

# Nonlinear finite element analysis for structural assessment of existing bridges: network manager experiences

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## Abstract

The Dutch Directorate-General for Public Works and Water Management (Rijkswaterstaat) is assessing its bridges as a part of the major renovation and replacement task of bridge-structures in the Netherlands. For assessments it appears that calculations show that an increasing number of existing bridges no longer comply with current assessment standards or are becoming restricted in their functionality. Complete renovation is costly, results in disruption of traffic, and is not sustainable. The Eurocode permits to demonstrate sufficient safety using a nonlinear finite element analysis (NLFEA). NLFEA offers a possibility to demonstrate additional structural safety of the existing bridge-structures.

The challenge is to gain confidence that the approach gives reliable results for the structural safety of the considered bridge. Moreover, experience learns that NLFEA demands many choices to be made by Rijkswaterstaat as a client and will not always lead to unambiguous results. These choices concern modelling aspects, applied safety format, load positions, and the required sensitivity analyses. Another question is what conclusions, based on the obtained results of this analysis, can be drawn for similar structures.

This paper shows how Rijkswaterstaat has dealt with these challenges with case 'Peddemors' and what lessons are learned, all from the viewpoint of a client.

**Keywords:** Existing bridges, NLFEA, composite continuously supported prestressed girder, structural assessments, safety formats

## 1 Introduction

Rijkswaterstaat is facing a major renovation and replacement task for bridge structures. Linear elastic calculations show that more and more bridges no longer meet current assessment standards or have to be limited in their functionality. A complete renovation is expensive, leads to disruption of traffic, and is not sustainable. Non-linear finite element analysis (NLFEA) offers

the possibility to more accurately determine the structural safety of existing bridges. The challenge is to gain confidence that this approach will lead to reliable results. Many decisions have to be made by the owner when applying NLFEA. Section 2 of this document describes why and when Rijkswaterstaat applies NLFEA. This is done through a viaduct called Peddemors, for which an NLFEA has been carried out and which is introduced in section 3. Section 4 describes experiences, considerations, and