Leeds City Council

LEEDS

SUPER BUSWAY

It's arrived

3285

It's working well !

Ever DREAMED of increasing bus ridership by 20+% in a single year? Well dream no more! The first section of Leeds *SUPER BUSWAY*, constructed on Scott Hall Road as part of a route quality enhancement scheme, has achieved a patronage gain approaching 45% since it opened in September 1995. With a second section now operational and more to follow, the Leeds project has already demonstrated that bus running times can be cut significantly and absolute consistency of service can be achieved during both the peak and off-peak periods.

With Demand Modelling, Detailed Design and Works Supervision all undertaken in-house by the City Council's Highways and Transportation Department, the *SUPER BUSWAY* system will form a major, innovatory element of a Transport Strategy aimed at preventing saturation of the urban road network in the next 20 years.

Could this be the answer to your Authority's highway congestion problems? Would you like to know more? Read on!

THE SUPER BUSWAY CONCEPT

At peak times, delays can more than treble the time it takes to travel from the outskirts to any city centre compared to off-peak. These delays are chiefly due to queues which build up at the approaches to junctions, as the traffic flows reach and then exceed the capacity of those junctions.

Bus lanes have been used before, but the benefits are greatly reduced by misuse and by illegally parked vehicles.

The *SUPER BUSWAY* strategy uses guideways to provide a more effective means for buses to by-pass these traffic queues, without causing further delay to other traffic.

This means that journeys by *SUPER BUSWAY* to and from the city centre have more consistent and reliable journey times, are quicker than normal bus journeys and in many cases are quicker than by car.

The *SUPER BUSWAY* approach is flexible. Guideways can be installed in phases; they can be in the central reserve of a dual carriageway or in the side verge (provided there is minimal frontage access); they could be long segregated lengths across undeveloped land or along a disused railway. They can be combined with bus lanes or other bus priority measures.

Construction costs are relatively low compared with other possible public transport systems, because the guideways are only installed at the locations where congestion occurs or where there is a need for some form of bus gateway. Typically, the cost for a section at the existing ground level would be in the order of £1,000 per lane metre.

The cooperation of bus operators is essential. They must carry out the necessary modifications to each bus and consider route revisions to optimise the potential guideway benefits both for routes penetrating the suburbs and out of town routes in conjunction with Park & Ride facilities.

HOW THE BUSWAY WORKS

The guideway is shown installed on the approach to a congested roundabout, it's length matched to that of the maximum observed queue. Additional sections of guideway can be introduced in the future if this proves necessary.

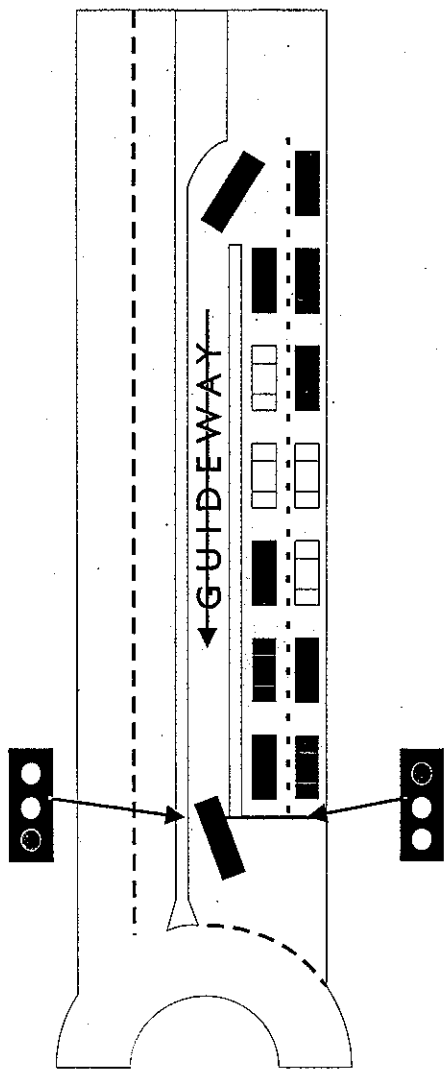
As a bus approaches the guideway, the driver steers into a funnel section and this adjusts the path of the bus smoothly into the guideway proper.

Once in the guideway, the steering is controlled automatically by kerbs bearing against the guide-wheels. As the bus by-passes the queue, the driver simply controls the acceleration and braking, staying alert to pedestrians crossing the guideway.

A vehicle detector in the guideway prompts the traffic signal controller to give a green signal for the bus by the time it arrives at the end of the guideway and a red signal briefly for the general traffic.

