Vehicle Collision into Steel Pedestrian Bridges

Lauri SALOKANGAS
Professor (act)
Aalto University
Espoo, FINLAND
lauri.salokangas@aalto.fi

Niko SAUNA-AHO
Civil Engineer (M.Sc)
Ramboll Finland
Espoo, FINLAND
niko.sauna-aho@ramboll.fi

Summary

During 2010 a few steel footbridges collapsed in Finland as a result of over-height vehicles colliding into the superstructure. This caused an investigation into horizontal impact loads on superstructures of pedestrian bridges and the magnitude of the collision force. To analyze the collision numerically, many parameters must be taken into account and a dynamic structural analysis must be performed. The magnitude of impact is strongly affected by the mass distributions and rigidities of the colliding vehicle and the bridge during the collision, as well as vehicle velocity, damping, changes in the geometry of both objects, the nature of the contact surface and resulting energy losses etc. The duration of collision time is short, usually only fraction of seconds, causing difficulties in the numerical analysis. In this paper a vehicle collision on bridge deck is reported. Collision forces of design codes are compared to the values obtained by simple spring mass system and results obtained by using dynamic nonlinear finite element analysis.

Keywords: Pedestrian bridge, steel bridge, impact, vehicle collision, collision forces, collapse, dynamic analysis, finite element method.

1. Introduction

In November 2010 a pedestrian bridge collapsed due to collision of over height vehicle on bridge's superstructure in Laajasalo, Helsinki. The driver did not notice that the loading crane of the truck was in upright position while driving. The crane hit on the superstructure and as a consequence the bridge collapsed.

1.1. Structure of the collapsed bridge

The bridge was statically determinate, one span pedestrian steel beam bridge with a wooden deck. The length of the superstructure was 20.2 m, the span 19.5 m and the effective width 3.5 m, respectively. The free height for under-pass was more than 4.6 m (Fig. 1).

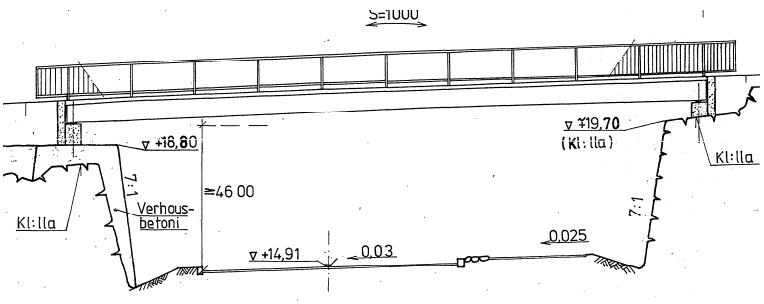

Fig. 1: Elevation of the collapsed pedestrian bridge.

The steel frame of the superstructure was a grillage consisting of two main girders (HE 600 B) and six transverse beams (HE 160).

The beams were connected by 5 mm fillet welds to the mid-height of the webs of the longitudinal girders as shown in Fig. 2.

https://doi.org/10.2749/222137813807018872