

# A Finnish Case Study of U-Trough Underpasses in High Water Table Conditions for Gravity vs Anchored Structural System

Manish Mehta M. Sc, Yatharth Mathur M. Sc

Bridges & Civils, Ramboll India, Gurugram, India

Raul Vibo

Bridges, Ramboll Finland, Espoo, Finland

Contact: [mthn@ramboll.com](mailto:mthn@ramboll.com)

## Abstract

This paper presents a case study of underpass situated on Säterinpuistontie Street as part of the ESKA railway widening project in Finland which facilitates a cycleway, road, and tram tracks passing under the railway. Due to the proximity of the water table to the ground level in this area, specific design considerations are necessary to prevent structure uplift. The primary objective of the case study is to conduct a comprehensive comparison of the material, cost and carbon emissions between two distinct design approaches for watertight U-shaped reinforced concrete trough structures which involves a gravity structural system using high-density concrete and normal-density concrete with structure anchored to the base rock using steel anchors. The study aims to emphasize design methodology, variations in structural analysis methods employed by these approaches and provides a comprehensive understanding of the environmental and economic implications.

**Keywords:** trough; anchors; reinforced concrete; high density concrete; GWP; carbon; sustainability

## 1 Introduction

### 1.1 Project Background

Espoon kaupunkirata (ESKA) railway widening project includes construction of two additional tracks next to the current tracks between Leppävaara and Kauklahti in Espoo, Finland. Espoon kaupunkirata is the first phase of the Helsinki-Turku high-speed rail project. This will help to improve capital region public transport system. Along with the track, cycling corridor near the track is also planned. This project involves construction of Railway and Pedestrian bridges, Underpass, Pile slabs and Retaining walls. The focus of this case

study is on one of these underpasses situated on Säterinpuistontie street. This underpass facilitates a road traffic, light traffic and tram tracks passing under the railway and cycle bridge. It also serves as a supporting structure municipal utility pipelines.

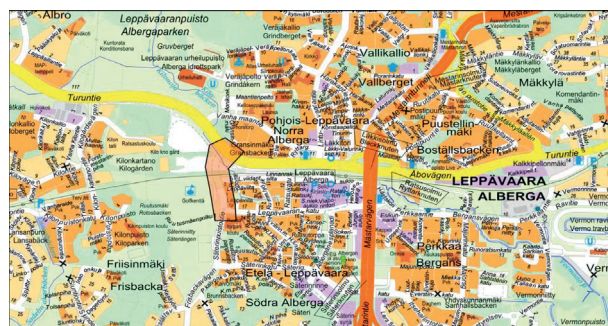


Figure 1. Location of Underpass