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The proper design of narrow backfill retaining walls is of utmost importance due to the potential catastrophic consequences of their failure on human safety. A well-designed narrow backfill retaining wall is essential for safeguarding human lives in densely populated urban areas. The importance of conducting experiments with only a limited amount of analytical work cannot be overstated, particularly when dealing with complex geotechnical challenges like calculating earth pressure for retaining walls in urban areas. While advanced analytical methods are essential, experiments in the field or laboratory provide invaluable real-world data that can validate and refine theoretical models.

In our research we have developed an experimental setup which can simulate the real world conditions of the narrow backfill retaining walls and help us study the effect of various parameters on the distribution and magnitude of the earth pressure. The setup has two sides made of acrylic sheets which facilitate the visualization of the slip surface inside the backfill as shown in **Figure 3**.

With India boasting the world's largest road network, the significance of narrow backfill retaining walls cannot be overstated. These structures are indispensable in supporting road construction in challenging terrains, ensuring safety, and enhancing connectivity. They play a pivotal role in safeguarding human lives and property while enabling access to remote regions. As India develops and expands its road infrastructure, the use of narrow backfill retaining walls will remain crucial for efficiency, resilience, and safety in this extensive transportation network.

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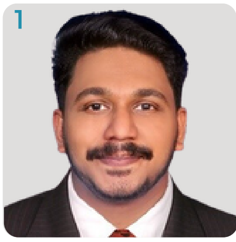
Mitigation of High-Speed Train Induced Ground Vibrations using EPS Geofoam In-Filled Trenches



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Over the recent decades, High-speed Railways (HSR) has emerged as a highly sought-after mode of transport across the globe to cater to the transportation needs of the rapidly growing world population. HSR is often referred to as the mode of transport of the future since it provides an economically viable solution to various challenges in roadways like traffic congestion, excessive air pollution, and discomfort in long-distance travel.

Although HSR offers several benefits, the ground vibrations generated during HSR operations have detrimental impacts on the railway infrastructure and sensitive structures in the track vicinity. They also cause discomfort to the passengers and residents in the buildings close to the tracks. According to the German national standard DIN4150 and Federal Transit Administration (FTA) guidelines, the vibration limits for residential and commercial structures are 5 mm/s and 3 mm/s, respectively.

Comprehensive analyses performed by Connolly et al. (2016) on train-induced vibrations in 1604 railway track sections across 16 countries revealed that ground vibration and noise limits were surpassed in 44% and 31% of instances, respectively.

The critical appraisal of the literature portrays extensive research on the generation and propagation of ground-borne railway vibrations and several measures to mitigate them effectively.

Ground-borne vibrations can be attenuated by vibration-control measures implemented at the source or receptor, or by obstructing the wave propagation path using wave barriers. Frequently, trenches positioned at varied distances away from the railway embankment (beside the track) are used as vibration wave barriers due to their low cost and excellent vibration-damping performance. It works as a discontinuity in the path of propagating waves, causing them to undergo reflection, refraction, transmission, and absorption (**Figure 1**).

