A FORWARD LOOK IN TRANSPORTATION

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Of all of the municipal problems facing American cities today, none is as great as that of the crisis proportion rapid transit problem—

A sober look at the reason and a shift in concept scale thinking is required to bring this horribly distorted picture back into focus so that a workable answer can be determined. The problem, of course, is to transport thousands of people, comfortably and rapidly and at a profit, into city centers from suburban living areas—and back again. All mass transportation forms, intercity and local public carriers have been fighting rising operating and maintenance costs while their percentage of persons carried of the total moved has dropped; reflecting a drop in their total percentage take of the transportation dollar. The drop in passengers carried has gone so far that the number needed for profit is no longer being reached, indeed the percentage needed to break even is not being reached. The result of operating at a sustained loss, of course, is bankruptcy.

What are the causes, major and contributing, of this situation?

The automobile, the resulting sprawling suburbs, and the ultra-conservative maintenance thinking on the part of the rapid transit systems are the major causes. As the transportation lines lose their income, the purchase of new equipment is stopped and the maintenance cost of the old equipment becomes staggering. Popular feeling will not accept the dingy, crowded, outmoded equipment and the rate of shift to automobiles increases. New and modern buses are on the roads but because of the bus bulk it is particularly subject to traffic snarls and the speed of bus transportation is reduced to a mere sixty percent of that possible by private automobiles.

What about the private automobile? Is it an answer to rapid transit? Are large and modern highways that not only by-pass but funnel thousands of cars into our cities the answer? Are multi-tiered, multi-laned, multi-million dollar elevated highways the answer? Can

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the auto traffic stifled cities accommodate themselves to onslaught after onslaught of cars? Can the cities lose taxable property to the parking lot—can they build garages—can the mercantile establishments stand the delivery difficulties—the answers are, of course, no.

What is the solution?

New and modern elevated lines, silent, on rubber wheels, with automatic controls are fast carriers of passengers but expensive—costing eight or nine million dollars a mile. Moving sidewalks are practical for city short hauls. These are all solutions and are all workable to varying degrees of success. The problem, as mentioned, is of crisis proportion and calls for a major revision in our thinking. It is my firm belief that only two solutions are possible. Subsidize the railroads so they can modernize—an expensive solution, economically and politically; or resort to a "modern" concept in transportation—the monorail.

The monorail is an adaptable, fast, economical rapid transit system, riding on a single rail above and relieving congestion, adjusting to almost any passenger capacity requirements. Monorail cabs in trains of five or six, traveling silently on pneumatic tires, sway free, gyroscopically balanced, riding above grade crossings, free from collisions, can carry thirty thousand passengers an hour on a single rail. The construction costs are less than any other form of rapid transit. A fifteen minute monorail ride instead of a fifty minute automobile ride.

This, admittedly, is a radical solution, but think of our problem, and remember other radical solutions to other crisis proportion problems—the elevator—the subway—the transcontinental railroad.

We must supply a twentieth century answer to a twentieth century problem. The usual resistance to a shift in thinking must be overcome. Reasons of why it can't be done will be offered and they will include—

1 — No history
2 — People won't like riding in the air
3 — It looks too radical
4 — People don't like being a part of an experiment.

A pilot monorail system would have to be engineered, and built to find and correct the operational bugs and misconceptions.

The organization of the project must be a management, engineer-

ing, construction, financial, legal, public relations, and a political one —ending in a solution that includes profit.

The engineering problem first. What would a monorail look like, how large would the cabs be, the rail, the towers? How about sway, uplift, power? How much space is required, how much land, how high above the ground—and how much money?

We require a rail or beam, supports for the rail and a cab. The cab could ride on top of or below the rail. We need a propulsion unit, wheels, controls and brakes.

The cab would be lightweight—all aluminum, an airplane body without wings. Physical dimensions could be 60′0″ long, 9′0″ wide, 7′9″ high. This would provide for 60 seats, room for 50 standees, 1.9 passengers per foot of car, 4 square feet per passenger. Car weight would be about 30,000 pounds, loaded weight about 52,000 pounds, with propulsion unit about one kip per running foot of beam. The design of a beam spanning, say, 100′0″ is not an unusual structural problem. If we supported the rail off of one side of columns spaced 100′0″ on center moments of the magnitude of eight hundred foot kips. are roughly what can be expected, including wind, impact, and centrifugal loading. We encounter far larger moments in transmission tower work, some buildings and many bridges—structurally we are not dealing with designs beyond the scope of our experience.

