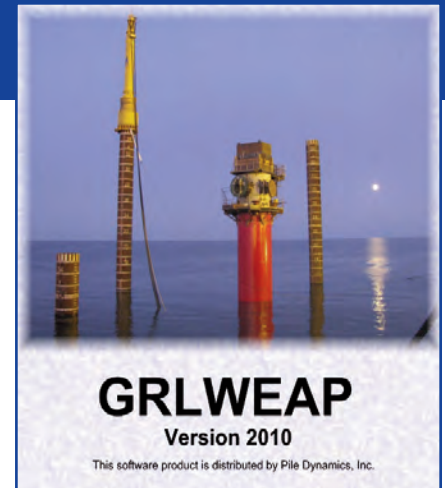# GRLWEAP Version 2010
Accurately Simulates Pile Driving

GRLWEAP 2010 is the software of choice for industry-leading piling professionals all around the world.

1. Calculates driving resistance, dynamic pile stresses, and estimated capacities based on field observed blow count, for a given hammer and pile system.

2. Helps select an appropriate hammer and driving system for a job with known piling, soil and capacity requirements.

3. Determines whether a pile will be overstressed at a certain penetration or if refusal will likely occur before a desired pile penetration is reached (driveability analysis).

4. Estimates the total driving time.

GRLWEAP
Version 2010
This software product is distributed by Pile Dynamics, Inc.

## GRLWEAP 2010: Available in Standard and Offshore Wave versions

The most widely used pile driving simulation software is now more powerful and user friendly. New features improve the accuracy of predicted stresses, bearing capacities, blow counts and installation time:

- Four static geotechnical analysis options: **ST** method, **SA** method with an updated input method, **CPT** method and a method based on American Petroleum Institute **(API)** requirements.
- Variable toe area input for consideration of plugging in selected soil layers.
- Simplified input for analysis of battered piles.
- More flexible Driveability Analyasis input.
- Friendlier interface with spreadsheet programs.

Exclusive Features of Offshore Wave Version:

GRLWEAP Offshore Wave Version is particularly well suited to analyze free riding hammers on non-uniform and/or inclined piles.

- Pipe Pile Builder simplifies input of complex pipe pile sections and add-ons.
- Alternate hammer location may be modeled (pile top, bottom or in-between).
- Static bending analysis for inclined pile driving.
- Fatigue Analysis output tables show stress ranges and extrema with number of occurrences for fatigue damage studies.
- Option to consider Soil Plug Weight.
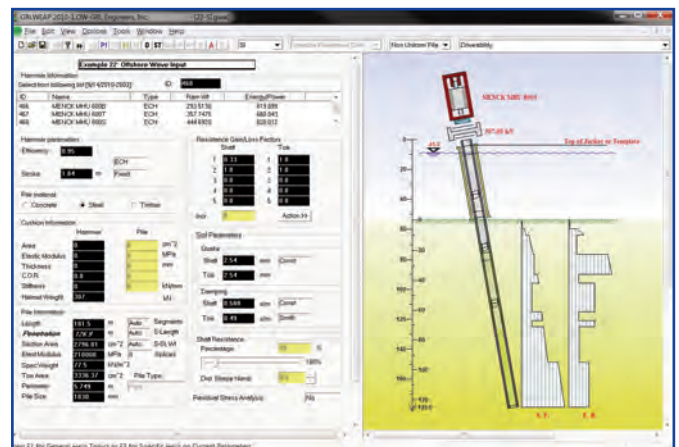
Offshore Wave Input Screen.

