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. II No. 4, 1975

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.

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

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

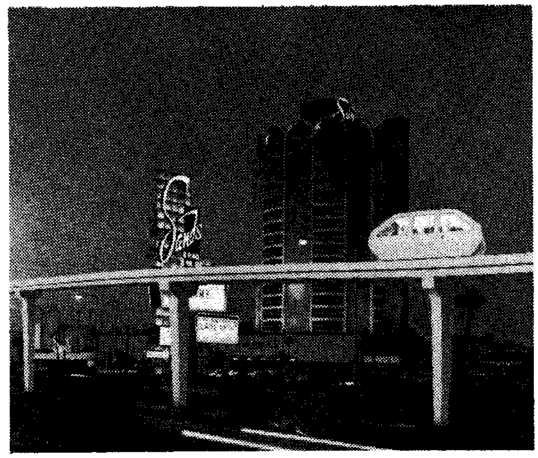
PATENTS: Design and developments in confidence, held consistent with Pullman, Inc., policy

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

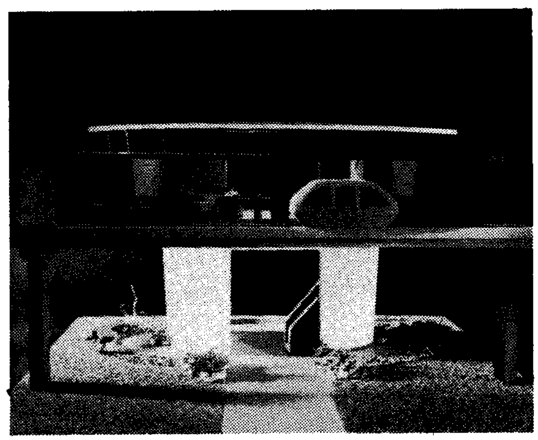
SYSTEM DESCRIPTION:

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

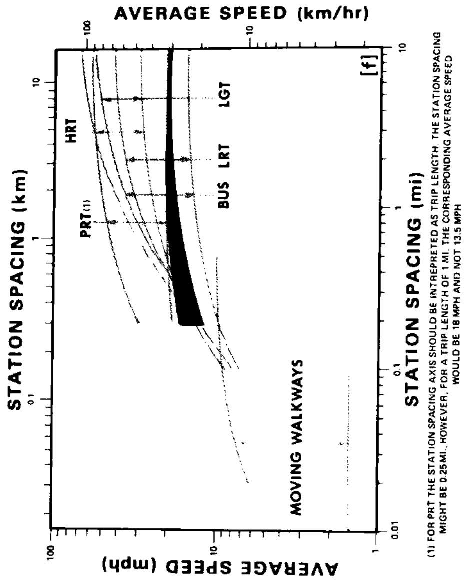


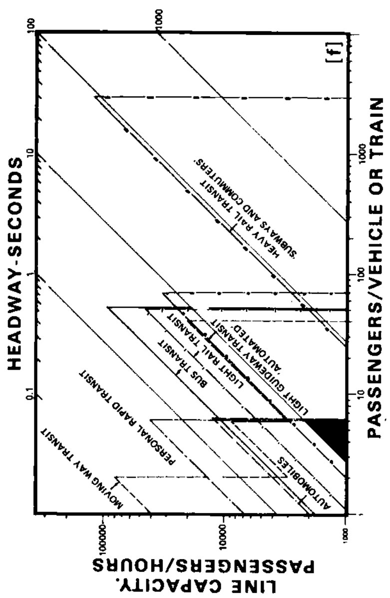
STATION MODEL

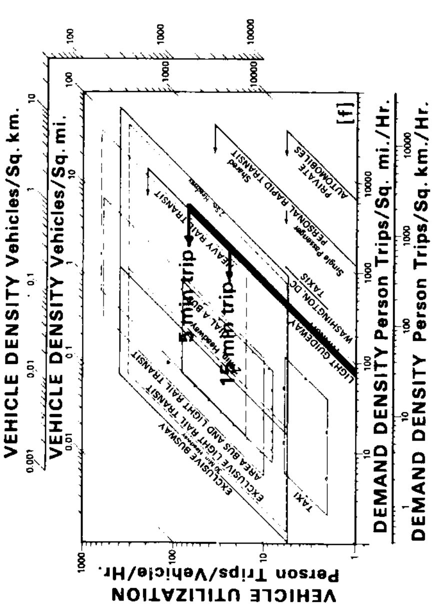
VEHICLE INTERIOR

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

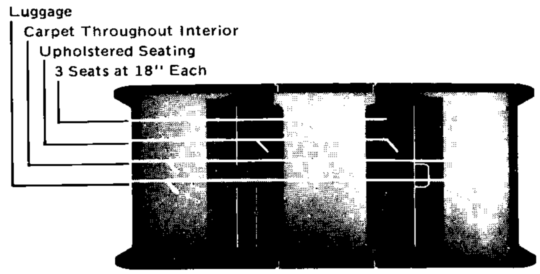
PERSONNEL REQUIREMENTS:

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

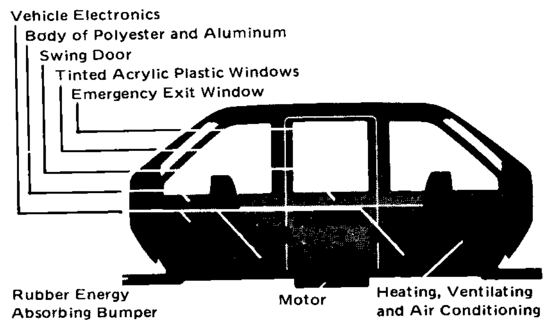


SUSPENSION:

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



VEHICLE

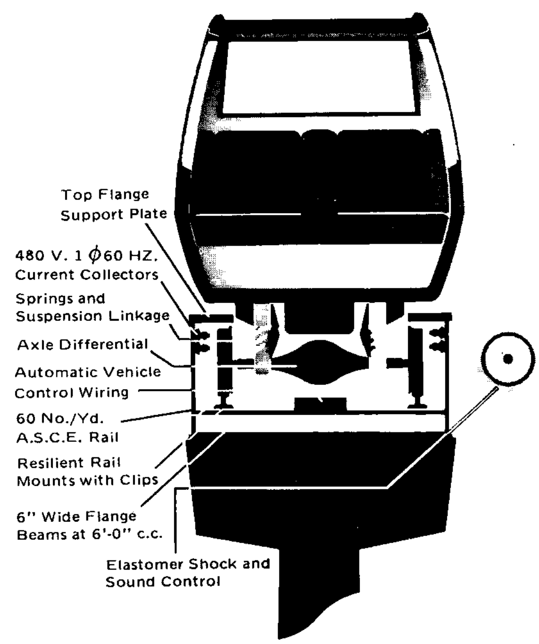
SWITCHING: [b 51]

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



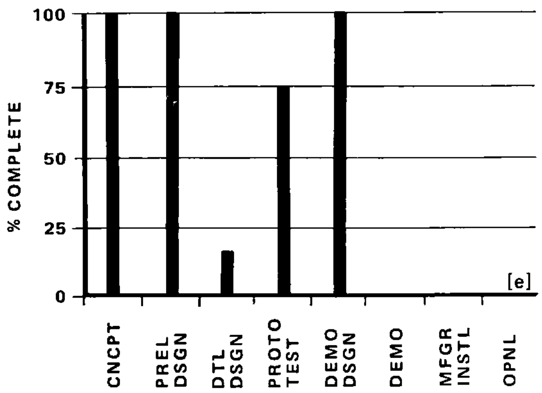
VEHICLE ON GUIDEWAY

CONTROL:

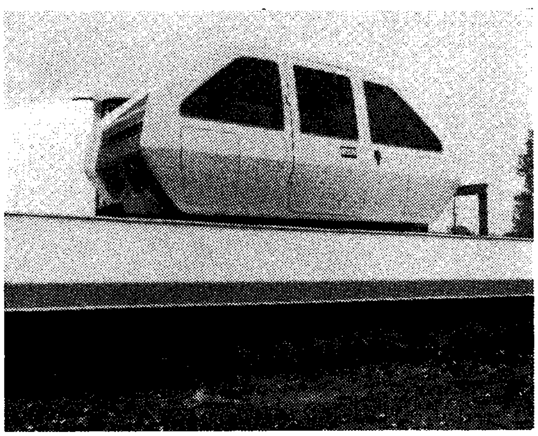
A central control computer provides overall traffic management and control, dispatches and routes vehicles, diagnoses failures, generates emergency commands, etc. It is linked to station units via a full duplex, hard-wired cable system and an asynchronous 1,800-baud data modem in the stations. Communication 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:

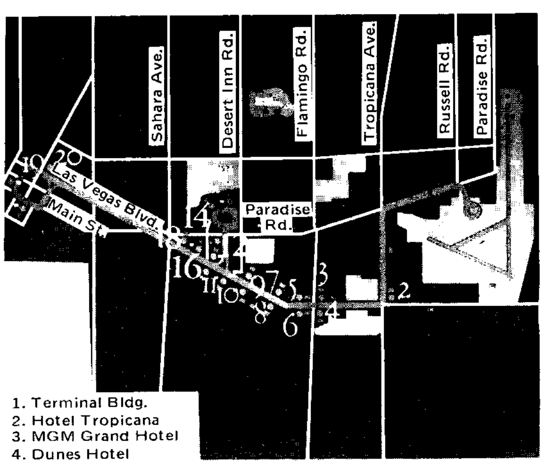
Stations are designed as elevated at guideway level, nominally with 3 berths each. The passenger area is circular in shape. Access is via stairs and an elevator.



STATUS OF DEVELOPMENT



PHOTOTYPE VEHICLE



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

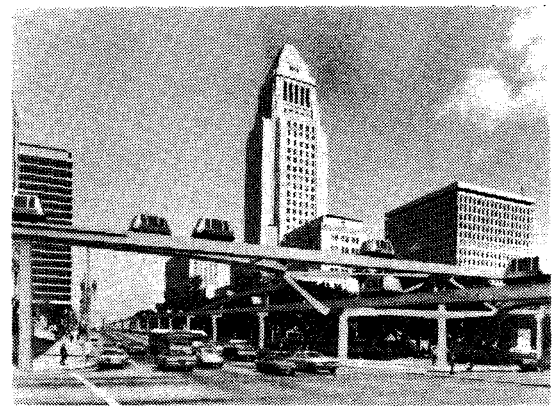
DEVELOPER: Aerospace Corporation
Ground Transportation Directorate
2350 E. El Segundo Boulevard
P.O. Box 95085
El Segundo, California 90045
U.S.A.
Tel: (213) 648-6424

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

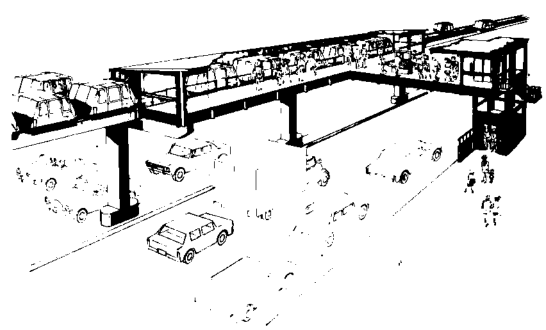
DATA REFERENCE CODE: [a 21: except as noted]



PHOTOMONTAGE OF SYSTEM AS IT MIGHT APPEAR IN LOS ANGELES

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).

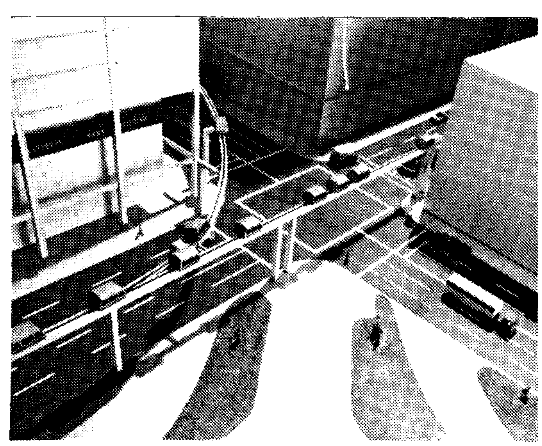


TYPICAL OFF-LINE STATION

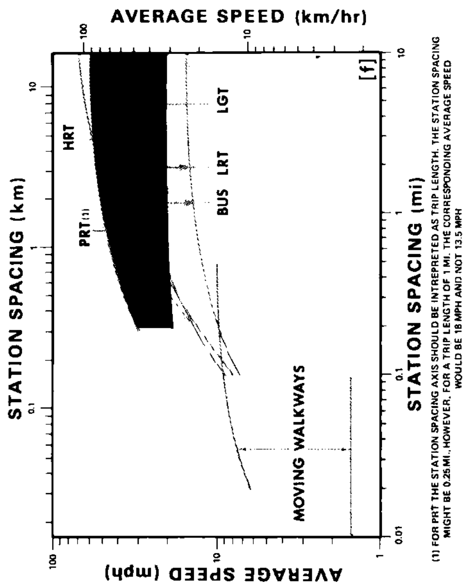
OPERATIONAL CHARACTERISTICS

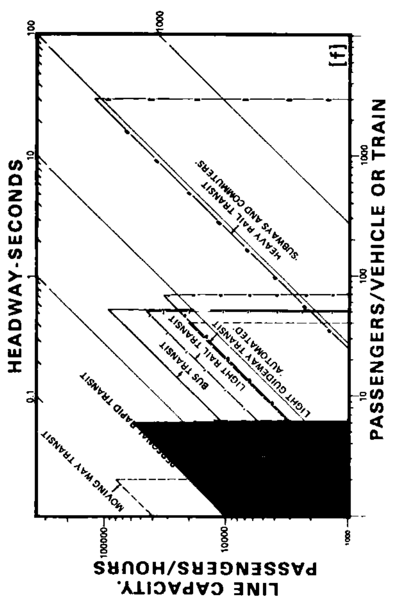
SYSTEM PERFORMANCE:

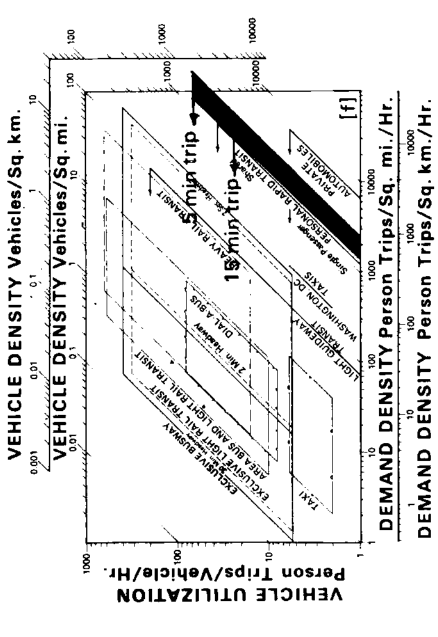
Max Theoretical One-Way Capacity	18,200 psgr/hr (1.3 psgr/veh)
Max Practical One-Way Capacity	14,500 psgr/hr (1.3 psgr/veh)
Min Theoretical Headway	0.25 sec
Min Practical Headway	0.33 sec
Availability	On-demand, 24 hrs/day
Type Service	Area-wide collection and distribution
Type Network	Urban area one-way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



TYPCIAL CBD INSTALLATION (from architectural model)







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 ConsumptionLess 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 unavailable
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:

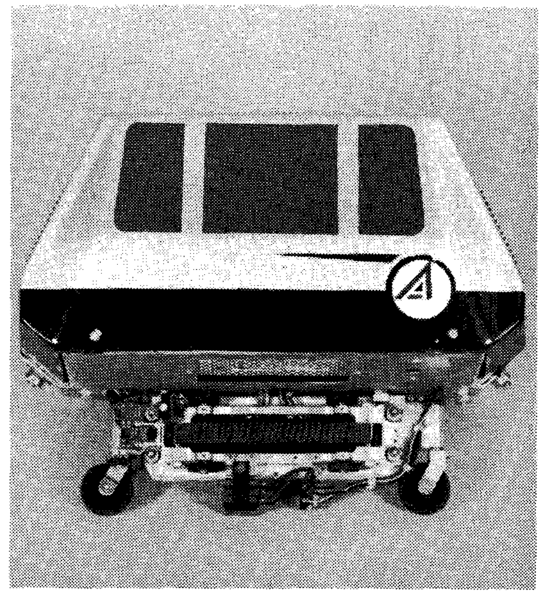
Type	Upright U-shaped channel
Materials	Prestressed concrete
Running Surface Width	Approx 0.5 ft (152 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	60 ft (18.3 m)
Overall Cross Section Width	2.7 ft (813 mm)
Overall Cross Section Height	3 ft (914 mm)
Design Load	Data unavailable
Double Lane Elevated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

CONTROL:

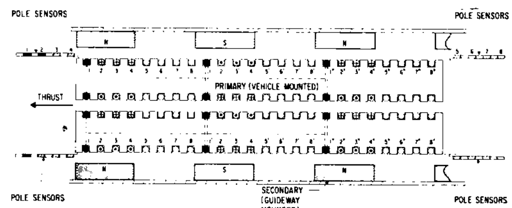
Control is by a quasi-synchronous hierarchial system. Headway is controlled synchronously along main lines as moving slots established by wayside computer. On-board vehicle computer commands pulse rate to dc linear motor. Vehicles commanded to slip or gain slots (according to on-board maneuver profiles) 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.

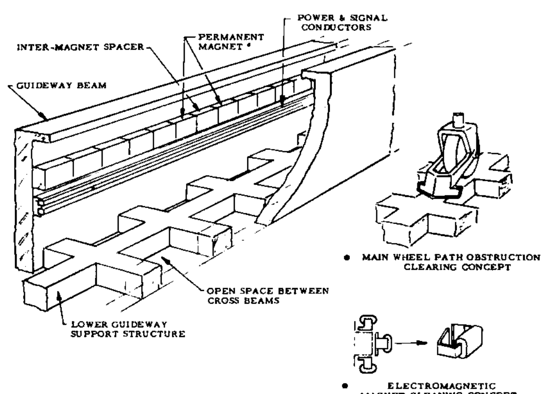


1/10th SCALE MODEL VEHICLE



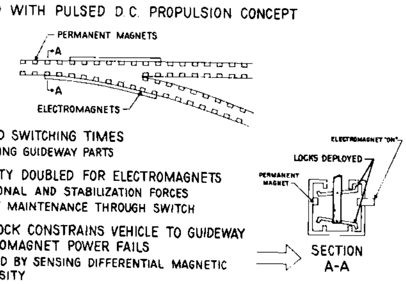
- COIL SWITCHING CONTROLLED BY POLE SENSORS (HALL EFFECT DETECTORS)
- SWITCHING RATE DEPENDS ON VELOCITY
- THRUST ADJUSTMENTS ARE MADE BY CONTROLLED VARIATIONS IN COIL CURRENT
- ELECTROMAGNETIC BRAKING BY REVERSING CURRENT TO COILS

PULSED DC LINEAR MOTOR CONFIGURATION



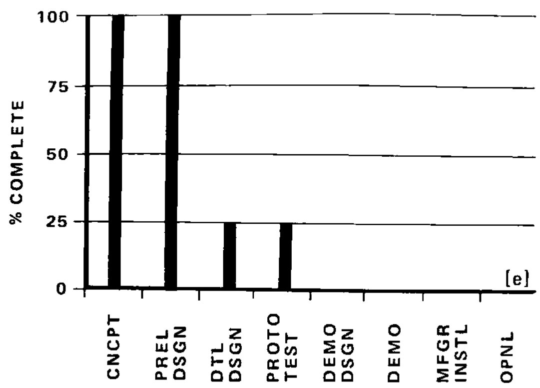
GUIDEWAY

- INTEGRATED WITH PULSED D.C. PROPULSION CONCEPT

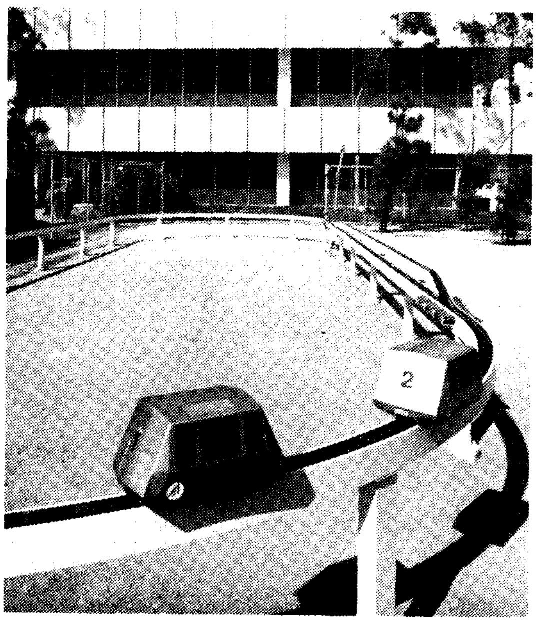


- MILLISECOND SWITCHING TIMES
  - NO MOVING GUIDEWAY PARTS
- FLUX DENSITY DOUBLED FOR ELECTROMAGNETS
  - DIRECTIONAL AND STABILIZATION FORCES
  - THRUST MAINTENANCE THROUGH SWITCH
- BACK-UP LOCK CONSTRAINS VEHICLE TO GUIDEWAY IF ELECTROMAGNET POWER FAILS
  - DEPLOYED BY SENSING DIFFERENTIAL MAGNETIC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

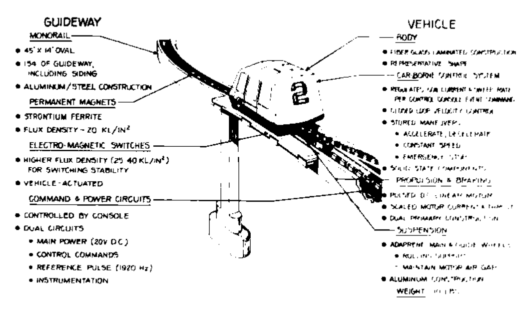
ELECTROMAGNETIC SWITCHING



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*

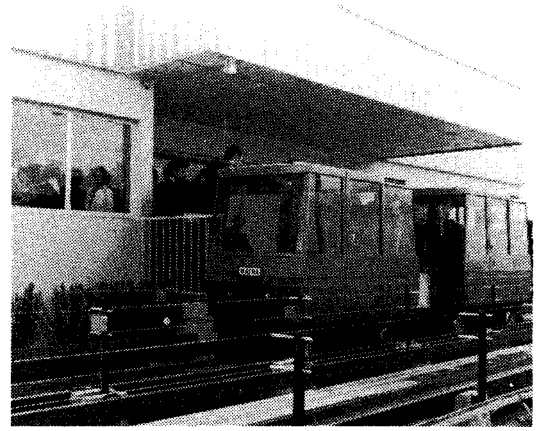
OTHER NAMES: Rames de vehiculés programmes (R.V.P.)

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.

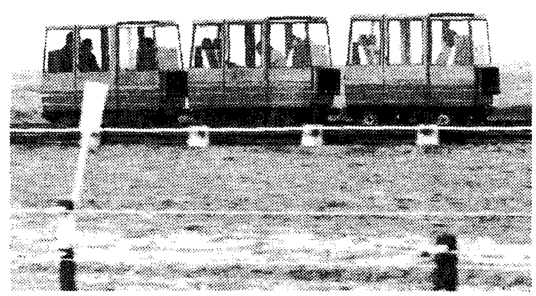
DATA REFERENCE CODE: [a 51: except as noted]



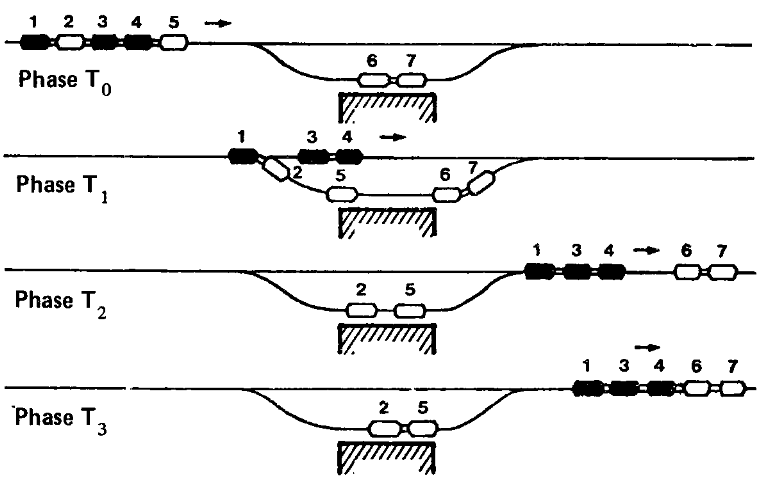
OPERATION OF STATIONS AND VEHICLE-PLATOONS

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.



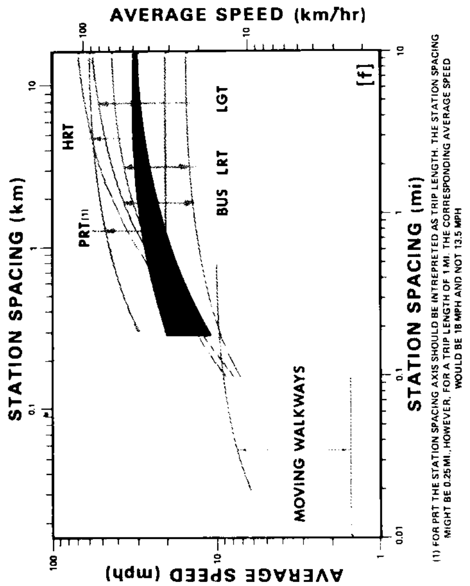
DEMONSTRATION OF EXTREMELY SHORT HEADWAY PLATOON OPERATION

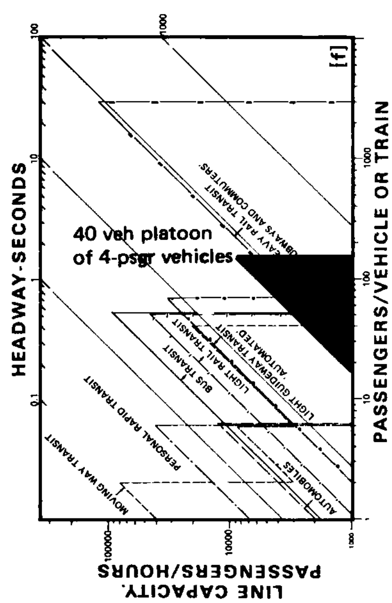


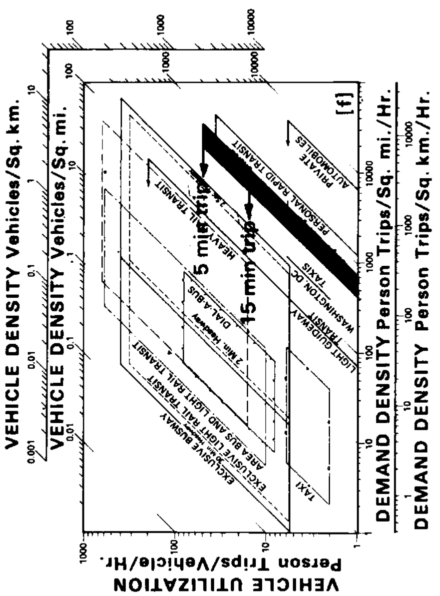
PROTOTYPE VEHICLES IN STATION AT ORLY AIRPORT