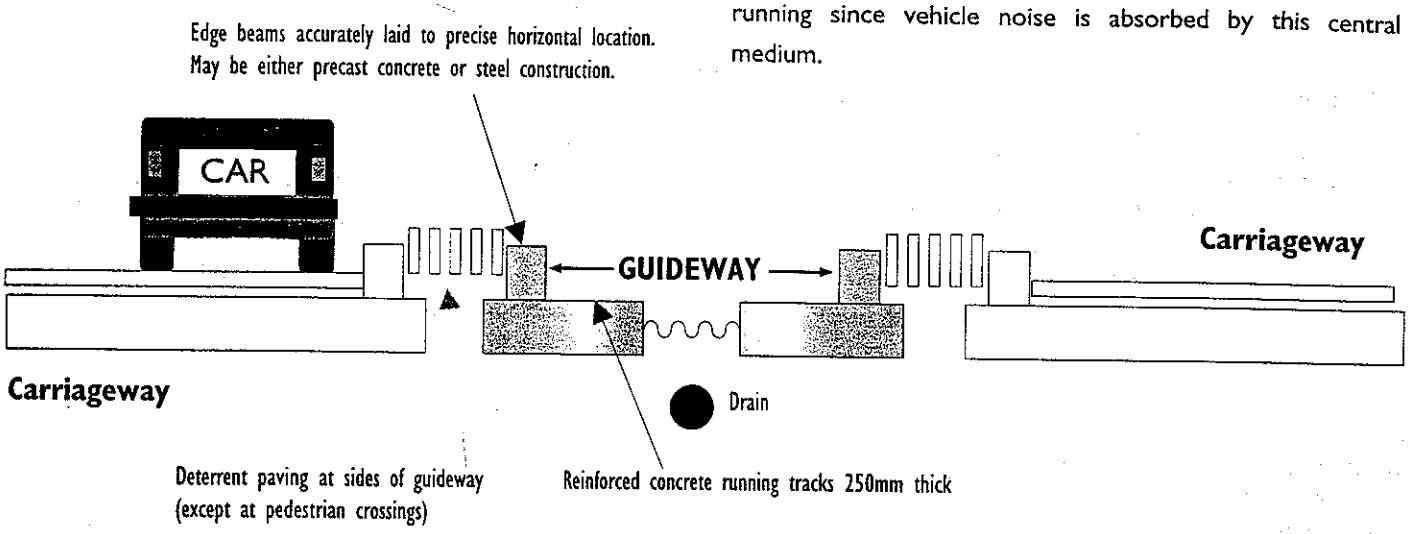
The bus leaves the guideway ahead of the traffic queue and progresses around the roundabout in the normal way. This approach can also be adapted to suit different forms of junction.

Whilst in the guideway, buses still occupy the highway and have to conform to normal highway regulations including speed limits.

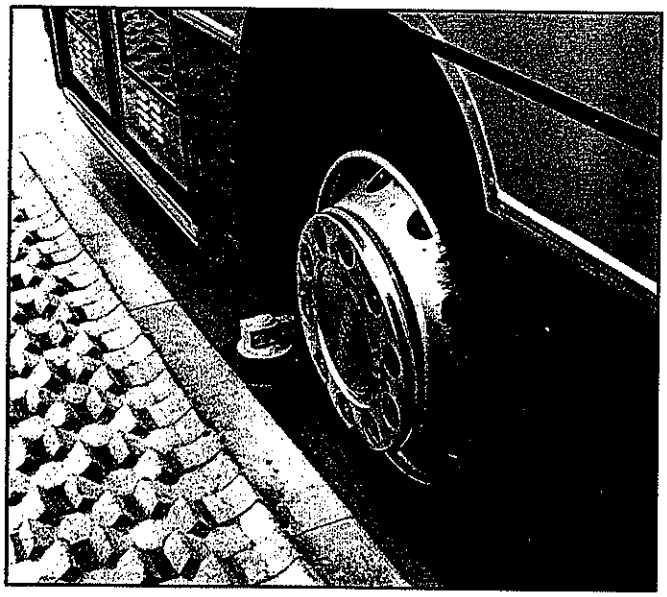


CONSTRUCTION OF THE GUIDEWAY SECTIONS

Guideways can be formed using twin running strips with a grass or gravel area in between. This results in quieter running since vehicle noise is absorbed by this central medium.



THE BUSES



To use the guideway section, buses need to be specially adapted by fitting small guide-wheels ahead of the front wheels, attached to the steering arms. Even with guide-wheels fitted, the buses can travel safely along existing routes.

It is a simple and relatively cheap operation to fit most existing buses with guide-wheels. However, in the context of a high quality *SUPER BUSWAY* service, operators have been encouraged to acquire new, specially adapted vehicles and to improve their marketing and customer care.

BUS STOPS

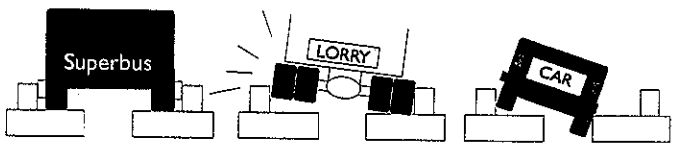
Bus stops on the guideway provide level boarding. On the highway, stops served by guided buses can be modified to reduce the step height. Improved pedestrian crossings and access are provided to all stops with careful attention being paid to design details to minimise problems for the physically and visually impaired.

ADVANTAGES OF THE BUSWAY

In certain locations the narrow width needed for the guideways can save space compared to providing extra traffic lanes. This is likely to be the case with two-way guideways, or guideways used in tidal flow fashion.

In most cases which use single directional guideways, there is little space advantage, but the guaranteed segregation from other traffic makes provision worthwhile.

