

# TOWARDS THE INTRODUCTION OF LOW FLOOR BUS TECHNOLOGY IN SOUTH AFRICAN CITIES

J S HUGO and J STANBURY\*

Directorate Transportation & Traffic, City of Cape Town – CMC Administration,  
P. O. Box 16548, VLAEBERG, 8018

\*ARCUS GIBB, P O Box 3965, Cape Town, 8000

## ABSTRACT

The advent of low floor bus technology has raised the profile of the bus mode of public transport throughout the developed world. The fact that people no longer have to negotiate steps when boarding and alighting makes getting on and off the bus easier and quicker for all passengers. It also makes it possible for persons with disabilities to use the mainstream public transport service and since it is accessible to more people, there is the potential for more off-peak trips to be made. Shorter dwell time at stops raises the productivity of staff and equipment and can also lead to a reduction in harmful exhaust emissions. User response to the introduction of low floor buses is overwhelmingly positive and bus services that use these vehicles have the potential to effectively compete with the private car for patronage from non-captive public transport users.

Low floor buses are part of an end-to-end service delivery chain, which also includes infrastructure, the ticketing system, information and marketing, driver training as well as traffic management and enforcement. Higher initial capital cost of new buses is offset by higher productivity and lower lifecycle costs.

The use of low floor buses has become the norm in the developed world. A demonstration project undertaken in Cape Town has shown that low floor buses can be deployed in South African cities with the same measure of success experienced elsewhere in the world.

## 1. INTRODUCTION

South African-built buses have traditionally been designed for relatively rough conditions, constructed on a truck-type chassis with the engine at the front as a rule. In this type of vehicle the floor is more than 1 metre above the road surface and as a rule it only has one door for use by passengers. Boarding and alighting is difficult and slow and the hard suspension provides an uncomfortable ride. Judging by new products recently launched locally this type of configuration is still the norm, despite the enormous advances made in bus design elsewhere in the world. Road conditions in most South African cities can be considered to be comparable to those in the USA and Europe and it can be argued that there is no great need for buses designed primarily for service on ill-kept gravel country roads to be in operation in our cities.

## 2. BACKGROUND

Begun as pilot projects in Europe in the late 1980's to improve the image of urban bus transport, low-floor buses were developed from the standard design for European commuter buses with underfloor engines<sup>(1)</sup>. The low floor buses developed for use on airport aprons led the way and as more countries adopted legislation to make public transport fully accessible, development was accelerated by the need to find a more practical alternative to the hydraulic wheel chair lifts that had been in use at the time.

Low floor buses are currently the norm rather than the exception in the developed world. For example more than 80% of all buses ordered by members of the Association of German Transport Operators during 1999 were low floor<sup>(2)</sup> and a leading British bus chassis manufacturer with a production rate of 2 700 units per year has indicated that since 1996 it has not produced bus chassis other than those for low floor buses.

## 3. DEFINITION OF A LOW FLOOR BUS

For the purpose of this paper the term "low-floor bus" implies that the bus floor level is at most 320 mm above the road surface when the vehicle is in motion on new tyres and that there is no difference in level between the step at the front door and the rest of the bus floor in front of the rear axle. When stopped the driver should be able to further lower the front of the bus by at least 80 mm to bring the floor at the front entrance to a height of not more than 240 mm above the road surface<sup>(3)</sup>. To bridge the gap where the driver is not able to pull in close to the kerb (i.e. further than 100mm) or where there is no kerb or raised bus stop area, a retractable ramp is deployed to facilitate access and egress. It is also implied that the suspension of the bus must be self-levelling to provide constant ride height under varying loads. Larger multi-door low floor buses may have the ramp at the middle or rear door, in which case the abovementioned dimension requirements will apply to the door with the ramp.

The emphasis is on level access and the vehicle stopping close to the kerb, as is shown below in figure 3.1.

