Key Technologies for Design and Construction of Steel Trestle Bridges in Deep Foundation Pits by Top-Down Method (Postprint)

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Abstract

Steel trestle bridges, characterized by convenient installation and removal as well as ease of recycling, have become a crucial technical solution for addressing construction challenges in top-down deep foundation pits, including limited working space and difficulties in excavation removal and construction material transportation. This paper investigates the design and construction of steel trestle bridges for top-down deep foundation pits in water-rich sand layers. The connection form between steel pipe column tops and Bailey beams is examined, and a "slope-type" connection end is developed, which is welded after the steel pipe columns are excavated, thereby ensuring installation accuracy and improving construction efficiency. The structural configuration and construction method of the pile-column support are optimized by employing a pre-insertion method to reliably connect steel pipe columns with uplift pile rebar cages before hoisting them to the design elevation at the construction working surface, which guarantees the verticality of both uplift piles and steel pipe columns. The Bailey beams and inter-column supports of the steel trestle bridge are installed concurrently with excavation, ensuring overall safety and stability. Loading numerical simulations of the main components and steel pipe column stability are performed using Midas finite element analysis software. The results demonstrate that the steel trestle bridge is safe and reliable, satisfying construction requirements.

Full Text

Preamble

Research on Key Technologies for the Design and Construction of Steel Trestle Bridges in Top-Down Deep Foundation Pit Excavation

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Abstract

Steel trestle bridges have become an important technical solution for addressing the challenges of limited workspace and difficult material transportation in top-down deep foundation pit excavation, owing to their convenient installation and removal, as well as their recyclability. This paper investigates the design and construction of steel trestle bridges for deep foundation pits in water-rich sandy strata using the top-down method. A novel "slope-type" connection detail between steel pipe columns and Bailey beams was developed, which is welded after the columns are excavated, ensuring installation precision and improving construction efficiency. The structural configuration and construction method for pile-column supports were optimized by employing a pre-insertion technique that reliably connects steel pipe columns to anti-uplift pile reinforcement cages before hoisting them to design elevation at the working face, thereby guaranteeing the verticality of both anti-uplift piles and steel pipe columns. The Bailey beams and inter-column supports of the trestle bridge are installed progressively as excavation proceeds, ensuring overall structural safety and stability. Numerical loading simulations of the main trestle bridge components and steel pipe column stability were performed using Midas finite element analysis software. The results demonstrate that the steel trestle bridge is safe and reliable, meeting all construction requirements.

Keywords: top-down construction method; deep foundation pit; steel trestle bridge; Bailey beam

Note: Figure translations are in progress. See original paper for figures.