*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]

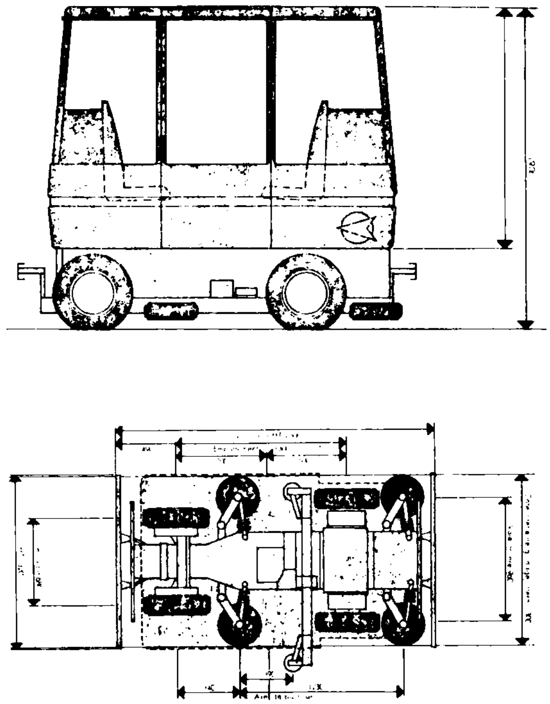
PERSONNEL REQUIREMENTS:

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



VEHICLE

SUSPENSION:

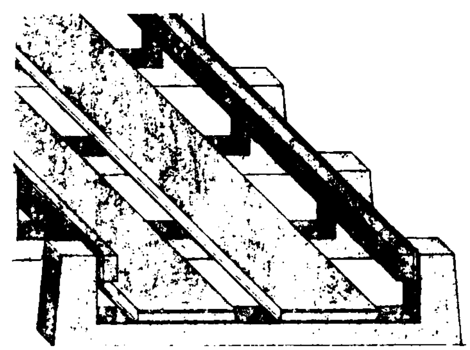
Type	Supported on 4 wheels with pneumatic tires
Design Load	Data unavailable
Lateral Guidance	4 pneumatic tired wheels rolling against 2 exterior lateral guiderails, front wheel steering (single Ackerman)

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]

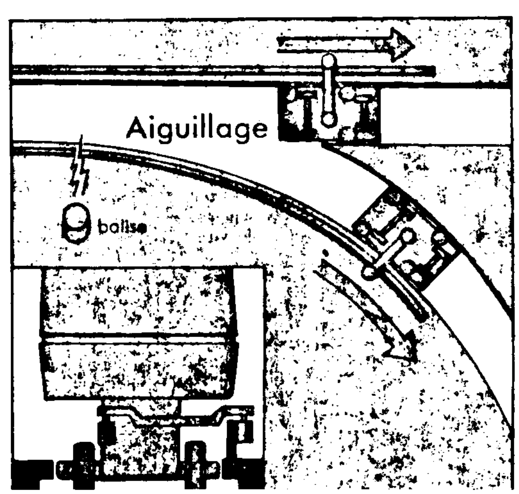
Type & Emplacement	Traverse engaging into special guiderail at switch, bolster mounted on vehicle
Switch Time (lock-to-lock)	Data unavailable
Speed Thru Switch	Mainline speed
Headway Thru Switch	Demerge at platoon headway of 0.168 sec



GUIDEWAY

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



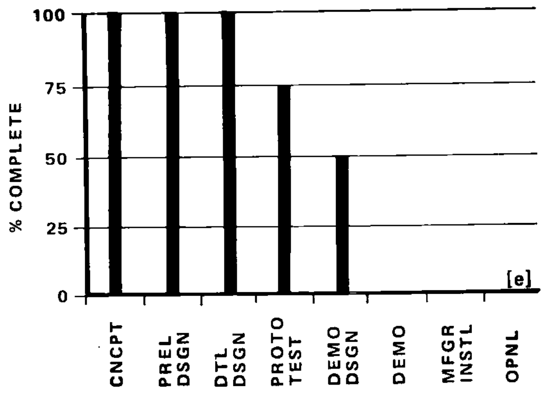
SWITCHING

CONTROL:

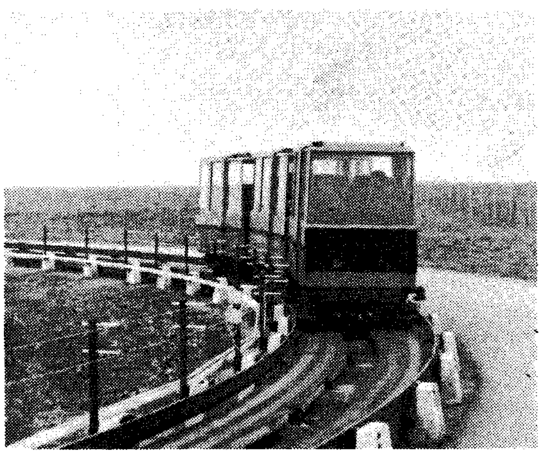
Vehicle is fitted with programming device (for destination choice by user). Vehicles are electronically coupled together and have always a spacing of 300 mm. Vehicle control is by two independent control systems: operating (such as door opening, switching) connected through track; the safety system for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



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

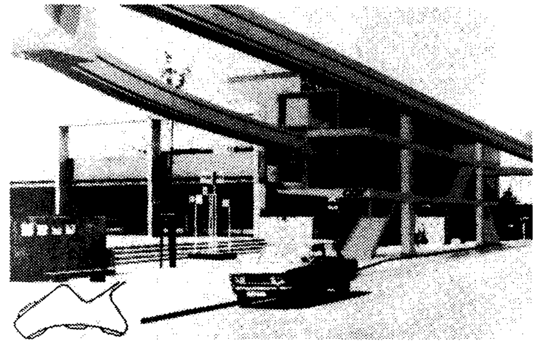
MBB, Messerschmitt-Bolkow-Blohm GmbH
Neue Verkehrssysteme
D-8000 München 80
Postfach 801265
West Germany
Tel: (089) 60003419
Telex: 0522279

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

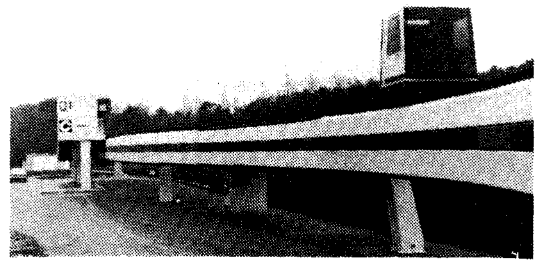
LICENSEES: None

PATENTS: Data unavailable

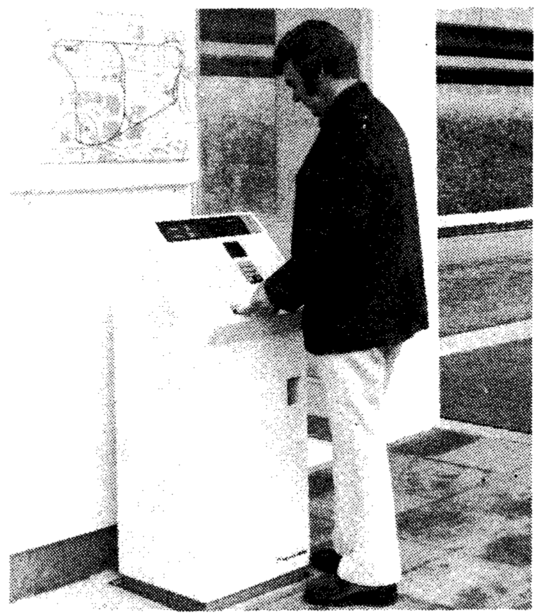
DATA REFERENCE CODE: [a 51: except as noted]



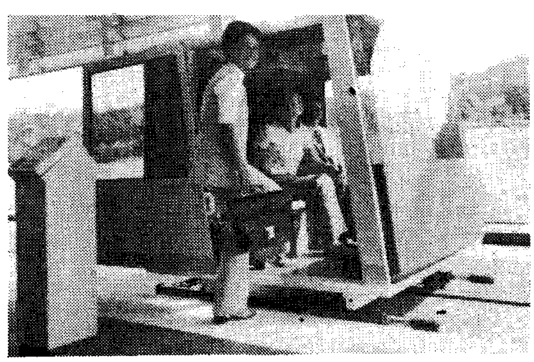
PHOTOMONTAGE OF OFF-LINE STATION



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.

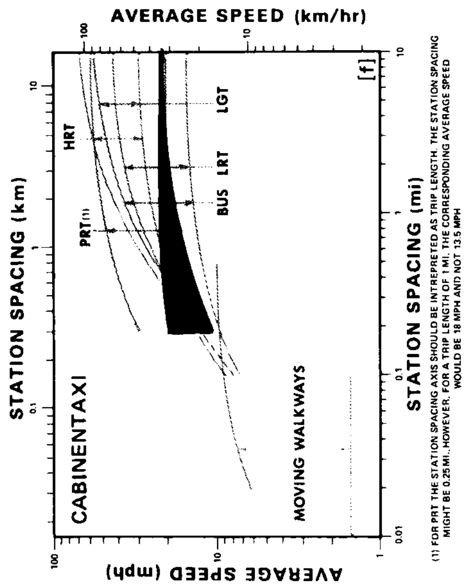
OPERATIONAL CHARACTERISTICS

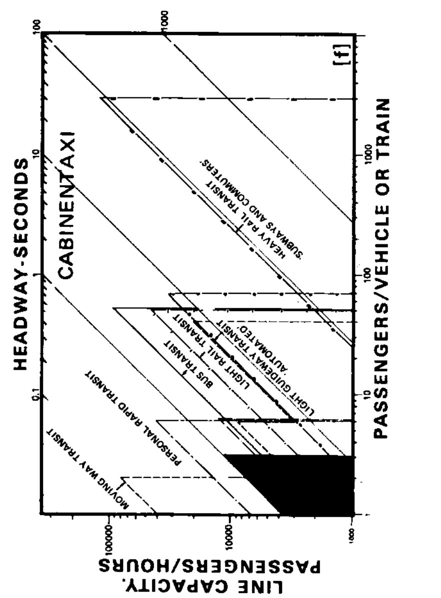
SYSTEM PERFORMANCE: [Cabinentaxi - a, Cabinenlift - f]

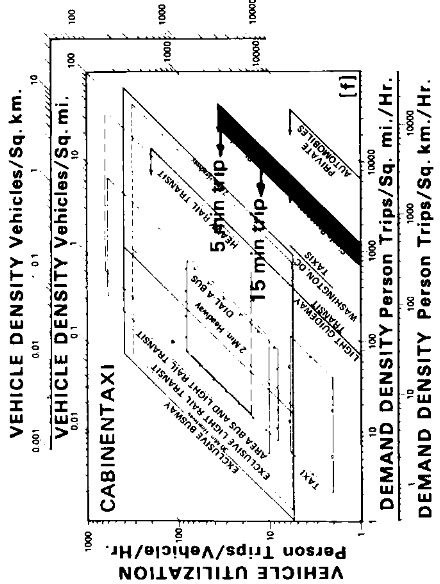
Max Theoretical One-Way Capacity	21,600/180 psgrs/hr[1]
Max Practical One-Way Capacity	15,000/144 psgrs/hr
Min Theoretical Headway	CT[2] - 0.5 sec
Min Practical Headway	CT - 1.0 sec
Availability	On-demand 24 hrs/day
Type Service	CT - limited area collection and distribution CL[2] - one-way shuttle service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

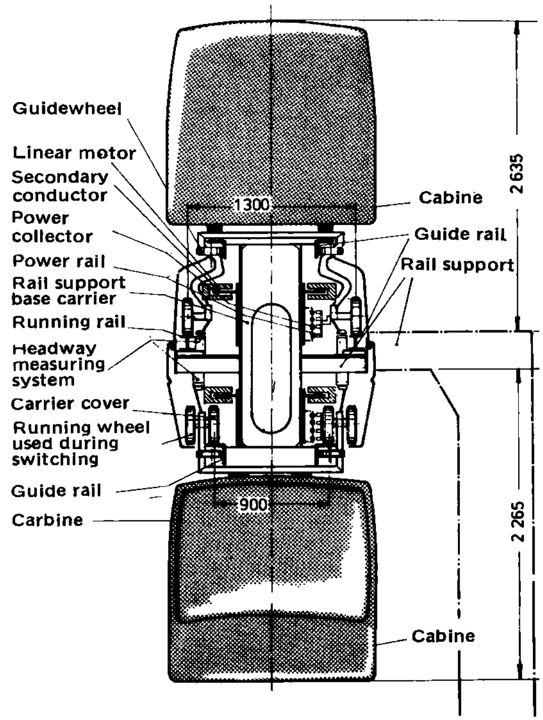
STATIONS:

Cabinentaxi — [a]

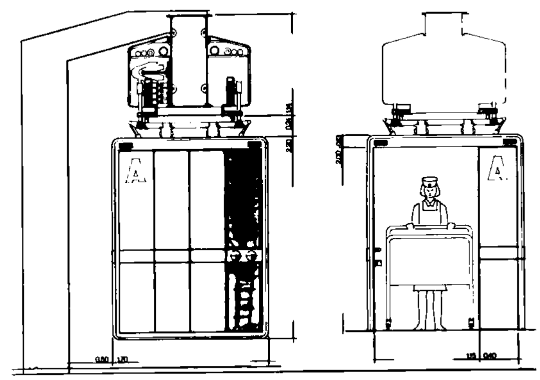
Stations may be incorporated in buildings or specially built structures. Off-line station guideway length of 361 ft (110 m) is min required including acceleration and deceleration lengths. One boarding area requires a length of 8.2 ft (2.5 m).