The motive power, wheel carriages, controls and brakes would be part of a separate unit riding atop the rail in the underslung version, or incorporated with the cab body on the rail straddling design. The propulsion unit could be gasoline, diesel or electric powered. The wheels—pneumatic rubber tires, steel or a combination of both.

The beam and columns or towers could be reinforced concrete, prestressed concrete, rolled steel sections or steel shell sections. Utilities and power lines would be carried on, under or in the beam. There is nothing new or radical in concept here. Safety devices would incorporate all the latest innovations developed by the automatic control people and would not be nearly as extensive in concept as those presently being employed and being considered by the railroads.

Wherever a lamp post can go we can also put a monorail tower.

1 — Center lane of highways
2 — River beds and river banks
3 — Sides of downtown city streets
4 — Railroad rights of way.

How high in the air would the top of the beam have to be for transit above the traffic—

The cab	8′0″ high
Beam, say,	4′0″
Space	1′0″
	13′0″

For a feeling of safe clearance, we would need about 15′0″ for a total of 28′0″ from grade to top of beam. The cab certainly could climb grades and with pneumatic tires the grades could be of 5% magnitude. Suburban stations could have ground level platforms—intown stations would unload in the air. People ride and have ridden in elevated transit lines in New York, Philadelphia and Boston for over a half century.

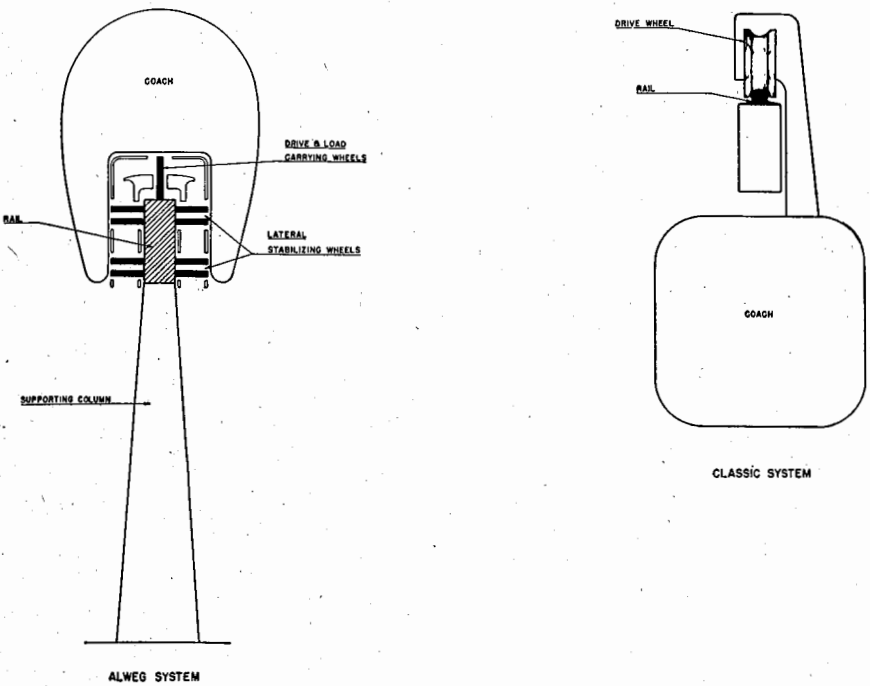
The control of side sway and uplift is certainly possible by many methods, the most obvious one being the use of guide wheels.

If we can design cabs to carry 100 people, if we can have trains of up to five cabs, if we can transport these people at 60 mph, then, we can handle high density traffic.

Costs—The primary controlling factor in most ventures, is extremely favorable. A modern elevated highway costs about 6 million dollars a mile, the depressed highway about 8 million dollars and a subway up to 20 million and not much less than 15 million dollars a mile. The monorail can be constructed and equipped for high density areas for less than a million dollars a mile. When one perceives the scope of this comparison the thought is staggering. Carried to an extreme ultimate condition this means that a single track monorail system can provide the same transit capacity as a twenty-four lane highway. The speed of construction is very great. The difficulty of terrain, a great problem in all other transit systems, provides relatively minor problems here. The alignment is maintained by merely varying the tower height in much the same manner as a transmission line is installed.

