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## Development of a Substructure Instrumentation System at the New I-10 Twin Span Bridge and Its Use to Investigate the Lateral Behavior of Batter Piles

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**ABSTRACT:** This paper presents the development of the substructure instrumentation system that was installed at a selected pier (M19 Eastbound) of the new I-10 Twin Span Bridge for short-term and long-term health monitoring of the bridge, and its use to monitor the behavior of the pier during a lateral load test. The selected pier is supported by 24–36 in. diameter batter pile foundation. The substructure instrumentation for the M19 Eastbound pier includes sister bar strain gauges and MEMS In-Place Inclometers (IPI) installed inside the foundation piles, triaxial accelerometers to measure lateral movements pile cap, water pressure cells to measure wave forces, tiltmeters, and corrosion meters on the pile cap rebar. A unique lateral load test was designed and conducted to investigate the lateral behavior of the pier and to assess the validity of the analysis method used to design the batter pile foundations using the FB-MultiPier software. Two high strength steel strand tendons were used to impose about 1900 kips of lateral load. The horizontal movements of the pier caps and bents were monitored using an automated survey station with prisms. The strains and deformations within the foundation piles were measured using the strain gauges and IPI inclinometers. This paper will discuss the substructure instrumentation plan and the novel approaches to preparation and design of lateral load testing of batter pile group foundation. The results of lateral load tests will be presented, discussed and compared with the predicted values using FB-MultiPier software. The soils'  $p$ - $y$  curves were also back-calculated and presented.

**KEYWORDS:** substructure monitoring system, lateral load test, battered pile foundation, pile instrumentation, FB-MultiPier,  $p$ - $y$  curves, smart bridge

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