COMPARISON OF THREE RAILWAY TRACK TRANSITION CURVE TYPES

Szabolcs Fischer
Széchenyi István University
Győr, Hungary
szabolcs.fischer@gmail.com

1. The problem

The reconstruction of the international main railway lines is an important task in Hungary. The allowed speed on these lines today is usually 100 or 120 km/h. The reconstructions currently in preparation are mostly planned for 160 km/h. However in Hungary there are only a few experiences with the construction and operation of railway lines with speeds of 160 km/h. Therefore the revision of the Hungarian railway track geometry design regulations (HRDR, GKM, 2003) in accordance with the relevant European norms (ENV, CEN, 2002) is necessary.

2. The analysis

The railway tracks consist of straights, transition curves and circular curves. I compared three types of transition curves. In the Hungarian railway design clothoide and cosinus transition curves are used, while in Austria a third type of transition curve exists, the Wiener Bogen, which was developed by Austrian engineers (ÖBB, 2004).

My analysis contained transition curve geometry, which just meets the standards’ requirements. On one hand I calculated the clothoide and the cosinus transition curves according to HRDR, the Wiener Bogen curves according to the ENV and the ÖBB standard. In a second approach I calculated the three types of transition curves according to the ENV. I computed every parameter of the transition curves, and I compared them with the limiting values of the standards.

The Hungarian regulations contain several geometric and dynamic parameters which have too meet certain requirements. In the ENV there are two additional new parameters: the angular acceleration about roll axis, and the angular jerk about roll axis. In some common parameters the ENV has stricter limits, but in some others the HRDR applies sterner values. I investigated whether it is reasonable to accept the recommended limiting values (RLV) of the ENV in Hungary, and whether it is important to use the additional two parameters. My analysis regards for the ENV „IIa” traffic category (mixed traffic lines, with passenger train speeds V=120…160 km/h).

3. The results of the analysis

Calculated according to Hungarian regulations, the clothoide curves do not meet all requirements of the ENV and the same calculated cosinus curves are good only in the interval R>3000 m (Fig. 1). The rate of change of non-compensated lateral acceleration (ROCONLA) is higher than the RLV.

If we calculate the transition curves according to the ENV rules, all transition curves meet the requirements, but the lengths of these curves are greater than in the first case.

In conclusion I have found that in the interval R=1600…6000 m the two additional new parameters of ENV are far below their limiting values. The minimal length of the transition curves is determined by the rate of change of cant deficiency as a function of time and the ROCONLA (Fig. 2).

Further to the above statements I have shown that the restriction on the use of the clothoide in HRDR for speeds not higher than 120 km/h has no reason. I found no dynamic problems with the use of clothoids up to 160 km/h.

The above results can help in the application of the ENV standard in the HRDR.
Fig. 1: The comparison of the transition curves as a function of rate of change of non-compensated lateral acceleration in 1st case

Fig. 2: The comparison of the transition curves as a function of rate of change of non-compensated lateral acceleration in 2nd case

4. Bibliography

