# Half-Price LRV Unveiled

*A mock-up of the first new tram to be designed in Britain since the early 1950s was unveiled by the Tram Group at the Light Rail 93 exhibition in Birmingham in November. The main feature of the new vehicle is its very low price: £700,000 for a 28m-long LRV. This coupled with more cost-effective track should make light rail more affordable.*

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THE TRAM Group plans to complete a prototype LRV by August for trials on Blackpool Transport's tram line. Durability running in revenue-earning service is planned to start at the end of the year. The Track Group, which is developing the new LR55 design of cost-effective track for installation in city streets, has been testing a 10m section since March 1993, and plans to install an 18m section in Blackpool by the end of March.

The Tram Group consists of Tickford Rail, the design arm of Babcock Rail; Tram Research; Blackpool Transport Service; East Lancashire Coachbuilders, a bus body builder; and PowerGen, one of Britain's private power generating companies. The Track Group comprises British Steel, Edgar Allen Engineering, Sika, and Costain-Dow Mac.

So how will it be possible to produce LRVs at no more than half the cost of existing designs? Mr Peter Morris, project manager with Tram Research, cites several reasons: "Some of the means adopted include technology transfer of existing or adapted components from the automotive, military, and nuclear industries; the use of high-strength materials; by avoiding the heavy rail approach; and through low-cost tooling requirements for building the vehicles."

Many of the components in the Tram will be of proven design. "The traction system will use industrial motors currently used for semi-traction purposes but derated and adapted for body mounting in the Tram," Morris told IRJ. "The driveline, air and vehicle electrical components will be common with those used on lorries and buses."

The Tram will be of modular design. The specification is based on a 28m-long two-car articulated unit. The low-floor version will have a floor height of 300mm over 70% of the vehicle. The high-floor vehicle will have a 800mm-high floor.

The Tram will weigh 20 tonnes unladen, which is about half that of conventional vehicles. This will reduce energy consumption, lower track forces, and produce infrastructure cost savings.

## Symmetrical Halves

Each half of the LRV will be functionally symmetric and interchangeable. This means that spare units can be based on half rather than full vehicles.

Other configurations include a single or twin-cab single car, and a double articulated Tram. All vehicles will be available in different lengths. Front ends can be styled to provide a distinctive design for each customer. Three body widths will be possible: 2.4, 2.5 and 2.65m. The vehicle will be 2.9m high. Two Trams can operate in multiple.

**Mock-up of the Tram at Light Rail 93 in Birmingham, Britain.**

The car body will be of a chassisless construction with a welded stainless steel frame clad with stainless steel sheets and GRP mouldings. All cavities will be filled with rockwool insulation, and sound absorbing and anti-drumming material will be used where necessary. All underfloor equipment including the bogies and wheelsets will be enclosed to reduce noise.

Side glazing will be bonded to the frame to add structural rigidity and to strengthen the bodyshell. Double glazing can be provided. Ventilation will be by forced air, and air-conditioning can be fitted if required.

A single-axle wheelset will support the central articulation. The two bogies at each end will consist of axles with inside bearings. All gears and cross shafts will be fully enclosed. Highly-resilient lightweight 700mm-diameter wheels will be fitted throughout the vehicle. "The unique 'free wheel' design reduces squeal between tread and rail even on tight curves," said Morris. The 28m-long Tram can cope with a track radius of 15m. Wheels can be replaced individually, avoiding the need to lift the vehicle or exchange whole wheelsets. Secondary suspension will be via twin air bellows.

A fully-sealed 90kW three-phase ac traction motor will be mounted within the body in the nose of each car. The maintenance-free motor will be connected to the interconnected drive axles by a cardan shaft. The maximum rate of acceleration and deceleration will be 1.5m/s$^2$. The Tram will have a power to weight ratio of 12kW per tonne.

The Tram will be able to cope with gradients of up to

10%. A maximum speed of up to 100km/h will be possible depending on the choice of drive gear ratio and controller design. The Tram will have on-board test equipment for fault analysis.

Regenerative braking, which is effective down to between 4 and 6km/h, will reduce energy consumption still further. Air-actuated disc brakes are provided for emergency braking and parking, plus dc injection braking to the motor. All three are blended together to minimise jerks and wear. Electromagnetic track brakes can be fitted as an additional emergency brake. Anti-skid protection is optional.

The Tram Group has selected technology-transferred components which are not only cheap to buy and easy to obtain, but are also fitted to the vehicle so that they are easily accessible for maintenance. For example, there are no roof-mounted components apart from the pantograph. There is no need for an underfloor wheel lathe.

The design of the vehicle means that it is not necessary to invest large amounts of money in special jigs or production tooling to build the Tram. The Tram Group intends to build vehicles at either Babcock Rail's Rosyth Royal Dockyard factory or at East Lancashire Coachbuilders. Alternatively, to encourage competition, other companies will be able to build Tram under licence by purchasing the drawings, a list of parts and sub-assemblies, details of warranted suppliers and sub-contractors, and assembly instructions and tooling requirements. Manufacturers will pay the Tram Group a royalty for each Tram built and sold. This will avoid the huge capital outlay which is normally required to start production of a new design of vehicle, and which has to be recouped from the customer.

The LR55 tram track system is the brain-child of Professor Lewis Lesley of Liverpool John Moores University, who also developed the concepts for the Tram. The system uses a new profile of rail and exploits the strength of existing highway pavements by transmitting the static and dynamic loads from the upper surface rather than the foot of the rail.

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This means that the load on the rail head distributed on to the highway sub-base has a stress sufficiently low so that a separate foundation is not normally required and the depth of excavation is minimised. This should obviate the need to remove under-street services such as pipes and cables. As many highway pavements are of uncertain quality, a retaining reinforced concrete channel has been designed into which the rail can be laid.

Following the successful completion of laboratory tests, a field trial has been underway at Rotherham bus station since March 1993. "The bus station was chosen," Lesley explained, "because road vehicles are more damaging to rail systems embedded in highways than the rail vehicles traversing the tracks." More than 5000 buses per day with axleloads of up to 11 tonnes pass over the 10m length of LR55 rail embedded in the bus station entrance. "There have been no signs of failure since the trial began, and we have had consistent readings from the strain gauges," Lesley told IRJ.

Lesley estimates that it should be possible to lay between 100 and 200m of track between 2000 and 0600 hours the following morning. "It cost between £1600 and £1800 per metre to lay the tracks in the city centre streets for the Manchester Metrolink project," Lesley said. "We estimate that it would cost between £400 and £600 per metre to lay the LR55 system." However, Lesley admits that it is very difficult to produce accurate estimates until some track is installed in a city street. **IRJ**