THE GUIDED BUS

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TRB's Annual Meeting in January included a session on Guided Buses. The speakers were persons most knowledgeable about guided bus developments: Ulrich Koch of the German consulting firm, SNV; Robert Crawford of the West Midlands (Birmingham, England) Passenger Transport Executive; Klaus Niemann of Daimler-Benz; Eberhard Hipp of M.A.N.; and Hans Albrecht of the Essen (West Germany) Transit Authority. This article is largely based on the presentations and discussions at that session.

INTRODUCTION

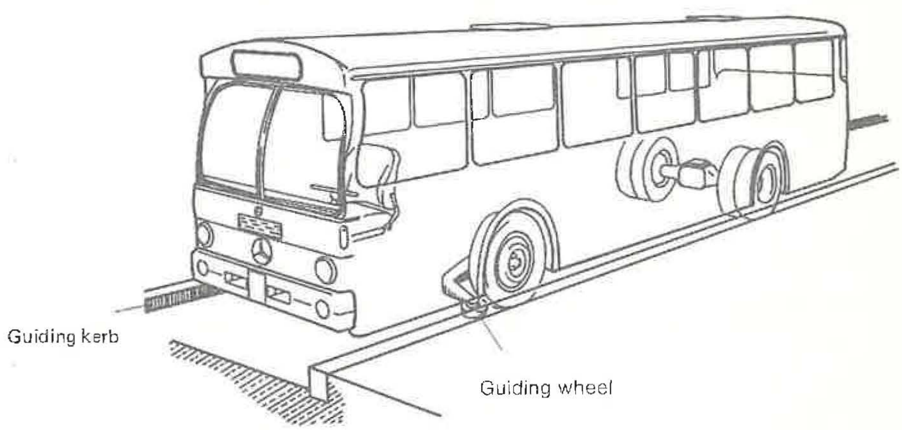
New Era

How many connoisseurs of public transportation remember the Dual-Mode Era? It wasn't that long ago—the 1960s, plus or minus a decade. And it was quite an effort. It could even be called a blast—of enthusiasm, experimentation, analysis, and skepticism. It was Bill Alden's Starrcar, Dwight Bauman's Mustang, schematic drawings, and lots of artistic airbrush pictures. It was cars, then buses, then both. It was wires and slots and arms and pallets. It was U.S. DOT, MIT, GM, Ohio State, TSC, and Rohr. It was Milwaukee and Boston and Orange County. It was planners, engineers, economists, and dreamers too numerous to mention. And then it was no longer. In the summer of 1974, Congress said "no" to a $3 million Urban Mass Transportation Administration (UMTA) Program and Dual-Mode was down—but not out.

The historical search for a system that combines the flexibility of the automobile and the bus with the advantages of rail systems has continued, and is currently producing some concrete results. In this article, a new era in that evolutionary pursuit is suggested—to be called the Guided Bus Era, evoking a reality that "Dual Mode" does not.

The good ideas of the Dual Mode Era have become public facilities and revenue vehicles in the new era. The Guided Bus Era is simple horizontal wheels running against a curb. It is the West German Ministry for Research and Technology (BMFT). It is Volvo and M.A.N. and Metro-Cammell and Daimler-Benz. It is Essen, Birmingham, Munich, Adelaide, Rastatt, and Halmstad. Will it be Denver, Columbus, or Seattle?

It is hoped that by highlighting here the positive attributes and some of the disadvantages of a new transit mode, an informed transit community across the country will be encouraged to evaluate the guided bus, among other systems, as a mature and viable alternative new system.



Arms position guided bus within curbed way.

Background

What has been accomplished since 1974? It has been a busy decade. Giving full credit to the American effort, the BMFT took an interest in guided-bus concepts and in 1975 undertook a development program. Two concepts, one mechanical and one electronic, were proven technically feasible, and both are being currently demonstrated in daily revenue operations. The mechanical system is being marketed commercially. The perceived safety of the electronic configuration will affect the timing of its broader adoption.

