SOLUTIONS FOR EMBANKMENT-BRIDGE TRANSITION ZONES

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ABSTRACT

High speed trains bring new problems due to high speeds (Di Mino and Di Liberto 2007) and it is easily understood that the quality criteria for high-speed lines must be much more restrictive than those for conventional rail lines to assure comfort and safety of passengers (Ju, 2002). Transition zones are, nowadays, one of the biggest problems of railways that have deserving a special attention by scientific community (Di Mino and Di Liberto, 2007).

Transition zones, such as bridge approaches (Sasaoka and Davis, 2005), are locations where a railway track exhibits abrupt changes in vertical stiffness (Lei and Mao, 2004) and can present serious problems when subject to dynamic loads which can generate impacts that contribute to accelerated degradation of the track and therefore its frequently maintenance, apart from a possible reduction on its life (Sasaoka and Davis, 2005).

According to Sasaoka and Davis (2005), track transition problems can be divided into three categories: i) differential settlements; ii) track stiffness case; iii) track damping case. To reduce the problems above mentioned is necessary to make a smooth change of vertical track stiffness and damping from an embankment to a bridge and vice-versa. This paper presents behavior and performance of several solutions based in a deep bibliography survey. These different solutions can be considered acting strictly at structural or geotechnical levels. Between these solutions it can be found some such as: i) variable tie's length or cross section, with possibility, at the same time, to reduce its spacing (Read and Li, 2006); ii) geocell or soil-cement mixture in embankment zone (Sasaoka and Davis 2005 and Read and Li 2006); approach slabs (Sasaoka and Davis 2005 and Read and Li 2006); iv) stone columns or piles as foundation reinforcement (Read and Li 2006); v) geosynthetic reinforced soil (GRS) bridge abutments (Wu *et al.* 2006); vi) lightweight fills (Read and Li 2006); vii) inverted wedge (Manterola and Cruz 2004).

More recently the solutions for transition zones of railways combine structural and geotechnical approaches. Between these solutions are: i) hot mix asphalt (HMA) underlayment in embankment zone (Read and Li 2006); ii) under sleeper pads (UPS) or under rail pads in bridge zone [rigid zone] (Read and Li 2006); iii) frame-sleeper-track (Riessberger 2006); iv) composite ties (Read and Li 2006).

In summary it can be concluded that the solutions based strictly on geotechnical or strictly on structural level have as main objective to increase progressively track stiffness from the embankment to the bridge. This can be achieved by strengthening and increasing the bearing capacity of embankment and foundation. However, these solutions don't exhibit the best performance to make transitions between embankments and bridges. The solutions based on a

combination of structural and geotechnical approaches, such as under sleeper or under rail pads and composite ties, have as main objective to reduce the stiffness on the bridge. However these solutions are new and its long term performance is still not proved, needing more research and monitoring of field behavior. These solutions show a good performance and a good behaviour to make transitions between embankments and bridges, and also can be designed to a desired level of stiffness. Frame-sleeper-track can also be a promissory solution for transition zones.

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