Re-using existing prefabricated prestressed concrete girders in new bridges

Rob Vergoossen, Gert-Jan van Eck, Danny Jilissen

Royal HaskoningDHV, Rotterdam, The Netherlands

Contact: rob.vergoossen@rhdhv.com

Abstract

The future of bridge and overpass design is to be fully circular. To reach that goal many innovations in construction should be made. One of the first steps is to alter the mainly existing linear construction sequence. Therefore, Royal HaskoningDHV started the innovation of re-using prefabricated concrete girders for new overpasses and bridges. In this paper the deconstruction and possible adaption processes are described. It was investigated if girders can be shortened, and their skew angle adapted. This was tested on a real girder. From this it can be concluded that adaption of existing girders is feasible. With this it is easier to re-use girders which can result in less time in storage and shorter transportation distance. Re-use for new design. It is also concluded that omitting the transverse diaphragm beams at the supports is an example of the highest principle of circularity 'rethink the needs' and find a non-material solution.

Keywords: Circular Overpass; prefabricated concrete girder; re-use; circular construction; bridge; prestress.

1 Introduction

It is estimated [1], the Dutch construction industry consumes about half of the raw materials and 40% of the total energy of the Netherlands. Construction is responsible for up to 40% of the waste produced and almost 35% of all CO2 emission released. About 97% of the construction waste is recycled and used as a foundation material for roads. However, the demand for road foundation material is decreasing by an expected amount of 40% due to less road development. On the other hand, it is expected more construction waste is produced, as more and more structures reach their end-of-service-life. Recycled aggregate from crushed concrete can also be used in new concrete. But for recycled aggregated concrete still a lot of energy is used and emissions are released. Currently less than 3% of the construction waste is used in recycled aggregate concrete.

The Dutch government supports the Concrete Agreement [2] where goals are set to reduce the CO2 emissions with 49% in view to 1990 and to recycle all concrete waste in new concrete in 2030.Besides, all governmental tenders should be circular from 2030.

Circularity can be achieved with multiple strategies like the 10-R method. The 10-R method contains a list of ten strategies, like refuse, reuse and reduce, that all begin with the letter R and can be hierarchical categorized. As a rule of thumb, the first R (refuse) has the most impact, and the tenth R (recover) has the lowest impact. Recycling is a strategy that is low rated in the 10-R method because the concrete can be used higher in the building cycle. The Dutch public works agency Rijkswaterstaat published [3] eight circular design principles for the built environment see figure 1. In this figure a hierarchy is also present between the circular design principles.