GRL NEWSLETTER

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GRL TESTS DRILLED SHAFTS

by Frank Rausche

The last GRL Newsletter described the design of a dynamic load test system for drilled shafts. As a sequel, we report in this issue several drilled shaft tests which GRL engineers performed during the past summer facing a variety of pile, soil and load conditions. Curiously, 3 of the 4 drilled shaft test sites were stadiums; we also tested driven piles at several stadium sites in 1997. Based on the experience made to date, we estimate the cost of dynamic pile tests using the Pile Driving Analyzer® between 5 and 10% of static load tests with greater savings realized for larger test loads or as the number of tests increase.

The table below summarizes a few technical parameters and site conditions. The narrative explains what hammers were used. **Since drop hammer availability is critical, we would greatly appreciate any information on other available drop hammers, preferably with guides/leads.**

Site	Drop Weight	Drop Height	Top Shaft Diameter	Capacity Mobilized	No. Test Piles
	t (kips)	m (ft)	mm (inch)	MN (kips)	
Cleveland	3 (6.6)	2.0 (6.6)	406 (16)	2.2 (500)	8
Bowling Green	3 (6.6)	2.0 (6.6)	460 (18)	3.1 (700)	2
Milwaukee	20 (44)	3.8 (12.5)	1,070 (42)	22.0 (4800)	15
Arkansas	9 (20)	2.4 (8.0)	1,370 (54)	3.1 (700)	6

Browns Stadium, Cleveland, OH

Berkel & Company constructed **400 mm (16 inch)** diameter auger cast (CFA) piles of approximately **30 m (100 ft)** length in firm to very stiff silty clay. Specifications called for 2 static load tests and 8 dynamic tests up to the required ultimate capacities of 1.8 MN (400 kips). Berkel's Alan Roach coordinated with GRL Cleveland's *C. Michael Morgano* to conduct the dynamic tests which activated up to **2.2 MN (500 kips)** under six consecutive hammer blows. Permanent sets were less than 3 mm (1/8 inch) per blow.

In preparation for the tests, pile tops were extended with a 1.5 m (5 ft) long casing and high quality grout. Windows were cut into the casings for the attachment of 4 accelerometers and 4 strain transducers. The loading device was **GRL's 3 tonne (6.6 kip)** diesel ram, guided by its cylinder (see photograph). The former FEC 3000 hammer was prepared by Fritz Koltermann, Foundation Equipment Corp., Dover, OH for low compression "dry" (no fuel) impacts. Transferred energies under six drops (with up to 2 m (6.6 ft) drop height averaged 50% of the available energy. This is better than average pile driving hammer performance on concrete piles.

Bowling Green, OH

The tests were performed for Mr. Ken Applebee of United Foundations, a piling contractor in Peninsula, OH and by *Neil Harnar*, GRL Cleveland. The GRL 3 tonne hammer (see Browns Stadium) loaded the **460 mm (18 inch)** diameter auger cast piles of **6 m (20 ft)** average length. Soils consisted of clayey silt over small boulders and then rock. Test loads reached **3.1 MN (700 kips)** with no permanent set; the required ultimate capacity was 1.8 MN (400 kips).

Miller Park, Milwaukee, WI

The construction of this new stadium for the Southeast Wisconsin Professional Baseball Park District and the Brewers team required drilled shafts of **1050 mm (42 inch)** diameter, typically **15 to 20 m (50 to 60 ft)** long, socketed into limestone rock and with required ultimate capacities of 18 MN (4000 kips). The shafts were drilled and tremie cast under slurry. Osterberg load tests had shown that loads of at least 26 MN (6000 kips) could be applied to both rock socket and shaft bottom. For the dynamic tests, the piles were extended by **1.5 m (5 ft)** using a short section of casing as a lost form. Chicago GRL manager *Pat Hannigan* attached 4 strain transducers and 4 accelerometers as is now standard for all drilled shaft and large diameter pile testing.

Seasons' Greetings

The year is not yet over, in fact we are experiencing a beautiful Indian Summer after a most dynamic and eventful year. Since time goes by so quickly, we will not be able to send you another greeting before the holidays. We therefore want to take this opportunity to wish you a peaceful holiday season and health and prosperity for the next year. We hope that we will be able to further strengthen our business and personal relationship with you in the next year.

The tests were conducted with a hammer, ingeniously designed by drilled shaft contractor, Edward E. Gillen Co., using casings available at the site and steel scrap from a nearby plant. The 20+ ton ram was free released by an ICE vibro hammer's hydraulic clamps. Drop heights up to 3.6 m (12 ft) compensated for a relatively low energy transfer caused by the compressible nature of the steel scrap filling. GRL's *Hasan Aboumatar* calculated CAPWAP capacities up to **22 MN (4,800 kips)** for blows generating pile top sets between 0 and 5 mm. A total of 15 shafts were tested with up to 7 shafts in one day.

GRL's 3 tonnes Hammer with Cleveland Skyline

Arkansas Bridge

Kent Glesener, P.E. of Jensen Construction utilized Pileco's (Houston, TX) 9 tonne (20 kip) ram with drop heights of up to 2.4 m (8 ft). GRL Florida's *Mohamad Hussein* performed the Pile Driving Analyzer tests on 6 shafts, calculating capacities of up to **3.1MN (700 kips)**. The **15 m (50 ft)** long shafts had a top diameter of **1,370 mm (54 inches)** over the top 3.3 m (10 ft) and 1.2 m (48 inches) below that. Five shafts were tested in one day.