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Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

X

2503

REFERENCE GUIDE
MOVING WAY TRANSIT
LIGHT GUIDEWAY TRANSIT

PERSONAL RAPID TRANSIT

LIGHT RAIL TRANSIT
HEAVY RAIL TRANSIT
BUS TRANSIT
PARA-TRANSIT
ROADWAY TRANSIT EQUIPMENT

Vol. II No. 4, 1975

4 NC CH 5

PREFACE

This issue is devoted to Personal Rapid Transit Systems which have been defined in the Reference Guide:

> "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 systems covered are essentially the same as in the 1974 issue of PRT, except that the data sheets have been expanded and much more detail added. In addition the UMTA High Performance Personal Rapid Transit System is reported.

A primary objective of the LEA TRANSIT COMPENDIUM is to remain impartial and unbiased in its choices of systems reported as well as the specific information and data. Therefore, the systems reported in this issue are not specifically endorsed or preferred by N. D. Lea Transportation Research Corporation over any systems which are not included. Further, no attempt has been made to rank or compare the systems reported. Any comparison would have to be made with respect to the conditions under which the systems would operate.

The reader is cautioned that the data and characteristics of the systems reported are subject to change. Therefore, data and information from the included data sheets should not be the sole source of information in assessing or comparing the relative merits of individual systems. Also they should not be used as the basis of the design of site specific installations — such information and data, for that purpose, should be obtained directly from the developer, manufacturer, or supplier.

Comments and suggestions are solicited from readers and developers regarding improvements in data sheet format, data considered unnecessary or to be added, and more definitive data presentation techniques.

THE LEA TRANSIT COMPENDIUM is an annually updated data reference manual on current international developments in transit technology. The Compendium is published in periodical form issued nine times per year. Each issue is devoted to a particular transit system class such that within one year all classes of transit are covered, completing the set. Individual issues are scheduled for release starting with No. 1 at the end of April, with the remaining eight issues released at the end of each subsequent month. Dependent upon receipt of data from developers, manufacturers, suppliers, and transit agencies, some issues may be released on dates later than scheduled such that a more complete and comprehensive issue can be published.

PUBLISHER

The LEA TRANSIT COMPENDIUM is prepared and published by the N. D. Lea Transportation Research Corporation, 110 Lily Flagg Road, Huntsville, Alabama 35802, U.S.A.; Telephone: (205) 881-4910; Cable: LEACONSLT, Huntsville; and 345 Lakeshore Road, East, Oakville, Ontario, L6J 1J5, Canada; Telephone: (416) 844-5533; Cable: LEACONSLT, Toronto.

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Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

PERSONAL RAPID TRANSIT

CONTENTS

Vol. II No. 4

INTRODUCTION

Personal Rapid Transit (PRT) is a new technology offering a totally new concept of transit service. One might consider that PRT borrows from the automobile its desirable features (personal, on-call, direct from origin to destination, does not stop for other passengers, alternate routes) while it excludes undesirable features (does not pollute, parking is not required, the guideway requires little or no at-grade right-of-way and does not divide communities, travel is not interrupted by other traffic, vehicles can enter directly into shopping centers and office buildings, etc., automated system precludes congestion).

Some automated small vehicle/guideway systems have been termed as PRT which do not offer exclusive personal service. To distinguish between PRT and such systems, the classification Light Guideway Transit (LGT) was selected. Issue No. 3 of the Compendium, "Light Guideway Transit", reports those systems. Other terms for PRT found in the literature have been Taxi-Transit, Autotaxi, Automatic Rail-Taxi-System, Capsule Transit, Spartaxi, and Programmed Modules.

A wide range of operational characteristics and physical configurations are presently offered by developers. Single one-way line practical capacity ranges from 2,160 psgrs/hr to 18,000 psgrs/hr. Most systems operate as single units; however, the "Aramis" System operates very closely spaced vehicles in platoons. Cruise velocities range from as low as 10 mph (16 km/hr) to 60 mph (97 km/hr). Guideways can be at-grade, elevated, in open cuts, or underground. Both single one-way or double two-way guideway configurations are available. Vehicles are proposed to be suspended below the guideway, riding over the top, and possibly along the side. The Cabinentaxi System operates on guideways structured so that one type of vehicle traverses the top side of the guideway while another type runs suspended below. Suspension systems offered are steel wheels on steel rails, rubber tires, air cushions, and magnetic levitation. Both rotary and linear electric motor propulsion systems are offered.

Considerable debate has occurred regarding safety at short headways. Some have maintained that "brick wall" stopping distances must be required, therefore limiting the minimum headway to 2 or 3 seconds. Others have argued that the brick wall criteria is not applicable pointing out that automobiles under manual control on freeways operate at separation distances less than the brick wall stopping distance. It is not the purpose of the Compendium to resolve the issue of headway by arguing either side. The final proof must come from the achievements of developers.

Because of the question of headway, three subclassifications of PRT have appeared in the literature. State-of-the-art PRT operates headways of 6 seconds and above, advanced or high performance PRT at 2 or 3 second headways, and high-capacity PRT with fractional second headways. CVS, developed by Japan Society for the Promotion of Machine Industry, is being demonstrated successfully at 2 second practical headway. Fractional second headways are presently under development with full-scale testing underway in Japan, France, and West Germany.

The table opposite presents a statistical summary of the characteristics of the PRT developments reported in this issue. Currently the mean development status for 11 different PRT developments is calculated to be approximately 41% complete. For the most part service is proposed as non-stop and on-demand between off-line stations. Seven of the systems have a mean headway of 0.5 sec contrasted to 4 systems with a mean headway of 25 sec. The average maximum theoretical headway of 13,756 psgrs/hr/direction suggests that PRT may never be considered as a high capacity transit concept and therefore may not be a desirable application in high density corridors.

One limitation of PRT is station capacity. Boarding capacities range from 480 psgrs/hr/berth – 3,000 psgrs/hr/berth, with a mean capacity of 1,250 psgrs/hr/berth. No station design has been proposed which could give satisfactory service for clearing a large sports arena or other large facility where heavy surge loads can be expected. However, if one considers the time required to empty parking lots of automobiles, PRT can be more efficient.

Because conventional transit systems utilize large vehicles and group passengers, effective and efficient service cannot be rendered in low density population areas. Many cities today are wide spread and are completely dependent upon the automobile for urban transportation. PRT with its on-demand personal service could effectively provide transit for such cities. While most of the installation studies, proposals, and market studies have been made for larger cities, where in many cases institutional problems are greater, it is expected that smaller cities might be better environments in which initial demonstrations should be built. The average total system cost (single one-way guideways, stations, vehicles) is approximately $2.9 million/mile. However, two modes are observed; the higher one being $3.86 million/mile. Because the higher mode results from developments which have a great development base, it is suggested that it be used for capital cost estimation in the planning process. The 14.4 mile TTI/Otis System to be installed in Nancy, France,

STATISTICAL SUMMARY OF INTERNATIONAL DEVELOPMENTS IN PERSONAL RAPID TRANSIT

	DEVELOPMENT STATUS (% Complete)	MAX THEORETICAL LINE CAPACITY (Psgrs/Hr/Direction)	HEADWAY (sec)	MAX VELOCITY (km/hr)	SERVICE ACCELERATION (m/sec^2)	SERVICE DECELERATION (m/sec^2)	VEHICLE CAPACITY (Psgrs/Veh)	TOTAL SYSTEM COST (Mill US $/km/Direction)
Sample Size	11 systems	7 systems[1]	7 systems[1]	11 systems	11 systems	11 systems	11 systems	8 systems
Mode	22, 75	16,000; 19,000; 22,000	0.9, 0.9	54.0, 72.0	0.8, 1.2, 2.5	0.8, 1.2, 2.5	4.0, 12.0	0.6, 2.4
Mean	40.6	13,756	0.49	57.8	1.51	1.51	5.8	1.78
Std. Deviation	22.1	7,806	0.39	39.6	0.87	0.87	6.1	1.44
Sample Size		4 systems[2]	4 systems[2]					
Mode		2,700; 4,300	5.0, 45.0					
Mean		11,574	25.2					
Std. Deviation		7,754	38.8					

AVAILABILITY . . . . . Schedule Mode – 2 systems
Demand Mode – 9 systems (One system operates in either mode)

TYPE STOPS . . . . Multi-stop – 1 system
Non-stop – 10 systems

TYPE STATIONS . . . . . On-line – 1 system (same system offering multi-stop)
Off-line – 10 systems (one system operates both station types)

[1] Systems where headway < 1.0 sec
[2] Systems where headway ≥ 1.0 sec

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[1] Systems where headway $<$ 1.0 sec
[2] Systems where headway $\geq$ 1.0 sec

is expected to cost approximately $5.5 million/mile. Some have proposed that PRT will not require subsidy operation and if urban goods movements is included, it may even operate at a profit.

The state-of-the-art is progressing, but some projects have slowed until further funding is available. The results of the High Performance PRT system now being developed by the Urban Mass Transportation Administration may seriously effect the future of PRT in the U.S.

Because of the relatively high initial capital expenditure required for research and development as well as installation, it appears that a single private developer cannot prudently invest what is required to develop fractional second headway PRT. Therefore, successful development may depend upon the commitment of substantial government funds for research and development. Such commitments appear to have been made in Japan, France, and West Germany.

AERIAL TRANSIT SYSTEM

CLASSIFICATION: Personal Rapid Transit*

OTHER NAMES: "Palomino" for Las Vegas Proposal

DEVELOPER: Pullman Incorporated
200 South Michigan Avenue
Chicago, Illinois 60604
Tel: (312) 939-4262

LICENSEES: None

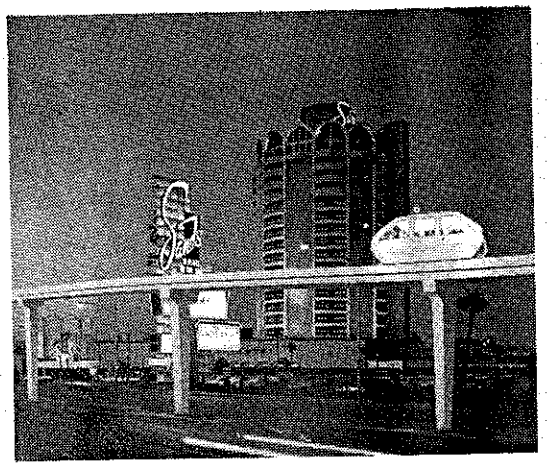
PATENTS: Design and developments in confidence, held consistent with Pullman, Inc., policy

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

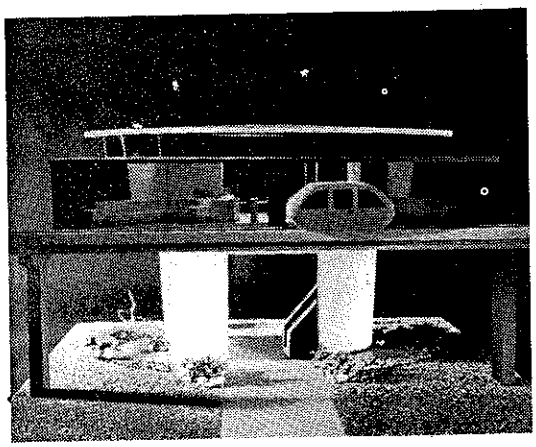
SYSTEM DESCRIPTION:

The Aerial Transit system is a low capacity totally automated PRT system for transporting seated passengers only in small vehicles over exclusive guideways. Service is on-demand and passengers may command an exclusive vehicle (no mixed parties) for a non-stop trip between origin and destination stations.

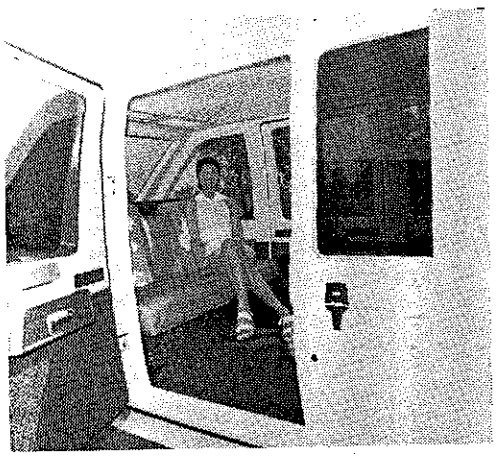
Vehicles are supported on conventional flanged urethane coated steel wheels riding on steel rails. Vehicle capacity is 6 passengers. The data herein is given for the system as proposed for the Las Vegas installation which would have been a totally elevated guideway with appropriate interface at hotel stations and the municipal bus system.



PHOTOMONTAGE OF
LAS VEGAS INSTALLATION



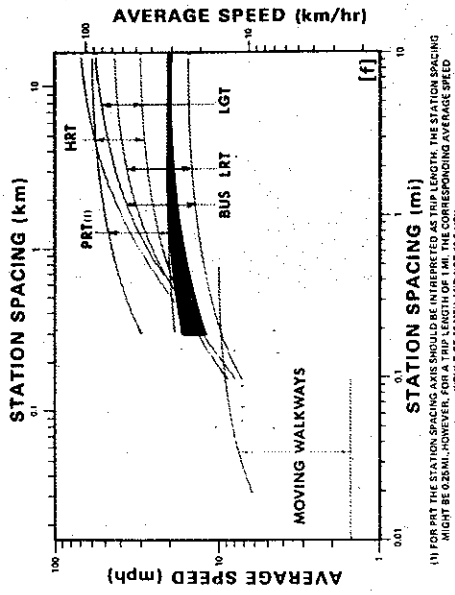
STATION MODEL

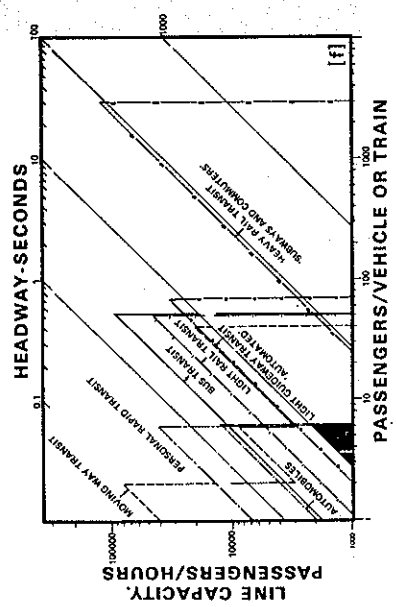


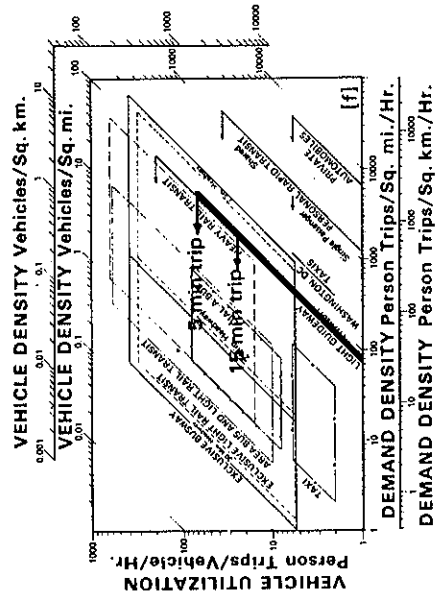
VEHICLE INTERIOR

**PUBLISHER'S NOTE:*

The editor understands that no current activity is underway in development of the Aerial Transit System. However, other development activity is underway of an automated guidance system, whereby conventional flanged steel wheels and their axles are steered using lateral guidance wheels.







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	2,700 psgrs/hr
Max Practical One-Way Capacity	2,160 psgrs/hr
Min Theoretical Headway	8 sec
Min Practical Headway	10 sec
Availability	On-demand 24 hrs/day
Type Service	Limited area collection and distribution
Type Network	Linear, loops, or area grid network
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles

VEHICLE PERFORMANCE:

Cruise Velocity	20 mph (32 km/h)
Max Velocity	35 mph (56 km/h)
Max Grade	5%
Service Acceleration	4.4 ft/s^2 (1.34 m/s^2)
Service Deceleration	4.4 ft/s^2 (1.34 m/s^2)
Max Jerk	6.4 ft/s^3 (1.96 m/s^3)
Emergency Decel	7.3 ft/s^2 (2.24 m/s^2)
Stopping Precision in Station	±6 in (± 152 mm)
Degradation if Guideway is Wet	No degradation
Degradation for Ice & Snow	No degradation
Vehicle Design Capacity	6 seated, 0 standing
Vehicle Crush Capacity	6 seated, 0 standing
Energy Consumption	2 kwh/veh-mi (1.24 kwh/veh-km)

STATIONS:

Type	Off-line, 3-berth, platoon loading
Type Boarding	Not level, one small step up
Ticket or Fare Collection	Automatic token turnstile
Security	Closed circuit TV
Boarding Capacity	840 psgrs/berth/hr
Deboarding Capacity	840 psgrs/berth/hr
Max Wait Time	5 min
Vehicle in Station Dwell Time	10 - 15 sec
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Exclusive use of vehicle
Transfers	Not necessary
Stops	Non-stop
Accommodation	Seated only
Comfort	Parameters equal to luxury automobile
Security	Closed circuit TV in station, intercom in vehicle
Instruction	Auditory messages and graphics

RELIABILITY & SAFETY:

Fail Safe Features	Three levels of control redundancy
Fail Operational Features	Failure detection and diagnostics
Total System Mean Time Before Failure	Design goal — 1 failure or less per 3 days
System Restore Time After Failure	Variable
Station Mean Time Before Failure	Design goal — 1 failure or less per 3 days
Station Restore Time After Failure	Information unavailable
Vehicle Mean Time Before Failure	Approx 1,400 hrs
Strategy For Removal of Failed Vehicle	Information unavailable
Strategy For Passenger Evacuation of Failed Vehicle	Information unavailable
System Lifetime	Design goal - 40 years
Vehicle Lifetime	Information unavailable

MAINTENANCE:

Vehicle and system are modularized. The design goal is to reduce failure rates and mean times, to replace components without imposing requirement similar to those used for military systems.

CARGO CAPABILITY:

Passenger Articles	Small packages and luggage
Goods Movement	Freight application to be determined later

PERSONNEL REQUIREMENTS:

Vehicles and stations are unmaned.. Operators are required at central control facility and personnel for maintenance and administration.

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 12 ft (3.65 m)
Overall Width . . . . . 5.5 ft (1.68 m)
Overall Height . . . . . 5.17 ft (1.58 m)
Empty Weight . . . . . 4,800 lbs (2 180 kg)
Gross Weight . . . . . 5,700 lbs (2 590 kg)
Passenger Space (Design Load) . . . . . .Seat width - 18 in (457 mm), knee space - 15 in (381 mm)
Doorway Width . . . . . 36 in (914 mm)
Doorway Height . . . . . 60 in (1 520 mm)
Step Height . . . . . .Data unavailable

SUSPENSION:

Type . . . . . .Vehicle supported on 4 urethane coated flanged steel wheels on steel rails; variable rate coil springs
Design Load . . . . . 900 lbs (419 kg) live load; 400 lbs (182 kg) dead load
Lateral Guidance . . . . . Conventional railroad lateral guidance

PROPULSION & BRAKING:

Type & No. Motors . . . . . Rotary traction drive dc motor
Motor Placement . . . . . .On-board vehicle
Motor Rating . . . . . 50 HP
Type Drive . . . . . .Data unavailable
Gear Ratio . . . . . .Data unavailable
Type Power . . . . . 480 vac 1ϕ 60 hz, on-board dc conversion by SCR
Power Collection . . . . . .Sliding contactors on vehicle
Type Service Brakes . . . . . Dynamic regenerative electric
Type Emergency Brakes . . . . . .Friction disks
Emergency Brake Reaction Time . . . . . 0.2 sec

SWITCHING: [b 51]

Type & Emplacement . . . . . Design is confidential. Switch is on-board vehicle whereby lateral guidewheels steer the axles through a passive guideway branch off.
Switch Time (lock-to-lock) . . . . . 3 sec
Speed Thru Switch . . . . . 20 - 30 mph (32 - 48 km/h) max
Headway Thru Switch . . . . . 8 sec min

GUIDEWAY: [b 51: except as noted]

Type . . . . . Duo-rail, shallow 4-shaped enclosure
Materials . . . . . .Structural steel - A36 grade
Running Surface Width . . . . . 60 lbs/yd (29.8 kg/m) ASCE rail
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . .Approx 50 - 60 ft (15.2 - 18.3 m) [e]
- Overall Cross Section Width . . . . . 5.33 ft (1 620 mm)
- Overall Cross Section Height . . . . . 2.33 ft (710 mm)
- Design Load . . . . . .Data unavailable

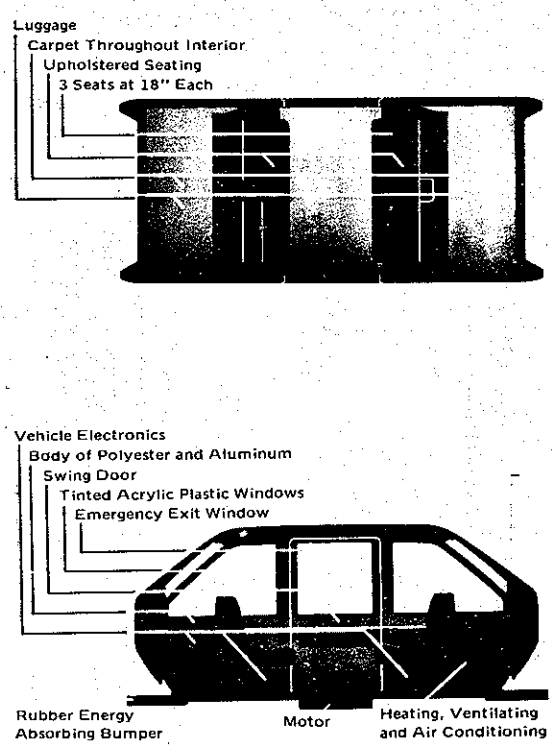
Double Lane Elevated Guideway: . . . . . .Data unavailable
Guideway Passenger Emergency Egress . . . . . .Information unavailable
Type Elevated Guideway Support Columns . . . . . .Information unavailable

CONTROL:

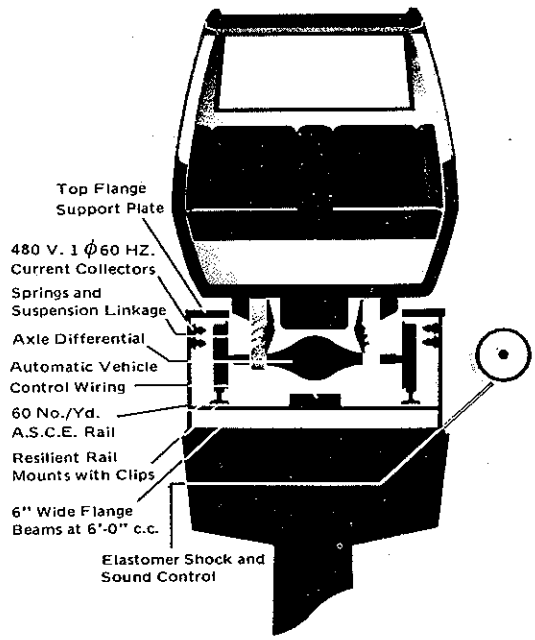
A central control computer provides overall traffic management and control, dispatches and routes vehicles, diagnoses failures, generates emergency commands, etc. It is linked to station units via a full duplex, hard-wired cable system and an asynchronous 1,800-baud data modem in the stations. Communication from station units to individual vehicles is via inductive loops. The system control is fully synchronous utilizing the moving block headway control concept. Destination assignments are stored on-board the vehicle.

STATIONS:

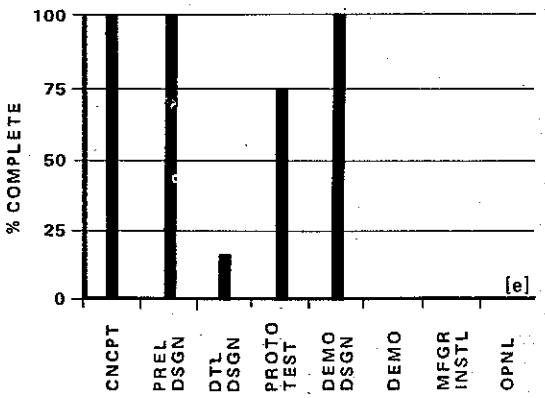
Stations are designed as elevated at guideway level, nominally with 3 berths each. The passenger area is circular in shape. Access is via stairs and an elevator.



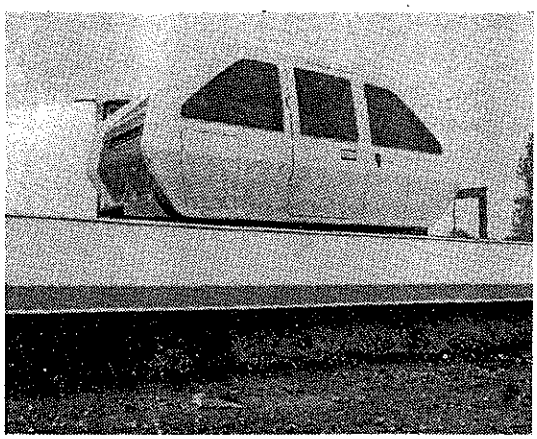
VEHICLE



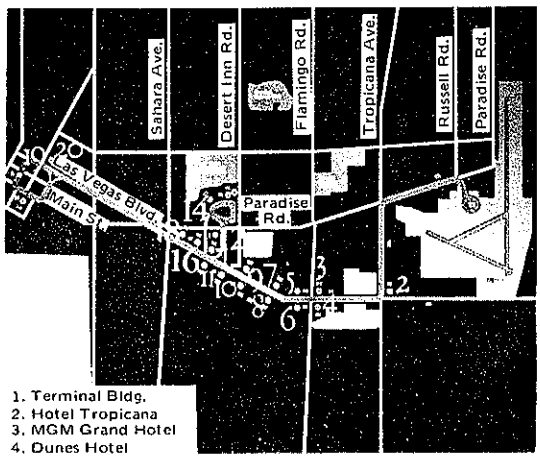
VEHICLE ON GUIDEWAY



STATUS OF DEVELOPMENT



PHOTOTYPE VEHICLE



1. Terminal Bldg.
2. Hotel Tropicana
3. MGM Grand Hotel
4. Dunes Hotel
5. Hotel Flamingo
6. Caesars Palace Hotel
7. Sands Hotel
8. The Castaways Hotel
9. Desert Inn
10. Frontier Hotel
11. Stardust Hotel
12. Landmark Tower
13. Las Vegas Convention Center
14. Las Vegas Hilton Hotel
15. Riviera Hotel
16. Circus Circus
17. Mark Anthony
18. Hotel Sahara
19. Alternate Downtwon Station Location
20. Union Plaza Depot

PROPOSED LAS VEGAS INSTALLATION

DEVELOPMENT HISTORY, PLANS & PROGRESS: [b]

The system was developed by Aerial Transit System of Nevada. Pullman Car Works of South Chicago is the car builder and Bendix Corporation designed the control system. Prototype design and construction have been completed, including guideway structure and vehicle testing. Presently, development of the Aerial Transit System has been curtailed. Interest has been focussed on the research and development of an automated guidance system in which the vehicle axle is steered in conjunction with the use of lateral guidance wheels. Prototype development is just beginning.

INSTALLATIONS & CONTRACTS: [b]

Prototype installation at Pullman Inc. — Research Facility, Hammond, Indiana, of 2100 ft (540 m) of guideway

COSTS:

Capital . . . . . Recent cost information unavailable
Las Vegas proposal (unsuccessful) for a system of 22 mi (35 km) of one-way guideway, 20 stations and 300 vehicles was for a total cost of $81,830,000 (Feb 1973) including right-of-way acquisition, utility relocation, and purchase of existing Las Vegas bus transit company

Operation . . . . . Las Vegas operation estimated at $6 million per year

Maintenance . . . . . Las Vegas maintenance estimated at $2 million per year

INSTALLATION OR RETROFIT CAPABILITY: [b: except as noted]

Single Lane Guideway Envelope Width . . . Approx 5.5 ft (1 680 mm)
Single Lane Guideway Envelope Height . . . Approx 8.5 ft (2 590 mm)
Single Lane Guideway Structural Weight . . . . . 250 lbs/ft (373 kg/m)
Double Lane Guideway Structural Weight . . . . . 500 lbs/ft (746 kg/m) [e]
Max Grade 5%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 50 ft (15.24 m)
Construction Process . . . . . Prefabricated modular guideway sections and stations
Staging Capability . . . . . Sections may be installed and operated while others under construction [e]

LIMITATIONS:

Station is not designed to accommodate large surge loads. [b]

Headway of 8 sec limits line capacity to low volume applications. [e]

ENVIRONMENTAL IMPACT: [b]

Emissions . . . . . No direct polluting emissions
Visual . . . . . Single overhead guideway
H_1 — 2.5 ft (0.76 m); H_2 — 8.5 ft (2.59 m)
W_1 — 5.33 ft (1.62 m); W_2 — 5.5 ft (1.68 m)
P_1 — 5.88 ft (1.79 m); P_2 — 9.6 ft (2.93 m)
Noise . . . . . Design goal of less than 63 dbA

PROPOSED LAS VEGAS INSTALLATION

AEROSPACE CORP. HIGH CAPACITY PRT

CLASSIFICATION: Personal Rapid Transit

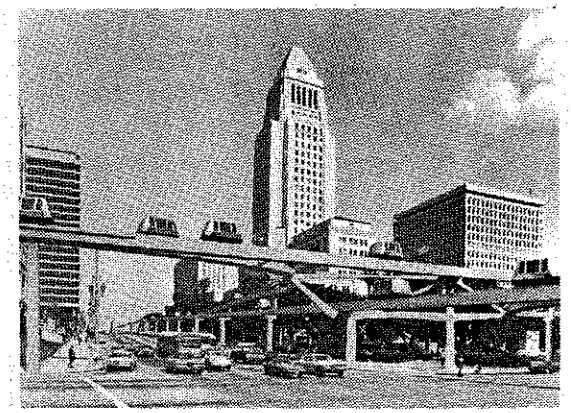
OTHER NAMES: Advanced PRT

DEVELOPER: Aerospace Corporation
Ground Transportation Directorate
2350 E. El Segundo Boulevard
P.O. Box 95085
El Segundo, California 90045
U.S.A.
Tel: (213) 648-6424

LICENSEES: None

PATENTS: U.S. Patent Applications
Monorail Support System
Variable Speed Self Starting Linear Synchronous Motor (2 types)
Linear Electric Motor
Guideway, Car, and Car Suspension

U.S. Patents Granted
Digisync Linear Motor
Electromagnetic Switching
Linear Motor Control

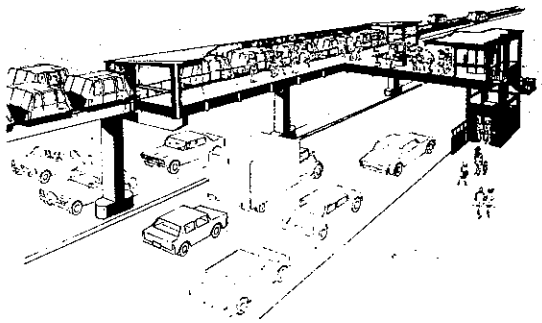


PHOTOMONTAGE OF SYSTEM
AS IT MIGHT APPEAR IN LOS ANGELES

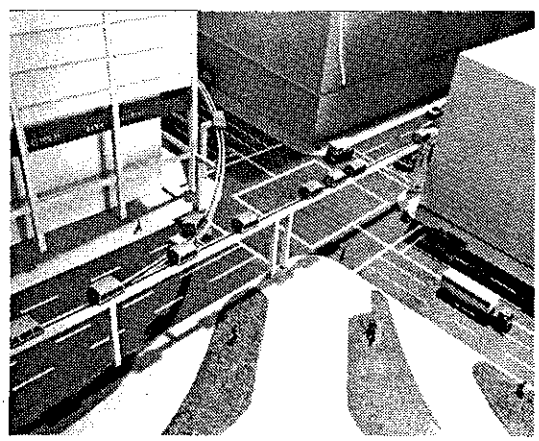
DATA REFERENCE CODE: [a 21: except as noted]

SYSTEM DESCRIPTION:

The system is an advanced, high capacity (14,400 vehicles/hr) Personal Rapid Transit system designed for transporting passengers in exclusive small six-passenger vehicles for non-stop urban trips over an exclusive grid network of guideway. The network is proposed as one-way such that a larger area may be served. Where the spacing between guideways is closest, a mainline speed of 20 mph (32 km/hr) is proposed with 60 mph (97 km/hr) arterial lines connecting to suburbs or between activity centers. The vehicles are propelled by pulsed dc linear electric motors which react with guideway mounted permanent magnets. The propulsion system is integrated into an overall quasi-synchronous control system where very short headways as low as 0.25 sec are proposed. In addition, an Automated Pallet Transporter is proposed for the movement of urban freight or small compact automobiles in a form of dual-mode. The system is designed as an attractive alternative to the private automobile with the assumption that average vehicle occupancy during the peak hour might be 1.25 passengers per vehicle (i.e., 18,000 passengers/hr/line).



TYPICAL OFF-LINE STATION

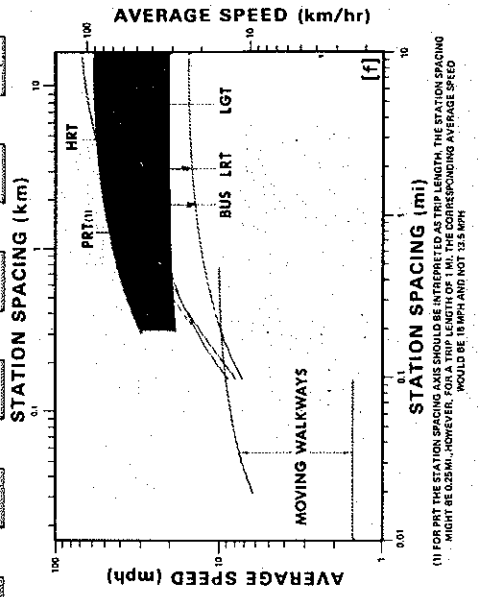


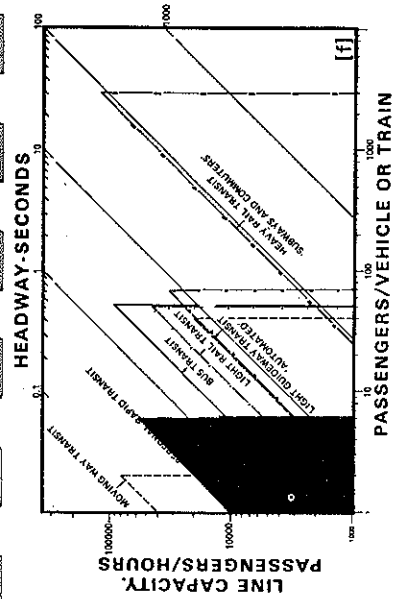
TYPCIAL CBD INSTALLATION
(from architectural model)

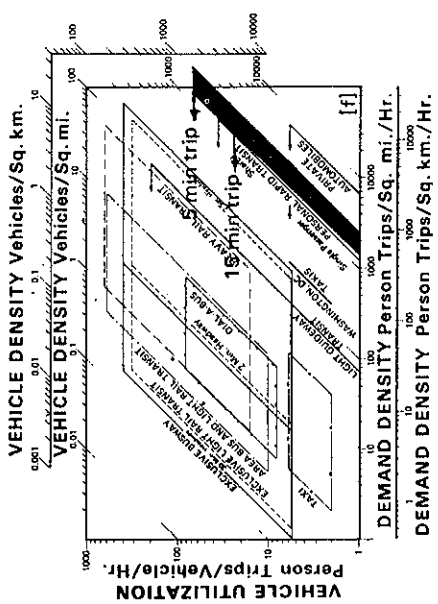
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	18,200 psgr/hr (1.3 psgr/veh)
Max Practical One-Way Capacity	14,500 psgr/hr (1.3 psgr/veh)
Min Theoretical Headway	0.25 sec
Min Practical Headway	0.33 sec
Availability	On-demand, 24 hrs/day
Type Service	Area-wide collection and distribution
Type Network	Urban area one-way grid network
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles







VEHICLE PERFORMANCE:

Cruise Velocity	20 - 60 mph (32 - 97 km/h)
Max Velocity	60 mph (97 km/h)
Max Grade	As required
Service Acceleration	8 ft/s^2 (2.5 m/s^2)
Service Deceleration	8 ft/s^2 (2.5 m/s^2)
Max Jerk	8 ft/s^3 (2.5 m/s^3)
Emergency Decel	26 ft/s^2 (7.85 m/s^2)
Stopping Precision in Station	±3 in (±76 mm)
Degradation if Guideway is Wet	No degradation
Degradation for Ice & Snow	No degradation
Vehicle Design Capacity	6 seated, 0 standing
Vehicle Crush Capacity	6 seated, 0 standing
Energy Consumption	Less than 0.33 kwh/veh-mi (0.21 kwh/veh-km) [f]

STATIONS:

Type	Off-line only
Type Boarding	Level
Ticket or Fare Collection	Automative machines
Security	Closed circuit TV
Boarding Capacity[1]	720 psgrs/hr/berth [f, b]
Deboarding Capacity[1]	720 psgrs/hr/berth [f, b]
Max Wait Time	Zero unless empty vehicle dispatched [e]
Vehicle in Station Dwell Time	Not applicable
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Exclusive use of vehicle
Transfers	Not necessary
Stops	Non-stop
Accommodation	Seated only
Comfort	Heated and air conditioned vehicles
Security	Closed circuit TV and emergency buttons
Instruction	Passive and active graphics in stations supplemented by telephone line to dispatcher

RELIABILITY & SAFETY:

Fail Safe Features	Vehicle body, bumpers, and passenger constraints protect passengers from all contingencies.
Fail Operational Features	Network and system redundancies, plus pushing vehicle strategy, ensure fail operational condition.
Total System Mean Time Before Failure Vehicle Mean Time Before Failure Station Mean Time Before Failure	10,000 hrs for major subsystem elements (i.e., control, propulsion, switching, braking, etc.)
System Restore Time After Failure	Less than 20 min
Station Restore Time After Failure	Data unavailable
Strategy For Removal of Failed Vehicle	Following vehicle softly engages failed vehicle and pushes it to next station. If vehicle cannot be pushed, then a special maintenance vehicle is dispatched to remove the failed vehicle.
Strategy For Passenger Evacuation of Failed Vehicle	Data unvailable
System Lifetime	30 years
Vehicle Lifetime	10 years

MAINTENANCE:

The system has automatic malfunction detection and automatic scheduling of maintenance. One 300-vehicle capacity maintenance facility serves 5,000 vehicles (25 mi of guideway). One 150-vehicle capacity storage and cleaning facility serves 200 vehicles.

CARGO CAPABILITY:

Passenger Articles	Small packages and luggage, wheelchairs, prams
Goods Movement	Special automated Pallet Transporter for urban freight containers

PERSONNEL REQUIREMENTS:

Vehicles do not require operators. Stations are unattended. Personnel are required only for central control, maintenance, and administration.

[1] Assumed 1.3 psgr/veh and respective headway times

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	10 ft (3.05 m)
Overall Width	Approx 5 ft (1.52 m)
Overall Height	Approx 5 ft (1.52 m)
Empty Weight	1,800 lbs (818 kg)
Gross Weight	2,400 lbs (1 091 kg)
Passenger Space (Design Load)	5 ft^2 (0.46 m^2) seated
Doorway Width	30 in (762 mm)
Doorway Height	Roof opens
Step Height	Level

SUSPENSION:

Type	Supported on two vertical rubber tired wheels in tandem, stablized by lateral guidewheels
Design Load	2,000 lbs per support wheel [b]
Lateral Guidance	Constrained by lateral guidewheels which ride on interior sides of guideway

PROPULSION & BRAKING:

Type & No. Motors	Pulsed dc linear electric motor rides inside guideway
Motor Placement	Active element on vehicle, permanent magnets in guideway
Motor Rating	Rated 300 lbs (137 kg) thrust (48 HP) at 60 mph (97 km/h)
Type Drive	Data unavailable
Gear Ratio	Data unavailable
Type Power	1,000 vdc
Power Collection	Power collector on vehicle, power rails inside guideway
Type Service Brakes	Dynamic regenerative electric and mechanical for holding vehicle at zero velocity
Type Emergency Brakes	Dynamic electric and back-up mechanical
Emergency Brake Reaction Time	0.1 sec [a 51]

SWITCHING:

Type & Emplacement	Electronmagnetic through linear motor backed up by mechanical locks. Electromagnets on guideway — locks on-board vehicle
Switch Time (lock-to-lock)	0.5 m sec for electronmagnetic build up (or decay) to 90% of total force [a 51]
Speed Thru Switch	Mainline cruise speed
Headway Thru Switch	0.1 sec min

GUIDEWAY:

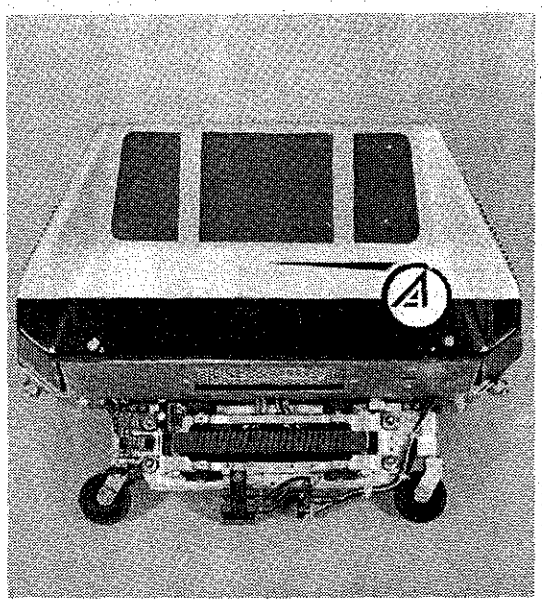
Type	Upright U-shaped channel
Materials	Prestressed concrete
Running Surface Width	Approx 0.5 ft (152 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	60 ft (18.3 m)
Overall Cross Section Width	2.7 ft (813 mm)
Overall Cross Section Height	3 ft (914 mm)
Design Load	Data unavailable
Double Lane Elevated Guideway:	Data unavailable
Guideway Passenger Emergency Egress	Data unavailable
Type Elevated Guideway Support Columns	Prestressed concrete

CONTROL:

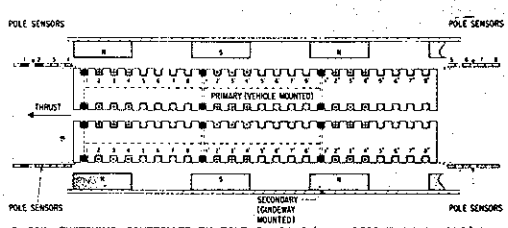
Control is by a quasi-synchronous hierarchial system. Headway is controlled synchronously along main lines as moving slots established by wayside computer. On-board vehicle computer commands pulse rate to dc linear motor. Vehicles commanded to slip or gain slots (according to on-board maneuver profiles) at interchanges and merges by interchange or wayside computer to integrate traffic. Routing, empty vehicle dispatching, overall traffic control, and total system regulation is by central computer.

STATIONS:

Basic off-line station with 6 load-unload berths is 60 ft (18.3 m) long with 1,000 ft^2 (93 m^2) covered area. Ingress/egress by outside stairs and elevator (optional escalator). Automatic fare collection and destination selection consoles are provided. The total guideway siding length is 580 ft (177 m). Suburban stations are basically 2-berth, 20 ft (6.1 m) long, with 300 ft^2 (29 m^2) covered area.

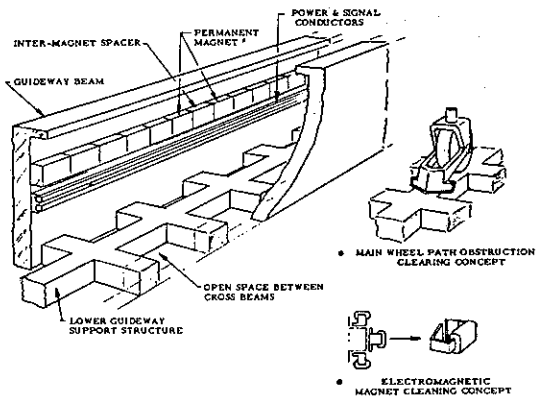


1/10th SCALE MODEL VEHICLE



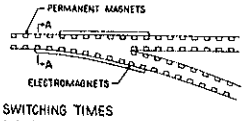
- COIL SWITCHING CONTROLLED BY POLE SENSORS (HALL EFFECT DETECTORS)
- SWITCHING RATE DEPENDS ON VELOCITY
- THRUST ADJUSTMENTS ARE MADE BY CONTROLLED VARIATIONS IN COIL CURRENT
- ELECTROMAGNETIC BRAKING BY REVERSING CURRENT TO COILS

PULSED DC LINEAR MOTOR CONFIGURATION

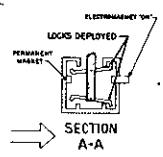


GUIDEWAY

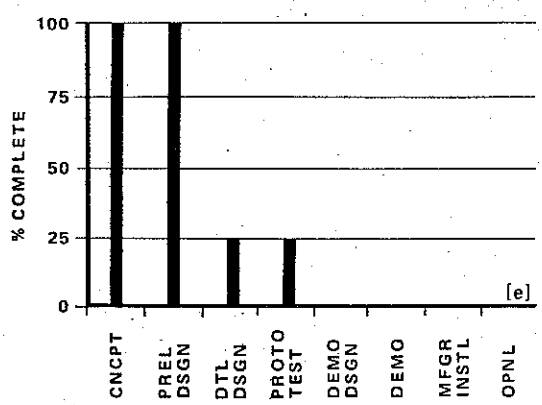
- INTEGRATED WITH PULSED D.C. PROPULSION CONCEPT



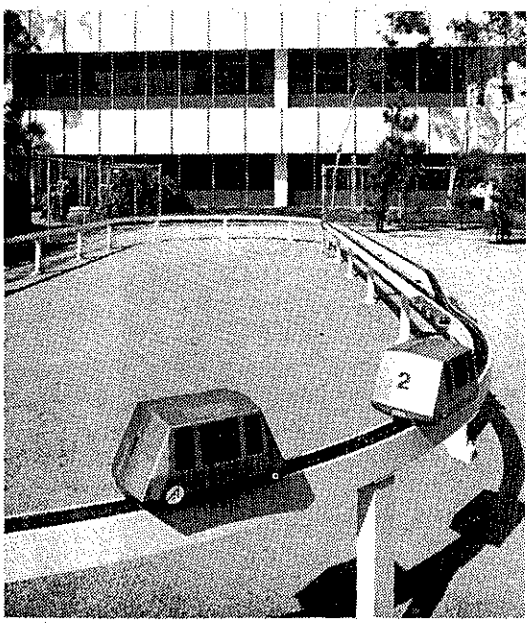
- MILLISECOND SWITCHING TIMES
  - NO MOVING GUIDEWAY PARTS
- FLUX DENSITY DOUBLED FOR ELECTROMAGNETS
  - DIRECTIONAL AND STABILIZATION FORCES
  - THRUST MAINTENANCE THROUGH SWITCH
- BACK-UP LOCK CONSTRAINS VEHICLE TO GUIDEWAY IF ELECTROMAGNET POWER FAILS
  - DEPLOYED BY SENSING DIFFERENTIAL MAGNETIC INTENSITY



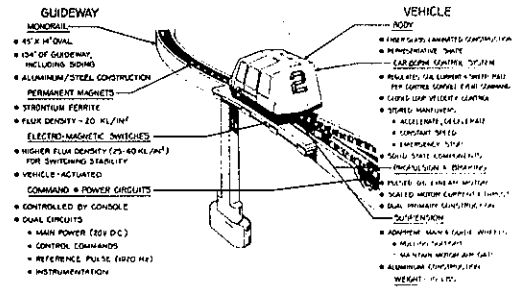
ELECTROMAGNETIC SWITCHING



DEVELOPMENT STATUS



1/10th SCALE LOOP TEST FACILITY



ELEMENTS OF 1/10th SCALE TEST FACILITY

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The system was developed by Aerospace Corporation internally funded, estimated at over $1 million. Initial work began in 1968. Extensive engineering studies and simulations have been performed and a 1/10th scale model was fabricated in 1971 which successfully tested the pulsed dc linear electric motor, the quasi-synchronous control concept, and electromagnetic switching. Because the Aerospace Corporation is a research and development organization (not a manufacturer), continued development will require other than internal funding.

INSTALLATIONS & CONTRACTS:

There is a 1/10th scale model with 3 totally automated vehicles on a 134 ft (41 m) guideway loop including one off-line siding and two switches.

COSTS:

[Based upon typical system of 100 mi (161 km) single lane guideway, 200 stations, 10,000 vehicles]

Capital Cost . . Total avg of $4.15 mill/mi ($2.58 mill/km) single lane
- Avg Cost per Vehicle . . . . . Data unavailable
- Avg Cost per Single Lane Guideway . . . . . $1.3 mill/mi ($808,000/km)
- Avg Cost Per Station $215,000
- Computers, Software, & Control Center . . . . . $28.0 mill
- Maintenance & Storage Facilities . . . . . $5.0 mill
- Power Distribution & Substations . . . . . $40.0 mill

Operation and Maintenance Costs . . . . . Total direct cost (without amortization) 5.3 cents/occupied veh-mi

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 6 ft (1 830 mm)
Single Lane Guideway Envelope Height . . . . . 8.5 ft (2 600 mm)
Single Lane Guideway Structural Weight . . . . . 186 lbs/ft (277 kg/m)
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade . . . . . As required
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 15 ft (4.57 m) at reduced speed
Construction Process . . . . . Prefabricated guideway and elevated station elements
Staging Capability . . . . . Sections can be operated while others are under construction.

LIMITATIONS:

Open guideway channel may limit operation in severe climatic conditions (ice & snow) dependent upon functionability of incorporated deflector. Extremely short headway (high-capacity) requires additional length of off-line guideway at interchanges.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Visual . . . . . Single elevated guideway
H_1 – 3 ft (0.91 m); H_2 – 8 ft (2.44 m)
W_1 – 2.67 ft (0.81 m); W_2 – 5 ft (1.52 m)
P_1 – 4 ft (1.22 m); P_2 – 8.33 ft (2.54 m)
Noise . . . . . Under study [b]

ARAMIS

CLASSIFICATION: Personal Rapid Transit*

OTHER NAMES: Rames de vehiculés programmes (R.V.P.)

DEVELOPER: Engins-Matra
37 av. Louis Brquet
B.P. no. 1
78140 - Velizy, France
Tel: 946.96.00
Telex: ENMATRA 69.077 F

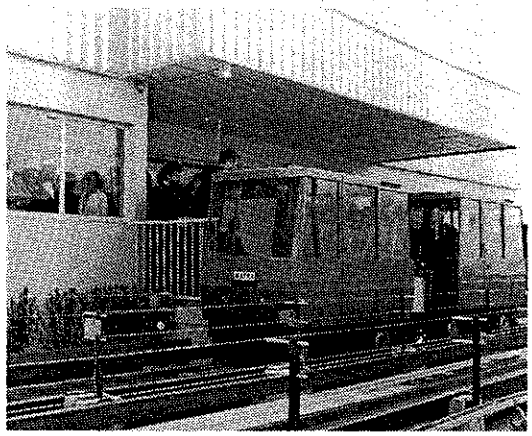
LICENSEES: None

PATENTS: Patents have been granted in France, USA, RFA, UK, Japan, Italy, Belgium, Switzerland, Canada, Argentina, and Spain.

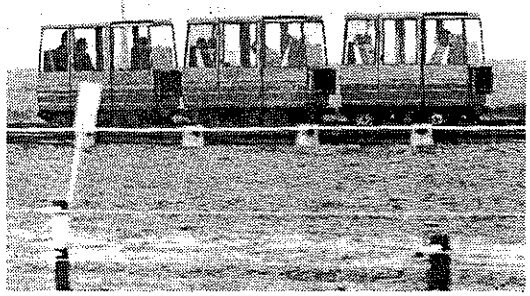
DATA REFERENCE CODE: [a 51: except as noted]

SYSTEM DESCRIPTION:

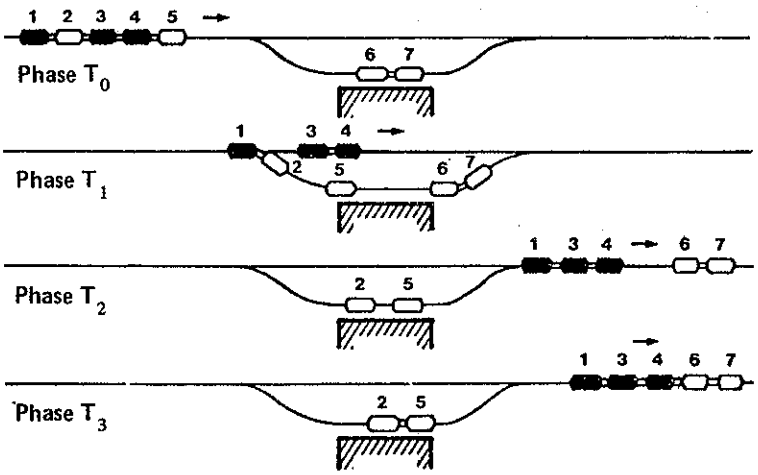
ARAMIS is a personal Rapid Transit system consisting of small vehicle running on an exclusive guideway intented for urban or suburban areas. Each vehicle can be used independently and has its own guidance control and switching capabilities, but the normal operating mode consists of vehicle-platoons controlled by station computers. Vehicles are automatically separated from the platoon on the mainline and dispatched to the off-line station. The platoons are reformed on the mainline and a vehicle leaving the station is coupled to a platoon in the leading position.



OPERATION OF STATIONS AND VEHICLE-PLATOONS



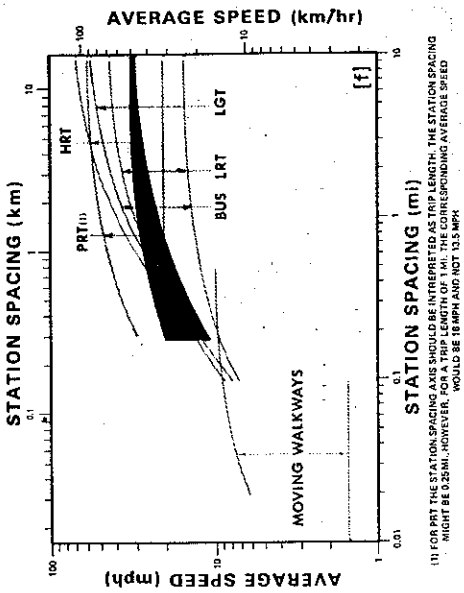
DEMONSTRATION OF EXTREMELY SHORT HEADWAY PLATOON OPERATION

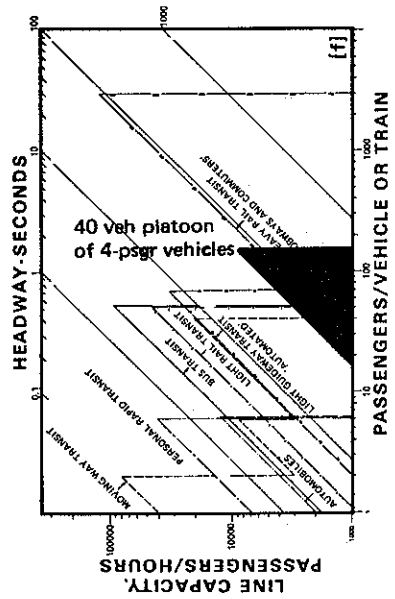


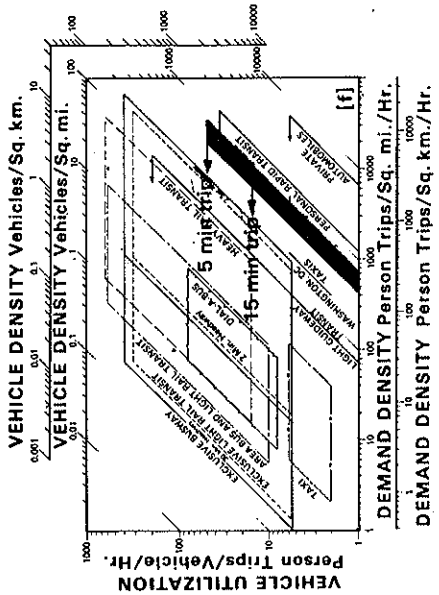
PROTOTYPE VEHICLES IN STATION AT ORLY AIRPORT

**PUBLISHER'S NOTE:*

4 to 10 passenger vehicles are proposed. The information in these data sheets is based on a 4 passenger vehicle. The same system can be used as a true PRT or, during peak period, as shared vehicles for same origin — destination pairs with predetermined routing.