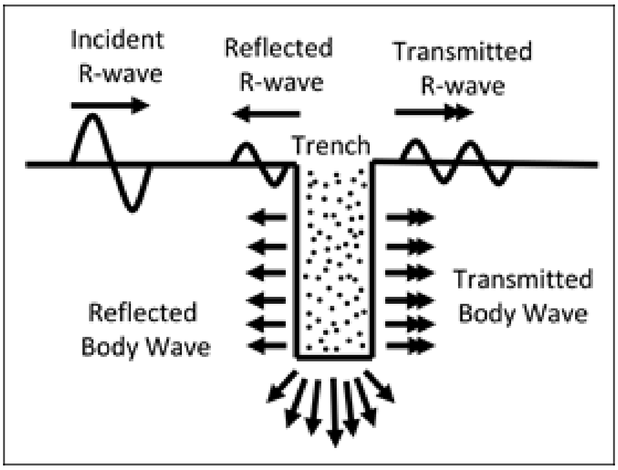

Figure-1: Propagation of surface waves through trench

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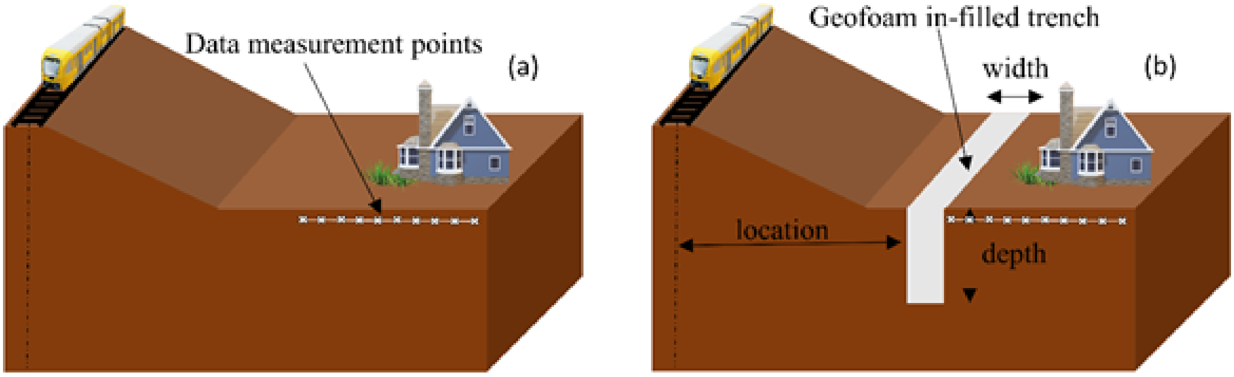

Figure-2: Railway embankment models (a) without trench (b) with EPS geofoam in-filled trench

Despite previous research works indicating that open trenches are more efficient than in-filled trenches, practical constraints in maintaining deep open trenches limit their field applications. These trenches are hence filled with construction materials like soil-bentonite mixtures, rubber-asphalt mixtures, etc., which possess excellent vibration mitigation characteristics.

The utilization of Expanded Polystyrene (EPS) geofoam as a wave barrier against ground vibrations has garnered significant attention recently. However, the survey of the literature reveals that limited research has been carried out on mitigating HST-induced ground vibrations using EPS geofoam. Research in this direction was hence carried out in the Railway Geotechnics Lab. at IITH, focusing on the mitigation of HST-induced ground vibration using EPS geofoam in-filled trenches. Finite element analyses were carried out using two-dimensional models of double-layer ballasted track segments for an axle load of 25 T using PLAXIS 2D, and the vibration attenuation efficiency of EPS geofoam trenches was evaluated in terms of reduction in the Peak Particle Velocities (PPV) of vibrations after installation of the trench beside railway embankment (**Figure 2**).

Studies were carried out on the influence of location, dimensions, and geofoam material in the trench for a wide range of train operating speeds. Results from the analyses revealed that vibration isolation trenches were most effective in mitigating vibrations when placed next to railway embankments. It was seen that deeper trenches exhibited a higher potential for attenuating vibrations and that the width of the trench was directly proportional to the efficiency of vibration attenuation.

About 44% reduction in the ground-borne railway vibrations could be achieved using optimized sections of EPS geofoam in-filled trenches. The research concluded that EPS geofoam in-filled trenches can serve as excellent passive vibration isolation barriers for attenuating ground-borne vibrations induced by high-speed trains.

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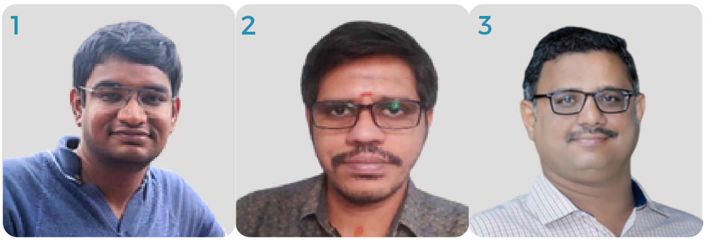
Modeling and Analysis of Back-to-Back Mechanically Stabilized Earth Walls for Highway and Railway Bridge Approaches



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Mechanically Stabilized Earth (MSE) Walls are flexible structures in which reinforcements are embedded into backfill to develop a frictional resistance between backfill soil and the reinforcements. This interaction through the mobilized frictional resistance provides stability of the MSE walls, as opposed to the conventional gravity retaining walls which achieves their stability by their self-weight.

Unlike a single MSE wall, when two MSE walls are placed in close proximity, they start to interact with each other, and a complex structure called back-to-back mechanically stabilized earth (BBMSE) walls is formed. MSE walls are designed based on the guidelines of the Federal Highway Administration (FHWA) [1]. FHWA guidelines for the design of BBMSE walls have given two extreme cases.