Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

PERSONAL RAPID TRANSIT

A SUPPLEMENT TO
Vol. II No. 4, 1975

Vol. III No. 4, 1976-77

The LEA TRANSIT COMPENDIUM is a periodically updated data reference manual on current developments in international transit technology. It consists of a Reference Guide plus 8 data issues, each devoted to a particular transit class, covering the complete range of transit systems and vehicles. Volume II (1975) remains the current basic edition. The issues for the two-year period 1976-77 are supplements to the issues of Volume II (except for the Reference Guide, which remains unchanged and is not republished in the supplementary edition). Thereafter, the complete edition will be republished over a two-year period, followed by two years of supplements, and so on. Issues through No. 5 will appear during the first year of the cycle and Nos. 6-9 during the second year. The supplementary editions will include one Special Issue per year on subjects of topical interest. Due to the long lead times for data collection, publication will always take place during the latter months of the year, approximately one issue per month. However, dependent upon the receipt of data, the release of some issues may be delayed beyond the originally scheduled dates, in order to provide a more complete and comprehensive issue.

PUBLISHER

The LEA TRANSIT COMPENDIUM is prepared and published by the N. D. Lea Transportation Research Corporation, 123 Green Street, Huntsville, Alabama 35801, U.S.A.; Telephone: (205) 539-2781; Cable: LEACONSLT, Huntsville; and 344 Lakeshore Road East, Oakville, Ontario, L6J 1J6, Canada; Telephone: (416) 844-5533; Cable: LEACONSLT, Toronto.

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Each additional subscription	US $50	US $55
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PREFACE

This supplementary issue is devoted to Personal Rapid Transit (PRT) systems, which have been defined in the Reference Guide as follows:

> "PRT is a transit class in which small vehicles (2 to 6 passengers seated) operate under total automatic control over an exclusive guideway. All stations are off-line and service is demand activated. By "personal" it is meant that one passenger can have exclusive use of a vehicle for a non-stop trip from his origin station to his destination station. He may take with him a small party of perhaps three to five others, possibly at no extra charge."

The present issue is supplementary in that it updates the corresponding issue from the preceding edition (Vol. II, No. 4, 1975) by reporting any changes or progress in systems included in that edition.

Updates to systems previously reported have been given in such a way that the reader can easily identify those data which have changed. Where there have been numerous changes in a system, the complete data report has been reprinted with the changes given in italics. Where there are few changes, only these are given, without reprinting the entire system report. Where there have been no changes, an entry is made for the system with a notation to this effect. All systems previously reported are thereby covered, providing the user with the option of taking the pages from Vols. II and III and combining them into one expanded and updated issue.

Of the 11 systems reported in the 1975 edition, two — Cabinentaxi/Cabinenlift and CVS — have undergone significant changes which necessitate printing completely revised reports. The TTI/Otis PRT System and the UMTA High Performance PRT System have been reclassified as Group Rapid Transit and are included in that issue (Vol. III, No. 3, 1976). The 7 remaining systems have experienced either little or no change in development since last reported. They appear under the section "Systems Where Little or No Change Has Occurred".

A primary objective of the LEA TRANSIT COMPENDIUM is to remain completely impartial and unbiased in the choice of systems reported as well as specific data and information included. Therefore, the systems reported in this issue are not specifically endorsed or preferred by the N. D. Lea Transportation Research Corporation over those not included. Furthermore, no recommendations are made with respect to ranking or comparison of the individual systems. Comparisons are left to the Compendium user and should be made with reference to the site-specific conditions under which a system would operate. The reader is also cautioned that system data and characteristics as reported are subject to change and should not be used as the sole source of information in assessing or comparing systems or as the basis for the design of site-specific installations. Information for this purpose should be obtained directly from the developer, manufacturer, or supplier.

Comments and suggestions are solicited from readers with regard to improvements in data report format, choice of data, and more definitive data presentation techniques.

Lea transit compendium

PERSONAL RAPID TRANSIT

CONTENTS

Vol. III. No. 4, 1976-77

INTRODUCTION

With this supplementary issue, the number of various Personal Rapid Transit (PRT) systems which have been under development has now been reduced to 9. Two systems which were formerly classified under this mode have now been reclassified as Group Rapid Transit (GRT) and have been reported in the appropriate issue, Vol. III, No. 3, 1976-77: the TTI/Otis PRT System (renamed the OTIS/TTD GRT System) and the UMTA High Performance PRT System (now called the UMTA Advanced GRT System). Of the 9 remaining PRT systems, only 5 have continued in active development; and of these 5, development appears to have continued seriously for only 3: Aramis, Cabinentaxi, and CVS. Thus far, no PRT system has been placed in regular operational service and only one — CVS — has been demonstrated in the public environment. Total development activity of PRT therefore appears to have declined during the past two years (1975 & 1976). Developers seem to be adapting their plans more to the current GRT trend. However, PRT remains the most sophisticated form of automated guideway transit, presenting the greatest challenge to developers and manufacturers.

Technologically, PRT systems can be subdivided into two categories: Category I, in which the minimum headway is equal to or less than 3 sec; and Category II, in which the minimum headway is greater than 3 sec. Debate continues over the safety of fractional-second headways, which are necessary to achieve greater line capacities with small vehicles and personal service. The "brick wall" stopping criterion (i.e., a vehicle must be capable of emergency stopping in a situation where the lead vehicle stops instantaneously) limits the minimum headway to greater than 3 sec. Others argue that a failure where a lead vehicle stops instantaneously is extremely improbable and that the only condition is to insure that catastrophic collisions do not occur. Therefore, developers of Category I systems concentrate safety assurance in emergency situations on safe collision velocities.

In general, PRT systems operate only single-vehicle traveling units. However, two systems do operate trains. In the Aramis System, vehicles travel in platoons (i.e., functional trains), following one another at extremely short distances (300 mm separation) with longer "brick wall" headways between platoons. Only the Flyda Systems have vehicles linked mechanically into trains, but here the coupler is designed so that a vehicle is free to uncouple laterally from the train to accomplish individual vehicle diverging.

DEVELOPMENT STATUS

Development status of each of the systems is reported in accordance with a series of defined stages, ranging from "Conceptual" to "Operational". By assigning the following weighted percentages to each stage, the percent complete (i.e., ready to be considered as operational) can be estimated for a particular system:

Conceptual	5%
Preliminary Design	10%
Detailed Design	15%
Prototype Testing	20%
Demonstration Design	5%
Demonstration	20%
Manufacture & Installation	10%
Operational	15%
TOTAL	100%

Figures 1 and 2 are modified histograms of the development status for Categories I and II PRT systems, respectively. In each figure the status of developed technology and of available equipment is given (upper and lower half of the figure, respectively). Under "developed technology" all systems which have been under development can be considered, even those which have been discontinued, since the results of those projects are available. "Available equipment" is understood to mean only those systems which remain in active development, including those which may already have reached the demonstration stage. The development stages listed above. The arrowheads give the average status of the systems within each of the ranges.

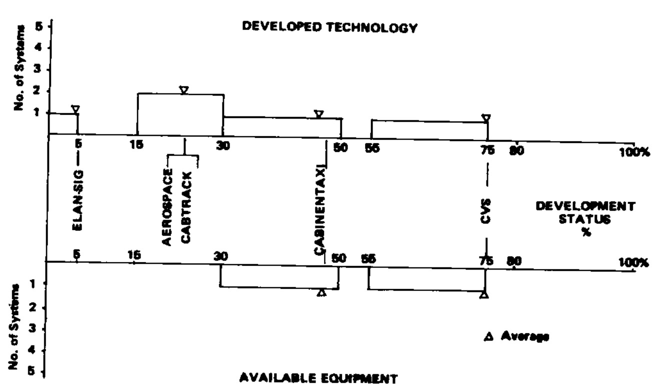


FIGURE 1: STATUS OF TECHNOLOGY AND EQUIPMENT AVAILABILITY CATEGORY I SYSTEMS (Headway ⩽ 3 sec)

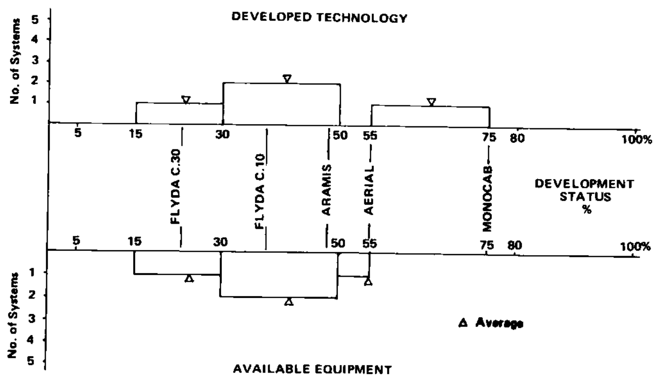


FIGURE 2: STATUS OF TECHNOLOGY AND EQUIPMENT AVAILABILITY CATEGORY II SYSTEMS (Headway $>$3 sec)

The bulk of activity appears to be centered near 50% (i.e., completion of prototype testing). Aramis has been classified as a Category II system because of its longer headways between platoons. This leaves only two Category I systems in active status — Cabinentaxi and CVS. The CVS System was publicly demonstrated during the second half of 1975 at Ocean Expo in Okinawa, Japan. Initial design work has begun for the installation of Cabinentaxi systems in Hamburg and Marl (both West Germany), with operations planned for 1979-80.

Development of the Aerial Transit System has been curtailed, although some activity has continued in the research and development of an automated guidance system. Rohr Industries reports that no activity is underway on the Monocab System. Of the more advanced systems, this leaves Aramis, Cabinentaxi, and CVS as the main contenders for the PRT market. Each of these can be considered as ready for installation in an urban public demonstration.

Since all serious PRT system development activity is occurring outside of the United States (France, West Germany, Japan), it is reasonable to expect that first demonstrations will be carried out there. Present activity in the United States is of a more general nature, aimed at an array of automated guideway transit system technologies. The U.S. Department of Transportation's Urban Mass Transportation Administration (UMTA) is carrying out a series of technology studies on such subjects as operations and control, lateral guidance, reliability/availability, guideway and station structures, etc. However, these studies are not intended to culminate in the fabrication of any hardware. Only UMTA's Advanced GRT System and Downtown Peoplemover projects involve hardware.

The present climate of PRT development is much quieter than in the period 1971-74, when a greater amount of Federal funding appeared to be available. Should the French, West Germans, or Japanese be successful in building an urban demonstration of PRT, a resurgence of activity may result, particularly in view of the large number of firms currently involved in GRT development. Otherwise, it can be expected that the eventual development of PRT will follow a natural evolutionary process, wherein existing GRT systems are gradually modified to deliver greater levels of service.