Unlike conventional bus-only lanes, the physical features of a guideway effectively prevent unauthorised use by other traffic.



Where suitable corridors are available, e.g disused railway lines, guideways can be constructed to give a fast, fully segregated route for buses.

In the course of designing the existing Leeds SUPER BUSWAY, the Council's Highways and Transportation Department's engineers have considered:-

Demand Modelling

- The scale of potential transfer of passengers from private car and other modes to an improved public transport system relative to the predicted improvement in journey times.
- Locations for park-and-ride facilities and their potential impact on the transport system.

Guideway Location and Design

- Design parameters for the guideway and buses and the formulation of safety standards with respect to other highway users.
- Identification of sections within the transport corridor that would benefit from guideway provision and the determination of its location within the highway corridor, taking account of bus movements, congestion, property access, junction turning movements etc.
- Identification of possible segregated off-highway sections of guideway.
- Design of the interface between the guideway and existing carriageway to ensure smooth transition between steered and guided mode and vice versa.
- Programming of Urban Traffic Control systems to include bus priority measures at guideway entry and exit points.
- Safety Audit of scheme design.

Structural Design of Guideway

- Assessment of loading from different vehicle types.
- Alternative guideway construction types, including drainage options, appropriate to location and ground conditions.
- Design options to minimise the diversion of statutory undertakers' apparatus. Access agreements when apparatus remains in place under the guideway.
- Options for appearance, particularly the surface finish of the guideway, adjacent paving, landscaping, and lighting in relation to the overall streetscape.
- Incorporation of design features to minimise misuse, abuse and illegal use.

Pedestrian and Passenger Issues

- Design of level-boarding platforms on guided sections and reduced step boarding facilities at highway stops (together with adaptation for a complete level access system using kneeling buses).
- Provision of integrated pedestrian safety measures at crossings of highway and guideway, and for access to boarding facilities.
- Incorporation of full facilities for mobility-impaired passengers and pedestrians.

Finance and Legal Issues

- Experience of Transport and Works Act procedures, Railway Inspectorate requirements, Traffic Regulation Orders and planning permissions.
- Preparation of bids to obtain finance for construction in a PFI environment.

There may well be scope for a guided bus system to enhance the performance of your town or city's public transport performance and image.

For further details of how Leeds' experience might help you, telephone -

Stuart Auty (0113) 247 6380
or Mike Evans (0113) 247 6379

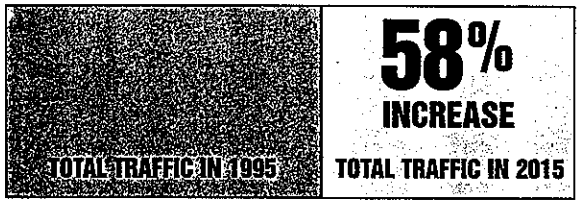
Guided Bus Planning and Design Team
Department of Highways & Transportation,
Selectapost 6,
19 Wellington Street,
Leeds LS1 4RR.

THE PROBLEM

In the ten years from 1984 to 1994 traffic levels rose significantly but bus travel fell.

(Sources: Road Traffic Statistics Great Britain 1994, Table 4.7 ; West Yorkshire Monitoring Report 1994)

In the next 20 years, general traffic levels could increase by over 50% again, though well before this time, many parts of the urban road system will become over-saturated. *(Source: RTSGB 1994 Table 5.1)*

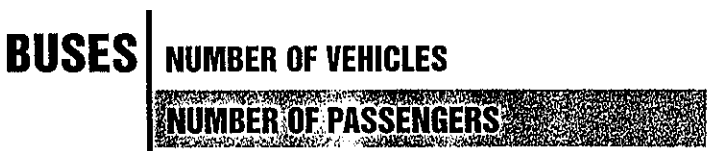


THE BUS SOLUTION

At present, buses account for 2% of all vehicle traffic, but carry 10% of the persons travelling by vehicle into a typical city.

It makes sense to improve public transport and encourage people to use cars less for travel to and from the city.

- .....LESS ROAD SPACE
- .....LESS ENERGY USE
- .....LESS POLLUTION
- .....LESS CAR PARKING
- .....LESS NOISE
- .....LESS ACCIDENTS



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THE GUIDEWAY CONCEPT

At peak times, delays can more than treble the time it takes to travel from the outskirts to the city centre, compared to off-peak.

These delays are chiefly due to queues which build up at the approaches to junctions, as the capacity of those junctions is reached and then exceeded.

Bus lanes have been used before but the benefits to buses are greatly reduced by misuse and by illegally parked vehicles.