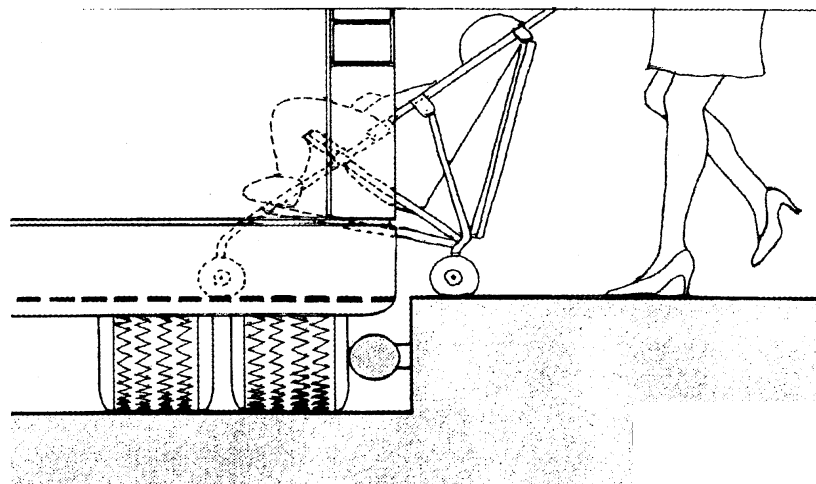


Fig. 3.1: Boarding a low floor bus<sup>(3)</sup>

## **4. ADVANTAGES OF USING LOW FLOOR BUSES**

### **4.1 All passengers can board easier, faster and safer**

Using a low floor bus involves less effort and delay and all passengers can board and alight more speedily. Trials in Europe<sup>(3)</sup> have recorded an average saving of 6 seconds per person. By, for example, reducing the floor height from 940 mm to 350 mm, the boarding time for young males was reduced by 36%. Safety hazards are reduced. The risk of injury due to incidents such as slipping on the stairs is decreased in proportion to the reduction in the floor height.

### **4.2 Potential for more off-peak trips**

The low floor bus has already proved to be more attractive to both actual and potential bus customers than its traditional alternative. The absence of steps at entrances and exits means that all those people (possibly the majority of bus customers at off peak times) who travel with shopping, luggage, small children and those who are elderly or with disabilities, find the vehicles easier to use or, in some cases, possible to use for the first time. This is expected to encourage the use of buses for purposes other than commuting between home and work, resulting in greater off-peak usage and the development of a true public transport service, instead of the current situation where the focus seems to be primarily on providing commuter services.

### **4.3 Accessibility for persons with special needs on the mainstream service**

With the introduction of low floor buses, people with reduced mobility who have been unable to use public transport or have done so only with great difficulty or with assistance, are being offered the opportunity to take advantage of public transport with a much higher level of comfort or in some cases, to use these services for the first time.

With these buses it is possible to be provide an integrated mainstream transport service without the need for separate or specialised systems for the many people who have been denied access to conventional buses. South African legislation requires this integration. In section 4(1)(k) of the National Land Transport Transition Act, no. 22 of 2000 it is stipulated that "*The needs of special categories of passengers must be considered in planning and providing public transport infrastructure, facilities and services, and these needs should be met as far as may be possible by the system provided for mainstream public transport.*"<sup>(4)</sup>

Dedicated special transport services for people with disabilities (such as door-to-door dial-a-ride public transport services), which can be relatively expensive<sup>(5)</sup>, can now be reserved for only those passengers who, as result of the severity their disability, cannot use the fully accessible mainstream service.

### **4.4 Shorter dwell time at stops**

Shorter dwell time as a result of easier and faster boarding and alighting is a benefit to all. Time saving at stops results in quicker trips, higher productivity of vehicles and drivers, less delay to other traffic and a relative reduction in pollution due to exhaust emissions.

