Detailing of a Concrete Tunnel: 
Application of Crack Inducers for Controlled Cracking of the Slab

Introduction

The railway viaduct that was passing through the city of Delft is being replaced by a new 2.4 km long four-track railway tunnel. In order to enable free train/car/tram traffic during the whole construction period and to minimize the working space, a phased top-down building method is applied. First the diaphragm walls were made and, subsequently the floor and roof slabs were poured between them (Figure 1). Contrary to traditional design, the slabs were made continuously and without the application of dilatation joints. During hardening, floor and roof slabs tend to shrink, but are restrained by (non-shrinking) diaphragm walls. In order to reduce stresses due to restrained deformation, an innovative concept is applied: crack inducers are placed every 14m in the concrete slab of the tunnel (Figure 2-left). These inducers should enable controlled cracking at “designed” locations and relief of stresses. Once the final crack pattern is reached (after concrete in the slab has hardened) cracks are injected and the structure is considered to be watertight.

Goal

The goal of this MSc project is to check the benefits of applying crack inducers, to calculate the crack spacing, crack width and stresses in the tunnel due to restrained deformations, during the hardening and exploitation phase. Project results will be verified with the actual crack pattern in the executed tunnel. The question that imposes is whether the spacing of crack reducers with the existing reinforcement are adequate to keep crack widths and spacing in the acceptable range. Furthermore, it is the intention to investigate other innovative concepts for the design and detailing. For example, the application of ultra-ductile concrete might be a promising solution to keep the cracks tight and avoid the need for the crack injection (Figure 2-right).

Are you a concrete structure person who is interested in innovative design and materials? 
If so, this project is for you!

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