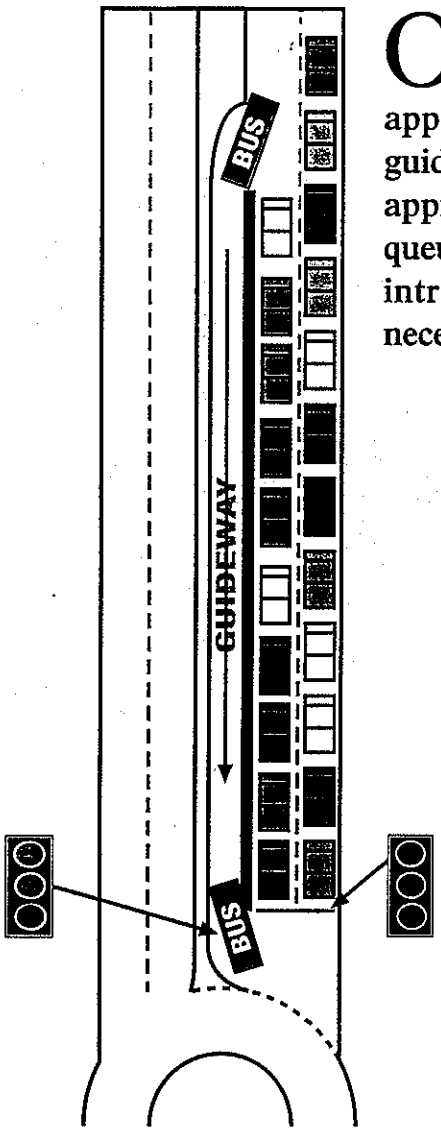
Guideways provide a more effective means for buses to by-pass these traffic queues, without causing further undue delay to other traffic.

This will mean that journeys to and from the city centre will have more consistent and reliable journey times, be quicker than normal bus journeys and in many cases quicker than the car.

It is hoped to attract car users onto the improved bus services.

This will enable them to be collected near to their homes and be given fast and reliable journies along the main corridors. Car users can also use high quality, secure Park-and-Ride sites located outside the congested sections.

HOW THE GUIDEWAY WORKS



Observers have recorded traffic queue lengths over a period of time on the approach to junctions. The length of the guideway sections has been calculated to be approximately equal to the longest traffic queue. Additional sections of guideway can be introduced in the future if this proves necessary.

A bus enters the guideway and by-passes the traffic queue....

..... as the bus passes over a detector, the traffic signal controller reacts to give a green signal to the bus by the time it arrives at the end of the guideway.

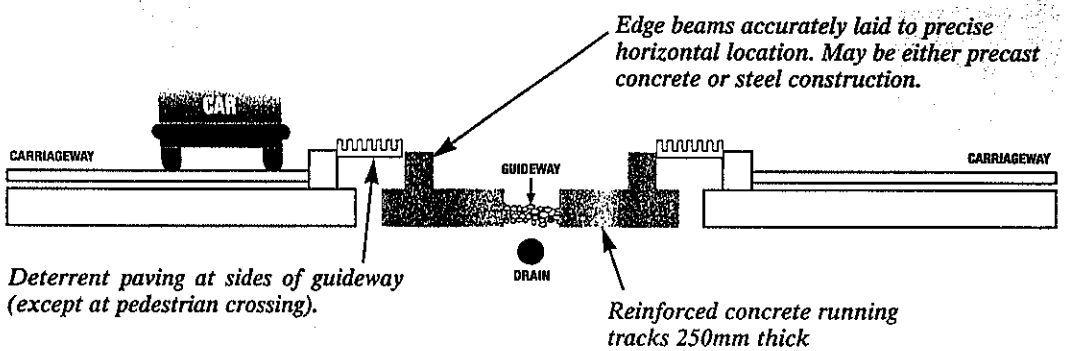
Traffic queues which form on the approach to a roundabout junction are held back briefly at traffic signals when they change to red in response to the presence of a bus on the guideway.

The bus leaves the guideway ahead of the traffic queue and progresses around the roundabout in the normal way.

Whilst in the guideway, buses still occupy the highway and have to conform to normal highway regulations including speed limits.

CONSTRUCTION OF THE GUIDEWAY SECTIONS

Example of guideway in central reserve



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PARK AND RIDE

The advantages in journey time, comfort and reliability which guided bus can offer will become increasingly evident as traffic levels generally rise, and there is much benefit in offering car drivers the choice of travelling on congested routes by car or taking advantage of guided bus. It is expected that 60% of car drivers who make the change will catch the guided buses near their homes.

For the remainder, Park and Ride sites will be provided where suitable locations exist. The attractive and secure parking areas will enable motorists to use guided bus for part of their journey into and out of the city , thus helping to relieve congestion and improve environmental conditions within the city.

The Scott Hall Road scheme features two park and ride sites, one King Lane, adjacent to Allerton High School, catering for 150 cars, and a similar facility adjacent to Harrogate Road. The car parks will be attractively laid out and landscaped, well lit and with security features approved by the police.

The use of the sites will be monitored and additional sites provided if the demand is sufficient to justify it.

