

Road versus rail - Facts sheet number 1 – Capacity, average flow, density of use

Updated April 2009

This facts sheet provides information on capacity, average flows, density of use and some anecdotal illustrations of the use that rail makes of its rights of way and compares that with the same for the motorway and trunk road network.

Capacity

The line haul

At Waterloo 50,000 crushed passengers alight in the morning peak hour. They could all find seats in 1,000 50-seat motor coaches. Those coaches would occupy no more than one lane of a motor road. At Waterloo there is room for 3 or 4 lanes in each direction. The waste is lamentable.

At Euston, 60,000 passengers alight all day. They would require no more than 3,000 coaches each with only 20 people aboard. 3,000 coaches could pass in 90 minutes in the space available on the approaches to the terminal but the railway has run out of capacity all day.

In the peak 3 hours some 500,000 passengers enter central London by surface Rail spread over 25 pairs of tracks. If half the passengers arrive in the peak hour the average flow per inbound track is 10,000 passengers. They could all fit in 200 50-seat coaches, sufficient to fill one fifth of the space available.

The Americans, particularly Don Morin, Head of Public Transport, US Department of Transport, concluded in the 1970's that there is no movement corridor in the world where demand cannot be satisfied by one lane of a motor road dedicated to coaches.

Terminals

Neither British Rail nor Railtrack would provide plans that would enable the areas of London terminals to be estimated and we have not enquired of Network Rail. However, at Waterloo probably the 21 platforms occupy an area 250 metres square, or thereabouts, a total of 6.25 hectares. If 50,000 alight in the peak hour the density of use is 8,000 passengers per hour per hectare.

In contrast (a) Victoria Coach station is said to be able to handle 10,000 passengers per hour, many with baggage, on one hectare. (b) The area in front of Victoria Rail terminal used to handle 280 buses an hour on 0.2 hectare's. If each bus had 50 people alighting the density of use was 70,000 passengers per hour per hectare.

Hence it appears likely that the nimble bus would use terminal space very much more efficiently than can the cumbersome train.

If at Waterloo as many as 1,000 buses an hour were to arrive and if each needed to stand for as long as 6 minutes then there would need to be 100 bus bays. If they were spread over 3 levels there would be 33 bays per level. That does not seem unreasonable. Perhaps the number could be halved if half the buses drove onwards, so avoiding the need for some of the passengers to alight.

Average Flow

The calculations appended show that national rail carried an average flow equivalent to only some 340-400 buses plus lorries per day per track in 2008 - a flow which is so small that it is fair to say that the network was, and is, substantially disused as it lies there basking in the sun of government subsidy.

Density of use

The calculations appended provide the following densities for rail and the motorway and trunk road systems for 2007. Data for earlier years is in the appendix.

For passengers:

National Rail	1.53 million passenger-km per km of track.
M'ways and trunk roads	4.66 million passenger-km per km of running lane.

For freight:

National Rail	0.72 million tonnes-km per km of track.
M'ways and trunk roads	2.24 million tonnes-km per km of running lane.

For passengers and freight combined

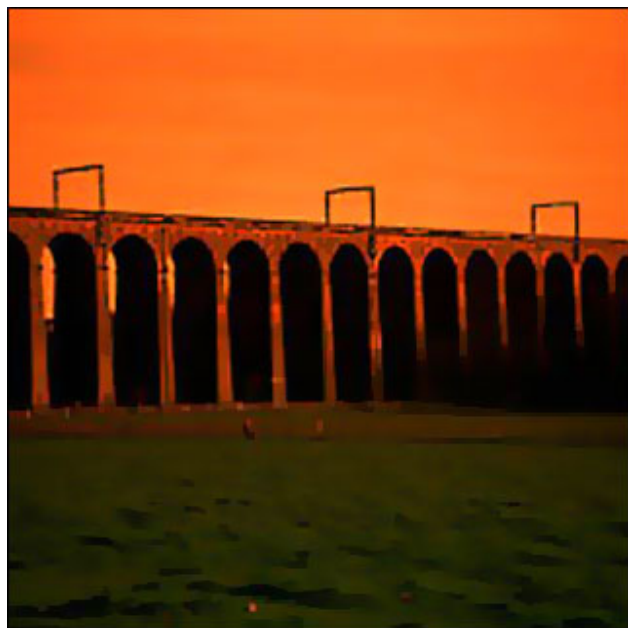
National Rail	2.25 million unit-km per km of track.
M'ways and trunk roads	6.90 million unit-km per km of track.

Despite the rail network occupying corridors of intense demand and penetrating to the hearts of our towns and cities the density of use is less than one third of that achieved by the strategic road network, which peters out on the fringes of urban areas.

Anecdotal illustrations

Anecdotal illustrations of the inability of rail to make reasonable use of track include:

Welwyn Viaduct, shown opposite, on the East Coast Main Line,. That viaduct has one track in each direction and carries 14 trains towards London in the peak hour (Letter from Railtrack dated 8th December 1999). Those trains are equivalent to not more than 150 buses and coaches, enough to fill one sixth of one lane of a motor road. Despite that trivial flow the viaduct limits the capacity of the entire route.



The Ouse Viaduct, Balcombe and **St Germain's Viaduct Cornwall** . These immense pieces of engineering, shown below, feature in the 1996 Network Management statements by Railtrack. Railtrack were not been able to identify the use to which the structures are actually put but flows are likely to be much below those for the Welwyn viaduct. Hence it is fair to say that the structures achieve little for the nation beyond photo opportunities.