Cabinenlift — [c]

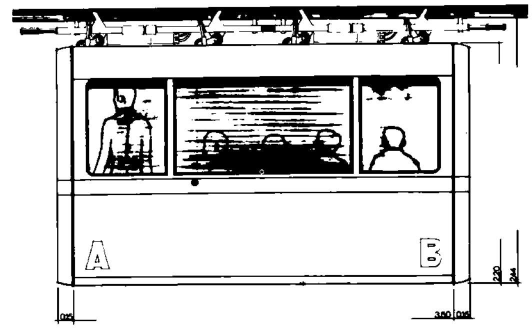
The stations are located on the second floor of each of the 2 buildings served. Direct access to the building is provided through the front of the vehicle. The connecting doors at the stations seal off completely the vehicle-station transition. vehicle-station transition.



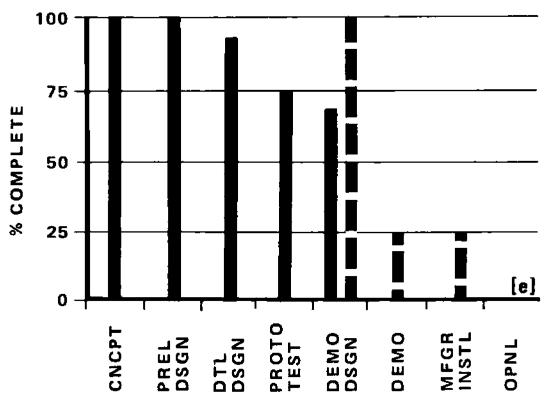
CABINENTAXI VEHICLE AND GUIDEWAY DESCRIPTION



CABINENLIFT VEHICLE DIMENSIONS



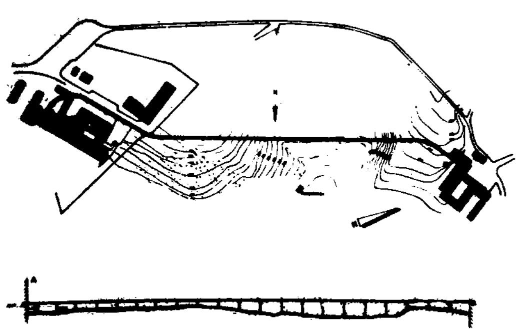
CABINENLIFT VEHICLE DIMENSIONS



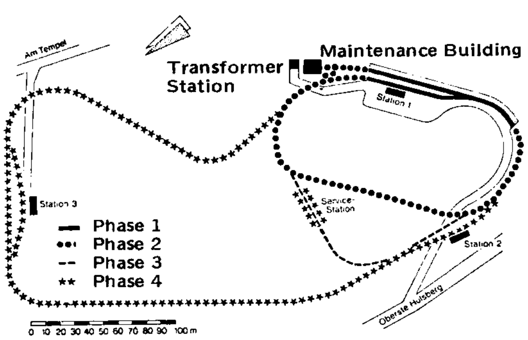
DEVELOPMENT STATUS

Cabinentaxi ▬▬▬
Cabinenlift ▬ ▬ ▬ ▬

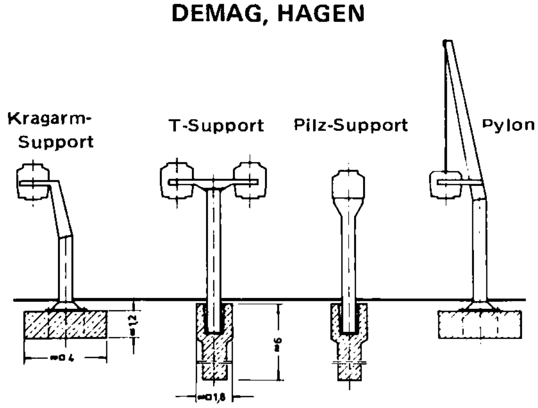
NOTE: **The Cabinenlift system is an application of Cabinentaxi and therefore the demonstration and manufacturer's installation stems from the pre-design and prototype testing of Cabinentaxi**



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

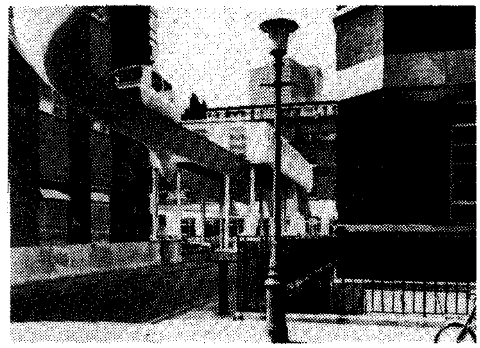
LICENSEES: None

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

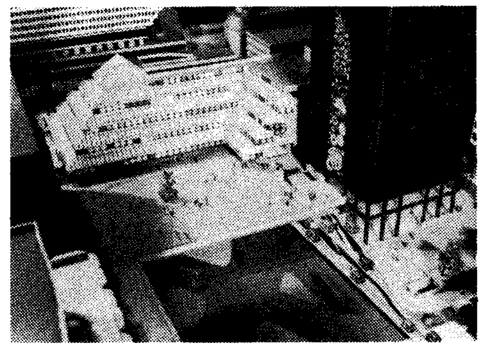
DATA REFERENCE CODE: [a 51: except as noted]

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).



Crown Copyright Reserved
PHOTOMONTAGE OF GUIDEWAY & STATION AT MORTIMER MARKET



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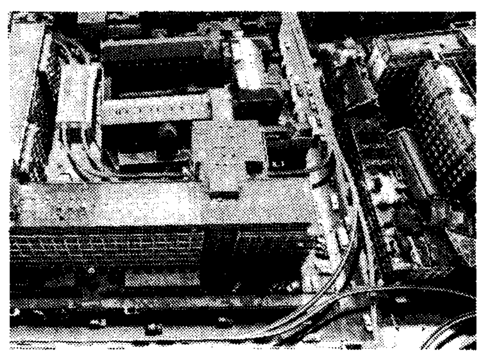
INSERTION INTO PICCADILLY CIRCUS REDEVELOPMENT



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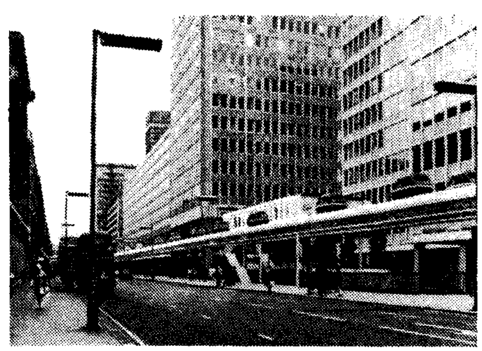
PHOTOMONTAGE OF SYSTEM AT MIDDLESEX HOSPITAL ANNEXE



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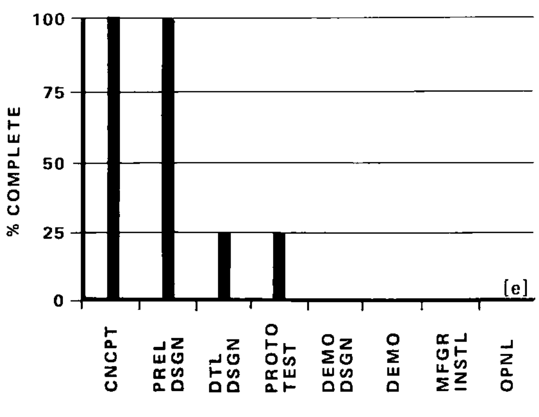
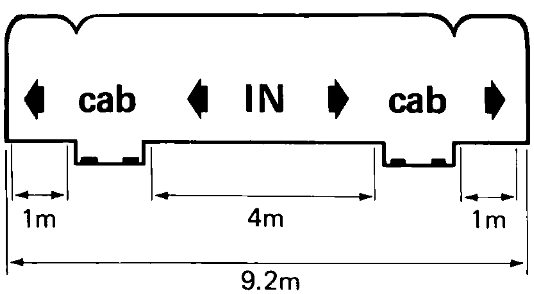
PHOTOMONTAGE OF GUIDEWAY & STATION ALONG VICTORIA STREET

**PUBLISHER'S NOTE:*

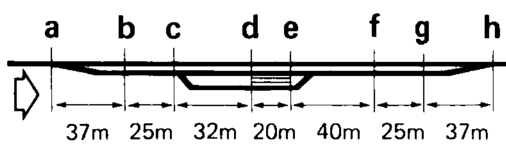
The Cabtrack studies were extensive in scope, performed during the period 1967-1971. At present work on this system has been curtailed in the Advanced Systems Division of the Transport Systems Department. It has been included because of its historical importance to the field of PRT, its in-depth investigations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



DEVELOPMENT STATUS

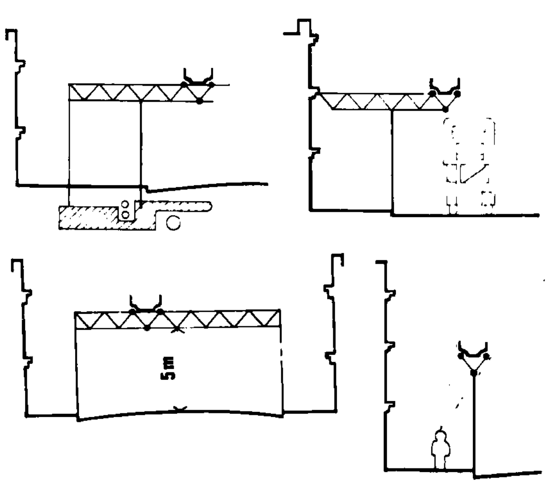


CROSSSECTION OF TYPICAL TWO-TRACK 5-BERTH (10 TOTAL) STATION



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 préclude 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]

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.)

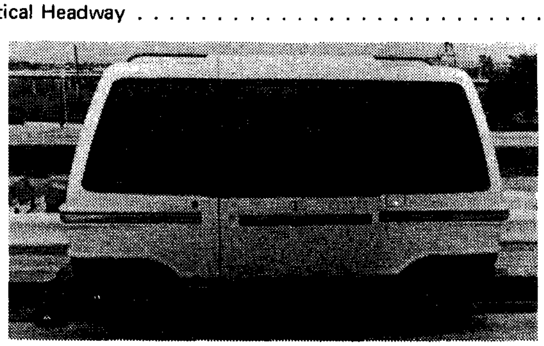
Proposed is a fairly tight grid network of guideways; some called superways and others medium-speed-ways or paths. Vehicles travel on the super-ways at 37 mph (60 km/hr) which are laid out as approximately 0.62 mi (1 km) square meshes of 2 or 3 single lanes in each direction with grade separated crossings,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

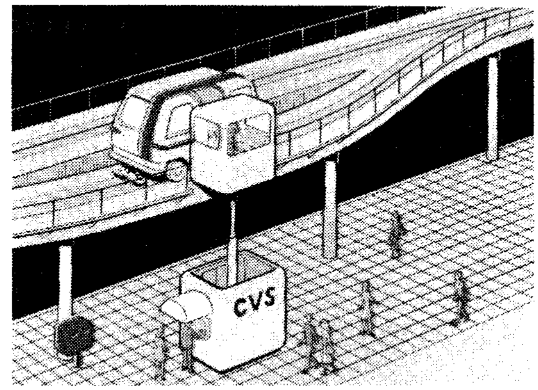
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

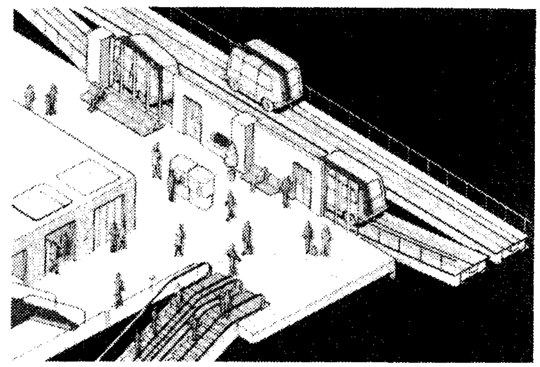
Max Theoretical One-Way Capacity	14,400 psgrs/hr
Max Practical One-Way Capacity	7,200 psgrs/hr
Min Theoretical Headway	1.0 sec