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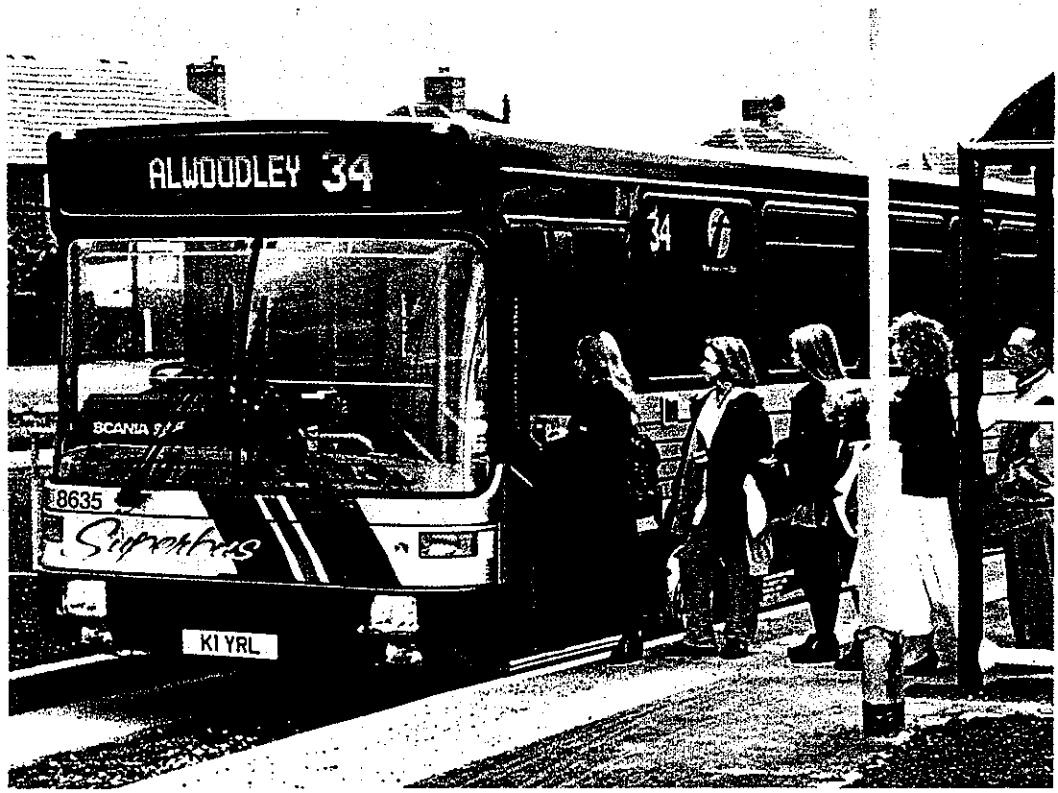
GUIDEWAY PATRONAGE GAINS



The two guideway systems presently in operation (Leeds and Ipswich) both feature the guideway as an integral part of a corridor or route quality enhancement scheme. The enhancements also include higher-specification vehicles, other bus priority measures, improved information techniques and customer-care trained drivers.

The Leeds scheme, for the same level of service as before, achieved a patronage gain of 9% within the first 4 weeks of service commencing. Growth has continued steadily since then at the rate of around 2% to 3% per month compared to other services in the city and is presently some 45% above the pre-guideway level. The initial 9% growth, is in itself, sufficient to pay for the additional vehicle equipment costs within 2 years.

The Ipswich scheme saw a 21% growth in patronage on the corridor within the first 4 months of operation, and 43% after 16 months. Some of this growth (unlike in Leeds) must however be attributed to the housing (and thus population) growth in the area served and to the significantly enhanced level of bus service provision.

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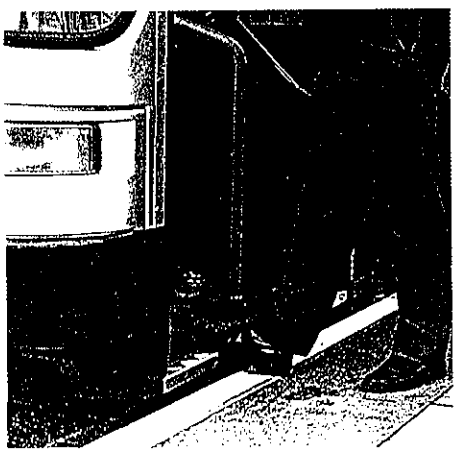
BUS STOPS

Once in the guideway, the buses can travel quickly by by-passing the traffic queues and by "calling-up" their own phase on the traffic signals at the exit from the section. There will be only a limited number of locations where bus stops will be placed within the guideway section itself.



Where these occur, passengers who have to cross the road to reach the bus, or to leave it, will have the benefit of improved pedestrian crossing facilities. At the stop itself, the kerb will be raised so that there will be a platform from which virtually level boarding into the bus will be possible. The bus, of course will pull up within millimetres of the platform edge, guided by its guidewheels. This will help those who have difficulty by almost eliminating the step.

Existing signal controlled pedestrian crossings will be retained and additional ones provided with gaps being created in the guide kerbs to allow level crossing of the guideway.

Elsewhere on the route, where there is no guideway, other bus stops may also be capable of modification to provide a raised platform, since the guidewheels on the bus will allow close alignment of the bus to the raised kerb edge.

GUIDEWAY PERFORMANCE BENEFITS

Although the time saving benefits of individual guideway sections will be some-what different in each individual application, the Leeds scheme has demonstrated the following benefits;-

- 450 metres of outbound guideway saves up to 3 minutes per bus in the afternoon peak
- 400 metres of inbound guideway saves up to 2.5 minutes per bus in the morning peak
- Both sections create absolute consistency in bus running times peak and off-peak, thereby enhancing service regularity and punctuality.