## **4.5 Reduced running costs**

It was initially expected that the running cost of low floor buses would be higher than that of conventional buses, particularly due to teething troubles resulting from the introduction of new technology. The suspensions, drive trains and brake systems developed for low floor buses were highly sophisticated and in many cases completely different from the parts used in conventional buses<sup>(6)</sup>. In practice, however, this concern appears to have been groundless. A trial project run in the United Kingdom proved that the introduction of low floor buses led to a 10% reduction in fuel consumption and the cost of parts was down by 5.6%. The cost of tyres was reduced by 1% and labour for maintenance 3% less. There were 11% fewer accidents and the damage cost 17% less to repair<sup>(7)</sup>.

## **4.6 User preference**

Wherever low floor buses were introduced or just put on trial, they were received with great enthusiasm by the passengers, whether it was New York<sup>(8)</sup> or Cape Town<sup>(9)</sup>.

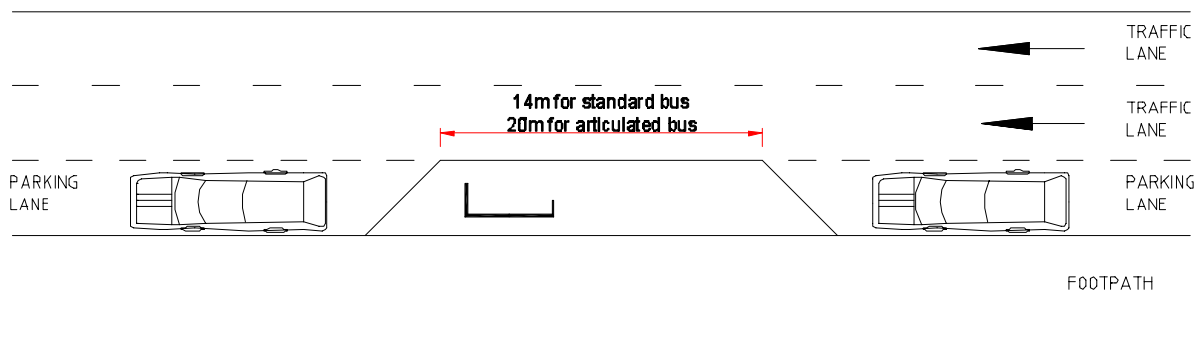
# **5. SYSTEM REQUIREMENTS**

The introduction of low floor buses should be seen as one link in an end-to-end delivery chain which forms a passenger friendly transport system. Bus stop environments that do justice to the needs of the passengers, bus stop facilities, passenger information, vehicle construction and layout, traffic management systems as well as the attitude and conduct of the driver are all equally important links in the chain. While many benefits can accrue from putting even some of the links in place, the full benefits can only be derived if the links are joined together to form a chain. The introduction of low floor buses should be seen as one link in the chain.

## **5.1 Bus stop design**

The use of conventional bus embayments is not recommended for low floor buses. The current experience of the Cape Town demonstration project has shown illegal parking to be a problem and it was also difficult for the driver to dock the bus close to the kerb while driving into the embayment. When manoeuvring close to the kerb the nose of the bus tended to sweep over the sidewalk area, posing the danger of a collision<sup>(3)</sup>. After leaving the traffic lane to pick up passengers at a stop in an embayment any bus as a rule has difficulty getting back into the traffic stream in heavy traffic.

Conventional bus embayments should not be regarded as public transport improvements, as they primarily benefit private motorists and make it difficult for buses to rejoin the traffic stream after stopping. Bus stops should rather be constructed according to the "peninsula" design<sup>(10)</sup>, which better facilitates parallel docking and in terms of which the position of the kerb on the street side coincides with the outside edge of the outside traffic lane, as is shown in figure 5.2.



## BUILDING

Fig. 5.2: “Peninsula” bus stop<sup>(10)</sup>

### 5.2 Ticketing system

Conventional on-board collection of fares delays the boarding process, particularly when a variety of fares is collected for different destinations and/or classes of passengers<sup>(11)</sup>. The benefit of rapid boarding and alighting can be lost as a result of an inefficient fare collection process. A ticketing system involving prepaid fares and rapid on-board validation should be used in conjunction with low floor buses.