Organization of financing, construction and operation would be peculiar to a specific community. We can do many things on paper but can they work—how practical is a monorail—have any full size systems been constructed. The idea is not new. Monorails were built in this country. In 1878 a steam driven, rail straddling, monorail system was successful in hauling passengers from Bradford to Gilmore,

Pennsylvania, a distance of 4 miles, at 30 mph. Five men were killed when a boiler exploded—the result was financial ruin. A model was built in Cambridge, Mass. in 1886. An electric car attained speed of 55 mph in 1892 in New York. These projects failed because of lack of financial interest and the lack of need. In 1901 in Wuppertal,

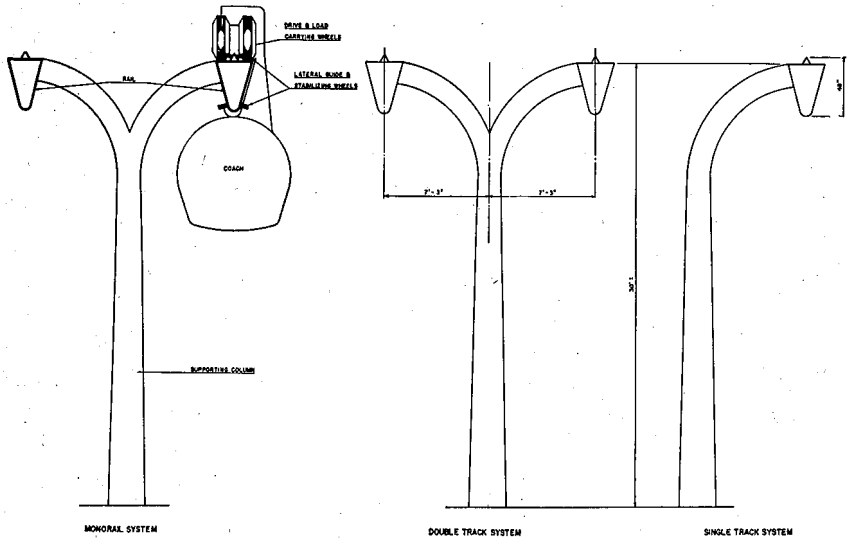


MONORAIL TYPES.

Germany a monorail system went into operation and has successfully carried roughly 900,000,000 passengers, without a fatality in 56 years. This line is 9½ miles long.

Another system is being built near Köln, Germany. A 1¼ mile full scale section has been completed, and test runs have produced speeds of 50 mph. I believe that prior to this full scale operation which was described in the August 29, 1957 issue of *Engineering News-Record,* a two-thirds scale model had to be built for test purposes. This is a rail straddling concept given the name ALWEG system developed by Alweg-Forschung, Inc.

We have a successfully operated monorail installation in this country. At Houston, Texas a Pilot Line with a full size cab was built and later was moved to Dallas, Texas where it has been in successful operation for a year. This system was installed by "Monorail, Inc." This firm has designed, tested, set up specifications, through experimentation has overcome many bugs, has operated a full scale system for over a year and because they have proved the claims it is reputed that they have financial backing amounting to over $100,000,000.



TOWER DESIGNS.

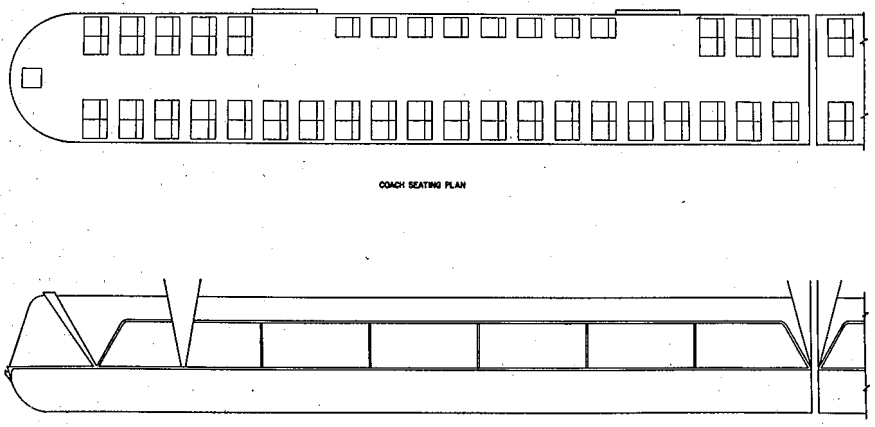
I would like to review their system and some of their claims.

