6-1600/1600 kg at 300 mpm 6-1350/1350 kg at 360 mpm
1986	TREASURY BUILDING SINGAPORE	50	3 GROUPS WITH 17 DD ELEVS.* 9-1350/1350 kg at 210 mpm 4-1150/1150 kg at 360 mpm 4-1150/1150 kg at 360 mpm * upper deck is "odd" service
1989	SHEARSON LEHMAN PLAZA NEW YORK, NY	39	3 GROUPS WITH 20 DD ELEVS. 7-1600/1600 kg at 150 mpm 7-1600/1600 kg at 210 mpm 6-1600/1600 kg at 300 mpm
1990	TORRE PICASSO MADRID, SPAIN	43	EITHER DD PASS OR UPPER-DECK SERVICE, LOWER-DECK PASS 3-1600/1600 kg at 150 mpm, 240 or 360 mpm
1992	THE CONCOURSE SINGAPORE	42	2 GROUPS WITH 8 DD ELEVS. 4-1150/1150 kg at 210 mpm 4-1150/1150 kg at 360 mpm
1992	GRAND 50 TOWER KAOHSIUNG TAIWAN	50	2 GROUPS WITH 12 DD ELEVS. 6-1350/1350 kg at 240 mpm 6-1350/1350 kg at 360 mpm
1992	TORE VILLA OLIMPICA BARCELONA, SPAIN	40	2 GROUPS WITH 8 DD ELEVS. 4-1250/1250 kg at 240 mpm 4-1250/1250 kg at 360 mpm
1994	TORRE PUERTA EUROPA MADRID, SPAIN	27	2 GROUPS WITH 4 DD ELEVS. 2-1600/1600 kg at 150 mpm 2-1600/1600 kg at 240 mpm
1994	D.B.S. BANK SINGAPORE	32	2 GROUPS WITH 8 DD ELEVS. 4-1150/1150 kg at 210 mpm 4-1150/1150 kg at 360 mpm
1995	REPUBLIC BUILDING SINGAPORE	60	7-1600/1600 kg at 300 mpm 8-1600/1600 kg at 360 mpm
1995	SHANGHAI TV TOWER SHANGHAI, CHINA	12	1-1750/1750 kg at 240 mpm
1996	PETRONAS TOWERS KUALA LUMPUR, MALAYSIA	88	TWIN TOWERS – UNITS/TOWER 6 GROUPS WITH 29 ELEVATORS 6-1600/1600 kg at 210 mpm 6-1600/1600 kg at 240 mpm 6-1600/1600 kg at 300 mpm 3-1600/1600 kg at 420 mpm 3-1600/1600 kg at 420 mpm 5-2100/2100 kg at 480 mpm
	SCHINDLER		
1991	SCOTIA PLAZA TORONTO, CANADA	72	6-1350/1350 kg at 210 mpm 6-1350/1350 kg at 300 mpm 5-1350/1350 kg at 360 mpm 5-1350/1350 kg at 425 mpm
	ELEVATORS PTY. LTD. (KONE)		
1994	PACIFIC TOWER (T&G BUILDING) HYDE PARK CENTER SYDNEY, AUSTRALIA	30	6-1350/1350 kg at 210 mpm* 5-1350/1350 kg at 300 mpm * presently being modernized to Otis 411M
	EXPRESS LIFT		
<>	NATIONAL WESTMINSTER TOWER LONDON, ENGLAND	<>	4 - <> 1-SERVICE/DIRECTOR EXPRESS LIFT
	HITACHI		
1973	TOYAMA KOWA BUILDING TOKYO, JAPAN (skip-stop operation)	18	4-1600/1600 kg at 180 mpm
	MODERNIZATIONS/REPLACEMENTS		
1992	SUN HUNG KAI – OTIS HONG KONG (skip-stop operation)	60	4-1350/1350 kg at 360 mpm (HIGH-RISE ONLY)
1995	U.O.B. PLAZA 2 – OTIS SINGAPORE	38	4-1150/1150 kg at 210 mpm 3-1150/1150 kg at 360 mpm