Early efforts in Sweden focused on the application of electronic guidance to control the approach and positioning of low-floor buses at stops. Floor-level platforms were part of an integrated design that facilitated the boarding and alighting of people and wheelchairs. And in England a mechanical system is proving its merit in the tricky dynamic environment of double-decked buses, again in revenue operations. In the 1970s, the United States focused on bus lanes and busways. Experience in New York, Washington, D.C., Pittsburgh, Los Ange-

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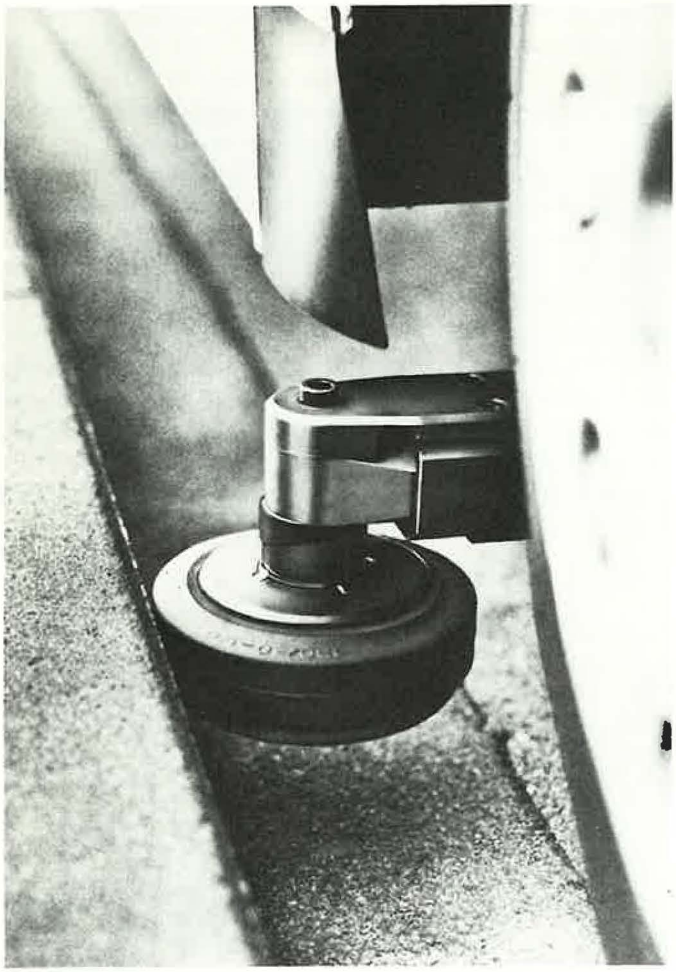


Roller arm and guide rail in operation.

les, Houston, and elsewhere showed how to reserve rights-of-way in exclusive and shared corridors, how to build roadways and stations, how to design operations, and how to mix high-occupancy vehicles.

Whether in the United States or elsewhere, these efforts recognized the multiple difficulties associated with the operation of buses in mixed traffic on public roads, difficulties that affect trip speed, dwell time, comfort, accessibility, and safety. Attempts to address these problems have recorded many significant successes and include exclusive busways and lanes; contra-flow lanes; express operations; signal priority and pre-emption; parking restrictions; exact, prepaid, self-service fares; bus-stop shelters and platforms; low floors; and various on-street control strategies. The guided bus is noteworthy for its potential for relating, expanding, organizing, amplifying, exploiting, coordinating, and over time incrementally implementing and organizing these elements into single integrated systems. No other concept of guided transit shows similar promise of potential ubiquity.