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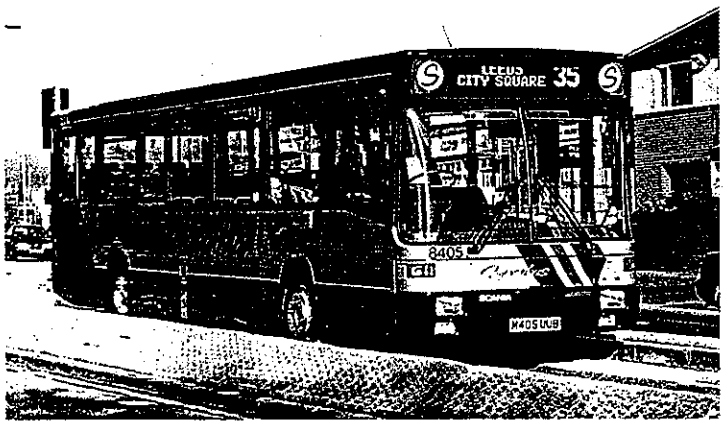
THE BUSES

To use the guideway sections, buses need to be specially adapted by fitting small guidewheels in front of the front wheels, attached to the steering arms. It is a simple and relatively cheap operation to fit most existing buses with guidewheels. However, more appropriate to the aim of providing a high quality route dedicated guided bus service? The use of high quality specially adapted vehicles should be encouraged.

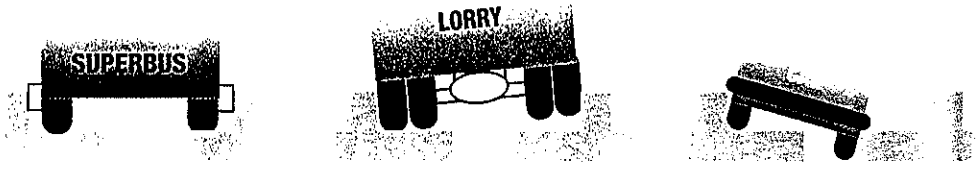


When the bus approaches the guideway, the drivers steer the bus into a funnel section and this adjusts the path of the bus smoothly into the guideway proper. Once in the guideway, the steering is controlled automatically by the kerbs bearing against the guidewheels. The driver simply controls the acceleration and braking, staying alert to pedestrians crossing the guideway.

ADVANTAGES OF THE GUIDEWAY

In certain locations, the narrow width needed for the guideways can save space compared to providing extra traffic lanes. This is likely to be the case with two-way guideways, or guideways used in tidal flow fashion. In most cases using single directional guideways, there is little space advantage, but the guaranteed segregation from other traffic makes provision worthwhile.

Guideways can be formed using twin running strips with a grass or gravel area in between. This results in quieter running since vehicle noise is absorbed by this central medium. Unlike conventional bus-only lanes, the physical features of a guideway effectively prevents unauthorised use by other road traffic.



SUITABLE GUIDEWAY BUSES

Several manufacturers have mainstream chassis designs suitable for full-width guided guideways.

Mecedes-Benz

The O 405 (rigid) and O 405 G (articulated) chassis are the world's most proven guided bus designs.

A special front axle (costing some £600 more than the 'conventional' one) is required for fitting with guide-arm equipment. This special axle is standard on FirstBus (ex GRT) chassis from this manufacturer.

A 3-month trial of a Grampian O 405 on the Leeds system was wholly successful.

Scania

All current Scania 'big bus' chassis have front axles suitable for the fitting of Scania guide-arm equipment as standard.

The Leeds system opened in September 1995 with 21 N113 chassis in use, and 5 L113 chassis were placed in service thereon in October 1996.

Scania have applied much development effort to perfecting an efficient and cost-effective guide-arm system and the latest versions are proving rugged and operationally sound. The weak-link short arm is appropriately cheap and performs to requirements.

Low-floor Scania chassis use exactly the same components and this standardisation throughout their product range is particularly practical.

Volvo

Trials were undertaken on the Leeds system during the summer with a Volvo B10LE low-floor guided bus under the aegis of LPD as part of Volvo's product development.

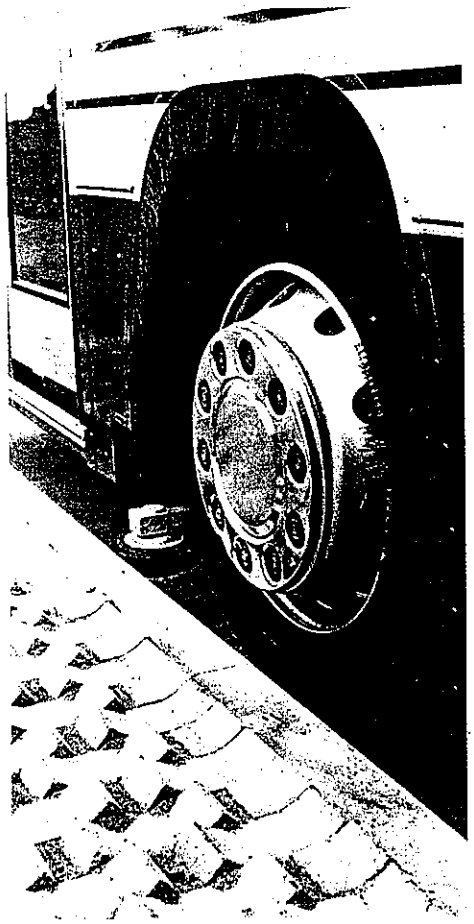
It is understood that these trials were wholly successful and a production Volvo B10LE guided bus is being offered to the Leeds System for long-term evaluation.

