



## Collapse of the roof of a football stadium

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### Summary

In the summer of 2011 the Dutch football club FC Twente was building an extension of their stadium De Grolsch Veste, to increase the capacity of the stadium. On July 7<sup>th</sup> 2011, during construction, the roof of the partially finished extension collapsed. As a result of this accident two workers were killed and nine were injured, a few of them critically.

After this accident an investigation was started, following a standard strategy for investigating structural incidents. After analysing the behaviour of the structure, combined with analysing the collapsed structure, possible scenario's were investigated. The most likely scenario for the cause of the collapse was finally validated by finite element calculations.

The investigations led to the conclusion that the combination of a partially finished main bearing structure, in combination with almost all final permanent loads, had caused the collapse. The investigation has also shown that the used strategy for investigating structural incidents was very useful and resulted in well based conclusions.

**Keywords:** Collapse, roof, steel structure, finite element method (FEM), forensic investigation.

### 1. Introduction

In the summer of 1998 the Dutch football club FC Twente moved to a new stadium with a capacity of 13,500 spectators. Due to successes of the club, the capacity of this new stadium turned out to be insufficient. This has led to an extension of the stadium in 2008 to a capacity of 24,200 spectators by building a second ring with a roof along one long and one short side of the stadium. A few years later in 2011 this so-called L-extension was further extended to an U-extension, by building an identical second ring along the other short side of the stadium. On July 7<sup>th</sup> 2011, during construction,

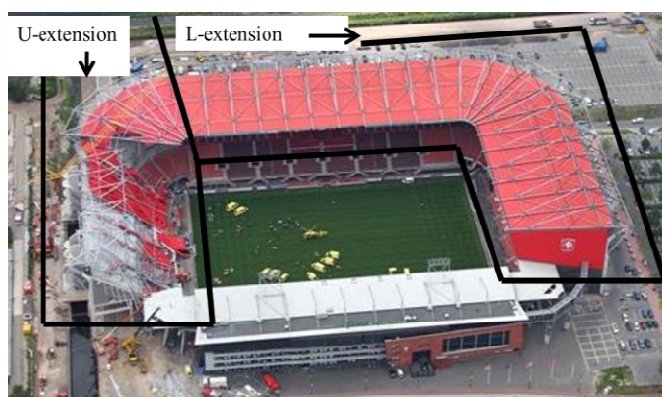


Fig. 1: Overview of the stadium

a major part of the roof of the U-extension collapsed. As a result of this accident two workers were killed and nine were injured, a few of them critically.

After the accident an investigation to find the cause of the collapse was started by the Public Prosecution, together with the Labour Inspectorate of the Ministry of Social Affairs and Employment and The Dutch Safety Board. These parties asked TNO to execute the technical part of that investigation. This paper presents an overview of the investigation executed by TNO and The Dutch Safety Board.