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . 2,000 to 15,000 psgrs/hr
Max Practical One-Way Capacity . . . . . 1,600 to 12,000 psgrs/hr
Min Theoretical Headway . . . . . 60 sec between platoons; 0.168 sec within platoon
Min Practical Headway . . . . . 75 sec between platoons
Availability . . . . . On-demand or pre-desination of vehicles
Type Service . . . . . Limited area collection and distribution
Type Network . . . . . Areawide network or loops
Type of Vehicle Routing . . . . . Variable and/or fixed
Traveling Unit . . . . . Up to 40 single vehicles per platoon

VEHICLE PERFORMANCE:

Cruise Velocity . . . . . 31 mph (50 km/h)
Max Velocity . . . . . 31 mph (50 km/h)
Max Grade . . . . . 4 to 10%
Service Acceleration . . . . . 3.28 ft/s^2 (1 m/s^2)
Service Deceleration . . . . . 3.28 ft/s^2 (1 m/s^2)
Max Jerk
Emergency Decel
Stopping Precision in Station
Degradation if Guideway is Wet
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 . . . . . Data unavailable
Energy Consumption, Cruise Only . . . . . Data unavailable

STATIONS:

Type . . . . . Off-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic
Security . . . . . Closed circuit TV might be installed
Boarding Capacity
Deboarding Capacity
. . . Not specified, dependent upon site-specific requirements and station design
Max Wait Time . . . . . Dependent upon frequency
Vehicle in Station Dwell Time . . . . . 30 sec [e]
Average Station Spacing . . . . . 0.19 mi (0.3 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Exclusive use or shared vehicle
Transfers . . . . . May be necessary for longer trips
Stops . . . . . Non-stop between transfer points
Accommodation . . . . . Seated only
Comfort . . . . . Heated and air conditioned
Security . . . . . Not specified
Instruction . . . . . Station indicator on pre-destined vehicles

RELIABILITY & SAFETY: Now under study

MAINTENANCE: Information unavailable

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages and luggage
Baggage space in vehicle is also provided.
Goods Movement . . . . . Vehicles might be designed for exclusive freight use [e]

PERSONNEL REQUIREMENTS:

Attendants at central control facility are required and maintenance personnel. Specific personnel requirement data is unavailable.

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	7.55 ft (2300 mm)
Overall Width	4.26 ft (1 300 mm)
Overall Height	6.23 ft (1 900 mm)
Empty Weight	1,430 lbs (650 kg)
Gross Weight	2,200 lbs (1 000 kg)
Passenger Space (Design Load)	Data unavailable
Doorway Width	24.8 in (630 mm)
Doorway Height	59.1 in (1 500 mm)
Step Height	Level

SUSPENSION:

Type	Supported on 4 wheels with pneumatic tires
Design Load	Data unavailable
Lateral Guidance	4 pneumatic tired wheels rolling against 2 exterior lateral guiderails, front wheel steering (single Ackerman)

PROPULSION & BRAKING:

Type & No. Motors	2 variable-resistance dc electric motors
Motor Placement	Coupled directly with the rear wheels
Motor Rating	8 kw
Type Drive	Data unavailable
Gear Ratio	Data unavailable
Type Power	400 vdc (or possibly 750 v)
Power Collection	Gliders and power rails
Type Service Brakes Type Emergency Brakes Emergency Brake Reaction Time	Data unavailable

SWITCHING: [a 41]

Type & Emplacement	Traverse engaging into special guiderail at switch, bolster mounted on vehicle
Switch Time (lock-to-lock)	Data unavailable
Speed Thru Switch	Mainline speed
Headway Thru Switch	Demerge at platoon headway of 0.168 sec

GUIDEWAY: [a 41: except as noted]

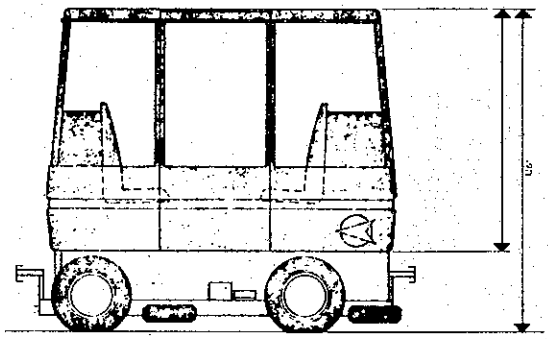
Type	2 running tracks & 2 lateral guidance tracks
Materials	Light cement in "sandwich" between 2 bonded metal sheets
Running Surface Width	4.26 ft (1 300 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	Data unavailable
Overall Cross Section Width	6.56 ft (2 000 mm) [c]
Overall Cross Section Height	Data unavailable
Design Load	Data unavailable
Double Lane Elevated Guideway:	
Max Elevated Span	Data unavailable
Overall Cross Section Width	10.5 ft (3 200 mm) [c]
Overall Cross Section Height	Data unavailable
Design Load	Data unavailable
Guideway Passenger Emergency Egress	Information unavailable
Type Elevated Guideway Support Columns	Information unavailable

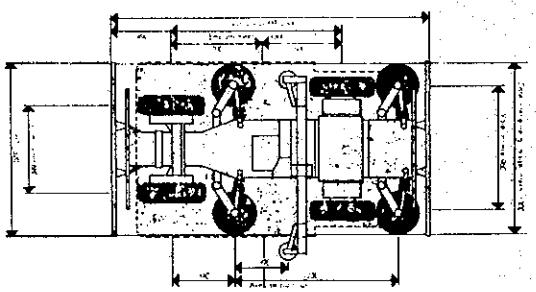
CONTROL:

Vehicle is fitted with programming device (for destination choice by user). Vehicles are electronically coupled together and have always a spacing of 300 mm. Vehicle control is by two independent control systems: operating (such as door opening, switching) connected through track; the safety system for emergency stopping is connected through the power destribution line.

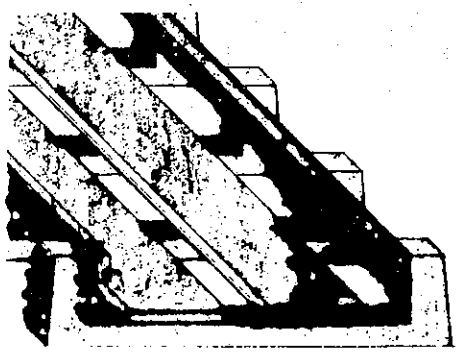
STATIONS:

Station length is proportional to the flow (for demand and service), or equal to platoon length (for predestined service). Stations have 2 tracks, one above the other or side by side.

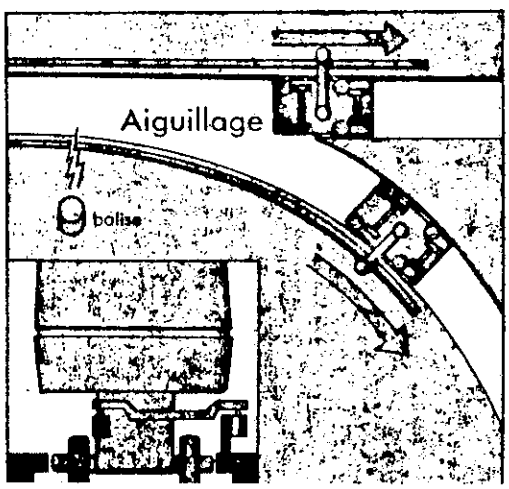




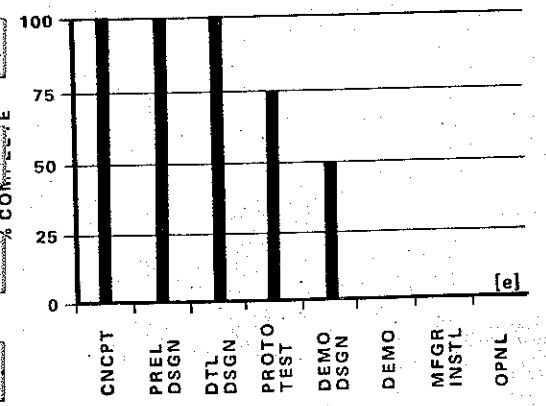
VEHICLE



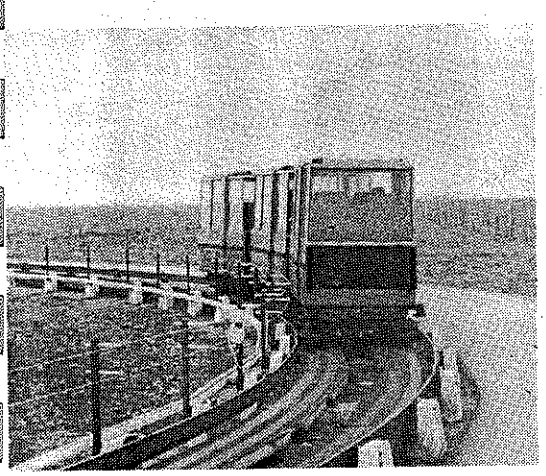
GUIDEWAY



SWITCHING



DEVELOPMENT STATUS



PROTOTYPE DEMONSTRATION AT ORLY AIRPORT

DEVELOPMENT HISTORY, PLANS & PROGRESS: [e, J.E. Anderson]

Aramis started from the ideas of Gerard Bardet, an inventor, in about 1967 on a budget of 10,000F, in part inspired by concepts which originated in the United States. Bardet's patents were bought by Matra in May 1970, who received its first grant from a state agency, DATAR (Government Office for Territory Development) in 1970/71.

A prototype test track of 1 km length was built at Orly Airport, Paris, (for exposition in 1973) where testing has been carried out since 1973.

The first phase of testing at the Orly Aiport test track is now complete, and planning is underway for the second phase, consisting mainly of safety and reliability testing. The second phase is under the direction of the Paris Metro Authority (Régie Autonome des Transports Parisiens, or RATP) and is 70% funded by them. The plan is to take 16 months for the RATP to review all prior work and to decide what needs further development. The first stage will be simulation and the second, urban design. RATP is also charged to make an economic study of Aramis. A decision point on this phase is expected in two years. For this phase, a new test track is to be built. It is to be about three km long and is to test ten six-place vehicles. The plan is to have vehicles certified by 1977 or 1978. The vehicles are to be reversible. In this program it is planned to determine MTBF. The goal is to have an MTBF for a vehicle at least as good as the Paris Metro cars. The MTBF of Aramis is still not satisfactory. The Metro transports $30(10)^8$ people between accidents and this is the goal for Aramis.

INSTALLATIONS & CONTRACTS:

None, except for the test track at Orly Airport, although eight application cases have been studied.

Planning studies are underway for at least three applications of Aramis: The City of Nice on the Mediterranean Sea where an underground system is planned, a new town in Southern France, and at the northern international airport serving Paris. On the latter project Matra is in competition with Airtrans, Aerobus, and Skybus. The project is to use 5 km of two-way guideway, eight stations, and six-passenger vehicles. The costs for Aramis are projected to be 120,000F per vehicle (about $24,000). The whole system counting vehicles, stations and guideway is projected to cost between 17 and 20 million F/km ($6.4m/two-way mile); 60% of the costs are in civil engineering. [e, J.E. Anderson]

COSTS: Data unavailable

INSTALLATION OR RETROFIT CAPABILITY: [a]

Single Lane Guideway Envelope Width	6.6 ft (2 000 mm)
Single Lane Guideway Envelope Height	6.23 ft (1 900 mm)
Single Lane Guideway Structural Weight	Data unavailable
Double Lane Guideway Structural Weight	Data unavailable
Max Grade	4 - 10%
Min Vertical Turn Radius	Data unavailable
Min Horizontal Turn Radius	32.8 ft (10 m) at reduced speed
Construction Process	Assume prefabricated guideway sections [e]
Staging Capability	Data unavailable

LIMITATIONS: [e]

It is estimated that the development of the control system for the PRT mode is only in a beginning phase. Installation as PRT, as herein reported, would be limited to low capacity applications.

ENVIRONMENTAL IMPACT: [e]

Emissions	No direct polluting emissions
Visual	Insufficient data to make assessment
Noise	Data unavailable

CABINENTAXI/CABINENLIFT

CLASSIFICATION: Personal Rapid Transit

OTHER NAMES: Cabin-Taxi (CAT)

DEVELOPER: DEMAG Fördertechnik
Produktneuentwicklung
D-5800 Hagen
Heinitzstr. 28
West Germany
Tel: (02331) 14091
Telex: 0823231

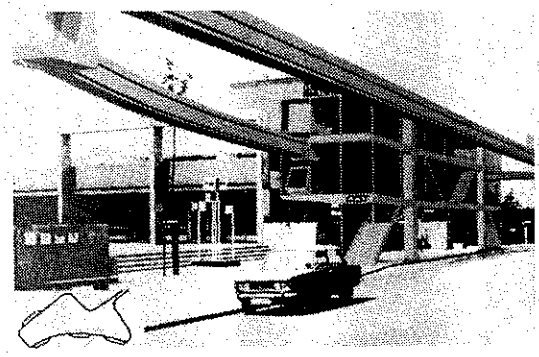
MBB, Messerschmitt-Bolkow-Blohm GmbH
Neue Verkehrssysteme
D-8000 München 80
Postfach 801265
West Germany
Tel: (089) 60003419
Telex: 0522279

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

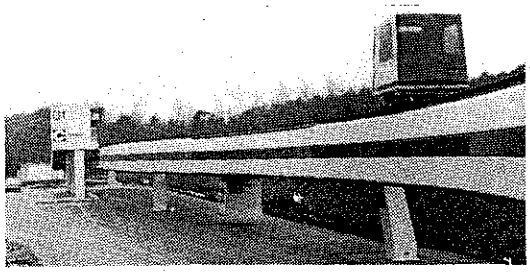
LICENSEES: None

PATENTS: Data unavailable

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

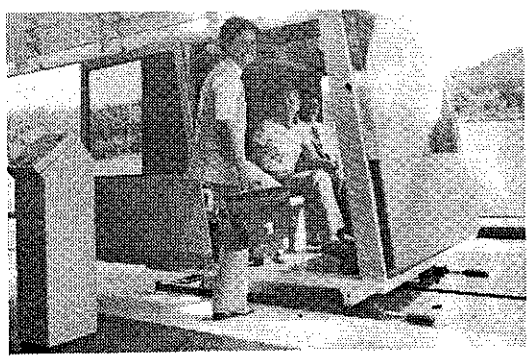


PHOTOMONTAGE OF OFF-LINE STATION



STATION, GUIDEWAY & VEHICLES AT TEST FACILITY

AUTOMATIC TICKETING AND DESTINATION SELECTION



BOARDING VEHICLE

SYSTEM DESCRIPTION:

Cabinentaxi –

Cabinentaxi is a Personal Rapid Transit system characterized by track-guided, small, 3-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, 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 feed-back vehicle travel, and linear motor propulsion unaffected by weather.

Because the system operates at headways of 0.5 - 1.0 sec, it may be further classified as advanced high-capacity PRT.

Cabinenlift –

The Cabinenlift system is an LGT system designed particularly for use as a "link-up lift" in a hospital complex. The system is built up from its predecessor Cabinentaxi using 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 equipment.

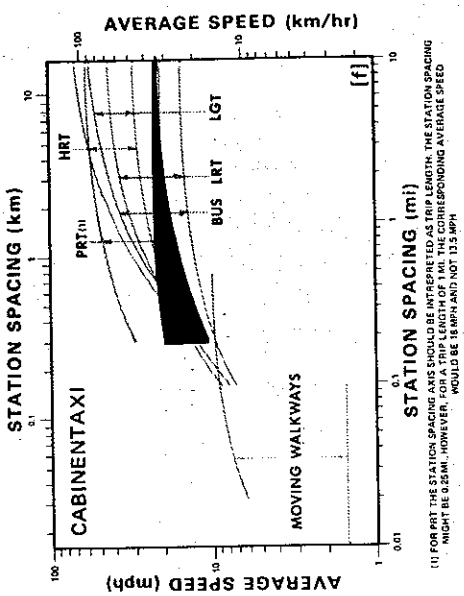
OPERATIONAL CHARACTERISTICS

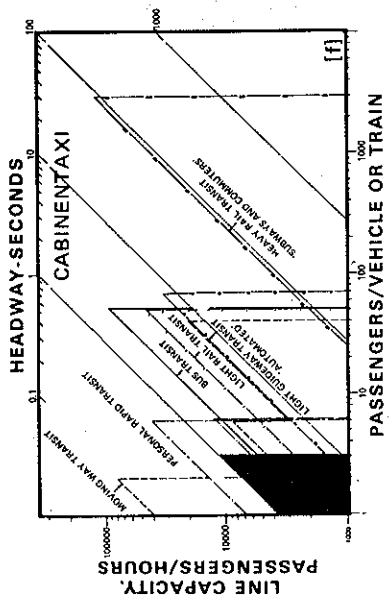
SYSTEM PERFORMANCE: [Cabinentaxi - a, Cabinenlift - f]

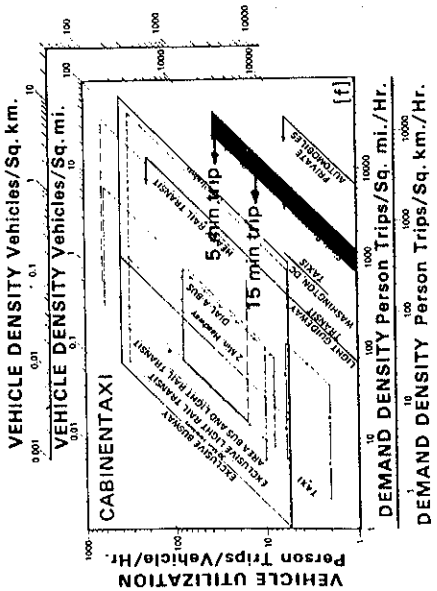
Max Theoretical One-Way Capacity	21,600/180 psgrs/hr[1]
Max Practical One-Way Capacity	15,000/144 psgrs/hr
Min Theoretical Headway	CT[2] - 0.5 sec
Min Practical Headway	CT - 1.0 sec
Availability	On-demand 24 hrs/day
Type Service	CT - limited area collection and distribution CL[2] - one-way shuttle service between 2 stations

[1] **Cabinentaxi/Cabinenlift**

[2] **CT - Cabinentaxi**
CL - Cabinenlift







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 seated, 0 standing
CL - 12 psgr vehicle with accommodations for hospital beds and equipment
Vehicle Crush Capacity . . . . . CT - 3 seated, 0 standing
Energy Consumption . . . . . 0.294 kwh/veh-mi (0.183 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 - 3,000 psgrs/hr/berth
Deboarding Capacity . . . . . CT - 3,000 psgrs/hr/berth
Max Wait Time . . . . . CT - zero for unsaturated operation
CL - 4 min [f]
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, CL - exclusive use of vehicle or sharing
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
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 1975 will determine actual MTBF.[c]
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 . . . . . 5.2/5.6 ft (1 600/1 700 mm)
Overall Height . . . . . 4.9/7.2 ft (1 500/2 200 mm)
Empty Weight . . . . . CT - 1,320 lbs (600 kg)
Gross Weight . . . . . CT - 2,200 lbs (1 000 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.

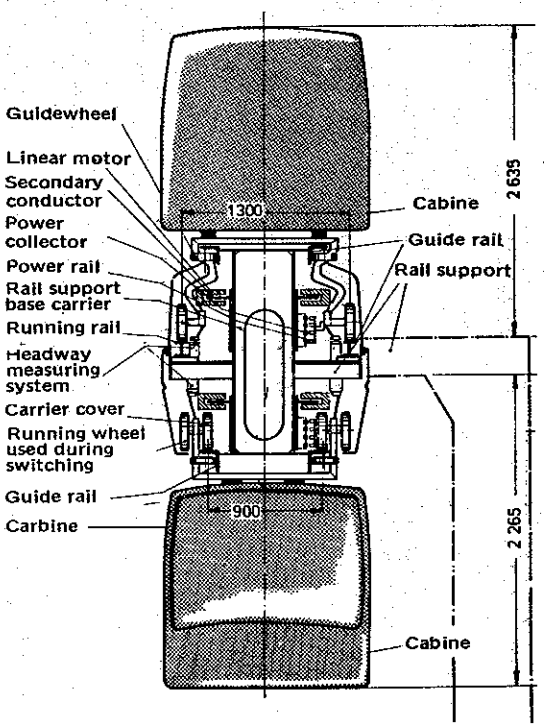
STATIONS:

Cabinentaxi — [a]

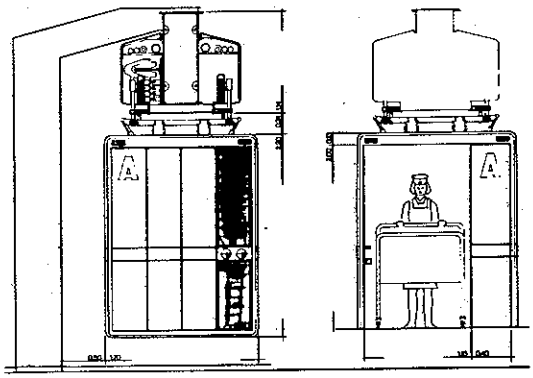
Stations may be incorporated in buildings or specially built structures. Off-line station guideway length of 361 ft (110 m) is min required including acceleration and deceleration lengths. One boarding area requires a length of 8.2 ft (2.5 m).

Cabinenlift — [c]

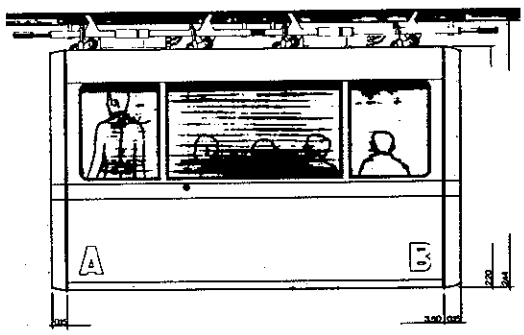
The stations are located on the second floor of each of the 2 buildings served. Direct access to the building is provided through the front of the vehicle. The connecting doors at the stations seal off completely the vehicle-station transition. vehicle-station transition.



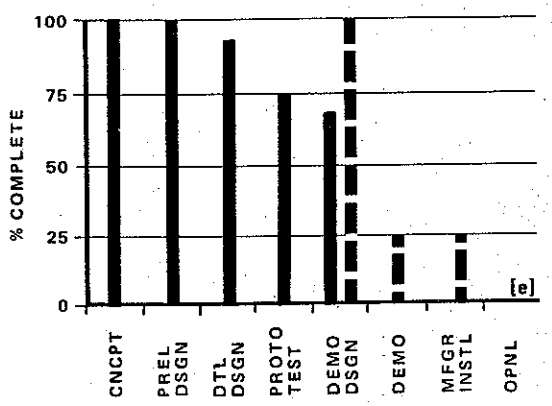
CABINENTAXI VEHICLE AND GUIDEWAY DESCRIPTION



CABINENLIFT VEHICLE DIMENSIONS



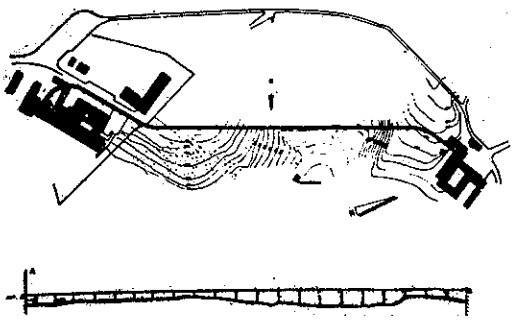
CABINENLIFT VEHICLE DIMENSIONS



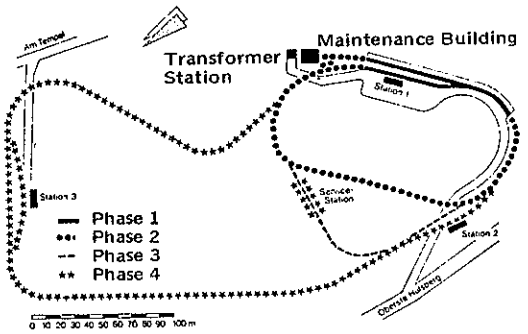
DEVELOPMENT STATUS

Cabinentaxi
Cabinenlift

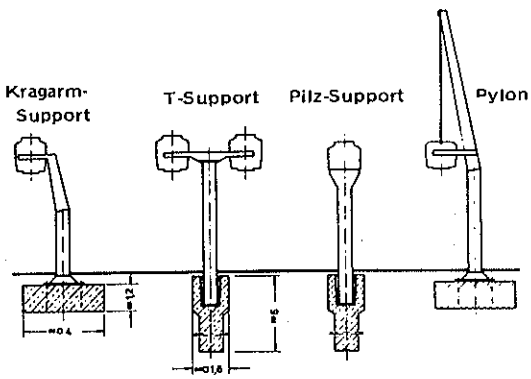
NOTE: **The Cabinenlift system is an application of Cabinentaxi and therefore the demonstration and manufacturer's installation stems from the pre-design and prototype testing of Cabinentaxi**



CABINENLIFT SYSTEM



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 Hague, Germany, at the DEMAG facilities. The completion dates are: Phase 1 - Aug '73, Phase 2 - May '74, Phase 3 - Sept '74, Phase 4 - May '75 (see map of system).

Test objectives and schedules:

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

Cabinenlift —

The construction work for Cabinenlift began in April, 1975, and the system is expected to start operation in December, 1975.

INSTALLATIONS & CONTRACTS:

Cabinentaxi —

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 $2.6 million/mi ($1.6 million/km) with an average station spacing of 0.4 mi (0.7 km) including vehicle cost of approx $9,500/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	Data unavailable
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 57 dbA at 23 ft (7 m) from guideway, 53 dbA inside vehicle

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

CABTRACK

CLASSIFICATION: Personal Rapid Transit*

OTHER NAMES: Autotaxi, Automatic Rail-Taxi System

DEVELOPER: Advanced Systems Division
(Formerly, Transport Research Assessment Group)
Transport Systems Department
Transport and Road Research Laboratory
Old Workingham Road
Crowthorne Berks RG11 6AU
England
Tel: Crowthorne 3131

ASSOCIATE DEVELOPERS: Hawker Siddeley Dynamics Ltd.
Manor Road
Hatfield, Hertfordshire AL 10 9LL
England
Tel: Hatfield 62300

Royal Aircraft Establishment
Farnborough, England

Robert Matthew, Johnson-Marshall & Partners
Welwyn Garden City, Hertfordshire
England

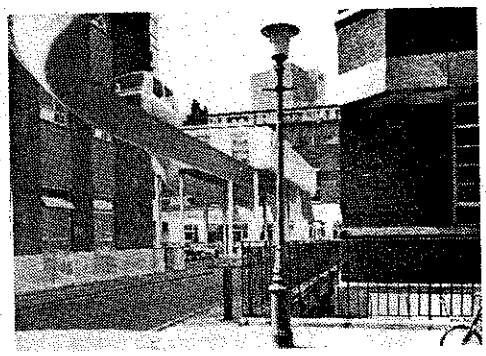
LICENSEES: None

PATENTS: British Patents applied for - 16183/71, relating to steering; 47433/70 and 6382/72, relating to control

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

SYSTEM DESCRIPTION:

Cabtrack is a Personal Rapid Transit system for transporting passengers in urban areas in small, four-passenger, rubber tired vehicles over exclusive guideways. The totally automated system provides on-demand exclusive service non-stop between origin and destination stations usually within a grid network of one-way guideways covering an urban area and two-way guideways as required. Guideways are proposed to be elevated for the most part, underground, and at-grade as well. Two of the vehicle seats may be folded up for accommodating wheelchairs or a pram. Relatively high capacities have been proposed (4,000 veh/hr).



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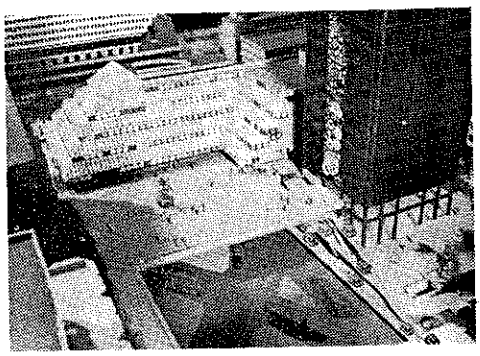
PHOTOMONTAGE OF GUIDEWAY & STATION AT MORTIMER MARKET



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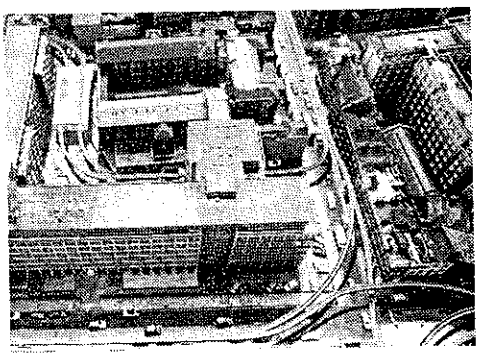
INSERTION INTO PICCADILLY CIRCUS REDEVELOPMENT



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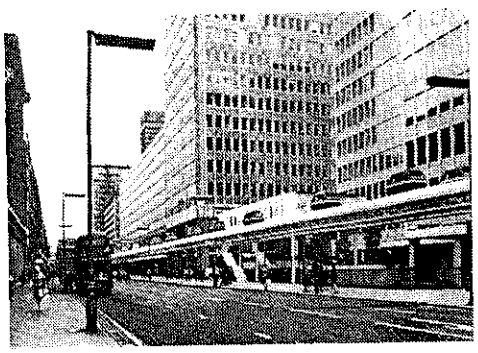
PHOTOMONTAGE OF SYSTEM AT MIDDLESEX HOSPITAL ANNEXE



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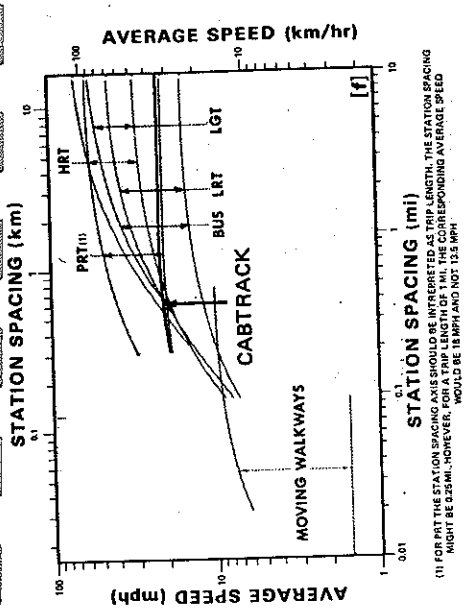
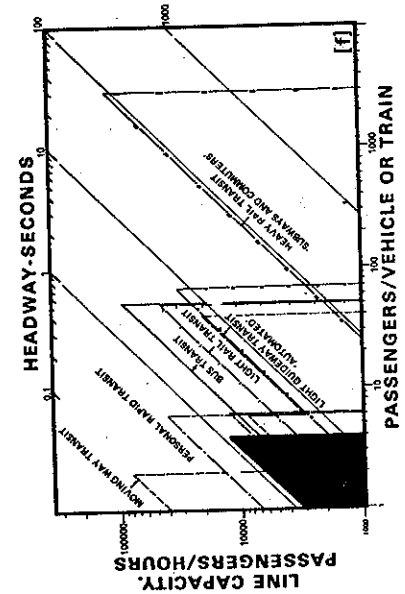
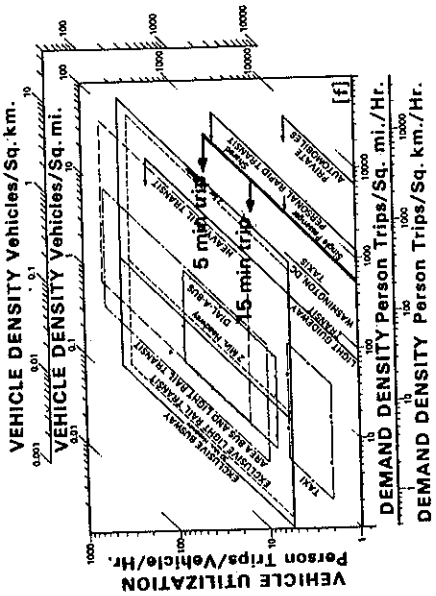
PHOTOMONTAGE OF GUIDEWAY & STATION ALONG VICTORIA STREET

**PUBLISHER'S NOTE:*

The Cabtrack studies were extensive in scope, performed during the period 1967-1971. At present work on this system has been curtailed in the Advanced Systems Division of the Transport Systems Department. It has been included because of its historical importance to the field of PRT, its in-depth investigations and its continued relevance in the design of advanced high-capacity PRT systems.







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	16,000 psgrs/hr*
Max Practical One-Way Capacity	12,800 psgrs/hr*
Min Theoretical Headway	0.9 sec
Min Practical Headway	1.13 sec
Availability	On-demand 24 hrs/day
Type Service	Area wide collection and distribution
Type Network	Urban area grid network
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles

VEHICLE PERFORMANCE:

Cruise Velocity	22.5 mph (36 km/h)
Max Velocity	45 mph (72 km/h)
Max Grade	10%
Service Acceleration	8.2 ft/s^2 (2.5 m/s^2)
Service Deceleration	8.2 ft/s^2 (2.5 m/s^2)
Max Jerk	4 ft/s^3 (1.23 m/s^3)
Emergency Decel	Data unavailable
Stopping Precision in Station	Data unavailable
Degradation if Guideway is Wet	Data unavailable
Degradation for Ice & Snow	Data unavailable
Vehicle Design Capacity	4 seated, 0 standing
Vehicle Crush Capacity	4 seated, 0 standing
Energy Consumption	Data unavailable

STATIONS:

Type	Off-line only
Type Boarding	Level
Ticket or Fare Collection	Automatic machines
Security	Closed circuit TV
Boarding Capacity	76 cabloads/hr/berth [b 31]
Deboarding Capacity	60 cabloads/hr/berth [b 31]
Max Wait Time	Zero nominally, 40 - 60 sec at peak hrs
Vehicle in Station Dwell Time	Not applicable
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Exclusive use of vehicle
Transfers	Not necessary
Stops	Non-stop
Accommodation	Seated only
Comfort	Heated and air conditioned vehicles
Security	Push button for stop at next station and loud speakers in vehicles
Instruction	Passive and active graphics in stations and vehicles

RELIABILITY & SAFETY:

Fail Safe Features	Vehicle switching mechanism, headway control system
Fail Operational Features	If supervisory computer fails system will continue to operate at a degraded performance. All vehicles come to safe stop. Public address to passengers remains in operation.
Total System Mean Time Before Failure Vehicle Lifetime System Lifetime System Restore Time After Failure Station Mean Time Before Failure Station Restore Time After Failure Vehicle Mean Time Before Failure	Insufficient work has been performed for these quantities to be defined.
Strategy For Removal of Failed Vehicle	Information unavailable
Strategy For Passenger Evacuation of Failed Vehicle	Information unavailable

MAINTENANCE: [b 11]

Guideway is designed for easy access by maintenance personnel. Running and guidance surfaces are designed for easy re-alignment and replacement. Withdrawal of vehicles for cleaning and maintenance is controlled by the supervisory computer.

CARGO CAPABILITY:

Passenger Articles	Small packages, luggage, wheelchairs
Goods Movement	Not provided, but could be

PERSONNEL REQUIREMENTS: [e]

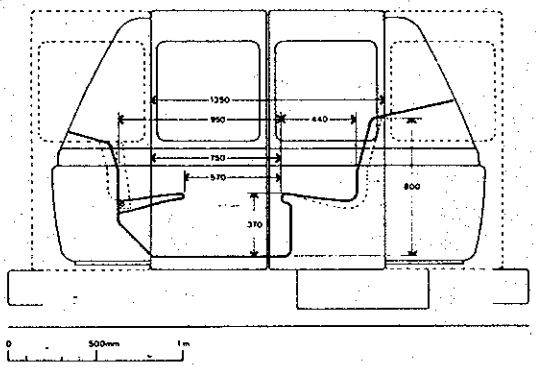
Vehicles and stations are unmaned. Operators are required only for central supervisory control. Personnel are required for administration and maintenance.

*** 4 passengers/vehicle assumed**

PHYSICAL DESCRIPTION[1]

VEHICLE:

Overall Length	10 ft (3.05 m)
Overall Width	4.5 ft (1.37 m)
Overall Height	5.5 ft (1.68 m)
Empty Weight	1,320 lbs (600 kg)
Gross Weight	2,200 lbs (1 000 kg)
Passenger Space (Design Load)	See dimension drawing at right
Doorway Width	53.2 in (1 350 mm)
Doorway Height	Roof opens
Step Height	Level



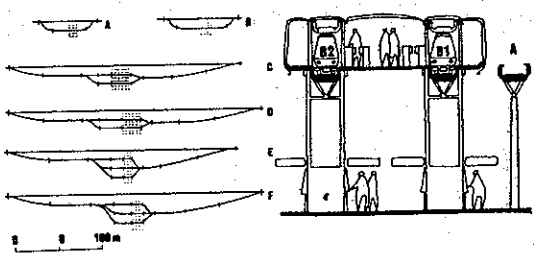
VEHICLE SIDE VIEW

SUSPENSION:

Type	4 wheel conventional automotive with pneumatic rubber tires
Design Load	1,100 lbs (500 kg)/front suspension 1,100 lbs (500 kg)/rear suspension
Lateral Guidance	Steered by lateral rubber tired guidewheels which ride on guideway sidewalls

PROPULSION & BRAKING:

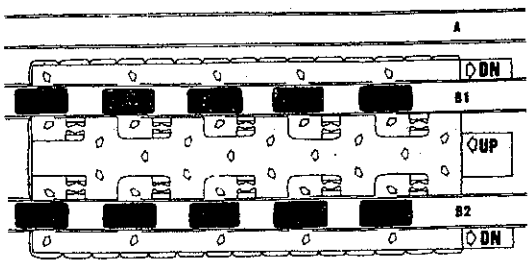
Type & No. Motors	Two proposals: Slip ring induction motor or dc motor
Motor Placement	One per vehicle with mechanical transmission
Motor Rating	20 HP, 25 kw
Type Drive	Data unavailable
Gear Ratio	Data unavailable
Type Power	415 vac, 3ϕ, 50 Hz
Power Collection	Data unavailable
Type Service Brakes	Electric dynamic supplemented by disc brakes at low speed
Type Emergency Brakes	Hydraulic operated disk brakes
Emergency Brake Reaction Time	Data unavailable



TYPICAL TRACK LAYOUTS

SWITCHING:

Type & Emplacement	On-board vehicle, hydraulic actuated guidewheel retraction mechanism
Switch Time (lock-to-lock)	Data unavailable
Speed Thru Switch	Mainline speed
Headway Thru Switch	Mainline headway



5-BERTH STATION OF MODULAR FORM

GUIDEWAY:

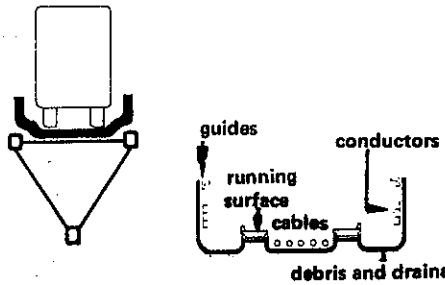
Type	Shallow U-shaped roadway with truss design
Materials	Steel and concrete
Running Surface Width	6.5 ft (1 980 mm)
Single Lane Elevated Guideway Double Lane Elevated Guideway	Dimension details are undetermined
Guideway Passenger Emergency Egress	Information unavailable
Type Elevated Guideway Support Columns	Information unavailable

CONTROL:

Control is totally automatic quasi-synchronous, hierarchically organized. Moving slots are established by wayside computers. Velocity and position is maintained by on-board controller using track Feducial marks and system clock responding to commands to accel, decel, stop, etc. Station and interchange controllers define and issue commands to each vehicle to maneuver as required to control traffic. Central computer regulates overall traffic, routes vehicles, controls ticketing, dispatches empty vehicle, emergency control, and regulates maintenance. Control is at merging points by a form of queing on branch tracks (vehicles continue moving during queing process).

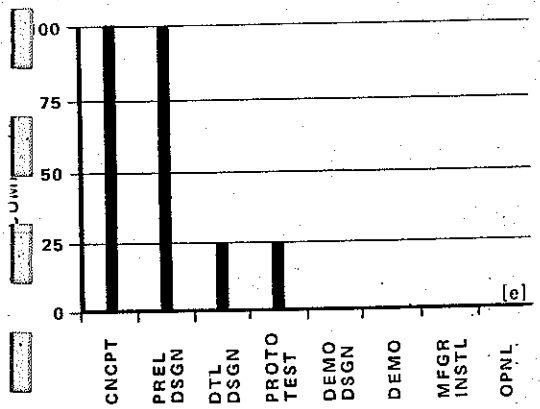
STATIONS:

Stations are of modular design. Smallest station accommodates one-way siding with 3 berths. Larger stations with 5 berths per each direction are designed. Access is via stairs, escalators, and elevators. Stations are designed based on vehicle arrival and departure of one per 40 sec.

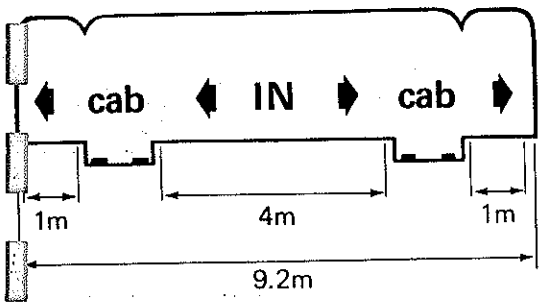


PREFERRED GUIDEWAY CROSS SECTION

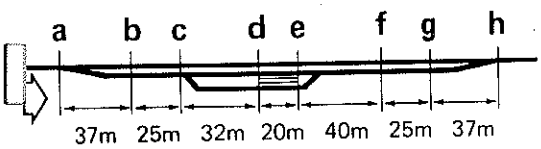
[1] **Detailed design of a prototype vehicle has not been undertaken. Actual vehicle characteristics might differ from data shown herein.**



DEVELOPMENT STATUS

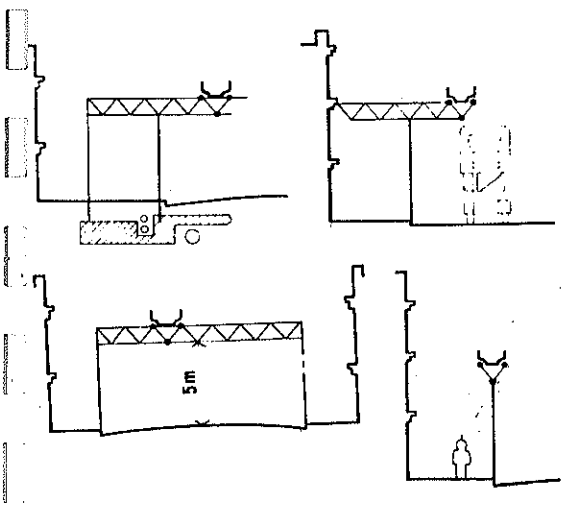


CROSSSECTION OF TYPICAL TWO-TRACK 5-BERTH (10 TOTAL) STATION



ab Sidestep off main track
bc Deceleration lane
cd Input Queues (8 x 4m cab spaces)
de Cabstop (Two platforms of 5 x 4m cab spaces)
ef Output Wueue (10 cab spaces)
fg Acceleration lane
gh Sidestep, returning to main track

TRACK DIMENSIONS TO SERVE A 5-BERTH STATION



TYPICAL INSTALLATION METHODS

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The concept was initiated by Dr. L. R. Blake as "Autotaxi" in 1966 at Brush Electrical Co. Ltd., now a subsidiary of Hawker Siddeley. The Department of the Environment (DOE) in 1967 formed the transport Research Assessment Group (now Advanced Systems Division) to manage research and development of the Cabtrack system. In-depth technical, economic, and social studies were performed by a multi-disciplinary team drawn from the DOE and the Royal Aircraft Establishment. Extensive architectural studies were performed at Robert Matthew, Johnson-Marshall & Partners. The larger effort to develop the system ceased in 1972; however, at the present time a 1/5th scale model is in operation at the Transport and Road Research Laboratory. Present efforts in England appear to be focused on the "Minitram" LGT system with efforts discontinued on the Cabtrack system.

INSTALLATIONS & CONTRACTS:

Extensive study of a network for London as a research exercise only, with main emphasis placed on architectural and envirnomental problems. A cost/benefit assessment study was carried out on two hypothetical networks in the West Midlands area.

COSTS: [a 21]

Recent cost information unavailable; however, cost studies performed in 1968 resulted as follows:

Capital . . . . . Based on 1968 English pound value converted to dollars at 1974 exchange rate: Total fixed facilities based on one-way guideways spaced in grid of 0.318 mi mesh size – $1.465-1.578 million/mi; Vehicle, including spares and other support facilities – $3,500 each (Subsequent studies with 0.5 mi mesh size shows similar results)

Operation & Maintenance . . . . . Very tentative, dependent upon detailed site-specific characteristics
Based on mesh size of 0.318 mi and system speed of 15 mph (37.6 cents/veh-mi at 1,000 person-trips/day or 6.8 cents/veh-mi at 16,000 person-trips/day (includes 10% interest charges on all fixed and movable equipment)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	Approx 6.6 ft (2 000 mm)
Single Lane Guideway Envelope Height	Approx 10 ft (3 050 mm)
Single Lane Guideway Structural Weight	Data unavailable
Double Lane Guideway Structural Weight	Data unavailable
Max Grade	10%
Min Vertical Turn Radius	Data unavailable
Min Horizontal Turn Radius	20 ft (6.1 m)
Construction Process	Prefabricated guideway sections and modular stations [a]
Staging Capability	Sections could be operated while other under construction

LIMITATIONS:

Traction braking limits emergency deceleration to approx 22.5 ft/s^2 (6.87 m/s^2) assuming ideal dry tire/surface interface conditions; therefore, system performance may be degraded under adverse climatic conditions. It is debated by some that proper design of guideway/vehicle interface and control system may preclude requirements for emergency deceleration greater than that for normal service. Developer has not yet decided the value for emergency deceleration, but indicates that it may be the same as normal service deceleration to eliminate the risk of injury to passengers in "false alarm" emergency stops.

ENVIRONMENTAL IMPACT: [e]

Emissions . . . . . No direct polluting emissions
Visual . . . . . Standard values for H, W, P are not given because guideway dimensions are not defind. An architectural and environmental study was performed by Robert Matthew, Johnson - Marshall & Partners.
Noise . . . . . Data unavailable

CVS

CLASSIFICATION: Personal Rapid Transit

OTHER NAMES: None

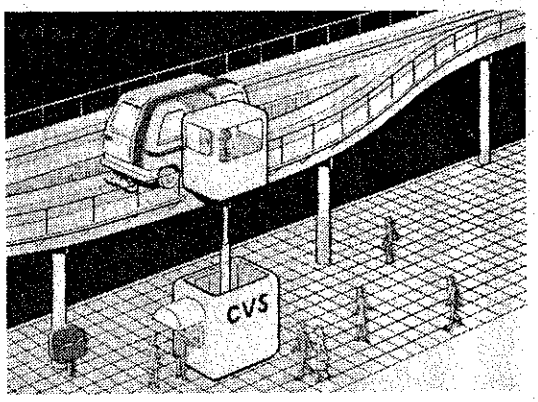
DEVELOPER: Japan Society for the Promotion of Machine Industry
3-5-8 Shiba Koen
Minato-ku
Tokyo, 105, Japan
Tel: (Tokyo) 434-8211

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)

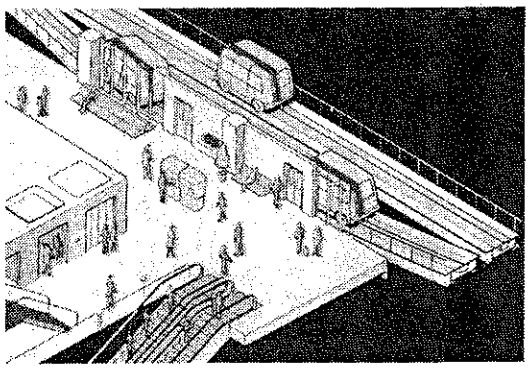
LICENSEES: None

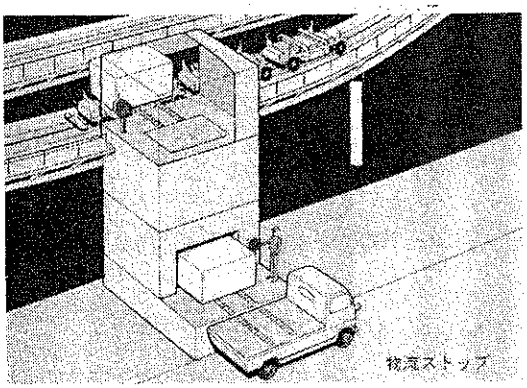
PATENTS: Data unavailable

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



TYPICAL SIMPLE STOP


TYPICAL STOP ADJACENT TO A BUILDING


TYPICAL CARGO STATION

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.)

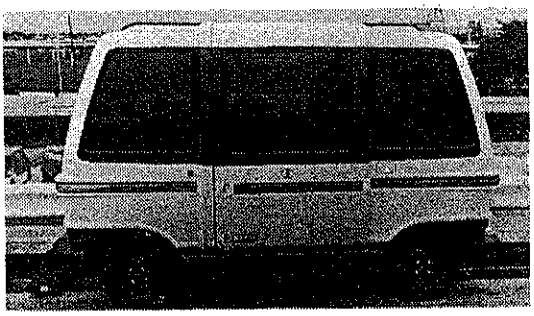
Proposed is a fairly tight grid network of guideways; some called superways and others medium-speed-ways or paths. Vehicles travel on the super-ways at 37 mph (60 km/hr) which are laid out as approximately 0.62 mi (1 km) square meshes of 2 or 3 single lanes in each direction with grade separated crossings, 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.

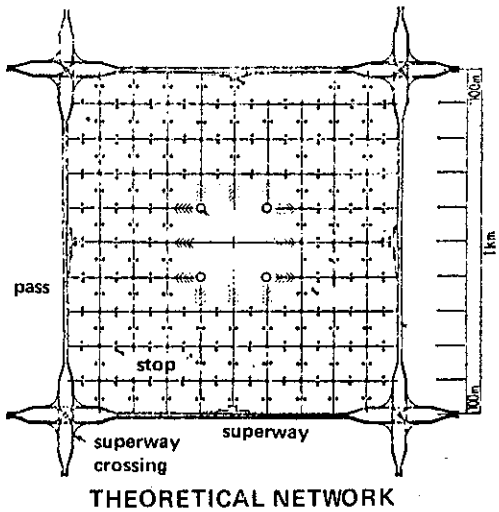
For the most part, guideways are proposed to be elevated over existing right-of-ways; however, underground, through buildings, and in uncovered trenches are also proposed.

OPERATIONAL CHARACTERISTICS

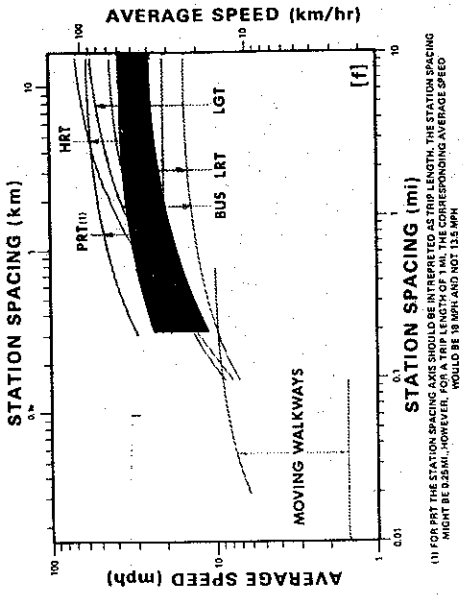
SYSTEM PERFORMANCE:

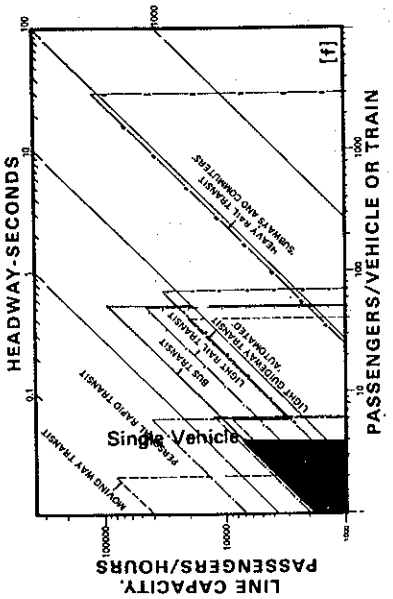
Max Theoretical One-Way Capacity	14,400 psgrs/hr
Max Practical One-Way Capacity	7,200 psgrs/hr
Min Theoretical Headway	1.0 sec

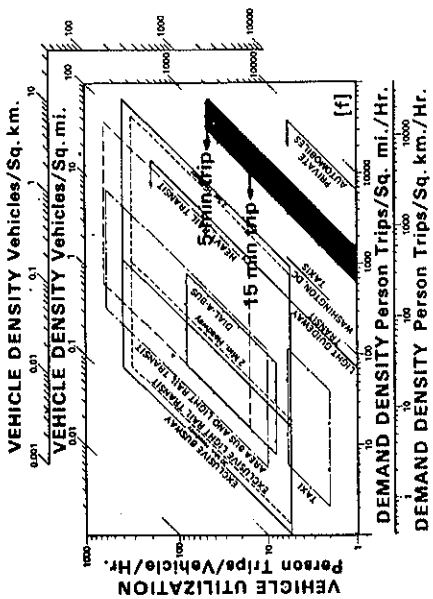

PROTOTYPE VEHICLE



THEORETICAL NETWORK







Min Practical Headway . . . . . 2.0 sec
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
System Restore Time After Failure
Station Mean Time Before Failure . . . . . } Data unavailable
Station Restore Time After Failure
Vehicle Mean Time Before Failure
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 Administrative 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

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	Data unavailable
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	0.1 sec

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:

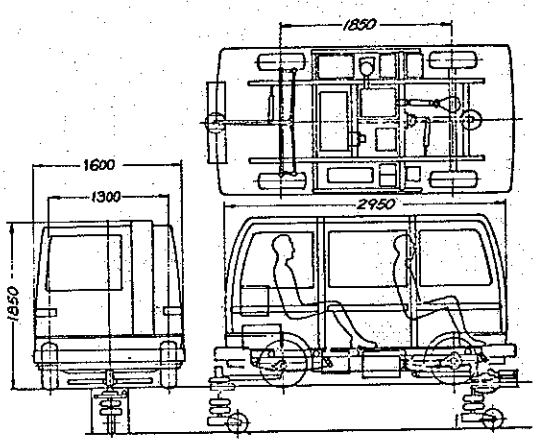
Type	At, above, or below grade, flat concrete surface or coated with plastic
Materials	Prestressed concrete and steel
Running Surface Width	5.9 ft (1 800 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	98.4 ft (30 m)
Overall Cross Section Width	5.9 + 2.0 (sidewalk) ft (1 800 + 600 mm)
Overall Cross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

CONTROL:

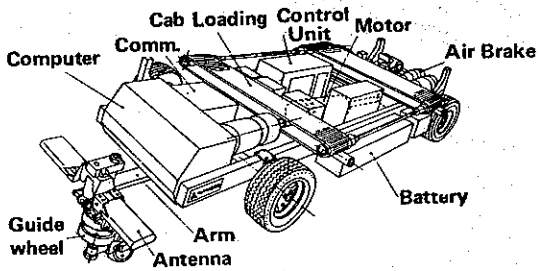
Control is by synchronous automatic hierarchial system. Headway control is via a point-follower. Points are established in a central computer in accordance with predetermined time-distance patterns. Each moving point is coded. For merging, both main line and merging line points have the same code. The 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:

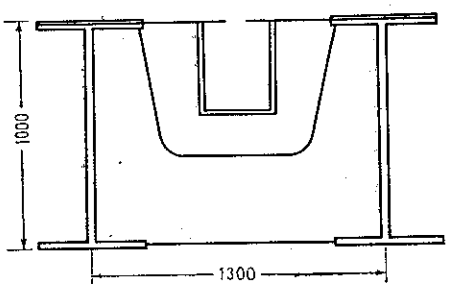
Stations are located at street level as an elevator cab. A passenger buys a ticket from an automated machine, boards the elevator from which he transfers to a waiting vehicle. Larger elevated station buildings are also proposed, as well as integration of stations within buildings.