The capacity sections of The West Coast Main line

Page 3-2 of the Environmental Statement of Main Report supporting Railtrack's case at the Public Inquiry into the West Coast Main Line Modernisation Programme provides the flows at the capacity sections. During the 18 hours 6 am to midnight these carry some 110 passenger trains and 55 freight trains, together equivalent to perhaps 2,500 buses plus lorries per day. Despite that relatively trivial flow the limitation on capacity forced 35 to 40 other goods trains to operate from midnight to 6 am. There are 3 running tracks at two of the capacity sections and two tracks at the third. If the 18 hour flow, equivalent to 2,500 buses plus lorries, is split between just two tracks the directional 18 hour flow is 1,250 vehicles per track, sufficient to fill one lane of a motor road for about 75 minutes.

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Appendix: Sources data and calculations

To see excel versions of the tabulations click here.

Rail

The source for passenger and tonne-km is the ORR's National Rail Trends year book 2008

Equivalent bus plus lorry flows are obtained by:

- a) Dividing passenger-km by a bus occupancy of 20 (5 less than claimed as the occupancy of coaches leaving Victoria coach station) or 16
- b) Dividing tonne-km by 15 (half the capacity of a 44 tonne lorry)

Adding the results of (a) and (b) and dividing by (i) the days in the year, 365 and (ii) the track length, 32,000 km yields the average flow per track.

Dividing passenger-km and tonne-km by the track length yields the density of use.

The following table provides the data for the years 2000 to 2007.

Table 1 Rail data

Year	2000	2001	2002	2003	2004	2005	2006	2007
Pass km (bn)	38.2	39.1	39.7	40.9	41.8	43.2	46.2	49
Tonne km (bn)	19	20.6	19.7	20.1	21.6	23.1	23.2	22.9
Equivalent daily bus plus lorry flows								
(a) 20 passengers per bus	272	285	282	290	302	317	330	340
(b) 16 passengers per bus	313	327	325	334	347	363	380	393
Density of use								
Mn Passenger-km per km	1.19	1.22	1.24	1.28	1.31	1.35	1.44	1.53
Mn Tonne-km per km	0.59	0.64	0.62	0.63	0.68	0.72	0.73	0.72
Totals	1.79	1.87	1.86	1.91	1.98	2.07	2.17	2.25

Road

The source for the data is Transport Statistics Great Britain. In the table below:

- a) Carriageway lengths for 2006 are from Table the 7.9 of the TSGB 2008 or its equivalent for earlier years except that of 2000 to 2001 there is no division between dual and single carriageways in the source. Consequently for those years the division has been estimated using the proportions for 2003. (Here we note that the section 7 of the TSGB 2008 has not been updated since November 2007)
- b) Lane lengths are estimated from:
 - (i) Motorway length x 6 plus dual carriageway length x 4 + single carriageway length x 2
 - (ii) Motorway length x 6.5 plus dual carriageway length x 4.5 + single carriageway length x 2.25
- c) The passenger-km on the motorway and trunk road network have been estimated by allocating the values for all roads available from table 1.1. of the TSGB in proportion to the non-good vehicle-km estimated from TSGB table 7.4.
- d) Likewise, the tonne-km on the motorway and trunk road network have been estimated by allocating the values for all roads available from table 4.1. of the TSGB in proportion to the good vehicle-km estimated from TSGB table 7.4.
- e) The density of use has been obtained by dividing the estimates of the passenger and tonne-km by the mean of the two estimates for lane length.

Table 2 Motorway and trunk road data

Year	2000	2001	2002	2003	2004	2005	2006	2007
Lengths motorway and trunk roads (km)								
Motorway	3467	3477	3477	3477	3524	3520	3558	3559
Dual Carriageways	4558	4563	4563	3645	3575	3490	3490	3597
Single Carriageways	7121	7129	7129	5695	5572	5293	5233	5196
Total Trunk	11679	11692	11692	9340	9147	8783	8723	8793
Lane Length (a)	53276	53372	53372	46832	46588	45666	45774	46134
Lane Length (b)	59068	59174	59174	51817	51531	50494	50606	51011
Vehicle, passenger and tonne-km								
All roads								
All Veh-km (bn)	466.5	473.7	485.9	490.3	498.6	499.4	506.4	513
Goods veh-km (bn)	28.2	28.3	28.3	28.47	29.4	29	29.1	29.4
Non-goods veh-km (bn)	438.3	445.4	457.6	461.83	469.2	470.4	477.3	483.6
Passenger-km (bn)	669	678	690	731	736	733	746	749
Tonne-km (bn)	150.5	149.4	149.8	162	163	163	167	173
Motorway and Trunk								
All Veh-km (bn)	NA	173.1	174.7	158.8	162.3	160.50	164.00	164.6
Goods veh-km (bn)	NA	19.7	19	17.76	18.4	18.00	18.30	18.5
Non-goods veh-km (bn)	NA	153.40	155.70	141.04	143.90	142.50	145.70	146.10
Est Passenger-km (bn)	NA	233.51	234.77	223.24	225.73	222.05	227.72	226.28
Est Tonne-km (bn)	NA	104.00	100.57	101.06	102.01	101.17	105.02	108.86
Density of use								
Mn Passenger-km per km	NA	4.15	4.17	4.53	4.60	4.62	4.73	4.66
Mn Tonne-km per km	NA	1.85	1.79	2.05	2.08	2.10	2.18	2.24
Total	NA	6.00	5.96	6.57	6.68	6.72	6.90	6.90
Percent on motorway and trunk								
% veh-km on M and T	NA	36.5	36.0	32.4	32.6	32.1	32.4	32.1
% Goods veh-km on M and T	NA	69.6	67.1	62.4	62.6	62.1	62.9	62.9