

## ABSTRACT

Adjacent precast, prestressed box beam bridges have a history of poor performance and have been observed to exhibit common types of deterioration including longitudinal cracking, concrete spalling, and deterioration of the concrete top flange. The nature of these types of deterioration leads to uncertainty of the extent and effect of deterioration on structural behavior. Due to limitations in previous research and understanding of the strength of deteriorated box beam bridges, conservative assumptions are being made for the assessment and load rating of these bridges. Furthermore, the design of new box beam bridges, which can offer an efficient and economical solution, is often discouraged due to poor past performance. Therefore, the objective of this research is to develop improved recommendations for the inspection, load rating, and design of adjacent box beam bridges. Through a series of bridge inspections, deteriorated box beams were identified and acquired for experimental testing. The extent of corrosion was determined through visual inspection, non-destructive evaluation, and destructive evaluation. Non-destructive tests (NDT) included the use of connectionless electrical pulse response analysis (CEPRA), ground penetrating radar (GPR), and half-cell potentials. The deteriorated capacity was determined through structural testing, and an analysis procedure was developed to estimate deteriorated behavior. A rehabilitation procedure was also developed to restore load transfer of adjacent beams in cases where shear key failures are suspected. Based on the understanding of deterioration developed through study of deteriorated adjacent box beam bridges, improved inspection and load rating procedure are provided along with design recommendations for the next generation of box beam bridges.