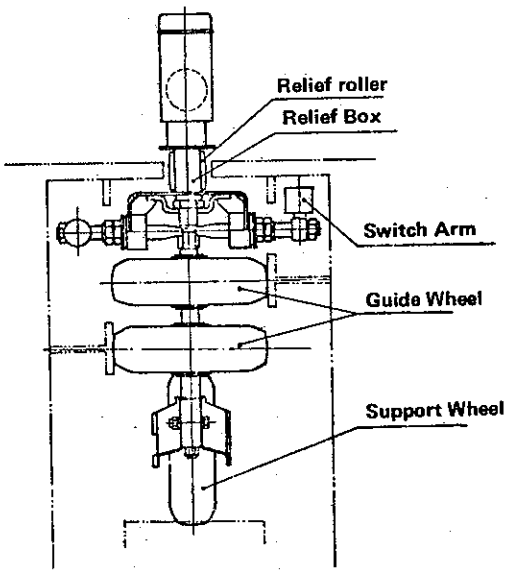
VEHICLE



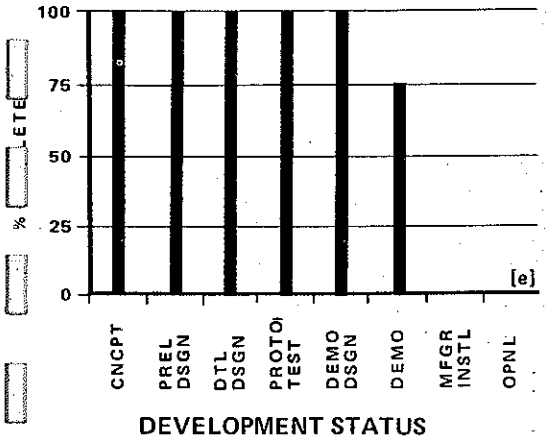
TYPICAL VEHICLE CHASSIS



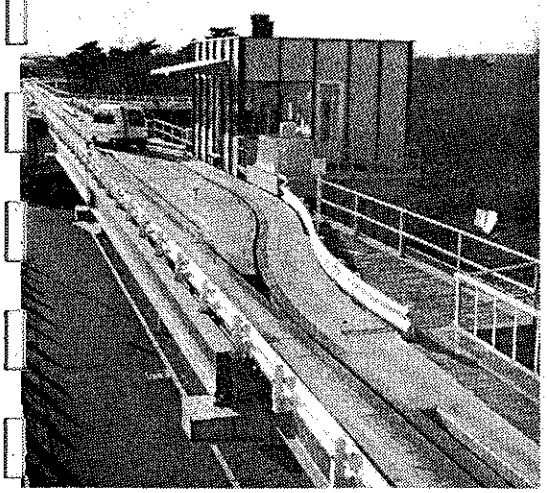
GUIDEWAY CROSS SECTION



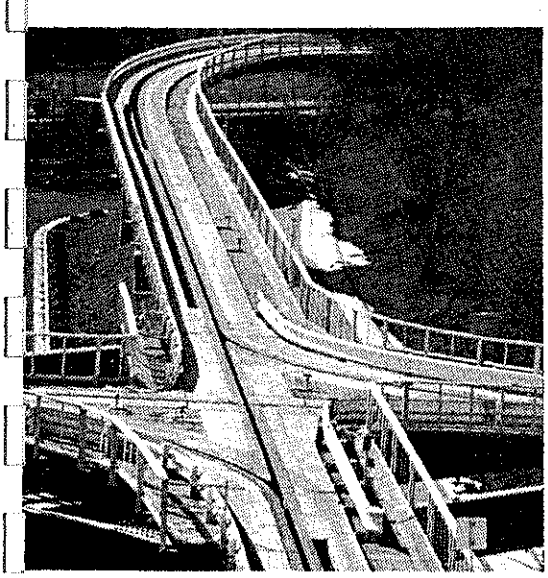
STEERING ARM & GUIDE WHEELS



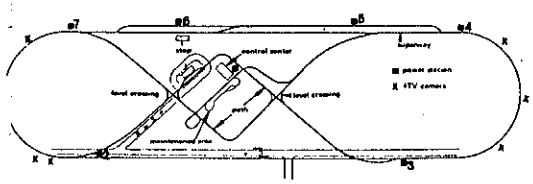
DEVELOPMENT STATUS



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.

INSTALLATIONS & CONTRACTS:

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

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 – 6.04 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

ELAN-SIG

CLASSIFICATION: Personal Rapid Transit

OTHER NAMES: None

DEVELOPER: SIG Swiss Industrial Company
Railway Carriage and Wagon Works
CH-8212 Neuhausen Rhine Falls
Switzerland
Tel: (053) 8 15 55
Telex: 7 61 56
Teleg: SEG Neuhausenamrheinfall

LICENSEES: None

PATENTS:

One-way vehicle of Rickshaw Principle:
Austria 310005; Switzerland 542741; U.S.A. 3,777,670; Italy 943616; France 2108518; and pending in Germany, Sweden, Japan, and Great Britian

Vehicle with Movable Seats and Floor:
Austria 313718; Switzerland 542069; U.S.A. 3,759,567; Italy 936806; France 2108519; and pending in Germany, Sweden, Japan, and Great Britian

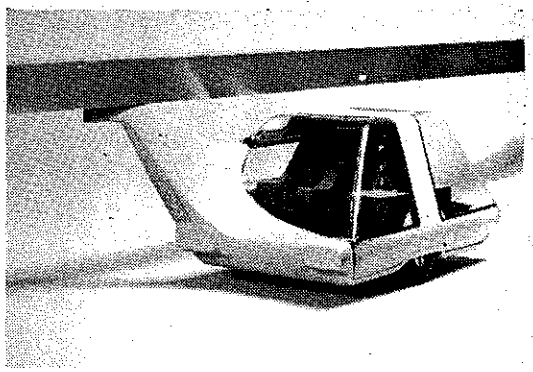
Vehicle Guidance and Switch:
Austria 315909; Italy 951416; France 2136439; and pending in Switzerland, Germany, U.S.A., Sweden, and Japan

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

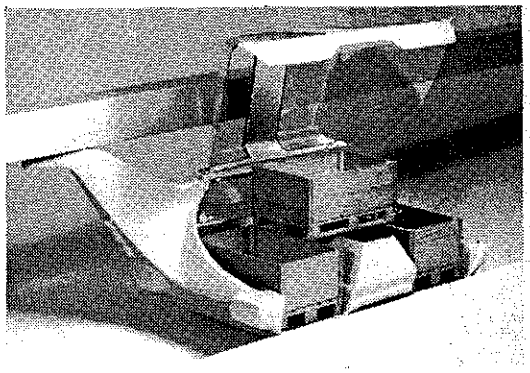
SYSTEM DESCRIPTION:

Elan-Sig is a Personal Rapid Transit system operating from, and controlled by, an overhead guideway, with the vehicles supported from below by two rubber tired wheels which run on a roadbed. The totally automated system using state-of-the-art components (automotive wheels and suspension, for example) and systems equipment, offers personal non-stop exclusive service to its passengers in small vehicles of 4 seats. The vehicle is designed for goods movement where the seats can be removed and freight containers placed aboard. The system is proposed as an advanced high-capacity PRT operating at 0.7 sec headways with capacities as high as 20,000 passengers/hr. The switching concept is claimed to be reliable and crashproof utilizing a small active knife-edge blade in the guideway which must pass to the right or left of another knife-edge blade on the vehicle's overhead bogie.

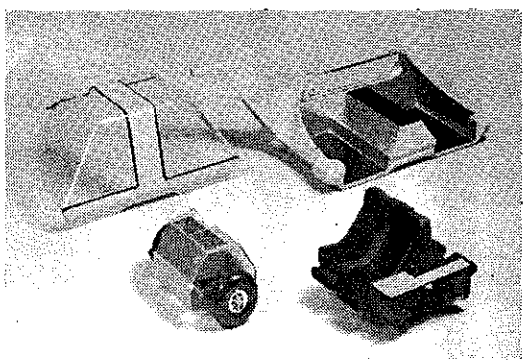
Of interesting note is the capability to tilt (or rotate) the vehicle about its horizontal axis by changing the distances between the roadbed and the overhead guidebeam, thus compensating for steep slopes, acceleration, and deceleration to give a safer and more comfortable ride.



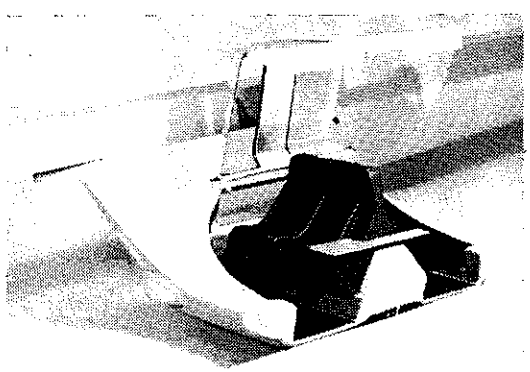
BASIC VEHICLE COMPONENTS



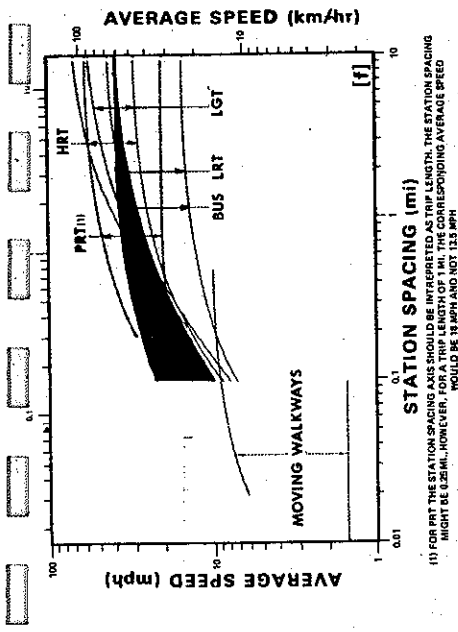
ELAN VEHICLE

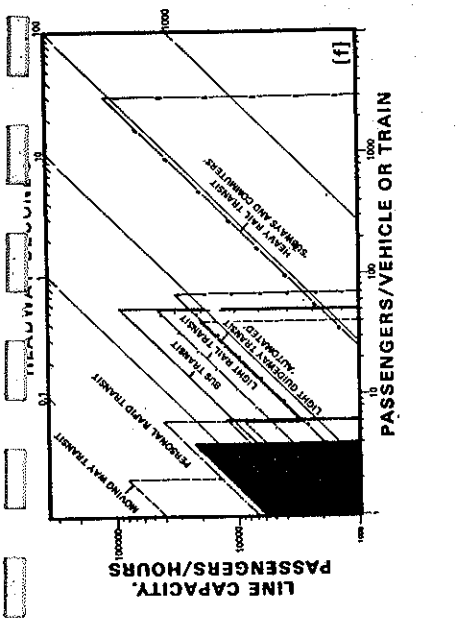


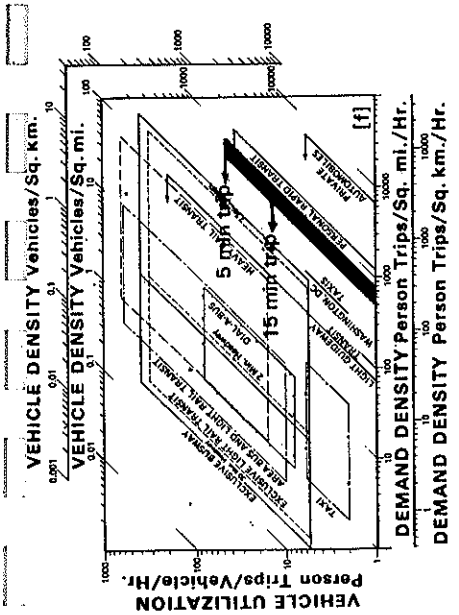
ELAN VEHICLE



GOODS MOVEMENT







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . 20,571 psgrs/hr
Max Practical One-Way Capacity . . . . . 16,457 psgrs/hr
Min Theoretical Headway . . . . . 0.7 sec
Min Practical Headway . . . . . 0.9 sec
Availability . . . . . On-demand 24 hrs/day
Type Service . . . . . Area wide collection and distribution
Type Network . . . . . Area wide grid network
Type of Vehicle Routing . . . . . Variable
Traveling Unit . . . . . Single vehicles

VEHICLE PERFORMANCE:

Cruise Velocity . . . . . 37 mph (60 km/h)
Max Velocity . . . . . 40 mph (64 km/h)
Max Grade 20%
Service Acceleration . . . . . 8.2 ft/s^2 (2.5 m/s^2)
Service Deceleration . . . . . 8.2 ft/s^2 (2.5 m/s^2)
Max Jerk . . . . . N/A
Emergency Decel . . . . . 16.4 ft/s^2 (5 m/s^2)
Stopping Precision in Station . . . . . N/A
Degradation if Guideway is Wet . . . . . No degradation
Degradation for Ice & Snow . . . . . No degradation
Vehicle Design Capacity . . . . . 4 seated, 0 standing
Vehicle Crush Capacity . . . . . 4 seated, 0 standing
Energy Consumption . . . . . 0.145 kwh/veh-mi (0.09 kwh/veh-km)

STATIONS:

Type . . . . . Off-line, at, above or below grade
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic machines
Security . . . . . Closed circuit TV could be installed.
Boarding Capacity . . . . . 480 psgrs/hr/berth
Deboarding Capacity . . . . . 480 psgrs/hr/berth
Max Wait Time . . . . . Zero for unsaturated operation
Vehicle in Station Dwell Time . . . . . 30 sec
Average Station Spacing . . . . . 0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Exclusive use of vehicle
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
Accommodation . . . . . Seated only
Comfort . . . . . Heated and ventilated vehicles
Security . . . . . Emergency stop pushbutton for next station
Instruction . . . . . Maps, signs, and active graphics

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Switch, on-board fault detection
Fail Operational Features . . . . . Passenger walkway is provided for escape path. Vehicles can be towed or pushed.
Total System Mean Time Before Failure . . . . . 10,000 hrs
System Restore Time After Failure . . . 1 hr by replacing exchange components
Station Mean Time Before Failure . . . . . 100,000 hrs
Station Restore Time After Failure . . . . . Data unavailable
Vehicle Mean Time Before Failure . . . . . 1,000 hrs
Strategy For Removal of Failed Vehicle . . . . . Data unavailable
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Data unavailable
System Lifetime . . . . . 30 years
Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE: Data unavailable

Maintenance Facility . . . . . Small maintenance building with automative hoists and storage space for approx 5% of total fleet

CARGO CAPABILITY:

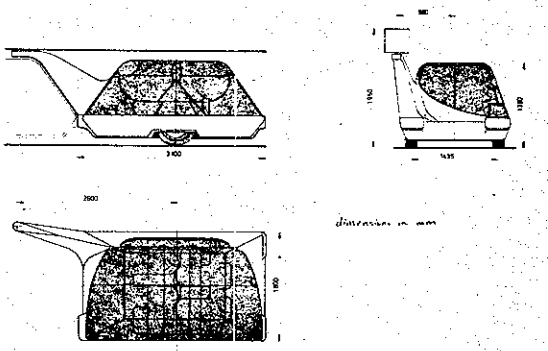
Passenger Articles . . . . . Small packages and hand luggage
Goods Movement . . . . . Seats can be removed and freight containers placed aboard vehicle

PERSONNEL REQUIREMENTS: Data unavailable

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	10.2 ft (3 100 mm)
Overall Width	5.9 ft (1 800 mm)
Overall Height	4.5 ft (1 380 mm)
Empty Weight	1,750 lbs (795 kg)
Gross Weight	2,400 lbs (1 100 kg)
Passenger Space (Design Load)	Same as compact automobile
Doorway Width, Doorway Height	Vehicle side and roof completely open for total exposure entry
Step Height	Level



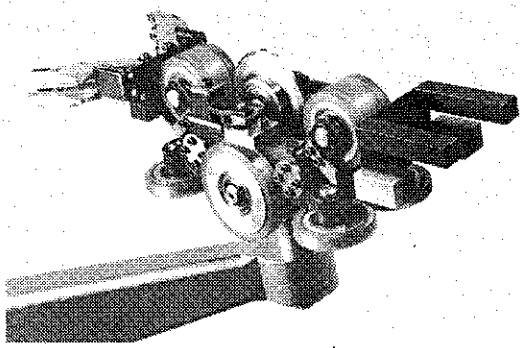
TYPICAL VEHICLE DIMENSIONS

SUSPENSION:

Type	2 pneumatic tired automotive wheels and suspension stabilized by leading guidearm
Design Load	1,200 lbs/wheel (550 kg/wheel)
Lateral Guidance	Guided by bogie constrained to ride inside overhead guidebeam with leading arm to veh.

PROPULSION & BRAKING:

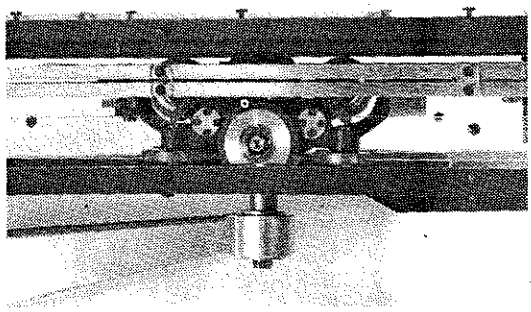
Type & No. Motors	Rotary dc electric traction drive thru support wheels
Motor Placement	Single motor on-board vehicle
Motor Rating	20 HP, 15 kw
Type Drive	Data unavailable
Gear Ratio	Data unavailable
Type Power	600 vdc
Power Collection	Double sided power pick-ups ride on guideway power bus.
Type Service Brakes	Dynamic electric
Type Emergency Brakes	Electrically controlled mechanical wheelbrakes
Emergency Brake Reaction Time	1 sec



GUIDANCE BOGIE

SWITCHING:

Type & Emplacement	Passive for merging - Active mechanical for demerging
Switch Time (lock-to-lock)	0.15 sec
Speed Thru Switch	Mainline cruise speed
Headway Thru Switch	Mainline minimum headway



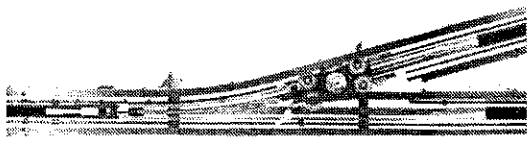
BOGIE INSIDE GUIDEBEAM

GUIDEWAY:

Type	Totally enclosed flat roadbed surface with overhead box guidebeam
Materials	Concrete or steel roadbed, steel overhead box beam
Running Surface Width	Approx 6.5 ft (2 000 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	150 ft (48 m)
Overall Cross Section Width	7.5 ft (2 300 mm)
Overall Cross Section Height	Approx 7.5 ft (2.3 m)
Design Load	Data unavailable
Double Lane Elevated Guideway:	Data unavailable
Guideway Passenger Emergency Egress	Exit vehicle to guideway, walk along guideway to nearest station [e]
Type Elevated Guideway Support Columns	T-section [e]

CONTROL:

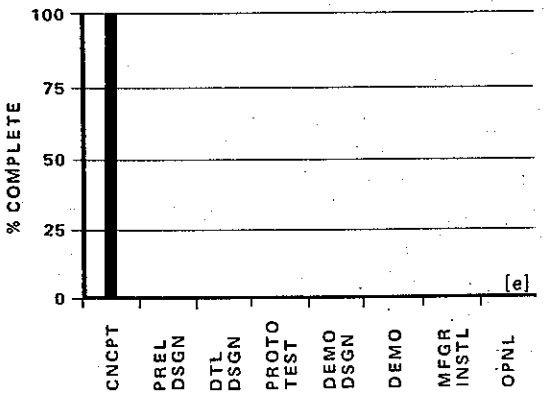
Control is by a hierarchial computer system with quasi-synchronous network control. Virtual slots (vehicle plus separation distance length) move along the guideway with vehicles assigned to a particular slot. Vehicles receive discrete commands from wayside computers having control over certain jurisdictions. A central computer supervises and controls the total network processing demands, dispatching empty vehicles, and assigning routes.



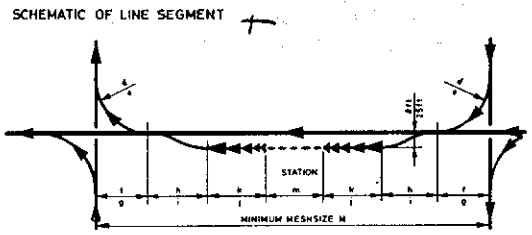
BOGIE IN SWITCH SECTION

STATIONS:

A typical off-line station would be 115 ft (35 m) long. Total off-line guideway length, including acceleration and deceleration, and station lengths for 37 mph (60 km/hr) mainline cruise speed and 8.2 ft/s^2 (2.5 m/s^2) accel/decel, could be 1,119 ft (341 m).



DEVELOPMENT STATUS



SCHEMATIC OF LINE SEGMENT

c	mph	45	38	31	25	19
d	ft	328	236	161	98	62
e	ft	525	380	260	157	95
f	ft	364	262	181	111	66
g	ft	585	423	285	177	105
h	ft	207	177	144	115	88
i	ft	381	314	259	203	158
k	ft	361	266	184	118	72
l	ft	295	216	148	98	62
m	ft	115	115	115	115	115
M	ft	1850	1430	1060	784	548

c mainline speed
d min. curve radius, 15% superelevation
e min. curve radius, no superelevation
f min. space, 90° turnoff with 15% superelevation
g min. space, 90° turnoff no superelevation
h S-transition with parallel spur at 8 ft
i S-transition with parallel spur at 25 ft
k accel. or decel. segment at 6.56 ft/s^2
l accel. or decel. segment at 8.02 ft/s^2
m station length
M Minimum grid mesh length

NETWORK INSTALLATION DIMENSIONS

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The Elan-Sig PRT project has been suspended pending increased demand for system production.

The concept was designed based on numerical data from provisional and assumed values. Models of vehicles, guideway, guidance, bogie and the switch have been fabricated. A prototype station and short length of guideway were planned. The vehicle and control system, both of which would be detail designed to suit the particular application and customer specification, were under development.

INSTALLATIONS & CONTRACTS:

Presently no installations are planned or committed to.

COSTS: [a]

Data insufficient for publication

INSTALLATION OR RETROFIT CAPABILITY:

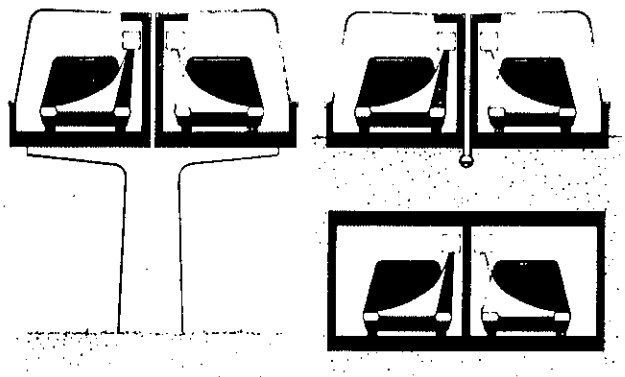
Single Lane Guideway Envelope Width . . . . . 7.5 ft (2.29 m)
Single Lane Guideway Envelope Height . . . . . 7.5 ft (2.29 m)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 20%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 240 ft (73 m)
Construction Process . . Guideway sections could be prefabricated [e]
Staging Capability . . . . . Sections could be operated while others under construction

LIMITATIONS:

Because the steering control force attach point is ahead of the propulsion force (in the powered mode), horizontal plane moments may be generated with resultant action a tendancy to turn the vehicle or cause fish-tailing.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]
Visual . . . . . Single elevated enclosed guideway [f]
H_1 & H_2 – 7.5 ft (2.3 m)
W_1 & W_2 – 7.5 ft (2.3 m)
P_1 & P_2 – 10.6 ft (3.23 m)
Noise . . . . . Expected to be approximately same or less than conventional electric trolley buses [b]



GUIDEWAY INSTALLATION VARIATIONS

FLYDA CHAIR

CLASSIFICATION: Personal Rapid Transit*

OTHER NAMES: None

DEVELOPER: Flyda Ltd.
The Manor House
South Cerney
Cirencester
Gloucestershire GL7 5TT
England
Tel: South Cerney 317

LICENSEES: None

PATENTS: U.K. Patent Nos. 1,213,453 and 1,371,511
U.S. Patent Nos. 3,777,667, 3,780,666 and 3,871,300

DATA REFERENCE CODE: [b 21]

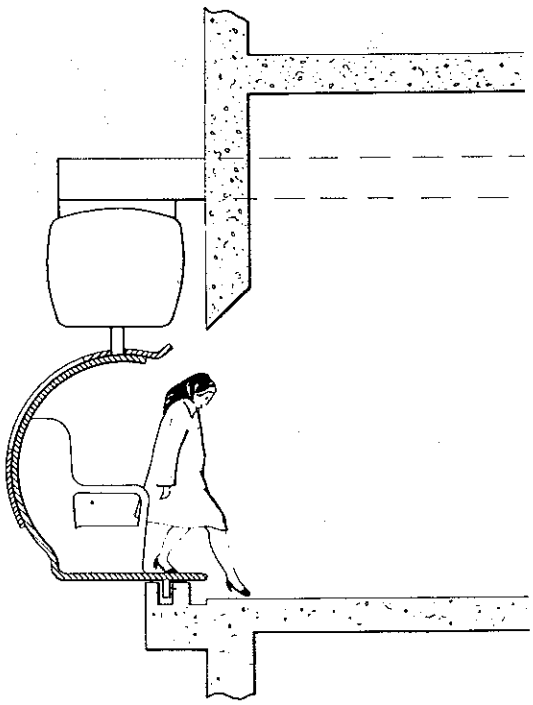
SYSTEM DESCRIPTION:

The system has been designed for application in activity centers and supplementary to public transport within large and medium-sized existing towns; to link pedestrian areas, parking lots, bus and rail interchanges. Guideways pass over streets, initially, but may subsequently be dismantled and re-erected to pass through special buildings, when major urban redevelopment makes this possible.

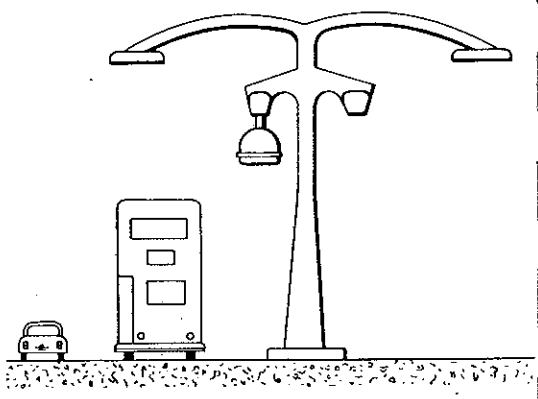
Two systems are offered, the C. 10 and the C. 30. Both offer an alternative to moving way transit, and are for distances of from 591 ft (180 m) upwards to 5 or 15 mi (8 or 24 km), respectively. The C. 10 is designed primarily for indoor use and for economy at light loads. Both systems offer demand-activation. A passenger may have exclusive use of a vehicle or share it with others, if he desires.

High capacity is provided by train formation. When in transit, individually demand-activated cars are able freely to join and diverge from continuously circulating "contact trains" and "discrete groups" (not platoons). Vehicles are automatically coupled. Uncoupling is by transverse relative motion on diverge or at stations. Trains and discrete groups conform to "option schedule", which is rigorously timed for approximately 15 sec to 60 sec headways. Cars per train can be up to 30 or 60, depending on demand.

PERSPECTIVE VIEW OF C.30 FLYDA CHAIR SYSTEM ALONG A STREET



ACCESS TO C.30 FLYDA CHAIR



INSTALLATION IN STREET MEDIAN

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	12,000/36,000 psgrs/hr[1]
Max Practical One-Way Capacity	6,000/18,000 psgrs/hr
Min Practical Headway	27/18 sec
Availability	On-demand
Type Service	C.10 - short corridor plus local area collection & distribution C.30 - corridor plus collection & distribution
Type Network	Linear or loops or grid
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicle or 5 vehicle trains

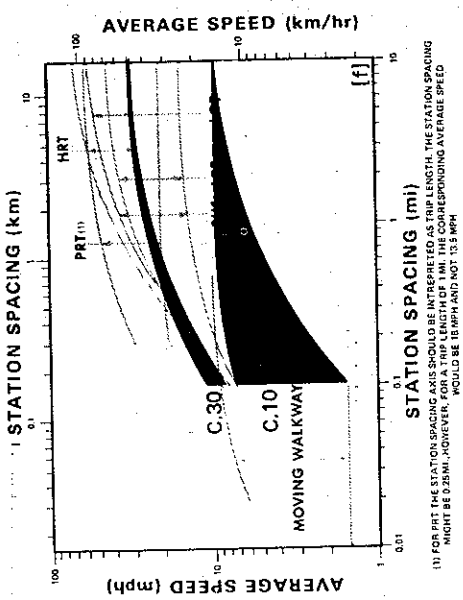
VEHICLE PERFORMANCE:

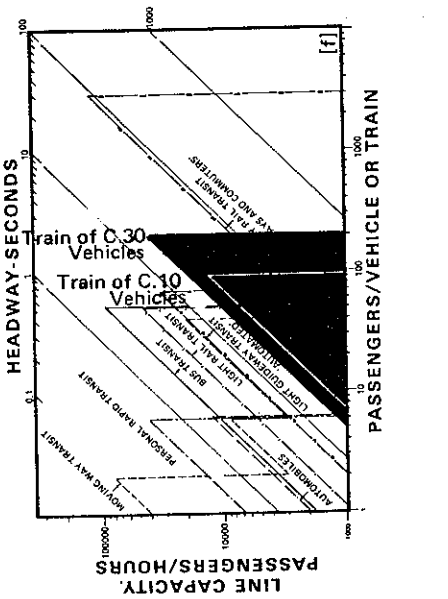
Cruise Velocity	$10/30^2$ mph (16/48 km/h)
Max Velocity	$10/30^2$ mph (16/48 km/h)

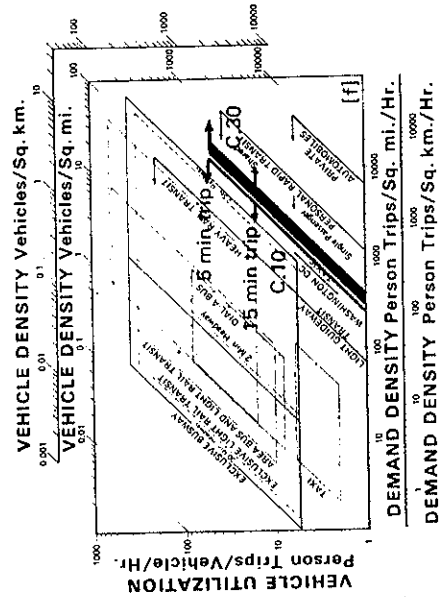
[1] All data shown are C.10/C.30 respectively.

PUBLISHER'S NOTE:

Two different systems are proposed: C.10 and C.30. Unless specifically stated the information herein relates to both systems.







Max Grade	12%
Service Acceleration	2.7 ft/s^2 (0.8 m/s^2)
Service Deceleration	2.7 ft/s^2 (0.8 m/s^2)
Max Jerk	3 ft/s^3 (1 m/s^3)
Emergency Decel	2.7 ft/s^2 (0.8 m/s^2)
Stopping Precision in Station	±2 in (±50 mm)
Degradation if Guideway is Wet	Guideway is protected on underside
Degradation for Ice & Snow	Guideway is protected on underside
Vehicle Design Capacity	3 or 4 seated, 0 standing
Vehicle Crush Capacity	3 or 4 seated, 0 standing
Energy Consumption, Accelerating and Decelerating Only	
Empty Vehicle	0.07/0.09 kwh/veh-mi (0.04/0.06 kwh/veh-km)
At Design Capacity	0.10/0.12 kwh/veh-mi (0.06/0.08 kwh/veh-km)
Energy Consumption, Cruise Only	
Empty Vehicle	0.03/0.08 kwh/veh-mi (0.02/0.05 kwh/veh-km)
At Design Capacity	0.03/0.09 kwh/veh-mi (0.02/0.06 kwh/veh-km)

STATIONS:

Type	Normally off-line
Type Boarding	Level, stopped
Ticket or Fare Collection	Automatic machines
Security	One policed station, others located in shopping areas
Boarding Capacity Deboarding Capacity	700 veh/hr/4-berth station or 1,000 psgr/hr assuming 1.5 psgr/veh
Max Wait Time	0 for unsaturated operation [f]
Vehicle in Station Dwell Time	Avg 10 sec; max - 30 sec
Average Station Spacing	Min 300 ft (91 m)

INDIVIDUAL SERVICE:

Privacy	Exclusive use of vehicle by one passenger
Transfers	Not necessary
Stops	May stop at some merge points
Accommodation	Seated only
Comfort	Provision for air conditioning where required
Security	Emergency routing to policed station - passenger or automatically commanded
Instruction	Station graphics supplemented by telephone

RELIABILITY & SAFETY:

Fail Safe Features . . . . . (1) Any main on-guideway programmer (duplicated + fail safe), (2) Brake total failure, mechanical or electrical, (3) Any traction failures, including fall in speed, power supply or brake failure, (4) On-guideway switching

Fail Operational Features . . . . . (1) Any one on-board routing programmer, (2) Most traction failures, (3) Any one power collector, (4) On-board switching

Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Not yet defined

Strategy For Removal of Failed Vehicle . . . . . Tow or push by adjacent coupled vehicle, with enslaved on-board switching

Strategy For Passenger Evacuation of Failed Vehicle . . . . . Passengers step out to walkway (indoors) or to elevated platform on road vehicle (or boat where guideway spans water).

System Lifetime . . . . . Not yet defined

Vehicle Lifetime . . . . . Not yet defined

MAINTENANCE:

The vehicle uses four sets of power collector shoes every 28 days running time.

The malfunction detection system automatically routes vehicles to the maintenance siding.

The guideway is treated with a 20 year preservative which has a premature deterioration indicator layer.

The guideway may be removed in sections for retreatment.

CARGO CAPABILITY:

Passenger Articles	Small articles, optional special stowage space
Goods Movement	Small articles only

PERSONNEL REQUIREMENTS:

Attendants are required at central control and possibly at a few select stations. Maintenance and administrative personnel are required. Vehicles are unmaned.

[2] **Both the C.10 and the C.30 are planned for subsequent development to approximately twice these velocities.**

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 3 seats - 6.5 ft (2 m), 4 seats or 3 plus luggage - 8.17 ft (2.5 m)
Overall Width . . . . . 5 ft (1 520 mm)
Overall Height . . . . . C.10 - 6.67 ft (2.03 m); C.30 - 7.33 ft (2.23 m)
Empty Weight . . . . . C.10 - 800 or 950 lbs (364 - 432 kg); C.30 - 1,000 or 1,150 lbs (455 - 523 kg)
Gross Weight . . . . . C.10 - 1,232 or 1,522 lbs (560 - 692 kg); C.30 - 1,420 or 1,722 lbs (645 - 783 kg)
Passenger Space (Design Load) . . . . . 13.7 ft^2 (1.27 m^2) seated
Doorway Width . . . . . 4.5 ft (1.37 m)/3 psgr veh; 5.9 ft (1.8 m)/4 psgr veh or 3 psgr plus luggage
Doorway Height . . . . . 4.82 ft (1.47 m)
Step Height . . . . . Data unavailable

SUSPENSION:

Type . . . . . C.10 - 2 overhead bogies, polyurethane tires C.30 - overhead carriage, pneumatic rubber tires
Design Load . . . . . 1,500 lbs (680 kg)/front suspension 1,540 lbs (700 kg)/rear suspension
Lateral Guidance . . . . . Bogies constrained by lateral guidewheels to run inside guideway

PROPULSION & BRAKING:

Type & No. Motors . . . . . Rotary electric induction motor - traction drive
Motor Placement . . . . . One or two motors per vehicle
Motor Rating . . . . . C.10 - 2 or 4 bHP, C.30 - 20 bHP
Type Drive . . . . . Fixed ratio reduction gears
Gear Ratio 3.4:1
Type Power . . . . . 380 - 440 vac 3ϕ 50 hz
Power Collection . . . . . 4 collector assemblies per vehicle, power rails on guideway
Type Service Brakes . . . . . Dynamic regenerative and plug
Type Emergency Brakes . . . . . Mechanical power-hold-off brakes
Emergency Brake Reaction Time . . . . . 0.25 sec

SWITCHING:

Type & Emplacement . . . . . On-board — wheel on arm captures overhead guide-rail. On-guideway — moving guide-rail captures wheel.
Switch Time (lock-to-lock) . . . . . 0.25 sec (on-board or on guideway)
Speed Thru Switch . . . . . Mainline speed
Headway Thru Switch . . . . . Mainline headway

GUIDEWAY:

Type . . . . . Overhead inverted U-shaped box-beam
Materials . . . . . Double skin steel with foam interfilling
Running Surface Width . . . . . Not applicable
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 39.4/65.6 ft (12/20 m)
- Overall Cross Section Width . . . . . 1.70/2.50 ft (514/762 mm)
- Overall Cross Section Height . . . . . 1.58/2.25 ft (480/690 mm)
- Design Load . . . . . 235 lbs/ft (349 kg/m)

Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 39.4/65.6 ft (12/20 m)
- Overall Cross Section Width . . . . . 6.60/7.42 ft (2 000/2 270 mm)
- Overall Cross Section Height . . . . . 1.58/2.25 ft (480/690 mm)
- Design Load . . . . . 235 lbs/ft (349 kg/m)

Guideway Passenger Emergency Egress . . . . . No
Type Elevated Guideway Support Columns . . . . . Steel fabrications or pre-stressed concrete

CONTROL:

Inter-train headways are controlled by a fixed block system: inter-vehicle (within the same discrete group) by motor speeds only. Every vehicle has means automatically to initiate synchronized emergency stop precedure for the train or group concerned.

Sections of guideway have designated speeds, which are controlled by guideway power supply. Merging is quasi-deterministic. Momentary stops at some merge points may occur as required to impose schedule and for automatic coupling.

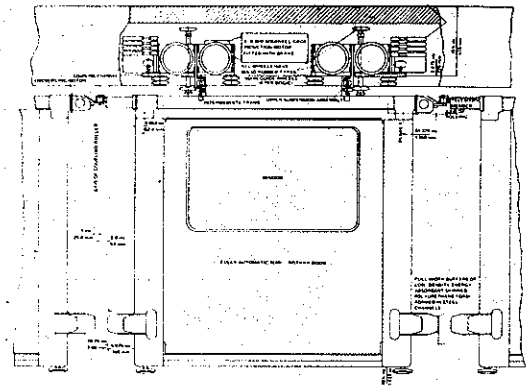
Variable routing is by electronic destination symbols. A pre-set group of symbols is transmitted before demerge points. Each vehicle has means to recognize its own and actuate on-board switching.

Regenerative and capacitance braking, is used with no-voltage mechanical brakes for holding and emergency.

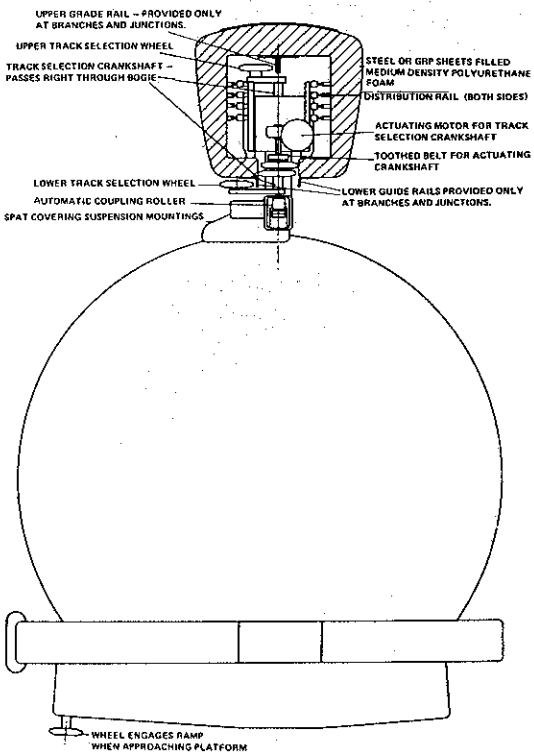
STATIONS:

Three types of stations: on-line stations, within buildings and for very simple installations; single-platform off-line stations, which are the most usual form, with four berths; and parallel off-line stations, for high capacity.

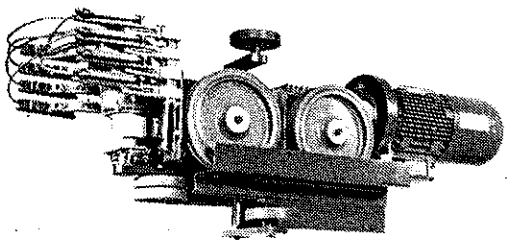
POWER COLLECTORS (FOURTH FOR SIGNALLING PURPOSES)



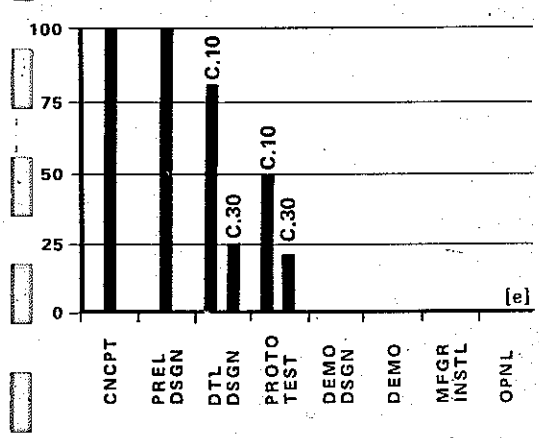
GENERAL ASSEMBLY SIDE VIEW C.10



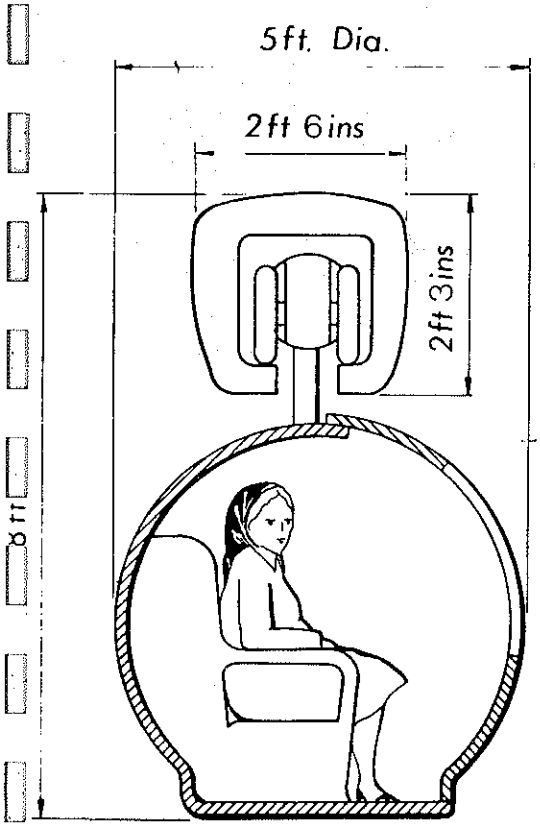
GENERAL ASSEMBLY END VIEW C.10



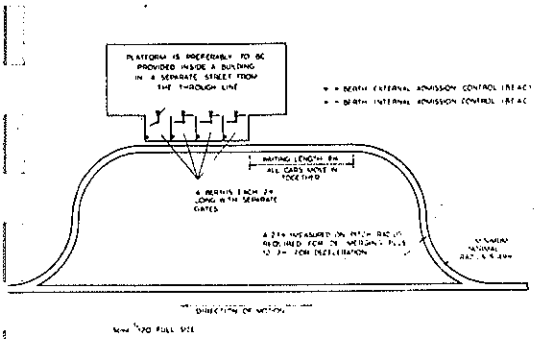
POWERED BOGIE



DEVELOPMENT STATUS



C.10 AND C.30 DIMENSIONS



TYPICAL C.10 STATION

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Commercial funding for the study has been established. Analysis of traffic movements when operating the network under line haul and optional scheduling and by contact trains has begun. Construction of scale models, full scale bogey and emergency stop precedure simulation has also begun by Flyda Ltd. A full scale development and prototype test program is planned.

INSTALLATION STUDIES & PROPOSALS:

Following proposals have been made:

1. Two 0.75 mi (1.2 km) link between railway station and city center with planned subsequent extension.
2. A 2 mi (3.4 km) loop from bus stops to city center.
3. A 1 mi. (1.6 km) link between railway station and city center, via a restricted access bridge.
4. As for 3, but through development property.
5. A 0.5 mi (0.8 km) link between railway station and two parking lots.
6. Network for urban island due for redevelopment.
7. Link between HRT station, parking lot and an international exhibition site and for internal circulation.

COSTS:

[Costs are based upon 1974 British pound sterling converted to U.S. $ at 2.5:1 and a typical system of 1 mi (1.6 km) single lane guideway, 3 stations, 99/35 vehicles, 7,200 veh-mi/day, 900 veh-hr/day, 16 hrs operation per day]

Capital Cost . . . . . Total Avg of $962,000/$889,000/mi ($601,000/$555,000/km) single lane
- Avg Cost per Vehicle . . . . . $3,000/$4,250
- Avg Cost per Single Lane Guideway . . . . . $425,000/$500,000/mi ($264,000/$313,000/km)
- Avg Cost Per Station . . . . . (Nominal allowance) $30,000
- Computers, Software, & Control Center . . (Nominal allowance) $50,000
- Maintenance & Storage Facilities . . . . . (Nominal allowance) $50,000
- Power Distribution & Substations . . . . . (Nominal allowance) $50,000

Operation & Maintenance Costs . . . . .
Fixed Cost $83/$100/weekday + Variable Cost $11/$29/weekday
=
Total Avg $10.8/$43.0/veh-hr or $1.31/$1.79/veh-mi ($0.82/$1.11 veh-km)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 8.7 ft (2.64 m)
Single Lane Guideway Envelope Height . . . . . 7.16/7.83 ft (2.18/2.39 m)
Single Lane Guideway Structural Weight . . . . . 47.8/71.7 lbs/ft (71/107 kg/m)
Double Lane Guideway Structural Weight . . . . . 96/143 lbs/ft (142/214 kg/m)
Max Grade . . . . . .C.10 and C.30 - 13%
Min Vertical Turn Radius . . . . . 16/27 ft (4.87/8.2 m) at 4.5/10 mph (6.6/16 km/h)
Min Horizontal Turn Radius . . . . . 18/20 ft (5.5/6.1 m) at 10 mph (16 km/h)
Construction Process . . . . . Prefabricated guideway spans transported to site in standard I.S.O. containers
Staging Capability . . . . . Sections may be operated while others under construction

LIMITATIONS:

Maximum trip distance is limited by relatively low speeds as initially proposed.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]
Visual . . . . . .Single elevated guideway [f]
- C.10: H_1 – 1.56 ft (0.48 m); H_2 – 7.2 ft (2.19 m)
  W_1 – 1.69 ft (0.52 m); W_2 – 5 ft (1.52 m)
  P_1 – 2.3 ft (0.70 m); P_2 – 6.4 ft (1.95 m)
- C.30: H_1 – 2.34 ft (0.71 m); H_2 – 8 ft (2.43 m)
  W_1 – 2.53 ft (0.77 m); W_2 – 5 ft (1.52 m)
  P_1 – 3.4 ft (1.04 m); P_2 – 7.2 ft (2.19 m)

Noise . . . . . .Advance specification of 66 dbA at 24.6 ft (7.5 m) from guideway and 67 dbA inside vehicle [b]

MONOCAB

CLASSIFICATION: Personal Rapid Transit

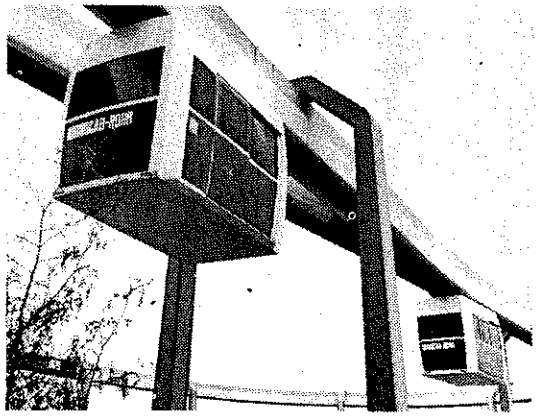
OTHER NAMES: Varo-Monocab

DEVELOPER: Rohr Industries, Inc.
Advanced Transportation Systems Division
P.O. Box 878
Chula Vista, California 92012
U.S.A.
Tel: (714) 426-7111

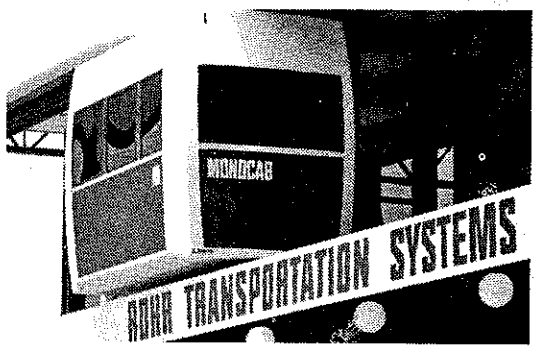
LICENSEES: None

PATENTS: Data unavailable

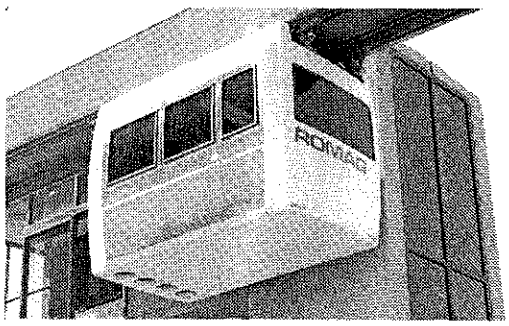
DATA REFERENCE CODE: [a 51]



TRANSPO '72 GUIDEWAY AND VEHICLES



TRANSPO '72 STATION



PROTOTYPE MAGNETICALLY LEVITATED TEST VEHICLE & MINIMUM FOOTPRINT STATION

SYSTEM DESCRIPTION:

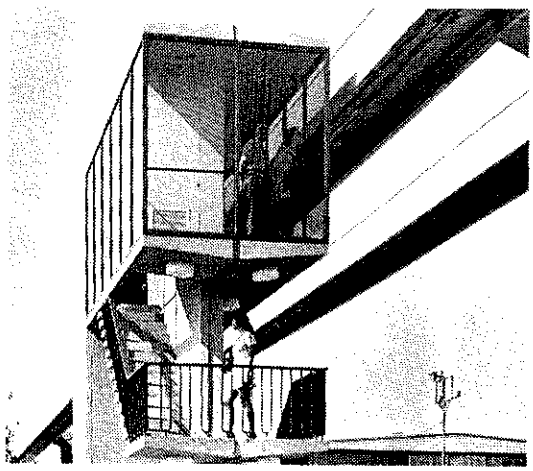
Monocab is a medium-capacity (at present design headway) transportation system of small, automatic, six-passenger vehicles operating on an overhead guideway, using parallel over/under stations, which allow direct origin-to-destination travel without the need for turnarounds or grade changes for access to the main line.

The system is electrically powered, using conventional traction motor drive and rubber tired suspension. A more advanced propulsion system — ROMAG — provides magnetic levitation and linear electric motor propulsion.

Guideway beams are designed to enclose power distribution and control systems for protection. Either concrete or steel may be used for guideway construction.

In addition to the six-passenger vehicle shown at Transpo '72, design work on a 12-passenger vehicle has been completed, implying that a light guideway transit version of Monocab is also available.

Two classes of demand service are available, rent-a-cab or rent-a-seat. In rent-a-cab, the passenger, by paying his fare, reserves an entire cab for him and his party, which takes his party nonstop from origin to destination. In rent-a-seat service, the passenger still operates on a nonstop origin-to-destination trip; however, several passengers in the same origin station, who wish to go to the same destination, may share the cab. The owner may elect to program the system for scheduled service during peak periods.



MINI — FOOTPRINT STATION

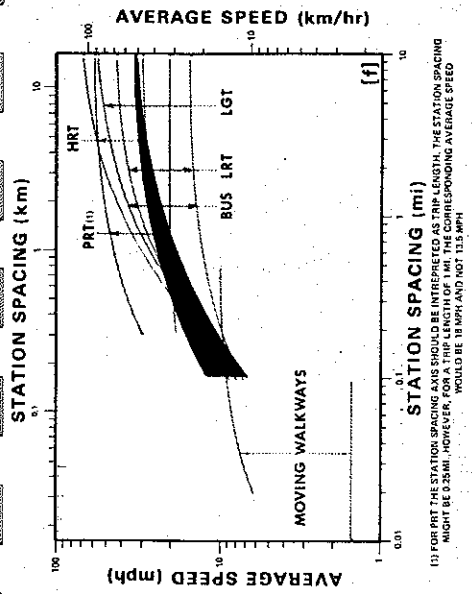
OPERATIONAL CHARACTERISTICS

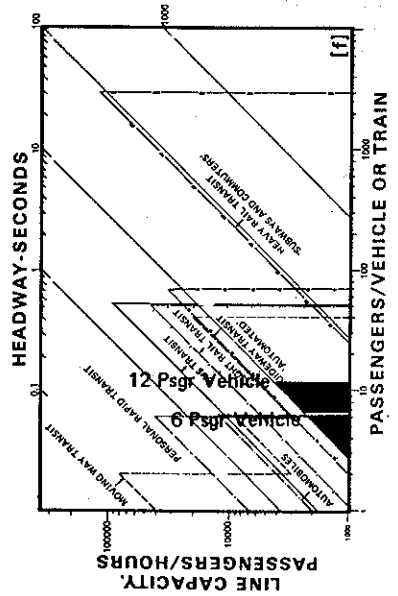
SYSTEM PERFORMANCE: (6 psgr vehicle)

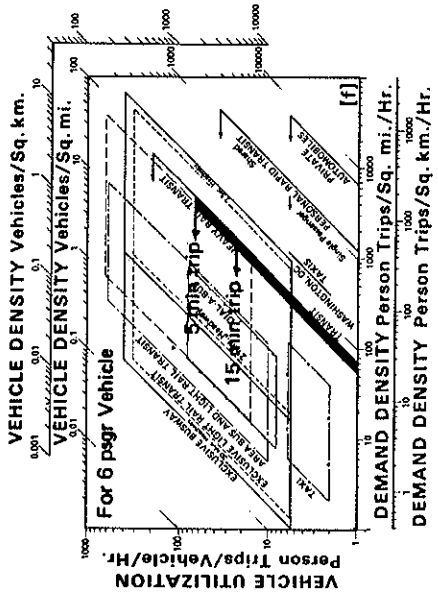
Max Theoretical One-Way Capacity	4,320 psgr/hr
Max Practical One-Way Capacity	2,160 psgr/hr
Min Theoretical Headway	5 sec
Min Practical Headway	10 sec
Availability	Any combination of on-demand or scheduled service
Type Service	Limited area collection and distribution
Type Network	Interconnecting loops or grid for max service
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles

VEHICLE PERFORMANCE:

Cruise Velocity	35 mph (56 km/h)
Max Velocity	45 mph (72 km/h)
Max Grade	10%







Service Acceleration	4 ft/s^2 (1.22 m/s^2)
Service Deceleration	4 ft/s^2 (1.22 m/s^2)
Max Jerk	4 ft/s^3 (1.22 m/s^3)
Emergency Decel	13 ft/s^2 (4 m/s^2)
Stopping Precision in Station	±6 in (±152 mm)
Degradation if Guideway is Wet Degradation for Ice & Snow	None, vehicle rides underneath guideway. Bogie with all moving parts is enclosed inside guideway beam.
Vehicle Design Capacity	6 seated, 0 standing
Vehicle Crush Capacity	6 seated, 0 standing
Energy Consumption, (Accel + Decel + Cruise)	
Empty Vehicle	1.1 kwh/veh-mi (0.69 kwh/veh-km)
At Design Capacity	1.3 kwh/veh-mi (0.81 kwh/veh-km)

STATIONS:

Type	Off-line, where possible
Type Boarding	Level
Ticket or Fare Collection	Automatic system
Security	Closed circuit TV, option
Boarding Capacity	720 psgrs/hr/berth
Deboarding Capacity	720 psgrs/hr/berth
Max Wait Time	5 min
Vehicle in Station Dwell Time	20 sec
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles
Transfers	Not necessary
Stops	Non-stop service
Accommodation	Seated only
Comfort	Heating and air conditioning
Security	Intercom and alarm button, reroute capability
Instruction	Active and passive station graphics

RELIABILITY & SAFETY:

Fail Safe Features	Propulsion, doors, vehicle separation, braking, switching
Fail Operational Features	Redundant computers, power supplies, and communication links; minor maintenance alerts
Total System Mean Time Before Failure System Restore Time After Failure Station Mean Time Before Failure Station Restore Time After Failure Vehicle Mean Time Before Failure	Data unavailable
Strategy For Removal of Failed Vehicle	Auxiliary power, creep mode, push or pull with retrieval vehicle
Strategy For Passenger Evacuation of Failed Vehicle	Creep or push/pull to next station, ground service vehicle for manual recovery
System Lifetime	Data unavailable
Vehicle Lifetime	Data unavailable

MAINTENANCE:

Inspection Frequency (One-way guideway assumed)	
Guideway	0.2 hrs every 7 days/1 mi (1.61 km)
Station	0.05 hrs every 1 day/station
Vehicle	0.2 hrs every 1 day
Periodic Maintenance	
Guideway	As required
Station	1 hrs every 90 days/station
Vehicle	3 hrs every 30 days
Adjustments Required	Guideway maintenance as required
Other Maintenance	Wayside and shop equipment as needed, periodic maintenance on wayside controls and mechanisms

CARGO CAPABILITY:

Passenger Articles	10 ft^3 (0.28 m^3) parcels and luggage under and behind seats and in aisle
Goods Movement	Vehicle without seats may be used for 190 ft^3 cargo

PERSONNEL REQUIREMENTS:

[Typical System of 1,000 vehicles, 2,000 stations and 200 mi (322 km) of one-way guideway]

No. of Operators/Vehicle	0
No. of Attendants/Station	0
No. of Administration Personnel	3
No. of Central Control Attendants	3/8 hrs
No. of Maintenance Personnel	115
Engineering Staff	3

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	9.6 ft (2.92 m)
Overall Width	5.5 ft (1.68 m)
Overall Height	6.6 ft (2.02 m)
Empty Weight	4,000 lbs (1 820 kg)
Gross Weight	5,000 lbs (2 270 kg)
Passenger Space (Design Load)	4.5 ft^2 (0.41 m^2) seated
Doorway Width	36 in (920 mm)
Doorway Height	75 in (1 900 mm)
Step Height	Level

SUSPENSION:

Type	Foam-filled rubber tires, dampened with air springs and shock absorbers
Design Load	2,500 lbs (1 135 kg)/front suspension 2,500 lbs (1 135 kg)/rear suspension
Lateral Guidance	Lateral wheels on center blade, dampened with springs

PROPULSION & BRAKING:

Type & No. Motors	DC shunt, electric
Motor Placement	One per vehicle
Motor Rating	40 HP at 2,500 rpm
Type Drive	Coupled
Gear Ratio	5.38:1
Type Power	480 vac 3ϕ
Power Collection	On-board vehicle
Type Service Brakes	Dynamic regenerative
Type Emergency Brakes	Mechanical friction
Emergency Brake Reaction Time	Less than 1.0 sec

SWITCHING:

Type & Emplacement	Positive entrapment switch on vehicle activated by wayside divertor
Switch Time (lock-to-lock)	Less than 1.0 sec
Speed Thru Switch	35 mph (56 km/h) max
Headway Thru Switch	10 sec min

GUIDEWAY:

Type	Overhead inverted U box beam, 2 level running surfaces
Materials	Fabricated steel or reinforced concrete
Running Surface Width	0.67 ft (200 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	120 ft (37 m)
Overall Cross Section Width	2.6 ft (795 mm)
Overall Cross Section Height	3 ft (915 mm)
Design Load	800 lbs/ft (110.6 kg/m)
Double Lane Elevated Guideway	2 single guideways at 10 ft (3.1 m) centerline-to-centerline
Guideway Passenger Emergency Egress	None
Type Elevated Guideway Support Columns	Inverted L or T shape of fabricated steel or reinforced concrete

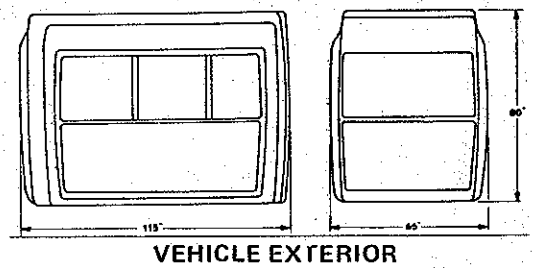
CONTROL:

Protection and control of system elements is accomplished through a distributed network of computer complexes. Network management is furnished by a centrally-located computer. A variable length moving block protection and control system, designed using established transit failsafe principles, allows movement of the vehicles at the highest speeds possible consistent with safety and traffic density. Failures always cause the system to revert to a state known to be safe.