Dennis

Although a Dennis Lance chassis with guide-arms was exhibited at 'Coach & Bus' some years ago, no operational test or production vehicle has been produced.

The 2.3 metre wide Dart used on the Ipswich system is too narrow for normal guideways, as is the 2.4 metre wide low-floor Dart (which has not been offered in guided bus form).

GUIDED BUS TECHNOLOGIES



Kerb Guided Bus (KGB)

This is the most proven form of guiding buses and the only form in operational service (Essen and Mannheim in Germany, Adelaide in Australia, Leeds and Ipswich in the UK).

Buses have small horizontal guidewheels ahead of the front axle which bear onto 180mm high kerbs set 2.6 metres apart (Ipswich 2.4 metres uniquely). No action is required to 'activate' guidance except to drive the bus into a 'funnel'.

Guided Light Transit (GLT)

This system features a single central guide rail with a groove each side; the buses have double-flanged (or pulley-wheel) guide wheels which have to be mechanically applied to the guide-rail for use.

The system is promoted by the Bombardier Group and, whilst a demonstration route has operated in Belgium for some years, the first 'authorised' system (for Caen in France) has been cancelled during construction.

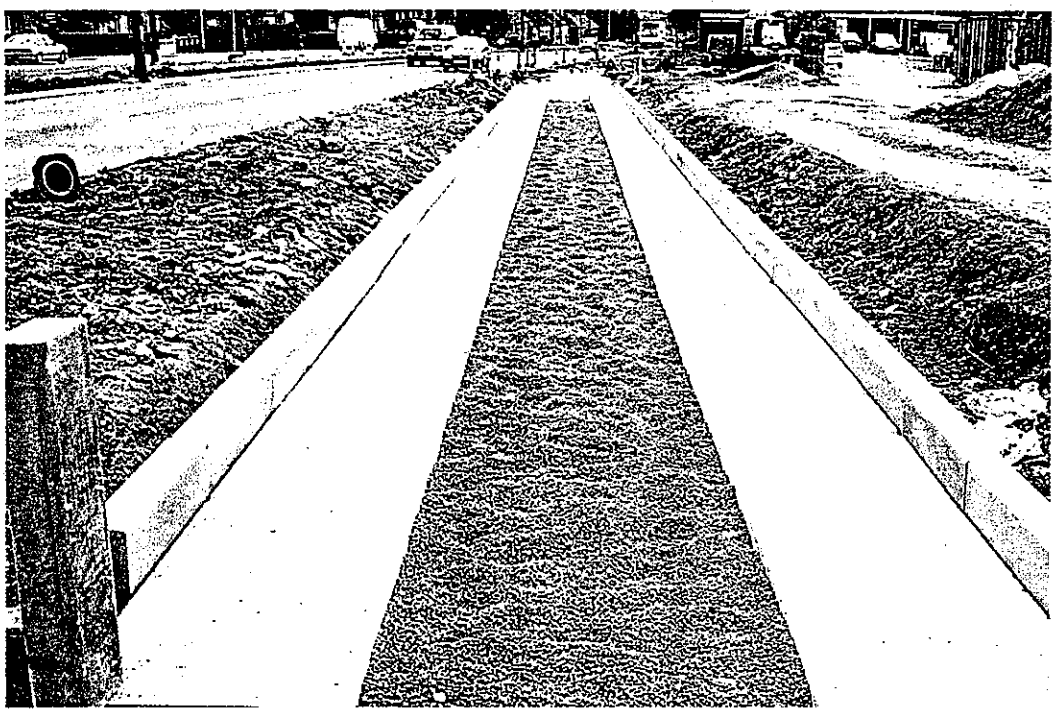
Electronic Guidance (EGB)

This was developed in parallel with KGB but, apart from a demonstration operation near Nürnberg in 1984/85, has yet to be applied commercially.

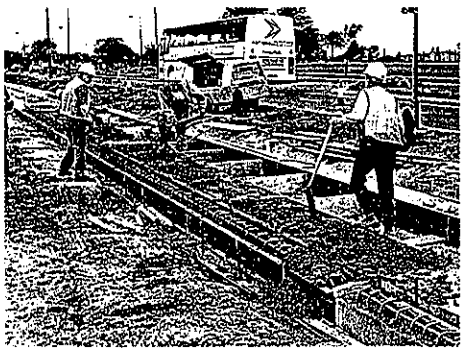
The bus follows a buried cable in the roadway with on-bus sensors connected to the steering. The technology is very well proven, being found in many 'tug' applications in factories etc. It is also used for emergency vehicles in the Channel Tunnel.