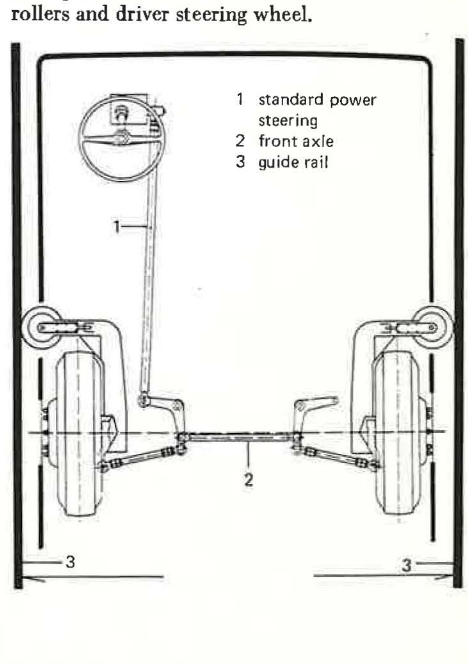
Description

What is a guided bus? Included in this article are illustrations that show vehicle and guideway; elevated, tunnel, and station structure; and switch. Guide rollers are fitted on either side of the bus forward of the front wheels and run along a guide rail or curb, 18 cm high and 2.6 meters apart. The guide rollers are directly connected to the steering linkage of the bus. The conventional steering of the bus remains unchanged. The driver switches from manual steering to track guidance simply by gripping or releasing the steering wheel without the need for mechanical switching.

Track guidance can be complemented by dual propulsion. In this case, an electric motor is installed in addition to the diesel engine and is powered from an overhead catenary. Automatic trolley pole control speeds the transition between propulsion modes. Buses with any alternative propulsion system and buses up to 79 feet long are suitable for guided operation.

The operation of the guided bus is simple. The driver need only accelerate and brake the bus; the horizontal guidewheels do the rest. Funnel-shaped spirals guide the bus into the guideway. The bus need not be steered through at-grade intersections that are only a lane or so wide. A switch will be made from manual steering to track guidance in locations where layout and safety prevent manual steering through passive junctions.

Safe positive connections link wheels with rollers and driver steering wheel.



ADVANTAGES

Small Beginnings

As starter systems, small pieces of bus guideway can provide incremental operating improvements. Benefits can be realized in months with only a small investment. Install a short section of guideway to bypass a busy intersection, combine it with a small piece of guideway in a congested arterial roadway, add a few buses retrofitted with guidewheels, and an "operable segment" can be implemented at a modest cost. The ability to create or improve bus routes by moving them step by step from roadway to guideway is a significant advantage of the guided bus system.

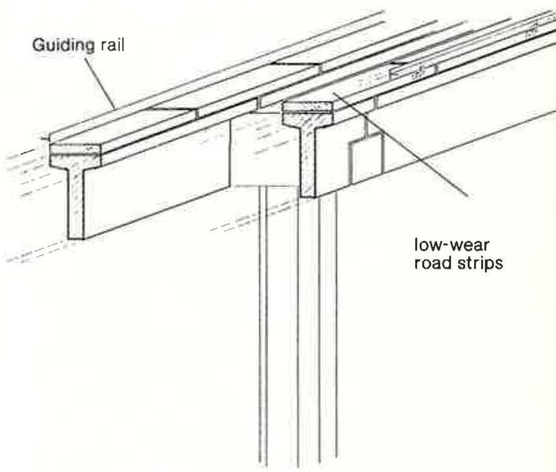
In Birmingham significant operational and safety benefits resulted from that city's construction of only 675 yards of dual carriageway on Streetly Road. Crawford emphasized the appeal of introducing bus rapid transit in his community, with immediate benefits resulting from less than $1.5 million total cost. Add and connect segments depending on finances, right-of-way availability, and operational priorities, and a new system is developed in an evolutionary and financially realistic way.

Door-to-Door Service

The introduction of efficiencies and other benefits of guideway operations without incurring great debt for a community or reaching into federal pockets is closely related to the ability of the guided-bus system to continue the distribution and collection services associated with conventional bus operations without introducing transfers into existing travel patterns. Particularly where origins and destinations served are in lower-density suburban areas, the ability of the bus to operate on local collector roads and serve as a door-to-door vehicle as well as a line-haul vehicle is attractive. Niemann estimated that in Adelaide, Australia, 80 percent of the travelers on a 12-km guided-bus system will take direct trips. The comparable projection for travelers on the light-rail alternative is 13 percent.

