



Major Changes and Updates to GRLWEAP 2010

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What's New in GRLWEAP 2010

GRLWEAP Version 2010 comes in two versions, “**Standard**” and “**Offshore Wave**”. GRLWEAP Standard contains all features of earlier GRLWEAP versions. The Offshore Wave Version includes all features of the Standard Version.

New Features of GRLWEAP 2010

For static geotechnical analysis, in addition to the existing **Soil Type (ST)** and the **SPT N-value (SA)** based algorithms, two additional methods are available:

- A **Cone Penetration Test** method (after Schmertmann) for which the data has to be provided in the form of a three column text file comprising depth, cone tip resistance and sleeve friction
- A method based on American Petroleum Institute (**API**) requirements.

The **SA method** was modified as follows:

- In lieu of entering an SPT-N value, the routine now allows for an **input of q, the unconfined compressive strength**, for clay and other cohesive soils, or for an **input of ϕ , the internal friction angle**, for sand and other cohesionless soils.
- The SPT-N value vs. depth input is now completed in the main **SA** window with automatic interpolation for each soil layer. Whenever a soil layer depth or thickness value is changed by the user, its SPT-N value is automatically interpolated, unless it has been manually modified. A manually modified SPT-N value for a soil layer is maintained regardless of its geometry.
- The graphic representation of the **SA** and **ST** input windows have been modified; they now allow for a range expansion by scrolling.

Enhancement for the analysis of **inclined (battered) pile driving**:

- A special input window has been created for specifying the pile inclination as a ratio or in degrees.
- The batter window allows for direct stroke, hammer efficiency and hammer and pile weight (or gravity) reduction factors and provides the associated help values
- The graphic representation of the main input form shows the pile in the inclined manner.

Improvements related to **Driveability** analysis include:

- **Most importantly: the end bearing input for driveability analyses now has to be made as a unit resistance in the S1 form. It is very important to remember this change when entering the soil resistance data;**
- **In the S1 input form, a new column, Toe Area, was added. This allows for a flexible and simplified data entry in cases of soil plugging in certain soil layers;**
- An automatic feature was added for generating an improved **Depth/Modifier** table; this feature initializes the **D-table** based on both the penetration entered in the main input form and the soil layer information of the **S1** table;
- The reset button in **D-table** input form has been improved to allow users to reset depths considering both depth increment and soil layers;
- The **D-Table** graphic input representation now depicts default values rather than zeroes, as appropriate;
- After the **S1-table** has been completed, **Gain/Loss factors** are initialized using the inverse of the maximum setup factor unless they had been manually set before;
- The **S1-Table** graphic input representation now shows defaults for zeroes as appropriate;



- The final **penetration** depth can now be modified in the main input form (before it was inactive and showed the last depth entered in the **D-table**). This penetration is now used to initialize the **D-table**.

For **Inspector Chart** analysis, the stroke increments are rounded off to either 0.5 ft or 1 ft (or 0.25 m or 0.5 m) depending on the starting stroke value.

In the **Numerical Output**, the format for SI output has been changed for steel piles with a cross sectional area $\geq 1 \text{ m}^2$ so that certain outputs will now be shown in MN and MN/mm rather than kN and kN/mm.

The bearing graph output now includes additional information such as pressure (diesel), coefficient of restitution of pile cushions (concrete piles) or hammer cushions (steel piles), and capacity (Inspector's Charts).

It is now possible to copy hammer/pile/soil model plots to other applications such as MS Word.

The help tables for **pile, hammer cushion and pile cushion** material properties have been combined and updated.

A copy/paste feature has been added to the **Pile Profile** form (P1) to allow creation/modification of pile input from other programs.

For **Non-uniform Piles** the pile strength/yield input has been changed to a **Critical Section Index** for a simple input of 0 for non-critical and 1 for critical sections.

Features available for the Offshore Wave Version

A Pipe Pile Builder for simplified input of complex pipe pile sections and add-ons, allowing for consideration of cut-offs and stabbing guides. In this case the graphical representation of the model shows the actual pipe pile/stabbing guides instead of the solid area plot.