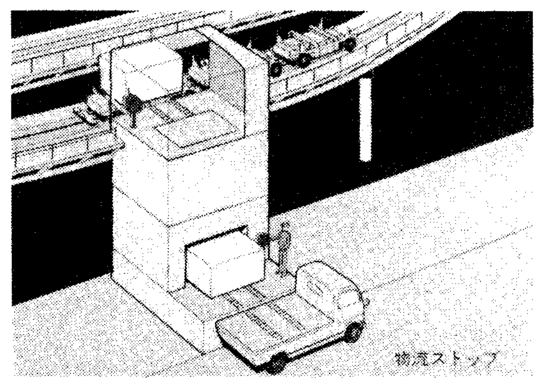
PROTOTYPE VEHICLE



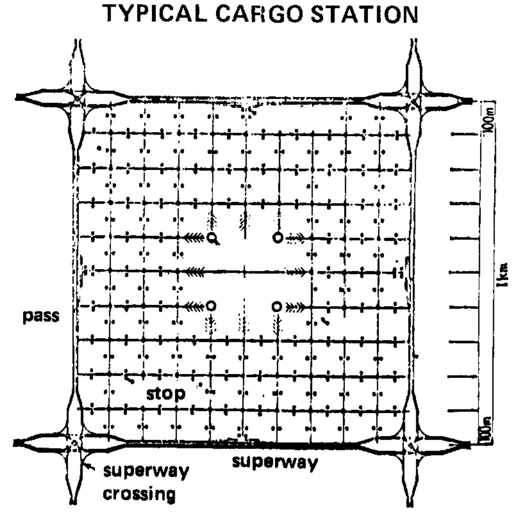
TYPICAL SIMPLE STOP



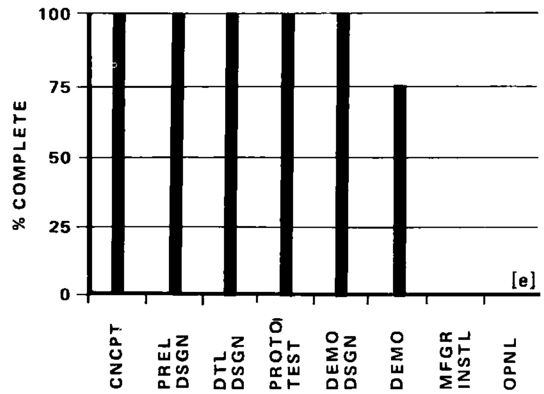
TYPICAL STOP ADJACENT TO A BUILDING



TYPICAL CARGO STATION



THEORETICAL NETWORK



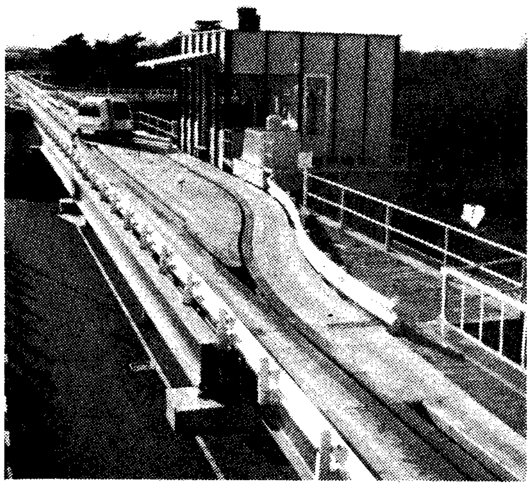
DEVELOPMENT STATUS

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



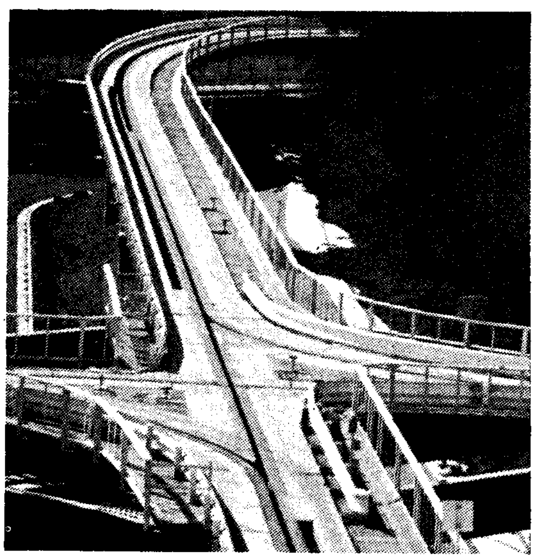
PROTOTYPE STATION AT TEST TRACK

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)



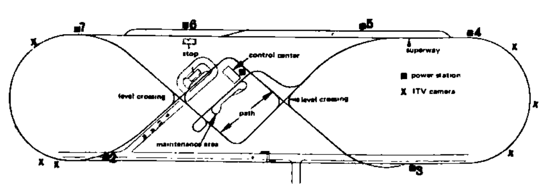
LEVEL CROSSING AT TEST TRACK

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).



LAYOUT OF TEST TRACK

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

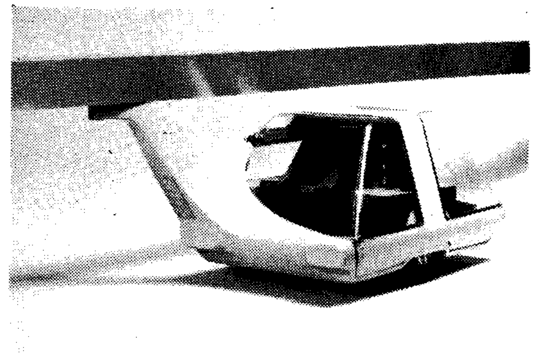
Vehicle Guidance and Switch:
Austria 315909; Italy 951416; France 2136439; and pending in Switzerland, Germany, U.S.A., Sweden, and Japan

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

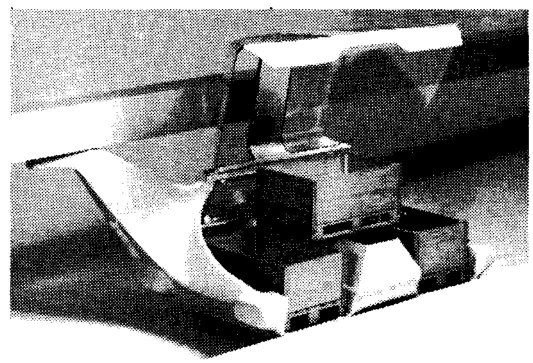
SYSTEM DESCRIPTION:

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.

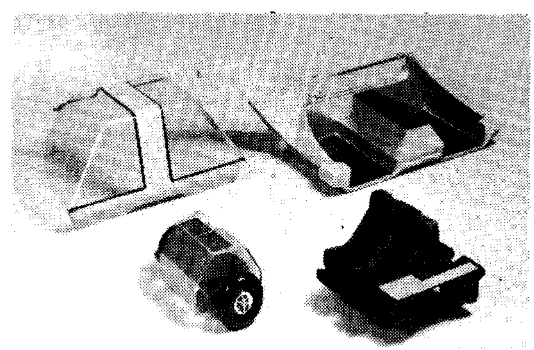
Of interesting note is the capability to tilt (or rotate) the vehicle about its horizontal axis by changing the distances between the roadbed and the overhead guidebeam, thus compensating for steep slopes, acceleration, and deceleration to give a safer and more comfortable ride.



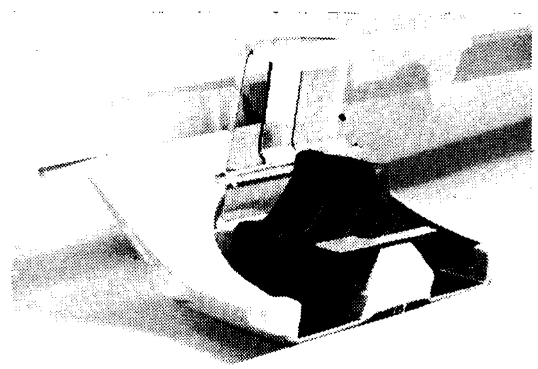
BASIC VEHICLE COMPONENTS



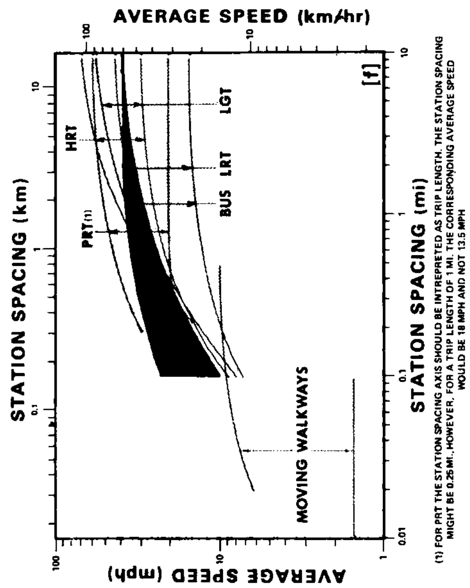
ELAN VEHICLE

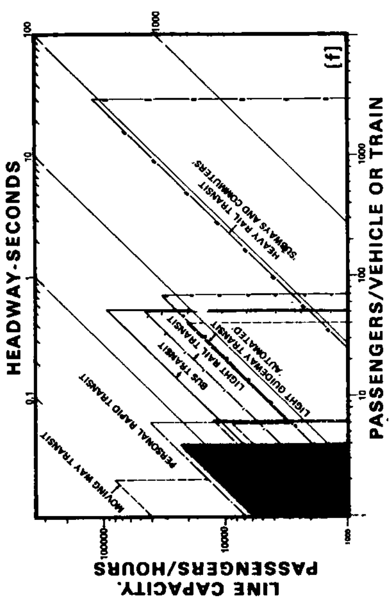


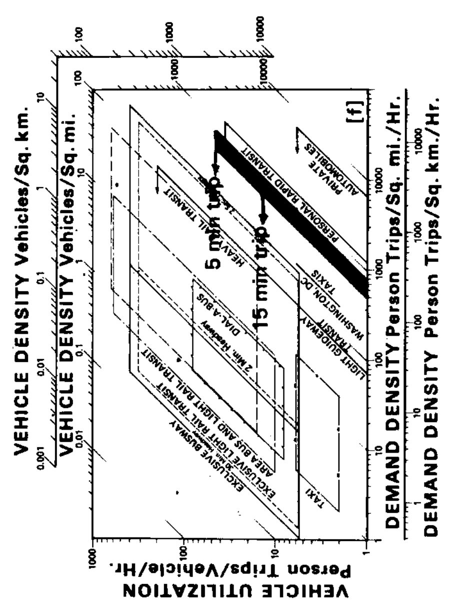
ELAN VEHICLE



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

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

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

GUIDEWAY:

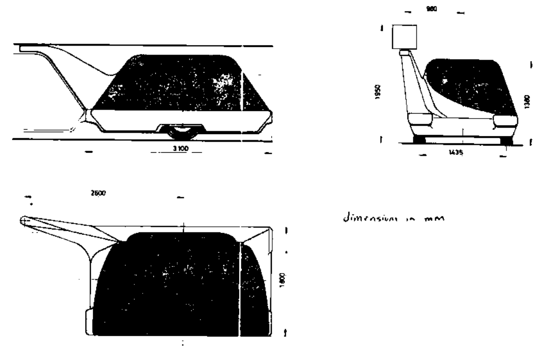
Type	Totally enclosed flat roadbed surface with overhead box guidebeam
Materials	Concrete or steel roadbed, steel overhead box beam
Running Surface Width	Approx 6.5 ft (2 000 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	150 ft (48 m)
Overall Cross Section Width	7.5 ft (2 300 mm)
Overall Cross 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:

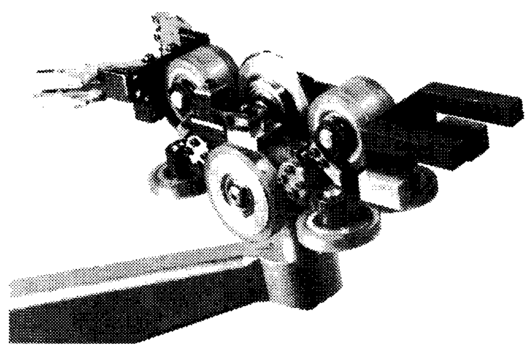
Control is by a hierarchial computer system with quasi-synchronous network control. Virtual slots (vehicle plus separation distance length) move along the guideway with vehicles assigned to a particular slot. Vehicles receive discrete commands from wayside computers having control over certain jurisdictions.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

STATIONS:

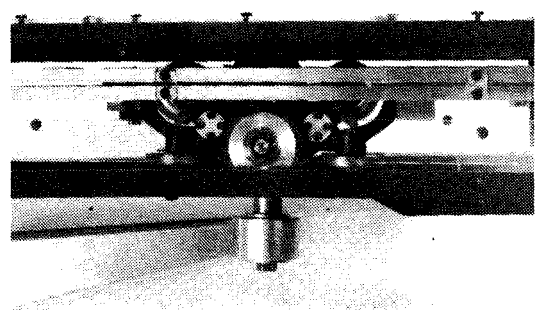
A typical off-line station would be 115 ft (35 m) long. Total off-line guideway length, including acceleration and deceleration, and station lengths for 37 mph (60 km/hr) mainline cruise speed and 8.2 ft/s^2 (2.5 m/s^2) accel/decel, could be 1,119 ft (341 m).



