Experimental studies on narrow backfill retaining walls

KID: 20230307

In the context of urbanization and the requirement for new roads, constructing retaining walls with limited width becomes even more critical. As cities expand and available space becomes scarcer, roads often need to be built in areas with challenging terrain, such as hillsides or sloping landscapes, as shown in **Figure 1 and Figure 2.** Limited width for retaining walls is a common constraint in such scenarios. These walls are essential to provide stability, prevent erosion, and maximize the available road space. Proper engineering and innovative design are necessary to ensure that retaining walls with limited width are not only functional but also environmentally friendly, blending seamlessly into the urban landscape while accommodating the increasing urbanization demands.

Calculating earth pressure for retaining walls with limited width in urban areas can be challenging, primarily because conventional earth pressure theories like Rankine's or Coulomb's are not applicable because of the assumption that the slip surface gets developed from the heel of the wall to the top of the ground surface. The constraints of limited space, adjacent structures, and varying soil conditions demand more sophisticated analysis methods. Engineers often turn to advanced geotechnical analysis techniques, such as finite element analysis (FEA) or limit equilibrium methods, to accurately model the complex interactions between soil, the retaining wall, and adjacent structures. These approaches take into account factors like soil properties, wall geometry, surcharge loads, and construction sequences to determine the appropriate design for retaining walls in urban environments.

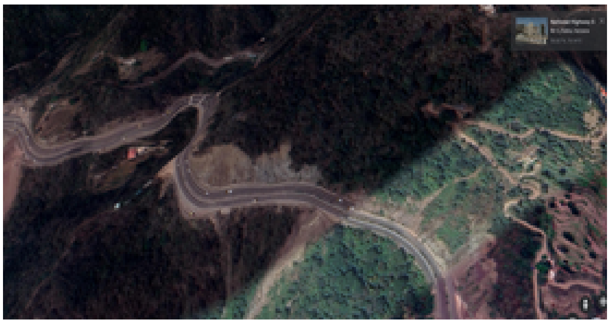

Figure-1: Kalka - Shimla Road NH5

Figure-2: Jammu Kashmir NH44

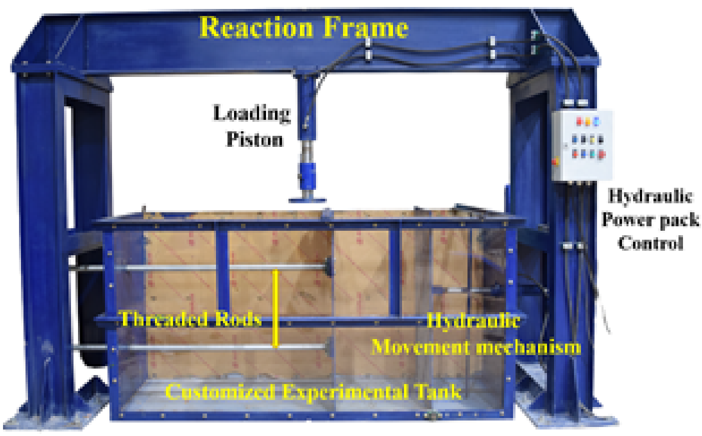

Figure-3: Customized experimental setup

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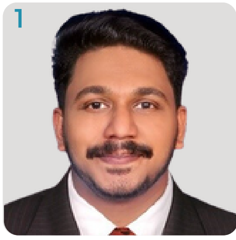
Mitigation of High-Speed Train Induced Ground Vibrations using EPS Geofoam In-Filled Trenches



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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**).

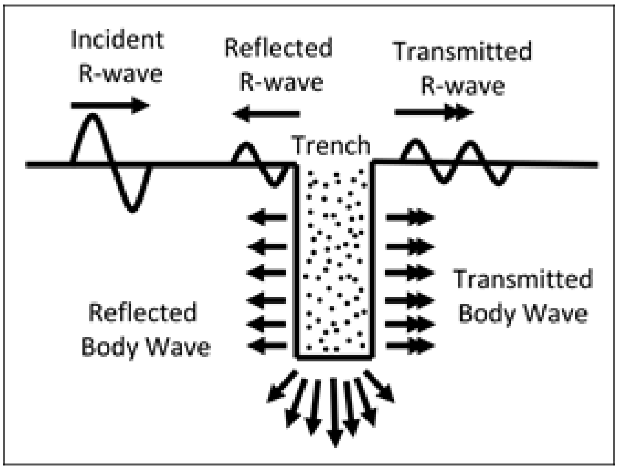

Figure-1: Propagation of surface waves through trench