

## TO STUDY OF VARIOUS ELEMENTS OF TRAM RAILWAY AND COMPARISATION

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**Abstract** –In response to the demand for improved mobility in metropolitan areas, the 1990s saw the development in Europe of a new transport system known as the tram-train. This system is based on the use of conventional railway lines with a low traffic density in order to extend urban tram or light rail services without the need to change vehicle, incorporating them into railway traffic. This allows for a wider range and scope of direct transport services and reduces waiting times and changes. The operation of light rail vehicles on conventional railway infrastructure involves finding solutions to a number of technical issues such as traction power supply system, rolling stock design, gauge, tyre and rail profile, structural strength, passenger access, signalling, etc. This paper describes these problems and the solutions arrived at by services currently in operation, or in advanced planning stages, worldwide.

**Key words**- light rail transit, public transport, tram-train

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**Introduction:**-A tram-train is a light-rail public transport system where trams run through from an urban tramway network to main-line railway lines which are shared with conventional trains. This combines the tram's flexibility and accessibility with a train's greater speed, and bridges the distance between main railway stations and a city Centre. There is also a train-tram, which is a train modified to also run on tramlines. Generally, the tram-train and train-tram are interchangeable, although a train-tram is based on a train design modified to also run as a tram and a tram-train is based on a tram design modified to also run on a train line.

**Back ground:**-A tram (also known as tramcar, streetcar, trolley or trolley car) is a rail vehicle which runs on tracks along public urban streets, and also sometimes on a segregated right of way. The lines or networks operated by tramcars are called tramways. Tramways powered by electricity, the most common type historically, were once called electric street railways (mainly in the United States) due to them being widely used in urban areas before the universal adoption of electrification.

**Tram lines:**-may also run between cities and towns (for example, interurbans, tram-train) or even countries, or be partially grade-separated even in the cities (light rail). Very occasionally, trams also carry freight. Tram vehicles are usually lighter and shorter than conventional trains and rapid transit trains, but the size of trams (particularly light rail vehicles) is rapidly increasing. Some trams (for instance tram-trains) may also run on ordinary railway tracks, a tramway may be upgraded to a light rail or a rapid transit line, two urban tramways may be connected to an interurban, etc. For all these reasons, the differences between the various modes of rail transportation are often indistinct.

Today, most trams use electrical power, usually fed by an overhead pantograph; in some cases by a sliding shoe on a third rail, trolley pole or bow collector. If necessary, they may have dual power systems—electricity in city streets, and diesel in more rural environments. Trams are now commonly included in the wider term "light rail", which also includes segregated systems.



**History:**-The idea is not new; in the early 20th century, interurban streetcar lines often operated on dedicated rights-of-way between towns, while running on street trackage in town. In 1924, in Hobart, Tasmania, sharing of tracks between trams and trains was proposed.

The difference between modern tram-trains and the older interurbans and radial railways is that tram-trains are built to meet mainline railway standards, rather than ignoring them. An exception is the USA's River Line in New Jersey which runs along freight tracks with time separation: passenger trains run by day, and freight by night.

### Types of trams

**Single-ended vs double-ended:**-A double-ended tram has an operator's cab and controls at each end of the vehicle, which allows it to easily be driven at full speed in either direction on a continuous segment of track. Typically at the end of a run, the tram's operator will walk from one end of the tram to the other, and then commence the tram route in the other direction. The tram is usually switched to another track by use of crossover points or Y-points. Conversely, a single-ended vehicle needs a method of turning at termini so that the operator's cab is in the front of the tram for the reverse journey. This usually necessitates a turning loop or triangle. On the other hand, the single cab and controls and fewer door spaces make the tram lighter, increases passenger accommodation (including many more seats) and effects reductions in equipment, weight, first-cost, maintenance cost, and operating expense.

A single-ended tram has operator's controls at only one end, and can safely be driven at speed in the forward direction but is also capable of reverse movement, typically at slower speed, using a small set of controls at the rear.

Two single-ended trams with doors on both sides may be coupled into a (semi-)permanently coupled married pair or twinset, with operator's controls at each end of the combination. Such a setup is operated as if it were a double-ended tram, except that the operator must exit one vehicle and enter the other, when reversing at the end of the run.

### Drop-Centres (lowered central section)

Many early 20th century trams used a lowered central section between the bogies (trucks). This made passenger access easier, reducing the number of steps required to reach the inside of the vehicle. These cars were frequently referred to as "drop-centres".