First-Class Service

There is a synergy between guidance system, bus driver, and station-stop design that leads to a number of direct and indirect improvements in the guided-bus passenger's trip. Trip speeds are increased along with rider comfort because the firm lateral stability offered by the fixed guidance reflects the driver's ability to concentrate on high, yet smooth, acceleration and braking. Without the need to swing to the curb, the undistracted driver can quickly and firmly stop in a position precise enough to accommodate raised-platform loading without gap problems. Elderly and handicapped persons, whether or not in wheelchairs, are not the only beneficiaries of level-platform, wide-door access to buses. All passengers can benefit because it contributes to a speedy trip by reducing dwell times. And with platforms come ramps, shelters, lights, windscreens, traffic barriers, and other amenities that add comfort and security to the trip. Finally, with less stress, the bus driver is able to respond to passengers with information and attention that could not be given on normal unguided operation in mixed traffic without jeopardizing safety.



Modular structural elements speed construction and cut costs.

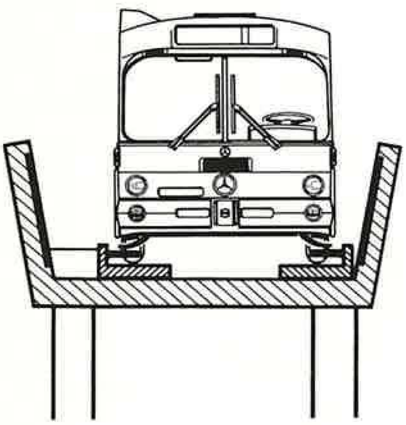
Safety

Mechanically guided buses positively direct the bus in safe movements. The guideway, serving as a barrier, also redirects unsafe movements by other vehicles more effectively than do signs, flashing lights, and road-surface markings. Undistracted bus drivers have better responses to unexpected events, and the guideway also prevents, in many cases, incorrect responses. Generally, security within the bus receives the attention of the driver only when his primary duty of vehicle operation has been performed.

Speakers at the session on Guided Buses held during the 1985 TRB Annual Meeting: *left to right*, Klaus Niemann, Daimler Benz AG, Federal Republic of Germany; Robert Crawford, West Midlands Passenger Transport Executive, England; Hans Albrecht, Essner Verkehrs AG, Federal Republic of Germany; Franz Gimmler, UMTA; Eberhard Hipp, M.A.N. AG, Federal Republic of Germany; and Ulrich Koch, Studiengesellschaft Nahverkehr mbH, Federal Republic of Germany.

Cost-Effectiveness

Couple a reduced vehicle dynamic envelope with the light weight and soft suspension of automotive technology and the result is another form of synergy, this one embodying cost reductions. Narrow tracks mean less land use for rights-of-way as well as reduced use of concrete. Tunnel costs decrease with the square of their diameter, and dynamic forces are as important as static loads in the cost-effective design of bridges. The result, especially with modular design, is lower structure costs. In some cases, regardless of cost, the guided bus can be built where other systems cannot, simply because it fits.



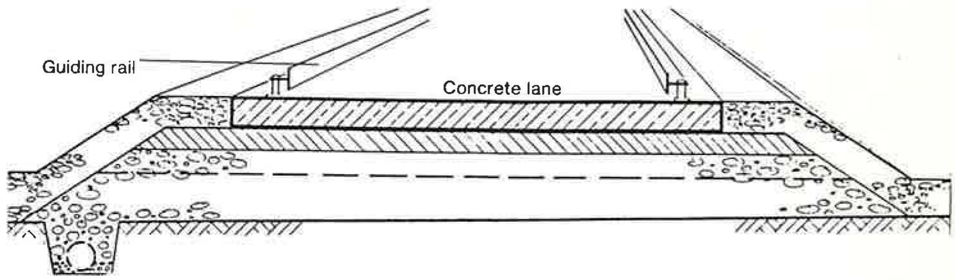
Noise barrier walls and walkways can be added to guide rail and road strip.

Automotive suppliers serve a large market and invest in product development to serve and profit from that market. Guided buses benefit from this innovation as much as they benefit from the mass production of some components and quantity production of others. Energy efficiency, maintainability, and weight reduction are goals of the automotive product managers. The result is continuing market pressure to reduce per-seat-mile capital and operating costs.

