TO	Network Wide
FROM	General Manager Technical Standards
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SUBJECT	Track and Civil Code of Practice – Section 4 - Under Ballast Mat (UBM) – Technical Note
REFERENCE	Technical Note – Under Ballast Mat

Background

Energy absorbing mats such as under ballast mat (UBM), also referred to as sub ballast mat (SBM), are resilient mats placed under the ballast layer. UBMs can be homogeneous (uniform structure) or layered (layers of different materials and properties).

The use of energy absorbing resilient pads (including UBMs) to attenuate rail track degradation is an established practice worldwide however there are no applicable Australian standards that nominate minimum requirements or performance criteria. Incorrect material specification or installation practices can contribute to poor track quality.

Scope

This document outlines guidance for the use of, and requirements for, UBM in ballasted railway tracks. UBM in ballast-less track systems are not covered by this Technical Note.

This Technical Note overrules any contradicting requirements in any other Engineering Standard while published.

Under Ballast Mat (UBM)

The more common applications of UBM on ballasted railways tracks include:

- Protection of concrete deck rail bridges, tunnel floors and culverts where there is insufficient ballast depth (a waiver will be required for non-compliant ballast depth).
- Reduce noise and/or vibration emitted into the environment.
- Modification of the overall vertical elasticity of the track substructure and to provide a smooth transition at locations where abrupt changes in vertical track modulus occur (e.g., transition to ballast top bridges).
- Reduce ballast degradation/breakage and therefore reduced requirement for track maintenance.
- Provide impact dampening for structures.

The Designer shall consider the impact of ballast mat on the whole track system, including the above-mentioned aspects.

The Designer shall specify the appropriate UBM properties to suit the specific application and purpose, taking into consideration the track substructure and superstructure, and operating conditions (primarily axle load and train speed).

The most important UBM properties are determined by the primary purpose/function of the mat, and may include:

- Static bedding modulus—simulates vertical rail deflection under the pressure of slow moving or stationary rolling stock. The static bedding modulus is non-linear, and as such the static bedding modulus is determined within different ranges of loads, depending on the application/purpose of UBM. The static bedding modulus is normally evaluated as a secant modulus with respect to the range of stresses assessed.
- Dynamic bedding modulus (low and high frequency)—simulates vertical rail deflection under the pressure of moving rolling stock and impact vibration transmission. The dynamic bedding modulus is a function of the loading force and loading frequency; as such, the dynamic bedding modulus should be determined under the anticipated pressures and frequency ranges. The dynamic bedding modulus obtained at low frequencies is normally used to determine the deformation of the rail under a rolling wheel and the modulus of the track system; whilst the dynamic bedding modulus obtained at higher frequencies is more often used to determine the damping of structure-borne noise.
- Dynamic stiffness ratio—the ratio between the low dynamic and static bedding modulus. Because the properties of elastomeric materials are dependent on the rate of loading, the bedding modulus and stiffness modulus should be determined for various excitation frequencies within the anticipated range. The Dynamic stiffness ratio is generally more important to the vibration damping properties of UBM. A ratio of 1.5 to 2.0 would be suitable for most UBM applications. A ratio of 1.3 to 1.5 would be expected for softer UBM used for vibration attenuation applications.

UBM should meet the following requirements unless specified otherwise by the Designer:

Table 1 Requirements for Under Ballast Mat (UBM)

Property	**Criteria**	**Test Method**
Tensile Strength	≥ 0.65 N/mm^2	ISO 527-3:2019-02
Elongation at Rupture	UBM with single homogenous layer ≥ 200% UBM with an integral ballast side structural layer ≥ 100%	ISO 527-3:2019-02
Static Bedding Modulus – General use Ballast Depth ≥ 300 mm Ballast Depth < 300 mm	 0.10–0.16 N/mm^3 0.06–0.10 N/mm^3	I.S. EN 17282:2020 Track Category TC4, freight with heavy axle loads including mixed traffic Load range: 0.14 N/mm^2 to 0.20 N/mm^2
Typical Static Bedding Modulus – Softer UBM for vibration attenuation	0.02–0.06 N/mm^3	

Other test methods to recognised standards may be referenced to determine product suitability if they can be shown to provide equivalent results. Testing must be carried out on a complete UBM sample, not on individual elements. The laboratory test report is to be provided to support any assessment of product suitability.

The UBM manufacturer must provide installation instructions, including joint treatments. Typically UBM are single layer, butt jointed and not lapped.

UBM may be smooth or have a textured finish; typically the textured side faces downward.

UBM shall only be installed over concrete surfaces.