BALLAST TRACKS FOR HIGH SPEEDS

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ABSTRACT

Traditional Track

Traditional Ballast Tracks have been installed in many High Speed Lines by a number of good reasons. The lessons learned from this applications can be summed up as follows:

- Uniformity in any respect is a major demand for the use of ballasted tracks for the purpose.
  - Extremely prominent is the thickness of the ballast layer and thus the correctness of the top-of-subgrade geometry.
  - The correct and uniform width of the ballast bed is required for longlasting track stability.
  - Already the stiffness of subgrade should be as uniform as possible.
  - Turnouts must be matched into the track in the most smooth manner.
  - Interconnections between ballast track and ballastless sections (at bridges etc.) must be treated carefully in the engineering process.

- The subgrade must be perfectly drained to avoid any damage by the action of water.

- Track-gauge must be chosen with respect to excellent running properties of the vehicles. It is a common mistake to decide for too tight gauges. Practical experience indicates that gauges below 1435 mm (with standard gauge) can cause wheelset instabilities with high speeds.

With these experiences thoughts have been given to improving the identified imperfectnesses. To this end some improvements were realized and tried out.

- Under-sleeper elastic pads proved themselves as an surprisingly sucessful improvement. The reason might be found in the considerably increased contact area between the sleeper bottom and the ballast surface.

- High-speed tracks are aligned with very small increments of curvatures. It was found that the separate treatment of plane and side view does not reflect the combined mechanism acting on the vehicle while transversing a transition curve. A track alignment, based on smooth guidance of the vehicle center-of-gravity into a curve by taking into consideration the rotations around the longitudinal and vertical axes, leads to more complex transition curve, which considerably reduces the wheel-force variation.
Ballastless track designs

For high speeds in the past decades ballastless tracks have been developed. Various types of those will certainly be subject of other presentations.

Frame-sleeper-track

Ideas of a (much) more durable track structure for high-speed purposes have been developed.
- As soft bottoms of the sleepers distribute the pressure much more evenly, consequently elastic sleeper bottom pads have been incorporated.

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Addition of a longitudinal beam below the rails result in a smooth load transmission under the running wheel. The addition leads to sleepers in the form of a frame and the design consequently was called “frame-sleeper”.

FE-analysis of the stresses within the ballast-bed, caused by the different track forms demonstrates the superiority of the new design over the traditional one. The design of the “frame-sleeper” includes a remarkable stiffening in the horizontal plane as a result of the (new) ability to distribute lateral loads not only by the rails but also by the structure of the sleeperage. This is because every “frame-sleeper” holds 4 fasteners, 2 per rail.

Eddy-current brakes for high-speed trainsets are ready for application. A matter of concern is the additional temperature increase excited by their action. The high stability of the “frame-sleeper” track allows for unlimited use of these braking systems.

Seen from practical application on already existing lines it is important to develop a structure to fit with the existing widths of the embankments. No widening of the subgrade was needed at anyone of the sections where “frame-sleeper” track was installed.

Full and transition curves with any radii have been laid with this type of track. Existing track machinery was used exclusively.

In 1999 a first test section was laid in a busy line in Austria, later also in Switzerland and Italy. The procedure of track construction is almost equal to present practices, the only difference is seen in fully tightening the fasteners only after the final tamping operation, which may include also aligning slews. Ballasting is done with the respective machinery in the normal way. Dynamic stabilisation concludes the installation as usual.

It is quite obvious that “frame-sleeppers” are somewhat more expensive than standard sleepers. However, LCC calculations clearly demonstrate the superior cost situation with “frame-sleeppers” for heavily loaded and/or high-speed tracks.