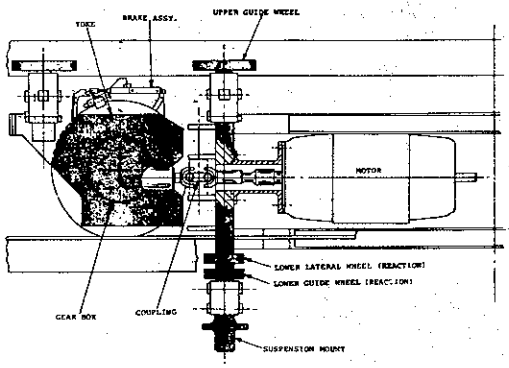
STATIONS:

Stations are designed as a function of site specific anticipated trip demand rate. Developer will assist architects in design of stations. With a properly balanced system, operating on-demand, much smaller station waitng areas are needed.

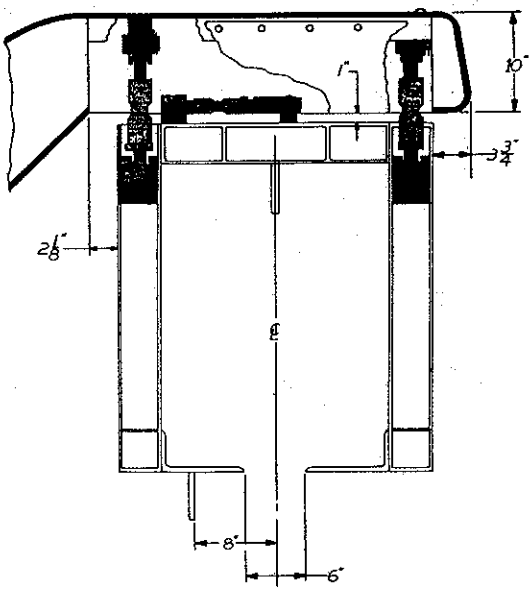
Minimum wait times, dynamic graphics, and functional design make passenger flow continuous, causing minimum queuing.



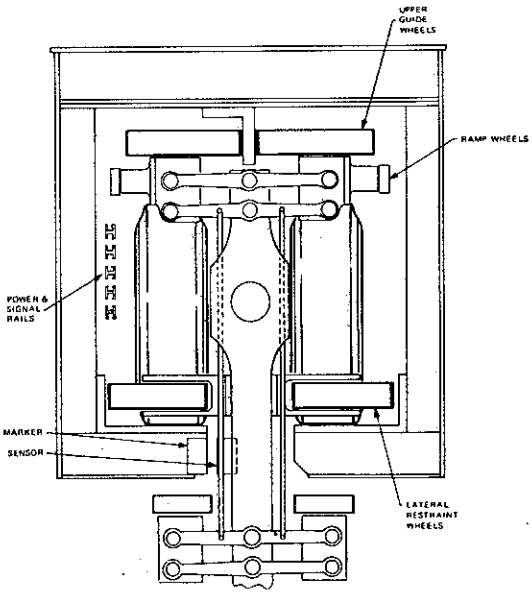
VEHICLE EXTERIOR



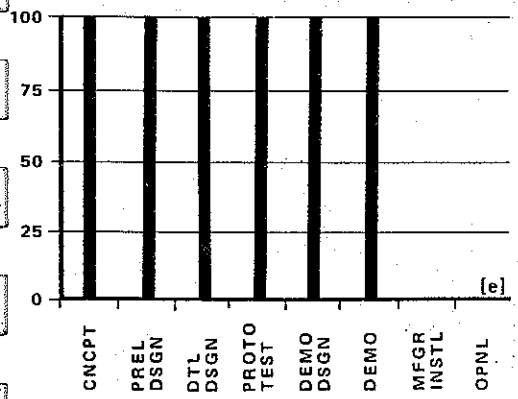
PROPULSION AND GUIDANCE



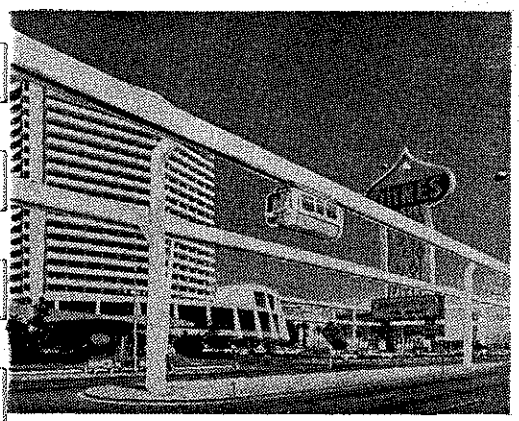
GUIDEWAY CROSS SECTION



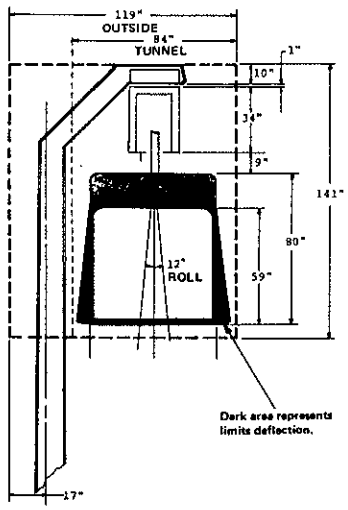
VEHICLE SUSPENSION



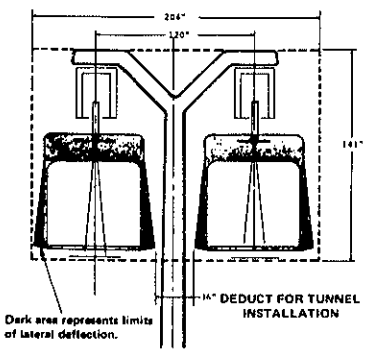
DEVELOPMENT STATUS



PHOTOMONTAGE OF LAS VEGAS SYSTEM



SINGLE COLUMN ENVELOPE



DOUBLE COLUMN ENVELOPE

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The Monocab system was first developed by Varo Corporation in 1969. It was acquired by Rohr in 1971. The system was successfully demonstrated at Transpo '72 in May, 1972. A test facility operated in Garland, Texas, for nearly three years and developed valuable data for product improvement. Development of a magnetically-levitated system has proceeded at Chula Vista, California, including a prototype test facility. In addition, design work has been completed on a 12-passenger vehicle which utilizes the same guideway and stations as the 6-passenger vehicle.

INSTALLATIONS & CONTRACTS:

The Monocab system was selected to build 22 mi (35 km) double guideway system in Las Vegas to connect major hotels, convention center, and airport. However, it has been reported that Rohr has now withdrawn their proposal. [c]

Transpo '72 demonstration — Single guideway loop of approx 0.33 mi (0.53 km) length, one off-line station, one off-line maintenance facility and 2 vehicles (dismantled)

Chula Vista Facility — 500 ft (152 m) of mainline guideway, 400 ft (122 m) of off-line station guideway, an elevated off-line station, and one vehicle.

COSTS:

[Based upon typical system of 22 mi (35.5 km) single lane guideway, 21 stations, 140 vehicles, 430 veh-mi/day, 20 veh-hr/day, 24 hrs operation per day]

Capital Cost . . . . . Total avg of $4 mill/mi ($2.5 mill/km) single lane

- Avg Cost per Vehicle $80,000
- Avg Cost per Single Lane Guideway . . . . . $1.2 mill/mi ($0.74 mill/km)
- Avg Cost per Station $150,000
- Computers, Software, & Control Center . . . . . $1.1 mill/mi ($0.68 mill/km)
- Maintenance & Storage Facilities . . . . . $1.0 mill
- Power Distribution & Substations . . . . . $0.6 mill/mi (0.37 mill/km)

Operation & Maintenance Costs . . . . .

Fixed Cost $6,000/weekday + Variable Cost $10,000/weekday
Total Avg $4.76/veh-hr or $0.27/veh-mi ($0.17/veh-km)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	See drawings at left
Single Lane Guideway Envelope Height	See drawings at left
Single Lane Guideway Structural Weight	276 lbs/ft (411 kg/m)
Double Lane Guideway Structural Weight	552 lbs/ft (823 kg/m)
Max Grade	10%
Min Vertical Turn Radius	300 ft (91.5 m) at 21 mph (33.8 km/h)
Min Horizontal Turn Radius	25 ft (7.6 m) at 4.75 mph (7.65 km/h)
Construction Process	Prefabricated guideway sections
Staging Capability	Sections may be operated while others under construction.

LIMITATIONS:

Shorter headways may require different headway control system design.

Switch operation time may limit short headway operation to values greater than 1.0 sec.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Meets FCC requirements

Visual, Single Lane Elevated Guideway . . . . .

H_1 — 2.9 ft (0.89 m), H_2 — 10.25 ft (3.12 m)
W_1 — 2.5 ft (0.76 m), W_2 — 5.5 ft (1.68 m)
P_1 — 3.75 ft (1.14 m), P_2 — 10 ft (3.05 m)

Noise . . . . . 70 dbA 4 ft (1.2 m) above floor inside vehicle
70 dbA at 50 ft (15.3 m) above
70 dbA at 50 ft (15.3 m) below
70 dbA at 50 ft (15.3 m) to side

TTI/OTIS PRT SYSTEM

CLASSIFICATION: Personal Rapid Transit*

OTHER NAMES: None

DEVELOPER: Otis Elevator Company
Transportation Technology Divisions
11380 Smith Road
Aurora, Colorado 80010, U.S.A.

MAILING ADDRESS:
P.O. Box 7293, Park Hill Station
Denver, Colorado 80207, U.S.A.
Tel: (303) 343-8780
Telex: 45-966

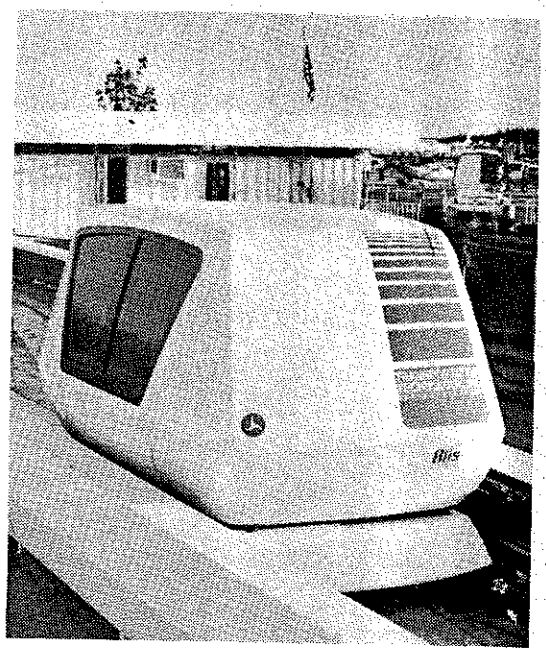
LICENSEES: None

PATENTS: Data unavailable

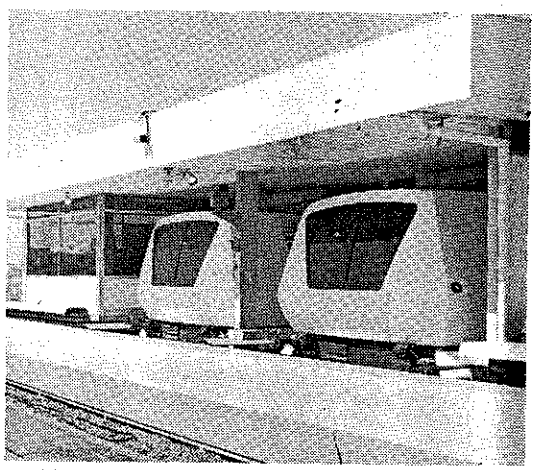
DATA REFERENCE CODE: [a 51]

SYSTEM DESCRIPTION:

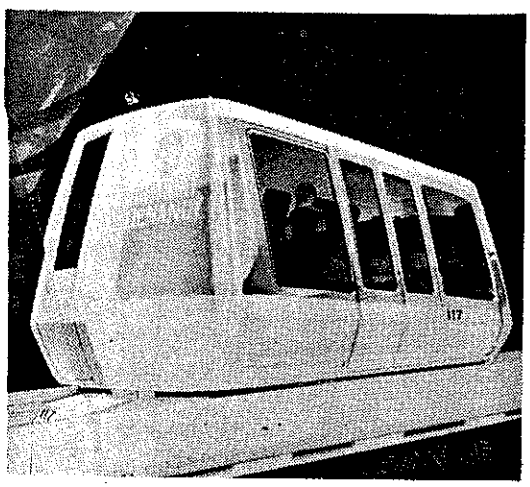
The Otis Elevator Company, Transportation Technology Division (OTIS-TTD), produces automated transit systems for transporting passengers and freight on exclusive guideways. The system hardware is adaptable for use with on-line, off-line, and docking type stations. The vehicles use air-bearing pads for vertical suspension and are propelled by linear induction motors. The air-bearing suspension permits sideways movement of the vehicles into off-line loading-unloading berths and also permits the use of modular chassis construction thus eliminating design constraints on vehicle sizing. Accordingly, the vehicle can be precisely sized for system requirements with a minimum of re-engineering and tooling. Vehicles with capacities of from 5 to 80 passengers have been designed. The vehicles may be connected into trains and a palletized version has also been designed for multi-mode operation.



DEMONSTRATION AT TRANSPO '72



DEMONSTRATION VEHICLES AT DULLES INTERNATIONAL AIRPORT



ARTIST SKETCH OF NANCY VEHICLE

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

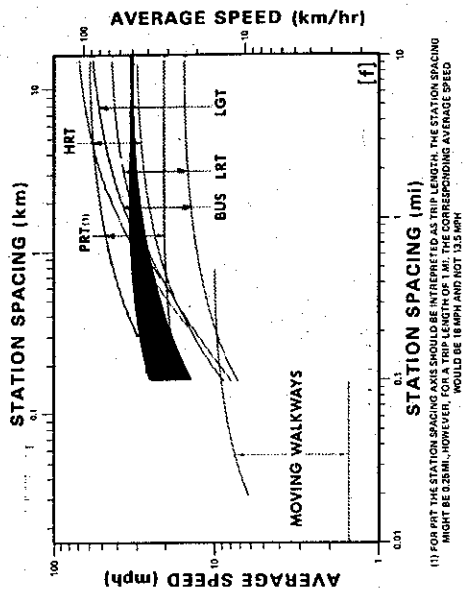
Max Theoretical One-Way Capacity	9,100 psgrs/hr**
Max Practical One-Way Capacity	6,900 psgr/hr
Min Theoretical Headway	45 sec
Min Practical Headway	50 sec
Availability	Scheduled operation, on-line stations; ultimate conversion to single vehicle, off-line stations to permit on-demand operation at less than 10 sec headways
Type Service	Collection and distribution
Type Network	Expandable grid
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicle or 2 or 3 vehicle trains

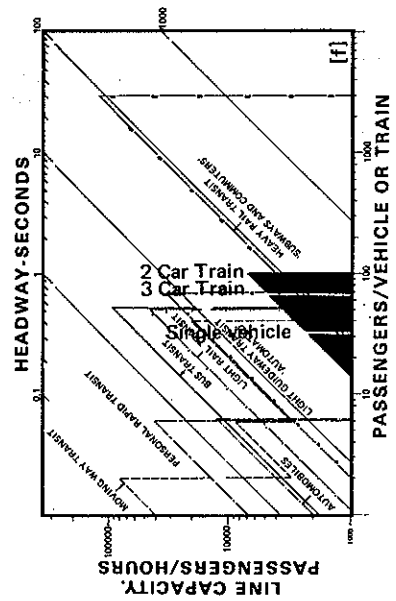
**** Max capacity is calculated using min theoretical headway and crush loading of 3 vehicles per train.**

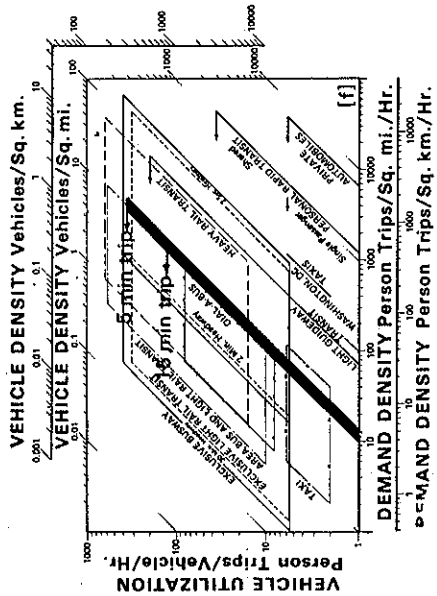
**PUBLISHER'S NOTE:*

The system has been classified as PRT because of the 6-passenger vehicle and the capability for on-demand exclusive use. The reader is advised that the developer offers a basic automated transportation technology which can be tailored to site-specific applications whether it be PRT, LGT, or high speed intercity service.

The data and information herein reported is based on a PRT application with the 6-passenger vehicle.







VEHICLE PERFORMANCE:

Cruise Velocity . . . . . 30.6 mph (49.3 km/h)
Max Velocity . . . . . 33.5 mph (53.9 km/h)
Max Grade 6%
Service Acceleration . . . . . 3.84 ft/s^2 (1.17 m/s^2)
Service Deceleration . . . . . 3.84 ft/s^2 (1.17 m/s^2)
Max Jerk . . . . . 3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel . . . . . 9.6 ft/s^2 (2.93 m/s^2)
Stopping Precision in Station . . . . . ±6 in (152 mm)
Degradation if Guideway is Wet . . . . . .Emergency braking rate reduced to 7.68 ft/sec^2 (2.34 m/sec^2)
Degradation for Ice & Snow . . . . . .Excessive amounts of ice and snow will cause service degradation
Vehicle Design Capacity . . . . . 12 seated, 20 standing
Vehicle Crush Capacity . . . . . 12 seated, 26 standing
Energy Consumption, Accel & Decel only, at Design Capacity . . . . . .
Accel - 15.2 kwh/veh-mi (9.42 kwh/veh-km)
Decel - 2.5 kwh/veh-mi (1.55 kwh/veh-km)
Energy Consumption, Accel & Decel Only, at Design Capacity . . . . . .
1.96 kwh/veh-mi (1.22 kwh/veh-km)

STATIONS:

Type . . . . . On-line, off-line and off-line with docking
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Owner option
Security . . . . . TV surveillance, lighting and station attendants
Boarding Capacity . . . . . 1,200 psgrs/hr/berth
Deboarding Capacity . . . . . 1,200 psgrs/hr/berth
Max Wait Time . . . . . 2 min
Vehicle in Station Dwell Time . . . . . 15 sec
Average Station Spacing . . . . . 0.4 mi (0.64 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Exclusive use or shared
Transfers . . . . . Not necessary
Stops . . . . . .Initially stops at every station, ultimate design is conversion to non-stop service.
Accommodation . . . . . All seated, all standing or combination available
Comfort . . . . . .Enclosed and air conditioned
Security . . . . . Two-way vocal communication with central control
Instruction . . . . . .Passenger route information in station and on-board vehicle

RELIABILITY & SAFETY:

Fail Safe Features . . . . . .Safety system protects against collision due to underspeed, overspeed and switching failure. Main power disconnect occurs if vehicle doors open. There is an automatic freon fire extinguisher system.
Fail Operational Features . . . . . .Partial loss of propulsion, air suspension, equipment overheat, air conditioning, interior lighting, partial loss of redundant switching
Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Data unavailable
Strategy For Removal of Failed Vehicle . . . . . Disabled vehicle can be pushed or pulled by other vehicles.
Strategy For Passenger Evacuation of Failed Vehicle . . . . . .Passengers exit vehicle and walk along guideway walkway.
System Lifetime . . . . . , 50 years
Vehicle Liftime . . . . . 20 years

MAINTENANCE:

Data unavailable

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages and hand luggage stored under seats
Goods Movement . . . . . Special cargo vehicles

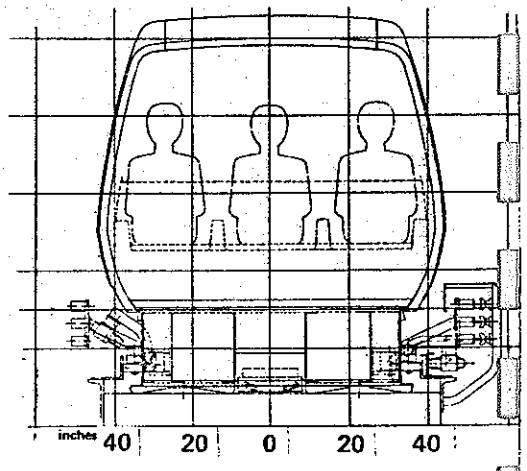
PERSONNEL REQUIREMENTS:

Data unavailable

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 20 ft (6 096 mm)
Overall Width . . . . . 10.74 ft (3 273 mm)
Overall Height . . . . . 9.83 ft (2 996 mm)
Empty Weight . . . . . 11,995 lbs (5 441 kg)
Gross Weight . . . . . 18,040 lbs (8 133 kg)
Passenger Space (Design Load) . . . . . 3.8 ft^2 (0.35 m^2) seated
2.5 ft^2 (0.23 m^2) standing
Doorway Width . . . . . 66 in (1 676 mm)
Doorway Height . . . . . 78 in (1 981 mm)
Step Height . . . . . Level



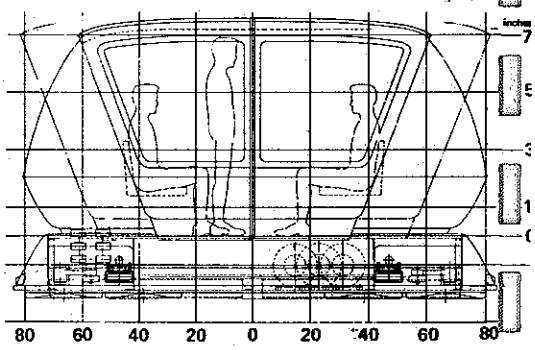
VEHICLE END VIEW

SUSPENSION:

Type . . . . . Air cushion
Lateral Guidance . . . . . Rubber wheels on steel guide rails

PROPULSION & BRAKING:

Type & No. Motors . . . . . Linear induction motors
Motor Placement . . . . . Along axial centerline
Motor Rating . . . . . 140 HP
Type Power . . . . . 480 - 575 vac 3ϕ,400/ϕ max amps
Power Collection . . . . . 3 rail-brush contactors
Type Service Brakes . . . . . Linear induction motors
Type Emergency Brakes . . . Braking materials are affixed to bottom of chassis. Brake pads engage guideway during emergency stop.
Emergency Brake Reaction Time . . . . . 3.25 sec



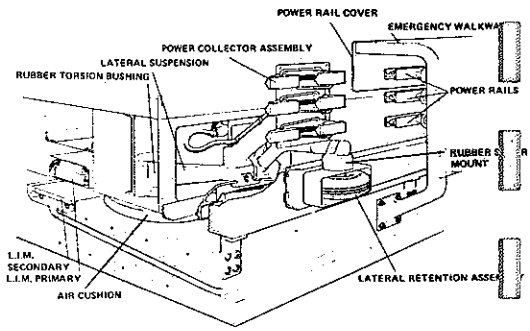
VEHICLE SIDE VIEW

SWITCHING:

Type & Emplacement . . . . . On-board, passive guideway
Switch Time (lock-to-lock) . . . . . 1 sec
Speed Thru Switch . . . . . Mainline speed
Headway Thru Switch . . . . . Mainline headway

GUIDEWAY:

Type . . . . . Shallow U-shaped roadway surface
Materials . . . . . Concrete and steel
Running Surface Width . . . . . 6 ft (1 829 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 100 ft (30.48 m)
Overall Cross Section Width . . . . . 6.9 ft (2 108 mm)
Overall Cross Section Height . . . . . 4 ft (1 219 mm)
Design Load . . . . . 900 lbs/ft (1 339 kg/m)
Double Lane Elevated Guideway:
Max Elevated Span . . . . . 100 ft (30.48 m)
Overall Cross Section Width . . . . . 16 ft (4 877 mm)
Overall Cross Section Height . . . . . 4 ft (1.22 m)
Design Load . . . . . 1,800 lbs/ft (2 679 kg/m)
Guideway Passenger Emergency Egress . . . . . Passengers exit through vehicle emergency exit onto walkway.
Type Elevated Guideway Support Columns . . . Reinforced concrete.



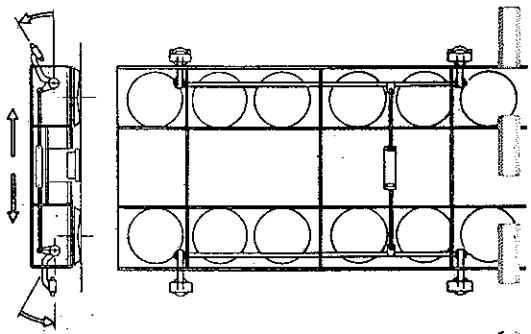
LATERAL SUSPENSION AND RETENTION ASSEMBLY

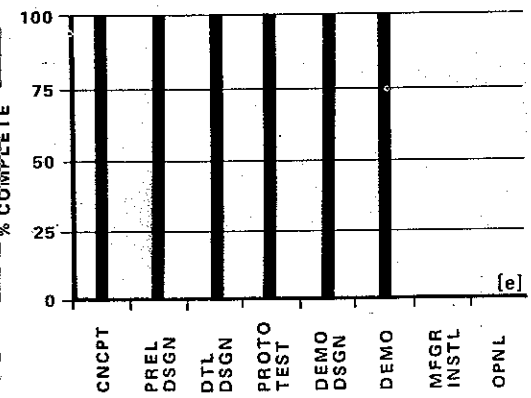
CONTROL:

1) Fixed-block using traditional railway schemes adapted for rapid transit applications
2) Moving-block using distributed minicomputers for operational control, separate fail-safe processors for headway assurance and other safety functions
3) Central computer for display and scheduling

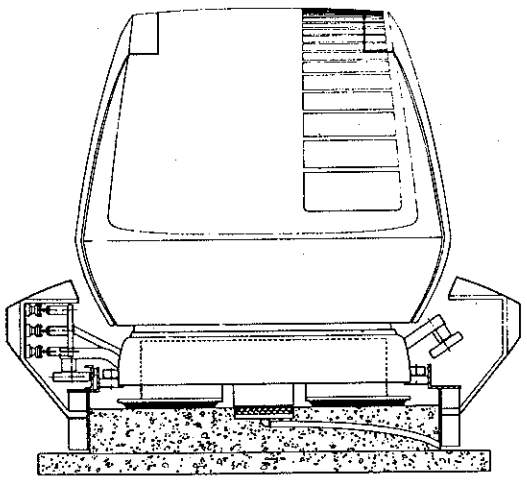
STATIONS:

On-line or docking stops are optional. When docking is used, vehicles are pulled laterally into berth. Docking increases station capacity by eliminating "first-in — first-out" problem.

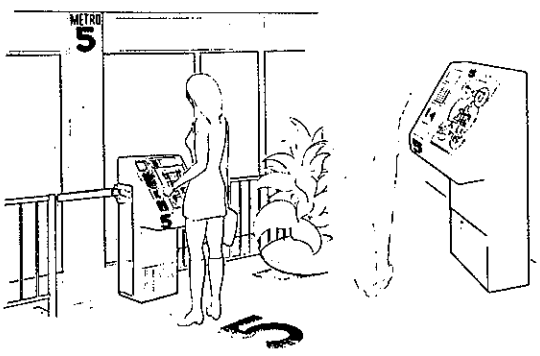

SWITCHING MECHANISM



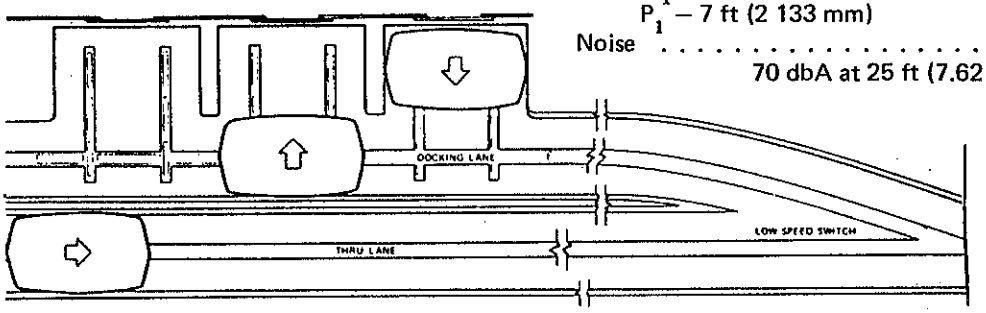
PHASE I
DEVELOPMENT STATUS



VEHICLE GUIDEWAY INTERFACE



ROUTE DISPLAY & CONSOLE



LATERAL DOCKING IN STATION

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Transportation Technology Division (TTD, originally Transportation Technology, Inc.) was organized in 1968 as a division of Sverdrup & Parcel & Assoc. and later reorganized in 1968 as a separate corporation. In July, 1970, Otis Elevator Co. acquired a major equity portion of the company. In May or June of 1974, the Otis Elevator Co. acquired the entire company and has subsequently reorganized it as a division of Otis Elevator Co. A full scale test facility was built in Detroit in 1969. The company later moved to Aurora, Colorado. The system was demonstrated at TRANSPO '72 at Dulles Airport in May-June, 1973, and was subsequently tested. OTIS-TTD was chose by UMTA to perform the Phase I design concept of the UMTA High Performance Personal Rapid Transit (HPPRT) system project.

TTD will be working with SOCEA, a French management, engineering and industrial firm, in a joint venture to install a full scale PRT system in Nancy, France. The system will be approx 14.4 mi (23 km) with 130 vehicles (24 psgr/veh), and will operate 19 stations situated on two inter-connected loops. The estimated cost of the French system is $80 million.

INSTALLATIONS & CONTRACTS:

Negotiations and/or design of systems to be located in the Continental U.S. and Europe are in process.

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 7 ft (2 133 mm)
Single Lane Guideway Envelope Height . . . 3 - 5 ft (912 - 1 524 mm)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 6%
Min Vertical Turn Radius . . . . . 3,000 ft (914 m) at 40 mph (64.4 km/h)
Min Horizontal Turn Radius . . . . . 50 ft (15.24 m) at 10 mph (16.1 km/h)
Construction Process . . . . . Precast
Staging Capability . . . . . Sections could be operated while others under construction

LIMITATIONS:

Excessive amounts of snow or ice may cause service degradation. Slippery surfaces due to surface coating of ice does not effect performance. Emergency stopping distance is increased.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No emissions from vehicles, RF emissions less FCC requirements
Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 4 ft (1 219 mm)
W_1 – 6.9 ft (2 108 mm)
P_1 – 7 ft (2 133 mm)
Noise . . . . . 70 dbA inside vehicle
70 dbA at 25 ft (7.62 m) to side and 4 ft (1.2 m) above

UMTA - HIGH PERFORMANCE PERSONAL RAPID TRANSIT SYSTEM

CLASSIFICATION: Personal Rapid Transit

OTHER NAMES: None

DEVELOPER: Urban Mass Transportation Administration (UMTA)
Department of Transportation
Washington D.C. U.S.A.

Phase I Prime Contractor:
Otis/Transportation Technology Division
Rohr Industries, Inc.
The Boeing Company

Phase II Contractor:
To be selected after the detailed design analysis of Phase I

DATA REFERENCE CODE: [c: Information drawn from RFP]

PROJECT DESCRIPTION:

UMTA is proceeding with a two-phase PRT development program. Phase I is a multi-contract competitive effort to obtain PRT designs that can be implemented and tested at a test track during subsequent Phase II. To assure the capability for expansion into a large network and to limit the size and total scope of Phase II, the development program will have three principal elements: (1) the design, fabrication and test of a prototype system to be embodied in a test track and having performance commensurate with its ultimate use; (2) the design of and verification of command and control system technology capable of handling a complex urban guideway net with many stations and vehicles; (3) the design and verification of an urban network failure management system that assures satisfactory system performance in the case of vehicle or control system failure.

Phase I is 39 weeks in duration, the performance period of the Prime Contractors is 30 weeks and the Government will use the remaining 9 weeks to evaluate the designs and select one design for Phase II. Phase II will be directed toward development of a system that is qualified for urban installation. Phase II will include detailed system design and fabrication test site preparation, installation and integration of the system at the test site, subsystem and system operational tests and evaluation by the Prime Contractor. The preferred duration of Phase II is 30 months or less.

The overall objectives of the two phase program are as follows:

(a) Bring a PRT system, capable of achieving capacities that satisfy demands required of urban regional systems, to a proven state of operational readiness for urban deployment.
(b) Perform engineering qualification of this system.
(c) Furnish complete technical documentation on the system for use by local authorities in procuring same.
(d) Provide design information to enable local authorities to make an optimum match of system characteristics versus their particular local needs.

**PUBLISHER'S NOTE:*

This RFP system is included in this issue because it is expected to have significant impact on the market for PRT systems. The results of this program could effect decisions and commitments on the financial future of PRT systems.

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . At least 14,000 seats/lane/hr
Min Theoretical Headway . . . . . 3 sec [f]
Availability . . . . . Capable of operating in a schedual mode as well as in a demand-responsive mode
Type Service . . . . . Provide service within and between downtown, residential areas and major activity centers
Type Network . . . . . Area-wide collection/distribution
Type of Vehicle Routing . . . . . Variable and/or fixed
Traveling Unit . . . . . Not specified

VEHICLE PERFORMANCE:

Max Velocity . . . . . Min 40 mph (64 km/h)
Max Grade 6%
Service Acceleration . . . . . 6.4 - 8.1 ft/s^2 (2.0 - 2.5 m/s^2)
Service Deceleration . . . . . 12.9 ft/s^2 (3.9 m/s^2)
Max Jerk . . . . . 6.4 ft/s^3 (2.0 m/s^3)
Perceived Lateral Accel . . . . . Max 3.2 ft/s^2 (1.0 m/s^2)
Perceived Lateral Jerk . . . . . Max 1.6 ft/s^3 (0.5 m/s^3)
Perceived Vertical Accel . . . . . Max 4.8 ft/s^2 (1.5 m/s^2)
Perceived Vertical Jerk . . . . . Max 3.2 ft/s^3 (1.0 m/s^3)
Emergency Decel . . . . . Not specified
Stopping Precision in Station . . . . . ± 6 in (± 152 mm)
Degradation if Guideway is Wet . . . . . No degradation at max 2 in (50 mm) rain per hour
Degradation for Ice & Snow . . . . . No degradation at max 2.5 in (64 mm) snow per hour with accumulation of up to 10 in
Vehicle Design Capacity . . . . Max 12 seated, 0 standing
Energy Consumption . . . . . Not specified

STATIONS:

Type . . . . . Off line only
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Passengers required to pay fare before boarding, fare collection devices activated by money or special fare card
Security . . . . . TV surveillance of stations, vehicle and station doors shall be interlocked.

Boarding Capacity
Deboarding Capacity
Max Wait Time
Vehicle in Station Dwell Time
Average Station Spacing
. . . . . Not specified

INDIVIDUAL SERVICE:

Privacy . . . . . Not specified
Transfers . . . . . Not specified
Stops . . . . . Limited number of stops in demand mode
Accommodation . . . . . Seated only
Comfort . . . . . Heating and air conditioning (maintained while loading and unloading)
Security . Adequate lighting and emergency alarm systems, station surveillance, voice communication between passengers and central control operator
Instruction . . . . . Graphic displays at stations and in vehicles to indicate the next destination(s)

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Effort should be made in the design to eliminate failures resulting from incorrect control operation and computer programming errors. Redundant devices shall be incorporated to provide backup for critical components and shall be capable of verification and status display during system operation.

A vehicle separation assurance function must be provided to protect vehicles against collisions as a result of headway violations or merge conflicts. This function must be reliable and assure negligible probability of collision.

Performance monitoring of critical subsystems shall be implemented so that malfunctions can be automatically detected, appropriate action automatically taken and the conditions displayed at central control.

Fail Operational Features . . . . . Auxiliary equipment and operating features shall be provided for emergencies such as fire, collisions, power failures, vehicle failures, wayside equipment failures, crowd control, trespassers, bomb threats, flooding and medical emergencies.

Total System Mean Time Before Failure . . . Not specified
System Restore Time After Failure . . . . . Not specified
Station Mean Time Before Failure . . . . . 750 hrs
Station Restore Time After Failure . . . . . 0.5 hrs
Vehicle Mean Time Before Failure . . . . . 1,500 hrs
Vehicle Restore Time After Failure . . . . . 0.5 hrs
Strategy For Removal of Failed Vehicle . . . . . Provision of a vehicle capability for pushing (or towing) a disabled vehicle on the guideway
Strategy For Passenger Evacuation of Failed Vehicle . . . . It shall be possible to evacuate passengers from a disabled vehicle in a safe manner to a safe distance from that vehicle.
System Lifetime . . . . . 30 years
Vehicle Lifetime . . . . . 20 years

MAINTENANCE:

The system shall provide appropriate test points and equipment to permit rapid diagnosis of faults and faulty subsystem replacement. Subsystems shall be designed to eliminate time consuming alignment procedures. Computer software components shall contain selectable tracing facilities to display pertinent information needed to diagnose errors. Components performing similar functions within the system shall be mechanically and electrically interchangeable where practical and should not result in excessive field adjustments after replacement. Central maintenance area should be equipped for automatic testing of such transportable system elements as signaling devices, speed control logic elements, switching gear, automatic fare collection, etc.

CARGO CAPABILITY:

Goods Movement . . . . . System shall provide station-to-station goods movement. Special vehicles and station configurations may be considered.

PERSONNEL REQUIREMENTS:

System operation shall be fully automatic without the need for attendants on board the vehicle or at stations. Building and custodial personnel shall be provided as required.

PHYSICAL DESCRIPTION

VEHICLE:

The vehicle shall be designed to provide a maximum capacity of 12 seated passengers (no standees). The vehicle exterior design shall be aesthetically pleasing and compliment station and guideway design. Vehicle interior shall be constructed of durable materials for ease of maintenance. Corrosion and fire resistant materials shall be used throughout. A reasonable amount of window space shall be provided consistent with air conditioning requirements. Seats shall be designed for passenger comfort and safety, durability and appearance. Seats shall be readily removable for replacement by maintenance personnel. Doors shall be sufficiently wide to allow for comfortable and rapid entry and exit of passengers.

SUSPENSION:

Type . . . . . .Primary suspension shall be by any suitable mechanism, secondary suspension system is to meet specified ride quality requirements.

Suspension systems being studied by each contractor are [e]:

Otis/TTD — Vehicle supported from underneath via air cushion or rubber tires

Rohr — Vehicle supported from overhead via magnetic suspension

Boeing — Vehicle supported from underneath via rubber tires

Lateral Guidance . . . . . Vehicles shall be positively guided at all points along guideway and shall allow switching and merging of vehicles at all speeds.

PROPULSION & BRAKING:

Propulsion power shall be supplied by means of rigid conductor rails mounted in such a manner as to prevent in advertant contact by anyone near the guideway. One rail shall be grounded at frequent intervals of not more than 200 ft (61 m), and shall be continuous throughout the system. Power shall be supplied from a properly grounded source whether 3ϕ AC or DC. Also, unless the vehicle is completely passive, redundant brushes or similar devices located on the vehicle shall always ground the vehicle frame through a continuous grounding rail. Power shall be purchased from the local power company. The secondary power distribution system as provided by the contractor, shall include: (a) wayside substations (including transformers and switch gear) (b) distribution along the guideway (c) power conditioning as required (d) power collection.

Type Emergency Brakes . . . . . The brake shall be maintained in the unapplied state by a device such as a piston or electrical solenoid. Upon power failure the hold-off device shall be de-energized and the emergency brake applied. The emergency braking system shall be as independent as is practicable from the normal braking system.

SWITCHING:

Interlocking of guideway switching mechanisms and functions, to provide safe operation shall be provided by the Contractor. Controls for guideway switching equipment shall be so designed that manual control of the switch is possible only if permitted by the Central Operations console operator or by key access to the actuation mechanism. A fail-safe indication of the status of switches shall be communicated to the central control facility and shall be displayed in appropriate positions in the vicinity of the mechanism.

GUIDEWAY:

The contractor shall assume responsibility for the design, fabrication, erection, inspection, reliability and safety of all guideway elements, support structures, compatability of the guideway and all other structures with the vehicle to provide a smooth and comfortable ride. The guideway shall be designed so that all system equipment stays within the system right-of-way at all times with consideration for operational malfunctions. The guideway shall be installed to allow at least 4 in (100 mm) between vehicles on adjacent guideways, and at least 2 in (50 mm) between a vehicle and any equipment or structures in the system right-of-way. Transition curves of suitable design shall be used between straight and curved sections of guideway, between curved sections of guideway of different radii, and between vertically separated sections of guideway to limit the jerk and acceleration to specified limits. Necessary guideway accel and decel ramp lengths shall be clearly indicated as shall be the lengths of exit and entrance queus for stations and berths.

CONTROL:

The command and control system shall provide the communications, commands, and status signals for managing vehicles in the system. It shall include destination selection equipment and shall interface with fare collection equipment and information display equipment for handling passenger flow. The command and control system shall be capable of efficiently operating the system with the max number of vehicles deployed over the total network. The system must be capable of adjusting for demand fluctuations and maintain a high degree of effectiveness.

The command and control system must be capable of performing the following operations automatically:

a) Vehicle headway and main speed control
b) Vehicle merging and diverging
c) Vehicle scheduling, routing and dispatching in response to a realistic demand situation
d) Passenger processing
e) Empty vehicle management
f) Vehicle control in station areas including assignment to berths, stopping, door operation, queue control, and in-station movement

STATIONS:

The stations will utilize off-line loading to permit mainline vehicular flow.

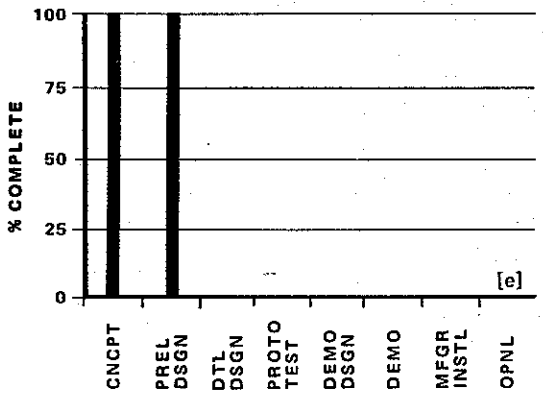
Stations shall provide the following minimum services:

a) Waiting areas, seating in high capacity stations
b) Displays of routing information, station locations, etc.
c) Public announcement system
d) Automatic fare collection and token vending machines, or equivalent
e) A telephone to central control for emergency passenger needs

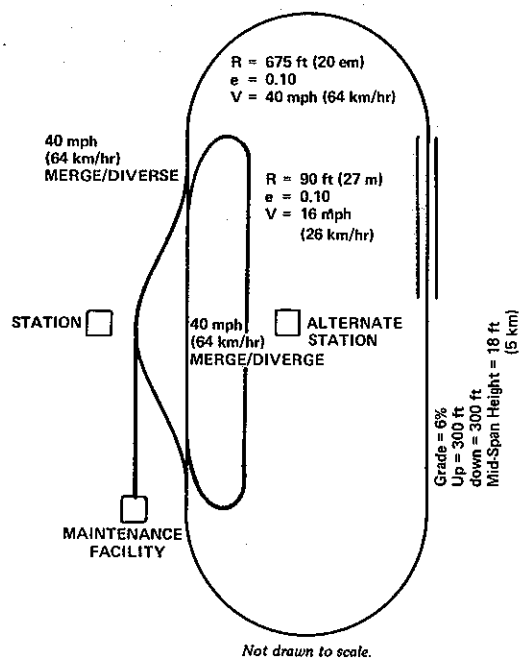
Stations shall be fully enclosed with controlled environment.

Stations shall be inegrated with existing and proposed parking facilities.

Stations sizes will vary, with specific accommodations dependent upon projected vehicle traffic, passenger traffic, cargo and goods movement and number of destinations.



DEVELOPMENT STATUS



PRT SYSTEM TEST FACILITY
DESIGN SPECIFICATION

DEVELOPMENT HISTORY, PLANS & PROGRESS: [e]

Separate contracts were let to Otis/TTD, Rohr Industries and Boeing, for $500,000 each, in Feb., 1975, to carry out the Phase I studies. It is understood that final reports are due from each competing contractor in Aug., 1975, however, these were not yet available at the time of printing.

Funding for Phase II is pending current congressional approval where funds were excluded by the House of Representatives but restored by the Senate. At the time of printing no decision or compromise had been reached.

TESK TRACK DESCRIPTION:

The nominal size of the test system is 2 mi (3.2 km) of single-lane guideway, five vehicles, two stations and a maintenance facility. One of the five vehicles shall be equipped as a diagnostic vehicle (see data on MAINTENANCE). In addition, a sixth vehicle, capable of operating under manual control, shall be provided for retrieval of failed vehicles. The track shall contain adequate representative numbers and types of merge/diverge points. The elevation, grade and turn radii of the guideway shall be representative of actual urban utilization. Operational software for the command and control system shall be representative of that to be used in an urban-size system.

COSTS:

[Based upon typical system of 200 mi (322 km) single lane guideway, 100 stations]

Capital Cost . . . . . .Total avg of $4.0 M*/mi ($2.49 M/km) single lane

Avg Cost per Vehicle . . . . . Max $5000/seated psgr

Avg Cost per Single Lane Guideway . . . . . $1.5 M/mi ($0.93 M/km)

Avg Cost per Station . . . . . .$0.1 M per berth (not including accel/decel ramps)

Total System Maintenance Cost . . Less than 0.1 man yr/veh/yr

ENVIRONMENTAL IMPACT:

The system shall be designed in accordance with requirements of Federal, State, and local environmental legislation and regulations. Particular attention shall be given to (a) aesthetics (b) recreation (c) conservation (d) landmarks (e) noise, air and water pollution. Frequency management shall be employed and shall consist of minimizing emission spectra and receiver bandwidths and controlling frequencies, pulse rise times, harmonics, side-bands and duty cycles.

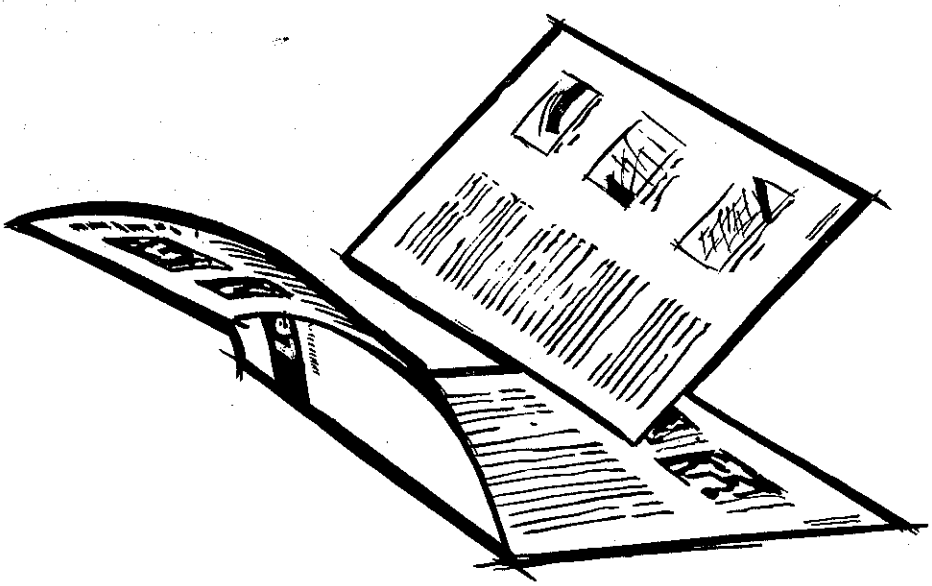
*M - Million

REPRINT INFORMATION

REPRINTS OF ANY SINGLE SYSTEM SET OF DATA SHEETS ARE AVAILABLE PER SPECIAL ORDER AT THE FOLLOWING PRICES + SHIPPING CHARGES:

500 Copies	$100.00
1000 Copies	$150.00
2000 Copies	$200.00

Minimum order of 500 copies



Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

REFERENCE GUIDE
MOVING WAY TRANSIT
LIGHT GUIDEWAY TRANSIT

PERSONAL RAPID TRANSIT

LIGHT RAIL TRANSIT
HEAVY RAIL TRANSIT
BUS TRANSIT
PARA-TRANSIT
ROADWAY TRANSIT EQUIPMENT

Vol. 1 No. 4 1974

Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

PERSONAL RAPID TRANSIT

CONTENTS

Vol.1 No. 4 1974

INTRODUCTION

Personal Rapid Transit (PRT) is a new technology offering a totally new concept of transit service. One might consider that PRT borrows from the automobile its desirable features (personal, on-call, direct from origin to destination, does not stop for other passengers, alternate routes) while it excludes undesireable features (does not pollute, parking is not required, the guideway requires little or no at-grade right-of-way and does not divide communities, travel is not interrupted by other traffic; vehicles can enter directly into shopping centers and office buildings etc., automated system disallows congestion to occur).

Some automated small vehicle/guideway systems have been termed as PRT which do not offer exclusive personal service. To distinguish between PRT and such systems, the classification Light Guideway Transit (LGT) was selected. Issue No. 3 of the Compendium, "Light Guideway Transit," reports those systems. Other terminology found in the literature for PRT have been Taxi-Transit, Autotaxi, Automatic Rail-Taxi-System, Capsule Transit, Spartaxi, and Programmed Modules.

A wide range of operational characteristics and physical configurations are presently offered by developers. Single one-way line capactiy ranges for 240 vehicle/hr to 21,000 vehicles/hr. Most systems operate as single units; however, the "Aramis" System operates very closely spaced vehicles in platoons and the "Flyda" System mechanically links vehicles into trains, except that vehicles are free to uncouple at any demerge point. Cruise velocities range from as low as 10mph (16km/hr) to 60mph (97km/hr). Guideways can be at-grade, elevated, in open cuts, or underground. Both single one-way or double two-way guideway configurations are available. Vehicles are proposed to be suspended below the guideway, riding over the top, and possibly along the side. Suspensions systems offered are steel wheels on steel rails, rubber tires, air cushions, and magnetic levitation. Both rotary and linear electric motor propulsion systems are offered.

Considerable debate has occured regarding safety at short headways. Some have maintained that "brick wall" stopping distances must be required, therefore limiting the minimum headway to 2 or 3 seconds. Others have argued that the brick wall criteria is not applicable pointing out that automobiles under manual control on freeways operate at separation distances less than the brick wall stopping distance. It is not the purpose of the Compendium to resolve the issue of headway by arguing either side. The final proof must come from the achievements of developers.

Because of the question of headway, three subclassifications of PRT have appeared in the literature. State-of-the-art PRT operates headways of 6 seconds and above, advanced or high performance PRT at 2 or 3 second headways, and high-capacity PRT with fractional second headways. Thus far only the state-of-the-art PRT's have been demonstrated to the public; however fractional second headways are presently under development with full-scale testing underway in Japan, France, and West Germany.

One limitation of PRT is station capacity. No station design has been propsed which could give satisfactory service for clearing a large sports arena or other large facility where heavy surge loads can be expected. However, if one considers the time required to empty parking lots of automobiles, PRT can be more efficient.

Because conventional transit systems utilize large vehicles and group passengers, effective and efficient service cannot be rendered in low density population areas. Many cities today are wide spread and are completely dependent upon the automobile for urban transportation. PRT with its on-demand personal service could effectively provide transit for such cities. While most of the installation studies, proposals, and market studies have been made for larger cities, where in many cases institutional problems are greater, it is expected that smaller cities might be better environments in which initial demonstrations should be built. The average total system cost (single one-way guideways, stations, vehicles) is approximately \$3 to 4 million/mile. The 22 mile system for Las Vegas has been proposed to cost approximately \$3.6 million/mile. Some have proposed that PRT will not require subsidy operation and if urban goods movement is included, it may even operate at a profit.

Because of the relatively high initial capital expenditure required for research and development as well as installation, it appears that a single private developer cannot prudently invest what is required to develop fractional-second headway PRT. Therefore, successful development may depend upon the committment of substantial government funds for research and development. Such commitments appear to have been made in Japan, France, and West Germany.

DATA SHEETS

USAGE INFORMATION

The data sheet format has been designed for quick reference. Specific data or information always appears in the same general location. Four pages of data are included per system. The first page identifies and describes the system, including its operation principle; the second page contains data on operational characteristics; the third page describes physical characteristics; and the fourth page gives information regarding the system status and its availability for installaation.

A coding system has been adopted regarding the types of sources from which data have been taken or derived which appears on the data sheets. The coding is a three-level code with the letter representing the general source and the numerals the method by which the data were derived. For easy reference these codes are repeated on the inside of the back cover. The following describes that code:

LEVEL 1:

a — Claims by developer, manufacturer, or supplier
b— Private correspondence from developer, manufacturer, or supplier
c — Published technical article or report by an independent individual or organization
d — Unpublished technical study by independent individual or organization
e — Observations by a representative of LTRC
f — Internal study or calculation by staff of LTRC

LEVEL 2: (first digit)

1 — Results of paper study
2— Results of in-depth engineering study
3 — Results of simulations
4 — Published results of tests performed by developer or manufacturer
5 — Unpulbished results of tests performed by developer or manufacturer
6 — Published results of tests of a demonstration system
7 — Unpublished results of tests of a demonstration system
8 — Published results of tests of an operational system
9 — Unpublished results of tests of an operational system
10 — Resulting from bid quotation

LEVEL 3:

1 — Interpretation by developer or manufacturer
2 — Interpretation by independent individual or organization
3 — Interpretation by system owner or operator
4 — Interpretation by staff of LTRC

EXAMPLES:

Code [a21] would be data from a published claim by the developer, manufacturer, or supplier, resulting from his in-depth engineering studies and interpreted by him.