SERVICE AVAILABLILITY

All of the current PRT systems are proposed to offer on-demand, single-party (private occupancy) service, generally without passengers waiting in stations. None are designed for fixed-schedule service only. Only with the Aramis and Monocab systems is fixed-schedule service even considered, and in these cases it is not the primary mode of operation.

Stations are all off-line, except for Flyda and Monocab, which propose a mix of on-line and off-line stations. On-line stations can exist only where vehicles do not stand idle in stations and where headways along those guideway sections are generally greater than 30 sec.

All of the systems except Aramis provide non-stop, origin-station to destination-station service. In the case of Aramis, a network would be made up of any number of loops, with passengers transferring between loops for longer trips.

SWITCHING

All of the PRT systems discussed have the capability to switch from one guideway path to another, so that merging and diverging operations can be carried out. Except for Elan-SIG and Aerospace, all systems have the active switching elements on board the vehicle, to insure positive switching at the shorter headways. In the cases of Elan-SIG (track-based toggle knife blade) and Aerospace (track-based electromagnetic), the guideway-mounted equipment is proposed to operate at lock-to-lock time periods of 0.15 sec and 0.005 sec, respectively.

LINE CAPACITY, HEADWAY, AND VEHICLE CAPACITY

Figure 3 plots the maximum theoretical capacity of the PRT systems as a function of minimum headway, vehicle design capacity, and traveling unit capacity. Here the Aramis System is shown with 40 vehicles per platoon and the Flyda Systems with 30 and 60 vehicles per train, with the remaining systems operating single-vehicle traveling units. Vehicle size remains small, with capacity never exceeding 6 passengers. There is some clustering near 20,000 psgrs/hr for the fractional-second headway systems (excluding Aerospace), taking into account the Flyda and Aramis Systems which have effective fractional-second headways.

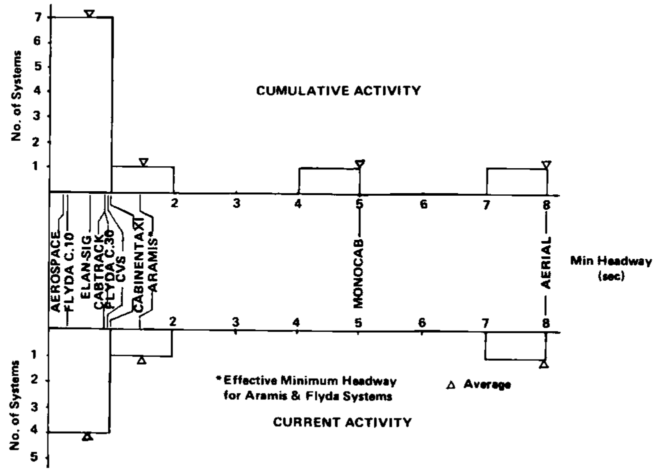
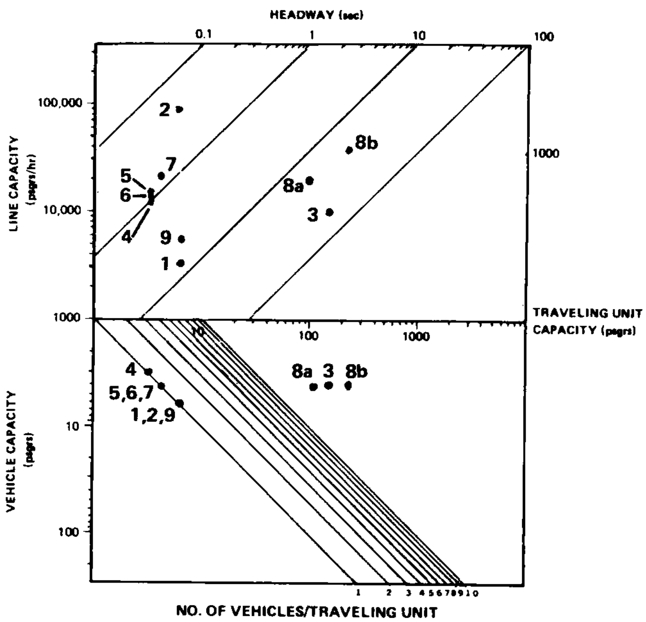


FIGURE 4: RANK DISTRIBUTION OF PRT SYSTEMS MINIMUM HEADWAY



1	AERIAL TRANSIT	6	CVS
2	AEROSPACE	7	ELAN-SIG
3	ARAMIS	8a	FLYDA C.10
4	CABINENTAXI	8b	FLYDA C.30
5	CABTRACK	9	MONOCAB

FIGURE 3: LINE CAPACITY AS A FUNCTION OF HEADWAY, VEHICLE CAPACITY AND TRAIN LENGTH

Figure 4 shows the distribution of proposed minimum headways. The Aramis and Flyda Systems are shown according to their effective (or average) headways, since they operate multiple-vehicle traveling units. Taking into account the development status, the major activity appears to have been toward systems of the Category I type (headway ⩽ 3 sec). This is also true of current activity.

Extremely high capacities, where vehicles are loaded to design capacity, cannot be achieved by systems offering personal, non-stop service. Figure 5 therefore gives the line capacities of systems at an average maximum occupancy of 1.3 psgrs/vehicle. A better perspective of the potential capacity of the systems, which is on the order of 4500 to 6500 psgrs/hr, can thus be gained. Only at a minimum headway of 0.25 sec or less can the maximum capacity approach 20,000 psgrs/hr. The systems with longer headways are shown to have very modest potential line capacities, making them applicable only to situations where demand is expected to be low.

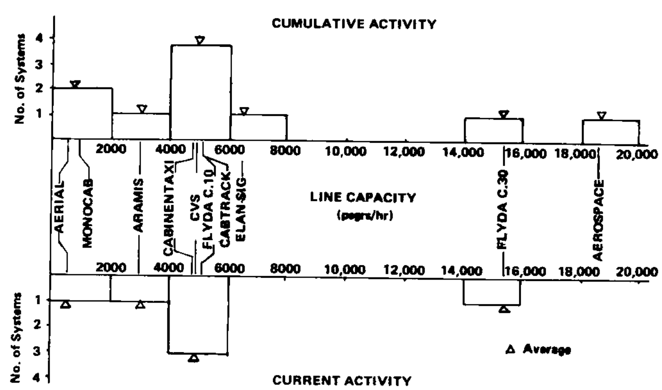


FIGURE 5: RANK DISTRIBUTION OF PRT SYSTEMS LINE CAPACITY AT 1.3 psgr per vehicle

PRT systems are designed more specifically for collection and distribution service within an area. If they are to provide line-haul service between two or more areas, multiple lanes in the same direction must be considered. Personal service with a maximum capacity of 5000 psgrs/hr/lane would require 3 lanes to provide a single-direction, line-haul capacity of 15,000 psgrs/hr. In a corridor, this would mean a total of 6 lanes to serve both directions. There are arguments, however, stating that traditional line-haul systems require larger capacities because passengers are forced to queue in stations, whereas PRT systems offer on-demand service which does not allow queues to form. The question therefore appears to be one of examining the rate of demand. Since the private automobile provides, in effect, on-demand service, consideration of the urban freeway gives some insight into this problem. Here 3 lanes, operating at maximum capacity during rush hours, are not uncommon, suggesting a possible similar requirement for PRT. The advantage of the PRT system is that the number of lanes can be varied to meet the capacity requirement of the corridor, thus permitting capital costs to be more proportional to maximum expected demand which varies along the corridor. The larger GRT, LRT, and HRT systems must be designed so that their single-lane capacity matches that point along the corridor where maximum demand occurs. This means that vehicles (or trains) will operate at lower load factors along sections of the corridor where demand is light. The line capacity argument is further discussed in the following section in connection with the effect of average trip speed.

AVERAGE SPEED

The average speed of a transit vehicle (or train) is expressed by[1]:

$$V_A = \frac{VS}{S+K} \; ; \; K = \frac{V^2}{2a} + \frac{V^2}{2d} + VT$$

where

$V_A \triangleq$ average speed
$V \triangleq$ cruise speed
$a \triangleq$ service acceleration
$d \triangleq$ service deceleration
$T \triangleq$ dwell time in stations for scheduled service
$S \triangleq$ station spacing distance
$K \triangleq$ station spacing factor

[1] LEA TRANSIT COMPENDIUM, Reference Guide, Vol. II, No. 1, 1975

When the station spacing distance (or average distance between stops) is equal to the station spacing factor (K), the average speed is exactly one-half the cruise speed. For PRT, the vehicles do not stop at intermediate stations during a passenger's trip. Therefore the station spacing distance (S) becomes the passenger's trip distance.

Figure 6 gives the range of average speeds for the 9 different PRT systems. The points plotted correspond to one-half the cruise speed where the trip distance is equal to the station spacing factor (K). For trip distances of 1.0 mi (1.6 km) or more, the majority of systems show average speeds clustering near 25 mph (40 km/h), which is close to their cruise speeds. This characteristic allows a PRT system to be operated at a lower cruise speed than conventional fixed-guideway systems and yet achieve the same or higher average speed. A higher average speed increases a vehicle's productivity and thereby the total capacity of a system to meet demand. There can be a definite gain from the use of PRT service to reduce the need for higher line capacity, assuming that the fleet size and its dynamic distribution properly match the rate of demand. The net effect is that the PRT system meets passenger demand on a continuous basis, whereas the fixed-schedule service, by storing passengers in stations, meets demand by a batch process which can require greater line capacity.

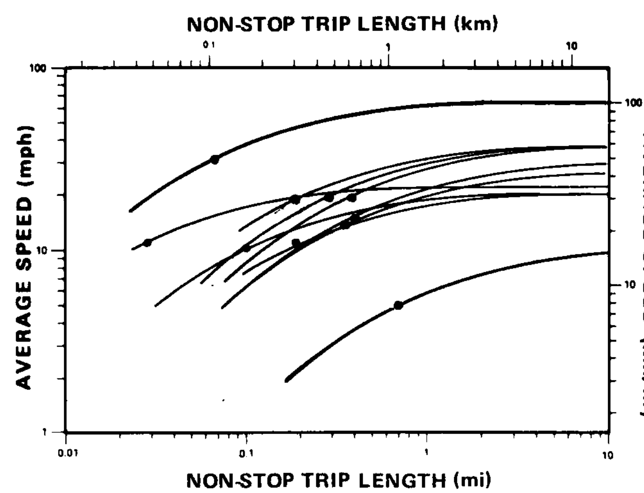
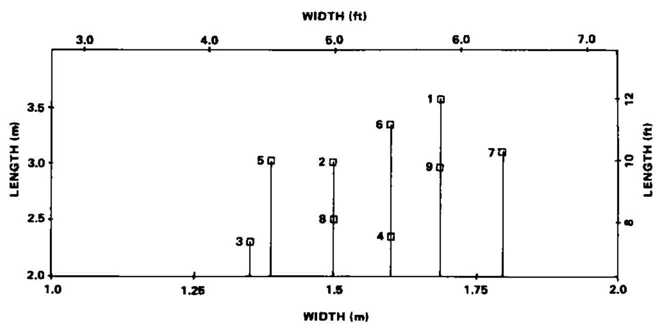


FIGURE 6: RANGE OF AVERAGE SPEED FOR PRT SYSTEMS

VEHICLE SIZE

The various PRT vehicles are shown in Figure 3 to range in maximum capacity from 3 to 6 passengers, all seated. Figure 7 gives the distribution of vehicle lengths and widths, which are found to cluster around mean values of 9.5 ft (2.9 m) long and 5.1 ft (1.6 m) wide. The PRT vehicle, then, is generally smaller than an automobile, with comparable passenger capacity. This is achieved by its box-like shape and the placement of all running gear under the floor or on a bogie inside the guideway.



