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Pile Dynamics, Inc.

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Cost-Effective High Capacity Piles through Soil Set-Up

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The Marquette Interchange in Milwaukee, WI built in the 1960s, is known for its many ramps, tight radii, and greater-than-capacity traffic. Designed for 130,000 vehicles per day, it now has to handle 300,000. The Wisconsin Department of Transportation (WisDOT) therefore decided on a major reconstruction of this system, which will make this project the most expensive ever for the State of Wisconsin.

APPLE Testing near the 6th St. Viaduct

The geology in the interchange area is made up of alluvial and estuarine (organic) deposits over glacial till sheets with interbedded lacustrine deposits. Bedrock in the core interchange area is at least 60 m (200 ft) below surface. Experience (e.g. Fellenius et al., 1989 and Komurka, 2004) with deep foundations in these soils have shown that relatively small driven piles can achieve high capacities if soil set-up is assessed and verified by testing. For example, at the adjacent 6th St. Viaduct in Milwaukee, an attractive cable-stayed structure, 324 mm (12.75 inch) diameter piles of up to 38 m (125 ft) length reached ultimate capacities of 380 tons and were installed for design loads of up to 190 tons.

During the summer of 2003, WisDOT and the interchange designer Milwaukee Transportation Partners (MTP) conducted a test program which involved 6 static load test sites and 43 indicator pile sites throughout the interchange area. Dynamic monitoring was performed during pile installation, and again during multiple restrike tests typically performed at 2.5 hours, 1 day, 10 days, and 4 weeks after installation. The later tests were conducted after the piles were filled with concrete since the high capacities could not be mobilized without damaging an unfilled steel pipe pile section. Since activating the high set-up capacities with the pile driving hammers used for installation was economically unfeasible (multiple driving rig moves) and technically problematic (lack of full activation), GRL's 133 kN (15 ton) APPLE system was used to conduct the longer-term dynamic restrike tests.

Wagner Komurka Geotechnical Group, Inc. of Cedarburg, WI and MTP, in concert with the GRL Chicago office, performed the static and dynamic testing during this extensive initial pile test program. Van Komurka conducted the internally instrumented static load tests, and Pat Hannigan was in charge of Pile Driving Analyzer® testing and CAPWAP® analyses. The team worked closely together to develop soil set-up vs. depth profiles for all 89 test piles. With this information, it will be possible during production pile driving to install the piles to end of drive capacities much smaller than required long-term, and to predict how much long-term capacity will be available as a result of set-up. Test-program capacity determinations indicate unit set-up of up to 239 kPa (5 ksf), and total set-up of up to 5338 kN (600 tons) on a 324 mm (12.75 inch) diameter, 32m (104 ft) long pile. As a result, the project will utilize 324, 355 and 406 mm (12.75, 14 and 16 inch) diameter piles with allowable loads of up to 1335, 1779 and 2224 kN (150, 200 and 250 tons), respectively.

References

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