It is believed that the design first originated in Christchurch, New Zealand, in 1906 when Boon & Co Ltd. built 26 such trams in three series. A number of these trams have been preserved. They were a popular design in Australia and New Zealand, with at least 780 such tramcars being built for use in Melbourne alone. Trams built since the 1970s have had conventional high or low floors.

**Low floor:**-From around the 1990s, light rail vehicles not made for the occasional high platform light rail system have usually been of partial or fully low-floor design, with the floor 300 to 360 mm (11.8 to 14.2 in) above top of rail, a capability not found in older vehicles. This allows them to load passengers, including those in wheelchairs, directly from low-rise platforms that are not much more than raised footpaths/sidewalks. This satisfies requirements to provide access to disabled passengers without using expensive wheelchair lifts, while at the same time making boarding faster and easier for other passengers. Passengers appreciate the ease of boarding and alighting from low-floor trams and moving about inside 100% low-floor trams.

**Ultra low floor:**-The Ultra Low Floor or (ULF) tram is a type of low-floor tram operating in Vienna, Austria as of 1997 and in Oradea, Romania, with the lowest floor-height of any such vehicle. In contrast to other low-floor trams, the floor in the interior of ULF is at sidewalk height (about 18 cm or 7 inches above the road surface), which makes access to trams easy for passengers in wheelchairs or with baby carriages. This configuration required a new undercarriage. The axles had to be replaced by a complicated electronic steering of the traction motors. Auxiliary devices are installed largely under the car's roof.

**Articulated:**-Articulated trams, invented and first used by the Boston Elevated Railway in 1912–13 at a total length of about twelve meters long (40 ft) for each pioneering example of twin-section articulated tram car, have two or more body sections, connected by flexible joints and a round platform at their pivoting midsection(s). Like articulated buses, they have increased passenger capacity. In practice, these trams can be up to 56 metres (184 ft) long (such as CAF Urbos 3 in Budapest, Hungary), while a regular tram has to be much shorter. With this type, the articulation is normally suspended between carbody sections.

**Double decker:**-Double decker trams were commonplace in Great Britain and Dublin Ireland before most tramways were torn up in the 1950s and 1960s. New York City's New York Railways experimented in 1912 with a Brill double deck Hedley-Doyle stepless centre entrance car, nicknamed the "Broadway Battleship", a term that spread to other large streetcars. Hobart, Tasmania, Australia made extensive use of double decker trams. Arguably the most unusual double-decker tram used to run between the isolated Western Australian outback town of Leonora and the nearby settlement of Gwalia. Double decker trams still operate in Alexandria, Blackpool and Hong Kong.

**Tram-train:**-Tram-train operation uses vehicles such as the Flexity Link and Regio-Alstom Citadis, which are suited for use on urban tram lines and also meet the necessary indication, power, and strength requirements for operation on main-line railways. This allows passengers to travel from suburban areas into city-centre destinations without having to change from a train to a tram. It has been primarily developed in Germanic countries, in particular Germany and Switzerland. Karlsruhe is a notable pioneer of the tram-train.



## TECHNOLOGY

- The tram-train often is a type of interurban, i.e. they link separate towns or cities. According to George W. Hilton and John F. Due's definition.
- Most tram-trains are standard gauge, which facilitates sharing track with main-line trains. Exceptions include Alicante Tram and Nordhausen, which are metre gauge.
- Tram-train vehicles are dual-equipped to suit the needs of both tram and train operating modes, with support for multiple electrification voltages if required and safety equipment such as train stops and other railway signalling equipment. The Karlsruhe and Saarbrücken systems use 'PZB' or 'Indusi' automatic train protection, so that if the driver passes a signal at stop the emergency brakes are applied.

**Trams in India-** Trams in India were established in the mid 19th century. Horse-drawn trams were introduced in Kolkata in 1873. Electric trams were started in Chennai in 1895. Trams were introduced in Mumbai, Nashik, Kanpur, Kochi, Patna and Bhavnagar. Trams were discontinued in most Indian cities between 1930 and 1960, leaving only Kolkata.

## SALIENT FEATURES

- Trams (and road public transport in general) can be much more efficient in terms of road usage – one vehicle replaces about 40 cars (which take up a far larger area of road space).