1 AERIAL TRANSIT SYSTEM
2 AEROSPACE
3 ARAMIS
4 CABINENTAXI
5 CABTRACK
6 CVS
7 ELAN-SIG
8 FLYDA
9 MONOCAB

FIGURE 7: DISTRIBUTION OF PRT VEHICLE WIDTH AND LENGTH

CAPITAL COSTS

Reported capital costs for PRT systems for which data is available (excluding any land acquisition, construction of special structures for interface with other transit modes, etc.), escalated to 1976 U.S. dollars at an 8% yearly rate of inflation, yields the following average system costs:

System	Millions 1976 US $ per single-lane mi (single-lane km)
Aerial Transit System	4.6 (2.9)
Aerospace PRT System	4.5 (2.8)
Aramis	3.5 (2.2)
Cabinentaxi	3.9 (2.4)
Cabtrack	3.0 (1.9)
CVS	3.6 (2.2)
Flyda Systems	1.0 (0.6)
Monocab	4.3 (2.7)

The majority of the capital cost estimates appear to be consistent. Discounting the Flyda systems, the average total system capital costs are found to be US $3.9 million per single-lane mile (US $2.4 million/km) of guideway. The reader is cautioned that these estimates have not been verified through the actual experience of constructing a system in a city. They do not include many additional expenses, for example: land purchase for free-standing structures and at-grade guideway, aerial rights for above-grade guideway, utility relocation, modification and/or demolition of existing structures, special structures for interface with other modes of transportation (bus terminals, park-and-ride facilities, etc.). Also, if PRT should be considered for corridor service, those sections requiring as many as 6 lanes of guideway may approach costs of $25 million/mile ($15 million/km). This last figure appears to be more consistent with the costs proposed for the UMTA Downtown Peoplemover projects, reported in the Compendium issue on Group Rapid Transit (Vol. III, No. 3, 1976-77).

SYSTEM DATA REPORTS

The majority of the following reports are updates to the 1975 edition of Personal Rapid Transit. Two systems previously reported in the PRT issue, "TTI/OTIS PRT System" and "UMTA - High Performance Personal Rapid Transit", have been moved to the Vol. III No. 3 issue. The "Cabinentaxi/Cabinenlift" and "CVS" systems have undergone significant change to warrant republishing the entire 4 page data reports in this issue.

Those systems which were reported in the 1975 edition have been updated in such a way as to make the changes easily identifiable to the reader. This has been done by two methods. First, if there has been no activity, if system development has been abandoned, or if only one or two changes have occurred, the changes only are listed in the entry or "no change" is noted, as applicable. The page numbers for the system in the 1975 issue are given beside the system name. These systems are reported under the section "Systems Where Little Or No Change Has Occurred".

Second, if there have been numerous changes, as in the case of "Cabinentaxi/Cabinenlift" and "CVS", the entire system data sheet has been republished, with the changes in italics. Where a significant deletion has been made from the 1975 report, the symbol "[—]" appears.

The reader has the option of taking the pages from the 1975 issue and this supplement and combining them into a single current PRT issue.

REFINEMENT OF REPORTING STANDARDS

There has been some confusion with regard to line capacity and headways reported in past editions. Therefore, new standards have been developed for reporting and have been applied to all of the entries in this supplement.

Minimum Headway: The minimum value of headway which is allowed to exist between two vehicles (or trains) without violating specified safety and operational requirements.

Max Theoretical Single Direction Line Capacity: The maximum capacity, in passengers per hour, which can flow past a point of a single lane of guideway in one direction, computed from the minimum headway and the crush capacity of the largest traveling unit (i.e. longest consist)

Max Demonstrated (or Operational) Single Direction Line Capacity: The maximum capacity, in passengers per hour, which has been achieved (by a demonstration or operational system) on a single lane of guideway in one direction.

The graph of line capacity, headway and vehicle capacity presents capacity from a slightly different viewpoint. Here the minimum headway and vehicle (or train) maximum design capacity are used. This yields a line capacity which is less than the above defined max. theoretical single direction line capacity. The user therefore is provided with a range of capacity values which has greater meaning in the planning process.

The max. theoretical single direction line capacity cannot be achieved in practice for systems where merging and demerging occurs. If the line is allowed to reach the maximum then it would be saturated and merging vehicles would be denied. Previous studies of this problem show that practical maximum values are on the order of 67 to 85% of the theoretical value dependent upon the type of network. Also for PRT service one cannot expect the vehicles to be loaded to design capacity, for example, a loading of 1.3 psgrs/vehicle may be a more prudent choice.

In computing the ranges of vehicle utilization, vehicle density and demand density the following standard has been used so that the capabilities of the different systems can be compared.

Assumption: A transit station is assumed to have an impact (or service) area with a radius of 0.25 mi (0.4 km). The vehicle density is computed from

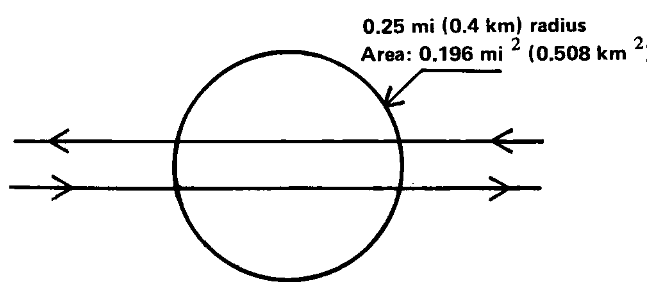
$$\rho_v = \frac{f_v L_A}{V_A}$$

, where f_v = frequency of vehicles computed from the minimum headway

L_A = density of transit line (length of line per unit of area) in the impact area

V_A = average speed of vehicles, taken from max or min station spacing to prescribe limits for the graph.

In computing the line density, L_A, a two-directional (2-lane) guideway with intermediate station are assumed. It is found that single-lane guideway in a grid with 0.5 mi legs will produce the same line density.



Within the impact area of the station there are 4 sections of line each 0.25 mi (0.4 km) in length. Therefore, the line density is computed to be 5.10 mi/mi^2 (3.15 km/km^2). The line density at a terminal station would be one half that value, however, only the intermediate station has been considered for the graphs presented.

SYSTEMS WHERE LITTLE OR NO CHANGE HAS OCCURRED

AERIAL TRANSIT SYSTEM (pp. 5-8)

CLASSIFICATION: Personal Rapid Transit

DATA REFERENCE CODE: [b 51]

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity .... 2700 psgrs/hr
Min Headway .... 8 sec

RELIABILITY & SAFETY:
Vehicle Lifetime .... Approx 15 years

PHYSICAL DESCRIPTION:

VEHICLE:
Step Height .... 5 in (127 mm)

PROPULSION & BRAKING:
Type Drive .... Chopper Motor Drive
Gear Ratio 1:3.85

GUIDEWAY: Delete reference code [e]
Single Lane Elevated Guideway:
Design Load ...... 540 lbs/ft (803 kg/m) [b, f]
Double Lane Elevated Guideway:
Design Load ..... 1080 lbs/ft (1603 kg/m) [b, f]
Type Elevated Guideway Support Columns . . Tubular steel

DEVELOPMENT HISTORY, PLANS & PROGRESS:
Delete last sentence "Prototype development"

DEVELOPMENT STATUS (Chart):
Detail Design is 100% complete
Prototype Test is 100% complete

AEROSPACE CORP. HIGH CAPACITY PRT (pp. 9-12)

CLASSIFICATION: Personal Rapid Transit

DATA REFERENCE CODE: [b 51]

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity .... 86,400 psgr/hr [f] *
Min Headway .... 0.25 sec

* Computed on basis of 6 psgrs/vehicle. At assumed loading of 1.3 psgrs/vehicle capacity reduces to 18,720 psgrs/hr.

VEHICLE PERFORMANCE:
Energy Consumption .... Delete "[f]"

STATIONS:
Boarding Capacity .... Delete "[f, b]"
Deboarding Capacity .... Delete "[f, b]"
Max Wait Time .... Delete "[e]"

COSTS:
Avg Cost per Vehicle . . $10,000 at 10,000 car production

INSTALLATION OR RETROFIT CAPABILITY:
Min Vertical Turn Radius .... Limit acceleration to $\leqslant 3.2$ ft/sec^2 (1 m/sec^2)

ARAMIS (pp. 13-16)

CLASSIFICATION: Personal Rapid Transit

DATA REFERENCE CODE: [b 51]

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity .... 9600 psgrs/hr [f]
Min Headway ..... 60 sec between platoons, 0.168 sec within platoons

STATIONS:
Vehicle in Station Dwell Time .... Delete "[e]"

CARGO CAPABILITY:
Goods Movement .... Delete "[e]"

GUIDEWAY: Delete "[a 41: except as noted]"
Single Lane Elevated Guideway:
Overall Cross Section Width .... Delete "[c]"
Double Lane Elevated Guideway:
Overall Cross Section Width .... Delete "[c]"

INSTALLATION OR RETROFIT CAPABILITY: Delete "[a]"
Construction Process ..... [—] Prefabricated guideway sections

LIMITATIONS: Delete "[e]"

ENVIRONMENTAL IMPACT: Delete "[e]"

CABTRACK (pp. 21-24)

CLASSIFICATION: Personal Rapid Transit

DATA REFERENCE CODE: [b 51]

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity .... 16,000 psgrs/hr
Min Headway .... 0.9 sec

PERSONNEL REQUIREMENTS: Delete "[e]"

DEVELOPMENT STATUS (Chart): [b]

COSTS: [b 21]

INSTALLATION OR RETROFIT CAPABILITY:
Construction Process . . . . [b]

ENVIRONMENTAL IMPACT: [b]

ELAN-SIG (pp. 29-32)

CLASSIFICATION: Personal Rapid Transit

DATA REFERENCE CODE: [b 51]

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity . . . . 20,570 psgrs/hr
Min Headway . . . . 0.7 sec

GUIDEWAY:
Double Lane Elevated Guideway . . . . Delete "[e]"
Type Elevated Guideway Support Columns . . Delete "[e]"

DEVELOPMENT STATUS: Delete "[e]"

ENVIRONMENTAL IMPACT:
Emissions . . . . Delete "[e]"
Visual . . . . Delete "[f]"

DEVELOPMENT HISTORY, PLANS & PROGRESS:
Change the first sentence to read as follows: "The Elan-SIG PRT project has been suspended pending increased demand for system production and at the present time, there are no plans to resume activities on it."

