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An Alternative Rectangular Tunnels to Conventional Twin Circular Bored Tunnels in Weak Ground Conditions

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Abstract : The outcomes of a numerical research study conducted using the PLAXIS software to analyze surface settlements and moments generated in tunnel linings. The investigation focuses on both circular and rectangular twin tunnels. The study suggests that rectangular tunnels, although considered unconventional in modern tunneling practices, may be a viable option for shallow-depth tunneling in weak ground. The recommendation for engineers in the tunneling industry is to consider the use of rectangular tunnel boring machines (TBMs) based on the findings of this analysis. The research emphasizes the importance of evaluating various tunneling methods to optimize performance and address specific challenges in different ground conditions. These findings provide valuable insights into the behavior of rectangular tunnels compared to circular tunnels, emphasizing factors such as burial depth, relative positioning, tunnel size, and critical distance that influence surface settlements and bending moments. This research explores the feasibility of utilizing rectangular Tunnel Boring Machines (TBMs) as an alternative to conventional circular TBMs. The research findings indicate that rectangular tunnels exhibit slightly lower settlement than circular tunnels at shallow depths, especially in a narrower range directly above the twin tunnels. This difference could be attributed to maintaining a consistent tunnel-lining thickness across all depths. In deeper tunnel scenarios, circular tunnels experience less settlement compared to rectangular tunnels. Additionally, parallel rectangular tunnels settle more gradually than piggyback configurations, while piggyback tunnels show increased moments in the tunnel built second at the same level. Both settlement and moment coefficients increase with the diameter of twin tunnels, irrespective of their shape. The critical distance for both circular and rectangular tunnels is around 2.5 times the tunnel diameter, and distances closer than this result in a notable increase in moments. Rectangular tunnels spaced closer than 5 times the diameter led to higher settlement, and circular tunnels spaced closer than 2.5 to 3 times the diameter experience increased settlement as well.

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