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Classification of Precast Concrete Segments Damages during Production and Transportation in Mechanized Shield Tunnels of Iran

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Abstract

Precast concrete segments used in shield tunnel linings are prone to damage in many situations. These damages can occur at different stages such as fabrication in segment factory, transportation to tunneling site, during tunneling process, and at serviceability stage. The aim of the present article is to study the damages inflicted on concrete segments during production and transportation, and to present a new classification of these damages throughout the two stages. The developed classification is based on field observations and examinations of major subway and water conveyance mechanized shield tunnels of Iran, located in Tehran, Tabriz, Mashhad, Kermanshah (Nosood) and Isfahan (Golab). The quality of tunnel lining suffers from what, as a direct consequence of any damage to concrete segments, during production and transportation, which will be also discussed in this article. For further investigation, more than 250 concrete segments from Tehran subway line 3 and 350 segments of concrete segments from Tehran subway line 7 were selected and studied for a statistical analysis of chipping and crack, consecutively. Absence of preventive measures to limit segment damages in precast segment factories is one of the main reasons for increased number of damaged concrete segments, and as a result, increased costs of tunnel construction at later stages. In this paper, production phase damages and factors contributing to these damages are studied. According to the findings of the study, the human (operator) error was the most important cause for chipping, and, time-dependent behavior of concrete was the essential reason in crack of precast segments. Eventually, final section of the article presents practical solutions for reduction of damages during fabrication and transportation of concrete segments.

Keywords: Concrete Segments; Statistical Investigation; Concrete Segments Damages; Chipping; Cracking.

1. Introduction

Concrete segments are employed as lining system in tunnels, which are excavated by TBMs (Tunnel Boring Machines). The segments are fabricated in segment factories and transported to the tunnel for being installed by the boring machine [1]. Various standards are provided for different aspects of precast concrete segments, which are used

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