There are major concerns about the potential loss of guidance in adverse weather conditions or by over-speeding on curves. However for low-speed operation in flush-paved pedestrian areas, EGB could be highly effective.

GUIDEWAY CONSTRUCTION COSTS



Guideway construction costs are relatively low in comparison to light rail but the major cost saving with guideways arises because of the need to install them only where there is traffic congestion (eg as in Leeds) or for some form of bus gateway (eg as in Ipswich).



Costs for individual sections will depend on ground conditions etc but, for an at-grade section (ie at the level of the existing and surrounding land) a cost of £1 million per lane-kilometre (£1,000 per lane metre) is a 'safe' estimate. A 2-lane 2-way construction will probably be of the order of £1.8 million per kilometre.

The first section of the Leeds system is some 450 metres in length (including entry and exit funnels) and cost, in 1995, £750,000 (or £1,667 per lane metre) but this included also the cost of:-

- Renewing street lighting (to latest standards)
- Traffic signals on - highway and on-guideway (triggered by bus)
- Environmental improvement work
- Two 'docking' stops on adjacent highway.

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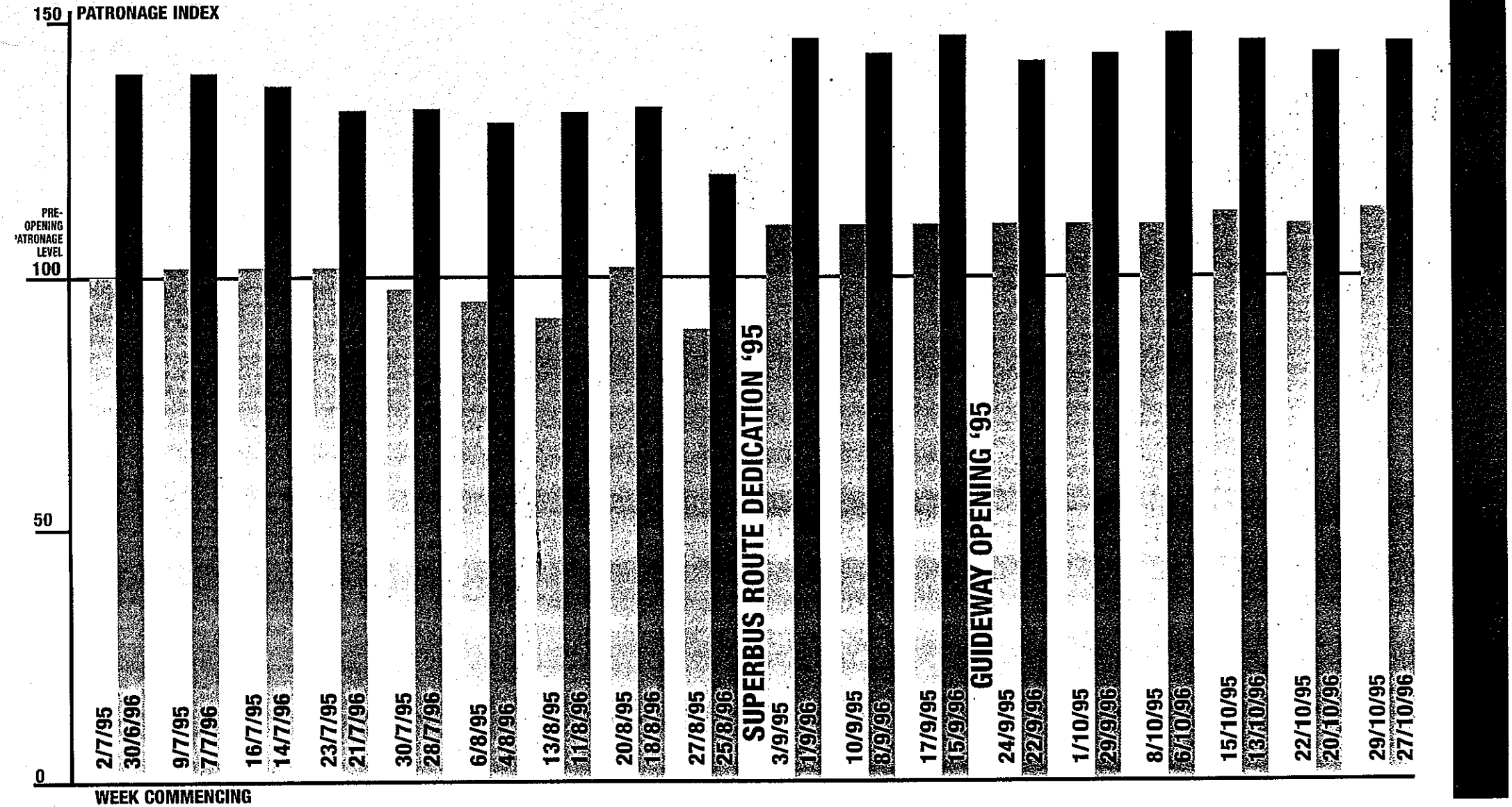
YEAR-ON-YEAR PATRONAGE GROWTH:
SCOTT HALL ROAD 'SUPERBUS' CORRIDOR



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