

# **The effects of Soil voids deformation behind the tunnel lining on it's structural behavior**

## **Case study - Badama tunnel lining (Syria)**

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### **Abstract**

**Badama tunnel is one of the eight railway tunnels which exist between Aleppo and Lattakia cities (Syria). It was built in 1971-1972. The Badama tunnel is suffering in many parts from deteriorations and groundwater leakages through lining cracks.**

**As a result of groundwater leakage from the surrounding soil, many voids were formed in the soil behind the lining. As these voids were not considered at the design stage, their presence may affect the lining structural behavior due to new non expected stresses applying on it. The additional stresses may lead to lining deterioration or collapse.**

**This article aims to study the voids effect on the structural behavior of Badama tunnel lining and its deteriorations using numerical modeling tools. We followed the methodology that depends on Transition from field observations to numerical modeling, because this way makes it easier to compare the field observations with the results obtained from our analysis. We found that the stress values produced in the lining is related to the voids volume behind it. And there is an accordance between the actual lining state and the numerical analysis results.**

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**Keywords: Tunnel, Lining, Deterioration, Voids, Numerical modeling, Distinct Element Method**

For the paper in Arabic see pages (277-292)

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