TIDC Transportation Infrastructure Durability Center AT THE UNIVERSITY OF MAINE

Detailed Finite Element Model of Devon Railroad Bridge East Abutment Span Under Typical Operation

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Abstract

Most railroad bridges currently in service in the United States were built in the late 19th and early 20th century using outdated design codes and technology. Although those bridges still operate under periodic inspections and enforced rating plans, they often exhibit an unusual dynamic response due to wear and tear owing to their old age (Malla et al., 2017). With the approaching life expectance of most bridges in the United States, it is essential to establish a methodology to evaluate the structural condition of existing bridges using cost-effective techniques. Therefore, there is a need to understand the bridge's behavior better. This study uses a different passenger vehicle to investigate long-span open-deck railroad truss bridge structural response using a computer model.

The Devon bridge is located over the lower Housatonic River between Milford and Stratford (Figure 1), Connecticut. It is a part of the Northeast corridor, the busiest passenger line in the nation, and it operates primarily under regular passenger trains such as Metro-North M8, Amtrak Acela, and Amtrak Regional (Lochner, 2011; Burns, 2022). The Finite Element (FE) model was created using ANSYS Workbench® (ANSYS Inc, 2009) to replicate the east abutment span of the Devon bridge with a 66.32 m (217'-7") span length. Due to uneven force distribution behavior, special attention has been given to bottom chord eyebar details (Jacobs, Dhakal, and Malla, 2021; Malla et al., 2017).

In addition, a series of triangular step forces with specific spacing has been used to represent and simulate different vehicles crossing the bridge span under static and dynamic analysis, using transient and influence line models, respectively.

Lastly, data collected during the field test using a laser Doppler vibrometer was converted to displacement time variation and compared with FE results in static and transient models (Figure 3).

Figure 1: Devon bridge east abutment span

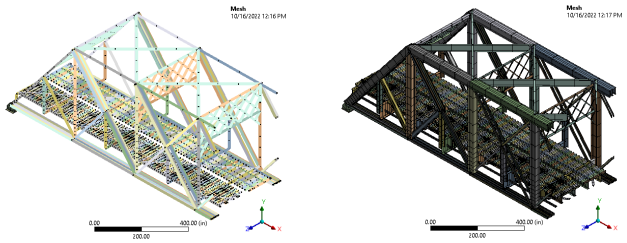

Figure 2: FEM 3D Model meshed half section, wire elements model (left), render model (right)

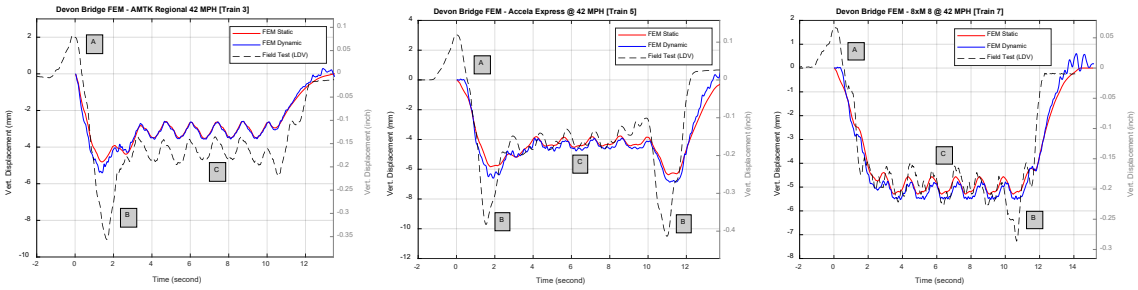

Figure 1: Vertical displacement FEM static (red), dynamic (blue), and LDV field test (dashed), Train 3 (left), Train 5 (middle), Train 5 (right)

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