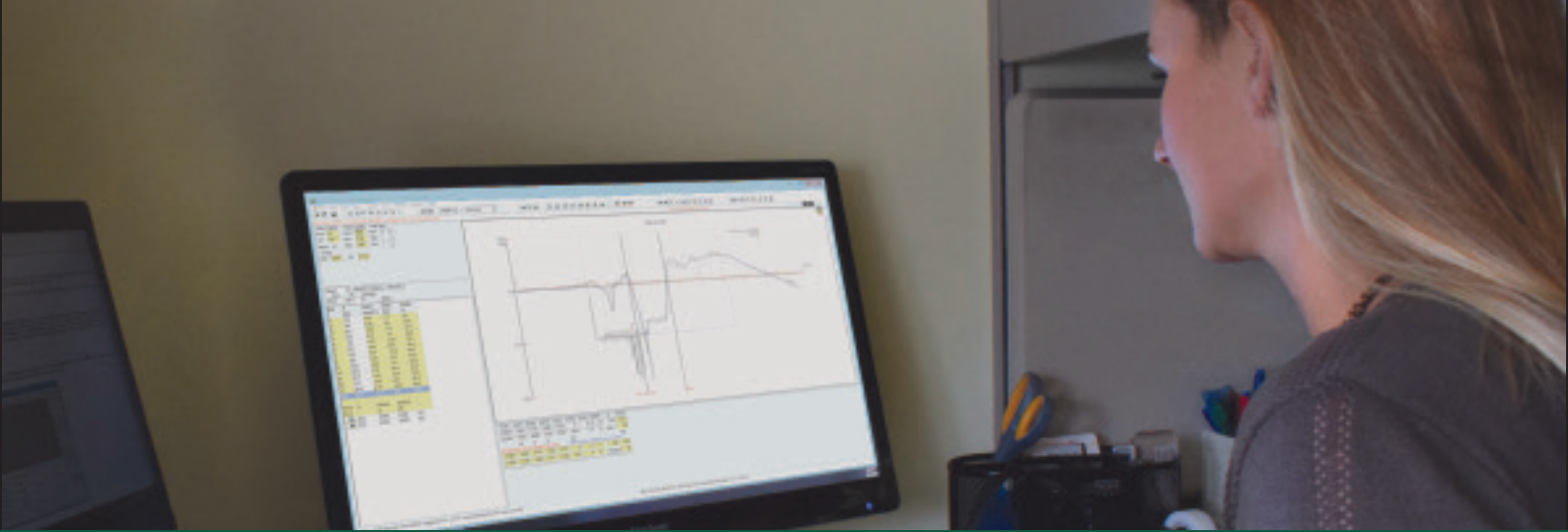




CAPWAP® Signal Matching Analysis

CAPWAP® Signal Matching Analysis is the most accurate analysis method to determine deep foundation capacity from pile top dynamic measurements. In pile driving analysis, there are three sets of unknowns: internal pile forces, pile motions, and external pile forces. CAPWAP uses pile or shaft top force and velocity measurements collected by a Pile Driving Analyzer® (PDA) to extract the external deep foundation forces consisting of the static and dynamic soil resistance models.

CAPWAP® Analysis Procedure

A CAPWAP analysis is performed on a representative hammer blow or impact acquired near the end of driving or beginning of restrike testing. The basic CAPWAP procedure consists of the following steps:

1. Retrieve force and velocity data measured by the PDA.
2. Input the pile model of known pile material types, their lengths and cross sectional areas.
3. Assume a set of soil parameters including resistance, quake, and damping.
4. Perform analysis using one of the measured quantities as an input and calculate the complementary quantity.
5. Compare the measured and computed complementary quantity and assess the match quality.
6. If match is not satisfactory, adjust soil model and return to step 3.
7. Output soil model, extrema table, plot of satisfactory match, table summarizing the deep foundation model, and simulated static load-movement curve.

Benefits of CAPWAP® Signal Matching Analysis

- Computes the total mobilized static soil resistance
- Determines shaft resistance magnitude and its distribution along the shaft, and the toe resistance
- Predicts the load displacement behavior of the tested deep foundation
- Computes compression and tension stresses at any point of the deep foundation
- Calculates a simulated static load test curve under compression and tension loading

GRL Engineers, Inc.

Corporate Office
Ohio

Office Locations

California	Georgia	Pennsylvania	Louisiana
Colorado	Hawaii	Texas	North Carolina
Florida	Illinois	Washington	



CAPWAP® Results

CAPWAP results include the deep foundation's mobilized total bearing capacity as well as the soil resistance distribution along the foundation length.

CAPWAP graphical results include the measured force and velocity record, the best match, the resistance distribution versus depth, and a simulated static load test load-set curve.

CAPWAP numerical results include the CAPWAP summary results table detailing the resistance distribution, the dynamic soil models, match quality, and pile stress maxima. For driven piles, the CAPWAP determined soil resistance and dynamic soil models are often used to develop GRLWEAP refined wave equation input parameters and establish the pile installation criterion.