FLYDA (pp. 33-36, previously named "FLYDA CHAIR")

CLASSIFICATION: Personal Rapid Transit
(Direct shuttle between two stations)

DATA REFERENCE CODE: [b 51]

PATENTS: Add "Swiss Patent No. 577905"

DEVELOPMENT HISTORY, PLANS & PROGRESS: [–] Flyda Ltd. is seeking indisputably to establish its main parameters by means of cost/benefit and feasibility studies related to specific urban sites.

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity . . . . 12,000/36,000 psgrs/hr*
Min Headway . . . . 27/18 sec between trains
Traveling Unit . . . . C.10 - up to 30 veh/train
C.30 - up to 60 veh/train

INSTALLATION STUDIES & PROPOSALS: [–] A cost/benefit and feasibility study for a central area of Manchester, performed by Manchester consultants for the operating authority, computed a social benefit rate of return of 26.2% per annum. (Copies of this report are available from Flyda Ltd., with acknowledgements to the greater Manchester Passenger Transport Executive).

COSTS:
Operational and Maintenance Costs:
Total Avg . . . . . [–] Dependent upon the specific application

ENVIRONMENTAL IMPACT:
Emissions . . . . Delete "[e]"
Visual . . . . Delete "[f]"
Noise . . . . [–] Not yet determined

* C.10/C.30

MONOCAB (pp. 37-40)

CLASSIFICATION: Personal Rapid Transit

DATA REFERENCE CODE: [b 51]

SYSTEM PERFORMANCE:
Max Theoretical Single Direction Capacity . . . . 4320 psgrs/hr
Min Headway . . . . 5 sec

DEVELOPMENT HISTORY, PLANS & PROGRESS:
The Monocab System is being held in its current status of design without further development pending firm information on positive fund availability for PRT projects.

DEVELOPMENT STATUS (Chart): [b]

INSTALLATION & CONTRACTS: Delete "[c]"

COSTS: Add "Based upon 1975 prices. Normal escalation should be added in line with rising industry and construction cost indicies."

CABINENTAXI/CABINENLIFT

CLASSIFICATION: Personal Rapid Transit

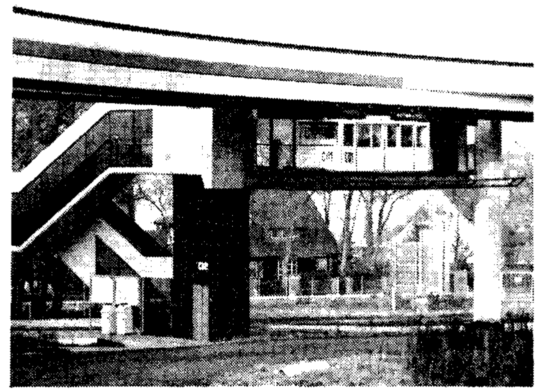
OTHER NAMES: *Cabin-Taxi, Cabinlift, C-Bahn*

DEVELOPER:

DEMAG Fordertechnik
Produktneuentwicklung
D 5802 Wetter/Ruhr
Postfash 67/87
West Germany
Tel: (02335) 827708
Telex: 0823231

USA Representative
Cabintrans Co.
18 Main St.
Concord, MA 01742

MBB, Messerschmitt-Bolkow-Blohm GmbH
Neue Verkehrssysteme
D-8000 Munchen 80
Postfach 801265
West Germany
Tel: (089) 60003419
Telex: 0522279



PROTOTYPE CABINENLIFT VEHICLE AT STATION

The development of both Cabinentaxi and Cabinenlift is a joint effort by DEMAG and MBB.

LICENSEES: None

PATENTS: Data unavailable

DATA REFERENCE CODE: [a 51: except as noted]

SYSTEM DESCRIPTION:

Cabinentaxi –

Cabinentaxi is a Personal Rapid Transit system characterized by track-guided, small, *3-12 passenger vehicles* driven by electric linear motors under totally automated control. The guideways are structured so that one type of vehicle traverses the top side of the guideway while another type runs suspended below. The main service characteristics are: vehicle always on-call, exclusive use of a vehicle for on-demand, *large cabins (12 psgrs) for use during peak hour collection/distribution,* non-stop from origin to destination station by as low as one person, off-line stations, seated passengers only, and area network coverage.

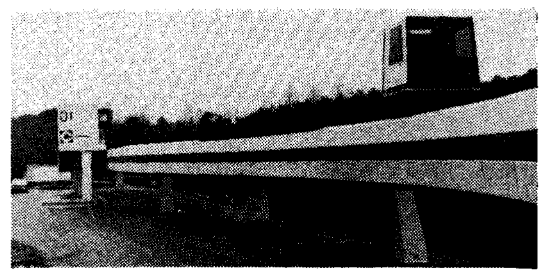
The main technology characteristics are: two tracks per guideway structure, lightweight vehicles, vehicles self guiding, autonomous *car follower control,* and linear motor propulsion unaffected by weather.

Because the system operates at *headways of 1.0-2.0 sec,* it may be further classified as advanced high-capacity PRT.

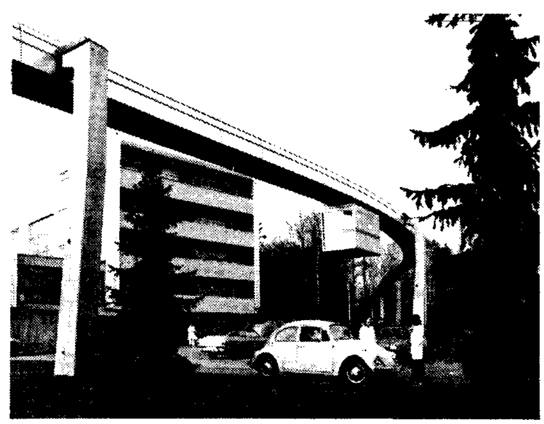
Cabinenlift –

The Cabinenlift system is an LGT system designed both for use as a "link-up lift" in a hospital complex *or urban shuttle loop GRT system.* The system is built up from its predecessor Cabinentaxi using many of the same functioning principles and use of tested Cabinentaxi components.

The Cabinenlift system forms a 1,970 ft (600 m) link between the two main buildings of the district hospital at Ziegenhain, Germany. A single, large-capacity vehicle runs on a suspension track and provides transport services for the clinic personnel, patients and *is also used as a service vehicle.*



STATION, GUIDEWAY & VEHICLES AT TEST FACILITY



CABINENLIFT INSTALLATION AT ZIEGENHAIN

OPERATIONAL CHARACTERISTICS

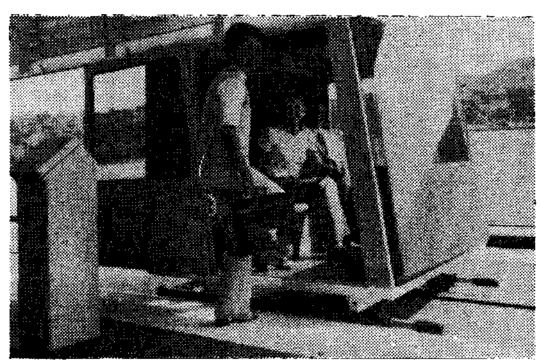
SYSTEM PERFORMANCE:

Max Theoretical Single Direction Capacity . . . . *CT[1] - 10,800 psgrs/hr (3 psgr veh) [f]; CT - 43,200 psgrs/hr (12 psgrs/veh) [f]; CT - 4680 psgrs/hr at 1.3 psgrs/veh [f]; CL[2] - Approx 150 psgrs/hr plus hospital beds and supplies as a single vehicle shuttle*

Min Headway . . . . *CT - 1.0 sec/CL - Approx 5 min for single lane shuttle*

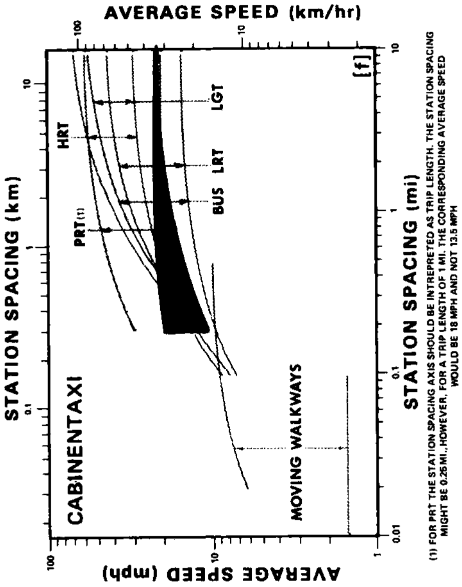
Available . . . . On-demand 24 hrs/day

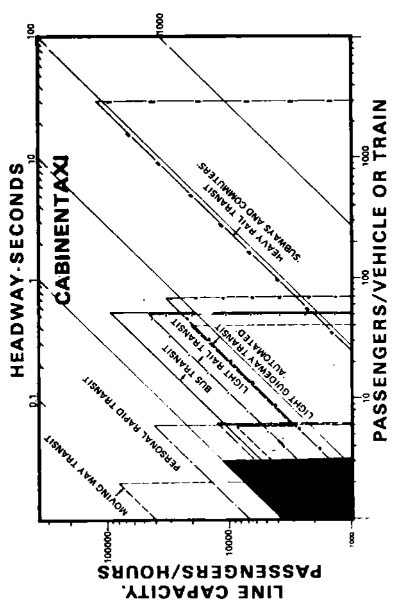
Type Service . . . . CT - limited area collection/distribution
CL - single direction shuttle service between 2 stations