Code [c32] would be data from a published technical article by an individual or organization resulting from a simulation and interpreted by him. If the code were [c34] the interpretation would be by the staff of LTRC.

In this issue, in many cases, it has been found practical to code to the first level only.

ENVIRONMENTAL IMPACT

On the fourth page of each full set of data sheets, the environmental impact is reported concerning emissions, visual, and noise. At present a satisfactory set of standards for this reporting has not been settled. Until such a standard is established (expected to result from reader response), the following defines the current method.

EMISSIONS

If the system does not emit directly any gaseous or particulate pollutants then it is so stated. However, because the system consumes energy, it places a requirement upon other energy producing facilities. The emissions impact must therefore be determined with respect to local power generating facility emissions, based upon the additional load expected to be produced by the total transit system.

VISUAL

Visual impact must be assessed through the eyes of the beholder. One cannot establish a firm standard with regard to what appears beautiful or ugly. A complete array of site-specific conditions and requirements must be established by the customer to which specific system hardware can be assessed. The following is a listing of some considerations of the hardware one must make:

1. What is the system's adaptability to different conditions and settings? (One can expect these to vary over the city areas in which the system may be deployed.)
2. Does the guideway require special materials? Is it dependent upon a particular shape and column configuration?
3. What is the overall size (width and height) of the various guideway elements (in single and double configuration)?
4. Is a parapet required, and what are its dimensions?
5. What is the vehicle loading (spacing of vehicles along the guideway)?
6. Must the guideway be enclosed?

7. If stations are off-line, what is the length requirement for off-line siding guideway?
8. Are the supporting structures single or double columns?
9. Does the guideway require overhead support?
10. What is the minimum radius of curvature?
11. If vertical separation is required at intersections, what is the required separation distance?
12. What overall station dimensions are required as a function of station berth capacity?
13. Do stations require elevators and/or escalators?
14. May the guideway be used for other purposes such as to house utility distribution, street lighting, signs, weather protection for a sidewalk, etc.?

To report all the above items under visual impact would be repetitious of a large number of data reported throughout the data sheets. Visual impact must therefore be left up to the reader. However, certain dimensions have been defined and are reported which can be considered what an individual might view of the guideway from certain positions, and at the same time would govern shadows produced. Figure 1 defines those dimensions.

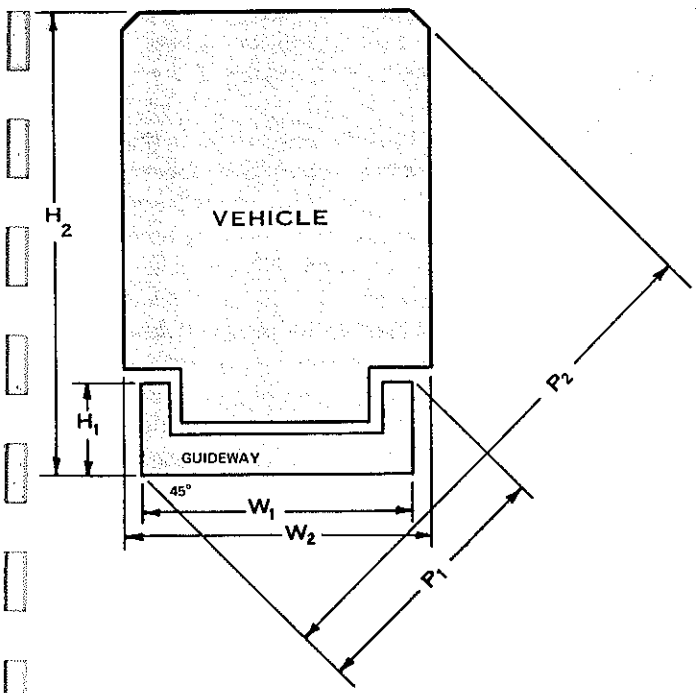


FIGURE 1: Definition of Visual Impact Parameters

NOISE

Developers are reporting noise levels by one of two methods. For both methods, the noise measured a given distance from the guideway and the average for inside the vehicle are given.

The reader is cautioned that a straight comparison cannot be made between systems because the acoustical environments are not necessarily the same (ex. atmospheric conditions, surrounding buildings or other objects, angular position to the guideway of the receiver, number of passengers inside the vehicle, etc.).

The first method essentially states the sound-pressure level in dbA, which one might assume is the rms average of levels for all frequencies preceived. The second method, while more specific, is based upon noise criteria curves. The NCA curves are the maximum compromise due to economic factors, allowing more of the difficult to remove low frequency energy than the NC curves. The NC curves would be the most favorable relationships between low and high frequencies. Figure 2 are the NCA curves and figure 3 the NC curves.

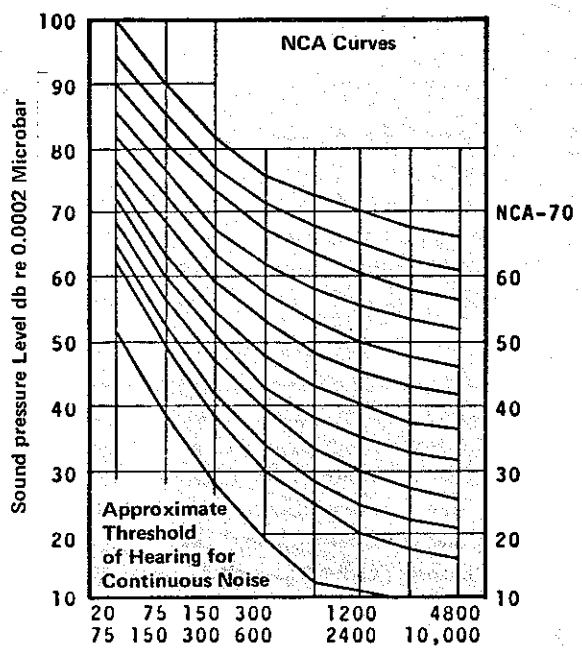


FIGURE 2

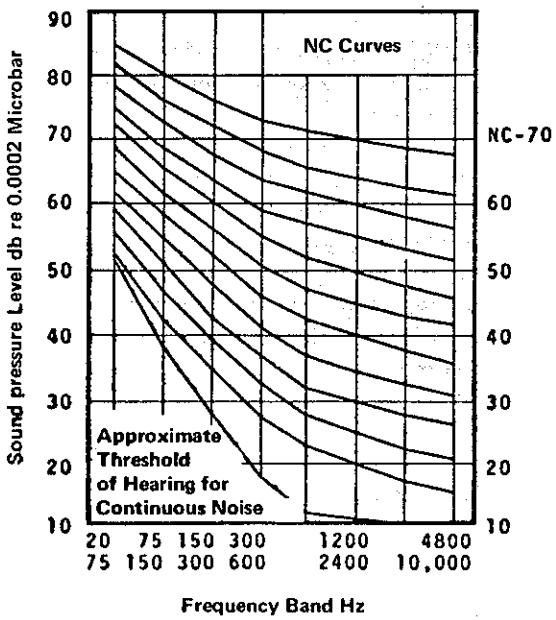


FIGURE 3

OPERATIONAL CHARACTERISTICS

One page of each set of data sheets includes three standard graphs which report average speed, line capacity, and vehicle utilization. In each graph the characteristics for the transit classifications are shown in black, and data specific to the particular system reported is shown in color. The following explains those graphs:

AVERAGE SPEED vs STATION SPACING

The average speed of a transit vehicle (or train) is expressed by

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

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

If the station spacing is equal to the station spacing factor, K, then the average speed will be exactly 1/2 the cruise velocity. The curves have been plotted with each coordinate of the graph on logrithmic scales. In this manner the shape (contour) of the curve is always the same because V and K are constants. It therefore becomes a simple matter to plot any system's average speed characteristics by simply translating the curve vertically by the value of V and horizontally by the value of K.

The average velocity curves for each of the transit classifications have been plotted according to data given in table 1.

SYSTEM	V MPH	V KPH	K MI.	K KM
Moving Walkway, constant speed	1.5	2.41	0	0
Moving Walkway, high speed	10	16.1	.0128	.0206
Light Rail Transit, CBD	15	24.1	.114	.183
Light Rail Transit, corridor	45	72.4	.525	.845
Motor Bus, CBD	15	24.1	.114	.183
Motor Bus, corridor	60	96.5	.822	1.323
Light Guideway Transit, CBD	30	48.3	.247	.397
Light Guideway Transit, corridor	60	96.5	.822	1.323
Heavy Rail Transit, short trips	30	48.3	.258	.415
Heavy Rail Transit, long trips	75	121.	.962	1.548
Personal Rapid Transit, close grid	20	32.2	.0204	.0328
Personal Rapid Transit, corridor	60	95.6	.183	.295

TABLE 1
TRANSIT SYSTEM CRUISE VELOCITIES AND STATION SPACING FACTOR

LINE CAPACITY vs PASSENGERS/VEHICLE OR TRAIN

One-way line capacity as a function vehicle or train capacity is related by the headway.

$$Q_L = 3{,}600 \frac{Q_V}{h}$$

where
- $Q_L \triangleq$ line capacity in passengers/hour
- $Q_V \triangleq$ vehicle or train capacity in passengers
- $h \triangleq$ headway in seconds

For each transit classification and the system reported, the graph displays the capacity to which the system might operate based on the minimum headway of traveling units on the main line and the maximum passengers per traveling unit (vehicle or train). One can consider that capacities defined for the region under the curve are achievable by that system. However, the reader is cautioned that a realistic or operational capacity for LGT and PRT systems is approximately 75 to 80% of that defined by the minimum headway, because space must be reserved for merging or the system will become saturated.

VEHICLE UTILIZATION vs. DEMAND DENSITY

The third graph relates vehicle utilization to the demand density over a given area by

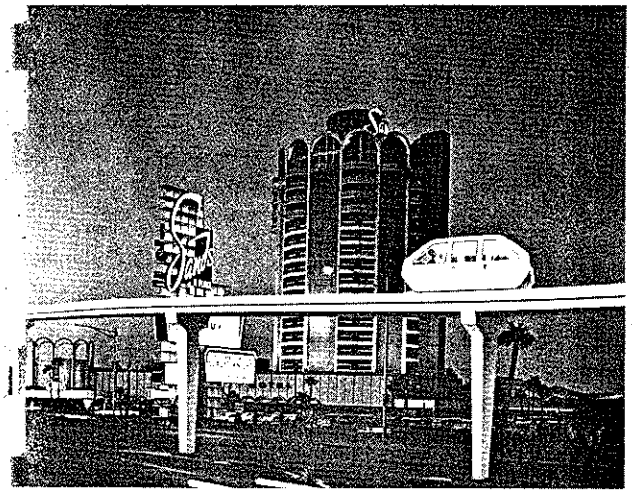
$$D_V = \frac{D_A}{\rho v} \; ; \quad \rho V = \frac{f_V L_A}{V_A}$$

where:
- $D_A \triangleq$ Demand Density (person trips/unit of area/hr
- $D_V \triangleq$ Vehicle Utilization (person-trips/vehicle/hr or fares/vehicle/hr)
- $\rho V \triangleq$ Vehicle Density (vehicles/unit of area)
- $f_V \triangleq$ Vehicle one-way line frequency (vehicles/hr)
- $L_A \triangleq$ Area Line Density (Length of one-way lines/unit of area)
- $V_A \triangleq$ Average Vehicle Speed (distance/hr)

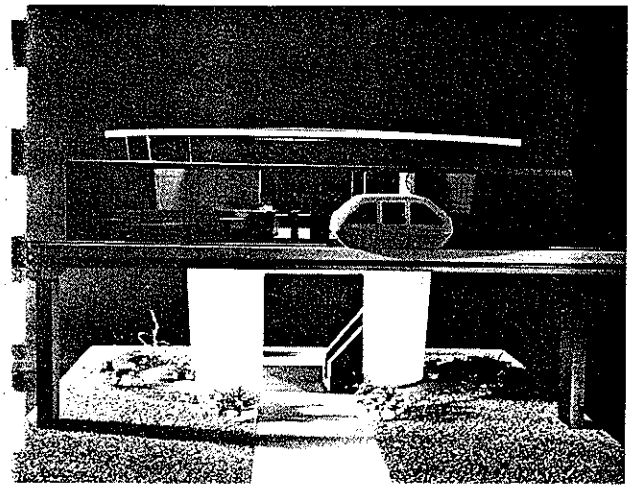
Two upper limits of vehicle utilization are given for the specific system shown in color. One is designated by the numeral "5" which represents the maximum vehicle utilization considering that the vehicle is filled to capacity and each passenger's trip time is five minutes. The other limit, designated by the numeral "15" is based on 15 minutes for each passenger's trip time.

A further explantion of this graph and the domains for each transit classification is given in the Reference Guide, pages 14 and 15.

AERIAL TRANSIT SYSTEM



PHOTOMONTAGE OF LAS VEGAS INSTALLATION



STATION MODEL

VEHICLE INTERIOR

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE NAMES: "Palomino" for Las Vegas Proposal

DEVELOPER: Aerial Transit System of Nevada, Inc.
Subsidiary of Pullman, Inc.
3547 Maryland Parkway
Las Vegas, Nevada 89109, USA
Tel: (702) 734-6834

LICENSEES: None

PATENTS IDENTIFIED: Design and developments in confidence, held consistent with Pullman, Inc. policy.

SYSTEM DESCRIPTION

The Aerial Transit system is a low capacity totally atuomated PRT system for transporting seated passengers only in small vehicles over exclusive guideways. Service is on-demand and passengers may command an exclusive vehicle (no mixed parties) for a non-stop trip between origin and destination stations.

Vehicles are supported on conventional flanged urethane coated steel wheels riding on steel rails. Vehicle capacity is 6 passengers. The data herein is given for the system as proposed for the Las Vegas installation which would be a totally elevated guideway with appropriate interface at hotel stations and the municipal bus system.

OPERATIONAL CHARACTERISTICS

SYSTEM [b]

Maximum One-Way Line Capacity ..... 2,700 seats/hr
450 vehicles/hr
Minimum Headway ..... 8 sec
Availability ..... On-demand 24 hrs/day
Network ..... Linear, loops, or area grid network
Way ..... Exclusive guideway
Routing ..... Variable
Traveling Unit ..... Single vehicles only
Manpower Requirements ..... Attendants at central control facility & maintenance personnel

VEHICLE [b]

Maximum Capacity ..... 6 Seated – 0 Standing
Crush Capacity ..... 6 Seated – 0 Standing

STATIONS [b]

Type ..... Off-line, 3-berth, platoon loading
Location ..... Elevated, adjacent to buildings
Type Boarding ..... One small step up
Ticket/Fare Collection ..... Automatic token turnstile
Security ..... Closed circuit T.V.
Boarding Capacity ..... 840 passengers/berth/hr
Deboarding Capacity ..... 840 passengers/berth/hr
Maximum Wait Time ..... 5 min
Vehicle Dwell Time ..... 10 to 15 sec
Average Station Spacing ..... 0.5 mi (0.8 km)

INDIVIDUAL SERVICE [b]

Privacy ..... Exclusive vehicle (no mixed parties)
Transfers ..... Not necessary
Stops ..... Non-stop
Accommodation ..... Seated only
Comfort ..... Parameters equal to luxury automobile
Security ..... Closed circuit T.V. in stations, intercom in vehicle
Instruction ..... Auditory messages and graphics

SAFETY AND FAILURE MODES [b]

Fail Safe Features ..... Failure detection & diagnostics
Fail Operational Features ..... Three levels of control redundancy
Power Failure Mode ..... Failure mode analysis incomplete
System MTBF ..... Design goal - 1 failure or less per 3 days
Vehicle MTBF ..... Approx. 1400 hrs.
Station MTBF ..... Design goal - 1 failure or less per 3 days
System Restore Time After Failure ..... Variable
System Lifetime ..... Design goal - 40 years

MAINTENANCE [b]

Vehicle and system are modularized. The design goal is to reduce failure rates and mean time to replace components without requirement for military standards.

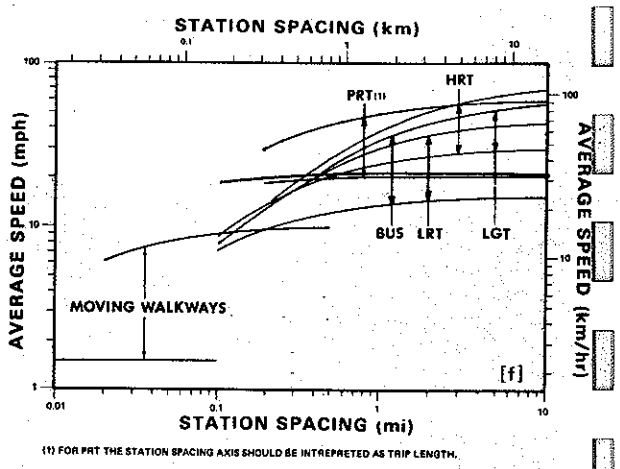
CARGO CAPABILITY [b]

Passenger Articles ..... Small packages and luggage
Goods Movement ..... Freight application to be determinded later

INTEGRATION WITH OTHER MODES [a]

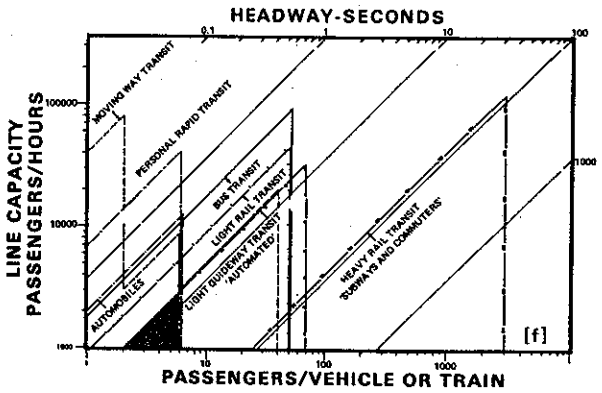
Las Vegas system designed to be integrated with municipal bus system to serve airport.

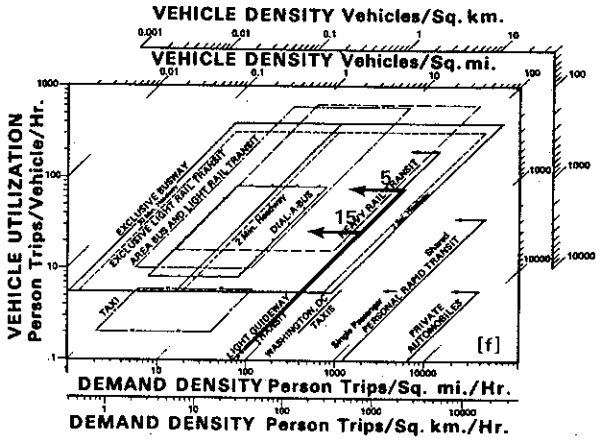
[1]Data Reference Code - See inside back cover for explanation.

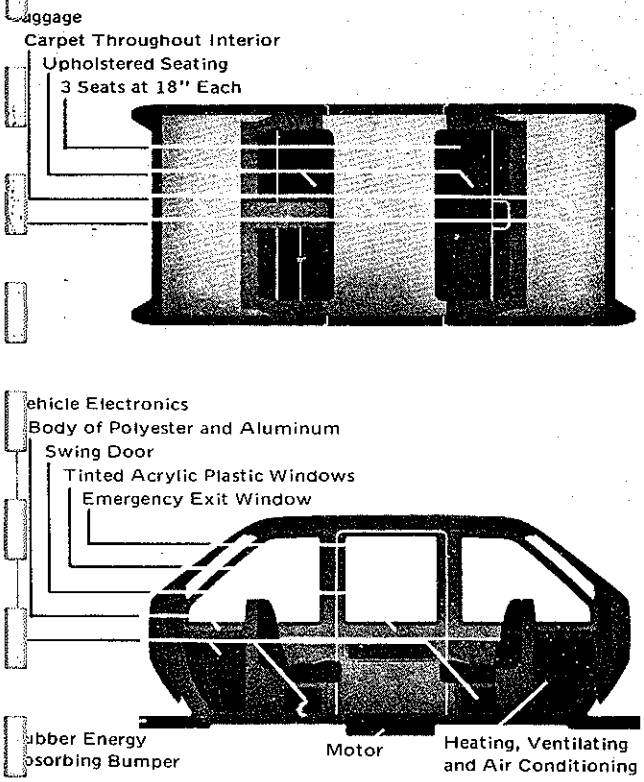


(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH.

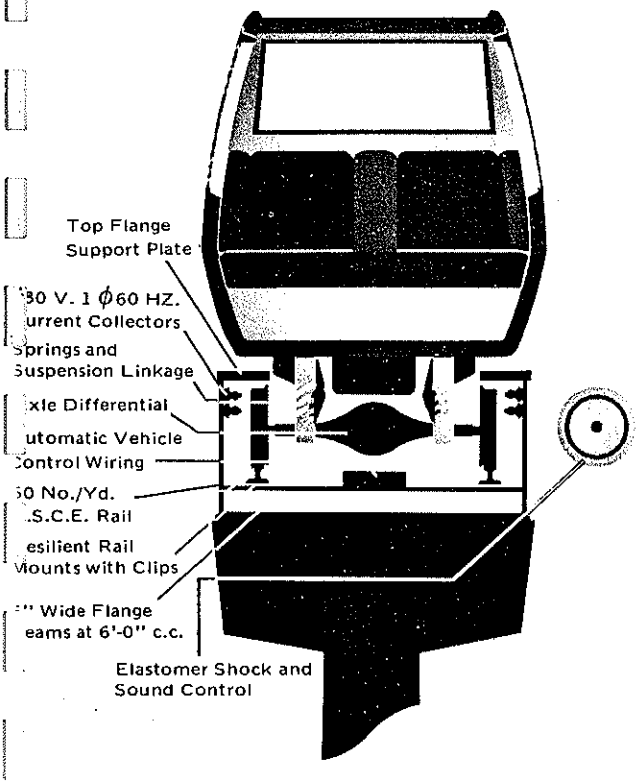
VEHICLE PERFORMANCE [b]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	20		
	km/h	32		
MAX VELOCITY	mph	35		
	km/h	56		
MAX GRADE	%	5	SAME AS CLEAR	SAME AS CLEAR
	%			
SERVICE ACCEL	ft/s^2	4.4		
	m/s^2	1.34		
SERVICE DECEL	ft/s^2	4.4		
	m/s^2	1.34		
MAX JERK	ft/s^3	6.4		
	m/s^3	1.96		
EMERGENCY DECEL	ft/s^2	7.3		
	m/s^2	2.24		
STOPPING PRECISION	in.	±6		
	mm	±152		







VEHICLE



VEHICLE ON GUIDEWAY

PHYSICAL DESCRIPTION

VEHICLE [b 51]

Length	12 ft (3.65 m)
Width	5.5 ft (1.68 m)
Height	5.17 ft (1.58 m)
Empty Weight	4,800 lbs (2,180 kg)
Gross Weight	5,700 lbs. (2,590 kg)
Passenger Space	seat width - 18 in. (457 mm), knee space - 15 in (381 mm)
Doorway Width	3 ft (0.914 m)
Doorway Height	5 ft (1.52 m)

SUSPENSION [b 51]

Type	Vehicle supported on 4 urethane coated flanged steel wheels on steel rails; variable rate coil springs
Design Load	900 lbs (419 kg) live load; 400 lbs (182 kg) dead load
Obstacle Clearance	Data not available
Steering	Conventional railroad lateral guidance

PROPULSION/BRAKING [b 51]

Type	Rotary traction drive dc motor
Emplacement	On-board vehicle
Propulsion Power	50 HP
Power or Fuel	480 vac 1ϕ 60 hz, On-board dc conversion by SCR
Power Transfer	Sliding contactors on vehicle
Power/fuel Consumption	2 kwh/veh-mi (1.24 kwh/veh-km)
Service Braking	Dynamic regenerative electric
Emergency Braking	Friction disks
Emergency Brake Reaction Time	0.2 sec

SWITCHING [b 51]

Type	Confidential
Emplacement	On-board vehicle
Switch Time	3 sec
Speed Thru	20-30 mph (32-48 km/hr)
Headway Thru	8 sec

GUIDEWAY [b 51: except as noted]

Type	Duo-rail, shallow U-shaped enclosure
Materials	Structural steel - A36 grade
Maximum Elevated Span	Approx. 50-60 ft (15.2 - 18.3 m) [e]
Crossection Height	28 in (710 mm)
Crossection Width	5.33 ft (1.62 m)
Rail Gauge	42 in (1067 mm)

CONTROL [a]

A central control computer provides overall traffic management and control, dispatches and routes vehicles, diagnoses failures, generates emergency commands, etc. It is linked to station units via a full duplex, hard-wired cable system and an asyhchronous 1,800-baud data modem in the stations. Communication from station units to individual vehicles is via inductive loops. The system control is fully synchronous utilizing the moving block headway control concept. Destination assignments are stored on-board the vehicle.

STATIONS [a]

Stations are designed as elevated at guideway level, nominally with 3 berths each. The passenger area is circular in shape. Access is via stairs and an elevator.

DEVELOPMENT [b]

The system was developed by Aerial Transit System of Nevada. Pullman Car Works of South Chicago is the car builder and Bendix Corporation designed the control system. Prototype design and construction have been completed, including guideway structure and vehicle testing. Next phase will be a ten-car demonstration, which is scheduled to start after contract award.

INSTALLATION [b]

Prototype installation at Pullman Inc. — Reseach Facility, Hammond, Indiana, of 2100 ft. (540 m) of guideway.

INSTALLATION STUDIES/PROPOSALS [b]

Las Vegas proposal is the only current activity. A system of 22 miles (35 km) of one-way guideway, 20 stations, and 300 vehicles was proposed at a cost of $81,830,000 (including ROW acquisition, utility relocation, and purchase of Las Vegas Transit Company).

COSTS [b]

Capital ..... Stations and guideway including electrical power - $2 million/mile of one-way guideway
Vehicles - $28,300 each

Operational ..... Approx. $6,000,000 per year for 300 vehicles, 22 one-way miles of guideway and 20 stations

Maintenance ..... Approx. $2,000,000 per year for 300 vehicles, 22 one-way miles of guideway and 20 stations.

INSTALLATION/RETROFIT CAPABILITY

[b: except as noted]

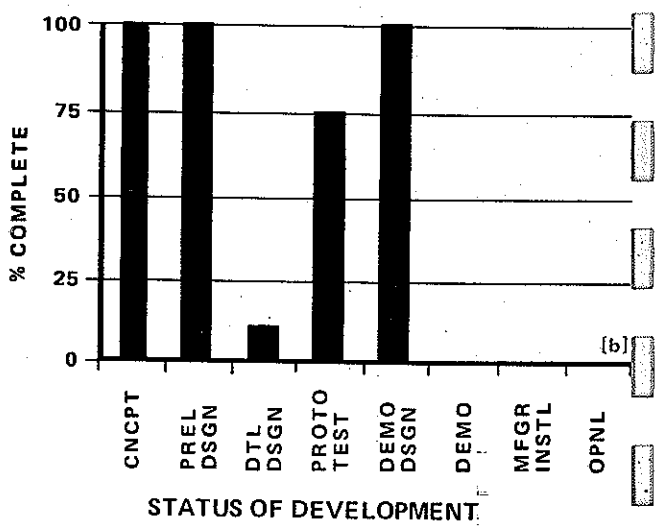
Envelop Width ..... Approx. 5.5 ft (1.68 m) single-lane
Envelop Height ..... Approx. 8.5 ft (2.59 m) guideway
Structural Weight ..... 250 lbs/ft (373 kg/m) per single-lane guideway
Maximum Grade 5%
Minimum Radius of Curvature ..... 50 ft (15.24 m)
Construction Process ..... Prefabricated modular guideway sections and stations [e]
Staging Capability ..... Sections may be installed and operated while others under construction [e]

LIMITATIONS

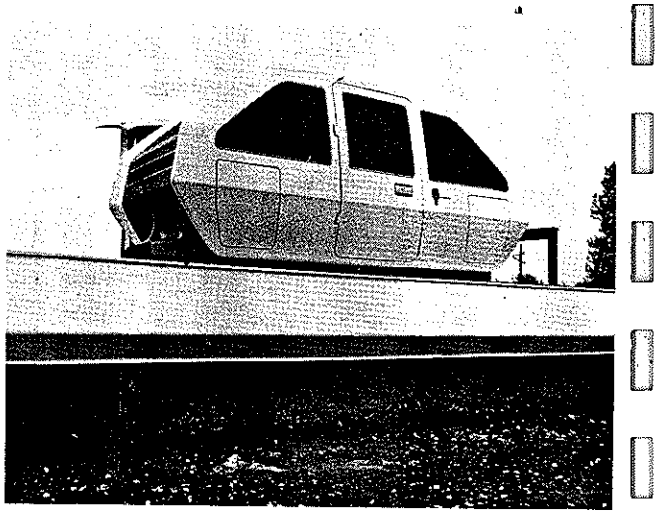
Station is not designed to accommodate large surge loads [b].
Headway of 8 sec. limits line capacity to low volume applications [e].

ENVIRONMENTAL IMPACT [b]

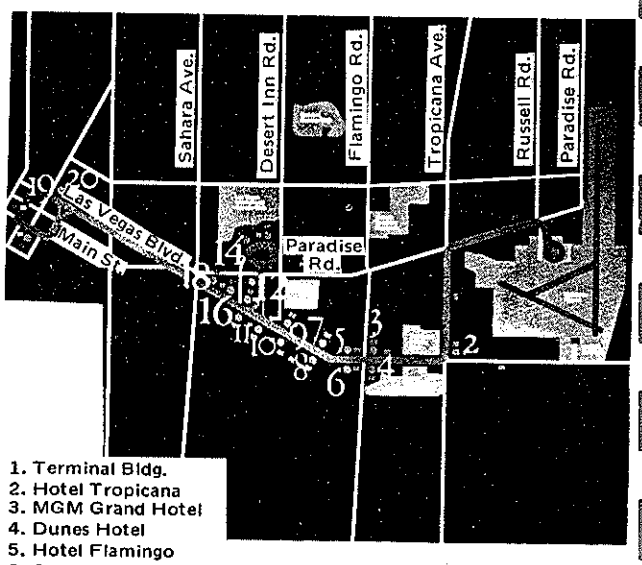
Emissions ..... No direct polluting emissions
Visual ..... Single Overhead guideway
H_1 - 2.5 ft (0.76 m); H_2 - 8.5 ft (2.59 m)
W_1 - 5.33 ft (1.62 m); W_2 - 5.5 ft (1.68 m)
P_1 - 5.88 ft (1.79 m); P_2 - 9.6 ft (2.93 m)
Noise ..... Design goal of less than 63 dbA



STATUS OF DEVELOPMENT



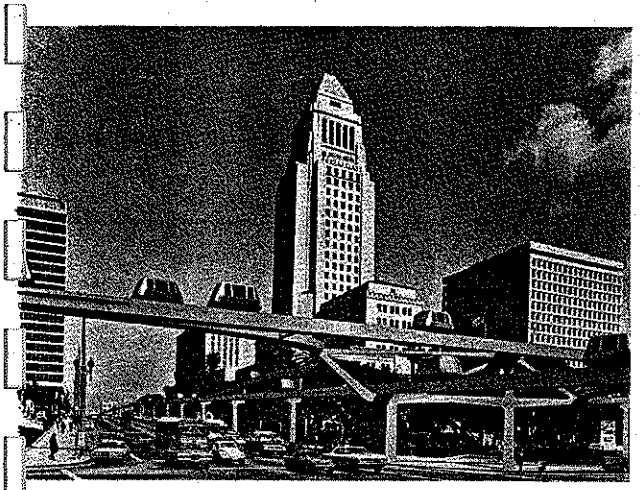
PHOTOTYPE VEHICLE



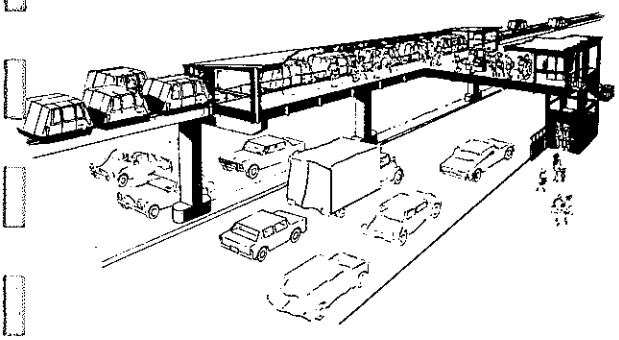
1. Terminal Bldg.
2. Hotel Tropicana
3. MGM Grand Hotel
4. Dunes Hotel
5. Hotel Flamingo
6. Caesars Palace Hotel
7. Sands Hotel
8. The Castaways Hotel
9. Desert Inn
10. Frontier Hotel
11. Stardust Hotel
12. Landmark Tower
13. Las Vegas Convention Center
14. Las Vegas Hilton Hotel
15. Riviera Hotel
16. Circus Circus
17. Mark Anthony
18. Hotel Sahara
19. Alternate Downtwon Station Location
20. Union Plaza Depot

PROPOSED LAS VEGAS INSTALLATION

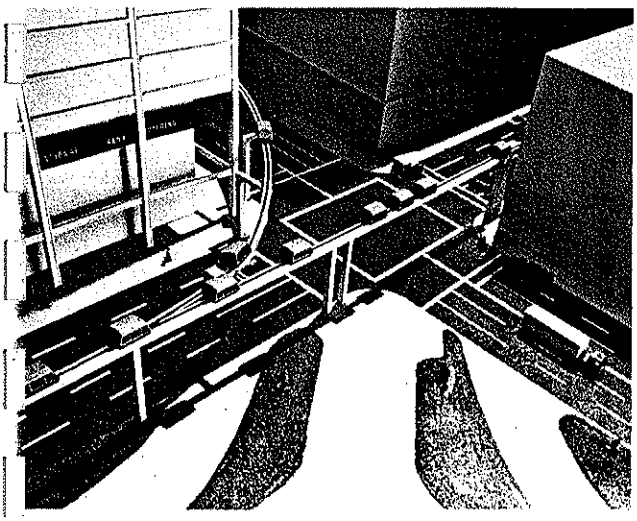
AEROSPACE CORP. HIGH CAPACITY PRT



PHOTOMONTAGE OF SYSTEM
AS IT MIGHT APPEAR IN LOS ANGELES



TYPICAL OFF-LINE STATION



TYPICAL CBD INSTALLATION
(from architectural model)

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE NAMES: Advanced PRT

DEVELOPER: Aerospace Corporation
Ground Transportation Directorate
2350 E. El Segundo Boulevard
P.O. Box 95085
El Segundo, California 90045
U.S.A.
Tel: (213) 648-6424

LICENSEES: None

PATENTS IDENTIFIED:

U.S. Patent Applications
- Monorail Support System
- Variable Speed Self Starting Linear Synchronous Motor (2 types)
- Linear Electric Motor
- Guideway, Car, and Car Suspension

U.S. Patents Granted
- Digisync Linear Motor
- Electromagnetic Switching
- Linear Motor Control

SYSTEM DESCRIPTION

The system is an advanced, high capacity (14,400 vehicles/hr) Personal Rapid Transit system designed for transporting passengers in exclusive small six-passenger vehicles for non-stop urban trips over an exclusive grid network of guideway. The network is proposed as one-way such that a larger area may be served. Where the spacing between guideways is closest, a mainline speed of 20 mph is proposed with 60 mph arterial lines connecting to suburbs or between activity centers. The vehicles are propelled by pulsed dc linear electric motors which react with guideway mounted permanent magnets. The propulsion system is integrated into an overall quasi-synchronous control system where very short headways as low as 0.25 sec are proposed. In addition, an Automated Pallet Transporter is proposed for the movement of urban freight or small compact automobiles in a form of dual-mode. The system is designed as an attractive alternative to the private automobile with the assumption that average vehicle occupancy during the peak hour might be 1.25 passengers per vehicle (i.e., 18,000 passengers/hr/line).

OPERATIONAL CHARACTERISTICS

SYSTEM [a 11: except as noted]

Maximum One-Way Line Capacity[2] . . . . . 86,4000 seats/hr [f, b]
14,4000 veh/hr [f, b]
Minimum Headway . . . . . 0,17 sec (0.25 sec nominal) [f, b 51]
Availability . . . . . On-demand 24 hrs/day
Network . . . . . Urban area one-way grid network
Way . . . . . Exclusive guideway
Routing . . . . . Variable
Traveling Unit . . . . . Single vehicles
Manpower Requirements . . . . . Attendants at central control facility and maintenance personnel

VEHICLE [a 11]

Maximum Capacity . . . . . 6 Seated — 0 Standing
Crush Capacity . . . . . 6 Seated — 0 Standing

STATIONS [a 11: except as noted]

Type . . . . . Off-line only
Location . . . . . At, above, or below grade
Type Boarding . . . . . Level
Ticket/Fare Collection . . . . . Automatic machines
Security . . . . . Closed circuit TV
Boarding Capacity[3] . . . . . 720 passengers/hr/berth [f, b]
Deboarding Capacity[3] . . . . . 720 passengers/hr/berth [f, b]
Maximum Wait Time . . . . . Zero unless empty vehicle dispatched [e]
Vehicle Dwell Time . . . . . Not applicable
Average Station Spacing . . . . . 0.5 mi (0.8 km)

INDIVIDUAL SERVICE [a 11]

Privacy . . . . . Exclusive use of vehicle
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
Accommodation . . . . . Seated only
Comfort . . . . . Heated & air-conditioned vehicles
Security . . . . . Closed circuit TV and emergency buttons
Instruction . . . . . Passive and active graphics in stations supplemented by telephone line to dispatcher

SAFETY AND FAILURE MODES [a 11]

Fail Safe Features . . . . . Propulsion & control system, passenger restraints, failed car pushing strategy
Fail Operational Features . . . . . Brakes, switching, control
Power Failure Mode . . . . . On-board auxiliary - exit nearest station
System MTBF, Vehicle MTBF, Station MTBF . . . . 10,000 hrs for major subsystem elements (i.e. control, propulsion, switching, braking, etc.)
System Restore Time After Failure . . . . . Less than 20 min
System Lifetime . . . . . 30 years for system, 10 years for vehicles

MAINTENANCE [a 11]

Automatic malfunction detection and automatic scheduling of maintenance. One 300-vehicle capacity maintenance facility per 5,000 vehicles (25 mi of guideway). One 150-vehicle capacity storage and cleaning facility per 200 vehicles.

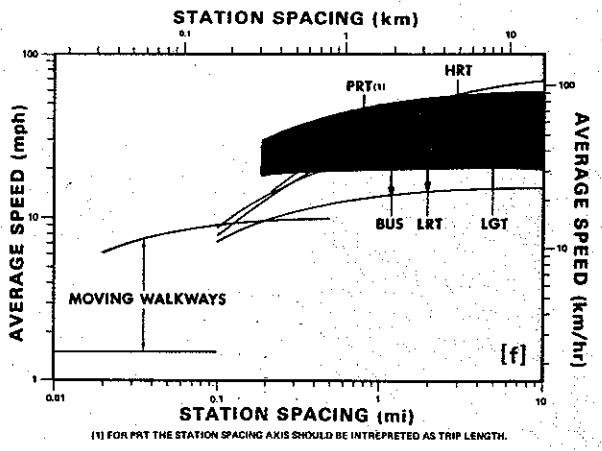
CARGO CAPABILITY [a 11]

Passenger Articles . . . . Small packages and luggage, wheel chairs, prams
Goods Movement . . . . Special automated Pallet Transporter for urban freight containers

INTEGRATION WITH OTHER MODES [e]

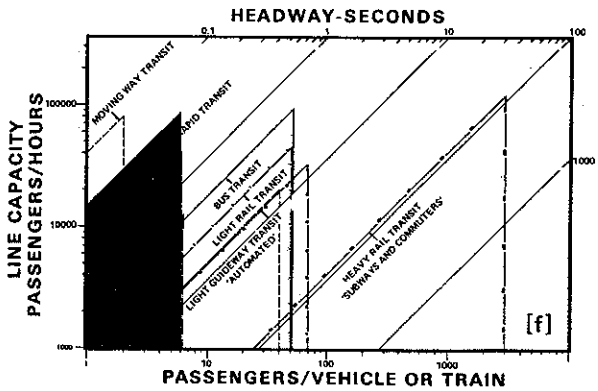
System may pass directly inside transportation facility for internal circulation and as a link between modes. Could also be used as feeder for HRT system.

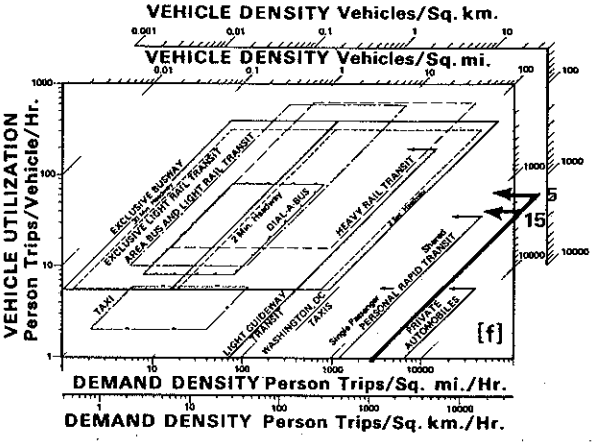
[1] Data Reference Code - See inside back cover for explanation
[2] Capacity based on nominal headway of 0.25 sec
[3] Assumed 30 sec dwell time in berth for loading or unloading and 6 passengers/vehicle

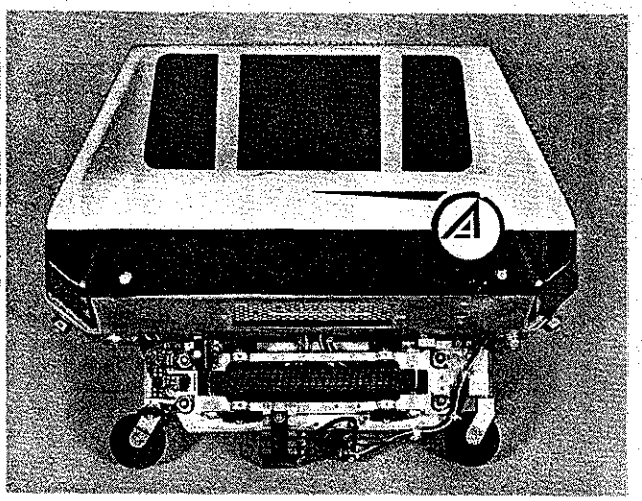


VEHICLE PERFORMANCE [a 21]

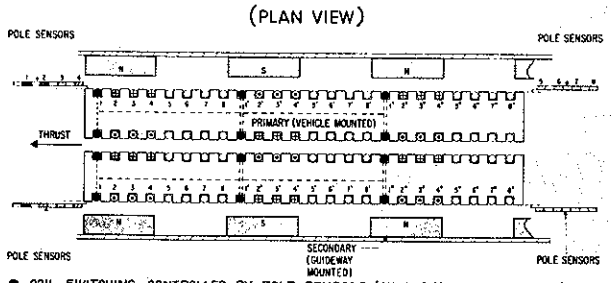
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	20-60		
	km/h	32-97		
MAX VELOCITY	mph	60		
	km/h	97		
MAX GRADE	%	As required	SAME AS CLEAR	SAME AS CLEAR
	%			
SERVICE ACCEL	ft/s^2	8		
	m/s^2	2.5		
SERVICE DECEL	ft/s^2	8		
	m/s^2	2.5		
MAX JERK	ft/s^3	8		
	m/s^3	2.5		
EMERGENCY DECEL	ft/s^2	26		
	m/s^2	7.85		
STOPPING PRECISION	in.	±3		
	mm	±76		





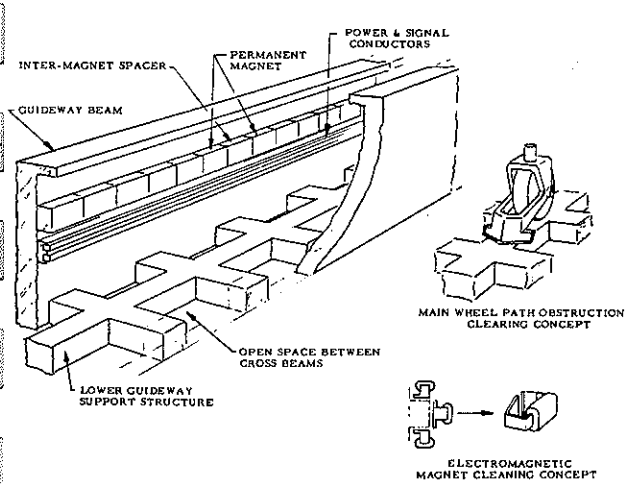


1/10th SCALE MODEL VEHICLE



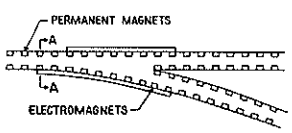
- COIL SWITCHING CONTROLLED BY POLE SENSORS (HALL EFFECT DETECTORS)
- SWITCHING RATE DEPENDS ON VELOCITY
- THRUST ADJUSTMENTS ARE MADE BY CONTROLLED VARIATIONS IN COIL CURRENT
- ELECTROMAGNETIC BRAKING BY REVERSING CURRENT TO COILS

PULSED DC LINEAR MOTOR CONFIGURATION

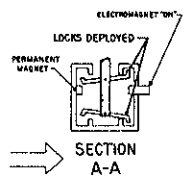


GUIDEWAY

- INTEGRATED WITH PULSED D.C. PROPULSION CONCEPT



- MILLISECOND SWITCHING TIMES
  - NO MOVING GUIDEWAY PARTS
- FLUX DENSITY DOUBLED FOR ELECTROMAGNETS
  - DIRECTIONAL AND STABILIZATION FORCES
  - THRUST MAINTENANCE THROUGH SWITCH
- BACK-UP LOCK CONSTRAINS VEHICLE TO GUIDEWAY IF ELECTROMAGNET POWER FAILS
  - DEPLOYED BY SENSING DIFFERENTIAL MAGNETIC INTENSITY



ELECTROMAGNETIC SWITCHING

PHYSICAL DESCRIPTION

VEHICLE [a 21: except as noted]

Length	10 ft (3.05 m)
Width	Approx. 5 ft (1.52 m)
Height	Approx. 5 ft (1.52 m)
Empty Weight	1,800 lbs (818 kg)
Gross Weight	2,400 lbs (1,091 kg)
Passenger Space	5 ft^2 (0.46 m^2)/seated psgr
Doorway Width	30 in (762 mm)
Doorway Height	roof opens

SUSPENSION

Type	Supported on two vertical rubber tired wheels in tandem. Stablized by lateral guidewheels
Design Load	2000 lbs per support wheel [b]
Obstacle Clearance	7 in cube removed by deflector on front wheel [e]
Steering	Constrained by lateral guidewheels which ride on interior sides of guideway

PROPULSION/BRAKING [a 21: except as noted]

Type	Pulsed dc linear electric motor rides inside guideway
Emplacement	Active element on vehicle, permanent magnets in guideway
Propulsion Power	Rated 300 lbs (137 kg) thrust (48 HP) at 60 mph (97 km/h)
Power or Fuel	1,000 vdc
Power Transfer	Power collector on vehicle, power rails inside guideway
Power/Fuel Consumption	Less than 0.33 kwh/veh-mi (0.21 kwh/veh-km) [f]
Service Braking	Dynamic regenerative electric and mechanical for holding
Emergency Braking	Dynamic electric and back-up mechanical
Emergency Brake Reaction Time	0.1 sec [a 51]

SWITCHING [a 21]

Type	Electromagnetic through linear motor backed up by mechanical locks
Emplacement	Electromagnets on guideway – locks on-board vehicle
Switch Time	0.5 m sec for electromagnetic build up (or decay) to 90% of total force [a 51]
Speed Thru	Mainline cruise speed
Headway Thru	0.1 sec [a 51]

GUIDEWAY [a 21: except as noted]

Type	Upright U-shaped channel
Materials	Prestressed concrete
Elevated Span	60 ft (18.3 m)
Crossection Height	36 in (914 mm)
Crossection Width	32 in (813 mm)
Running Surface Width	Approx 6 in (152 mm) [e]

CONTROL [a 51]

A quasi-synchronous hierarchial system. Headway is controlled synchronously along main lines as moving slots established by wayside computer. On-board vehicle computer commands pulse rate to dc linear motor. Vehicles commanded to slip or gain slots (according to on-board maneuver profiles) at interchanges and merges by interchange or wayside computer to integrate traffic. Routing, empty vehicle dispatching, overall traffic control, and total system regulation by central computer.

STATIONS [21]

Basic off-line station with 6 load-unload berths is 60 ft (18.3 m) long with 1,000 ft^2 (93 m^2) covered area. Ingress/egress by outside stairs and elevator (optional escalator). Automatic fare collection and destination selection consoles provided. Total guideway siding length of 580 ft (177 m). Suburban stations are basically 2-berth, 20 ft (6.1 m) long, with 300 ft^2 (29 m^2) covered area.

DEVELOPMENT [e]

The sytem was developed by Aerospace Corporation internally funded, estimated at over $1 million. Initial work began in 1968. Extensive engineering studies and simulations have been performed and a 1/10th scale model was fabricated in 1971 which successfully tested the pulsed dc linear electric motor, the quasi-synchronous control concept, and electromagnetic switching. Because the Aerospace Corporation is a research and development organization (not a manufacturer), continued development will require other than internal funding.

INSTALLATIONS [a]

A 1/10th scale model with 3 totally automated vehicles on a 134 ft (41 m) guideway loop including one off-line siding and two switches.

INSTALLATION STUDIES/PROPOSALS [a]

A 630 one-way miles system including over 1000 stations, and 65,000 vehicles has been studied for Los Angles at a cost of $1.75 billion which is ½ the cost estimated by Southern California Rapid Transit District (SCRTD) consultants for an HRT System.

A 54.3 one-way miles system of 57 stations and 2,200 vehicles was studied for Tucson, Arizona, at $85 million for capital cost.

COSTS [a 21]

Capital . . . . . Average of $3.51 million/one-way mile (2.18 million/km) based on a system of 100 mi of one-way guideway, 10,000 vehicles, and 200 stations.

- COST INDEPENDENT OF FLEET SIZE: Guideway – $110.1 million; Stations (200 each) – $36.4 million; Computers, Software, and Control Center – $23.5 million
- COSTS DEPENDENT UPON FLEET SIZE: Vehicles (10,000 each) – $88 million; Power Distribution Substations – $34 million; Vehicles Storage Cleaning & Checkout Facilities – $35 million; Vehicle Maintenance Facility – $4 million; 6% System Engineering & Technical Management – $20 million.

Operational, Maintenance . . . . . Total direct cost (without amortization) 3.4 cents/occupied veh-mi (2.11 cents/veh-km)

INSTALLATION/RETROFIT CAPABILITY

[a: except as noted]

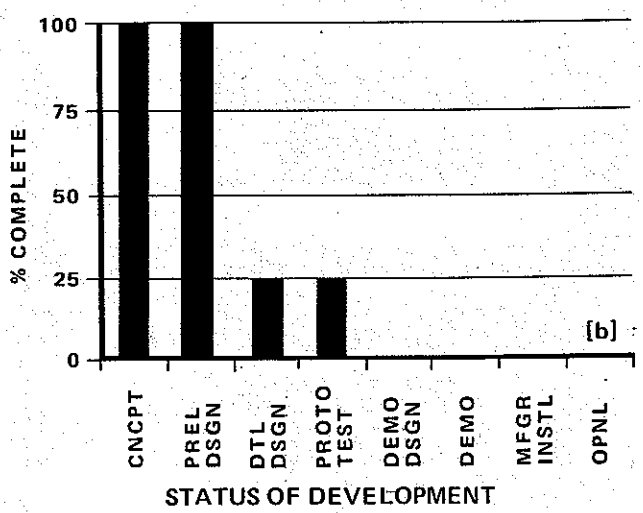
Envelop Width . . . . . Approx 6 ft (1.83 m)
Envelop Height . . . . . Approx 8.5 ft (2.6 m)
Structural Weight . . . . . 186 lbs/ft (277 kg/m)
Maximum Grade . . . . . As required
Minimum Radius of Curvature . . . . . 15 ft (4.57 m) at reduced speed, limited by suspension system
Construction Process . . . . Prefabricated guideway and elevated station elements [e]
Staging Capability . . . . . Sections can be operated while others under construction [e]

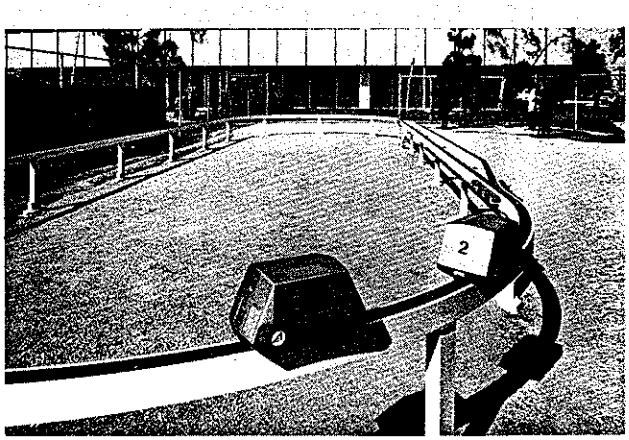
LIMITATIONS [e]

Open guideway channel may limit operation in severe climatic conditions (ice & snow) dependent upon functionality of incorporated deflector. Extremely short headway (high-capacity) requires additional length of off-line guideway at interchanges.

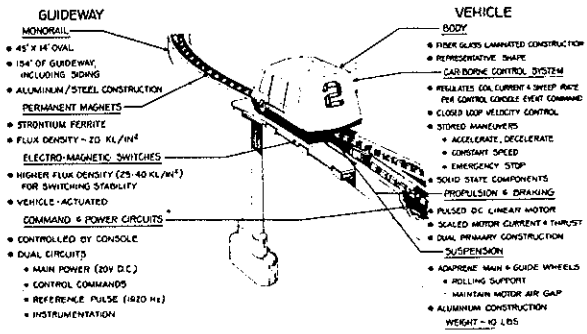
ENVIRONMENTAL IMPACT

Emissions . . . . . No direct polluting emissions [e]
Visual . . . . . Single elevated guideway [f]
H_1 – 3 ft (0.91 m); H_2 – 8 ft (2.44 m)
W_1 – 2.67 ft (0.81 m); W_2 – 5 ft (1.52 m)
P_1 – 4 ft (1.22 m); P_2 – 8.33 ft (2.54 m)
Noise . . . . . Under study [b]



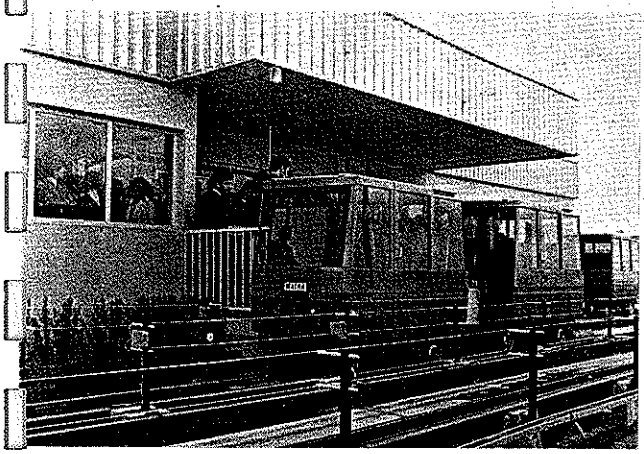


1/10TH SCALE LOOP TEST FACILITY

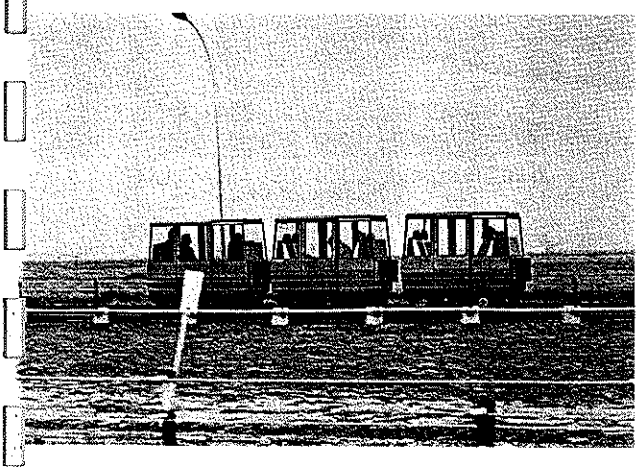


ELEMENTS OF 1/10 SCALE TEST FACILITY

ARAMIS



PROTOTYPE VEHICLES IN STATION
AT ORLY AIRPORT



DEMONSTRATION OF EXTREMELY SHORT
HEADWAY PLATOON OPERATION

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit*

OTHER TRADE NAMES: Rames de véhicules programmes (R.V.P.)