In general, they have modified the classic monorail system. Towers support beams which act as the rail. The cabs are hung from a propulsion unit, the wheels are pneumatic rubber tires. The tower designs are architecturally pleasing, and are made of steel all welded box sections, the towers taper from the ground to cantilever arm. Towers have been developed for single and double tracks. The use of a double track system is economical in that construction costs are very nearly as much for a single track as for a double track. The height of the towers has been designed to allow clearance of the coach bottom from zero to 50 feet above grade.

The rail as designed and used by Monorail is a welded steel box

girder. The rail is 30″ wide, 42″ deep with a guide fin on top. It is designed to span 100′0″ and rails have been developed that span 150′0″. Expansion joints have been designed and made. The services for an all electric system are carried inside the beam.

The cab designed along the lines of and employing the aircraft designs is a very lightweight structurally and aerodynamically correct body. The coach body is embossed aluminum with green tinted solex type windows. The floor is vinyl plastic tile, wall panels below the window levels are scratch and wear resistant, rigidized metal, the ceil-



COACH DESIGN.

ing is light-reflective fiberglass reinforced plastic. The windows comprise 25% of the total surface area of the coach body. There are three basic coach designs for individual and train operation. The head-end coach is the power and prime control coach for all train make-up, squared off at the trailing end. There is a train make-up coach squared at both ends, powered or unpowered, and there is a trailing end coach powered and equipped with limited control equipment. The basic coach, as designed, is 52′ long 7′9″ high, 8′9″ wide with a seating capacity for 64 persons and room for 50 more standing which breaks down to 2.2 passengers per foot of car length. Present designs are for two 48″ divided doors at approximately ¼ points. All controls are designed for maximum safety and the use of fully automatic control and operation devices is possible. Cars can be separated or intercommunicating. The car weight is 26,700 pounds.

The power Nacelle consists of propulsion equipment, truck assemblies, wheels and accessory equipment. It is completely detachable from the coach body and interchangeable with other coaches of same control design. The coaches are powered with 4-600 VDC-100 horsepower traction motors and dynamic braking. Braking is by standard drum type air brakes on each load wheel. The brakes and door operator controls are interlocked for maximum safety.

Speeds of over 100 mph can be obtained and on a curve with a radius of 1800′ maximum speeds are possible. The system can operate on curves that can turn on ordinary city street corner at speeds of 20 mph.

Actual land requirements are about 6 square feet every 100′0″ and the aerial right of way. The claims that the system can be constructed and equipped for $850,000 per mile for a double track system sounds low and most of us would want to see a firm agreement in miles and dollars. There was recorded such an agreement in the August 29 issue of the *New York Herald-Tribune*. A petition to construct 7½ miles of monorail system from Upper Darby to Media, Pennsylvania has been filed by the Red Arrow Lines with the Public Utility Commission. Service is proposed to start by spring of 1959 and the total cost is to be $4,500,000.

I think that we have enough proof that the monorail system can work and has worked. I would even go so far as to say that I believe it is going to be one of the major solutions to the increasing problems of transportation from suburbs to city centers.

In Boston as in all American cities the most fantastic problem facing us today is our totally bankrupt transport system. Turning to the automobile for solution only begets more trouble in the form of more automobiles, more extremely expensive elevated or depressed highways, more traffic jams with their resulting staggering loss of productive time. The glutting of city streets with private automobiles brings about the strangulation of the mercantile operation and finally the construction of parking facilities on valuable downtown properties completes the suicidal pyramid. The way to economic Renaissance for Boston does not lie through the automobile. What is necessary is the reconstruction of our mass rapid transit. Fantastic is the cry! If they can't do with what they have how can we build new systems. A solution is not a matter of choice. Our present problem is a crisis and now while private capital can still be interested in new transit systems is

the time to make a start. With imaginative planning, with energetic non-restrictive thinking and with less money than we are now spending, we can go far in curing our transportation ills. Railroad technology has advanced to a point that allows us to drop operating costs to an extremely low level. Whatever plan is adopted it will first have to have an administration that would extend beyond Boston to all of the suburbs.