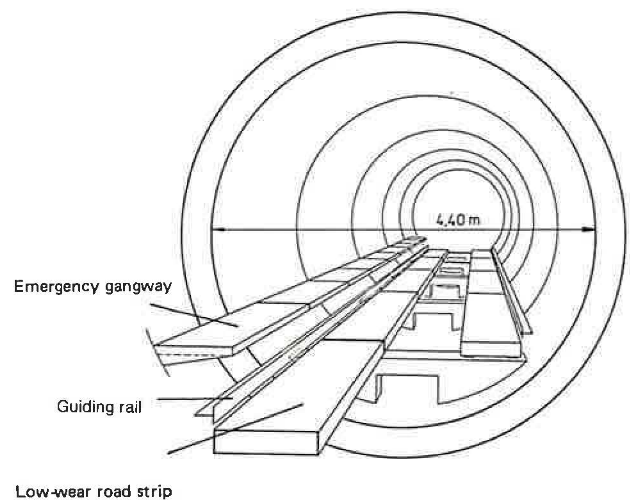
With efficient technology, the guided bus brings efficient service. Higher, safer, and more comfortable operating speeds due to reduced number of lateral accelerations, nonstop service, reduced congestion, larger vehicles, and shorter dwell times all promise more seat-miles, more passenger-miles, and more revenue per platform-hour and operating dollar.

Growing with the City

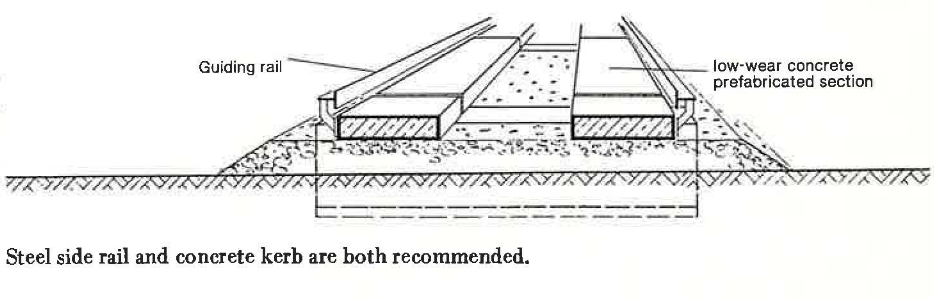
The ability to tune the growth of a guided-bus system to the growth of the city is probably its most attractive feature. To implement this transit alternative public officials need not bet large



Ground conditions and costs may favor full-width concrete slabs, cast in place.



Exhaust collection and venting makes possible combustion engine operation in tunnels.



Steel side rail and concrete kerb are both recommended.

Wide doors and bilevel entries provide flexibility, speed, and safety.

sums on a community development pattern that is largely beyond their control. Under current land use controls in a city, the guided bus can strike a balance between the sometimes-conflicting roles of transit in both serving and shaping travel needs. Transit improvements can be sized according to the local revenue stream and assigned priority according to congestion delays, maximum load points, bottlenecks, and other route-refinement objectives. Actions can be opportunistic, responding to right-of-way availability, developer decisions, and other exploitable events. Each action brings marginal benefits commensurate with the marginal cost of each. Hipp emphasized this growth feature by highlighting the range of vehicle sizes that can operate on the guideway—and off. He noted that 79-foot guided buses that operate at 2-minute headways can carry 4,500 passengers per hour in each direction.

Bus or Train

Experience with the guided bus has demonstrated its potential for growth and for adaptation to increasingly demanding operational requirements. The substitution of methanol for diesel power is obvious. Electrification is initially realized in the form of dual-powered vehicles for operation on and off the guideway. Add energy storage in the form of batteries or flywheels, and electric operation is no longer limited to the guideway. High-level platform stations and larger buses have already been considered. Double articulated vehicles with capacities of 150 seated and standing passengers are "off the shelf." By utilizing European standee experience, capacities can approach 230 passengers.

Automatic speed and headway command beyond simple "cruise control" is not a visionary concept. Electronic operation is currently being demonstrated, although not in a revenue environment. With the eventual all-electric/electronic operation of captured vehicles on exclusive guideways, rubber-wheeled rapid transit will be realized. On the other hand, steel wheels may be utilized in the future, because corridor movements may well justify, if not require, the even higher capacities and speeds of steel rail or other technologies.

Low-level operation does not ignore safety and other amenities.

