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How the PPM System Can Provide Environmentally Friendly Town Centre Access

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Trams, the one clear success story of the National Transport Plan, provide access to larger town centres but at a high price due to the technology required. Innovations in the traction systems of rail vehicles, together with a new method of constructing track in the top surface of the road, promise to make tramways more affordable and available to many more urban centres.

What Works? Trams Work

The Department for Transport has just issued figures which record that in the last year light rail systems provided 136 million passenger journeys – a threefold growth in two decades. Over the same period car use has also grown, but in percentage terms to a far smaller extent. It has become recognised that in the areas concerned, car use has reduced as people have transferred to trams. Trams are 'carrots'.

However, less than *two percent* of Britain's population lives within easy access to a tram or light rail system and the benefits are not very significant so far in the overall situation.

Elsewhere, despite strenuous and highly commendable efforts to enhance the image of what is referred to as 'The Humble Bus', the only instances where the trend for commuters and shoppers has been to switch to buses is where special *infrastructure* has been installed or lane restrictions to thwart the movement of private motorists into town or to make them pay through the nose for the privilege of parking. Measures which make private motoring more difficult or expensive are 'sticks'.

The Dog on a Lead

A further crucial difference between tram and bus emerges when access needs to be provided to the town centre. Put buses and cars amongst pedestrians and you will see mothers clutching the arms of their children while peering into windscreens of the vehicles to be sure the drivers have noticed them crossing the road.

By contrast, images of a British town centre of the 1930s or of many European cities nowadays show the relaxed compatibility between trams and pedestrians. Difficult to explain but none-the-less true, the highly vulnerable person on foot is reassured by the predictability of a vehicle guided by rails and is prepared to cross behind or in front without fear.

The presence of the guiding rails is as reassuring as a strong collar and lead on a large dog. And while the styling, power and external noise of many motor vehicles reflects the competitive aggression of the purchasers, the appearance and sound of most trams is not in the least threatening, with wheels hidden and transmission quiet. So, in a well planned modern town centre trams are encouraged, motor traffic excluded.

The British public are more familiar with railways which are also returning to popularity. However, as a result of being acceptable in areas from which normal road traffic is excluded, the tramway does something that a railway cannot do – it *distributes* workers and shoppers along its alignment stopping at short intervals which greatly reduces walking distances to the final destinations. A tram

stop need be no more elaborate than a bus shelter and an area of surrounding pavement. Conventional heavy railways cannot easily replicate these features. Many stopping places on the approach to an urban centre station would reduce average speeds and capacity and stations themselves take up a lot of space. Urban centre railways do not distribute, they concentrate and so it is good practice to run a tramway past main train stations to provide the distributing function.

But Trams are Expensive

With all of their environmental and access advantages, trams ought to be everywhere if it were not for the problem of cost. As a vehicle a modern tram would be seen as most similar to a bus but they are not built like buses, more like trains. A single carriage of a train with power transmission and full braking equipment costs at least *six times more than a bus*. Modern trams ('Supertrams' in today's parlance) have twice the capacity of a double decker bus but cost *eight times* as much.

And that is just the starting point. When you launch a boat you do not have to pay anyone for providing the river. Similarly with a bus, the road is seen as a free part of the geography – actually an illusion – roads are very expensive to build and maintain and if half the space is made into a bus lane this valuable piece of capital should be seen as part of a 'system'. For tramways, the biggest cost is *the electrified permanent way* on which conventional trams run.

Why has electrification of a tramway now become so expensive? After a few forays into the use of horses, steam, compressed air, petrol and naptha gas, from 1900 onwards the propulsion of trams became almost entirely concentrated on electric power. Historically the authorities latched on to the strong business case for introducing electric tramways by using planning powers to bring in some of the first district electric supplies as well as the first paved roads constructed between and alongside the tram rails.

Electrification of a tramway system ought by now to be very mature and robust having originally been pioneered and introduced in the late Victorian era. However, while much of modern equipment is very similar, the world around has changed making it anything but routine to re-introduce a 600-750V electrical network into a modern street. While the ground below most Victorian streets comprised the original soil, below the surface of a *modern* street you will encounter domestic power lines, phone, computer and TV cables.

750V of electricity used to power the trams is always looking for the quickest way back to the substation and if it can follow someone's computer cables, it will. As a result construction of a tramway nowadays begins with draconian measures to clear the subsoil of all of the buried apparatus which might be damaged by strong currents or where access for maintenance would become far more difficult once the stray-current-trapping reinforced concrete slabs on which electric tramways are now built are in place. However, trams transformed British towns and cities, and the closure of over 200 systems in the middle of the last century is now seen as a big mistake, hard to reverse.