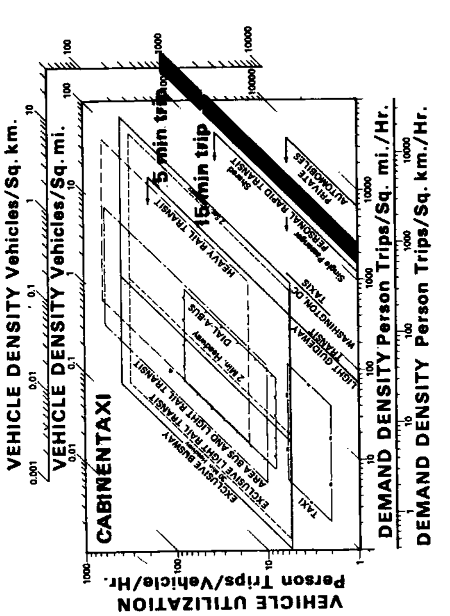
BOARDING VEHICLE

1 **Cabinentaxi**
2 **Cabinenlift**





UPDATED FOR 1976



UPDATED FOR 1976

Type Network . . . . .CT - Area wide urban network
CL - Single track, one-way line
Type of Vehicle Routing . . . . CT - variable
Traveling Unit . . . . .Single vehicle

VEHICLE PERFORMANCE:

Cruise Velocity . . . ., 22.4/12.4 mph (36/20 km/h)
Max Velocity . . . . 22.4/12.4 mph (36/20 km/h)
Max Grade . . . . CT - 15%
Service Acceleration .CT - 8 ft/s^2 (2.45 m/s^2)
Service Deceleration .CT - 8 ft/s^2 (2.45 m/s^2)
Max Jerk . . . . CT - 8.2 ft/s^3 (2.5 m/s^3)
Emergency Decel . . . . .CT - 16 ft/s^2 (4.9 m/s^2)
Stopping Precision in Station . . . . CT $<$3.94 in ($<$100 mm)
Degradation if Guideway is Wet . . . . .No degradation
Degradation for Ice & Snow . . . . .No degradation
Vehicle Design Capacity . . . . *CT 3 or 12 seated, 0 standing*
CL - 12 psgr vehicle with accommodations for hospital beds and equipment
Vehicle Crush Capacity . . . . CT - 3 seated, 0 standing
Energy Consumption . . . . *0.48 kwh/veh-mi (0.3 kwh/veh-km)*

STATIONS:

Type . . . . .CT - off-line, CL - located in clinic buildings
Type Boarding . . . . CT - level, through side doors of vehicle
CL - level, through doors at end of vehicle
Ticket or Fare Collection . . . . .CT - automatic ticket machines (magnetic card)
Security . . . . CT - optional closed circuit TV; CL - only hospital staff have key to activate vehicle
Boarding Capacity . . . . *CT - 4500 psgrs/hr/platform*
Deboarding Capacity . . . . *CT - 4500 psgrs/hr/platform*
Max Wait Time . . . . .CT - zero for unsaturated operation
CL - 6 min
Average Station Spacing . . . . CT - 0.19-0.5 mi (CT - 0.3-0.8 km)
CL - 0.4 mi (CL - 0.6 km)
Vehicle in Station Dwell Time . . . . CT - not applicable, CL - as required

INDIVIDUAL SERVICE:

Privacy . . . . *CT - exclusive use of vehicle or ride sharing, CL - exclusive use of vehicle or sharing*
Transfers . . . . Not necessary
Stops . . . . *Non-stop (3 psgr vehicle), stops (12 psgr vehicle)*
Accommodation . . . . CT - seated only, CL - seated and standing
Comfort . . . . .Vehicles heated and ventilated
Security . . . . .CT - closed circuit TV and crash pads
Instruction . . . . Indicator maps in stations

RELIABILITY & SAFETY:

Fail Safe Features . . . . CT - automatic redundant spacing control
CL - In case of power failure in vehicle's linear brake system, the wheels are braked automatically by the external speed controls.
Fail Operational Features . . . . CT - vehicles pushaway technique under development, emergency current supply available
Total System Mean Time Before Failure . . . . 25,000 hrs calculated as a result of individual component MTBFs. *Full scale tests during 1976/77 will determine actual MTBF.*
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure . . . . Data unavailable
Strategy For Removal of Failed Vehicle
Strategy For Passenger Evacuation of Failed Vehicle
System Restore Time After Failure . . . CT - short, due to modular construction
System Lifetime . . . . .CT - Guideway - 50 years
Vehicle Lifetime . . . . .CT - 10 years

MAINTENANCE:

CT — Automatic cleaning of vehicles (interior & exterior); computer-aided checkout at regular intervals; modular construction of electronics; and semi-automatic guideway maintenance by special vehicles

CARGO CAPABILITY:

CT — Luggage space for: baby carriages, parcels, hand luggage, skis
CL — Hospital beds, laundry, food and equipment

PERSONNEL REQUIREMENTS: Data unavailable

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	7.5/12.5 ft (2 300/3 800 mm)
Overall Width	*5.2/6.4 ft (1 600/1 960 mm)*[3]
Overall Height	4.9/7.2 ft (1 500/2 200 mm)
Empty Weight	*CT (3 psgrs/veh) - 1984 lbs (900 kg)*
Gross Weight	*CT (3 psgrs/veh) - 2646 lbs (1200 kg)*
Passenger Space (Design Load)	CT - approx 35 ft^3 (3 m^3)/psgr
Doorway Width	35.4/45 in (900/1 130 mm)
Doorway Height	55.1/78 in (1400/1990 mm)
Step Height	Level

SUSPENSION:

Type	Solid rubber tired wheels on bogies which ride inside guideway (but outside of girder)
Design Load	CT - 2,200 lbs (1 000 kg)
Lateral Guidance	Constrained by lateral solid rubber tired guidewheels

PROPULSION & BRAKING:

Type & No. Motors	2 double-comb horizontal linear induction motors
Motor Placement	On-vehicle
Motor Rating	111 lbs/lb (23 kg/kg) motor weight at 19 mph (30 km/h)
Type Drive	Linear motor drive
Type Power	CT - 500 vac
Power Collection	Power collectors on vehicle, power rails on guideway
Type Service Brakes	Dynamic thru motor plus drum brakes
Type Emergency Brakes	CT - same as service brakes; CL - automatic braking by external speed control device
Emergency Brake Reaction Time	CT - rise time less than 20 msec

SWITCHING:

Type & Emplacement	CT - on-board vehicle, mechanical branch-off mechanism; CL - not necessary
Switch Time (lock-to-lock)	CT - less than 1 sec
Speed Thru Switch	CT - mainline cruise velocity
Headway Thru Switch	CT - mainline headway 0.5 sec

GUIDEWAY:

Type	Box-beam, inverted and upright U-shaped
Materials	Steel and/or concrete
Running Surface Width	Not applicable
Single Lane Elevated Guideway:	
Max Elevated Span	131 ft (40 m)
Overall Cross Section Width	4.7-5.3 ft (1 420-1 600 mm)
Overall Cross Section Height	3.0-4.3 ft (910-1 300 mm)
Design Load	Data unavailable
Double Lane Elevated Guideway: (with standing & suspended veh)	
Max Elevated Span	131 ft (40 m)
Overall Cross Section Width	5.3 ft (1 600 mm)
Overall Cross Section Height	5.74 ft (1 750 mm)
Design Load	Data unavailable
Guideway Passenger Emergency Egress	Data unavailable
Type Elevated Guideway Support Columns	As required, concrete & steel construction

CONTROL:

Cabinentaxi — [a 51]

Headway feedback control is by attenuation of a high-frequency signal in a special cable. Inductive signal transmission in emitter and receiver. Hierarchical system control is based on three data levels: Headway control and destination coding of the autonomous vehicles; station control including braching-off and merging: network computer for empty-vehicle program and traffic optimization.

Cabinenlift — [c]

The controls operated by the passengers are very similar to the designs used for conventional overhead guideway systems. At the two stations there are graphic displays of vehicle locations. The vehicle is called on-demand. Upon boarding, the doors close and the vehicle moves off after the blocking mechanism has been released. The vehicle automatically accelerates to 12.4 mph (20 km/hr) and before the station is reached the vehicle automatically slows down to 2 mph (3 km/hr) until stopping at the station within the building.

STATIONS:

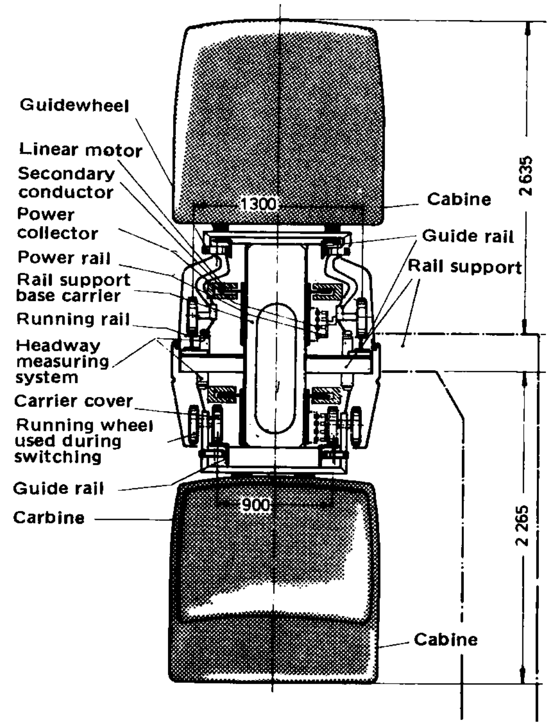
Cabinentaxi — [a]

Stations may be incorporated in buildings or specially built structures. Off-line station guideway length of 361 ft (110 m) is min required including acceleration and deceleration lengths. One boarding area requires a length of 8.2 ft (2.5 m).

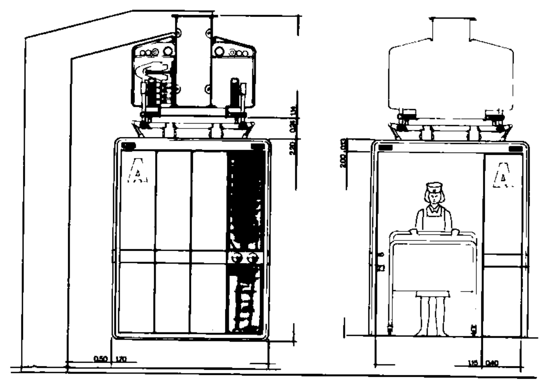
Cabinenlift — [c]

The stations are located on the second floor of each of the 2 buildings served. Direct access to the building is provided through the front of the vehicle. The connecting doors at the stations seal off completely the vehicle-station transition. vehicle-station transition.