Sequential bus purchases and staged bus-stop upgrades lead to full, high-level rapid-transit operation.

Koch noted the decisive importance of total traffic volume (total passengers per peak hour per direction) in selecting the most economic alternative. Although recognizing that each region varies, he described three conditions for orientation:

- Condition A: Traffic volume is 9,000—clearly favorable to conventional and guided-bus systems.
- Condition B: Traffic volume is 9,000 to 18,000—transitional between guided-bus and light-rail systems (although guided buses should be preferred because of the cost advantage).

• Condition C: Total volume is more than 18,000—favorable to light-rail transit because longer train units can be formed.

THE FUTURE

Challenges

Even those most committed to realizing the proper role for guided buses in urban transit do not hesitate to recognize its disadvantages. Because of current vehicle-coupling limitations, longer trains that provide high capacities along with lower labor costs are not currently being demonstrated. Albrecht noted another limitation in the somewhat complicated, costly, and heavier duo-bus vehicle that has two full-sized power plants. And although Albrecht has overcome to his satisfaction the challenges of winter operations in Essen, Crawford is still watching the Birmingham operation closely. Has disabled vehicle removal been proven? What disadvantages are associated with rear-axle guidance? When is it needed? And finally, no one in this country has picked up on the challenge of associating the guided-bus concept with current concepts of high-occupancy-vehicle operations in the evolution of future American transit systems. Good experience is now being accumulated to answer these and other questions. More remains to be done.

Expectations

After evaluating alternative transit schemes according to local needs and priorities, several cities across the globe have decided to play a part in the new Guided Bus Era. Birmingham, England, opened guided-bus operations in fall 1984. Since then 14 guided buses have been successfully serving passengers on track line 65 by utilizing a one-third-mile section of dual guideway. This "carriageway" is one element in a total route-enhancement project.

Guided-bus system in Essen, West Germany, mixes operations, increasing corridor capacity and facilitating modal transitions.

Essen was the first to enter the Guided Bus Era and remains in the lead in fleet size, guideway miles, and satisfied revenue-paying, guided-bus passengers. As of this past January, Essen had experience with 27 guided buses, including dual-powered vehicles, traveling a total of 3 million miles, one-quarter million of which were on the guideway. A unique feature in Essen is the mixed operation of guided buses and light-rail vehicles on a compound guideway, which will include mixed operations through a tunnel with automatic vehicle protection starting in 1987.

Adelaide, Australia, represents the world's first guided-bus "new start." During 1986, 90 guided buses will operate in regular revenue service along routes that ultimately will utilize 7 miles of two-way guideway, including 10 river-crossing bridges. Scheduled speeds on the guideway will be 60 mph.

Will other cities follow? How quickly? Will any be American cities? What barriers will have to be overcome? Which disadvantages, if any, will be significant in the American institutional and operating environment? Which advantages will prove compelling? Who will lead?