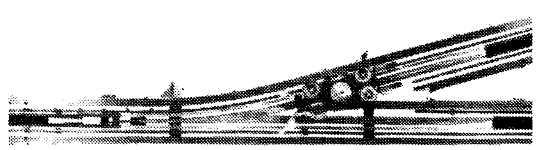
TYPICAL VEHICLE DIMENSIONS



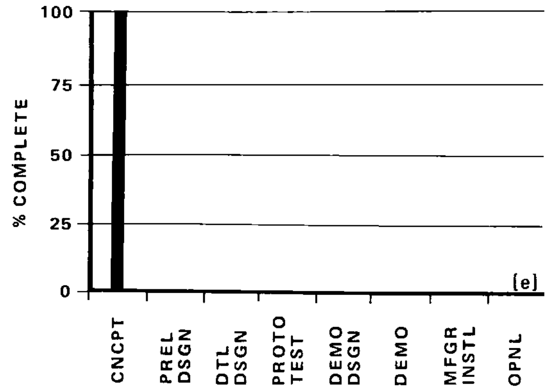
GUIDANCE BOGIE



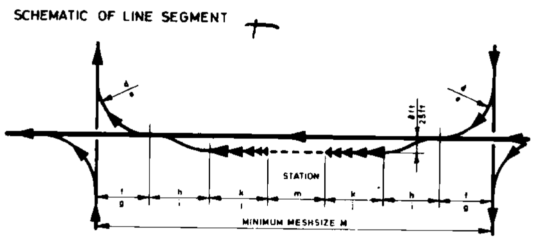
BOGIE INSIDE GUIDEBEAM



BOGIE IN SWITCH SECTION



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:

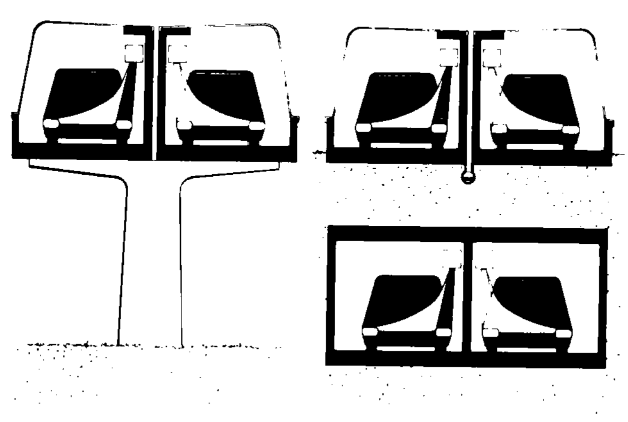
Single Lane Guideway Envelope Width . . . . 7.5 ft (2.29 m)
Single Lane Guideway Envelope Height . . . . 7.5 ft (2.29 m)
Single Lane Guideway Structural Weight . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . Data unavailable
Max Grade 20%
Min Vertical Turn Radius . . . . Data 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]

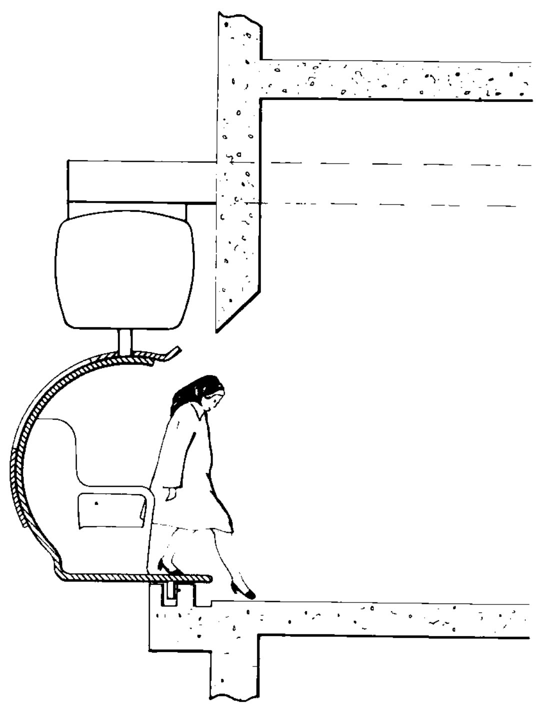
PERSPECTIVE VIEW OF C.30 FLYDA CHAIR SYSTEM ALONG A STREET

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.



ACCESS TO C.30 FLYDA CHAIR

OPERATIONAL CHARACTERISTICS

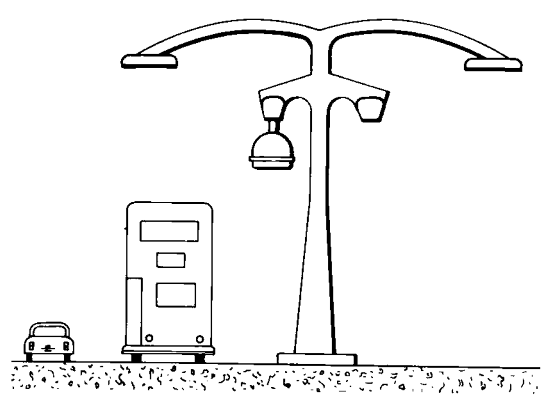
SYSTEM PERFORMANCE:

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)

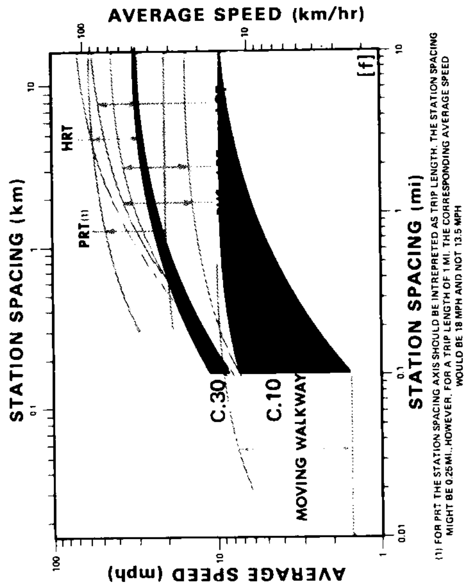
[1] **All data shown are C.10/C.30 respectively.**

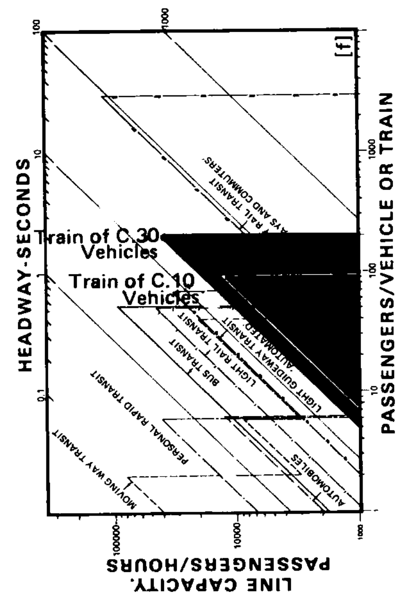


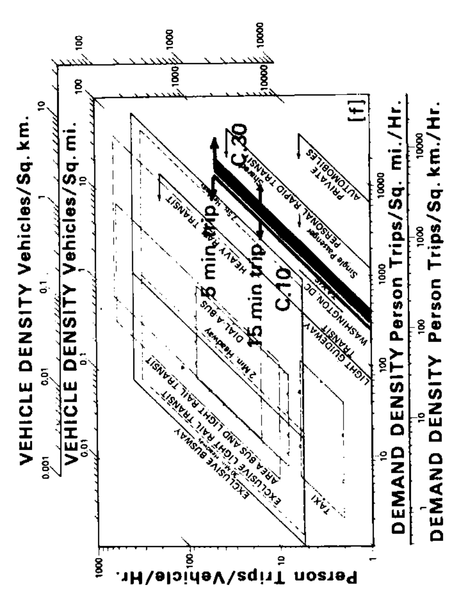
INSTALLATION IN STREET MEDIAN

**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/s² (0.8 m/s²)
Service Deceleration . . . . 2.7 ft/s² (0.8 m/s²)
Max Jerk . . . . 3 ft/s³ (1 m/s³)
Emergency Decel . . . . 2.7 ft/s² (0.8 m/s²)
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 } . . . . 700 veh/hr/4-berth station or
Deboarding Capacity } 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.

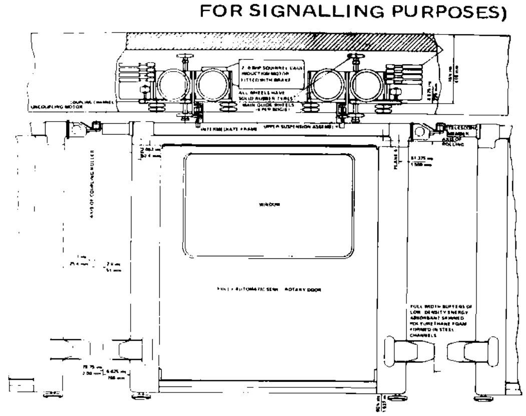
Sections of guideway have designated speeds, which are controlled by guideway power supply. Merging is quasi-deterministic. Momentary stops at some merge points may occur as required to impose schedule and for automatic coupling.

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.

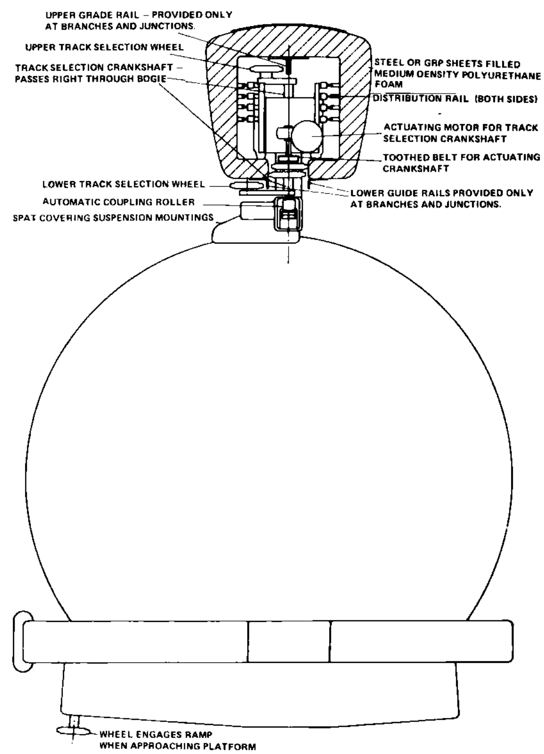
Regenerative and capacitance braking, is used with no-voltage mechanical brakes for holding and emergency.

STATIONS:

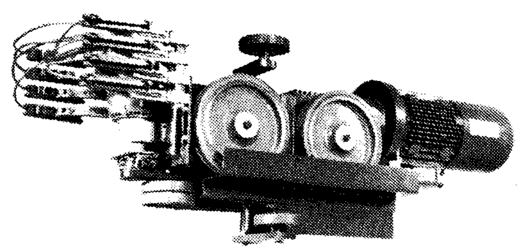
Three types of stations: on-line stations, within buildings and for very simple installations; single-platform off-line stations, which are the most usual form, with four berths; and parallel off-line stations, for high capacity.



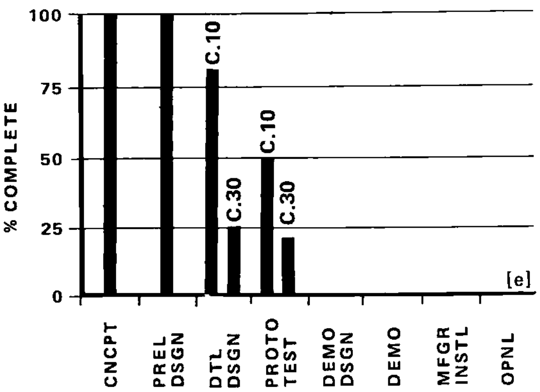
GENERAL ASSEMBLY SIDE VIEW C.10



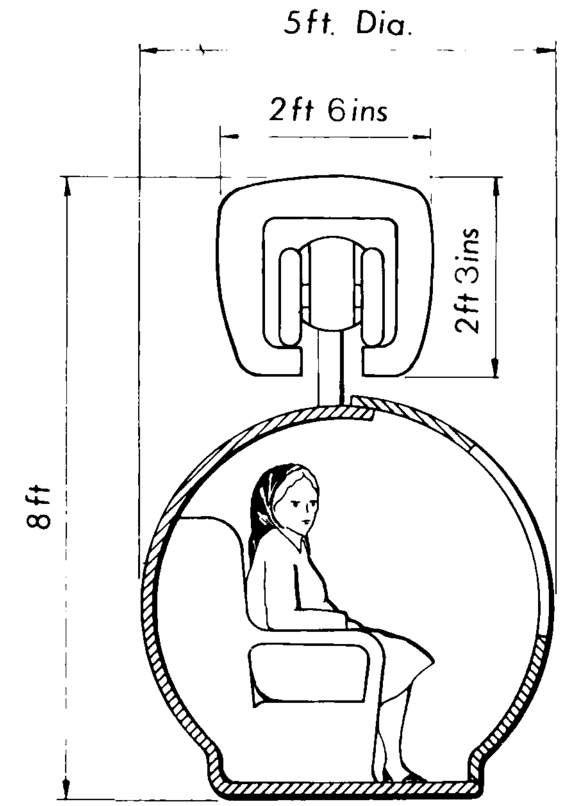
GENERAL ASSEMBLY END VIEW C.10



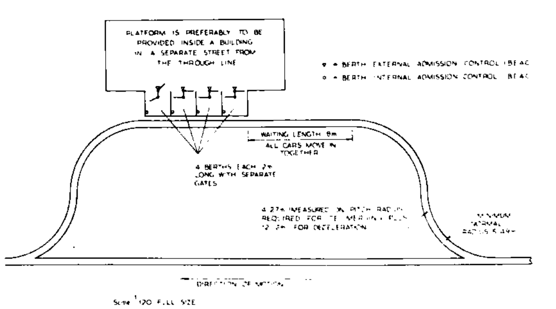
POWERED BOGIE



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]

SYSTEM DESCRIPTION:

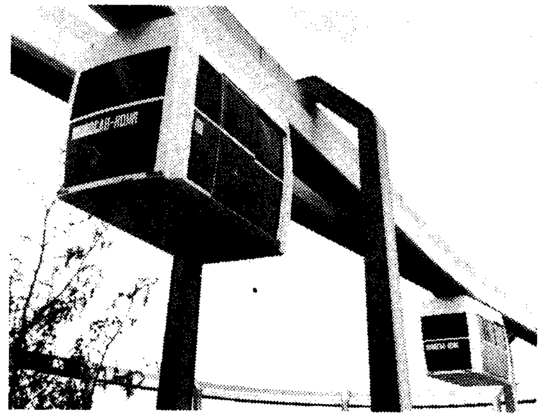
Monocab is a medium-capacity (at present design headway) transportation system of small, automatic, six-passenger vehicles operating on an overhead guideway, using parallel over/under stations, which allow direct origin-to-destination travel without the need for turnarounds or grade changes for access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

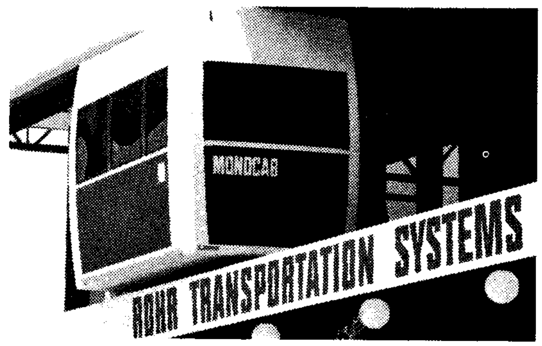
Guideway beams are designed to enclose power distribution and control systems for protection. Either concrete or steel may be used for guideway construction.