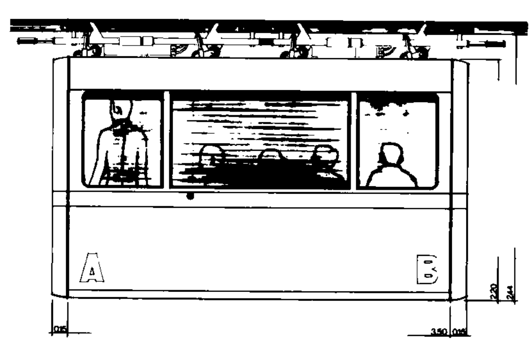
[3] Cabinentaxi/Cabinenlift



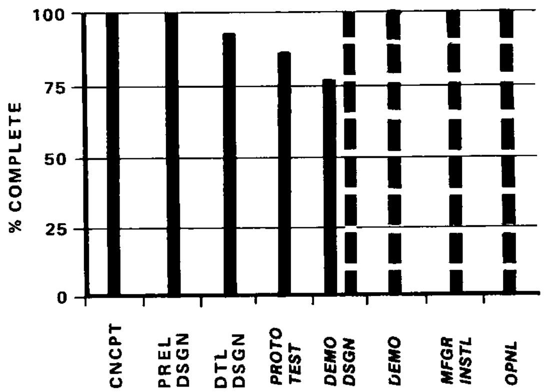
CABINENTAXI VEHICLE AND GUIDEWAY DESCRIPTION



CABINENLIFT VEHICLE DIMENSIONS



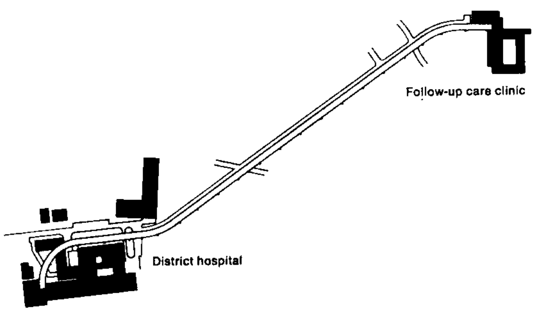
CABINENLIFT VEHICLE DIMENSIONS



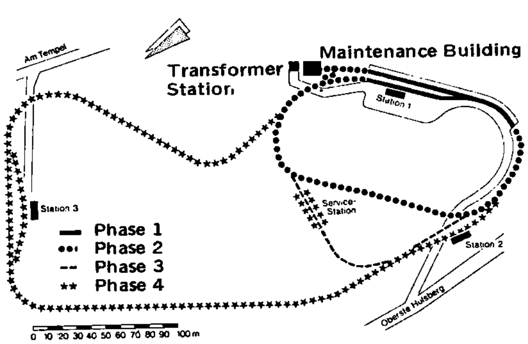
DEVELOPMENT STATUS

Cabinentaxi ▬▬▬
Cabinenlift ▬ ▬ ▬

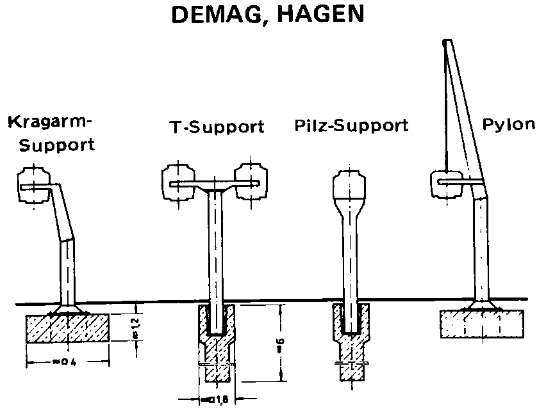
NOTE: **The Cabinenlift system is an application of Cabinentaxi and therefore the demonstration and manufacturer's installation stems from the pre-design and prototype testing of Cabinentaxi**



CABINENLIFT INSTALLATION AT ZIEGENHAIN



SYSTEM TEST FACILITY DEMAG, HAGEN



CABINENTAXI GUIDEWAY SUPPORT COLUMNS

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Cabinentaxi –

A test track of 1.24 mi (2 km) was scheduled to be constructed in 4 phases in Hagen, Germany, at the DEMAG facilities. The completion dates are: Phase 1 - Aug '73, Phase 2 - May '74, Phase 3 - Sept '74, *Phase 4 - 1976/77.*

Test objectives and schedules:

1972 - Critical components *(Complete)*
1973 - Drive system, guideway and switches *(Complete)*
1974 - Demonstration of automated operation including automated headway control and fare collection *(Complete)*
1975 - Demonstration of system reliability and of operation with passengers *(75% Complete)*

Cabinenlift –
The construction work for the Ziegenhain Cabinenlift began in April, 1975 and the system went into operation in 1976

INSTALLATION & CONTRACTS:

Cabinentaxi –
Initial design phases have begun for installations in Hamburg and Marl, West Germany, operation is planned for 1979/80.
Selection of a city in West Germany for the demonstration project is scheduled for 1976 provided that all test objectives have been fulfilled.

Cabinenlift –
Cabinenlift links two main clinics at the district hospital at Ziegenhain, Germany.

COSTS:

Cabinentaxi –

The estimated cost of the demonstration project is $3.9 million/mi $2.4 million/km with an average station spacing of 0.4 mi (0.7 km) including vehicle cost of approx $10,000/vehicle.

Cabinenlift –

The total system cost is estimated to be $864,000.
Operation & Maintenance . . . . Estimated to be the same as for bus systems in Hagen and Freiberg – 26 to 36 cents/passenger-mi (40-50 pf/passenger-km).[c]

INSTALLATIONS OR RETROFIT CAPABILITY: [a]

Single Lane Guideway Envelope Width . . . . 6.8 ft (2 060 mm)
Single Lane Guideway Envelope Height . . . . 10.7 ft (3 270 mm)
Single Lane Guideway Structural Weight . . . . 402 lbs/ft (600 kg/m) [c]
Double Lane Guideway Width* . . . . 9.55 ft (2 910 mm)
Double Lane Guideway Height . . . . 18.70 ft (5 700 mm)
Max Grade 15%
Min Vertical Turn Radius . . . . *328 and 656 ft (100 and 200 m)*
Min Horizontal Turn Radius . . . . 98.4 ft (30 m)
Construction Process . . . . Prefabricated sections
Staging Capability . . . . .Sections can be operated while others under construction

LIMITATIONS:

Cabinentaxi –
Short wheel-base on vehicles may cause uncomfortable ride at speeds of 50 or 60 mph (80 - 97 km/h) where higher speeds on long guideway lengths may be desirable [e]. Developer states that vehicle design modifications are anticipated for high speed application. [b]

ENVIRONMENTAL IMPACT: Cabinentaxi

Emissions . . . . .No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . .
H_1 – 5.2 ft (1 600 mm), H_2 – 10.8 ft (3 290 mm)
W_1 – 5.2 ft (1 600 mm), W_2 – 5.2 ft (1 600 mm)
P_1 – 7.4 ft (2 260 mm), P_2 – 11.3 ft (3 440 mm)
Noise . . . . *Less than 60 dbA* at 23 ft (7 m) from guideway, 53 dbA inside vehicle

*** Includes support columns, see drawing.**

CVS

CLASSIFICATION: Personal Rapid Transit

OTHER NAMES: None

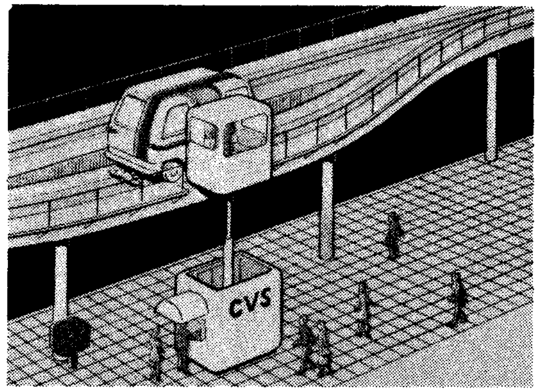
DEVELOPER: Japan Society for the Promotion of Machine Industry
3-5-8 Shiba Koen
Minato-ku
Tokyo, 105, Japan
Tel: (Tokyo) 434-8211

ASSOCIATED DEVELOPERS: Ministry of International Trade Industry
University of Tokyo
Toyo Kogyo Co. Ltd. (vehicle)
Mitsubishi Heavy Industries, Ltd. (vehicle)
Nippon Steel Co. (guideway)
Hitachi, Ltd. (control)
Toshiba Electric Co. (control)
Fujitsu Co. (control)
Sumitomo Electric Industries, Ltd. (communications)
Nippon Electric Co. (communications)

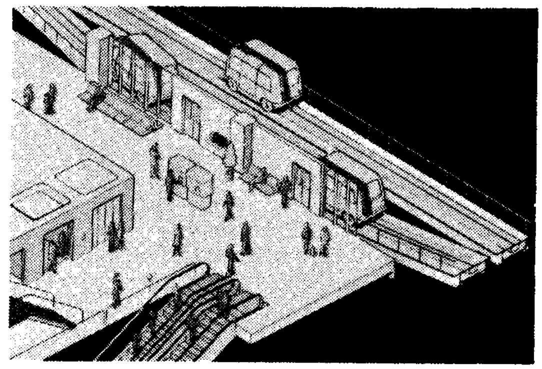
LICENSEES: None

PATENTS: *USA - 3822648, 3844224, 3916798; France - 72-29735, 72-30920; Sweden - 380308*

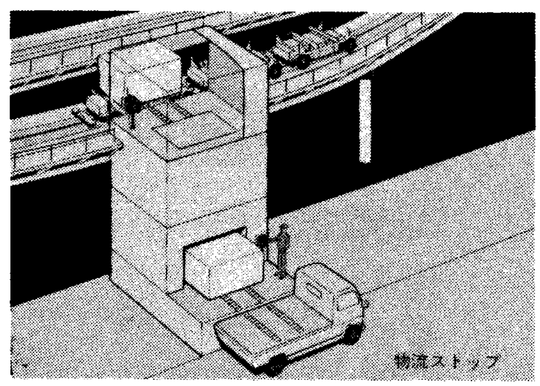
DATA REFERENCE CODE: [a 71: except as noted]



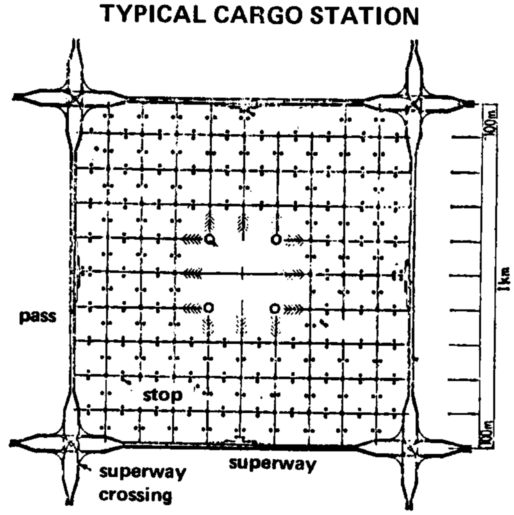
TYPICAL SIMPLE STOP



TYPICAL STOP ADJACENT TO A BUILDING



TYPICAL CARGO STATION



THEORETICAL NETWORK

SYSTEM DESCRIPTION:

CVS is a high performance, high capacity, totally automated Personal Rapid Transit system for carrying both passengers and freight for short distances within an urban area. Passenger service is non-stop, on-demand from off-line stations in four-passenger small, electrically propelled, rubber-tired vehicles which ride over exclusive guideways. Vehicles are designed for specific purposes (i.e., passengers, waste, goods, mail, etc.)

