

Structural Health Monitoring of Henry Hudson I89

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1 Abstract

To increase construction safety during and after establishing an alternative load path for the arch supports of the Henry Hudson I89 Bridge in New York a Structural Health Monitoring System (SHMS) was employed in combination with a digital twin calibrated by the SHMS data. This method is one of the first in the United States used on a large-scale bridge installation.

The calibration was done by moving a Live Load across the bridge and use the strain gauges to detect weight, speed, and spacing of the passing trucks.

The measured configuration of the Live Load has subsequently been applied to a Digital Twin creating the digital responses. The measured forces analysed by applying linear stress theory and least square method on the strain gauge measurements, and the calculated Digital Twin forces show the same behaviour and the absolute values do not deviate more than 5%. This despite of a very small utilisation.

After the Live load validation of the measurements a data-driven approach has been applied to identify critical behavior of the bridge while the digital twin has been held as backup for analyzing consequences of any extreme load combination, should it occur.

Keywords: Digital twin, Structural Health Monitoring, Calibrated FE-Model, Predicative maintenance tool, Safe operation, Warning System

2 Introduction

To increase safety during critical retrofit construction work on the Henry Hudson bridge in New York, a Structural Health Monitoring System has been implemented. This article focuses on the method used to ensure that the Structural Health Monitoring System provides valid information and is backed up by a Digital Twin able to predict responses from possible critical scenarios. The output of this is to have a Digital Twin of the structure producing the same responses as

monitored on the real bridge when the same loading is applied.

The methods used to validate the SHM System is:

1. A weighed and GPS tracked Live Load Test has been conducted and the results have been compared to the results from the Digital Twin
2. Long-time results from the measurements have been compared to results from the Digital Twin.