



Practical Integration of Risk Management and Monitoring During Rebuilding of Subway Station CS Rotterdam

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Summary

In the centre of Rotterdam, extensive reconstructing works were executed in the underground subway station CS during the period 2005 – 2011. The goal was to provide sufficient passenger transfer capacity in the future.

This paper describes the process and the results from evaluation of the project's monitoring experience by comparing the design phase (contract specifications) with the construction phase (control of building activities with monitoring results). Within this context the monitoring of some technical project features will be highlighted. It is concluded that the complete risk control and monitoring format as followed by Rotterdam Public Works has proven to be of vital importance for safe and proper execution of construction works in an urban environment.

Keywords: Risk management, monitoring; ground water level, deformation, tunnel, lessons learned, building in urban area

1. Introduction

The underground subway station is transformed from a two-track, single platform lay-out into a three-track, two platform configuration. The building activities of the project were executed direct on, above and below the existing subway station which had to be fully operational at all times. An extra complicating factor is that the existing subway tunnel has a direct physical connection with the high rise office building (height 140 m) that is located very close (less than 2 m) from the new station.

2. Risk driven monitoring

During this large construction project risk management and monitoring were integrated and given an important role. The risk management process can be split in 2 parts: 1) during design phase and 2) during the construction phase. Both parts have an interaction with each other.

The main activities during the design phase involve risk analysis, set-up of a monitoring plan related to the building specifications of the new subway station. The scope of building the new subway station in its four dimensional (x, y, z & time) surrounding is the basis for defining the risk profile. Based on the risk profile some risks can be controlled by monitoring. The technical monitoring specifications were based on the design of the new station and focussed on the specific risks.

In this project the principal is responsible for the design, whereas the contractor is responsible for the construction. The contractor has been responsible for almost all monitoring activities by making the monitoring specifications part of the contract. After contract award the contractor prepares his monitoring plan, in which the implementation of the monitoring specifications (how to measure, the choice of apparatus, the way of registration and warning procedures) is elaborated. At the same time the contractor makes plans how to control the risks related to his own building method, including possible solutions and mitigation.

3. Case and Evaluation

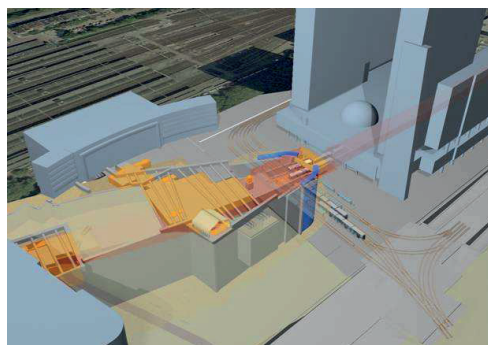
This case in the paper illustrates that monitoring can be very helpful to explain unexpected behaviour of the structures. By doing so a potential very high risk can be considered to its merits.

With the experience from recent projects the engineering department of Rotterdam Public Works (RPW) has evaluated the risk management and monitoring process. Additionally recommendations from Dutch guideline for Monitoring of Building Projects CUR 223 which has been available since 2010, have been compared to experience of RPW.

4. Lessons Learned & Conclusions

The monitoring specifications as prepared by RPW have proven to be an effective aid for control of risks within the building process. The monitoring specification's format is suitable for implementation in different types of contract. It is essential that monitoring together with its specifications are adequately incorporated in both the contract and the organization.

For adequate monitoring it is essential that monitoring is taken seriously, considering technical as well as organizational aspects, both during design and construction phase. The complete risk control and monitoring format as followed by RPW has proven to be of vital importance for safe and proper execution of construction works in urban environment. The risk management approach has, also by the lessons learned, developed to a standard procedure in RPW projects.



The Rotterdam practice for monitoring appears to be mainly subscribed by Dutch engineering guideline CUR 223, although optimizations are to be considered on the recommendations as included in latter document.

Figure 1: Overview Metro Station Central Station with diaphragm walls and collar construction