



GRLWEAP Wave Equation Analysis

Wave Equation Analysis of Pile Driving Software

Proven. Trusted. Flexible.

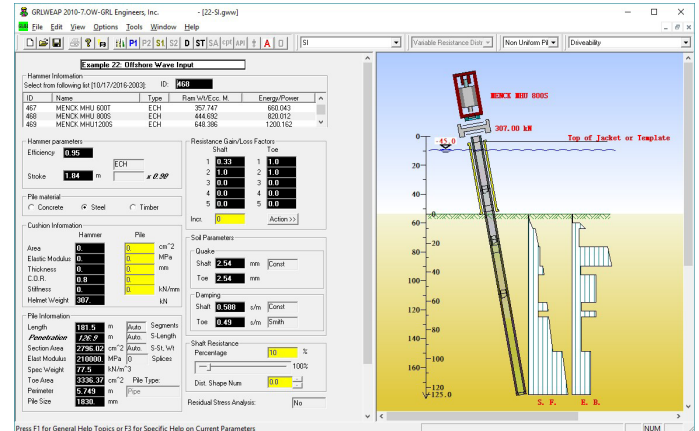
GRLWEAP is the software of choice for industry-leading piling professionals around the world. Developed by the founders of Pile Dynamics, Inc., GRLWEAP:

- Calculates soil resistance, dynamic pile stresses, and estimated capacities based on field observed blow count, for a given hammer and pile system
- Helps select an appropriate hammer and driving system for a job with known piling, soil and capacity requirements
- 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)
- Estimates the total driving time

GRLWEAP is a one dimensional wave equation analysis program to simulate motions and forces in a foundation pile when driven by either an impact or a vibratory hammer. Since initially developed in early the 1970s, the program has been improved continuously to add many features which help improve the accuracy of predicted stresses, bearing capacities, blow counts and installation time. The accuracy has been improved and proven by matching the results with field observation and measurement by the Pile Driving Analyzer® system (PDA).

The features added or improved include:

- Static geotechnical analysis tools including methods based on soil type, SPT or CPT information and the American Petroleum Institute (API) method
- Residual stress analysis
- Variable toe area input for consideration of plugging in selected soil layers



- Simplified input for analysis of battered piles
- Flexible Driveability Analysis input
- User-friendly interface with spreadsheet programs
- Traditional US or SI Units
- New hammer data files added to the hammer database featuring close to 1000 hammer models
- Extensive driving system data for a special version for offshore specific problems



- Simulates the pile response to impact or vibratory hammer forces
- Helps select appropriate hammer and driving system with known piling, soil and capacity requirements
- Determines pile driveability and estimates total driving time
- Available in standard and offshore versions

GRLWEAP's Offshore Wave Version is particularly well suited to analyze complex situations encountered in offshore pile driving, such as:

- Pipe Pile Builder simplifies input of complex pipe pile sections stabbing guides and add-ons
- Hammer location at pile top, bottom or in-between
- Static bending analysis for inclined pile driving by free riding hammers
- Output tables of stress ranges and extrema with number of occurrences for fatigue damage studies of piles
- Soil plug weight mass consideration
- Two soil fatigue options to calculate static soil resistance to driving (SRD)

GRLWEAP Output Graphics

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

The Driveability Graph is a plot of capacity, blow count and dynamic stress extrema versus depth. It allows for consideration of 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 rate of hammer blows (blows per minute).

The inspector's chart depicts stroke (or hammer energy) versus blow count for a single capacity value.

Inspector's Charts are used to establish a driving criterion and as an aid in construction control.

The Variable vs Time graph shows any calculated quantity as a function of time for comparison with measurements or illustration of stress wave propagation.

Computation 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
- Thermodynamic and intuitive analysis for diesel hammer stroke calculation
- Multi-material analysis for composite piles
- Two-pile analysis for mandrel driven piles



Pile Dynamics, Inc. (PDI) is the world leader in developing, manufacturing and supplying state of the art QA/QC products and systems for the deep foundations industry. The company is headquartered in Cleveland, Ohio, USA, with offices and representatives worldwide. For additional information visit us at www.pile.com or contact info@pile.com.