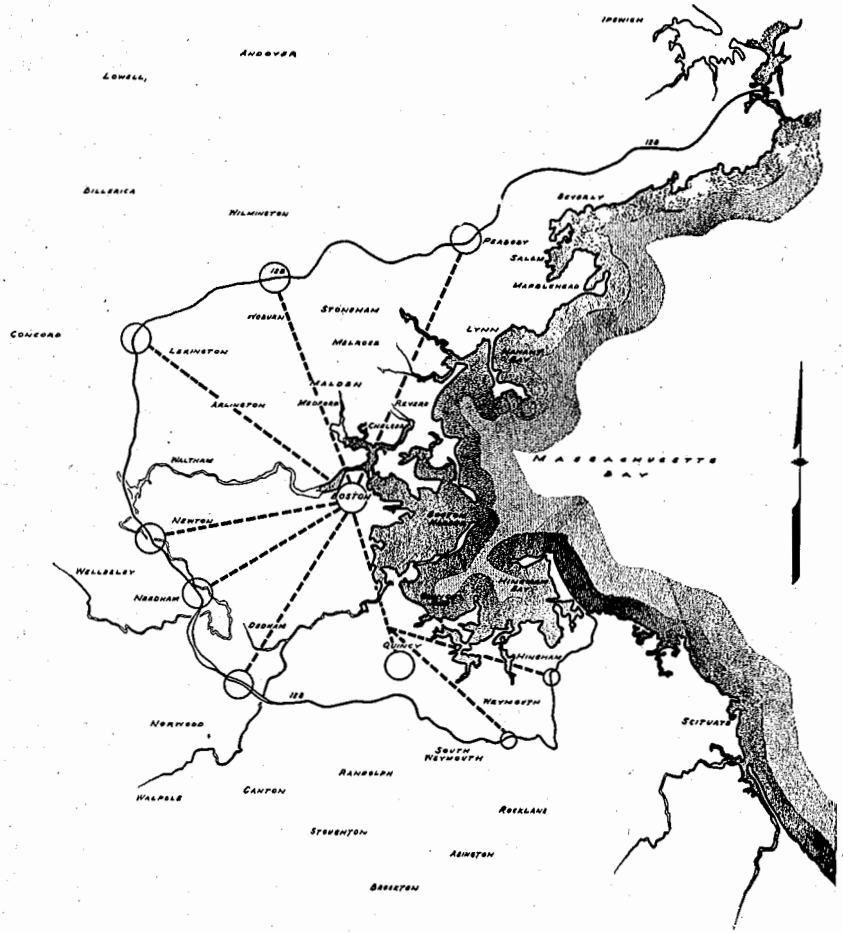
Two immediate problems are now making the newspaper columns. One is the problem of the South Shores battle with the Old Colony and the latter's threat to abandon the line entirely. With the existing right of way it is possible to establish a monorail system to Weymouth from Boston for less than last year's deficit chalked up by the M.T.A. —eight million dollars.

Transportation to Newton—another sore point. Rather than expensive M.T.A. extension why not a monorail system along the same right of way, or along the Charles River—express to Watertown? Or along the center strip of the proposed toll road. These are not fanciful dreams but highly practical solutions that should be considered. To discuss an ultimate solution, let us look at Boston and its suburbs.

Route 128 forms a ring around Boston through its major suburbs. The ultimate desirable would be radial transit lines extending from Boston to 128. At these junctions would be huge parking facilities plus the system's maintenance shops. Veins or suburban feeder lines would connect this main system—busses or surface cars running on transit only roads. The total number of miles for this main system with links to Lynn, Woburn, Lexington, Waltham, Wellesley, Dedham, Weymouth and Hingham, following roughly routes 107, 28, 2, 20, 9, 1, 3 and 3a would be 78 miles. Total initial installation cost would be in the neighborhood of 70 million dollars. The arteries would be any modern rapid transit method that could be most economically installed. The above figure was based on the monorail over most of the lines. The communities involved would contribute the right of way and land franchise in which case I believe enough private capital would be interested to accept the construction and operating risk.

