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 driving 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 vibratory hammer. Since initially developed in early 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®.
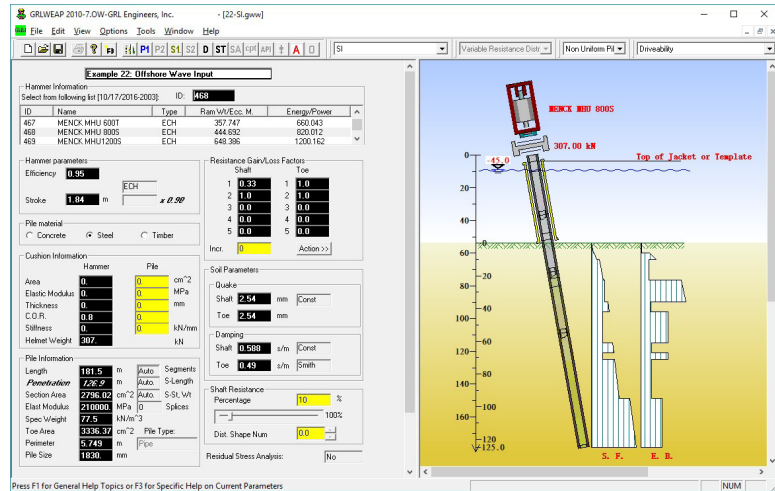
The features added or improved include:

- Static geotechnical analysis tools: ST method, SA method, CPT method and American Petroleum Institute (API) requirements method

- 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

- New hammers added to the hammer database features close to 1000 hammer models and extensive driving system data

- Offshore Wave version available

GRLWEAP comprehensive help includes:

- On-screen specific procedure and easy to search tool bar

- Background report containing extensive information for both beginners and experienced users

- Suggestions and recommendations on soil parameters

- 25 examples and six special cases cover all possible applications

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
- Soil Fatigue options include two soil fatigue models to calculate static resistance to drive

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.

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.

- Simulates the pile response to pile driving equipment
- 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

The Variable 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 of API method

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 today.