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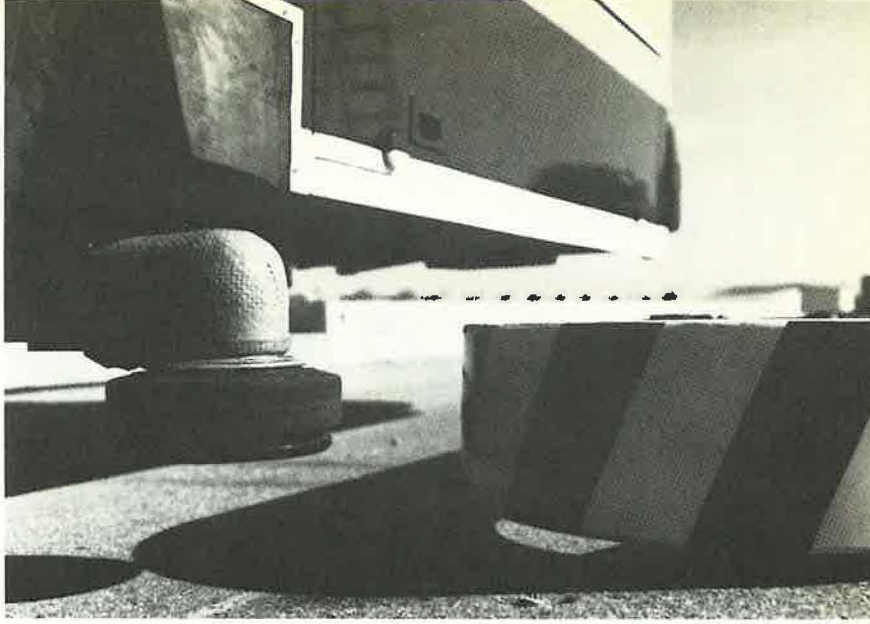
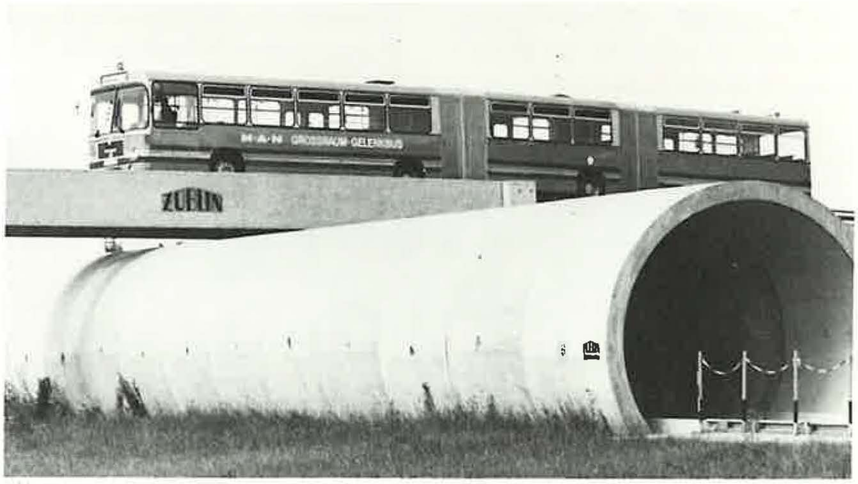


Entry point in Fulerumer Strasse, Essen.



Profiles and shapes are scaled to urban dimensions, designed to fit human and automobile-based modules.

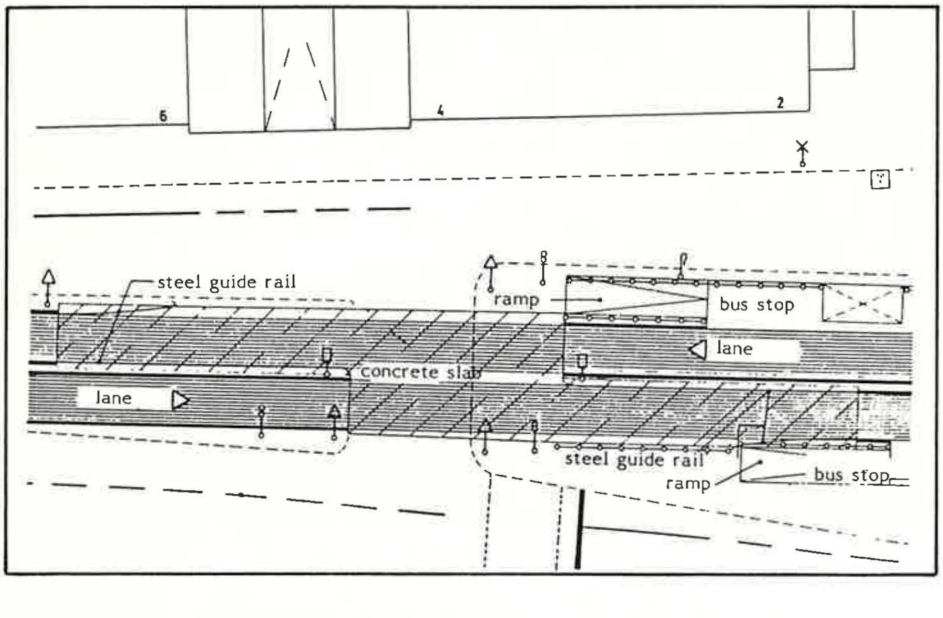


Diagram of entry and exit points in Fulerumer Strasse, Essen.