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.

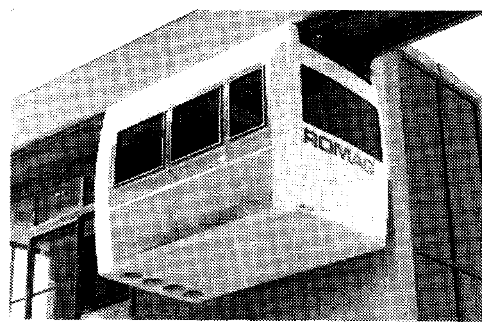
Two classes of demand service are available, rent-a-cab or rent-a-seat. In rent-a-cab, the passenger, by paying his fare, reserves an entire cab for him and his party, which takes his party nonstop from origin to destination. In rent-a-seat service, the passenger still operates on a nonstop origin-to-destination 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.



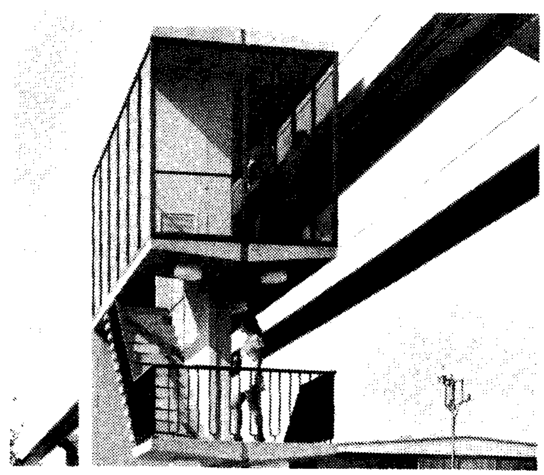
TRANSPO '72 GUIDEWAY AND VEHICLES



TRANSPO '72 STATION



PROTOTYPE MAGNETICALLY LEVITATED TEST VEHICLE & MINIMUM FOOTPRINT STATION



MINI — FOOTPRINT STATION

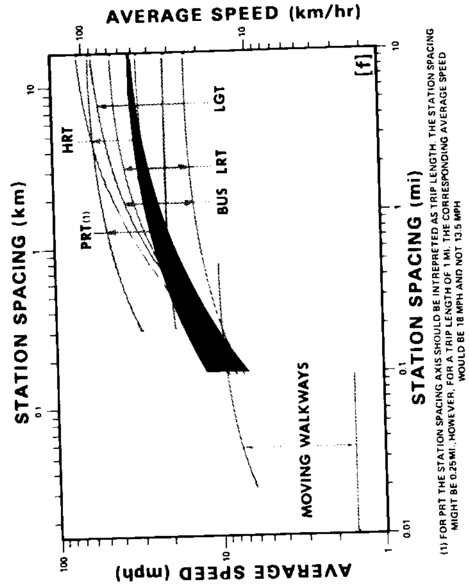
OPERATIONAL CHARACTERISTICS

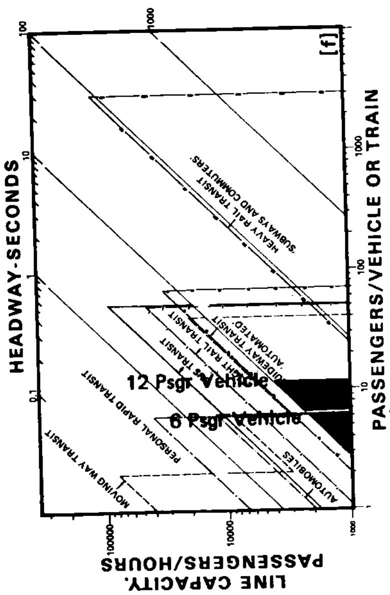
SYSTEM PERFORMANCE: (6 psgr vehicle)

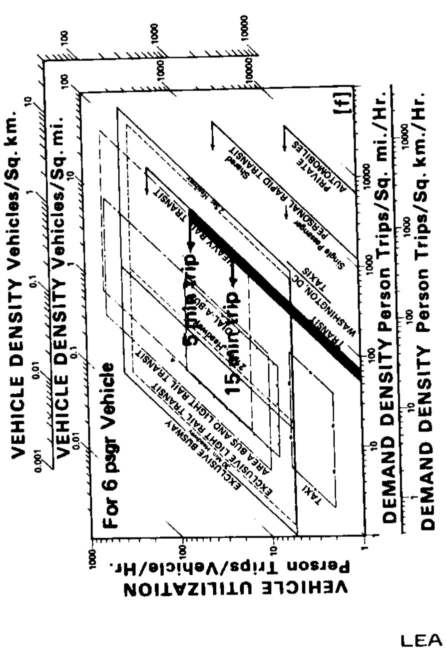
Max Theoretical One-Way Capacity	4,320 psgr/hr
Max Practical One-Way Capacity	2,160 psgr/hr
Min Theoretical Headway	5 sec
Min Practical Headway	10 sec
Availability	Any combination of on-demand or scheduled service
Type Service	Limited area collection and distribution
Type Network	Interconnecting loops 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

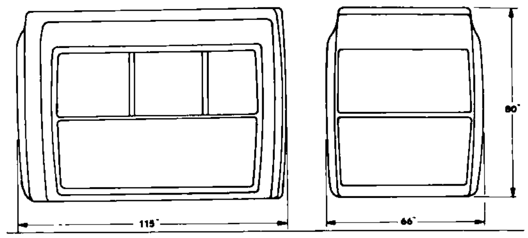
CONTROL:

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.

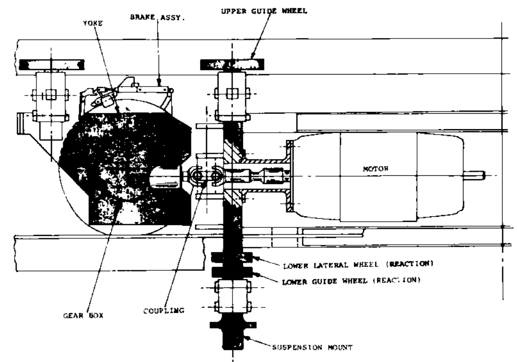
STATIONS:

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.

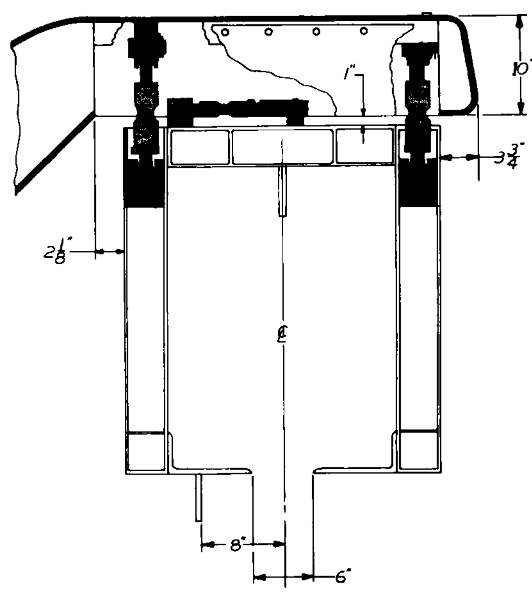
Minimum wait times, dynamic graphics, and functional design make passenger flow continuous, causing minimum queuing.



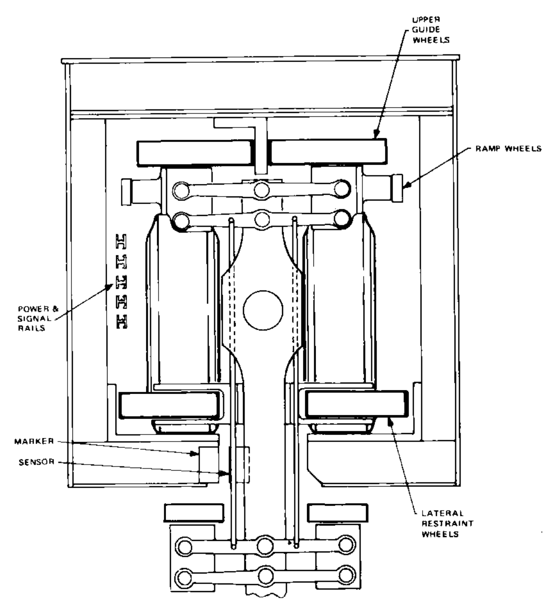
VEHICLE EXTERIOR



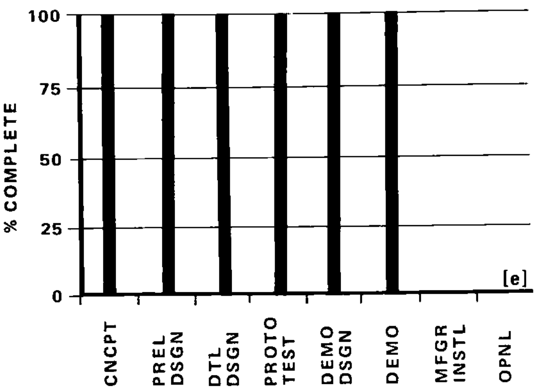
PROPULSION AND GUIDANCE



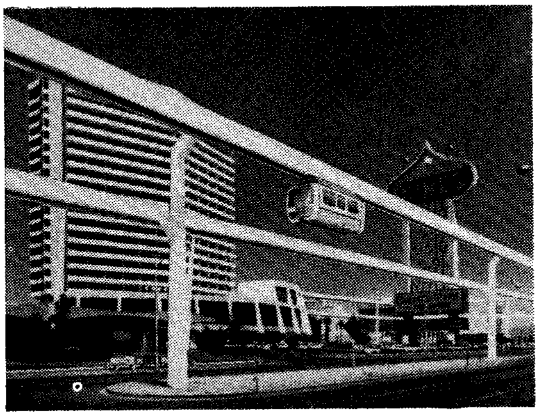
GUIDEWAY CROSS SECTION



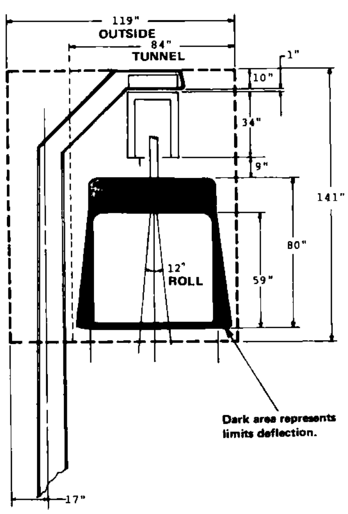
VEHICLE SUSPENSION



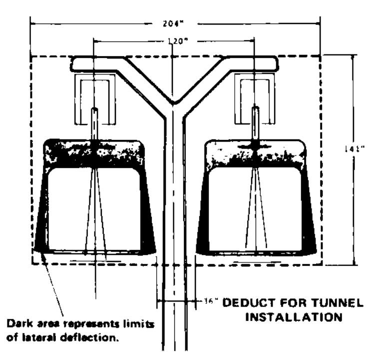
DEVELOPMENT STATUS



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

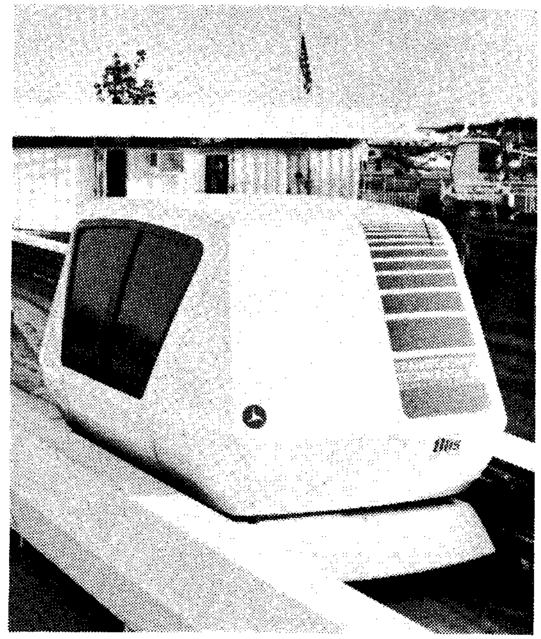
LICENSEES: None

PATENTS: Data unavailable

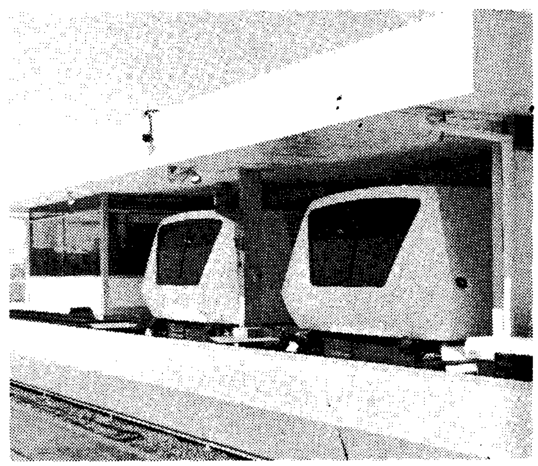
DATA REFERENCE CODE: [a 51]

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

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

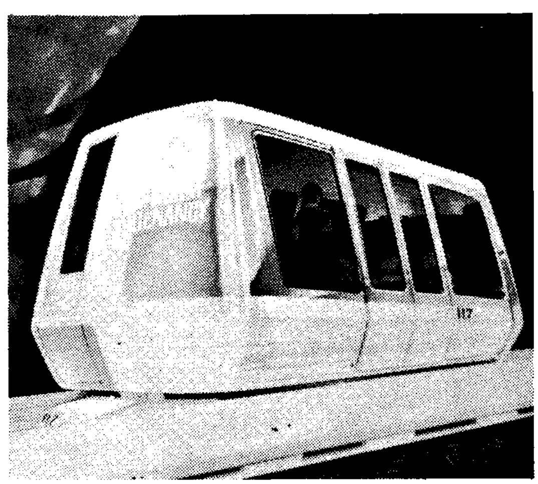
Max Theoretical One-Way Capacity . . . . 9,100 psgrs/hr**
Max Practical One-Way Capacity . . . . 6,900 psgr/hr
Min Theoretical Headway . . . . 45 sec
Min Practical Headway . . . . 50 sec
Availability . . . . Scheduled operation, on-line stations; ultimate conversion to single vehicle, off-line stations 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.