Alternate hammer location can be input for any point along the pile, including the pile toe. The related inputs are

- hammer location as a distance below pile top,
- hammer cushion stiffness,
- helmet (element between hammer bottom and pile wall) stiffness.

Static bending analysis for inclined pile driving; related possible additional inputs are:

- center of hammer gravity above pile top,
- hammer total weight (should include the portion of leads that adds to bending),
- jacket/template height above sea floor,
- water depth.

The latter two inputs are also shown on the main screen graphics. The output replaces the tension stresses with the combined static bending and dynamic compression stresses in the pile section above the jacket/template top.

Fatigue Analysis tables are now calculated and are made an output. They are set up as follows:

- For each pile segment and for each depth value analyzed, the blow count and the maximum compressive and tensile stresses.
- For each pile segment and a user specified number of stress ranges, the number of occurrences (blows).



Optional consideration of the **Soil Plug Weight** in the static equilibrium analysis, which considers how much this weight can help the pile driveability.

Updates implemented by GRLWEAP 2010-3

- Corrected a problem with the critical index which did not work properly when multiple temporary pile lengths were used in the **D** Input Form for the Driveability analysis.
- Hammer database updates:

ID	Make	Model	Type
458	Menck	UW	Modify
463	Menck	MHU 500T	Modify
422	BERMINGH	B2005	Modify
559	ICE	DKH-3U	New
606	BSP	CGL370	New
607	BSP	CGL440	New
608	BSP	CGL520	New
609	BSP	CGL590	New
865	PILECO	D280-22	New
866	PILECO	D160-22	New ID
1340	H&M	H150	New
1341	H&M	H1700	New
1401	FAMBO	HR250	New
1402	FAMBO	HR500AKK	New
1403	FAMBO	HR500	New
1404	FAMBO	HR1000	New
1405	FAMBO	HR1500	New
1406	FAMBO	HR2000	New
1407	FAMBO	HR2750	New
1408	FAMBO	HR3000	New
1409	FAMBO	HR4000	New
1410	FAMBO	HR5000	New
1411	FAMBO	HR7000	New
1412	FAMBO	HR8000	New
1413	FAMBO	HR10000	New

- Manufacturer's recommended driving system help:
 - Updated PILECO and ICE
 - Added Fambo Hammers



- Material properties help for cushion and pile:
 - Corrected, edited and/or added material properties
- Help document:
 - Updated on-screen help and background report, primarily concerning vibratory hammer analyses and Offshore Wave option.

Updates implemented by GRLWEAP 2010-2

Fixes:

- XP compatibility issue: The menu items no longer disappear under Windows XP.
- The Input Wizard when using menu "File->New" now works under English units.

Improvements:

- Inclined pile plot in Bearing Graph (BG) output: Moved the plot left to give more room to plot an inclined pile.
- Clarified the labels in BG output such as the shaft % for non-proportional analysis.
- Clarified notes or warnings for API dialog, battered pile input, etc.
- Changed default toe area to 1 square foot when converting total toe resistance to unit toe resistance for driveability analysis when importing pre-2010 files without toe area.
- Added a check on the total number of soil layer entries in **S1** (Soil resistance Input Form for Pile 1); provided a warning if maximum number of soil layers is exceeded. Large numbers of soil layers may happen when CPT method is used. Reduced the number of CPT data points to avoid this problem.
- Added a check on the total number of depth modifier entries in **D** (Depths, Modifiers Input Form); provided warning if maximum number of entries is exceeded.
- Displayed reduction factors for stroke and efficiency for inclined pile on main input form.
- User is now allowed to change unit system in the Input Wizard after "File->New".
- User is now allowed to change the last depth when using the Reset button in **D** (Depths, Modifiers Input Form) for Driveability Analysis.

Offshore Wave related updates

Updated the default modeling of the stabbing guide and the default entries of temporary lengths and depths. For details, please read the topic, "Offshore Wave Input," and the description of Example 22 on the On-Screen Help (press F1 to start the On-Screen Help while running GRLWEAP 2010-3, click the "Content" tab and select "GRLWEAP Input Forms" then "Offshore Wave Input".)