For additional information on CAPWAP Signal Matching Analysis or any other GRL Engineers service please contact info@GRLengineers.com or visit us at www.GRLengineers.com.

Total CAPWAP Capacity: 198.9; along Shaft 123.9; at Toe 75.0 kips

Soil Sgmnt No.	Dist. Below Gages ft	Depth Below Grade ft	Ru kips	Force in Pile kips	Sum of Ru kips	Unit Resist. (Depth) kips/ft	Unit Resist. (Area) ksf
1	20.3	8.3	2.0	198.9	2.0	0.24	0.05
2	27.1	15.1	2.0	194.9	4.0	0.30	0.06
3	33.9	21.9	2.0	192.9	6.0	0.30	0.06
4	40.6	28.6	2.0	190.9	8.0	0.30	0.07
5	47.3	35.3	2.0	188.9	10.0	0.30	0.07
6	54.0	42.0	2.0	186.9	12.0	0.30	0.07
7	60.7	48.7	2.0	184.9	14.0	0.30	0.07
8	67.5	55.5	2.5	182.4	16.5	0.37	0.08
9	74.2	62.2	12.2	170.2	28.7	1.82	0.40
10	80.9	68.9	21.5	148.7	50.2	3.20	0.70
11	87.6	75.6	23.7	125.0	73.9	3.53	0.78
12	94.3	82.3	25.0	100.0	98.9	3.73	0.82
13	101.0	89.0	25.0	75.0	123.9	3.73	0.82
Avg. Shaft			9.5			1.39	0.31
Toe			75.0				47.89

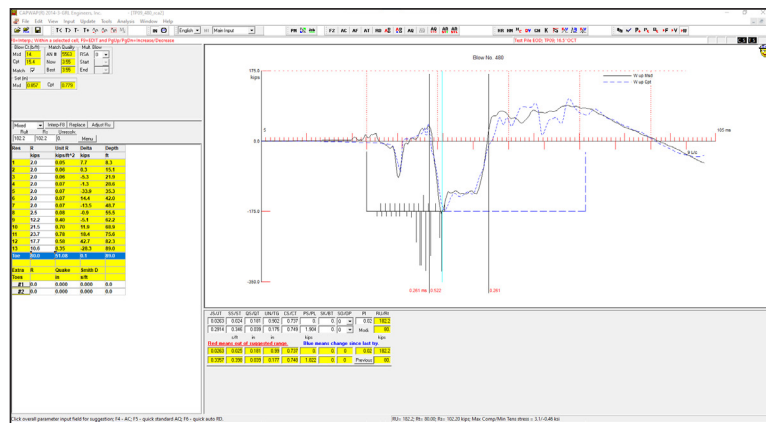
Soil Model Parameters/Extensions

	Shaft	Toe
Smith Damping Factor	0.02	0.28
Quake (in)	0.17	0.18
Case Damping Factor	0.03	0.22
Damping Type	Viscous	Viscous
Unloading Quake (% of loading quake)	73	54
Reloading Level (% of Ru)	100	100
Unloading Level (% of Ru)	67	
Resistance Gap (included in Toe Quake) (in)		0.14
Soil Plug Weight (kips)		1.982

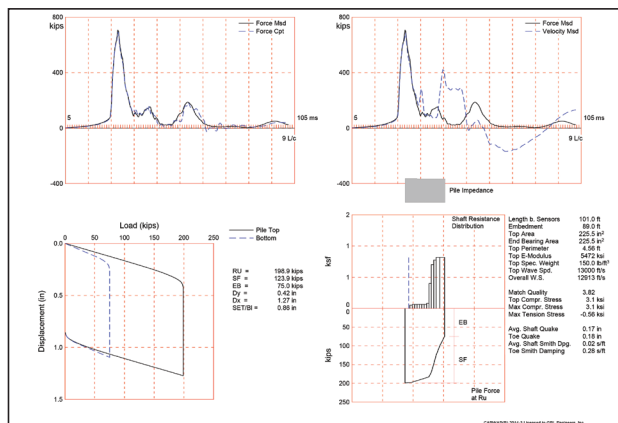
CAPWAP match quality	= 3.82	(Wave Up Match; RSA = 0)
Observed: Final Set	= 0.86 in;	Blow Count = 14 b/ft
Computed: Final Set	= 0.78 in;	Blow Count = 15 b/ft
Transducer	F1 (V419) CAL: 144.3; RF: 0.95; F2 (V420) CAL: 144.2; RF: 0.95	
	A1 (K11002) CAL: 384; RF: 1.00; A2 (K2294) CAL: 390; RF: 1.00	

max. Top Comp. Stress	= 3.1 ksi	(T= 28.4 ms, max= 1.005 x Top)
max. Comp. Stress	= 3.1 ksi	(Z= 80.9 ft, T= 34.7 ms)
max. Tens. Stress	= -0.56 ksi	(Z= 67.5 ft, T= 39.6 ms)
max. Energy (EMX)	= 22.7 kip-ft;	max. Measured Top Displ. (DMX)= 1.11 in

CAPWAP Numerical Results



Drilled Shaft Test Results



CAPWAP Data Output Graphs

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