Rolling stock for high speed on European railways: present and future development

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This paper deals with the possibility of increasing commercial speed of freight trains. First technical constraints that have so far prevented railway owners from increasing the speed of freight trains are considered. Such constraints concern both fixed installations and rolling stock; this paper focuses on the latter. Then, traction units for high speed trains operated in the most important networks of Western Europe are examined in order to identify which units could be used for hypothetical high speed freight services. Some proposals for new vehicles specifically conceived for such services are also discussed. The study points out that trains made up of luggage vans represent an interesting solution to transport freight up to 200 km/h provided that size of bundles do not exceed the width of side doors; for other load units such as containers special versions of high speed trains seem to be preferable.

1 Introduction

Almost all European freight trains run at speeds not higher than 120 km/h whilst it is well known that many passenger trains can run at 180 km/h on conventional lines and at over 250 km/h on high speed recently built lines. It could be interesting to increase operating speed of freight trains up to those values that are usual for passenger ones for two basic reasons:

- reducing goods travel time, freight transport on rail could get more attractive and competitive compared with road transport;
- should they run faster, freight trains would cause less interference with passenger ones and could be allowed to enter new high speed lines.

The first reason has been discussed on several occasions. According to a widely-accepted opinion, the travel time of goods currently moved by railway is mainly affected by handling operations and intermediate stops rather than relatively low cruising speeds. Consequently, according to that opinion, in order to improve rail freight services it would be more advisable (also in terms of investments) to reorganise the logistic chain rather than to increase the top speed of trains (Cerullo et al., 1997).

On the contrary, the second reason has its objective validity, as it can be easily proved that the traffic capacity of a railway line increases when the difference among speeds of trains belonging to various categories is reduced (Galaverna, 1999). Introducing freight trains into new high speed lines would be advantageous also in terms of profitability and return on investment of the new infrastructures; this particularly concerns those sections of European High Speed Rail Network (EHSRN) whose foreseeable passenger traffic is not intense enough to justify the construction costs.

Unfortunately, the increase of freight trains top speed, approximately up to a range between 160 and 200 km/h, or even more, arises several technical difficulties as far as rolling stock is concerned.

2 Technical constraints in rolling stock for freight trains

Excluding issues related to fixed installations, which are not the subject of this article, technical constraints that have so far prevented railway owners from increasing the speed of freight trains mainly concern:

- the braking system of wagons
- the reduction in maximum load
- traction units.

Brakes usually adopted for wagons are not suitable to operating speeds higher than 140 km/h. Even operation at 160 km/h requires important modifications to the braking system of wagons. First, this problem was faced by replacing traditional brake shoes with synthetic brake discs, but the excessive thermal stress did not result sustainable by wheels in every running condition. As a consequence, when speeds higher than 140 km/h must be attained, a new conception bogie similar to those used for passenger coaches seems to be necessary. At speeds higher than 140 km/h also a system for the brakes electronic control becomes necessary, and this makes it mandatory to provide wagons with an electric line linked to the traction unit or a generator van, as those used on non-electrified railways to supply auxiliary services of passenger coaches; electric lines for power distribution are a common presence inside passenger coaches, but till now there has been no need for electric power supply on wagons.

For these reasons, the cost of a 160km/h wagon is estimated to be 30-40% higher than the cost of a traditional wagon. It must be observed that the technical solutions that make a wagon suitable to run at 160 km/h are quite similar to those necessary to increase its speed up to 200 km/h.

Another problem is that the possibility to run at speeds higher than 140 km/h implies a reduction in the maximum load per axle whereas this fact is in contrast with current trends in freight transportation; indeed, some European railway owners intend to increase the maximum load per axle from the current value of 22.5 t/axle up to 25 t/axle (and to 30 t/axle in the long term).