In downtown Boston there could be an inner monorail loop, following Atlantic Avenue from South Station to North Station, Park Square area, down Stuart Street to South Station, with a chord line running down Washington Street from Stuart through Scollay Square to North Station. This last would be a local with two stops along

Washington Street. Stations at downtown points would be above street level and could enter at second floor levels of several stores with a lobby area and escalators or direct entrance to stores. The platform would be a canopy over the sidewalk. The termini at the 128 end of all the major lines would be made available, landwise, by the towns involved. The termini would be basically parking areas, parking to



MASTER PLAN
RAPID TRANSIT SYSTEM
ALONZO B. REED INCORPORATED
ARCHITECTS-ENGINEERS

be in concentric circles. A concentration of people of this magnitude would naturally be of interest to certain types of mercantile establishments which in turn would stimulate real estate interest in the form of build and lease shopping areas. As I picture it, these buildings could be circular, housing maintenance shop, storage of coaches could be on two track levels, platforms at grade rising 30′ to travel level.

More consideration must be given to the Boston area in the form of city planning. The concept I have in mind is peculiarly practical for Boston because of the mercantile and financial concentration in a small area.

First, we must prohibit any private automobile traffic in an area of downtown Boston bounded roughly by Park Square, Scollay Square, Tremont Street and Devonshire Street.

Second, convert Washington Street from Stuart to Scollay Square to a sidewalk plaza.

Third, the preparation of a master plan for the rehabilitation of Boston to be accomplished by Boston architectural and engineering firms, each firm designing for a different area. This would keep the designs in the hands of vitally interested parties and also provide the intelligence of design that comes with living with the problem. Further, by decentralizing the master plan, variety and a mild sense of competition would guarantee the choice of ideas of a great number of the thinking men in our country as they are represented by our many Boston firms. Property owners would be made aware of what was in store for their holdings in the future. Some would react immediately by complying with the plan, some would be forced into a move by their neighbors, some would sell to new forming real estate syndicates and some property would have to be taken by eminent domain. Revisions to the city would have to include dock area planning and the energetic pursuit of steamship and airline franchises of foreign countries. Delivery to the mercantile houses would be underground and by ramps, roughly approximating the side streets we now have, Temple Place, Winter Street, etc. Time schedules for each area are necessary so that a record can be kept of progress. Responsibility for this program will have to be multiple. The major control of the scheme should be by the private enterprises most affected. It should have approval by the state, the interested enthusiasm of city officialdom, and energetic promotion by the Chamber of Commerce.

Any city master plan would have to be coordinated and integrated

with a highway master plan and a transportation master plan and note I do not consider the latter two plans as being anything like synonymous.

That is an overall ultimate. I would now like to suggest a South Shore rapid transit system that would encompass the territory roughly once served by the Old Colony as an immediate solution.

I think that a triple line could be run to Quincy with a spur entering Quincy, a double line continuing to Hingham with a spur turning at Braintree for future expansion. I believe that a minor terminal could be constructed at Hingham with a major terminal planned for Plymouth in the future and with a major terminal for Quincy now. A group containing town and city representatives from Boston, Quincy, Braintree, Weymouth, Hingham, interested real estate and Railroad representatives should go to Texas, see what this existing line looks like, talk to the operator, ride the cars. If, in the opinion of these interested parties, the monorail is indeed a possible answer to our transit problem, then, we can make a survey of the proposed line. The cities and town can conduct surveys to determine possible popular use, real estate and banking and railroad people can determine platform sizes and mercantile possibilities. Monorail, Inc. can be invited to make their construction proposal in terms of money and miles. If, then, we can put in the above system as described, including rolling stock to amply handle transportation of people during the rush hours, plus several other coaches during the day, plus light freight and mail, if a ride from Hingham can be made in 23 minutes, if the cost for travel can be held to 3 cents a mile, then, I think this is a sound solution.

One can make all the suppositions one wants, all the drawings, and all the claims, but there is nothing like a firm contract in terms of money and performance. I believe that the above described system can be installed, making extensive use of the very great technical advances in automatic controls that the railroads have made in recent years, complete with rolling stock, exclusive of land rights and stations, for $12,000,000. If this is so, then serious consideration should be given to this first possible link in Boston's required forward look.

TECHNICAL INFORMATION SOURCES

1. "Wuppertaler Schwebebahn" das Vereines Deutscher Ingenieure Bd. 93 (1951) Nr. 75,153 — 169.
2. Monorail, Inc., Houston, Texas.