Quality Assurance for Deep Foundations
30725 Aurora Road   Cleveland Ohio 44139 USA
tel: +1-216-831-6131   fax: +1-216-831-0916
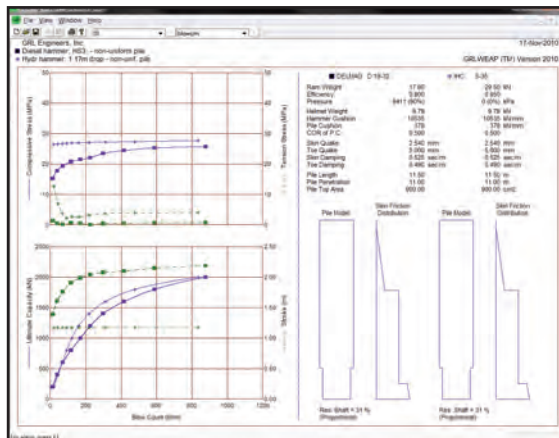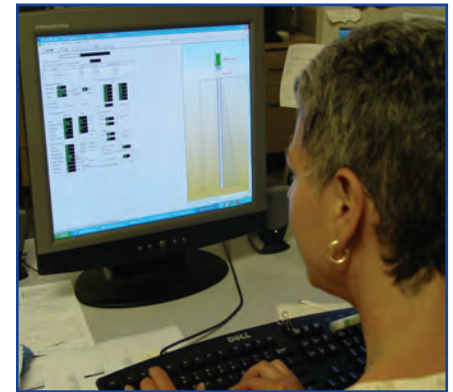Email: info@pile.com   www.pile.com

vertreten durch
GSP mbH

Background:

GRLWEAP - GRL Wave Equation Analysis of Pile Driving - simulates motions and forces in a foundation pile when driven by either an impact or vibratory hammer. (Replaces blow count with speed of penetration for vibratory hammers.) Its continuously updated, internet accessible hammer database featuers over 800 hammer models and extensive driving system data.

During the early development of the GRLWEAP program in the 1970s and continuously since that time, the program authors have improved program performance by matching GRLWEAP results with measurements by the Pile Driving Analyzer®.

GRLWEAP Output Graphics

The **Bearing Graph** depicts the relationship of capacities, pile driving stresses and stroke versus blow count. It can be used to estimate the pile bearing capacity given an observed blow count; the required blow count for a specified capacity; or the maximum capacity that a hammer-pile-soil system can achieve.

Superimposed bearing graphs compare two hammers.

The **Driveability Graph** is a plot of capacity, blow count and dynamic stress extrema versus depth. It allows for consideration of pile add-ons, hammer energy and efficiency changes, cushion deterioration, soil resistance degradation and soil setup during driving interruptions. The numerical summary also includes an estimate of driving time based on the calculated number of blows and on the hammer blows per minute rate.

The **Inspector's Chart** compares stroke (or hammer energy) versus blow count for a single capacity value. Inspector's Charts are used for diesel hammers and external combustion hydraulic (ECH) hammers to determine, for a given bearing capacity, the required blow count versus variable hammer energy.

The **Variables vs. Time** graph shows any calculated quantity as a function of time for comparison with measurements or illustration of stress wave propagation.
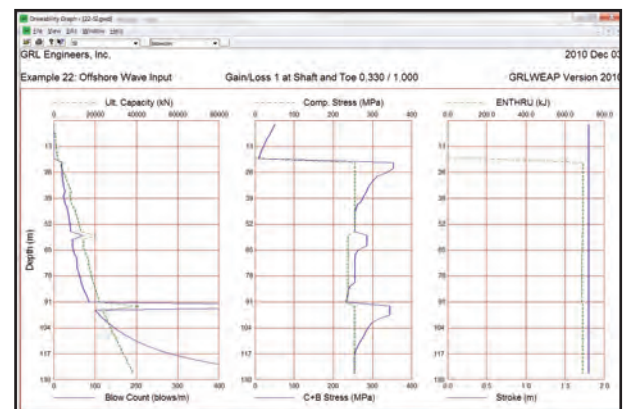
Computational process features:

- Smith-type lumped mass hammer and pile model with Newmark predictor-corrector type analysis.
- Realistic non-linear stress-strain analysis of pile with splices, slacks, cushions, and other material interfaces.
- Basic Smith-type soil model with several research extensions.
- Bearing graph analysis with proportional, constant shaft or constant toe resistance.
- Thermodynamic analysis for diesel hammers.
- Iterative diesel hammer analysis for stroke calculation.
- Residual stress (multiple blow) analysis.
- Multi-material analysis for composite piles.
- Two-pile analysis for mandrel driven piles.
- Static soil analysis based on soil type, SPT N value, CPT data files or API method.

Driveability Graph