DEVELOPER: Engins-Matra
37 av. Louis Brequet
B.P. no. 1
78140 - Vélizy, France
Tel: 946.96.00
Telex: ENMATRA 69.077 F

LICENSEES: None

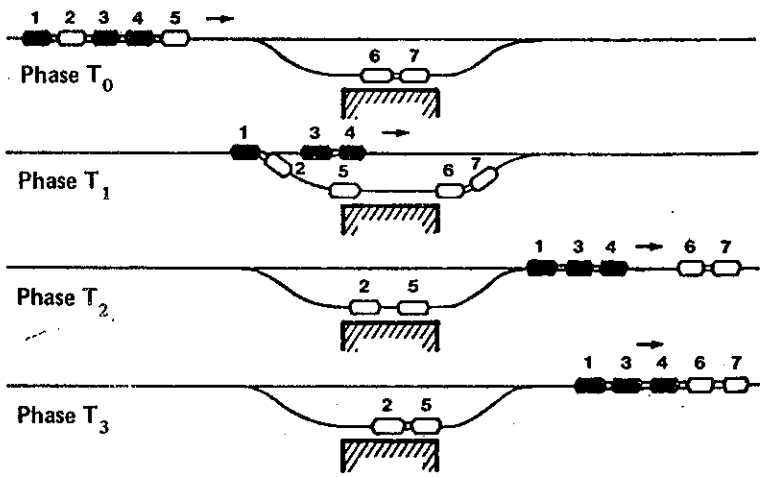
PATENTS IDENTIFIED:
Patents have been granted in France, USA, RFA, UK, Japan, Italy, Belgium, Switzerland, Canada, Argentina, and Spain.

SYSTEM DESCRIPTION

ARAMIS is a personal Rapid Transit system intended for urban or suburban areas consisting of small vehicles running on an exclusive guideway. Each vehicle can be used independently and has its own guidance control and switching capabilities, but the normal operating mode consists of vehicle-platoons controlled by station computers. Vehicles are automatically separated from the platoon on the mainline and dispatched to the off-line station. The platoons are reformed on the mainline and a vehicle leaving the station is coupled to a platoon in the leading position.

**PUBLISHER'S NOTE:*

4 to 10 passenger vehicles are proposed. The information in these data sheets is based on a 4 passenger vehicle. The same system can be used as a true PRT or during peak period shared vehicles for same origin — destination pairs with predetermined routing.



OPERATION OF STATIONS
AND VEHICLE-PLATOONS

OPERATIONAL CHARACTERISTICS

SYSTEM [a]

Maximum One-Way Line Capacity . . . . . 2000 to 15,000 seats/hr
Minimum Headway . . . . . 60 sec between platoons; 0.168 sec within platoon
Availability . . . . . On-demand or pre-destination of vehicles
Network . . . . . Areawide network or loops
Way . . . . . Exclusive guideway
Routing . . . . . Variable and/or fixed
Traveling Unit . . . . . Up to 40 single vehicles per platoon
Manpower Requirements . . . . . Attendants at central control facility and maintenance personnel

VEHICLE [a]

Maximum Capacity . . . . . 4 Seated — 0 Standing
Crush Capacity . . . . . 4 Seated — 0 Standing
(Vehicles with up to 10 seats also available)

STATIONS [a: except as noted]

Type . . . . . Off-line
Location . . . . . At, above or below grade
Type Boarding . . . . . Level
Ticket/Fare Collection . . . . . Probably automatic [e]
Security . . . . . Closed circuit TV might be installed [e]
Boarding Capacity, Deboarding Capacity . . . . Not specified. Dependent upon site-specific requirements and station design
Maximum Wait Time . . . . . Dependent upon frequency
Vehicle Dwell Time . . . . . 30 sec [e]
Average Station Spacing . . . . . 984 ft (300 m)

INDIVIDUAL SERVICE [a]

Privacy . . . . . Exclusive vehicle or shared vehicle
Transfers . . . . . May be necessary for longer trips
Stops . . . . . Non-stop between transfer points
Accommodation . . . . . Seated only
Comfort . . . . . Heated & air-conditioned
Security . . . . . Not specified
Instruction . . . . . Station indicator on pre-destined vehicles

SAFETY AND FAILURE MODES

Fail Safe Features
Fail Operational Features
Power Failure Mode
System MTBF
Vehicle MTBF
Station MTBF
System Restore Time After Failure
System Lifetime
. . . . . Now under study

MAINTENANCE

Information unavailable

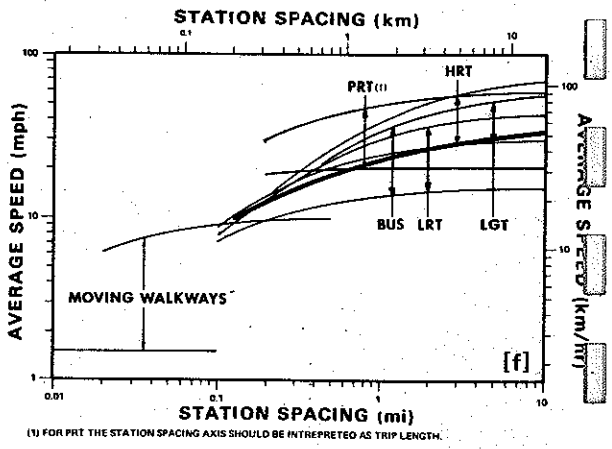
CARGO CAPABILITY

Passenger Articles . . . . . Small packages and luggage. Baggage space in vehicle is also provided [a]
Goods Movement . . . . . Vehicles might be designed for exclusive freight use [e]

INTEGRATION WITH OTHER MODES

System has been proposed to connect with airports and as internal circulation [a]. Could be used as link in connecting other modes (air, rail, parking lots) and as a feeder to HRT systems [e].

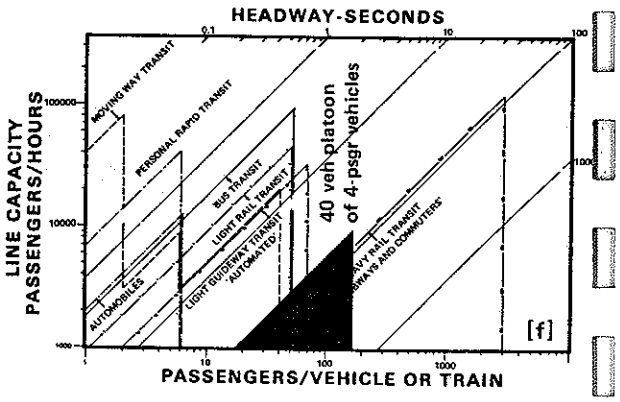
[1] **Data Reference Code - See inside back cover for explanation**

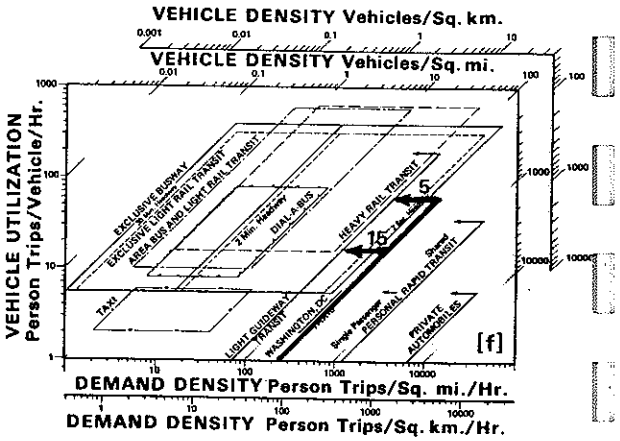


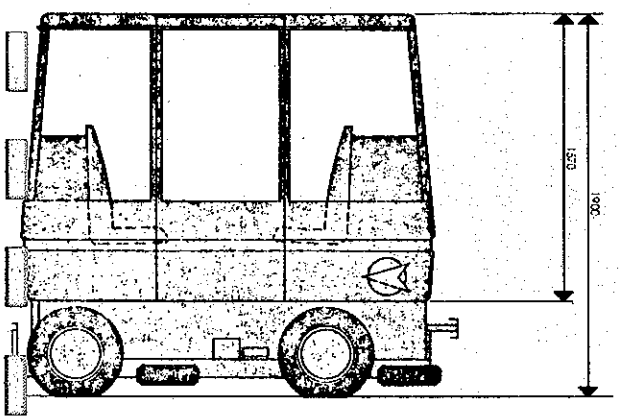
(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH.

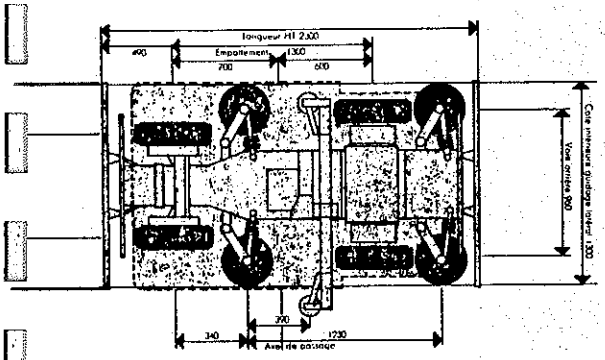
VEHICLE PERFORMANCE [a 41]

PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	31		
	km/h	50		
MAX VELOCITY	mph	31		
	km/h	50		
MAX GRADE	%	4 to 10		
	%			
SERVICE ACCEL	ft/s^2	3.28		
	m/s^2	1		
SERVICE DECEL	ft/s^2	3.28		
	m/s^2	1		
MAX JERK	ft/s^3			
	m/s^3			
EMERGENCY DECEL	ft/s^2			
	m/s^2			
STOPPING PRECISION	in.			
	mm			

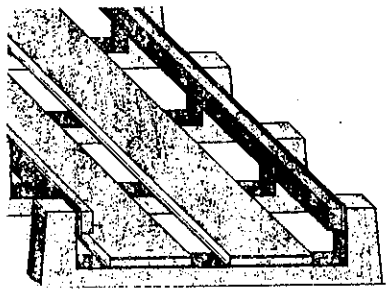




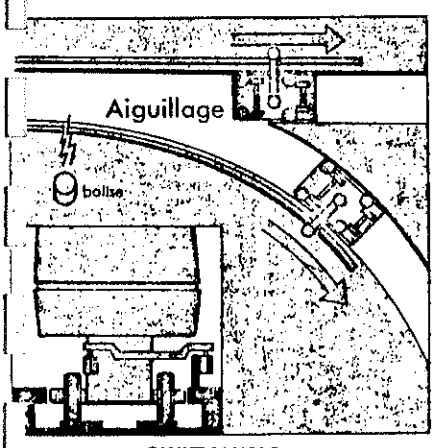




VEHICLE



GUIDEWAY



SWITCHING

PHYSICAL DESCRIPTION

VEHICLE [a 41: except as noted]
(4-passenger vehicle)

Length	7.55 ft (2.3 m)
Width	4.26 ft (1.3 m)
Height	6.23 ft (1.9 m)
Empty Weight	1,430 lbs (650 kg)
Gross Weight	2,200 lbs (1,000 kg)
Passenger Space	Data unavailable
Doorway Width	2.07 ft (0.63 m) [c]
Doorway Height	4.92 ft (1.5 m) [c]

SUSPENSION [a 41]

Type	Supported on 4 wheels with pneumatic tires
Design Load, Obstacle Clearance	Data unavailable
Steering	4 pneumatic tired wheels rolling against 2 exterior lateral guiderails. Front wheel steering (single Ackerman)

PROPULSION/BRAKING [a 41]

Type	2 variable-resistance dc electric motors
Emplacement	Coupled directly with the rear wheels
Propulsion Power	Motor rated at 8 kw
Power or Fuel	400 vdc (or possibly 750 v)
Power Transfer	Gliders and power rails
Power/Fuel Consumption, Service Braking, Emergency Braking, Emergency Brake Reaction Time	Data unavailable

SWITCHING [a 41]

Type	Traverse engaging into special guiderail at switch
Emplacement	Traverse bolster mounted on vehicle
Switch Time	Data unavailable
Speed Thru	Mainline speed
Headway Thru	Demerge at platoon headway of 0.168 sec

GUIDEWAY [a 41: except as noted]

Type	2 running tracks & 2 lateral guidance tracks
Materials	Light cement in "sandwich" between 2 bonded metal sheets
Maximum Elevated Span	Data unavailable
Crossection Height	Data unavailable
Crossection Width	6.56 ft (2 m) [c]
Running Surface Width	Approx 4.26 ft (1.3 m)

CONTROL [a 41]

Vehicle fitted with programming device (for destination choice by user). Vehicles are electronically coupled together and have always a spacing of 300 mm. Vehicle control by two independent control systems: operating (such as door opening, switching) connected through track and safety system for emergency stopping connected through power destribution line.

STATIONS [e]

Length proportional to the flow (for demand and service), or equal to platoon length (for predestined service). Stations with 2 tracks, one above the other or side by side.

DEVELOPMENT [a]

First study for DATAR (Government Office for Territory Development, France) in 1970/71. Prototype testing since 1973. Experimental track of 1 km length built at Orly Airport, Paris for exposition, 1973. First commercial applications will be in the suburbs of Paris between two cities connected by a 5.5 km line.

INSTALLATIONS

None except for 1 km test track.

INSTALLATION STUDIES/PROPOSALS [a]

8 application cases were studied.

COSTS

Capital, Operational, Maintenance ..... Data unavailable

INSTALLATION/RETROFIT CAPABILITY [a]

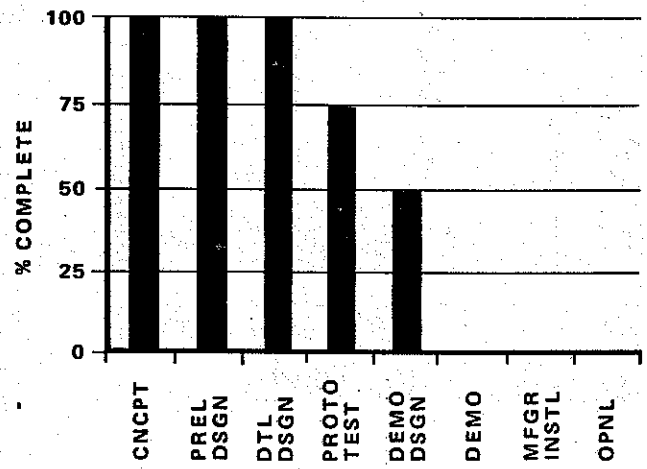
Envelop Width	Two-way: 10.5 ft (3.2 m); One-way: 6.6 ft (2 m)
Envelop Height	6.23 ft (1.9 m)
Structural Weight	Data unavailable
Maximum Grade	4% to 10%
Minimum Radius of Curvature	32.8 ft (10 m) at reduced speed
Construction Process	Assume prefabricated guideway sections [e]
Staging Capability	Data unavailable

LIMITATIONS [e]

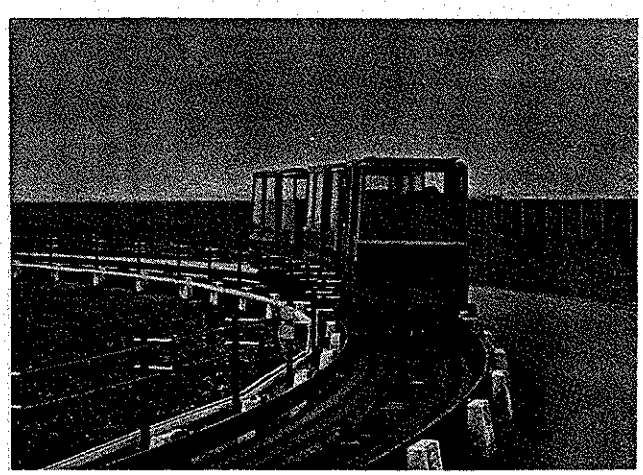
It is estimated that the development of the control system for the PRT mode is only in a beginning phase. Installation as PRT, as herein reported, would be limited to low-capacity applications.

ENVIRONMENTAL IMPACT [e]

Emissions	No direct polluting emissions
Visual	Insufficient data to make assessment
Noise	Data unavailable

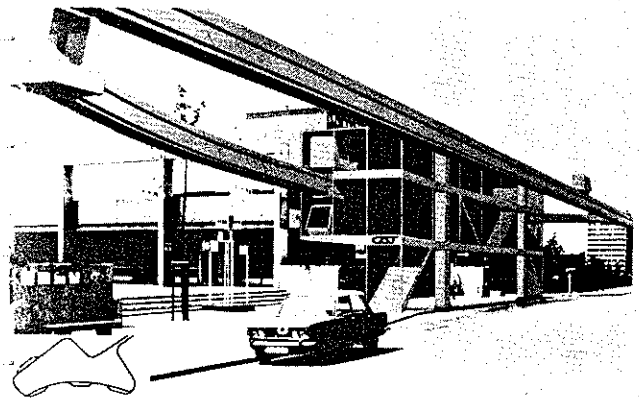


STATUS OF DEVELOPMENT

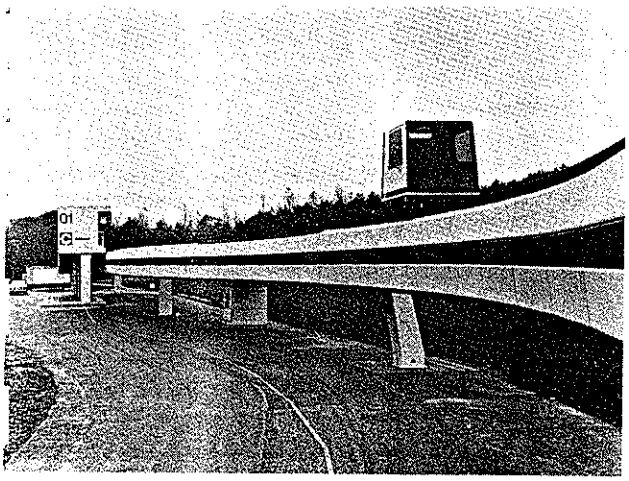


PROTOTYPE DEMONSTRATION AT ORLY AIRPORT

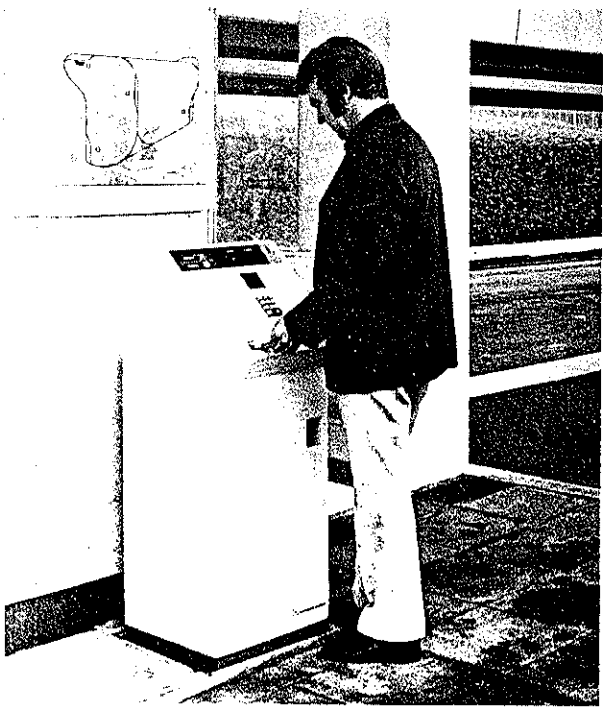
CABINENTAXI



PHOTOMONTAGE OF OFF-LINE STATION



STATION, GUIDEWAY & VEHICLES
AT TEST FACILITY



AUTOMATIC TICKETING
AND DESTINATION SELECTION

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE NAMES: Cabin-Taxi (CAT)

DEVELOPER: DEMAG Fördertechnik
Produktneuentwicklung
D-5800 Hagen
Heinitzstr. 28
West Germany
Tel: (02331) 14091
Telex: 0823231

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

LICENSEES: None

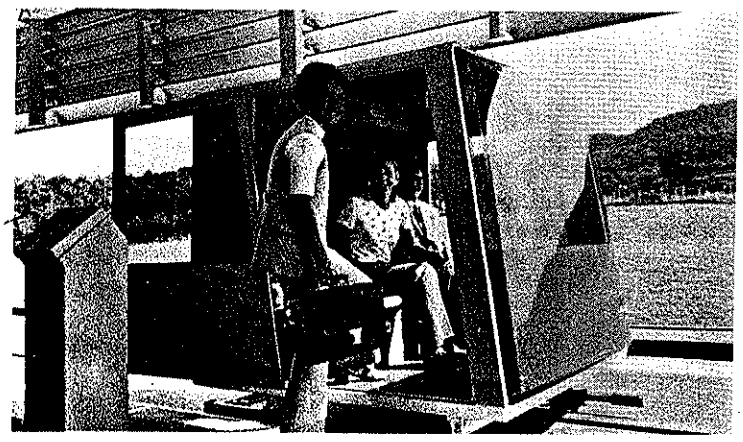
PATENTS IDENTIFIED: Data Unavailable

SYSTEM DESCRIPTION

Cabinentaxi is a Personal Rapid Transit system characterized by track-guided small 3-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: vehicles always on-call, exclusive use of a vehicle for on-demand, 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 feed-back vehicle travel, and linear motor propulsion unaffected by weather.

Because the system operates at headways of 0.5-1.0 sec, it may be further classified as advanced high-capacity PRT.



BOARDING VEHICLE

OPERATIONAL CHARACTERISTICS

SYSTEM [a]

Maximum One-Way Line Capacity . . 5,000 veh/hr or 15,000 seats/hr for guideway 70% full; 7,200 veh/hr or 21,6000 seats/hr at 100% full [f]
Minimum Headway . . . . . 0.5 to 1.0 sec
Availability . . . . . On-demand 24 hrs/day
Network . . . . . Area wide urban network
Way . . . . . Exclusive guideway
Routing . . . . . Variable
Traveling Unit . . . . . Single vehicle
Manpower Requirements . . . Attendants at central control facility and maintenance personnel

VEHICLE [a]

Maximum Capacity . . . . . 3 Seated — 0 Standing
Crush Capacity . . . . . 3 Seated — 0 Standing

STATIONS [a]

Type . . . . . Off-line
Location . . . . . At, above, or below grade
Type Boarding . . . . . Level
Ticket/Fare Collection . . . . . Automatic ticket (magnetic card)
Security . . . . . Optional closed circuit T.V.
Boarding Capacity . . . . . 1,000 vehicles/hr
Deboarding Capacity . . . . . 1,000 vehicles/hr
Maximum Wait Time . . . . . Zero for unsaturated operation
Vehicle Dwell Time . . . . . Not applicable
Average Station Spacing . . . . . 0.186-0.5 mi (0.3-0.8 km)

INDIVIDUAL SERVICE [a]

Privacy . . . . . Exclusive use of vehicle by single passenger
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
Accommodation . . . . . Seated only
Comfort . . . . . Vehicles heated & ventilated
Security . . . . . Closed circuit T.V. and crash pads
Instruction . . . . . Indicator maps in stations

SAFETY AND FAILURE MODES [a]

Fail Safe Features . . . . . Automatic redundant spacing control
Fail Operational Features . . . . . Vehicle pushaway technique under development
Power Failure Mode . . . . . Emergency current supply
System MTBF, Vehicle MTBF, Station MTBF . . . . . Data will be available upon completion of tests
System Restore Time After Failure Short, due to modular construction
System Lifetime . . . . . Guidway - 50 yrs; vehicle - 10 yrs

MAINTENANCE

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

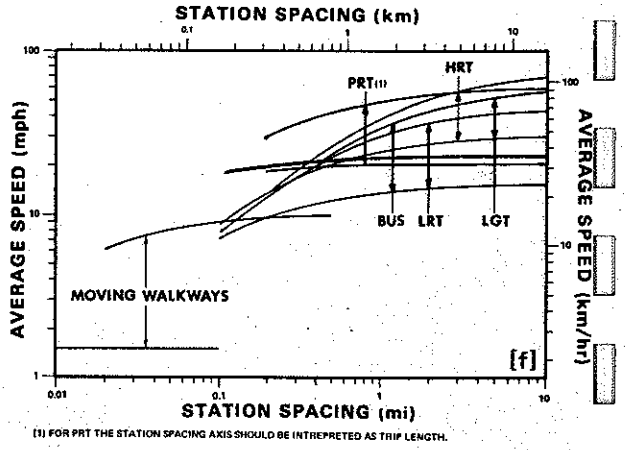
CARGO CAPABILITY [a]

Passenger Articles . . . . . Luggage space for: baby carriages, parcels, hand luggage, skis
Goods Movement . . . . . Special freight vehicles are planned

INTEGRATION WITH OTHER MODES [a]

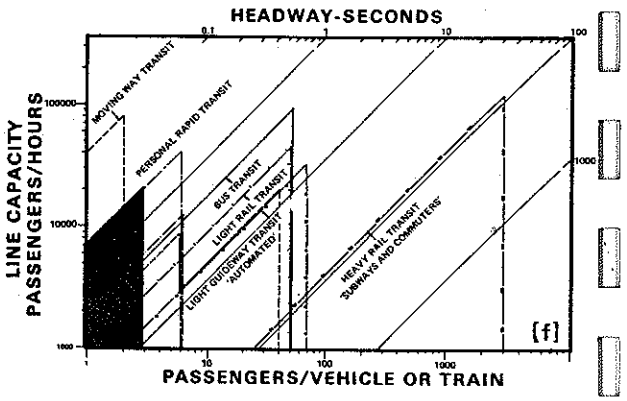
Proposed as urban area transit service, circulation for airports and other transportation terminals, and as a feeder and distributor for high-capacity line-haul systems.

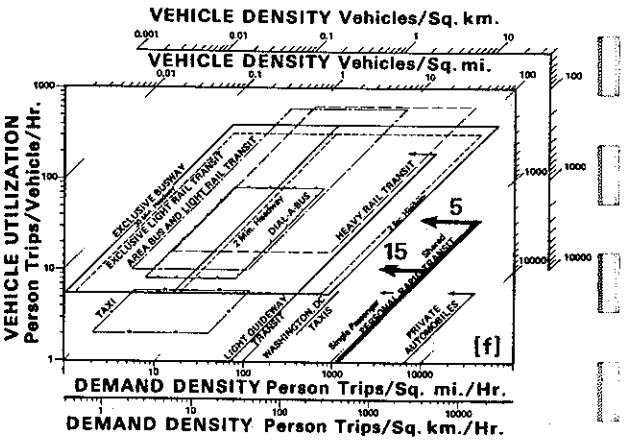
[1] **Data Reference Code - See inside back cover for explanation.**



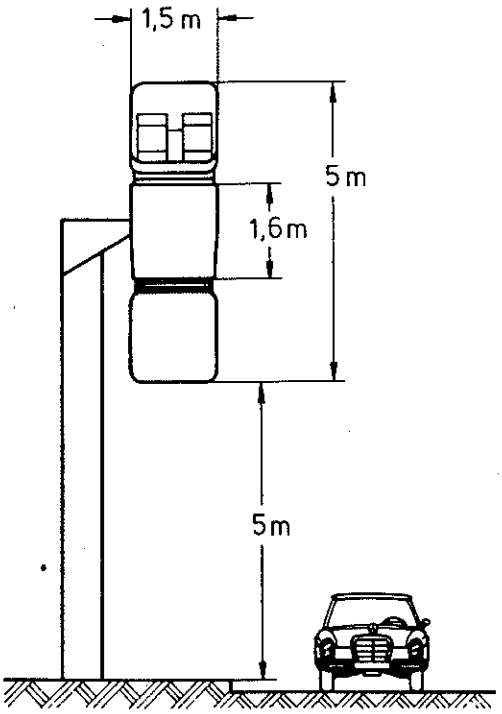
(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH.

VEHICLE PERFORMANCE [a 51]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	22.4		
	km/h	36		
MAX VELOCITY	mph	22.4		
	km/h	36		
MAX GRADE	%	10	SAME AS CLEAR	SAME AS CLEAR
	%	(Up to 15%)		
SERVICE ACCEL	ft/s^2	8		
	m/s^2	2.45		
SERVICE DECEL	ft/s^2	8		
	m/s^2	2.45		
MAX JERK	ft/s^3	8.2		
	m/s^3	2.5		
EMERGENCY DECEL	ft/s^2	16		
	m/s^2	4.9		
STOPPING PRECISION	in.	< 3.94		
	mm	< 100		

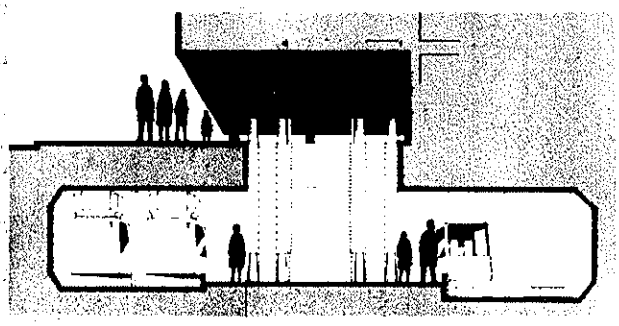




SUSPENDED VEHICLE



OVERHEAD GUIDEWAY INSTALLATION



UNDERGROUND STATION
AS PROPOSED FOR HAGEN

PHYSICAL DESCRIPTION

VEHICLE [a51]

Length	7.5 ft (2.3 m) (including bumpers)
Width	5.2 ft (1.6 m)
Height	4.9 ft (1.5 m)
Empty Weight	1,320 lbs (600 kg)
Gross Weight	2,200 lbs (1,000 kg)
Passenger Space	Approx. 35 ft^3 (3 m^3)/psgr.
Doorway Width	2.95 ft (0.9 m)
Doorway Height	4.59 ft (1.4 m)

SUSPENSION [a51]

Type	Solid rubber tired wheels on bogies which ride inside guideway (but outside of girder)
Design Load	2,200 lbs (1,000 kg)
Obstacle Clearance	5.9 in (150 mm)
Steering	Constrained by lateral solid rubber tired guidewheels.

PROPULSION/BRAKING [a51]

Type	2 double-comb horizontal linear electric motors
Emplacement	On-vehicle
Propulsion Power	111lbs/lb (23 kg/kg) motor weight at 19 mph (30 km/h)
Power or Fuel	500 vac
Power Transfer	Power collectors on vehicle, power rails on guideway
Power/fuel Consumption	0.294 kwh/veh-mi (0.183 kwh/veh-km)
Service Braking	Dynamic thru motor plus 4 wheel drum brakes
Emergency Braking	Same as service brakes
Emergency Brake Reaction Time	Rise time less than 20 m sec

SWITCHING [a51]

Type	Mechanical branch-off mechanism
Emplacement	On-board vehicle
Switch Time	Less than 1 sec
Speed Thru	Mainline cruise velocity
Headway Thru	Mainline headway 0.5 sec

GUIDEWAY [a51]

Type	Box-beam, inverted and upright U-shaped
Materials	Steel and/or concrete
Elevated Span	131 ft (40 m)
Crossection	5.2 ft (1.6 m)
Crossection Width	5.2 ft (1.6 m)
Running Surface Width	Not applicable

CONTROL [a51]

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

STATION [a]

Stations may be incorporated in buildings or specially built structures. Off-line station guideway length of 361 ft (110 m) is minimum required including acceleration and deceleration lengths.

DEVELOPMENT [a]

Development was begun in 1970 by MBB and DEMAG. Component bench tests and detailed design was performed in 1972. A circular test apparatus has been built for testing the short headway control system. A 490 ft. (150 m) full scale test track was built in 1973 in Hagen and is to be extended to 1,800 ft. (550 m) in 1974. Presently operational are 6 vehicles, 1 station, and 4 switches.

INSTALLATION [a]

Hagen Test Facility . . . . 18,00 ft. (550 m) single over and under guideway, 3 stations, 10 switch point, and 24 vehicles. Planned extension to 1.18 mi (1.9 km) during 1974-1975.

INSTALLATION STUDIES/PROPOSALS [a]

Studies

Perlach, W. Germany (opening of a suburban community)
Freiburg, W. Germany (linking a suburban community to the CBD)
Hagen, W. Germany (overall city network for 400,000 population)

COSTS [a: based on Hagen study]

Capital . . . . . $1.9 million/mi ($1.184 million/km) for single guideway, stations, and control system - $5550 per vehicle

Operational / Maintenance . . . . . 4.05 cents/veh-mi (2.52 cents/veh-km

INSTALLATION/RETROFIT CAPABILITY

[a: except as noted]

Envelop Width . . . . . 6.25 ft (1.9 m) [e]
Envelop Height . . . . . 17.5 ft (5.33 m) for over/under [e]
Structural Weight . . . . . Classified
Max Grade 10%
Min Radius of Curvature . . . . . 98 ft (30 m)
Construction Process . . . . . Prefabricated guideway sections
Staging Capability . . . . . Sections can be operated while others under construction

LIMITATIONS

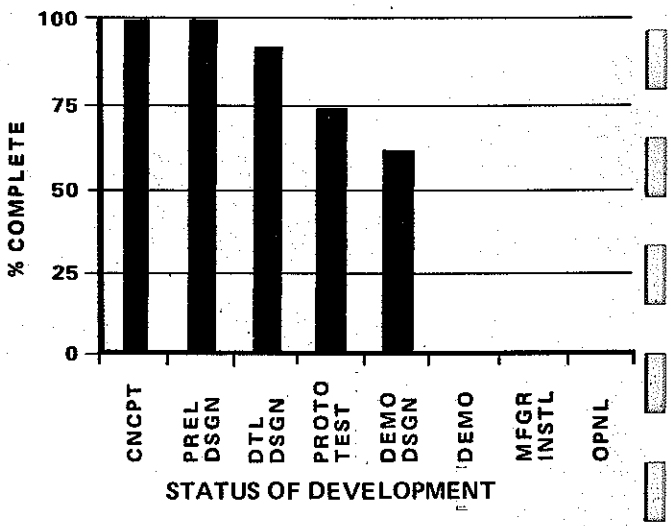
Short wheel-base on vehicles may cause uncomfortable ride at speeds of 50 or 60 mph (80-97 km/h) where higher speeds on long guideway lengths may be desirable [e]. Developer states that vehicle design modifications are anticipated for high speed application [b]

ENVIRONMENTAL IMPACT

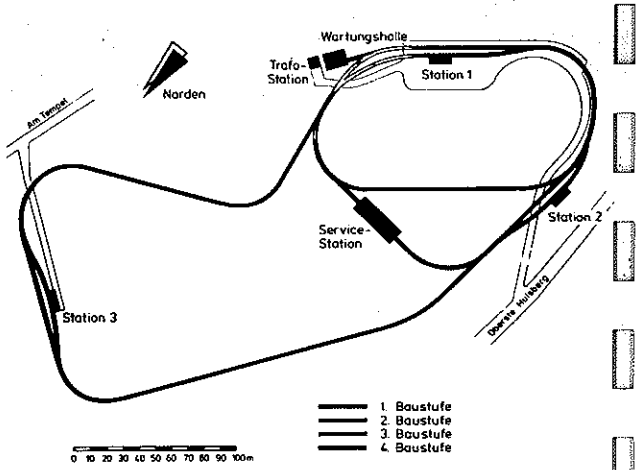
Emissions . . . . . No direct polluting emissions
Visual . . . . . Single overhead guideway with single vehicle above or below [f]

H_1 - 5.2 ft (1.6 m); H_2 - 10.8 ft (3.29 m)
W_1 - 5.2 ft (1.6 m); W_2 - 5.2 ft (1.6 m)
P_1 - 7.4 ft (2.26 m); P_2 - 11.3 ft (3.44 m)

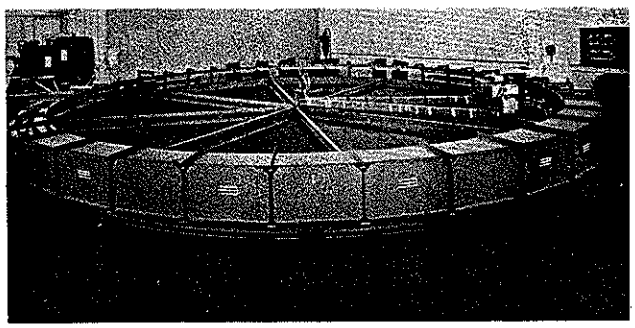
Noise . . . . . Less than 57 dbA at 23 ft (7 m) from guideway, 53 dbA inside vehicle

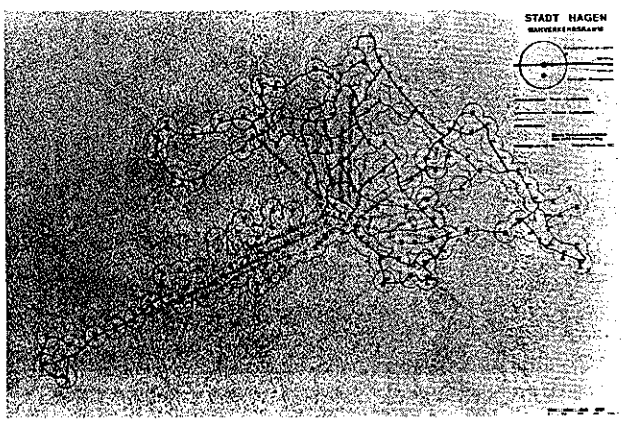


STATUS OF DEVELOPMENT



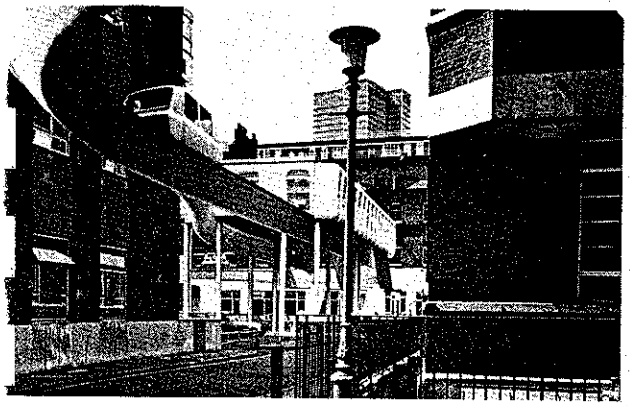
TEST FACILITY AT HAGEN


SHORT HEADWAY CONTROL TEST APPARATUS

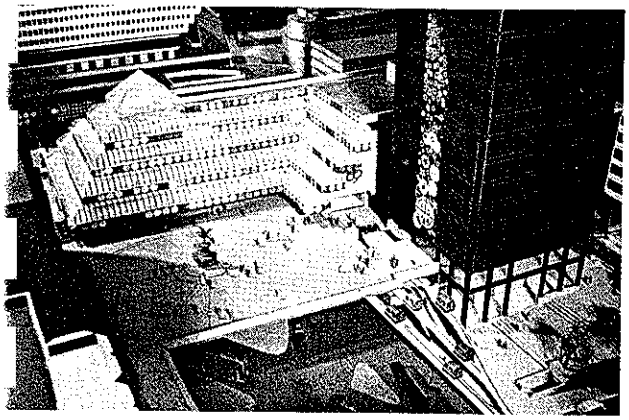


AREA NETWORK PROPOSED FOR HAGEN

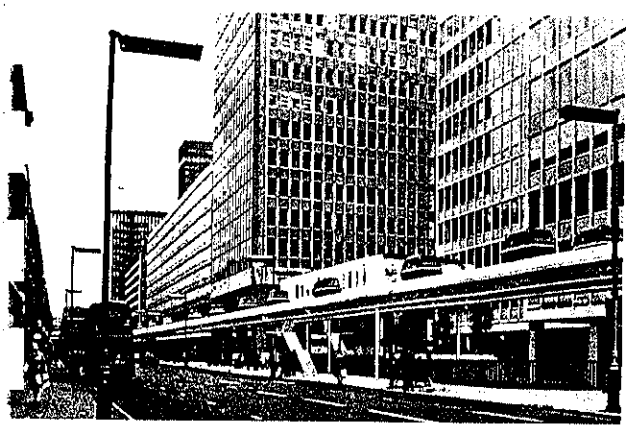
CABTRACK



PHOTOMONTAGE OF GUIDEWAY & STATION AT MORTIMER MARKET



INSERTION INTO PICCADILLY CIRCUS REDEVELOPMENT



PHOTOMONTAGE OF GUIDEWAY & STATION ALONG VICTORIA STREET

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE NAMES: Autotaxi, Automatic Rail-Taxi System

DEVELOPER

Advanced Systems Division
(Formerly, Transport Research Assessment Group)
Transport Systems Department
Transport and Road Research Laboratory
Old Wokingham Road
Crowthorne Berks RG11 6AU
England
Tel: Crowthorne 3131

ASSOCIATE DEVELOPERS:

Hawker Siddeley Dynamics Ltd.
Manor Road
Hatfield, Hertfordshire AL10 9LL
England
Tel: Hatfield 62300

Royal Aircraft Establishment
Farnborough, England

Robert Matthew, Johnson-Marshall & Partners
Welwyn Garden City, Hertfordshire
England

PATENTS IDENTIFIED:

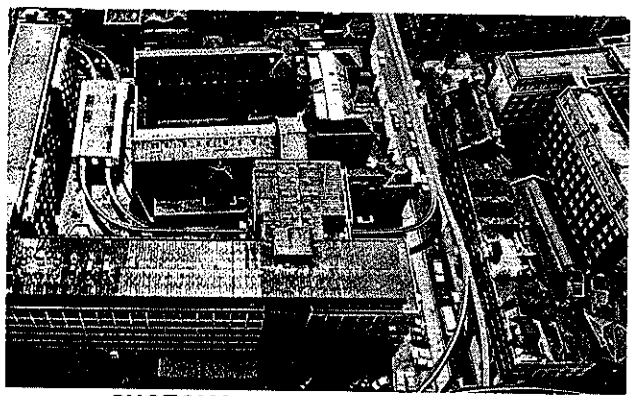
British Patents applied for — 16183/71, relating to steering; 47433/70 and 6382/72, relating to control.

SYSTEM DESCRIPTION

Cabtrack is a Personal Rapid Transit system for transporting passengers in urban areas in small four-passenger rubber tired vehicles over exclusive guideways. The totally automated system provides on-demand exclusive service non-stop between origin and destination stations usually within a grid network of one-way guideways covering an urban area, and two-way guideways as required. Guideways are proposed to be elevated for the most part, underground, and at-grade as well. Two of the vehicle seats may be folded up for accommodating wheel chairs or a pram. Relatively high capacities have been proposed (4,000 veh/hr).

PUBLISHER'S NOTE

The Cabtrack studies were extensive in scope performed during the period 1967-1971. At present it remains a low level effort in the Advanced Systems Division of the Transport Systems Dept. It has been included because of its historical importance to the field of PRT, its in-depth investigations, and its continued relevance in the design of advanced high-capacity PRT systems.



PHOTOMONTAGE OF SYSTEM AT MIDDLESEX HOSPITAL ANNEXE

OPERATIONAL CHARACTERISTICS

SYSTEM [a 11: except as noted]

Maximum One-Way Line Capacity . . . . . 16,000 seats/hr [f]
4,000 vehicles/hr [f]
Minimum Headway . . . . . 0.9 sec
Availability . . . . . On-demand 24 hrs/day
Network . . . . . Urban area grid network
Way . . . . . Exclusive guideway
Routing . . . . . Variable
Traveling Unit . . . . . Single vehicles
Manpower Requirements . . . . . Attendants at central control and maintenance personnel [e]

VEHICLE [a 11]

Maximum Capacity . . . . . 4 Seated — 0 Standing
Crush Capacity . . . . . 4 Seated — 0 Standing

STATIONS [a: except as noted]

Type . . . . . Off-line only
Location . . . . . At, above, or below grade
Type Boarding . . . . . Level
Ticket/Fare Collection . . . . . Automatic machines
Security . . . . . Closed circuit T.V.
Boarding Capacity . . . . . 76 cabloads/hr/berth [b 31]
Deboarding Capacity . . . . . 60 cabloads/hr/berth [b 31]
Maximum Wait Time . . . . . Zero nominally, 40-60 sec at peak hrs [e]
Vehicle Dwell Time . . . . . Not applicable
Average Station Spacing . . . . . Approx. 0.5 mi (0.8 km)

INDIVIDUAL SERVICE [a 11]

Privacy . . . . . Exclusive use of vehicle
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
Accommodation . . . . . Seated only
Comfort . . . . . Heated & air-conditioned vehicles
Security . . . . . Push button for stop at next station and loud speakers in vehicles
Instruction . . . . . Passive and active graphics in stations and vehicles

SAFETY AND FAILURE MODES [b 11]

Fail Safe Features . . . . . Vehicle switching mechanism, headway control system
Fail Operational Features . . . . . If supervisory computer fails system will continue to operate at a degraded performance
Power Failure Mode . . . . . All vehicles come to safe stop. Public address to passengers remains in operation

System MTBF
Vehcile MTBF
Station MTBF
System Restore Time After Failure
System Lifetime
. . . . . Insufficient work has been performed that these quantities cannot be defined

MAINTENANCE [b 11]

Guideway is designed for easy access by maintenance personnel. Running and guidance surfaces are designed for easy re-alignment and replacement. Withdrawal of vehicles for cleaning and maintenance is controlled by the supervisory computer.

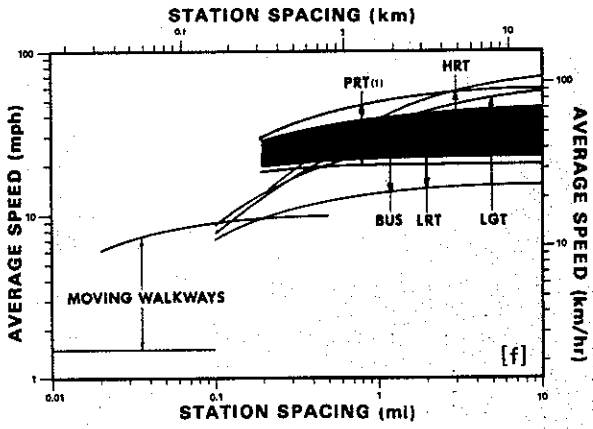
CARGO CAPABILITY

Passenger Articles . . . . Small packages, luggage, wheelchairs, prams [a]
Goods Movement . . . . . Not provided, but could be included [e]

INTEGRATION WITH OTHER MODES [e]

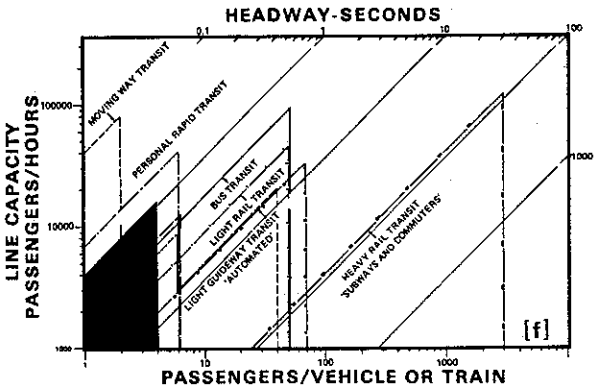
Could be installed directly into transportation terminals to provide internal circulation and to connect modes (air, rail, parking lots, etc.), and as a feeder to high-capacity HRT systems.

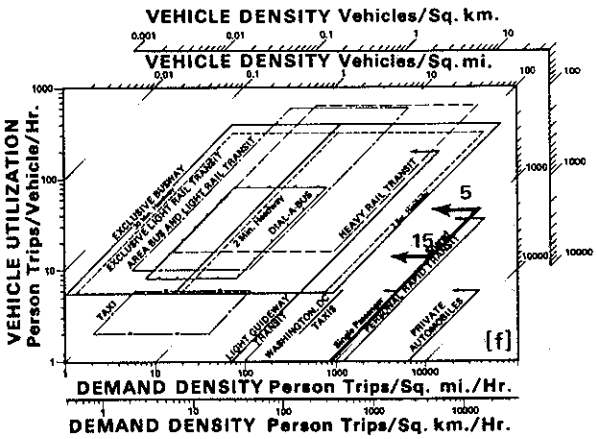
[1] **Data Reference Code - See inside back cover for explanation**

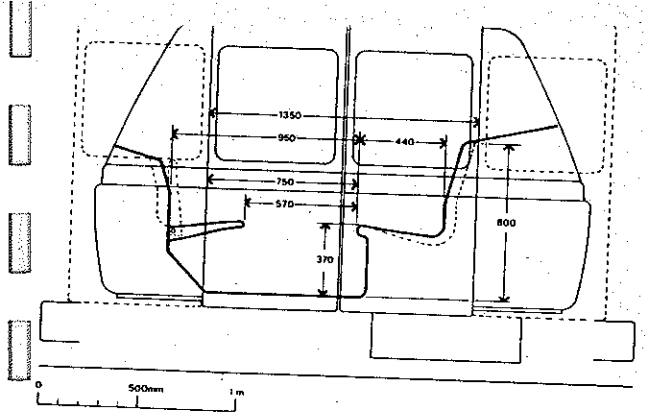


(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH.

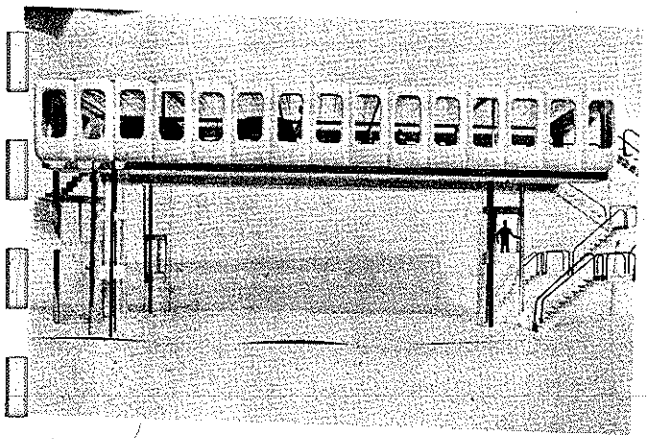
VEHICLE PERFORMANCE [b 21]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	22.5		
	km/h	36		
MAX VELOCITY	mph	45		
	km/h	72		
MAX GRADE	%	10	SAME AS CLEAR	SAME AS CLEAR (Heated Guideway Surface)
	%			
SERVICE ACCEL	ft/s^2	8.2		
	m/s^2	2.5		
SERVICE DECEL	ft/s^2	8.2		
	m/s^2	2.5		
MAX JERK	ft/s^3	4		
	m/s^3	1.23		
EMERGENCY DECEL	ft/s^2	Undecided		
	m/s^2			
STOPPING PRECISION	in.	N/A		
	mm			

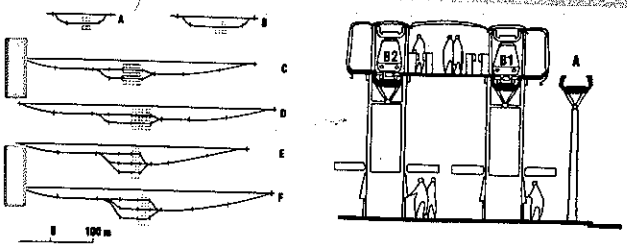


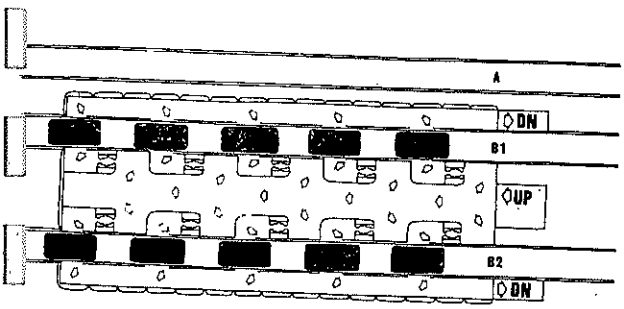




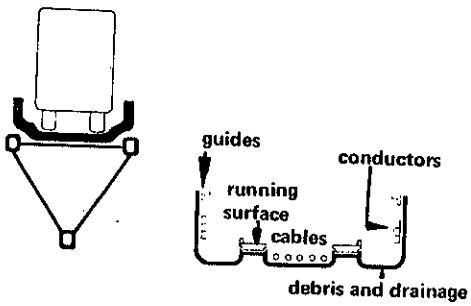
VEHICLE SIDE VIEW







5-BERTH STATION OF MODULAR FORM



PREFERRED GUIDEWAY CROSS SECTION

PHYSICAL DESCRIPTION [1]

VEHICLE [a 21: except as noted]

Length	10 ft (3.05 m)
Width	4.5 ft (1.37 m)
Height	5.5 ft (1.68 m)
Empty Weight	1,320 lbs (600 kg) [d]
Gross Weight	2,200 lbs (1,000 kg) [d]
Passenger Space	See dimension drawing at left
Doorway Width	4.43 ft (1.35 m)
Doorway Height	Roof opens

SUSPENSION [a 21]

Type	4 wheel conventional automotive with pneumatic rubber tires
Design Load	1,100 lbs. (500 kg)/axel
Obstacle Clearance	Not yet defined
Steering	Steered by lateral rubber tired guidewheels which ride on guideway sidewalls

PROPULSION/BRAKING [a 21]

Type	Two proposals: Slip ring induction motor or DC motor
Emplacement	One per vehicle with mechanical transmission
Propulsion Power	Rated 20 HP, 25 kw
Power or Fuel	415 vac, 3ϕ, 50 Hz
Power/Fuel Consumption	0.24 kwh/veh-mi (0.15 kwh/veh-km)
Service Braking	Electric dynamic supplemented by disc brakes at low speed
Emergency Braking	Hydraulic operated disk brakes
Emergency Brake Reaction Time	Data not available

SWITCHING [a 21]

Type	Hydraulic actuated guidewheel retraction mechanism
Emplacement	On-board vehicle
Switch Time	Data not available
Speed Thru	Mainline speed
Headway Thru	Mainline headway

GUIDEWAY [a 21]

Type	Shallow U-shaped roadway with truss design
Materials	Steel and concrete
Maximum Elevated Span	65 ft (19.8 m)
Crossection Height, Crossection Width	Detail undetermined
Running Surface Width	6.5 ft (1.98 m)

CONTROL [d]

Totally automatic quasi-synchronous, hierarchically organized. Moving slots are established by wayside computers. Velocity and position is maintained by on-board controller using track fiducal marks and system clock responding to commands to accel., decel., stop, etc. Station and interchange controllers define and issue commands to each vehicle to maneuver as required to control traffic. Central computer regulates overall traffic, routes vehicles, controls ticketing, dispatches empty vehicle, emergency control, and regulates maintenance. Control at merges by a form of queing on branch tracks (vehicles continue moving during queing process)

STATIONS [a 21]

Stations are of modular design. Smallest station accommodates one-way siding with 3 berths. Larger stations with 5 berths per each direction are designed. Access is via stairs, escalators, and elevators. Stations are designed based on vehicle arrival and departure of one per 40 sec.

[1] **Detailed design of a prototype vehicle has not been undertaken. Actual vehicle characteristics might differ from data shown herein.**

DEVELOPMENT [e]

The concept was initiated by Dr. L. R. Blake as "Autotaxi" in 1966 at Brush Electrical Co. Ltd., now a subsidiary of Hawker Siddeley. The Department of the Environment (DOE) in 1967 formed the transport Research Assessment Group (now Advanced Systems Division) to manage research and development of the Cabtrack system. In-depth technical, economic, and social studies were performed by a multi-disciplinary team drawn from the DOE and the Royal Aircraft Establishment. Extensive architectural studies were performed at Robert Matthew, Johnson-Marshall & Partners. The larger effort to develop the system ceased in 1972; however, at the present time a 1/5th scale model is in operation at the Transport and Road Research Laboratory. Present efforts in England appear to be focused on the "Minitram" LGT system with Cabtrack at a low level.

INSTALLATION STUDIES/PROPOSALS [b]

Extensive study of a network for London as a research exercise only, with main emphasis placed on architectural and environmental problems. A cost/benefit assessment study was carried out on two hypothetical networks in the West Midlands area.

COSTS [a 21]

Capital . . . . . Based on 1968 English pound value converted to dollars at 1974 exchange rate: Total fixed facilities based on one-way guideways spaced in grid of 0.318 mi mesh size — $1.465-1.578 million/mi; Vehicle, including spares and other support facilities — $3,500 each. (Subsequent studies with 0.5 mi mesh size shows similar results)

Operation & Maintenance . . . . . Very tentative dependent upon detailed site-specific characteristics.

Based on mesh size of 0.318 mi and system speed of 15 mph 37.6 cents/veh-mi at 1,000 person-trips/day or 6.8 cents/veh-mi at 16,000 person-trips/day (includes 10% interest charges on all fixed and movable equipment.)

