American Railway Engineering and Maintenance of Way Association
Letter Ballot

1. **Committee and Subcommittee**: Committee 30 – Subcommittee 4

2. **Letter Ballot Number**: 30-18-02

3. **Assignment**: D4-3-15: Research tie pads and ballast pads and include in Chapter 30.Ongoing assignment.

4. **Ballot Item**: Introduction of new section with description of under tie pads

5. **Rationale**: Under tie pads are components that have originated from the European market and have grown in use in North America in the last decade. However, only a simple mention of the component in Section 1.8.3 exists in the current manual. This section is intended to provide additional verbiage that describe the component in more detail and designates current uses and known benefits based on published research available to-date.
SECTION 1.8 RESILIENT TRACK COMPONENTS

This section details information regarding resilient, or elastic, elements used in the railway track. Components may be installed at different interfaces of the structure and with various stiffness while serving similar purposes.

1.8.1 UNDER TIE PADS

Under tie pads (UTPs) are pads made from plastic, thermoplastic or elastomeric materials that are attached to the bottom of crossties. In North America, under tie pads have been used regularly, though not exclusively, at special trackwork (e.g. turnouts, diamond crossings, etc.) and on ballasted bridge decks given their ability to help mitigate transition challenges (see Section 1.9.2) (Mademann and Otter, 2013; Sol-Sánchez et al., 2015). Further, UTPs have been used more extensively in Europe and in other parts of the world. UTPs are manufactured with dimensions allowing approximately a 0.5 inch space around the perimeter of the crosstie to which they are installed to protect the component and avoid any impact to maintenance activities (e.g. tamping, etc.).

Figure 30-1-2. Under tie pad on concrete crosstie, (a) Connection layer (used for installation into fresh concrete during production); (b) Elastic layer

1.8.1.1 Purpose

The implementation of UTPs has thus far had two primary purposes: 1) maintenance reduction and track quality improvement, and 2) vibration mitigation. Undoubtedly, a clear distinction between these two purposes is not always possible as high resiliency UTPs can be used for vibration mitigation as well as for areas where high dynamic impacts are expected. Nevertheless, products should always be evaluated based on their intended application purpose.

1.8.1.1.1 Maintenance Reduction and Track Quality Improvement

As the track and its components degrade over time, maintenance is required on a regular basis. UTPs have shown they can help to reduce ballast degradation and prevent excessive permanent settlement due to the following effects (Veit and Marschnig, 2013):

a. Load distribution:
   Due to the reduced stiffness of the track, the deflection basin is extended and therefore more crossties share the applied load. In addition, the load is distributed between the crossties more evenly. These combined effects reduce the maximum load on each crosstie. Consequently, track component mechanical stresses are reduced (Mademann and...
b. Increased contact area:
The elastic – or elastoplastic – behavior of UTPs leads to increased contact area between the crosstie bottom and ballast, resulting in a reduction of ballast pressures and increased lateral resistance. New unpadded concrete crossties show a typical contact area of 1-9% (Lichtberger, 2005), whereas padded crossties can show up to 35% (Gräbe et al., 2016). This reduction in ballast contact pressure reduces ballast deterioration (e.g. fouling) and other related problems such as hanging crossties or uncontrolled settlement (McHenry, 2013; Potocan and Dorfner, 2013).

1.8.1.1.2 Vibration Mitigation

In areas where vibration mitigation is needed, high resiliency UTPs can be employed and may provide up to 15 VdB insertion loss (at 63Hz) depending on maximum allowed rail deflection (RIVAS, 2011).

1.8.1.2 – Fixation

Methods of fixation for UTPs vary based on the crosstie material used. Common fixation methods are:

a. Concrete crossties:
   (1) During casting: insertion of integral connection layer into fresh concrete
   (2) Finished crosstie: gluing
b. Steel crossties:
   (1) Gluing
c. Timber/Composite crossties:
   (1) Stapling/Nailing
   (2) Gluing (challenging when creosote or other oil-like treatment chemicals are present)

1.8.1.3 Examples for Areas of Use

1.8.1.3.1 Special Trackwork

Special trackwork typically require a greater amount of maintenance than open track. Due to complex geometry, different sections of turnouts and diamonds exhibit different stiffness, and supporting crossties are subject to off-center loads. UTPs can help to adjust the stiffness within these sections and make crossties exhibit more uniform displacements. Impacts loads are also reduced, leading to decreased maintenance efforts (Loy, 2009).

1.8.1.3.2 Track Transitions

Section 1.9.3 states that elastic components in the track structure can be used in transition zones to adjust abrupt differences in vertical track stiffness.

1.8.1.3.3 Reduction of Ballast Thickness

UTPs may also be installed to allow a reduction in the total ballast layer thickness due its ability to distribute loads and reduce the stresses in the track structure.
References


