Miller Park Stadium Receives DFI Outstanding Project Award
2001 Outstanding Project Award

Miller Park Stadium
Milwaukee, Wisconsin

The race for DFI’s Outstanding Project Award for 2001 was hotly contested. The winning nominee was Miller Park Stadium in Milwaukee, Wisconsin, and Van E. Komurka accepted the award on behalf of his firm, Wagner Komurka Geotechnical Group, Inc. Twelve other projects were accorded honorable mention status (see article in this issue of Fulcrum).

Miller Park is a premier state-of-the-art baseball stadium, the new home of the Milwaukee Brewers. With its fan-shaped retractable roof, Miller Park weighs 500,000 tons, making it the heaviest structure in Wisconsin. Miller Park is unusual in that it is supported on a deep-foundation system consisting of both rock-socketed drilled piers and soil-bearing driven piles. Subgrade conditions consist of fill, underlain by a relatively thin deposit of organics, overlying medium dense to dense granular deposits to bedrock. Depth to bedrock varies beneath the stadium footprint, from approximately 35 feet (10m) behind home plate to 125 feet (38m) at the outfield wall.

Wagner Komurka Geotechnical Group, Inc. (“WKG”) was the geotechnical engineer for the project, and was responsible for the value engineering and design of the deep foundations. An indicator pile test program was performed, including initial drive and restrike dynamic monitoring of both 12.75-inch-O.D. steel pipe piles and 16-inch Monotube® piles. To evaluate the relative performance of these two pile sections, pipe and Monotube test piles were installed in pairs, and two pairs were statically load tested. Based on support costs (normalized in terms of dollars per ton supported), results indicated Monotube piles to be the more-economical section.

Where bedrock was shallow, driven piles’ resistance to uplift loads was inadequate, and rock-socketed drilled piers offered lower support costs than driven piles. Since installation cost, and therefore support cost, of rock-socketed drilled piers increases disproportionately with increasing depth to rock, driven piles offered lower support costs where rock was deep. Using the results of the pile test program combined with pile and pier cost information supplied by Edward E. Gillen Company (“Gillen”), WKG recommended that a two-foundation-type system be used, and determined the optimal depth to rock along the baselines at which to transition from drilled piers to driven piles. The use of this two-foundation-type system saved $4 million compared to foundations consisting of all drilled piers.

Two full-scale drilled pier load tests were performed using Osterberg cells (“O-cells”) which applied load at the base of the drilled piers: one test in a shallow rock socket to evaluate socket friction, and one test in a deep rock socket to evaluate end bearing. Design values of 45 and 500 ksf (2.15 and 23.94 Mpa) were recommended for rock socket friction and end bearing, respectively. Gillen offered the value alternative of extending the production rock sockets deep enough to support the entire design load in socket friction, saving money by reducing the need to clean the bottom of the rock socket. Full-scale “twin” lateral load tests were performed by jacking the two adjacent test piles towards each other.

A total of 325 drilled piers, with 5-foot-deep rock sockets, diameters ranging from 3 to 5 feet (914mm to 1524mm), and design loads of up to 1325 tons (11,787kN), were installed. During construction, the capacity of several production piers was confirmed using high-strain dynamic testing. A 40-kip (178kN) weight was used, with drops as high as 20 feet (6m) and dynamic monitoring confirmed desired capacities.

A total of 1512 Monotube piles, with a design capacity of 200 tons (1,779kN) each and accounting for a total footage of 104,351 feet (31,807m), were installed. Beneath the outfield track beams, which support the moveable roof panels, eight columns are supported by 100-pile caps. To model deflection of these track beam foundations resulting from variable loading conditions (from opening and closing the roof and from wind loads), the large pile groups were modeled as equivalent mat foundations. Pressuremeter moduli were used to estimate load-deflection behavior of equivalent mat foundations to develop “spring constants” for the foundation systems used by the structural engineer. Consistency of moment-induced foundation response around the centroid of support was evaluated by 3-dimensionally modeling the uniformity of production pile toe elevations.