The PPM System – More Than Just a Vehicle

The light tramway system developed by Parry People Movers over the period 1992-2003 has several key features which make it possible to penetrate, like Heineken Beer, to parts which other forms of tramway can no longer reach. However, before mentioning what these special features are, it is vital to ensure that all of the aspects which have enabled the *conventional* light rail mode to be so successful are retained. These are:

- High levels of passenger safety and comfort
- Rapid acceleration and ability to brake quickly, but smoothly
- Low external noise and minimal pollution
- Robust, durable materials and components
- Ability to move large numbers of passengers through narrow 'corridors', frequently off-road
- Energy efficiency exceeding that of cars and buses
- High passenger appeal due to convenience and accessibility to all categories of passenger and the steady predictable ride which allows them to stand or move about within the vehicle while it is running between stops.

The objective of the PPM development has been to tackle those aspects of light rail technology which, in delivering the above benefits, have brought with them huge burdens of cost and lengthy timescales for construction. The factors which cause costs to be so high are:-

- Electrification of the permanent way which causes the diversion of statutory undertakers' equipment. *The PPM system avoids this*;
- The planning and legal costs associated with embarking on major civil works in urban areas. *Because the PPM concept makes it possible for the rails, ties and surrounding surface materials to be carried out as routinely as the work of resurfacing a worn out road, it is proposed to use a different, simpler approach to obtain authorisation for this work*;
- Relationships with owners of services in the 'subsoil' below the surface of the road are assumed to involve conflict, requiring the tramway enforcing the removal of such equipment through a Transport and Works Order. *The PPM approach is to have available the means of easily* ***diverting*** *the tramway to enable the statutory undertakers continued emergency access to their equipment through manholes and trenches as with an ordinarily surfaced road. They should then have no cause to object to the tramway.*

Use of a shallow system of track construction and the associated simplification of procedures can potentially cut civil and p.w. costs to less than a quarter of that normally incurred with at least a halving of timescales.

The consequence of these cost-saving measures allows much more flexibility in the design and scale of vehicle which can run on the system. With lower system costs, the threshold of farebox revenue can be lower and minimum numbers of passenger journeys similarly less. Few conventional tram services can pay their way with less than 6 million passenger journeys taken in a year, an average of about 1,000 passengers an hour. The essential characteristic of a tramway is frequent intervals, a minimum of 10 services each hour. Bearing in mind that with an average of 100 passengers joining the service every 10 minutes the peak can easily be 2½ times as much. For this reason the typical model of tram in use on modern systems provides for a 'crush' loading of 250 passengers and is therefore nearer in size and weight to a suburban train than a bus.

By bringing the threshold of viability to as low as a quarter of the passenger flow, PPM has made it possible to run far smaller vehicles – the same size as buses. This in turn gives rise to the possibility of building tram bodies using bus elements and power transmission and running gear using cheap-to-buy and easy-to-maintain automotive parts. A PPM tram will cost more than a bus, perhaps twice but not eight times as much as is the case of a supertram.

Innovations

The PPM light tram and the special type of urban tramway on which it will run draw together years of design and development involving the efforts of many companies and individuals.

Most pivotal in the technology of the vehicle which enables it to operate with the same efficiency and cleanliness of the traditional electric tram, is the Parry flywheel energy storage system using continuously variable transmission. The flywheel which provides up to 250kW of torque to accelerate the tram away from stops is the ultimate straightforward system of short term energy storage, releasing power on demand with no perceptible environmental pollution – no exhaust emission and virtually no noise. PPM flywheel trams can take in energy in a variety of ways:-

1. From a short, low voltage power rail at stopping places.
2. During descents of hills or when slowing down.
3. From an on-board, low emission engine such as an lpg or hydrogen powered i/c unit

or, as the technology becomes available -

4. From a constantly running electric motor which is supplied with electricity from an on-board *fuel cell*, again using hydrogen as fuel.

The other major area of innovation is the new type of street tramway which has a fully relocatable, permanent way (though a curious contradiction of terms). The successful railway industry firm, HoldFast, assisted by Corus Rail and Parry have devised an adaptation of HoldFast's panel system now used for level crossings in Britain, Australia and Eastern Europe. The panels provide a street surface material between and on either side of the rails. The whole structure is contained in a 150mm (6 inch) deep slot in the wearing surface of the street. As a 'dry' system it can be installed during weekends avoiding disruption to the businesses with frontages onto the street and not causing traffic hold-ups in the working week.

This tramway track innovation is now gaining interest with the transport authorities. The new type of street tramway which is of standard railway track gauge and fits normal rail profile wheels, can therefore connect directly on to a branch railway line. As a result passengers will in theory be able to board a 'railcar' at their local rural station and then ride into town to complete the journey at any number of stops along the High Street, the ideal means of achieving convenient, environmentally friendly access to the town.