INSTALLATION/RETROFIT CAPABILITY

[e: except as noted]

Envelop Width	Approx. 6.6 ft (2 m)
Envelop Height	Approx. 10 ft (3.05 m)
Structural Weight	Data unavailable
Maximum Grade	10%
Minimum Radius of Curvature	10 ft (6.1 m)
Construction Process	Prefabricated guideway sections and modular stations [a]
Staging Capability	Sections could be operated while other under construction

LIMITATIONS

Traction braking limits emergency deceleration to approx. 22.5 ft/s^2 (6.87 m/s^2) assuming ideal dry tire/surface interface conditions; therefore, system performance may be degraded under adverse climatic conditions. It is debated by some that proper design of guideway/vehicle interface and control system may preclude requirements for emergency deceleration greater than that for normal service. Developer has not yet decided the value for emergency deceleration, but indicates that it may be the same as normal service deceleration to eliminate the risk of injury to passengers in "false alarm" emergency stops.

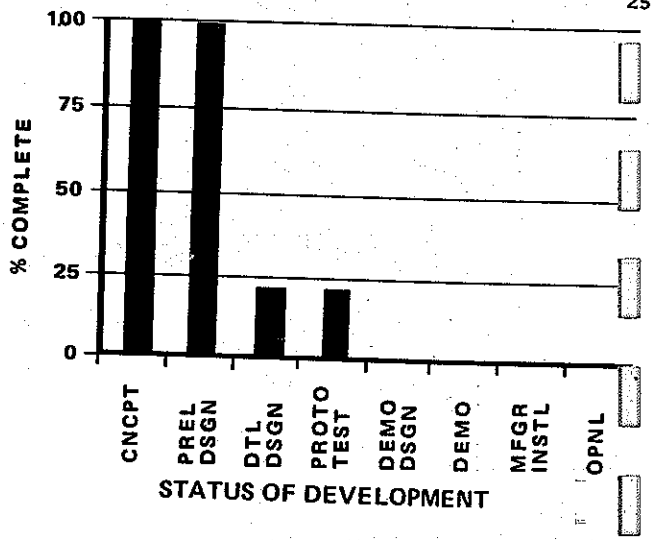
ENVIRONMENTAL IMPACT [e]

Emissions . . . . . No direct polluting emissions

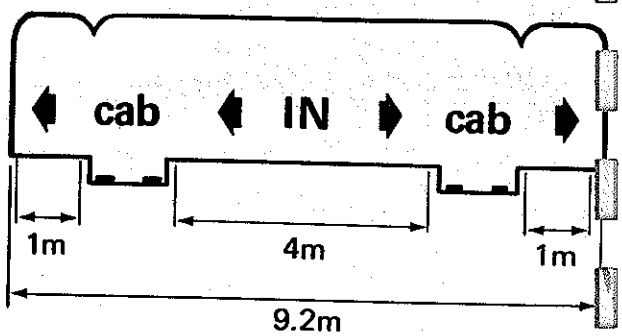
Visual . . . . . Standard values for H, W, P are not given because guideway dimensions are not defined.

An architectural and environmental study was performed by Robert Matthew, Johnson - Marshall & Partners.

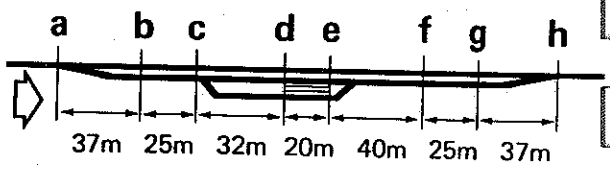
Noise . . . . . Data unavailable



STATUS OF DEVELOPMENT

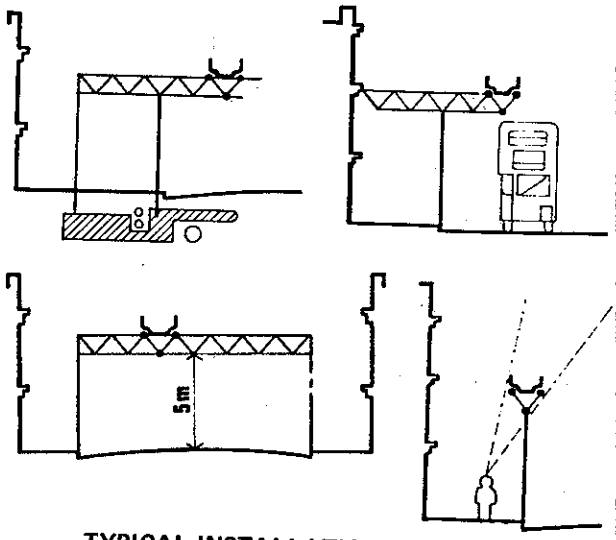


CROSS SECTION OF TYPICAL TWO-TRACK 5-BERTH (10 TOTAL) STATION



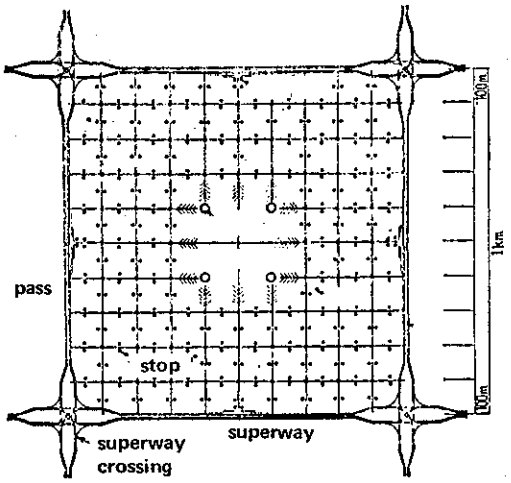
ab Sidestep off main track
bc Deceleration lane
cd Input Queues (8 x 4m cab spaces)
de Cabstop (Two platforms of 5 x 4m cab spaces)
ef Output Wueue (10 cab spaces)
fg Acceleration lane
gh Sidestep, returning to main track

TRACK DIMENSIONS TO SERVE A 5-BERTH STATION

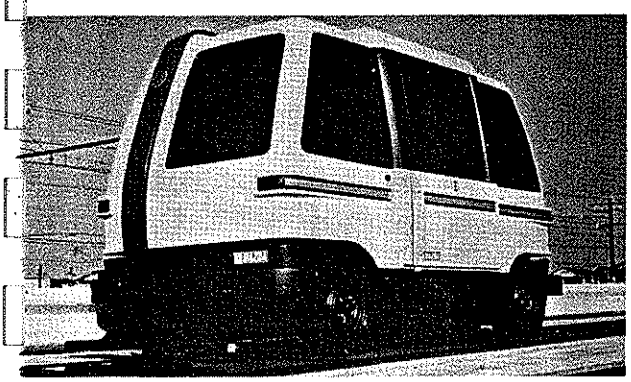


TYPICAL INSTALLATION METHODS

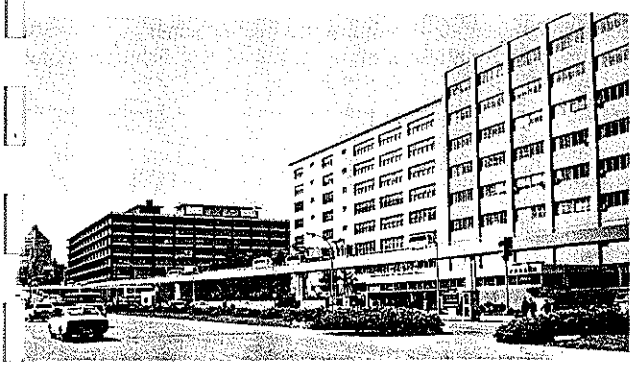
CVS



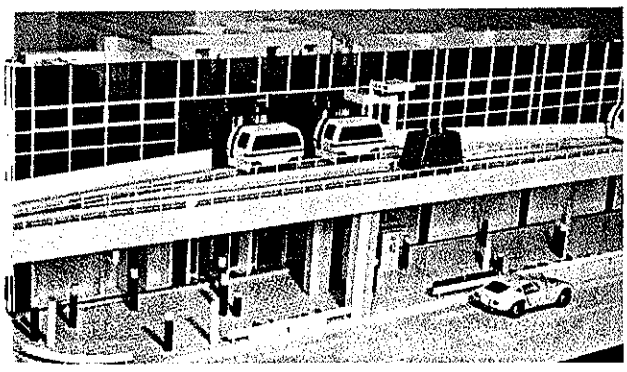
TYPICAL NETWORK



CVS CITY CAR MODEL



GUIDEWAY PHOTOMONTAGE



TYPICAL STATION STOP

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE 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 and 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 IDENTIFIED: Data unavailable

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 two to 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 [a: except as noted]

Maximum One-Way Line Capacity ..... 14,400 seats/hr [f]
3,600 veh/hr [f]
Minimum Headway ..... 1.0 sec
Availability ..... On-demand 24 hrs/day
Network ..... Grid network over urban area
Way ..... Exclusive
Routing ..... Variable
Traveling Unit ..... Single vehicles
Manpower Requirements ..... Attendants at central control facility and maintenance personnel

VEHICLE [a]

Maximum Capacity ..... 2-4 Seated — 0 Standing
Crush Capacity ..... 2-4 Seated — 0 Standing

STATIONS [a]

Type ..... Off-line
Location ..... Board elevator at-grade and transfer above-grade
Type Boarding ..... Level
Ticket/Fare Collection ..... Automated machines
Security ..... Open stations on city streets
Boarding Capacity ..... 180 persons/hr/berth
Deboarding Capacity ..... 180 persons/hr/berth
Maximum Wait Time ..... Approximately 20 sec
Vehicle Dwell Time ..... Approximately 20 sec
Average Station Spacing ..... 3.28 ft (100 m)

INDIVIDUAL SERVICE

Privacy ..... Exclusive vehicle per person or party
Transfers ..... Not necessary
Stops ..... Non-stop
Accommodation ..... Seated only
Comfort ..... Air conditioned vehicles
Security ..... Telephone, emergency button, air bag, passengers are seated facing the rear with seats designed for safe emergency deceleration
Instruction ..... Signs, active graphics, active indicators

SAFETY AND FAILURE MODES [a]

Fail Safe Features
Fail Operational Features
Power Failure Mode — Vehicle Battery
System MTBF
Vehicle MTBF
Station MTBF
System Restore Time After Failure
System Lifetime

} Present test program to determine these features and data

MAINTENANCE

Information not presently available

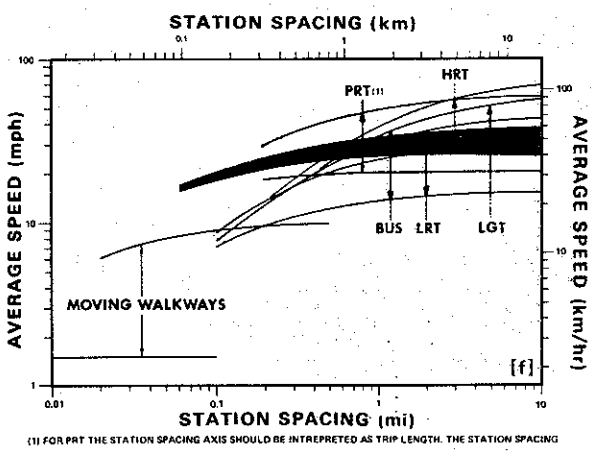
CARGO CAPABILITY [a]

Passenger Articles ..... Small packages & luggage; special vehicles for accommodating handicapped & wheelchairs
Goods Movement ..... Special vehicles being designed. Development of automated cargo handling equipment underway.

INTEGRATION WITH OTHER MODES [e]

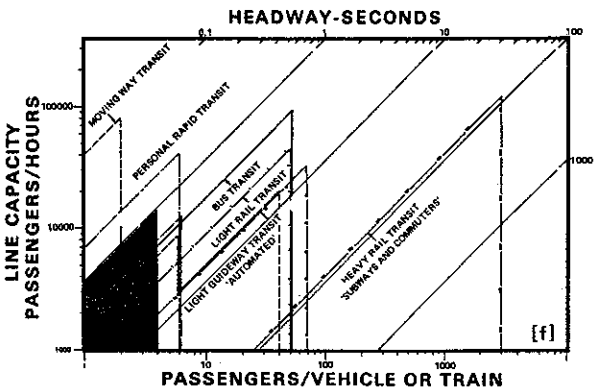
Stations could be placed in major transportation terminals and other transit stations. System could be used to link connecting flights in airports and to feed other high-capacity line-haul systems.

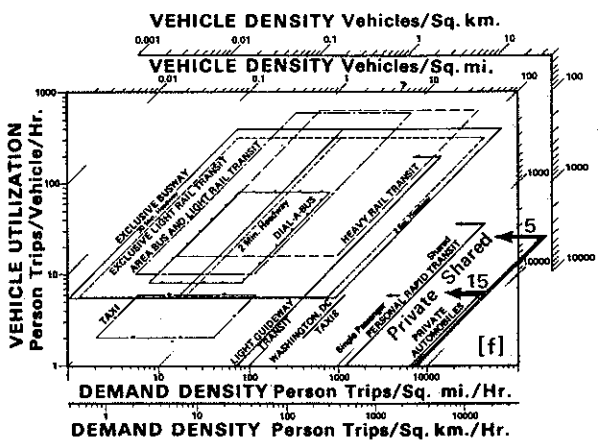
[1]**Date Reference Code - See inside back cover for explanation.**

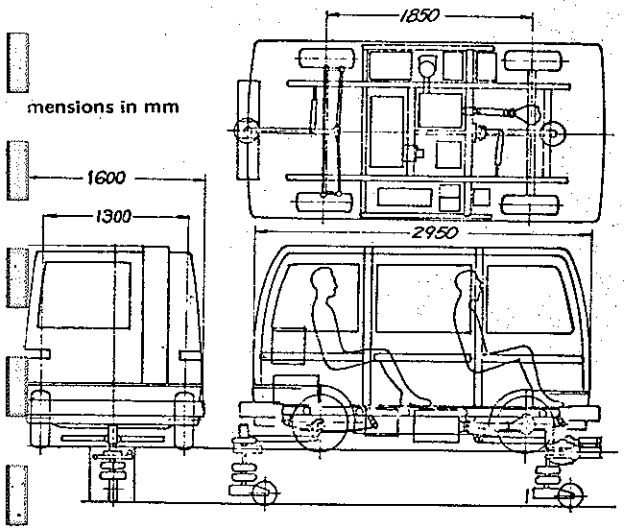


(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH. THE STATION SPACING

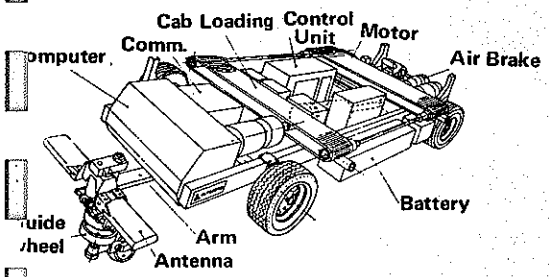
VEHICLE PERFORMANCE [a]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	25-37	DATA NOT AVAILABLE	DATA NOT AVAILABLE
	km/h	40-60		
MAX VELOCITY	mph	50		
	km/h	80		
MAX GRADE	%	6		
	%	at 60 km/hr		
SERVICE ACCEL	ft/s^2	6.4		
	m/s^2	1.96		
SERVICE DECEL	ft/s^2	6.4		
	m/s^2	1.96		
MAX JERK	ft/s^3	6.4		
	m/s^3	1.96		
EMERGENCY DECEL	ft/s^2	64.4		
	m/s^2	19.6		
STOPPING PRECISION	in.	±20		
	mm	±500		



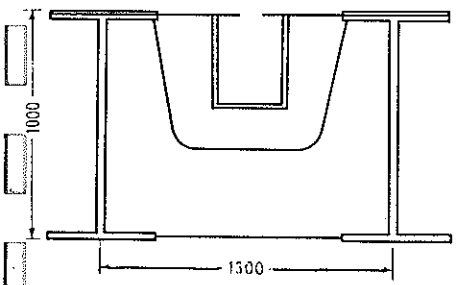




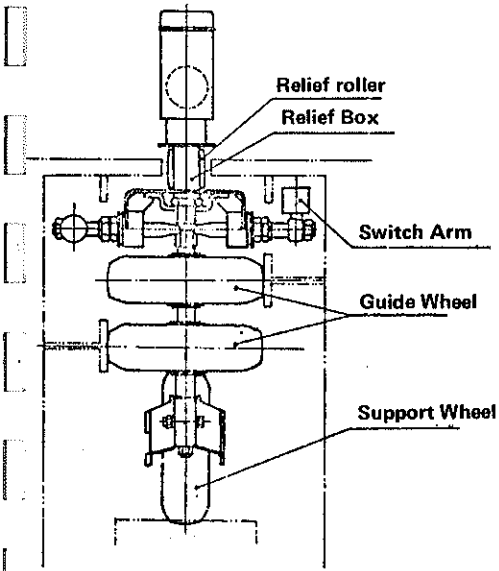
VEHICLE



TYPICAL VEHICLE CHASSIS



GUIDEWAY CROSS SECTION



STEERING ARM & GUIDE WHEELS

PHYSICAL DESCRIPTION

VEHICLE [a]

Length ..... Total 11 ft (3.35 m), Cabin 9.8 ft (3 m)
Width ..... 5.25 ft (1.6 m)
Height ..... 6.07 ft (1.85 m)
Empty Weight ..... 1,694 lbs (770 kg)
Gross Weight ..... 2,420 lbs (1,100 kg)
Passenger Space ..... Similar to compact automobile
Doorway Height ..... Top opens
Doorway Width ..... 3.28 ft (1 m)

SUSPENSION [a]

Type ..... Supported on 4 pneumatic rubber tires with leaf springs and shock absorbers
Design Load ..... Data unavailable
Obstacle Clearance ..... Data unavailable
Steering ..... Ackerman steering actuated by front steering arm which rides in a center groove in the guideway

PROPULSION/BRAKING [a]

Type ..... Rotary dc electric traction motor
Emplacement ..... One per vehicle
Propulsion Power ..... 12 kw — 120v motor
Power or Fuel ..... 220v ac 1ϕ - rectified and charges vehicle battery
Power Transfer ..... Power rail and collector shoes
Power/Fuel Consumption ..... Data unavailable
Service Braking ..... High speed - electrodynamic; Low speed - mechanical
Emergency Braking ..... Air brake - positive gripping of guideway rail (Calipers)
Emergency Brake Time ..... Developing 0.1 sec

SWITCHING [a]

Type ..... Mechanical positive entrappment roller engages switch rail
Emplacement ..... On-board vehicle
Switch Time ..... Not applicable - mechanism operates advance of switch
Speed Thru ..... Line speed
Headway Thru ..... 1.0 sec

GUIDEWAY [a]

Type ..... Elevated road surface with center guide groove
Materials ..... Prestressed concrete and steel
Maximum Elevated Span ..... 98 ft (30 m)
Crossection Height ..... 3.28 ft (1 m)
Crossection Width ..... 6.6 ft (2 m)
Running Surface Width ..... 5.25 ft (1.6 m)

CONTROL [a]

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 [e]

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.

DEVELOPMENT [a]

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) was performed October, 1973 - March, 1973. Secondary test runs were made April, 1973 - August, 1973. A full-scale test track with collective computer operation is to begin in August, 1974 and tests are to be completed by March, 1975. At present 60 experimental vehicles are in operation.

INSTALLATIONS [a]

Tokyo Motor Show (October, 1974) - a 1/20th scale operating model under computer control.

Prototype Test Facility - 5 km test track (shown at right) full-scale with 100 vehicles and including merges, demerges, interchanges, and stations. The test facility is located at Higashi-murayama-shi of Tokyo.

INSTALLATION STUDIES/PROPOSALS [b]

Central District of Tokyo, New Tokyo International Airport, Mebashi City and Takasaki City

COSTS [a 41]

Capital ....Guideway Only - ¥200,000,000 ($770,000)/single-lane km
- ¥322,000,000 ($1,240,000)/single-lane mi
All other system components & vehicles - same

Operational / Maintenance ..... ¥43/veh-km (16.6 cents/veh-km)
¥69/veh-mi (26.7 cents/veh-mi)
including capital costs

INSTALLATION/RETROFIT CAPABILITY

[a: except as noted]

Envelop Width / Envelop Height / Structural Weight ..... Not yet decided
Maximum Grade ..... Nominally 10% - up to 23%
Minimum Radius of Curvature ..... 16 ft (5 m)
Construction Process .... Prefabricated and modular construction [e]
Staging Capability ..... Sections can be built and put into operation while others are under construction. [e]

LIMITATIONS [e]

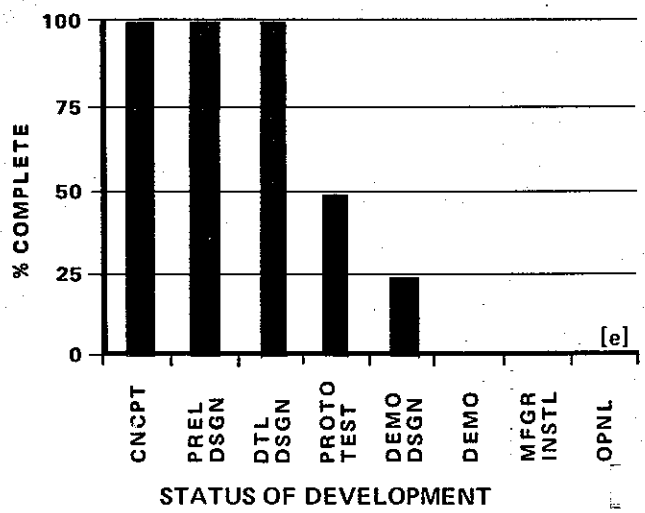
Traction drive may require degraded performance for inclimate weather operation (including snow and ice removal).

Guideway width may limit certain retrofit installations.

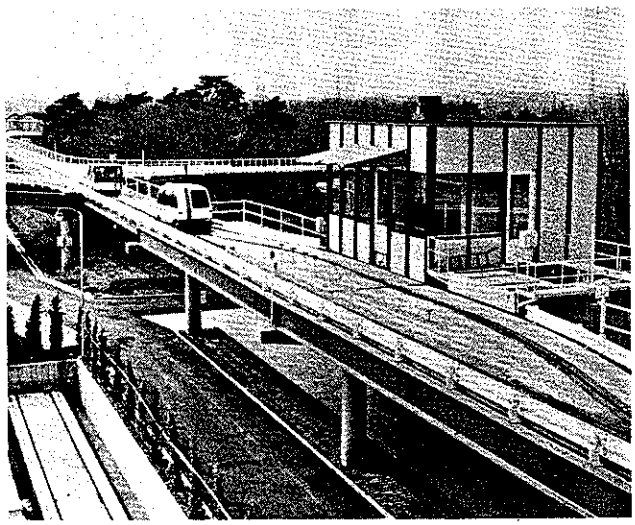
Guideway width may limit certain retrofit installations.

ENVIRONMENTAL IMPACT

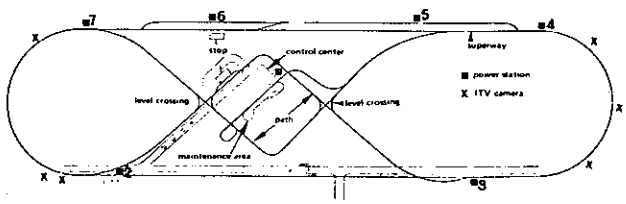
Emissions .....No direct polluting emissions [e]
Visual ..... Single elevated guideway [f]
H_1 – 3.28 ft (1.0 m); H_2 – 9.35 ft (2.85 m)
W_1 – 6.6 ft (2.0 m); W_2 – 6.6 ft (2.0 m)
P_1 – 6.25 ft (1.9 m); P_2 – 10.1 ft (3.08 m)
Noise ..... Under experiment [b]



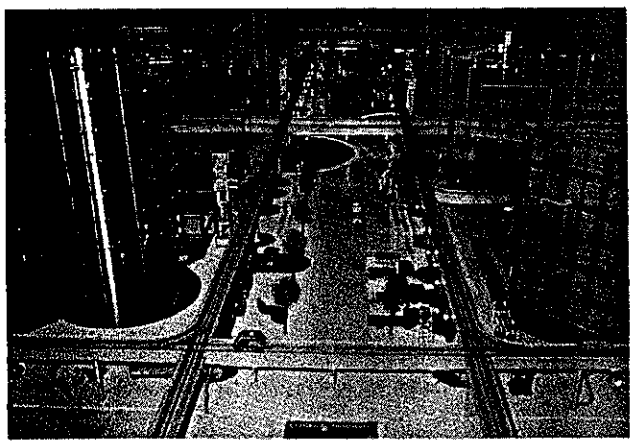
STATUS OF DEVELOPMENT



VEHICLE ON TEST TRACK

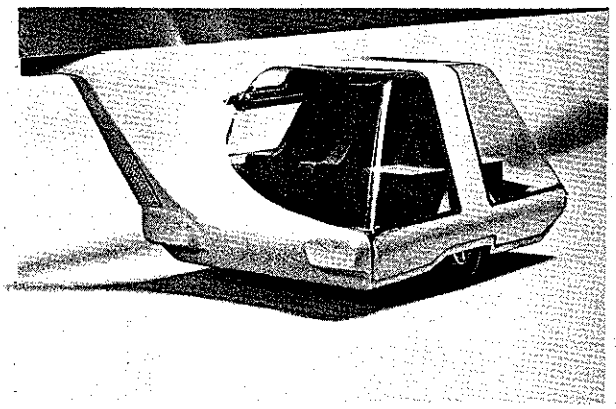


TEST TRACK

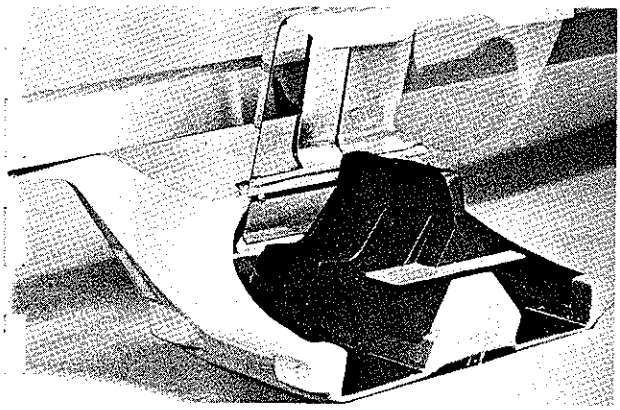


1/20TH SCALE MODEL AT TOKYO MOTOR SHOW (OCT. 1971)

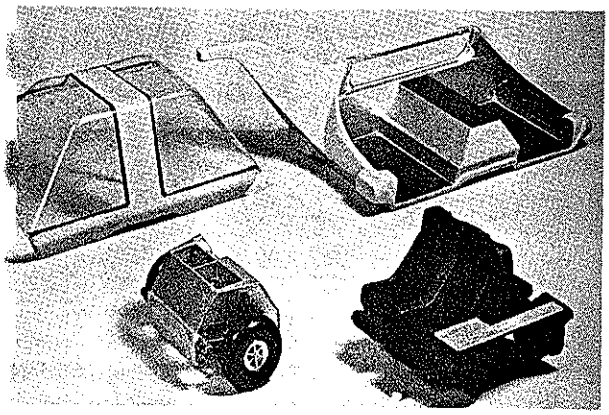
LAN-SIG



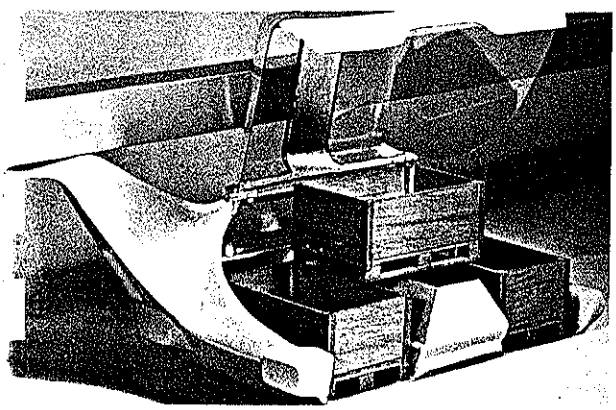
ELAN VEHICLE



ELAN VEHICLE



BASIC VEHICLE COMPONENTS



GOODS MOVEMENT

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE NAMES: None

DEVELOPER: SIG Swiss Industrial Company
Railway Carriage and Wagon Works
CH-8212 Neuhausen Rhine Falls
Switzerland
Tel: (053) 8 15 55
Telex: 7 61 56
Teleg: SEG Neuhausenamrheinfall

LICENSEES: None

PATENTS IDENTIFIED:

One-way vehicle of Rickshaw Principle:
Austria 310005; Switzerland 542741; U.S.A. 3,777,670; Italy 943616; France 2108518; and pending in Germany, Sweden, Japan, and Great Britian.

Vehicle with Movable Seats and Floor:
Austria 313718; Switzerland 542069; U.S.A. 3,759,567; Italy 936806; France 2108519; and pending in Germany, Sweden, Japan, and Great Britian.

Vehicle Guidance and Switch:
Austria 315909; Italy 951416; France 2136439; and pending in Switzerland, Germany, U.S.A., Sweden, and Japan.

SYSTEM DESCRIPTION

Elan-Sig is a Personal Rapid Transit system operating from, and controlled by, an overhead guideway, with the vehicles supported from below by two rubber tired wheels which run on a roadbed. The totally automated system using state-of-the-art components (automotive wheels and suspension, for example) and systems equipment, offers personal non-stop exclusive service to its passengers in small vehicles of 4 seats. The vehicle is designed for goods movement where the seats can be removed and freight containers placed aboard. The system is proposed as an advanced high-capacity PRT operating at 0.7 sec headways with capacities as high as 20,000 passengers/hr. The switching concept is claimed to be reliable and crashproof utilizing a small active knife-edge blade in the guideway which must pass to the right or left of another knife-edge blade on the vehicle's overhead bogie.

Of interesting note is the capability to tilt (or rotate) the vehicle about its horizontal axis by changing the distances between the roadbed and the overhead guidebeam, thus compensating for steep slopes, acceleration, and deceleration to give a safer and more comfortable ride.

OPERATIONAL CHARACTERISTICS

SYSTEM [a: except as noted]

Maximum One-Way Line Capacity . . . . . 20,571 seats/hr [f]
5,143 vehicles/hr [f]
Minimum Headway . . . . . 0.7 sec
Availability . . . . . On-demand 24 hrs/day
Network . . . . . Area wide urban network
Way . . . . . Exclusive guideway
Routing . . . . . Variable
Traveling Unit . . . . . Single vehicles
Manpower Requirements . . . . . Attendants at central contral facility and maintenance personnel

VEHICLE [a]

Maximum Capcity . . . . . 4 Seated — 0 Standing
Crush Capacity . . . . . 4 Seated — 0 Standing

STATIONS [a: except as noted]

Type . . . . . Off-line
Location . . . . . At, above, or below grade
Type Boarding . . . . . Level
Ticket/Fare Collection . . . . . Automatic machines
Security . . . . . Closed circuit T.V. could be installed [e]
Boarding Capacity . . . . . 480 passengers/hr/berth [f]
Deboarding Capacity . . . . . 480 passengers/hr/berth [f]
Maximum Wait Time . . . . . Zero for unsaturated operation [e]
Vehicle Dwell Time . . . . . 30 sec
Average Station Spacing . . . . . Approximately 0.5 mi (0.8 km) [e]

INDIVIDUAL SERVICE [a: except as noted]

Privacy . . . . . Exclusive use of vehicle
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
Accommodation . . . . . Seated only
Comfort . . . . . Heated & ventilated vehicles
Security . . . . . Emergency stop pushbutton for next station
Instruction . . . . . Maps, signs, and active graphics [e]

SAFETY AND FAILURE MODES [a]

Fail Safe Features } Switch, on-board fault detection.
Fail Opnl. Features } . . . . . Passenger walkway provided for escape
Power Failure Mode } path. Vehicles can be towed or pushed.
System MTBF . . . . . 10,000 hrs
Vehicle MTBF . . . . . 1,000 hrs
Station MTBF . . . . . 100,000 hrs
System Restore Time After Failure . . . . . 1 hr by replacing exchange components
System Lifetime . . . . . 30 yrs

MAINTENANCE [a]

Small maintenance building with automative hoists and storage space for approximately 5% of total fleet.

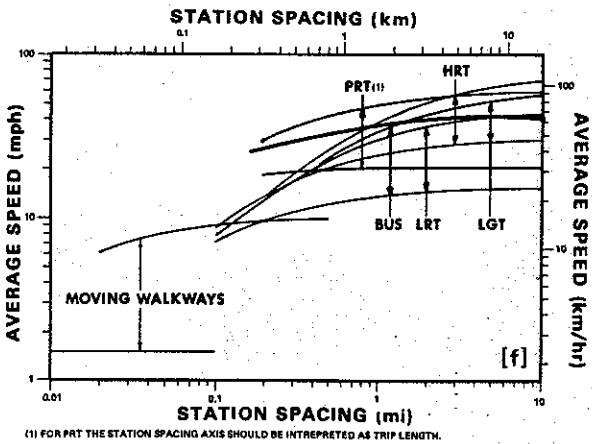
CARGO CAPABILITY

Passenger Articles . . . . . Small packages and hand luggage [e]
Goods Movement . . . . . Seats can be removed and freight containers placed aboard vehicle [a]

INTEGRATION WITH OTHER MODES [e]

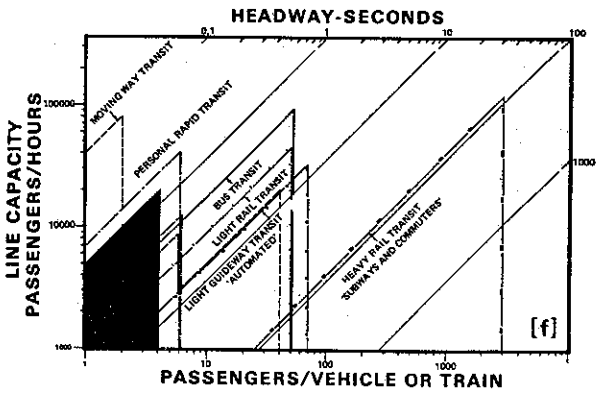
Could be used as circulation system in transportation terminals, link between other modes (air, rail, etc.), and as a feeder for other high capacity modes such as HRT.

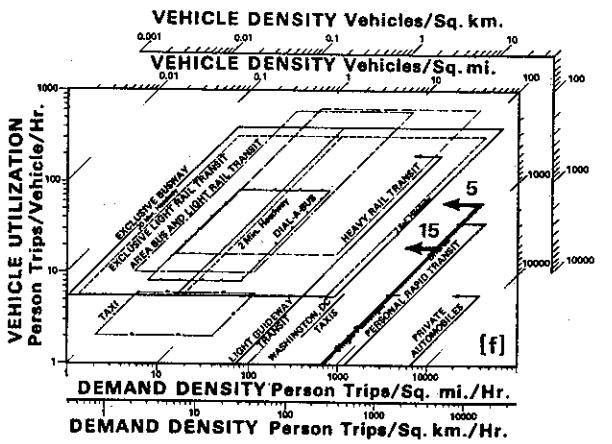
[1] **Data Reference Code - See inside back cover for explanation.**

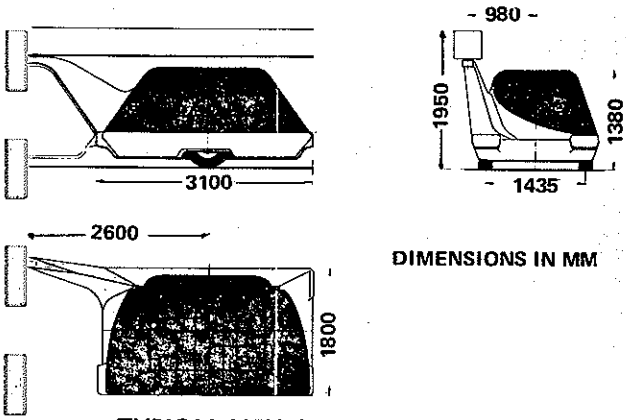


(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH.

VEHICLE PERFORMANCE [a]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	37		
	km/h	60		
MAX VELOCITY	mph	40		
	km/h	64		
MAX GRADE	%	20%	SAME AS CLEAR (Covered guideway)	SAME AS CLEAR (Covered guideway)
	%			
SERVICE ACCEL	ft/s^2	8.2		
	m/s^2	2.5		
SERVICE DECEL	ft/s^2	8.2		
	m/s^2	2.5		
MAX JERK	ft/s^3	N/A		
	m/s^3			
EMERGENCY DECEL	ft/s^2	16.4		
	m/s^2	5		
STOPPING PRECISION	in.	N/A		
	mm			

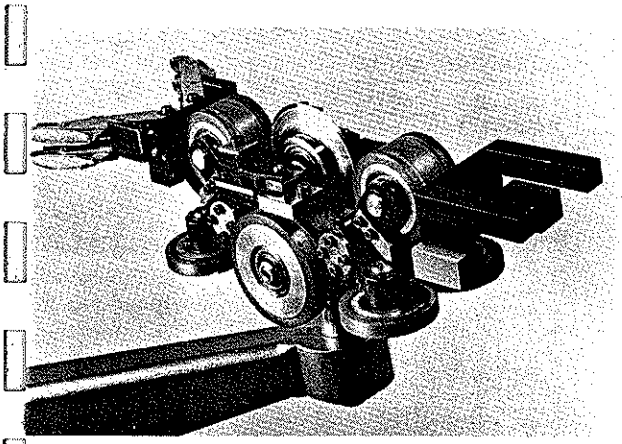




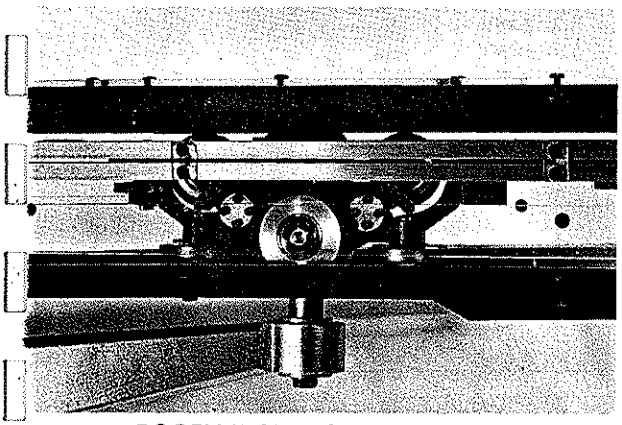


DIMENSIONS IN MM

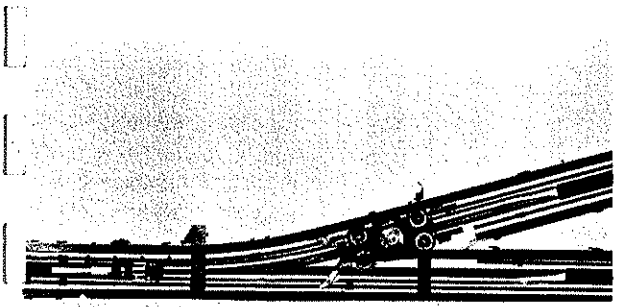
TYPICAL VEHICLE DIMENSIONS



GUIDANCE BOGEY



BOGEY INSIDE GUIDEBEAM



BOGEY IN SWITCH SECTION

PHYSICAL DESCRIPTION

VEHICLE [a]

Length ..... 10.2 ft (3.1 m)
Width ..... 5.9 ft (1.8 m)
Height ..... 4.5 ft (1.38 m)
Empty Weight ..... 1,750 lbs (795 kg)
Gross Weight ..... 2,400 lbs (1,100 kg)
Passenger Space ..... Same as compact automobile
Doorway Width, Doorway Height ..... Vehicle side and roof completely open for total exposure entry

SUSPENSION [a: except as noted]

Type ..... 2 pneumatic tired automotive wheels and suspension stabilized by leading guidearm
Design Load ..... 1,200 lbs/wheel (550 kg/wheel)
Obstacle Clearance ..... Approximately 4.6 in (117 mm) [e]
Steering ..... Guided by bogie constrained to ride inside overhead guidebeam with leading arm to veh.

PROPULSION/BRAKING [a]

Type ..... Rotary dc electric traction drive thru support wheels
Emplacement ..... Single motor on-board vehicle
Propulsion Power ..... 20 HP, 15 kw rated
Power or Fuel ..... 600 vdc
Power Transfer ..... Double sided power pick-ups ride on guideway power bus
Power/Fuel Consumption ..... 0.145 kwh/veh-mi (0.09 kwh/veh-km)
Service Braking ..... Dynamic electric
Emergency Braking ... Electrically controlled mechanical wheelbrakes
Emergency Brake Reaction Time ..... 1 sec

SWITCHING [a]

Type ..... Passive for merging — Active mechanical for demerging
Emplacement ..... On-guideway active switching tongue
Switch Time ..... 0.15 sec
Speed Thru ..... Mainline cruise speed
Headway Thru ..... Mainline minimum headway

GUIDEWAY [a: except as noted]

Type ..... Totally enclosed flat roadbed surface with overhead box guidebeam
Materials ..... Concrete or steel roadbed, steel overhead box beam
Maximum Elevated Span ..... 150 ft (48 m)
Crossection Height ..... Approximately 7.5 ft (2.3 m) [e]
Crossection Width ..... 7.5 ft (2.3 m)
Running Surface Width ..... Approximately 6.5 ft (2 m) [e]

CONTROL [a]

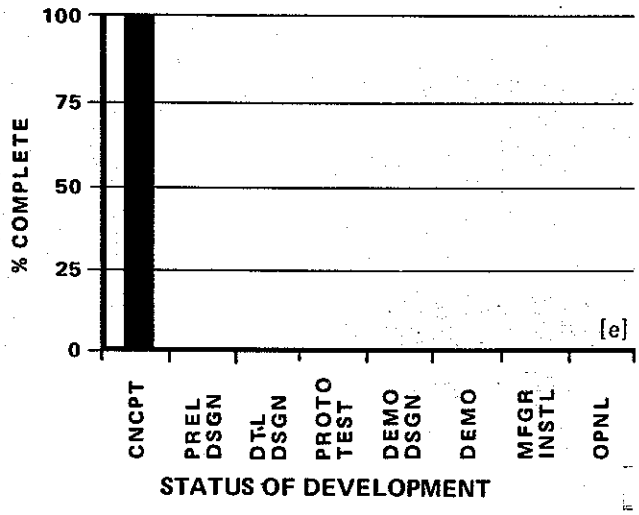
A hierarchial computer control system with quasi-synchronous network control. Virtual slots (vehicle plus separation distance length) move along the guideway with vehicles assigned to a particular slot. Vehicles receive discrete commands from wayside computers having control over certain jurisdictions. A central computer supervises and controls the total network processing demands, dispatching empty vehicles, and assigning routes.

STATIONS [a]

A typical off-line station would be 115 ft (35 m) long. Total off-line guideway length including acceleration and deceleration, and station lengths for 37 mph (60 km/hr) mainline cruise speed and 8.2 ft/s^2 (2.5 m/s^2) accel/decel, could by 1,119 ft (341 m).

DEVELOPMENT [a]

The concept was designed based on numerical data from provisional and assumed values. Models of vehicles, guideway, guidance, bogey, and the switch have been fabricated. A prototype station and short length of guideway are being planned. The vehicle and control system, both of which would be detail designed to suit the particular application and customer specification, remain under development.



INSTALLATIONS

Presently no installations are planned or committed to.

INSTALLATION STUDIES/PROPOSALS

Study for Goteborg, Sweden

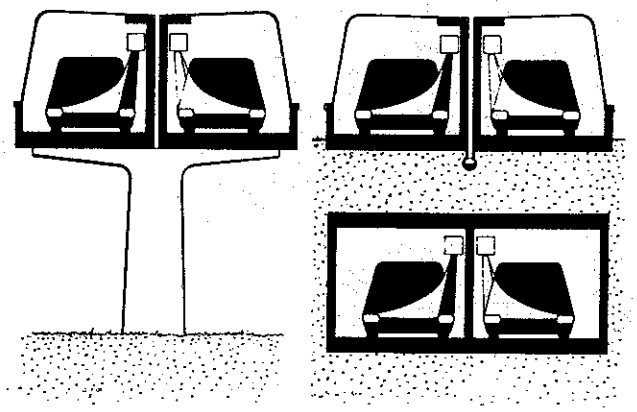
COSTS [a]

Capital ..... Vehicle cost estimated at $4,900
Operational, Maintenance ..... Expected seat-mile costs to be same as for electric trolley bus

INSTALLATION/RETROFIT CAPABILITY

[a: except as noted]

Envelop Width ..... 7.5 ft (2.29 m)
Envelop Height ..... 7.5 ft (2.29 m)
Structural Weight ..... Data not available
Maximum Grade 20%
Minimum Radius of Curvature ..... 240 ft (73 m)
Construction Process ..... Guideway sections could be prefabricated [e]
Staging Capability ..... Sections could be operated while others under construction



GUIDEWAY INSTALLATION VARIATIONS

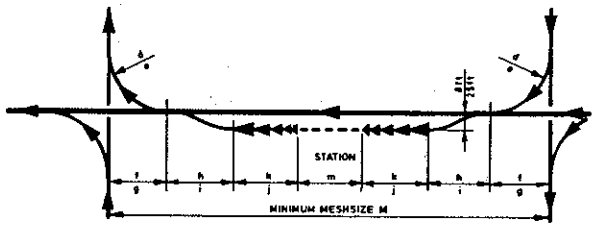
LIMITATIONS [e]

Because the steering control force attach point is ahead of the propulsion force (in the powered mode), horizontal plane moments may be generated with resultant action a tendancy to turn the vehicle or cause fish-tailing.

ENVIRONMENTAL IMPACT

Emissions ..... No direct polluting emissions [e]
Visual ..... Single elevated enclosed guideway [f]
H_1 & H_2 – 7.5 ft (2.3 m)
W_1 & W_2 – 7.5 ft (2.3 m)
P_1 & P_2 – 10.6 ft (3.23 m)
Noise ..... Expected to be approximately same or less than conventional electric trolley buses [b]

SCHEMATIC OF LINE SEGMENT



c	mph	45	38	31	25	19
d	ft	328	236	161	98	62
e	ft	525	380	260	157	95
f	ft	364	262	181	111	66
g	ft	585	423	285	177	105
h	ft	207	177	144	115	88
i	ft	381	314	259	203	158
k	ft	361	266	184	118	72
l	ft	295	216	148	98	62
m	ft	115	115	115	115	115
M	ft	1850	1430	1060	784	548

c	mainline speed
d	min. curve radius, 15% superelevation
e	min. curve radius, no superelevation
f	min. space, 90° turnoff with 15% superelevation
g	min. space, 90° turnoff no superelevation
h	S-transition with parallel spur at 8 ft
i	S-transition with parallel spur at 25 ft
k	accel. or decel. segment at 6.56 ft/s^2
l	accel. or decel. segment at 8.02 ft/s^2
m	station length
M	Minimum grid mesh length

NETWORK INSTALLATION DIMENSIONS

FLYDA CHAIR

PERSPECTIVE VIEW OF C.30 FLYDA CHAIR SYSTEM ALONG A STREET

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit

OTHER TRADE NAMES: None

DEVELOPER: Flyda Ltd.
The Manor House
South Cerney
Cirencester
Gloucestershire GL7 5TT
England
Tel: South Cerney 317

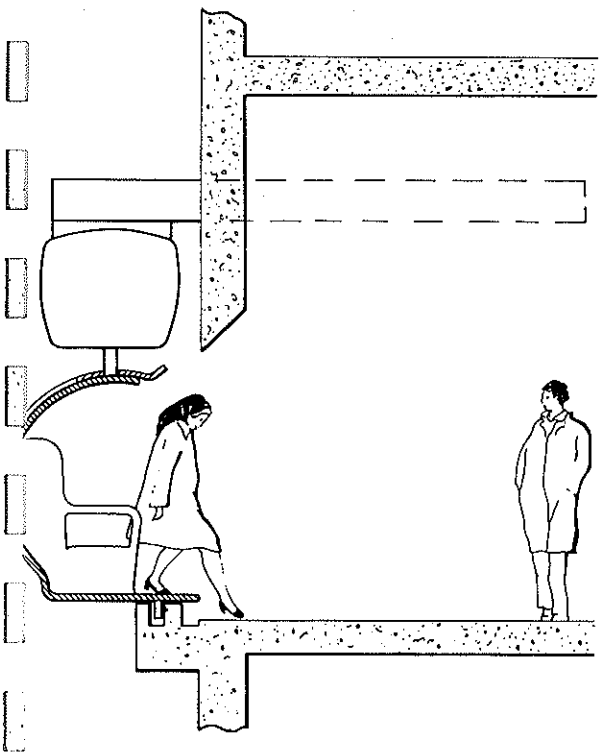
LICENSEES: None

PATENTS IDENTIFIED: U. K. Patent No. 1,213,453
U. S. Patents Nos. 3,777,667 and 3,780,666

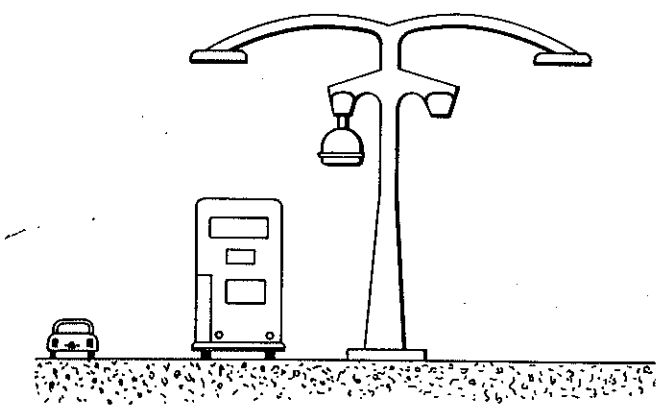
SYSTEM DESCRIPTION

The Flyda Chair is a Personal Rapid Transit system for transporting passengers in small vehicles suspended from an overhead monorail. Service is on-demand and a passenger may have exclusive use of a vehicle or share the vehicle with others, if he desires. Relatively high capacities are achieved by coupling the vehicles into trains. Before joining any potentially congested portion of mainline guideway, a stream of individual vehicles is momentarily halted and end-to-end contact established which is subsequently maintained by full-automatic couplings. The adjacent vehicles are coupled longitudinally, but are free transversely for demerging. After demerging, any group of vehicles may be subsequently recoupled. Routing is by patented on-vehicle track selection from electronic, local destination symbols. The symbols are transmitted before any given demerge point to every approaching vehicle. Each vehicle has means to recognize its own destination symbol and to pre-select its route through the demerge point.

PUBLISHER'S NOTE
Two different systems are proposed: C.10 and C.30. Unless specifically stated the information herein relates to both systems.



ACCESS TO C.30 FLYDA CHAIR



INSTALLATION IN STREET MEDIUM

)PERATIONAL CHARACTERISTICS

YSTEM [a] [1]

lax One-Way Line Capacity . . . .C.10 - 12,000 seats/hr (4,000 veh/hr)
C.30 - 36,000 seats/hr (12,000 veh/hr)
linimum Headway . . . . .C.10 - 27 sec.; C.30 - 18 sec (between trains)
vailability . . . . . .On-demand
etwork . . . . . C.10 - local area only:
C.30 - local area plus corridor
/ay . . . . . Exclusive guideway
outing . . . . . Variable
raveling Unit . . . . . .Individual vehicles. Trains formed in transit
of maximum C.10 - 30 veh or C.30 - 60 veh
lanpower Requirements . . . Attendants at central control and at a few
select stations, maintenance personnel

EHICLE [a]

laximum Capacity . . . . . .3 or 4 Seated — 0 Standing
(alternative cab designs)

TATIONS [a]

ype . . . . . .Usually off-line
ocation . . . . . Usually above grade
ype Boarding . . . . . Level
icket/Fare Collection . . . . . .Automatic machines
ecurity . . . . . .One policed station,
others located in shopping areas
oarding Capacity } . . . . . 700 veh/hr/4-berth station or
eboarding Capacity } . . . . . 1,000 pass/hr assuming 1.5 persons/veh
ehicle Dwell Time . . . . . Avg. 10 sec; max - 30 sec
verage Station Space . . . . . .600 ft (183 m)

NDIVIDUAL SERVICE

rivacy . . . . . .Exclusive use of vehicle by one passenger
ransfers . . . . . .Not necessary
tops . . . . . May stop at some merge points
ccommodation . . . . . Seated only
omfort . . . . . .Provision for air-conditioning where required
ecurity . . . . . .Emergency routing to policed station -
passenger or automatically commanded
nstruction . . . . . Station graphics supplemented by telephone

AFETY AND FAILURE MODES [b]

ail Safe Features . . . . . .Dead Block follows each contact train
and/or discrete group of vehicles
ail Opnl. Features . . . . Fail safe electrical links between individual veh
in a group to insure synchronous speed changes and emergency stops
ower Failure Mode . . . . . .Initiate emergency stop.
Automatic sequenced restart

ystem MTBF
ehicle MTBF
tation MTBF
ystem Restore Time After Failure } . . . . . .Data unavailable
ystem Lifetime

IAINTENANCE [b]

our sets of power collector shoes per vehicle per 28 days running time.
ehicles automatically routed to maintenance for other service as well.
lalfunction detection system.

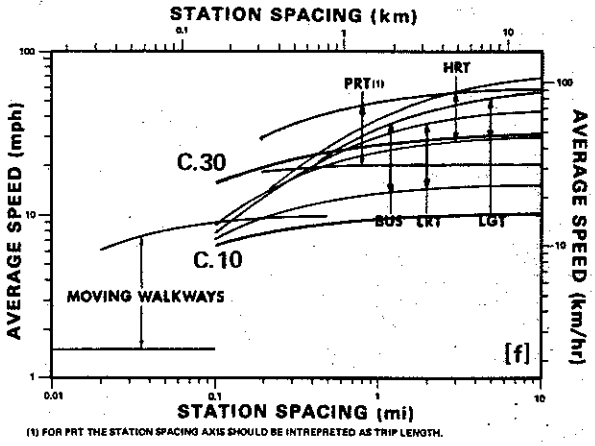
CARGO CAPABILITY [a]

assenger Articles . . . . . .C.10 - Small packages only
C.30 - Special luggage compartment
oods Movement . . . . . Special vehicles proposed.

NTEGRATION WITH OTHER MODES [a]

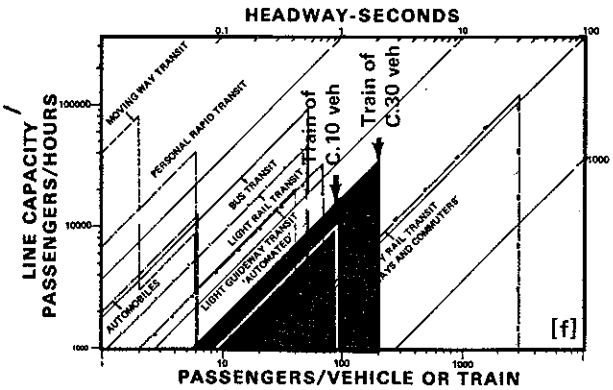
ystem proposed as circulation within airports and for linking modes
air, rail, parking lots, etc.) with central urban areas (especially
edestrian streets).

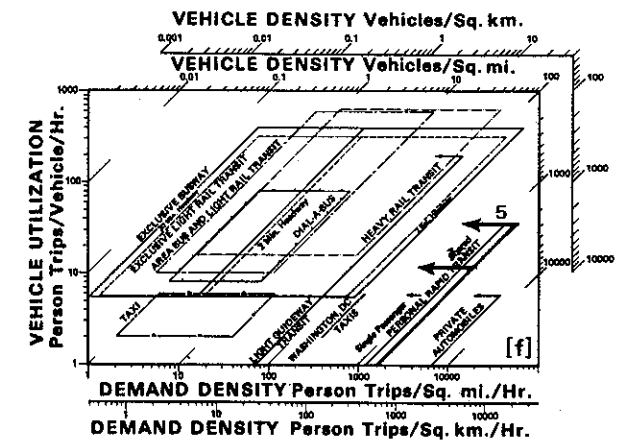
[1] **Data Reference Code - See inside back cover for explanation.**

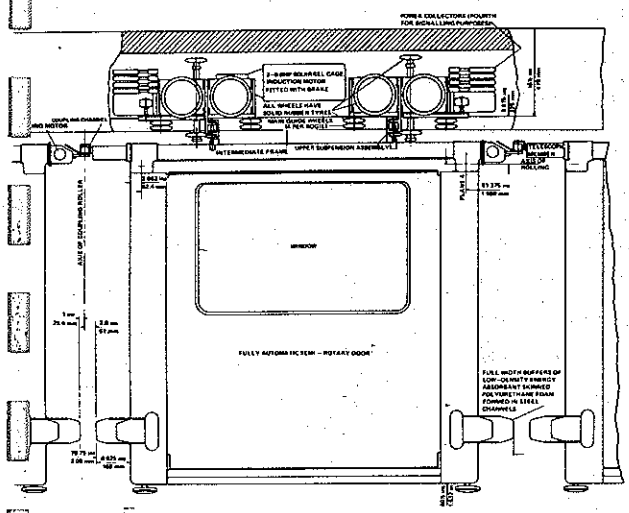


(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTREPRETED AS TRIP LENGTH.