- Vehicles run more efficiently and overall operating costs are lower.
- Tram vehicles are very durable, with some being in continuous revenue service for more than fifty years.
- In many cases tram networks have a higher capacity than similar buses. This has been cited as a reason for the replacement of one of Europe's busiest bus lines (with three-minute headways in peak times) with a tram by Dresdner Verkehrsbetriebe.
- Trams and light rail systems can be cheaper to install than subways or other forms of heavy rail
- Passengers can reach surface stations quicker than underground stations. Subjective safety at surface stations is often seen to be higher
- Trams can be tourist attractions in ways buses usually aren't

### ADVANTAGES

- Trams (and road public transport in general) can be much more efficient in terms of road usage – one vehicle replaces about 40 cars (which take up a far larger area of road space).
- Vehicles run more efficiently and overall operating costs are lower.
- Tram vehicles are very durable, with some being in continuous revenue service for more than fifty years. This is especially compared to internal combustion buses, which tend to require high amounts of maintenance and break down after less than 20 years, mostly due to the vibrations of the engine.
- In many cases tram networks have a higher capacity than similar buses. This has been cited as a reason for the replacement of one of Europe's busiest bus lines (with three-minute headways in peak times) with a tram by Dresdner Verkehrsbetriebe.

### DISADVANTAGES

- Tram tracks can be hazardous for cyclists, as bikes, particularly those with narrow tyres, may get their wheels caught in the track grooves. It is possible to close the grooves of the tracks on critical sections by rubber profiles that are pressed down by the wheel flanges of the passing tram but that cannot be lowered by the weight of a cyclist. If not well-maintained, however, these lose their effectiveness over time.
- When wet, tram tracks tend to become slippery and thus dangerous for bicycles and motorcycles, especially in traffic. In some cases, even cars can be affected.

### Comparison of tram and train tracks

A railroad or railway is a track where the vehicle travels over two parallel steel bars, called rails. The rails support and guide the wheels of the vehicles, which are traditionally either trains or trams. Modern light rail is a relatively new innovation which combines aspects of those two modes of transport. However fundamental differences in the track and wheel design are important, especially where trams or light railways and trains have to share a section of track, as sometimes happens in congested areas. Both trams and trains have flanged iron wheels with a horizontal section transferring the vehicle weight to the rail and a vertical flange "inboard" to guide the vehicle along the rail using its inside edge.

### Difference between Train and Tram

	Train	Tram
Definition	A train is a mode of transportation but they run on specially laid tracks of iron rails and is generally used for long distances; a train usually runs outside city limits.	A tram is also a rail borne mode of transportation designed to travel short distances on streets in the city and runs along public urban streets.
Track	A separate track from road generally laid	Along a road, sharing the road with other



	outside the limits of city.	modes of transportation.
Purpose	Mostly to connect long distance cities etc.	Mostly to cover short distances.
Length	In general, train is longer than tram.	In general, train is longer than tram.
Meant for	Both passengers and goods.	In general, for passengers.
Track level	A few inches above the ground.	Same level as the road.

### FUTURESCOPE AND DEVELOPMENT OF TRAM RAILWAY

- The nationalized Calcutta Tramways Company is in the process of upgrading the existing tramway network at a cost of ₹ 240 million (US\$3.7 million).
- The urban development ministry plans to introduce tramways in medium-size cities with populations of 1-4 million people in a throwback to the 1960s when trams were last seen on most Indian roads.
- The ministry will shortly begin a trial-run in a tier II city before taking the vintage-era transportation system to other cities and connecting the tramways with major bus and railway stations, urban development minister. Currently, Kolkata is the only city where trams are in use.
- Transportation is critical to India's economic growth and a clean energy solution is essential to provide smart mobility in urban areas and allow freight to move easily, he said.
- "Operating costs are lower than for buses. A tram system will provide easy interoperability with first-mile/last-mile modes such as bikes and walking, existing transportation systems, as well as high speed rail and rapid transportation systems of the future"

### CONCLUSION

- Tram Train has been seen for some time as the miraculous solution for rail-bound regional public transport.
- However, the number of implemented cases is limited and those projects which came further than the initial feasibility study often have developed in another direction.
- "Master planning" is needed from the beginning to create a final system layout, to allocate the roles of different modes in the overall scheme and to identify the consequences for urban planning
- Rolling stock design is another feature and one has to find the right ratio between a conservative "reliability" and a progressive "design is everything" policy. Despite all the technical extra requirements of a Tram Train-vehicle - it will not be acceptable to run an "ugly duckling" alongside attractive "normal" trams.

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