As traffic and congestion increases so is the likelihood of collisions. The solution to this problem is usually through a rehabilitation process with mainly two options - widening or complete replacement (new construction of roadway and bridge). The most feasible and cost effective way to reduce traffic congestion and collisions is through widening of the roadway, which usually includes the road and bridges. While road expansion (widening) poses very minimal issues, the same cannot be said of bridge widening. The widening of an existing bridge presents a multitude of individual challenges during the planning and design phases, during construction, and throughout its service life. Special attention is required in both the design and detailing of the widening in order to minimize construction and maintenance problems.

The primary objective of this paper is to present a study to better understand the structural behavior and capacity used in an existing widened structural system which has been in service for over forty years (original bridge was constructed in 1973 and widened in 2003). The load demand on this bridge has double over the years. The widened structural system is composed of four - span continuous prestressed concrete bridge segments.

To better understand the widened bridge under investigation, an initial comparative analysis is performed between the original bridge constructed in 1973 with the exciting bridge which was widened in 2003. This comparative analysis for the two bridges will include the determination of the capacity, distribution factors and load rating factors using the AASHTO Load and Resistance Factor Design (LRFD) Specifications design codes. The original codes used for these bridges should however be noted; the American Association of State Highway and Transportation Officials (AASHTO) - Load Factor Design code was used for the original bridge and a combination of the AASHTO - LFD and AASHTO Load and Resistance Factor Design (LRFD) Specifications was used for the exciting bridge. Linear three-dimensional finite element models are developed for both bridges to obtain the maximum moment and shear values with varying HL - 93 load cases for these analyses.

To develop models that bound the possible existing condition of the structure (exciting widened bridge), two-dimensional nonlinear element models are developed by changing the most critical parameters. The critical parameters are categorized as material properties and boundary conditions. Sensitivity studies are conducted using parametric models for simulations with moving loads for the different load cases using the HS 20 and HL 93 truck3. The load rating and reliability indexes are computed for all the cases under different loading conditions. The parameters that have the most influence on the load rating and reliability are also presented. The information generated from these analyses can be utilized for better - focused visual inspection, widened bridge load rating criteria and can also be used for developing a long - term widening structural monitoring plan. Additionally, this study is to be a benchmark for future studies, and to establish a procedure and methodology for widening bridge structures.
Approved for distribution by Necati Catbas, Committee Chair, on December 8, 2016.

The public is welcome to attend.