### 5.3 Driver training

Driving a low floor bus would appear to be more complicated than a conventional bus. A low floor bus has at least 2 operational features that conventional buses don't have, namely the “kneeling” suspension system and the retractable ramp. Some buses have the option for the suspension to be raised on rough roads<sup>(7)</sup>. Also, docking at a bus stop has to be more precise. As a low floor bus is fully accessible, persons with disabilities, as well as greater numbers of elderly persons and people accompanying small children can be expected to use it and bus drivers will need special awareness skills to deal with these passengers with special needs.

Drivers of low floor buses will have to be trained in these aspects and aspirant drivers may have to be screened to determine their aptitude in this regard.

As part of the Cape Town demonstration project some 15 different drivers have operated the low floor bus. It has been driven in varying traffic conditions and environments. After initial training had been given to these drivers none experienced difficulties.

### 5.4 Information and marketing

The low floor bus cannot be expected to attract new customers if potential users do not know about the improvements being offered. In a case where not all the buses on a route are low floor it is important to indicate the low floor buses on the timetable, to enable passengers who depend on the unique features of the bus to plan their journey accordingly<sup>(12)</sup>. In Cape Town the presence of the low floor bus was announced on the local radio and it was advertised in the community newspapers. The bus was also taken on a tour to selected organisations (e.g. old age homes) along the route.

## **5.5 Traffic management and enforcement**

The bus competes with the private car for passengers. If it loses any of its competitive advantages through illegal use of its facilities, it will lose passengers. Measures to ensure compliance with restrictions on parking and the use of exclusive bus facilities have to be rigorously enforced and traffic control measures should give priority to public transport vehicles over private cars<sup>(11)</sup>.

## **6. DISADVANTAGES OF LOW FLOOR BUS SYSTEMS**

### **6.1 Cost**

The main disadvantage of low floor buses experienced in Europe is that their initial purchase price can be between 5% and 20% higher than that of conventional buses<sup>(3)</sup>. However, this can be more than made up for in lower running costs<sup>(7)</sup>. Also, unit production cost decreases as the number of units produced increases.

South African bus builders have indicated to the authors in writing that they can produce low floor buses locally at competitive prices.

### **6.2 Design and skilled manpower requirements.**

Low-floor designs necessarily displace the equipment otherwise located under the floor. This equipment must, therefore, be relocated to unconventional, less accessible and/or less convenient locations, such as the roof structure (typically between the ceiling panels and the roof skins), or added to an already overcrowded engine compartment (or both of the foregoing). Such equipment typically consists of air reservoirs, pneumatic valves, air dryers, plumbing, pumps, water heaters, and the like. Locating such equipment in this manner complicates maintenance and increases the risk of accidents since workmen will have to use scaffoldings to get access to the roof<sup>(6)</sup>. While it could be anticipated that this more dangerous and more complicated maintenance procedure would cost more, it was found in practice not to be the case<sup>(7)</sup>.

### **6.3 Lower capacity**

An American manufacturer has reported that the seating capacity of its low floor buses is 16% lower than that of its conventional models. This is attributed to the presence of the front wheel wells and the step in front of the rear axle<sup>(6)</sup>. Providing more standing space, which could be acceptable in urban situations where journeys are often relatively short, can restore the passenger capacity.

## **7. THE CAPE TOWN DEMONSTRATION PROJECT**

During February 2000 a low floor bus was put into service in the Cape Town metropolitan area as part of a demonstration project funded by the National Department of Transport. The local bus company Golden Arrow Bus Services operated it on various routes throughout the metropolitan area and nowhere were any difficulties experienced relating to road conditions. Passenger reaction to the bus was overwhelmingly positive and on-board survey results revealed that 48% of passengers waited specifically for this particular bus and 11% of passengers were individuals who did not regularly use public transport, but who started doing so when the low floor bus was introduced on the route<sup>(9)</sup>.