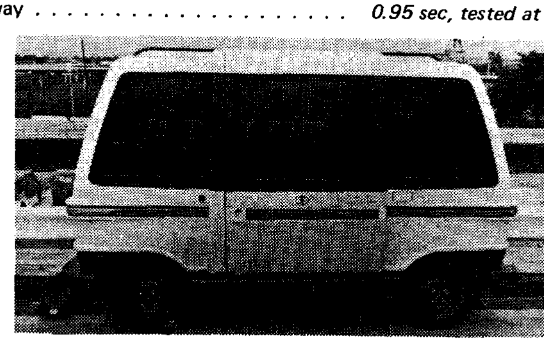
Proposed is a fairly tight grid network of guideways; some called superways and others medium-speed-ways or paths. Vehicles travel on the super-ways at 37 mph (60 km/hr) which are laid out as approximately 0.62 mi (1 km) square meshes of 2 or 3 single lanes in each direction with grade separated crossings, without right turning ramps. The path network consists of 328 ft (100 m) square meshes, contained within the super way meshes of two lane guideways (each direction) and level crossings. Stations, called stops, are located at one place for each path link on siding tracks, one each side of a 100 m x 100 m square mesh.

For the most part, guideways are proposed to be elevated over existing right-of-ways; however, underground, through buildings, and in uncovered trenches are also proposed.

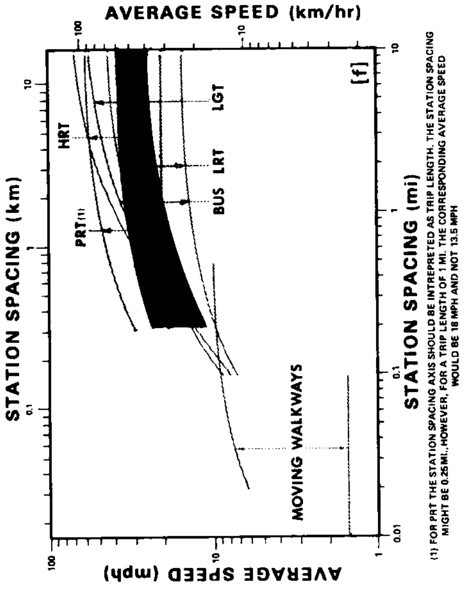
OPERATIONAL CHARACTERISTICS

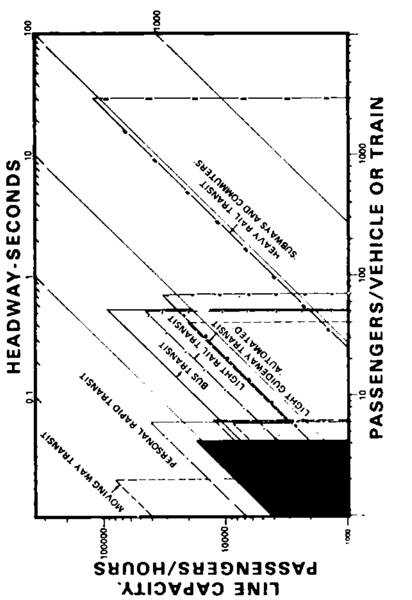
SYSTEM PERFORMANCE:

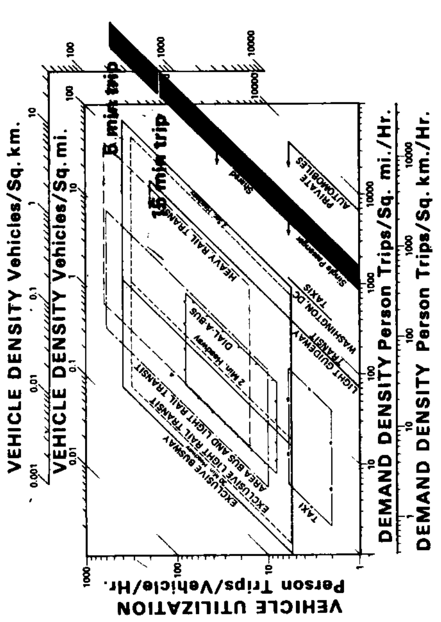
Max Theoretical Single Direction Capacity . . . . *15,160 psgrs/hr [f]*
Min Headway . . . . *0.95 sec, tested at full scale [e]*



PROTOTYPE VEHICLE







Availability . . . . On-demand
Type Service . . . . Area-wide collection and distribution
Type Network . . . . Grid
Type of Vehicle Routing . . . . Variable
Traveling Unit . . . . Single vehicle or max 10 vehicle trains

VEHICLE PERFORMANCE:

Cruise Velocity . . . . 25 - 37 mph (40 - 60 km/h)
Max Velocity . . . . 50 mph (80 km/h)
Max Grade . . . . Max 20%
Service Acceleration . . . . $6.6\ ft/s^2$ ($2\ m/s^2$)
Service Deceleration . . . . $6.6\ ft/s^2$ ($2\ m/s^2$)
Max Jerk . . . . $3.3\ ft/s^3$ ($1\ m/s^3$)
Emergency Decel . . . . $16.4 - 65.6\ ft/s^2$ ($5 - 20\ m/s^2$)
Stopping Precision in Station . . . . ±11.8 in (±300 mm)
Degradation if Guideway is Wet . . . . No degradation
Degradation for Ice & Snow . . . . Data unavailable
Vehicle Design Capacity . . . . 4 seated, 0 standing
Vehicle Crush Capacity . . . . 4 seated, 0 standing
Energy Consumption, Accelerating and Decelerating Only
- Empty Vehicle . . . . 0.5 kwh/veh-mi (0.3 kwh/veh-km)
- At Design Capacity . . . . 0.5 kwh/veh-mi (0.3 kwh/veh-km)

Energy Consumption, Cruise Only
- Empty Vehicle . . . . 0.2 kwh/veh-mi (0.1 kwh/veh-km)
- At Design Capacity . . . . 0.2 kwh/veh-mi (0.1 kwh/veh-km)

STATIONS:

Type . . . . Off-line
Type Boarding . . . . Level
Ticket or Fare Collection . . . . Ticket vending machines
Security . . . . Open stations on city streets
Boarding Capacity . . . . 1,200 psgrs/hr/berth
Deboarding Capacity . . . . 1,200 psgrs/hr/berth
Max Wait Time . . . . 60 sec
Vehicle in Station Dwell Time . . . . Approx 20 sec
Average Station Spacing . . . . 0.16 mi (0.25 km)

INDIVIDUAL SERVICE:

Privacy . . . . Exclusive use of vehicle
Transfers . . . . No transfers
Stops . . . . Non-stop service
Accommodation . . . . Seated only
Comfort . . . . Air conditioned vehicles
Security . . . . Emergency call button, telephones
Instruction . . . . . . Active graphics, chimes at 3 and 1 min before vehicle arrival

RELIABILITY & SAFETY:

Fail Safe Features . . . . Power supply breakdown - vehicle is powered to nearest stop using on-board battery, vehicle fails between stations - psgrs walk to the nearest station on sidewalks along guideway.
Fail Operational Features . . . . A segment of line between two stations can suffer an immobilizing failure and be shut down, however, other traffic can be detoured on other segments.

Total System Mean Time Before Failure	Data unavailable
System Restore Time After Failure	Data unavailable
Station Mean Time Before Failure	Data unavailable
Station Restore Time After Failure	Data unavailable
Vehicle Mean Time Before Failure	Data unavailable

Strategy For Removal of Failed Vehicle . . . . Pulled to maintenance area by rescue vehicle
Strategy For Passenger Evacuation of Failed Vehicle . . . . Passengers walk to nearest station on the sidewalk along guideway.
System Lifetime . . . . Data unavailable
Vehicle Lifetime . . . . 5 years

MAINTENANCE:

Inspection Frequency (One-way guideway assumed) . . . .
- Guideway . . . . Data unavailable
- Station . . . . Data unavailable
- Vehicle . . . . 0.05 hrs

Periodic Maintenance . . . .
- Guideway . . . . Data unavailable
- Station . . . . Data unavailable
- Vehicle . . . . 0.5 hrs every 10 days

Adjustments Required . . . . Data unavailable
Other Maintenance . . . . Data unavailable

CARGO CAPABILITY:

Passenger Articles . . . . Baby carriage or wheelchair can be placed between front seats and rear seats.
Goods Movement . . . . Max container pay load 1,100 lbs (500 kg)

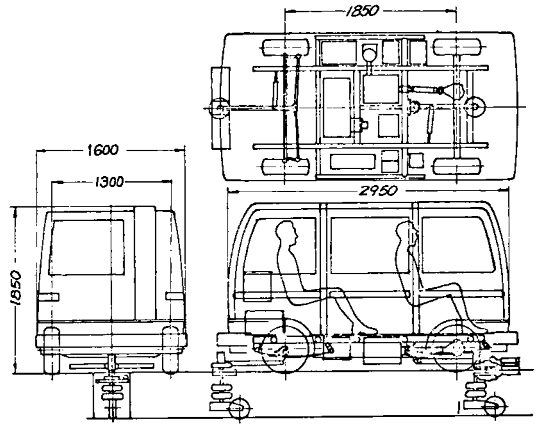
PERSONNEL REQUIREMENTS:

[Typical System of 4,000 vehicles, 800 stations and 280 mi (450 km) of one-way guideway]
No. of Operators/Vehicle 0
No. of Attendants/Station 0
No. of Adminstrative Personnel 16
No. of Central Control Attendants . . . . 20/24 hrs
No. of Maintenance Personnel 140
Engineering Staff 3

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	11.0 ft (3 350 mm)
Overall Width	5.3 ft (1 600 mm)
Overall Height	6.1 ft (1 850 mm)
Empty Weight	1,698 lbs (770 kg)
Gross Weight	2,205 lbs (1 000 kg)
Passenger Space (Design Load)	28.0 ft^2 (2.6 m^2) seated
Doorway Width	35.4 in (900 mm)
Doorway Height	52.8 in (1 340 mm)
Step Height	Level



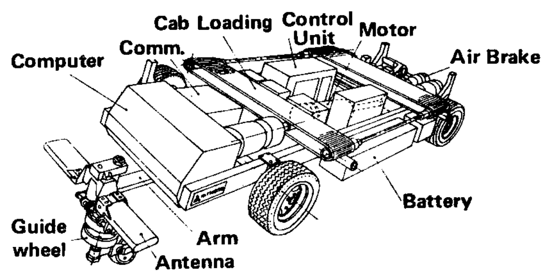
VEHICLE

SUSPENSION:

Type	Supported on 4 pneumatic rubber tires with leaf springs and shock absorbers
Design Load	1,102 lbs (500 kg)/front suspension 1,102 lbs (500 kg)/rear suspension
Lateral Guidance	Ackerman steering actuated by front steering arm which rides in a center groove in the guideway

PROPULSION & BRAKING:

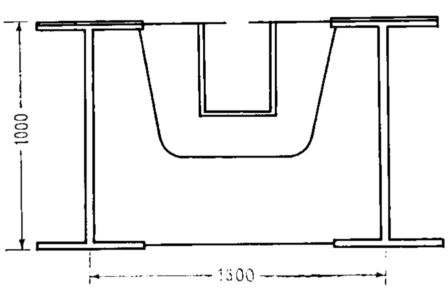
Type & No. Motors	Rotary dc electric traction motor
Motor Placement	One per vehicle, under floor
Motor Rating	16 kw
Type Drive	Rear wheel drive
Gear Ratio	*1:7.167*
Type Power	220 vac 1 ϕ- rectified and charges vehicle battery
Power Collection	Power rail and collector shoes
Type Service Brakes	High speed - electrodynamic; low speed - mechanical
Type Emergency Brakes	Hydraulic - positive gripping of guideway rail
Emergency Brake Reaction Time	*0.09 sec*



TYPICAL VEHICLE CHASSIS

SWITCHING:

Type & Emplacement	Mechanical positive entrappment rollers engages switch rail
Switch Time (lock-to-lock)	Mechanism operates advance of switch
Speed Thru Switch	Line speed
Headway Thru Switch	1.0 sec min



GUIDEWAY CROSS SECTION

GUIDEWAY:

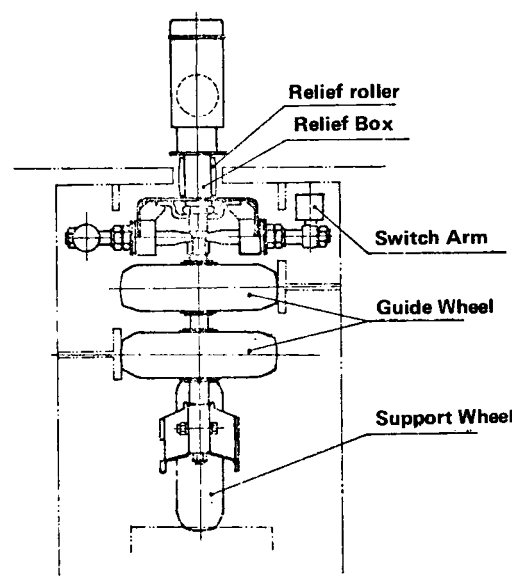
Type	At, above, or below grade, flat concrete surface or coated with plastic
Materials	Prestressed concrete and steel
Running Surface Width	5.9 ft (1 800 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	98.4 ft (30 m)
Overall Cross Section Width	5.9 + 2.0 (sidewalk) ft (1 800 + 600 mm)
Overall Cross Section Height	2.6 ft (800 mm)
Design Load	*235 lbs/ft (350 kg/m)*
Double Lane Elevated Guideway:	
Max Elevated Span	98.4 ft (30 m)
Overall Cross Section Width	11.8 + 2.0 (sidewalk) ft (3 600 + 600 mm)
Overall Cross Section Height	2.6 ft (800 mm)
Design Load	*470 lbs/ft (700 kg/m)*
Guideway Passenger Emergency Egress	Via guideway sidewalks
Type Elevated Guideway Support Columns	Steel pipe 1.6 ft (500 mm) diameter

CONTROL:

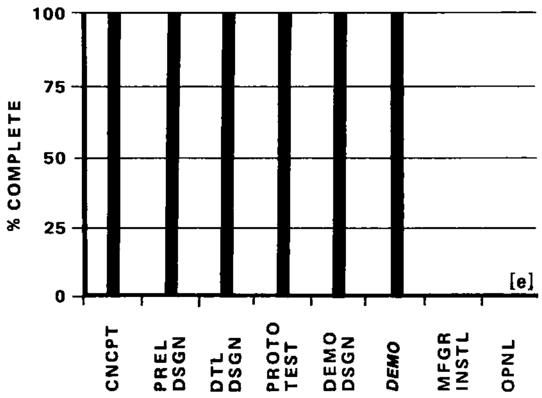
Control is by synchronous automatic hierarchial system. Headway control is via a point-follower. Points are established in a central computer in accordance with predetermined time-distance patterns. Each moving point is coded. For merging, both main line and merging line points have the same code. The Vehicle Computer controls speed and braking via wayside command. The modes for the Vehicle Computer control are powering, coasting, electrical braking, and mechanical braking. Other computers in the hierarchy are intersection computers and station computers.

STATIONS:

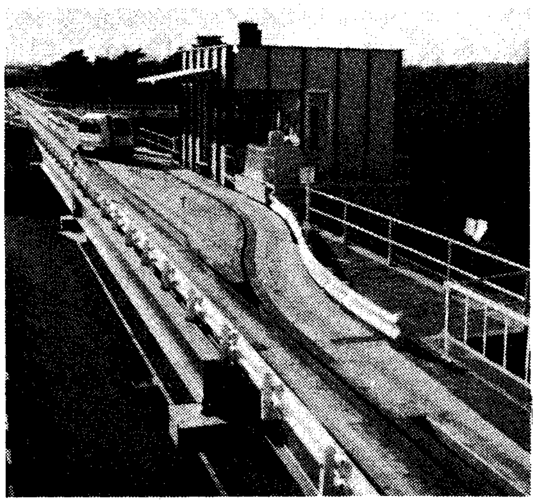
Stations are located at street level as an elevator cab. A passenger buys a ticket from an automated machine, boards the elevator from which he transfers to a waiting vehicle. Larger elevated station buildings are also proposed, as well as integration of stations within buildings.



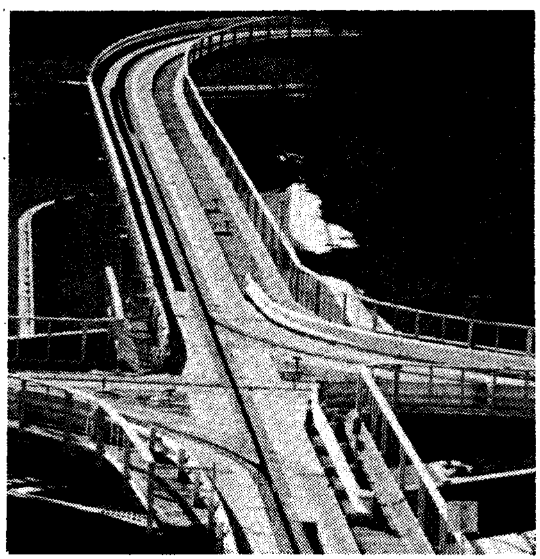
STEERING ARM & GUIDE WHEELS



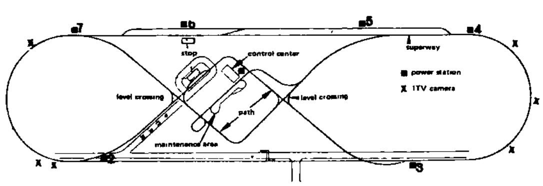
DEVELOPMENT STATUS



PROTOTYPE STATION AT TEST TRACK



LEVEL CROSSING AT TEST TRACK



LAYOUT OF TEST TRACK

DEVELOPMENT HISTORY, PLANS & PROGRESS:

CVS is being developed by the Japan Society for the Promotion of Machine Industry under the sponsorship of the Ministry of International Trade and Industry. Technical supervision is by the University of Tokyo. Eight other companies are participating with each company supplying 27% of the development funding for their responsibility. Primary tests of the vehicle on a track (230 m) were performed October, 1973. A full scale test track with collective computer operation began in August, 1974. At present, full scale test is continuing and the Phase I test will be completed in March, 1976. *Full scale test of Phase I was completed in June, 1976. Planning of Phase II of development is underway.*

INSTALLATIONS & CONTRACTS:

Higashi - Murayama City (demonstration) 5 km single lane guideway, 2 stations (each has passenger berth and cargo berth) *and* 100 vehicles.

At the International Ocean Exposition in Okinawa (July 1975 - January 1976), CVS was adopted as the passenger transportation system of the site. The system at the Expo consists of 1 mi (1.6 km) single lane guideway, 5 stations and 16 vehicles (including 4 dual-mode vehicles); the system carried 800,000 passengers and traveled 124,000 mi (200,000 km).

COSTS:

[Based upon typical system of 280 mi (450 km) single lane guideway, 800 stations, 4,000 vehicles, 609,000 veh-mi/day, 27,200 veh-hr/day, 24 hrs operation per day]

Capital Cost . . . . Total single lane avg of $3.32 mill/mi ($2.06 mill/km) [f]

- Avg Cost per Vehicle $17,000
- Avg Cost per Single Lane Guideway . . . . $1.61 mil/mi ($1.0 mill/km)
- Avg Cost per Station $700,000
- Computers, Software, & Control Center . . . . $77 million
- Maintenance & Storage Facilities / Power Distribution & Substations } . . . . $50 million

Operation & Maintenance Costs . . . .

Fixed Cost $210,000/weekday + Variable Cost $15,000/weekday
Total Avg $8.30/veh-hr or $0.12/veh-mi ($0.2 veh-km)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . Data unavailable
Single Lane Guideway Envelope Height . . . . Data unavailable
Single Lane Guideway Structural Weight . . . . 672 lbs/ft (1 000 kg/m)
Double Lane Guideway Structural Weight . . . . 1,344 lbs/ft (2 000 kg/m)
Max Grade 10%
Min Vertical Turn Radius . . . . 328 ft (100 m) at 12.4 mph (20 km/h)
Min Horizontal Turn Radius . . . . 16.4 ft (5 m) at 6.2 mph (10 km/h)
Construction Process . . . . Prefabricated and modular construction
Staging Capability . . . . Sections can be built and put into operation while others are under construction

LIMITATIONS: [e]

Traction drive may require degraded performance for inclimate weather operation (including snow and ice removal.)

ENVIRONMENTAL IMPACT:

Emissions . . . . No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . .

H_1 – 2.62 ft (800 mm), H_2 – 8.69 ft (2 650 mm)
W_1 – 5.91 ft (1 800 mm), W_2 – 5.25 ft (1 600 mm)
P_1 – 60.4 ft (1 840 mm), P_2 – 10.1 ft (3 080 mm)

Noise . . . . NCA 60 inside vehicle
NCA 50 at 32.8 ft (10 m) to side

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