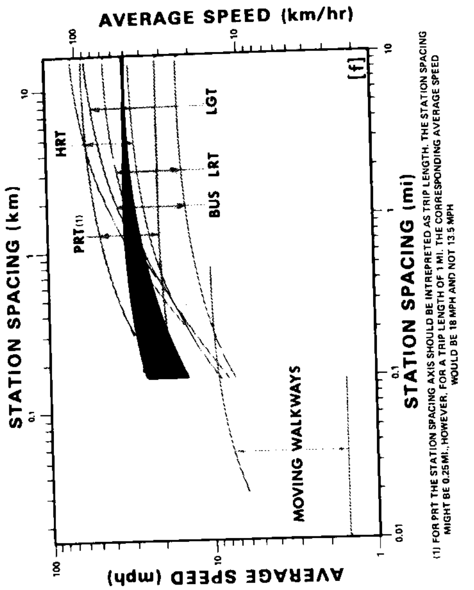
**PUBLISHER'S NOTE:*

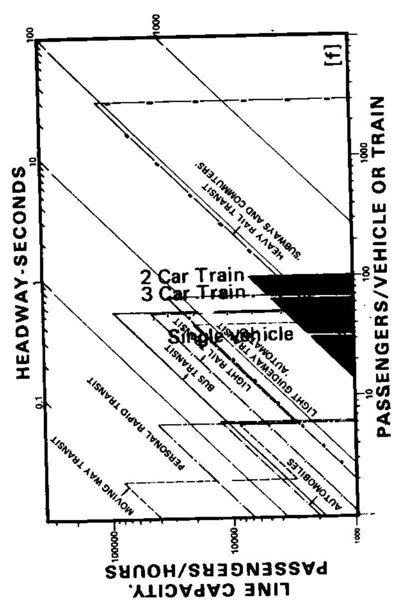
The system has been classified as PRT because of the 6-passenger vehicle and the capability for on-demand exclusive use. The reader is advised that the developer offers a basic automated transportation technology which can be tailored to site-specific applications whether it be PRT, LGT, or high speed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

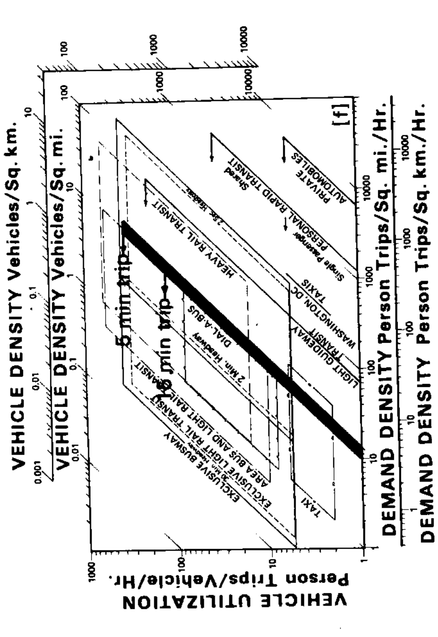
The data and information herein reported is based on a PRT application with the 6-passenger vehicle.



ARTIST SKETCH OF NANCY 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

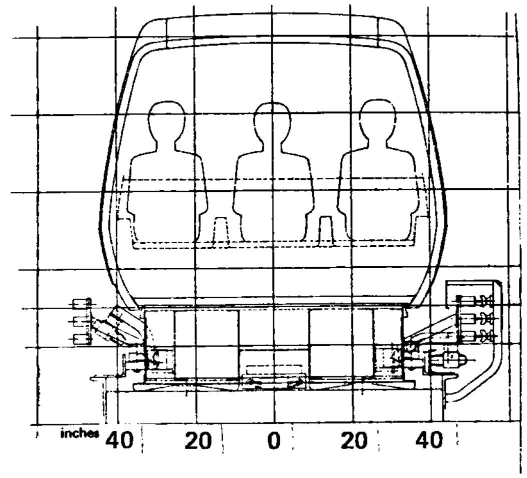
PERSONNEL REQUIREMENTS:

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



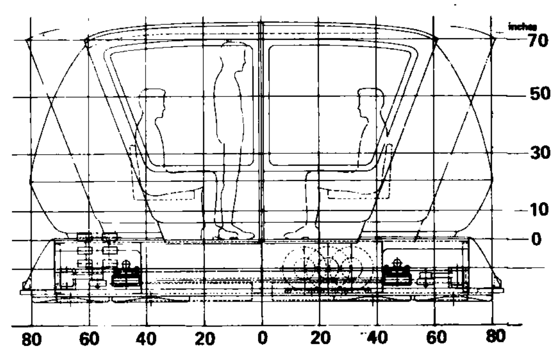
VEHICLE END VIEW

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



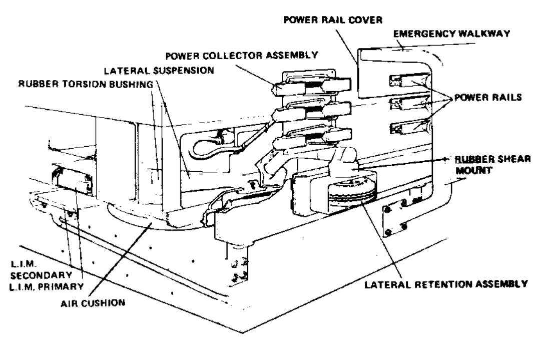
VEHICLE SIDE VIEW

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.



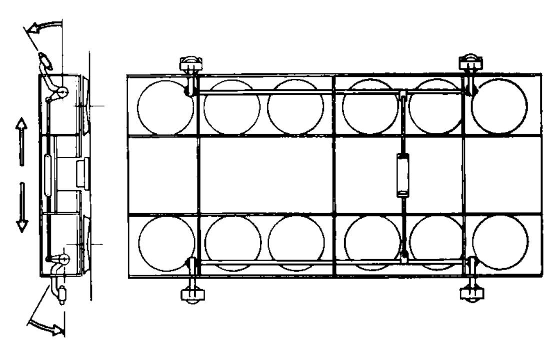
LATERAL SUSPENSION AND RETENTION ASSEMBLY

CONTROL:

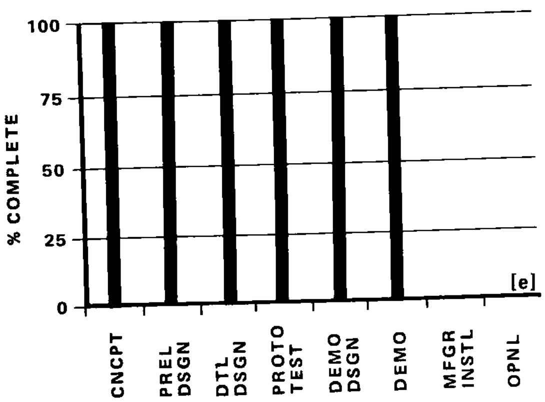
1) Fixed-block using traditional railway schemes adapted for rapid transit applications
2) Moving-block using distributed minicomputers for operational control, separate fail-safe processors for headway assurance and other safety functions
3) Central computer for display and scheduling

STATIONS:

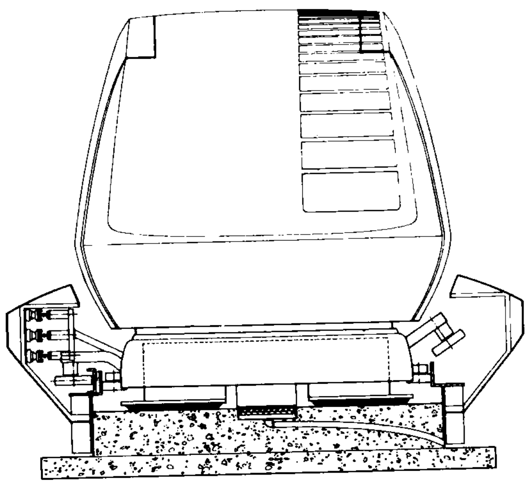
On-line or docking stops are optional. When docking is used, vehicles are pulled laterally into berth. Docking increases station capacity by eliminating "first-in — first-out" problem.



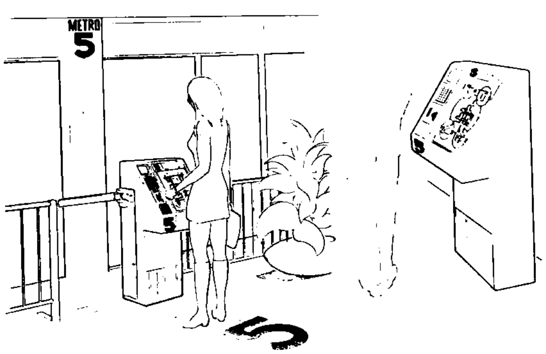
SWITCHING MECHANISM



PHASE I
DEVELOPMENT STATUS



VEHICLE GUIDEWAY INTERFACE



ROUTE DISPLAY & CONSOLE

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:

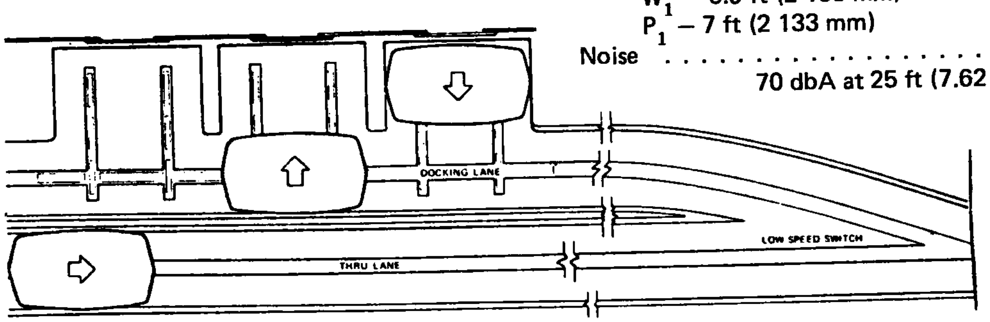
Excessive amounts of snow or ice may cause service degradation. Slippery surfaces due to surface coating of ice does not effect performance. Emergency stopping distance is increased.

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



LATERAL DOCKING IN STATION

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 . . . . $\pm$6 in ($\pm$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 trans-formers 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.

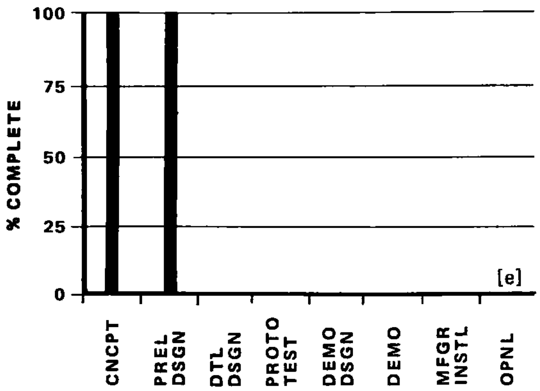
Stations shall provide the following minimum services:

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

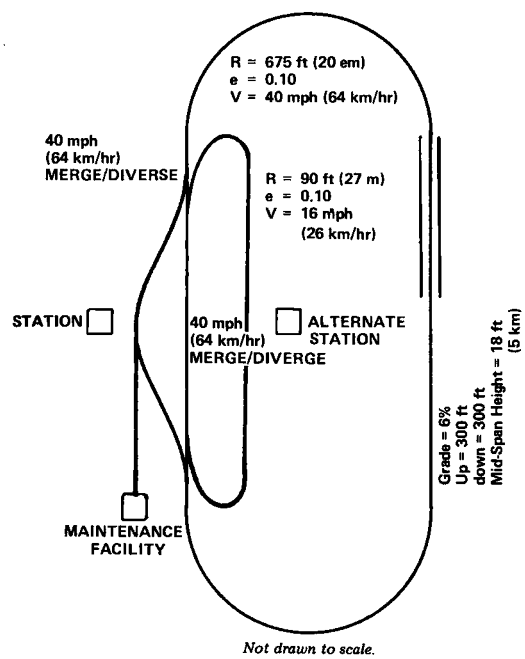
Stations shall be fully enclosed with controlled environment.

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