

## Topic Sheet No. 5

# A QUESTION OF CAPACITY

**THE CAPACITIES** of different modes of transport are generally quoted as 0-10 000 passengers per hour for bus, 2000-20 000 for light rail, and 15 000 upwards for heavy rail.

➤ In most applications where light rail is an option the required **Capacity** will be much less than the maximum. Capacity is only one reason for its selection over other modes -environmental considerations can make light rail an attractive option even at the lower capacity levels.

➤ Maximum capacity is only likely to be required for a few hours during peak hours, and even here there are likely to be variations both day by day and within each hour. The capacity required originates from the route's social characteristics.

➤ As for the vehicles, buses have a comfort capacity equal to the number of seats, and a maximum capacity equal to seats plus standing load.

➤ In the case of trams, it is more complicated. The nominal maximum capacity is calculated at four passengers per square metre of available floor space (a reasonably comfortable level), plus the number of seats.

➤ As trams are designed to carry a large standing load, the ratio of standees to seats is quite high. The standing area is also important for the carrying of wheelchairs, pushchairs, shopping and sometimes bicycles. Some manufacturers quote maximum capacity using 6p/m<sup>2</sup> while a figure of 8p/m<sup>2</sup> is used as a measure of crush capacity. This last figure is also employed to determine the motor rating of the vehicle.

➤ A further complication is that even when there are seats available, some passengers prefer to stand. This may be because they are only travelling for a few stops, that they want to stretch their legs, or may just prefer to stand.

➤ A tram's comfort capacity can therefore be considered as the number of seats, plus the voluntary standees who may amount to up to 10-15% of the nominal maximum number of standing passengers.

### ELASTICITY

➤ It is the difference between the average passenger load for any particular time and the crush load which gives light rail its **Elasticity Factor**, allowing it to cope with variations in conditions such as sudden surges or emergency conditions.

➤ Standing is made more acceptable by the design of track and vehicle, reducing the forces acting on the passenger to a minimum. This makes for a smooth ride, as well as ensuring ease of access, good support and the ability to see out without having to stoop.

➤ Where a route is mainly urban with short journey times, the number of vehicles required should be calculated on the nominal maximum. On longer journeys outside the central area, a lower level may be more appropriate, dependent on the route's characteristics. Even on rural sections, there are likely to be a number of short distance riders, and the loading factor will increase nearer to the urban area.



The interior of a Siemens low-floor tram in Mannheim.

Michael Taplin



The passenger experience in Karlsruhe, Germany - 70% low-floor tram.

Michael Taplin

### COMPRESSIBILITY

➤ While it might be thought desirable to offer every passenger a seat, it is in fact the ability to carry high loadings in a confined area (the **Compressibility Factor**) which enables light rail to achieve many environmental benefits, allowing large numbers of people to be carried without harming, and often improving, the features of a city.

➤ It is city centres where several routes combine that the most capacity is required. A typical situation could be a pedestrian street with six routes operating at 10-minute headway giving 36 double coupled trams per hour each with a capacity of 225. This gives a nominal capacity of 16 200 passengers per hour which can be increased to 25 200 pph in extremis without extra vehicles. Light rail is unique in this ability to operate on the surface with its capacity without detracting from the amenities which it serves.

➤ A further factor in setting the resources required is the need to lure motorists out of cars. The more difficult the traffic conditions, the higher

the loadings will be acceptable. It is however important that crush loads are not allowed for more than the shortest of periods on an infrequent basis, both to maintain customer satisfaction and prevent elasticity of the system being compromised.

➤ It is vital that public transport can cope with sudden changes in demand, such as extreme inclement weather or air quality violations which can cause private traffic to be halted. This is where the elasticity inherent in light rail is so beneficial in enabling an instant response in an economical fashion. A tram may be crowded, but its infinitely better than having to wait in the snow of smog until extra vehicles are brought into service.

➤ It is this unique combination of **Capacity**, **Compressibility** and **Elasticity** rather than capacity alone which makes light rail so successful as an urban transport mode.

➤ *Note Statistics are based on Karlsruhe, using GT8-100c/2 cars.*

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