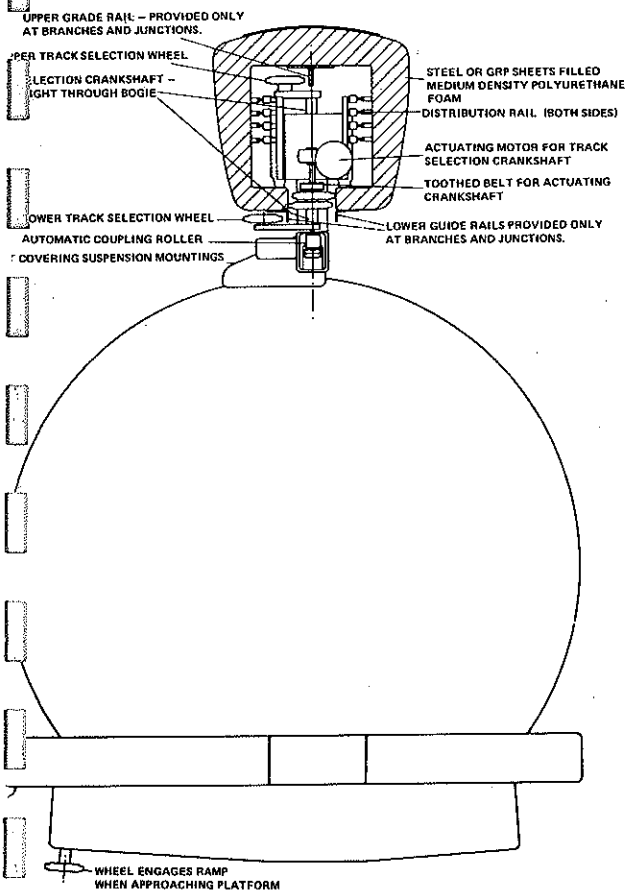
VEHICLE PERFORMANCE [a]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
C.10 CRUISE VELOCITY (and max.)	mph	10		
	km/h	16		
C.30 CRUISE VELOCITY (and max.)	mph	30		
	km/h	48		
MAX GRADE	%	6-25	SAME AS CLEAR	SAME AS CLEAR
	%			
SERVICE ACCEL	ft/s^2	4		
	m/s^2	1.2		
SERVICE DECEL	ft/s^2	4		
	m/s^2	1.2		
MAX JERK	ft/s^3	5.9		
	m/s^3	1.8		
EMERGENCY DECEL	ft/s^2	9		
	m/s^2	2.7		
STOPPING PRECISION	in.	±4		
	mm	±102		



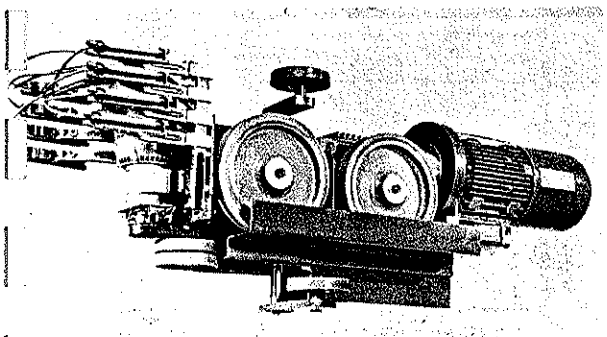




GENERAL ASSEMBLY SIDE VIEW C.10



GENERAL ASSEMBLY END VIEW C.10



POWERED BOGEY

PHYSICAL DESCRIPTION

VEHICLE [a]

Length ..... 3 seats - 6.5 ft (2 m), 4 seats or 3 plus luggage - 8.17 ft (2.5 m)
Width ..... 5 ft (1.52 m)
Height ..... C.10 - 6.67 ft (2.03 m); C.30 - 7.33 ft (2.23 m)
Empty Weight ..... C.10 - 800 or 950 lbs (364-432 kg); C.30 - 1,000 or 1,150 lbs (455-523 kg)
Gross Weight ..... C.10 - 1,232 or 1,522 lbs. (560-692 kg) C.30 - 1,420 or 1,722 lbs (645-783 kg)
Passenger Space ..... 17" wide seat/psgr
Doorway Width ..... 4.5 ft (1.37 m)/3 psgr. veh; 5.9 ft (1.8 m)/4 psgr veh or 3 psgr plus luggage
Doorway Height ..... 4.82 ft (1.47 m)

SUSPENSION [a]

Type ..... C.10 - 2 overhead bogies, polyurethane tires C.30 - overhead carriage, pneumatic rubber tires
Design Load ..... C.10 - 3,040 lbs (1,380 kg); C.30 - 3,440 lbs (1,560 kg)
Obstacle Clearance ..... Not applicable
Steering ..... Bogies constrained by lateral guidewheels to run inside guideway

PROPULSION/BRAKING [a]

Type ..... Rotary electric induction motor - traction drive
Emplacement ..... 1 or 2 motors per vehicle
Propulsion Power ..... C.10 - 2 or 4 bHP; C.30 - 20 bHP
Power or Fuel ..... 380-440 vac 3ϕ 50 HZ
Power Transfer ..... 4 collector assemblies/vehicle - power rails on guideway
Power/fuel Consumption .. Approx. 0.8 kwh/veh-mi (0.5 kwh/veh-km) at 10 mph (16 km/h) level
Service Braking ..... Dynamic regenerative and plug
Emergency Braking ..... Mechanical power-hold-off brakes
Emergency Brake Reaction Time ..... 0.25 sec

SWITCHING [a]

Type ..... Mechanical - wheel on arm captures right or left rail
Emplacement ..... On-vehicle
Switch Time ..... 0.5 sec
Speed Thru ..... Mainline speed
Headway Thru ..... Mainline headway

GUIDEWAY [a]

Type ..... Overhead inverted U-shaped box-beam
Materials ..... Double skin steel sheets with foam interfilling
Maximum Elevated Span ..... 40 ft (12.2 m)
C.10 - 18.75 in (476 mm); C.30 - 28.1 in (714 mm)
C.10 - 10.25 in (514 mm); C.30 - 30.4 in (772 mm)
..... Not applicable

CONTROL [a]

On-board vehicle destination control routed by guideway-to-vehicle communication of destination symbols subject to overall central control. Before specific merging points, one of the converging streams may be momentarily halted, thereby establishing end-to-end contact and automatic longitudinal coupling into trains. Vehicles are automatically uncoupled transversely when demerging. Train headways are controlled by fixed block system. Sections of guideway have designated speeds which are controlled by the guideway mounted power supply.

STATIONS [a]

Three types of stations: On-line stations which are located with buildings, single platform off-line stations nominally with 4 berths as the most common form, and parallel platform off-line stations for high capacity.

DEVELOPMENT [b]

The Flyda Chair systems were designed to patents held by Mr. F. Perrott. Commercial funding for study, design development, and construction of scale models and a full scale bogey has been by Flyda Ltd. A full scale development and prototype test program is planned.

INSTALLATIONS [e]

None

INSTALLATION STUDIES/PROPOSALS [b]

Following proposals have been made:

1. Direct 0.75 mi. (1.2 km) link between railway station and city center with planned subsequent extension.
2. A 2 mi. (3.4 km) loop from bus stops to city center.
3. A 1 mi. (1.6 km) link between railway station and city center, via a restricted access bridge.
4. As for 3, but through development property
5. A 0.5 mi. (0.8) km) link between railway station and two parking lots.
6. Network for urban island due for redevelopment.
7. Link between HRT station, parking lot and an international exhibition site and for internal circulation.

COSTS [b: estimated]

Capital ..... Single line elevated guideway: C.10 - $425,000/mi ($264,000/km); C.30 - $500,000/mi ($311,000/km)
Vehicles - C.10 - $3,000; C.30 - $3,5000

Operational ..... C.10 - 1 cent/veh mi (0.6 cents/veh km); C.30 - 2 cents/veh mi (1.2 cents/veh km)

Maintenance ..... C.10 - 1.2 cents/veh mi (0.75 cents/veh km); C.30 - 1.5 cents/veh mi (0.9 cents/veh km)

INSTALLATION/RETROFIT CAPABILITY

(a: except as noted)

Envelop Width ..... Approx. 6 ft (1.83 m) for C.10 and C.30 [b]

Envelop Height ..... Approx. 7 ft (2.13 m) for C.10 [b]
Approx. 8 ft (2.44 m) for C.30 [b]

Structural Weight ..... Approx. 43 lbs/ft (64 kg/m) for C.10
Approx. 77 lbs/ft (115 kg/m) for C.30

Maximum Grade ..... C.10 and C.30 - 13% [b]

Minimum Radius of Curvature .. C.10 - 18 ft (5.5 m) for coupled units
C.10 - 5 ft (1.5 m) for single units
C.30 - 20 ft (6.1 m) for single or coupled units

Construction Process .... Prefabricated guideway spans transported to site in standard I.S.O. containers

Staging Capability ..... Sections may be operated while others under construction [e]

LIMITATIONS [e]

Maximum trip distance limited by relatively low speeds as initially proposed. The formation of trains would cause appreciable delays for short journeys at speeds higher than those which are initially proposed.

ENVIRONMENTAL IMPACT

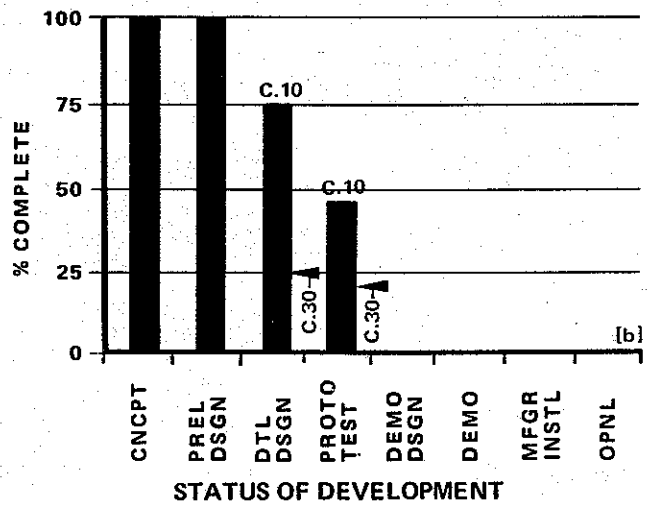
Emissions ..... No direct polluting emissions [e]

Visual ..... Single elevated guideway [f]

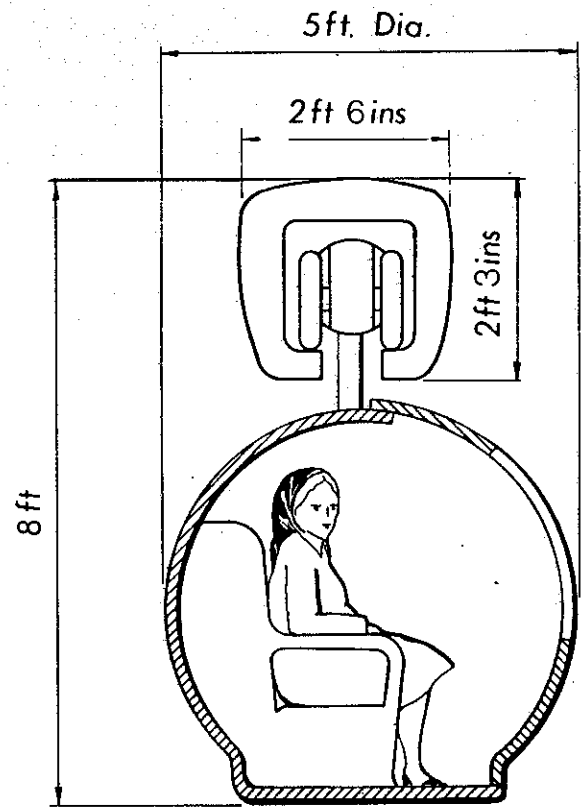
C.10: H_1 - 1.56 ft (0.48 m); H_2 - 7.2 ft (2.19 m)
W_1 - 1.69 ft (0.52 m); W_2 - 5 ft (1.52 m)
P_1 - 2.3 ft (0.70 m); P_2 - 6.4 ft (1.95 m)

C.30: H_1 - 2.34 ft (0.71 m); H_2 - 8 ft (2.43 m)
W_1 - 2.53 ft (0.77 m); W_2 - 5 ft (1.52 m)
P_1 - 3.4 ft (1.04 m); P_2 - 7.2 ft (2.19 m)

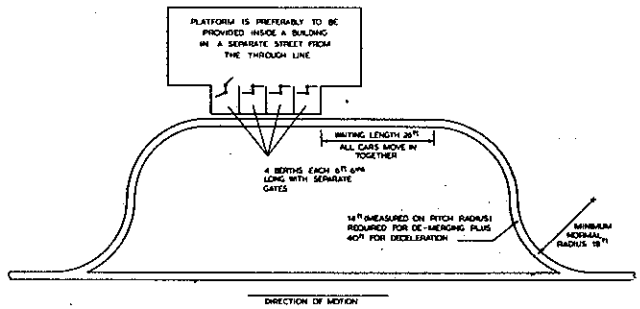
Noise ..... Advance specification of 66 dbA at 24.6 ft (7.5 m) from guideway and 67 dbA inside vehicle [b]



STATUS OF DEVELOPMENT

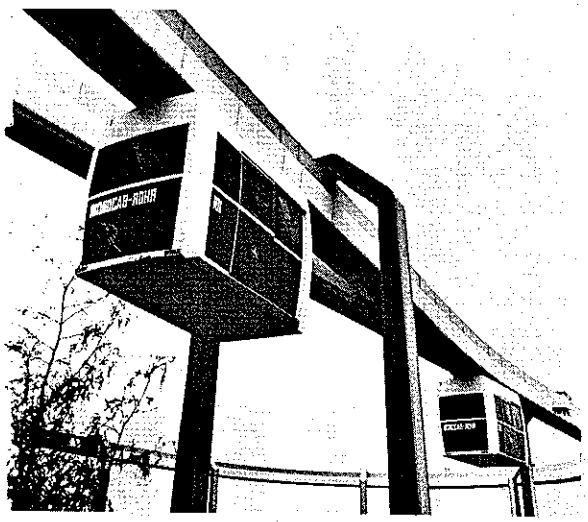


C.10 AND C.30 DIMENSIONS

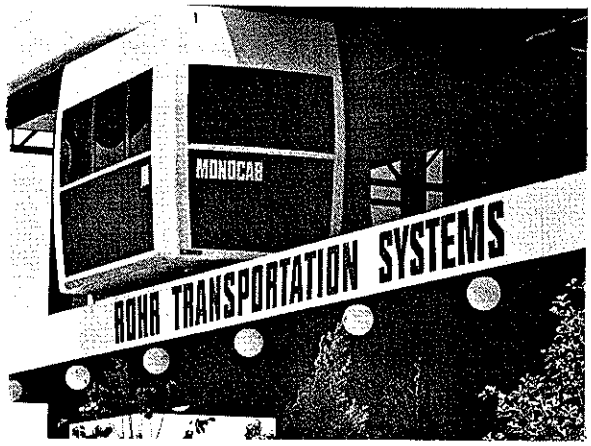


TYPICAL C.10 STATION

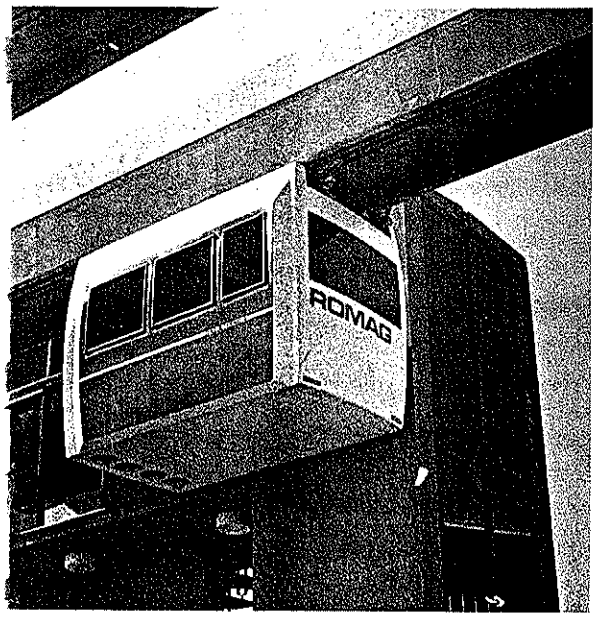
ONOCAB



TRANSPO '72 GUIDEWAY AND VEHICLES



TRANSPO '72 STATION



PROTOTYPE MAGNETICALLY LEVITATED TEST VEHICLE & MINIMUM FOOTPRINT STATION

INDENTIFICATION

CLASSIFICATION: Personal Rapid Transit*

OTHER TRADE NAMES: Varo-Monocab

DEVELOPER: Rohr Industries, Inc.
P. O. Box 878
Chula Vista, California 92012
U. S. A.
Tel: (714) 426-7111

Monocab, Inc.
Subsidiary of Rohr Industries, Inc.
2700 Oakland Avenue
Garland, Texas 75401
U. S. A.
Tel: (214) 278-6156

LICENSEES: None

PATENTS IDENTIFIED: Data not available

SYSTEM DESCRIPTION

Monocab is a medium capacity (at present design headway) transportation system of small automatic six-passenger vehicles operating on an overhead guideway, using parallel over/under stations which allow direct origin-to-destination travel without the need for turnarounds or grade changes for access to the main line.

Two classes of service are avaibable, rent-a-cab, or rent-a-seat. In rent-a-cab, the passenger, by paying his fare, reserves an entire cab for him and his party, which takes his party non-stop from origin to destination. In rent-a-seat service, the passenger still operates on a non-stop origin-to-destination trip; however, several passengers in the same origin station who wish to go to the same destination may share the cab.

**PUBLISHER'S NOTE:*
Besides the six-passenger vehicle shown at Transpo '72, design work on a 12-passenger vehicle has been completed, implying that a Light Guideway Transit version of Monocab is also available. Another development, ROMAG — a magnetically levitated system, has been incorporated with the Monocab system and tested at the Chula Vista facilities.

OPERATIONAL CHARACTERISTICS

SYSTEM [a][1]

Maximum One-Way Line Capacity[2] ..... 4,320 to 8,640 seats/hr @ 5 sec headway
2,160 to 4,320 seats/hr @ 10 sec headway
(Higher figure for 12 passenger vehicle)
Minimum Headway ..... 10 sec or 5 sec
Availability ..... On-demand or scheduled
Network ..... Area wide network or loops
Way ..... Exclusive guideway
Routing ..... On-demand or local and express
Traveling Unit ..... Single vehicle or 2-3 vehicle trains
Manpower Requirements ..... Attendants at central control facility and maintenance personnel

VEHICLE [a]

Maximum Capacity ..... 6 Seated — 0 Standing
Crush Capacity ..... 6 Seated — 0 Standing
(12 and 20 passenger vehicles also available)

STATIONS [except as noted]

Type ..... Off-line
Location ..... Usually above grade [e]
Type Boarding ..... Level [e]
Ticket/Fare Collection ..... Automatic system
Security ..... Closed circuit T.V.
Boarding Capacity ..... Approx. 720 passengers/hr/berth [b]
Deboarding Capacity ..... Approx. 720 passengers/hr/berth [b]
Maximum Wait Time ..... 5 min
Vehicle Dwell Time ..... 20 sec average
Average Station Spacing ..... Approx. 0.5 mi (0.8 km) [e]

INDIVIDUAL SERVICE [a: except as noted]

Privacy ..... Private and/or shared (6 or 12 psgr/veh)
Transfers ..... Not necessary
Stops ..... Non-stop
Accommodation ..... Seated only
Comfort ..... Air conditioning & heating
Security ..... Intercom with vehicles, direct route to police stations by central computer
Instruction ..... Active & passive station graphics

SAFETY AND FAILURE MODES [a]

Fail Safe Features ..... Propulsion, doors, vehicle separation, emergency braking, switching
Fail Operational Features ..... Redundant computers, power supplies, & communication links
Power Failure Mode ..... 20 min emergency communication power aboard each vehicle
System MTBF ..... 97% system availability
Vehicle MTBF ..... 500 hrs
Station MTBF ..... 500 hrs
System Restore Time After Failure ..... Typically 10 min
System Lifetime ..... Typically 30 years for system, 20 years for vehicle

MAINTENANCE [a]

Standard guideway maintenance consists of routine painting and realignment. Detailed inspection and service schedules have been worked out for vehicles, propulsion unit, station, control system, and divert ramps.

CARGO CAPABILITY [a]

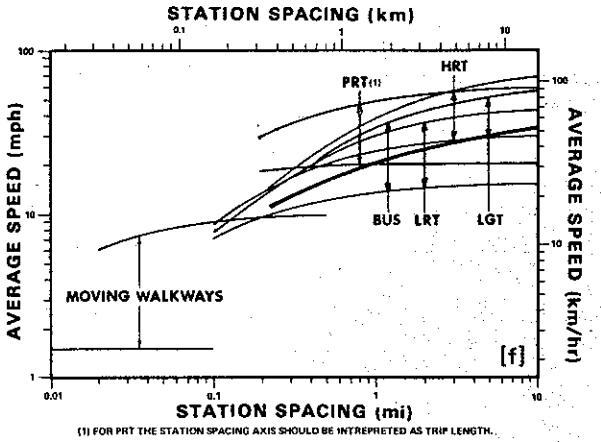
Passenger ..... Small parcels and hand luggage, 7.5 ft^3 (0.212 m^3) cargo capacity under seats, and in aisle
Goods Movement ..... Freight vehicles may also be used

INTEGRATION WITH OTHER MODES [a]

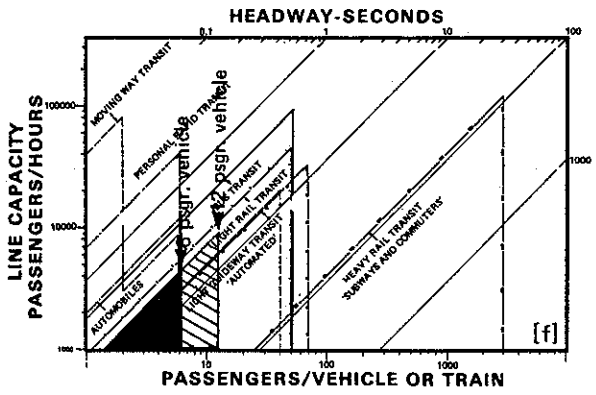
The system is designed for trips normally less than 10 minutes and to be integrated with other transportation modes.

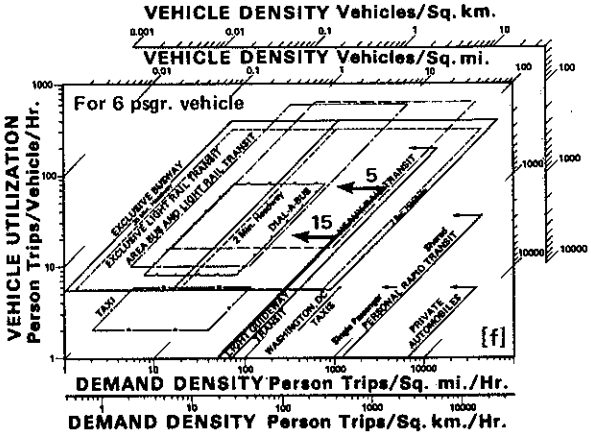
[1] Data Reference Code - See inside back cover for explanation

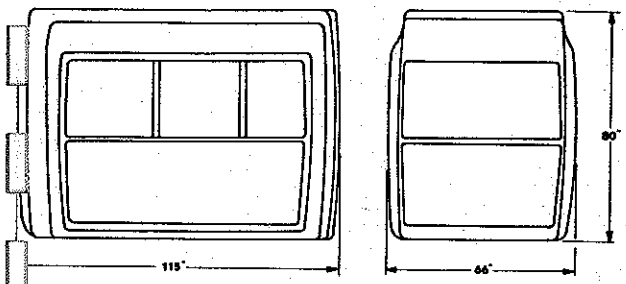
[2] Capacity given for single vehicle operation only



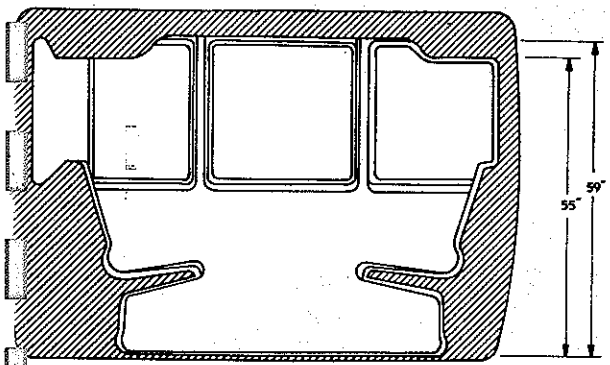
VEHICLE PERFORMANCE [a 51]				
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	30		
	km/h	48		
MAX VELOCITY	mph	35		
	km/h	56		
MAX GRADE	%	7 nominal	SAME AS CLEAR	SAME AS CLEAR
	%	10 max.		
SERVICE ACCEL	ft/s^2	4		
	m/s^2	1.22		
SERVICE DECEL	ft/s^2	4		
	m/s^2	1.22		
MAX JERK	ft/s^3	2.75		
	m/s^3	0.84		
EMERGENCY DECEL	ft/s^2	13		
	m/s^2	4		
STOPPING PRECISION	in.	±1.25		
	mm	±31.6		



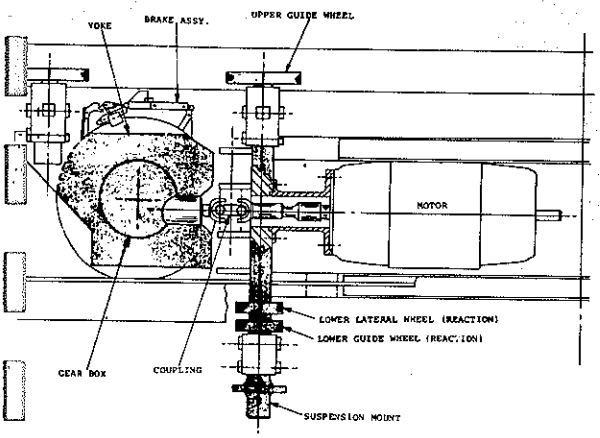




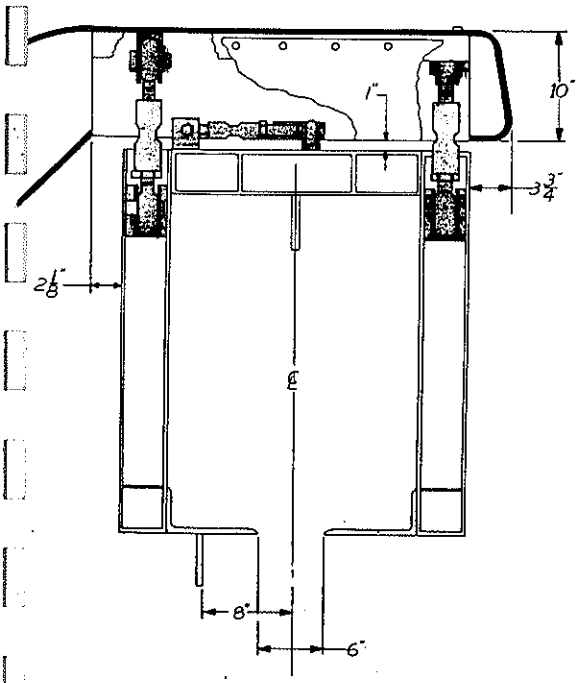
VEHICLE EXTERIOR



VEHICLE INTERIOR



PROPULSION AND GUIDANCE



GUIDEWAY CROSS SECTION

PHYSICAL DESCRIPTION

VEHICLE [a 61] (6-passenger vehicle for Transpo '72)

Length	9.58 ft (2.92 m)
Width	5.5 ft (1.68 m)
Height	6.67 ft (2.03 m)
Empty Weight	3,000 lbs (1,364 kg)
Gross Weight	4,000 lbs (1,818 kg)
Passenger Space	20 in (508 mm) wide, 15 in (381 mm) knee space
Doorway Width	30 in (762 mm)
Doorway Height	5.33 ft (1.63 m)

SUSPENSION [a 61]

Type	Vehicle suspended from rubber tired bogey which runs inside guideway box-beam, springs and shock absorbers
Design Load	Data not available
Obstacle Clearance	Not applicable
Steering	Lateral guidewheels

PROPULSION/BRAKING [a 61: except as noted]

Type	Traction drive dc shunt wound electric motor
Emplacement	One aboard each vehicle
Propulsion Power	40 HP nominal, 75 HP max
Power or Fuel	480 vac 3ϕ, SCR conversion aboard vehicle
Power Transfer	Power pickup on vehicle, power rails on guideway
Power/Fuel Comsumption	0.12 kwh/veh-mi (.071 kwh/veh-km) [f]
Service Braking	Dynamic regenerative
Emergency Braking	Fail-safe spring actuated mechanical
Emergency Brake Reaction Time	Less than 1 sec

SWITCHING [a 61: except as noted]

Type, Emplacement	Positive entrappment switch on vehicle activated by wayside diverter blade
Switch Time	1 sec
Speed Thru	Mainline cruise speed
Headway Thru	10 sec [e]

GUIDEWAY [a 61]

Type	Overhead inverted U box-beam
Materials	Steel
Maximum Elevated Span	100-120 ft (30-37 m)
Crossection Height	35 in (889 mm)
Crossection Width	30 in (762 mm)
Internal Height	30 in (762 mm)
Internal Width	22 in (559 mm)

CONTROL [a 61]

On-board logic reacts to on-demand operation, controls vehicle functions of speed, switching, etc. Headway is via moving-block system provided by General Railway Signal. Station computers control car entrance and exit to stations and other station functions (call for empty vehicle, berth stop position, etc.) Typical central computer functions are empty car routing, overall system speeds, overriding vehicle & station computers, closed circuit T.V., and intercom system.

STATIONS [a]

Designed as a function of site specific anticipated trip demand rate. Developer will assist architects in design of stations.

DEVELOPMENT [b]

The Monocab system was first developed by the Varo Corporation in 1969. It was acquired by Rohr in 1971. The system was successfully demonstrated at Transpo '72 in May, 1972. A test facility is located at the Garland, Texas facility. Development of a magnetically levitated system has proceeded at Chula Vista, California, including a prototype test facility. In addition, design work has been completed on a 12-passenger vehicle, which utilizes the same guideway and stations as the 6-passenger vehicle.

INSTALLATIONS [b]

Monocab has been selected by A. J. Kavanaugh & Associates to build 22 mi (35 km) double guideway system in Las Vegas to connect major hotels, convention center, and airport, (privately funded at $80 million).

Transpo '72 Demonstration – Single guideway loop of approximately 0.33 mi (0.53 km) length, one off-line station, one off-line maintenance facility, and 2 vehicles (dismantled)

Garland Test Facility – Data unavailable at time of printing.

Chula Vista Facility – 500 ft (152 m) of mainline guideway, 400 ft (122 m) of off-line station guideway, an elevated off-line station, and one vehicle.

INSTALLATION STUDIES/PROPOSALS

Information not available

COSTS [a]

Capital .....Total system of vehicles, guideway, & stations typical cost of $4 million/mi ($2.5 million/km)/single guideway
Operational .....Data unavailable
Maintenance .....Date unavailable

INSTALLATION/RETROFIT CAPABILITY

[a: except as noted]

Envelop Width ..... See drawings at right
Envelop Height ..... See drawings at right
Structural Weight .....Data unavailable
Maximum Grade .....10% at reduced speed
Minimum Radius of Curvature ..... 40 ft (12.2 m)
Construction Process .....Prefabricated guideway sections [e]
Staging Capability .....Sections may be operated while others under construction [e]

LIMITATIONS [e]

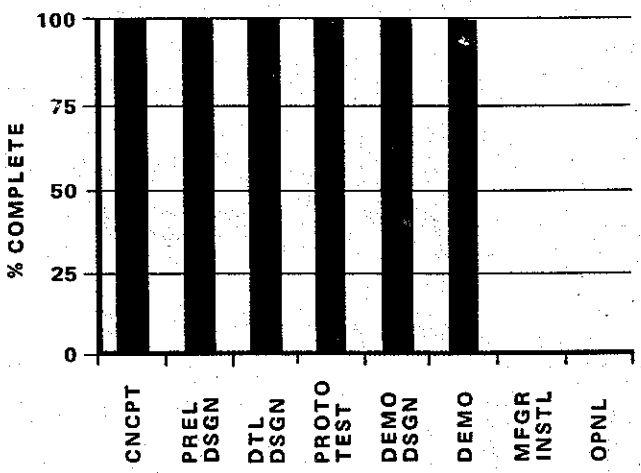
Moving-block headway (5 sec) limits system capacity to 4,320 pass/hr when 6-passenger vehicles are used.

Shorter headways may require different headway control system design.

Switch operation time may limit short headway operation to values greater than 1.0 sec.

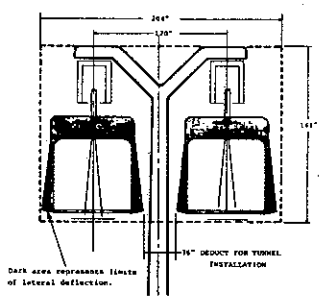
ENVIRONMENTAL IMPACT

Emissions .....No direct polluting emissions [e]
Visual ..... Single elevated guideway [f]
H_1 – 2.9 ft (0.89 m); H_2 – 10.25 ft (3.12 m)
W_1 – 2.5 ft (0.76 m); W_2 – 5.5 ft (1.68 m)
P_1 – 3.75 ft (1.14 m); P_2 – 10 ft (3.05 m)
Noise ..... All conditions within NCA 60 limits [a]

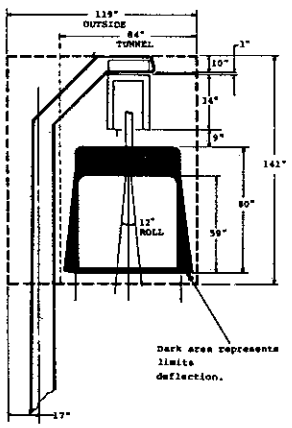


STATUS OF DEVELOPMENT

PHOTOMONTAGE OF LAS VEGAS SYSTEM

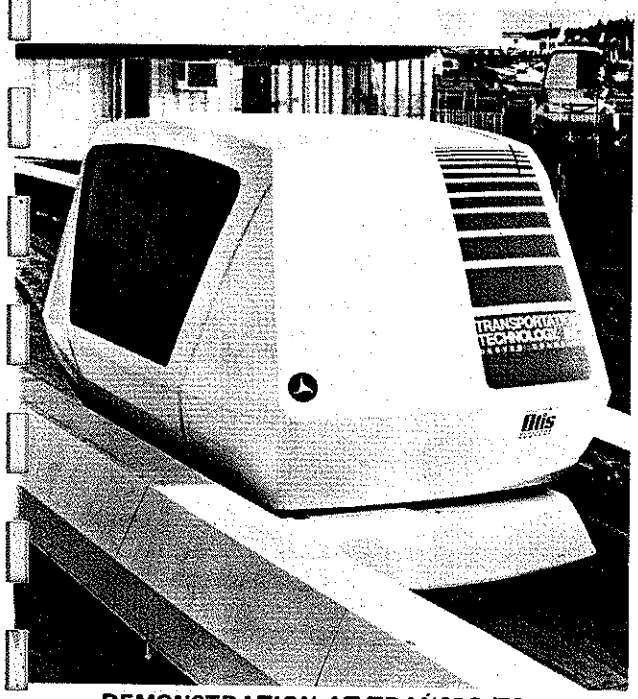


DOUBLE GUIDEWAY INSTALLATION ENVELOP



SINGLE GUIDEWAY INSTALLATION ENVELOP

TTI/OTIS PRT SYSTEM



DEMONSTRATION AT TRANSPO '72

IDENTIFICATION

CLASSIFICATION: Personal Rapid Transit*

OTHER TRADE NAMES: None

DEVELOPER: Transportation Technology
Division of Otis Corporation
11380 Smith Road
Aurora, Colorado 80010
U.S.A.
Mailing Address:
P.O. Box 7293 Park Hill Station
Denver, Colorado 80207, U.S.A.
Tel: (303) 343-8780
Telex: 45-966

LICENSEES: Information unavailable

PATENTS IDENTIFIED: Information unavailable

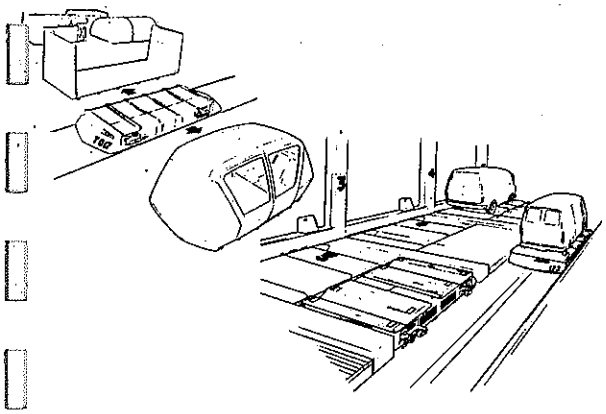
SYSTEM DESCRIPTION

The TTI/OTIS PRT system utilizes 6-passenger vehicles (up to 30-passenger vehicles available as an LGT system) for transporting passengers over exclusive guideways between off-line stations. The vehicles are supported on air-cushion pads and propelled by linear induction motors. In the off-line stations, random access docking is achieved by moving the vehicles sideways into individual loading/unloading berths. In its present design it is a low capacity PRT (3,600 passengers/hr, vehicles at 6 sec headway) system. In addition to the 6-passengers vehicle, a 10-passenger vehicle may operate in the same system to provide group rides with a minimum number of intermediate stops. A palletized version has also been designed for multi-mode operation.

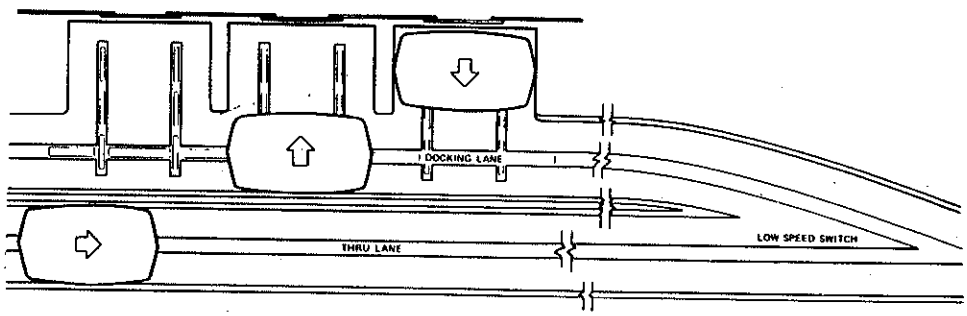
**PUBLISHER'S NOTE:*

The system has been classified as PRT because of the 6-passenger vehicle and the capability for on-demand exclusive use. The reader is advised that the developer offers a basic automated transportation technology which can be tailored to site-specific applications whether it be PRT, LGT, or high speed intercity service.

The data and information herein reported is based on a PRT application with the 6-passenger vehicle.



MULTI-MODE CAPABILITY



LATERAL DOCKING IN STATION

OPERATIONAL CHARACTERISTICS

SYSTEM [c: except as noted]

Maximum One-Way Line Capacity . 3,600 seats/hr, 600 veh/hr as PRT; up to 18,000 psgr/hr as LGT [f]
Minimum Headway . . . . . 6 sec at present, 2 sec future
Availability . . . . . Automatic scheduling or on-demand
Network . . . . . .Line-haul, loops, or limited area [e]
Way . . . . . .Exclusive guideway
Routing . . . . . Variable
Traveling Unit . . . . . Single vehicles
Manpower Requirements . . . . . Attendants at central control and maintenance personnel

VEHICLE [c]

Maximum Capacity . . . . . .6 Seated — 0 Standing
Crush Capacity . . . . . .6 Seated — ? Standing
(10-30 passenger vehicles available for LGT)

STATIONS [e: except as noted]

Type . . . . . Off-line random access lateral docking [c]
Location . . . . . At, above, or below grade
Type Boarding . . . . . Level
Ticket/Fare Collection . . . . . .Automatic machines
Security . . . . . .Closed circuit TV
Boarding Capacity . . . . . 337 passengers/hr/berth
Deboarding Capacity . . . . . 337 passengers/hr/berth
Maximum Wait Time . . . . . .Approx 30 sec
Vehicle Dwell Time . . . . . .Approx 30 sec in scheduled mode as LGT
Average Station Spacing . . . . . .Approx 0.5 mi

INDIVIDUAL SERVICE [e]

Privacy . . . . . Exclusive use or shared
Transfers . . . . . Not necessary
Stops . . . . . Non-stop and/or minimum number
Accommodation . . . . . .Seated only
Comfort . . . . . Heated & air-conditioned vehicles
Security . . . . . Closed circuit TV in stations and two-way intercom with vehicles
Instruction . . . . . Passive and active graphics

SAFETY AND FAILURE MODES [a]

Fail Safe Features, Fail Operational Features } Emergency brakes, collision avoidance, speed limiting, merge safety
Power Failure Mode, System MTBF, Vehicle MTBF, Station MTBF, System Restore Time After Failure, System Lifetime } . . . . . .Data unavailable

MAINTENANCE

Data unavailable

CARGO CAPABILITY [e]

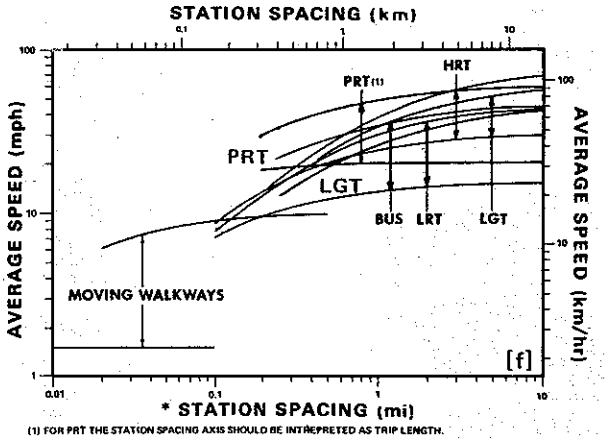
Passenger Articles . . . . . .Small packages, hand luggage, wheelchairs
Goods Movement . . . . . Freight pallet for special freight containers

INTEGRATION WITH OTHER MODES [e]

System could be used for circulation within transportation terminals or as link to connect modes (rail, air, parking lots, etc.)

[1] Data Reference Code - See inside back cover for explanation

[2] Based on 6-passenger PRT Vehicle and 30 passenger LGT Vehicle

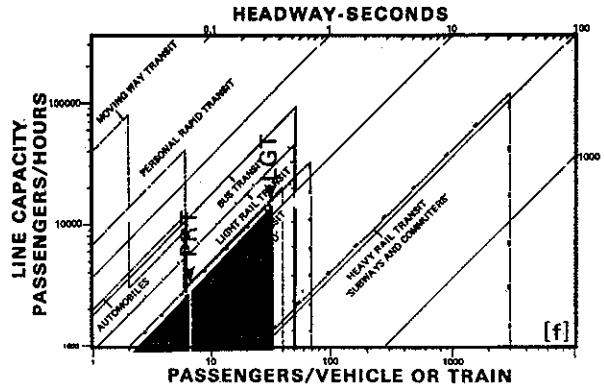


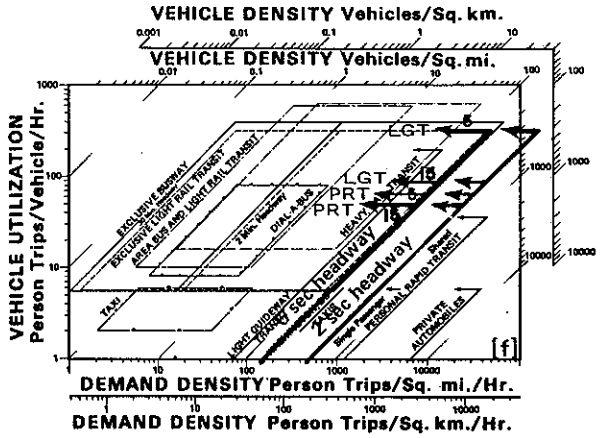
(1) FOR PRT THE STATION SPACING AXIS SHOULD BE INTERPRETED AS TRIP LENGTH.

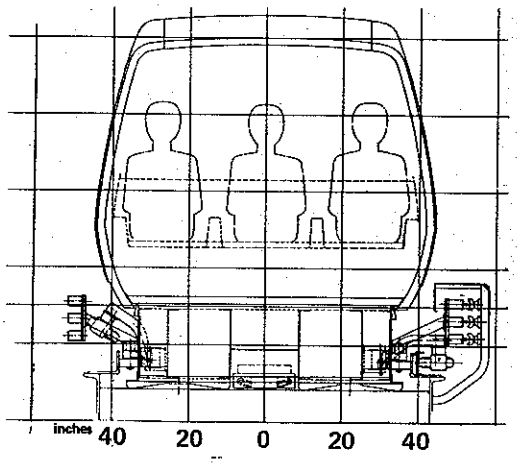
Interpret as trip length for TTI/OTIS PRT

VEHICLE PERFORMANCE [c]

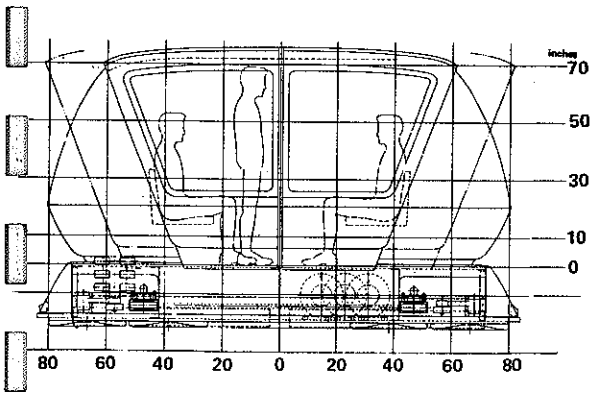
PARAMETER	UNITS	CLEAR	WET	ICE/SNOW
CRUISE VELOCITY	mph	0-45		
	km/h	0-72		
MAX VELOCITY	mph	45		
	km/h	72		
MAX GRADE	%	6		
	%			
SERVICE ACCEL	ft/s^2	3.22		
	m/s^2	0.98		
SERVICE DECEL	ft/s^2	3.22		
	m/s^2	0.98		
MAX JERK	ft/s^3	1.5		
	m/s^3	0.46		
EMERGENCY DECEL	ft/s^2	12.9		
	m/s^2	3.93		
STOPPING PRECISION	in.			
	mm			



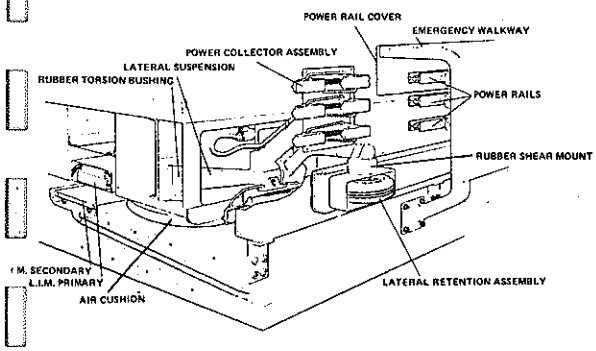




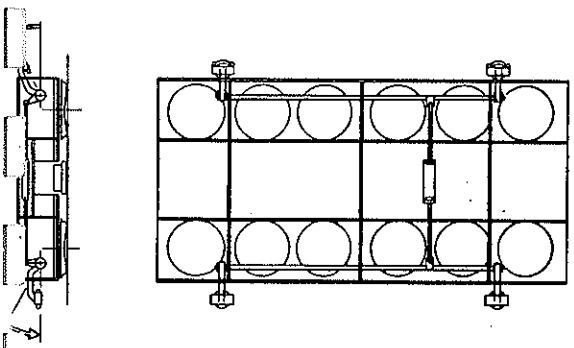
VEHICLE END VIEW



VEHICLE SIDE VIEW



LATERAL SUSPENSION AND RETENTION ASSEMBLY



SWITCHING MECHANISM

PHYSICAL DESCRIPTION

VEHICLE [c: except as noted]

Length . . . . . 14.33 ft (4.37 m)
Width . . . . . 8.67 ft (2.64 m)
Height . . . . . 8.17 ft (2.49 m)
Empty Weight . . . . . 7,200 lbs (3,273 kg)
Gross Weight . . . . . 9,100 lbs (4,136 kg)
Passenger Space . . . . . 6.8 ft^2 (0.63 m^2)/passenger
Doorway Width . . . . . 4 ft (1.22 m)
Doorway Height . . . . . 6 ft (1.83 m)

SUSPENSION [c]

Type . . . . . 10 air levitation pads (2 psi or less air pressure) underneath vehicle. Rubber shear mounts between chassis and cab
Design Load . . . . . approx 91 lbs (41 kg) per levitation pad
Obstacle Clearance . . . . . Data not available
Steering . . . . . Constrained to guideway by lateral guidewheels

PROPULSION/BRAKING [c]

Type . . . . . Single sided Linear Induction Motors (LIM)
Emplacement . . . . . Passive element in guideway - 6 motors/vehicle
Propulsion Power . . . . . 350 lb (159 kg) static force per motor
Power or Fuel . . . . . 480 vac 3ϕ
Power Transfer . . . . . Power collector assembly on vehicle, rails on guideway
Power/Fuel Consumption . . . . . Data unavailable
Service Braking . . . . . Dynamic electric
Emergency Braking . . . . . Drop onto 8 vehicle skid pads
Emergency Brake Reaction Time . . . . . Data unavialable

SWITCHING [c]

Type . . . . . Electromagnetic through two of LIMs backed up by retention arm with pneumatic tire positively engaging passive switching rail
Emplacement . . . . . On-board
Switch Time, Speed Thru, Headway Thru . . . . . Data unavailable

GUIDEWAY

Type . . . . . Shallow U-shaped roadway surface [d]
Materials . . . . . Concrete or steel with smooth surface covered by epoxy [e]
Maximum Elevated Span . . . . . 40-60 ft (12.2-18.3 m) [d]
Crossection Height . . . . . Data unavailable
Crossection Width . . . . . Approx 9 ft (2.74 m) [e]
Running Surface Width . . . . . 6.5 ft (1.98 m) [d]

CONTROL [a]

Synchronous hiearchial control system divided into following subsystems:

Station Control — Handling of vehicles in station area, select available dock, actuate switch mechanism, verify flotation, dock, unlock & open doors, terminate flotation, process malifunction data, close & lock door, accept trip vector, energize flotation, undock, send identification, dispatch capability, mode of operation, trip request, trip vector storage, vehicle position

Safety System — Collision avoidance, speed limiting, merge safety

Vehicle Management — Schedule trip vectors, initiate trips, monitors reported vehicle position vs. scheduled vehicle positon determines system speed, determines operational mode, supplies data on condition of system to operator, implements operational scheme

Vehicle Control — Velocity, accelerate - jerk, trip vector data, malfunction data, switch command, suspension command, door, precision stop, manual control

STATIONS [c]

Vehicles stop alongside a station berth, are mechanically coupled with, and pulled laterally into the berth. A typical 8 berth station is 120 ft (36.6 m) in length.

DEVELOPMENT [c]

T.T.I. was organized in 1968 as a division of Sverdrup & Parcel & Associates and later reorganized in 1969 as a separate corporation. In July, 1970, Otis Elevator Company acquired a major equity portion of the company. In May or June of 1974, the Otis Elevator Company acquired the entire company and has subsequently reorganized it as a division of Otis Elevator Co. A full scale test facility was built in Detroit in 1969. The company later moved to Aurora, Colorado. The system was demonstrated at Transpo '72 at Dulles Airport in May-June, 1973, and was subsequently tested. Company also has current study competition contract with UMTA (approx. $550,000) for dual-mode LGT. One contractor is to be chosen to develop and demonstrate a system by mid 1977 ($26.4 million).

INSTALLATIONS [c]

Contract at approx. $80 million for system of 14.4 mi (23.2 km) of single guideway (1/3 underground and 2/3 elevated) with 130 vehicles in Nancy, France. Transpo '72 Demonstration — 750 ft (230 m) straight reversible single guideway lane, 2 vehicles, a 2-berth off-line station, and maintenance facility.

INSTALLATION STUDIES/PROPOSALS

Study for El Paso — Juarez
Proposed as system for Denver PRT installation
Study for Kennedy International Airport

COSTS [c]

Capital . . . . . All inclusive system cost $3-6 million/mi ($1.86-3.73 million/km) dependent upon site specific requirements and system size

Operational, Maintenance . . . . . .Data unavailable

INSTALLATION/RETROFIT CAPABILITY

[c: except as noted]

Envelop Width . . . . . .Data unavailable
Envelop Height . . . . . .Data unavailable
Structural Weight . . . . . Approx 1,240 lbs/ft (1,849 kg/m) for 50 ft (15.2 m) span [d]
Maximum Grade . . . . . 6% based on present propulsion system
Minimum Radius of Curvature . . . . . 35 ft (10.7 m)
Construction Process . . . . . .Data unavailable
Staging Capability . . . . . Sections could be operated while others under construction

LIMITATIONS [e]

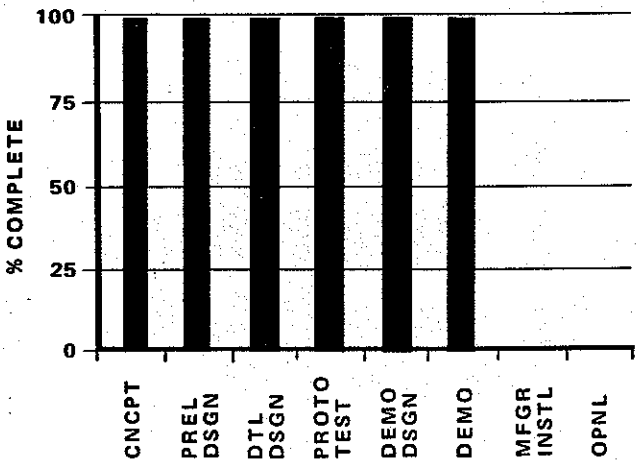
Present line capacity limited by 6 sec headway. Future capability of 2 sec headway would yield 10,800 psgr/hr max line capacity.

Present low capacity PRT system applications may be confined to limited area activity centers.

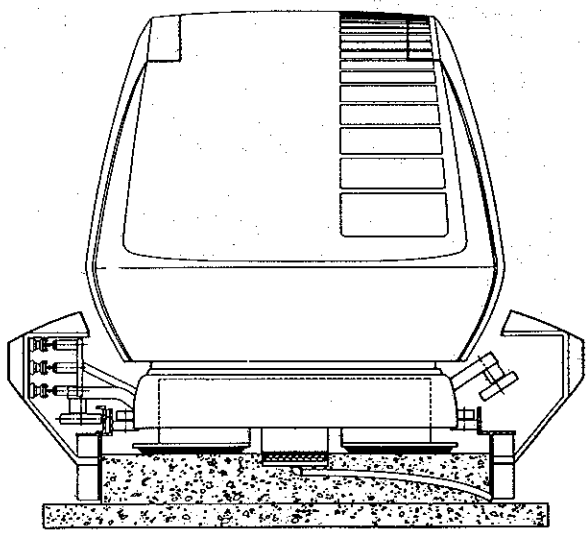
A trade-off exists between air levitation pad wear and construction of very smooth guideway surface.

ENVIRONMENTAL IMPACT

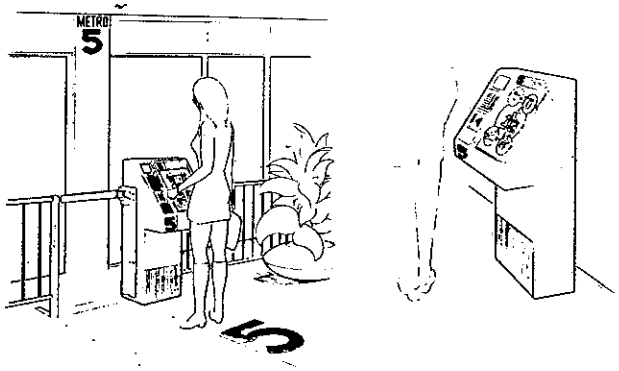
Emissions . . . . . No direct polluting emissions [e]
Visual . . . . . Cannot be assessed because of insufficient data
Noise . . . . . .Data unavailable



STATUS OF DEVELOPMENT



VEHICLE GUIDEWAY INTERFACE



ROUTE DISPLAY & CONSOLE