Boarding and alighting trials showed that it was much quicker and easier to get on and off the bus and confirmed the European results quoted earlier. The results of the Cape Town demonstration project clearly showed that low floor bus technology has the potential to significantly increase usage of public transport.

## 8. CONCLUSION

An important objective of the National White Paper on Transport Policy is to increase the public transport modal share to 80%<sup>(13)</sup>. In practice, however, public transport has steadily been losing ground to the private mode and there has also been a gradual shift towards smaller vehicles not specifically designed for mass transport. Low floor buses have the potential to attract choice users and passengers lost to other modes. It puts within reach the goal of 80% of trips by public transport, which in the case of Cape Town currently stands at 50%.

It has been shown in Europe and the USA that modern high technology low-floor buses can substantially improve the accessibility of the public transport service to passengers with special needs and can draw choice users back to public transport. It also significantly enhances levels of satisfaction for “captive” public transport passengers. The results from a demonstration project conducted in Cape Town during 2000 have confirmed this.

## ACKNOWLEDGEMENT

The authors would like to express their thanks to Modalink and Golden Arrow Bus Services for their co-operation.

## REFERENCES

- (1) *The London low floor Bus Project.* London Transport, London, 1995.
- (2) *Improving Transport for People with Mobility Handicaps. A Guide to Good Practice.* European Conference of Ministers of Transport, Paris, 1999.
- (3) *COST 322. Low floor buses. The low floor bus system.* European Commission, Luxembourg, 1995.
- (4) Republic of South Africa. *National Land Transport Transition Act. No. 22 of 2000.* Government Gazette, 23 August 2000.
- (5) C.J. VENTER. *Review of Accessible Transport Pilot Projects.* CSIR, Pretoria, March 2000.
- (6) *Advantages of standard-floor buses vs. low-floor buses.* North American Bus Industries Inc., Anniston, Alabama, USA, 2000.
- (7) *Low floor bus trials in a rural area.* U.K. Department of the Environment, Transport and the Regions. London, October 1999.
- (8) B. SCHALLER, D. LOWELL AND K. R. STUART. *MTA New York City Transit Research Shows What Customers Want in Low Floor Buses.* Mass Transit, Washington, May/June 1998.

- (9) *Demonstration Project P3 Experimental Vehicles. Passenger Comments on Dennis Dart (Bellville – City Route)* Unpublished interim report by the Cape Metropolitan Council, Cape Town, October 2000.
- (10) *The Design and Operation of Accessible Public Transport Systems. Report of Thematic Group 8.* European Union, Brussels, November 1996.
- (11) *Issues in Bus Rapid Transit.* Paper prepared for the Bus Rapid Transit Forum by the Federal Transit Administration and Volpe Centre. Washington, 15 January 1998.
- (12) *Demonstration Project P3 Experimental Vehicles. Report 1 - Dennis Low Floor Bus.* Unpublished interim report by the Cape Metropolitan Council, Cape Town, July 2000.
- (13) Republic of South Africa. *White Paper on National Transport Policy.* National Department of Transport, Pretoria, September 1996.



# **TOWARDS THE INTRODUCTION OF LOW FLOOR BUS TECHNOLOGY IN SOUTH AFRICAN CITIES**

J S HUGO and J STANBURY\*

Directorate Transportation & Traffic, City of Cape Town – CMC Administration,  
P. O. Box 16548, VLAEBERG, 8018

\*ARCUS GIBB, P O Box 3965, Cape Town, 8000

## **Curriculum vitae: Mr. J. S. Hugo (Author and presenter)**

Cobus Hugo is responsible for passenger transport planning at the City of Cape Town. He is a Professional Engineer and also holds a postgraduate qualification in transport planning, the field in which he has been active for the past 15 years.

## **Curriculum vitae: Mr. J. Stanbury (Co-author)**

Jim Stanbury is a Professional Engineer who has worked with the international firm of consulting engineers GIBB for 20 years in the UK, East Africa, the Middle East and South Africa.