The three concentric outfield track beams on which the roof panels roll are constructed of cast-in-place reinforced concrete; each beam is 3 feet wide and 8 feet high (0.91m wide and 2.44m high). During construction of these beams, the formwork and fluid concrete were supported by temporary shoring towers which were supported at-grade on cribbing bearing partially between new pile caps, and partially above new pile caps. Due to compressible organic soils, the cribbing bearing between pile caps was expected to settle more than the cribbing bearing above pile caps, and the pile caps
were considered “hard spots” likely to attract load. WKG’s analyses indicated that at some locations, the piles would be overstressed, and supplemental piles were driven to support the temporary shoring towers.

WKG® was also the geotechnical engineer for the infrastructure relocation and construction related to the stadium, which included 9 bridges, 4 retaining walls, embankments up to 22 feet high, pavements, and below-grade culverts. In-situ vane shear testing justified high enough design strengths in soft organic soils beneath a mechanically stabilized earth retaining wall to preclude previously

Distinguished Service Award

At the Awards Dinner at the Ritz Carlton St. Louis, Stanley Merjan, P.E. was presented with DFI’s highest individual award, the Distinguished Service Award. The presentation was made by William F. Loftus, the recipient of the award for the year 2000.

Through this award DFI annually recognizes leaders in the deep foundation design and construction industry for their lifetime contributions to the profession.

Stanley Merjan is the senior consultant of Underpinning & Foundation Constructors, Inc., located in Maspeth, New York. The company is engaged in the performance of all types of deep foundation contracts, including concrete, pipe, H and wood piles, drilled-in-caissons, braced sheeting and cofferdams, and underpinning. A specialty of this company is the TPT® Piling System, which Mr. Merjan invented. He is the holder of 9 patents re TPT®. His responsibilities include all of the components of the business including bidding, negotiations, management of field operations and engineering. Stanley is also a co-inventor, along with Jack Dougherty, of a patented new product, Tapertube™ Piles, currently being used extensively at New York’s Kennedy Airport and elsewhere.

Prior to joining Underpinning & Foundations Constructors, Inc. in 1955 as a field superintendent, he was a field engineer for construction of the diversion tunnel for the NYC Board of Water Supply in Downsville, NY. He moved on to bridge design for D.B. Steinman in New York City, and then to stress analysis and structural design for the atomic submarine Nautilus at General Dynamics in Groton, CT.

Mr. Merjan graduated from City College of New York in 1948 with a B.C.E. in Civil Engineering and is a registered Professional Engineer in New York, Massachusetts and Florida. He has given numerous lectures on pile driving in New York, Boston, Washington, DC, New Orleans and elsewhere. Stan has published three papers on piles for the TRB of the National Academy of Sciences, worked with BOCA Code Committee in 1981 on the piling code, and is co-author of a manual of recommended procedures for the installation of concrete piles by ACI. Stanley is a life member of the ASCE, as well as a member of the American Concrete Institute, Deep Foundations Institute, the Moles and the National Society of Professional Engineers.

The following remarks are gleaned from Mr. Merjan’s notes for his DSA acceptance speech:

“I am pleased and honored to receive this award. I have truly enjoyed the 15 years I have been a member of the Deep Foundations Institute. We are a unique organization with many special and talented people. Where else can you find a group such as ours, dedicated to exchanging knowledge, information, and experience between contractors, consulting engineers, academics, government agencies, material and equipment suppliers and others, from all over the United States, Canada, and the world?

Ours is a fascinating business. I think of each new job as another adventure because of the anticipation of the unexpected. The infinite variety of soil conditions, often not adequately portrayed by pre-construction soil investigation, regularly presents a challenge to foundation construction. Identifying the problems, and then developing the means to overcome them, is very gratifying; all the more so if this can be done at a profit!

I never cease to wonder at the wealth of information about new equipment, techniques, and materials that are presented at our meetings. Foundation construction practices and equipment vary so greatly from place to place that each of us has something to learn from one another. These meetings also give us the opportunity to meet and develop new business and social relationships. And, speaking of social relationships, the friendships that have developed between many of the wives of DFI members are extraordinary.

The tragedy of September 11, 2001 weighs heavily on all of our minds these days. Our presence here in St. Louis is testimony to our determination to overcome these horrible events and move on with our lives. I commend you all for coming, and again thank you for this prestigious award.”