Analysis Studio Engineering Tools

Leg penetration, pile capacity and pile driveability in one place, with every assumption visible.

Client briefing · how to use the four tools

Leg penetration
Jack-up spudcans, punch-through and rig screening

Pile capacity
Driven and drilled & grouted piles, axial

Pile driveability
Impact hammers, blow counts, stresses and fatigue

Sheet pile driveability
Vibratory hammers, penetration speed and refusal

Client briefing · user & engineering guide
For engineers using NAVBathy Analysis Studio

Prepared Nov 2026
navbathy.com

EXECUTIVE SUMMARY

Four offshore foundation tools, one way of working

Analysis Studio puts the main checks for jack-up and pile foundation work in one workspace. All four tools use the same layout, keep the soil profile consistent from tool to tool, and record exactly which inputs and method values produced each result.

4
tools: leg penetration, pile capacity, pile driveability and sheet pile driveability

1
soil profile, from your project's boreholes, carried from capacity to driveability

0.25 m
depth step of the driveability tables (blows, stresses, rate)

100%
of method values visible and editable, each with its source and a verified flag

1. **One layout everywhere.** Each tool has the same structure: the inputs in tabs or lettered sections on the left, and a live, to-scale drawing on the right that updates as you type. Then a run, results, and downloadable reports.

2. **Starts from your project.** When opened from a project on the NAVBathy map, the leg penetration and pile capacity tools are pre-filled from the selected location: water depth, nearest borehole and nearest CPT. The driveability tools take their soil from a pile capacity run, or from a borehole log PDF that you review layer by layer.

3. **Engineering you can follow.** The tools use recognised published methods: ISO 19905-1 and SNAME 5-5A for spudcans, API RP 2GEO with a CPT-based check for piles, and the Smith wave equation for impact driving. They show methods side by side and bounds (lower, best estimate, upper) so you can see the spread, not just one number.

4. **Your values, your sign-off.** Every partial factor, coefficient and limit sits on a Method settings page. Your engineers enter values from their licensed standards and project data, record the source, tick verified, and save with a change note. Each run keeps a fingerprint of the settings it used.

5. **Honest about status.** Until the settings a run uses are verified by your team, the run and its reports are stamped **NOT FOR DESIGN**. The tools support engineering decisions; they do not replace the engineer of record.

GETTING STARTED

Two ways into the Studio

Open the tools on their own, or from inside a project on the NAVBathy map, where they start with that project's site data.

A · The Studio on its own

navbathy.com/studio

- Sign in. The header shows **Analysis Studio** and four tool tabs.
- Leg penetration (LPA) opens first. Switch tools with the tabs; each tool fills the screen.
- Your email and a sign-out button are top right. Trial accounts also see the days left and a **Send feedback** link.
- Best for quick checks, or for work that is not tied to a map project.

B · From a project on the map

navbathy.com/map → Project

- In **Navigation & Controls**, click the **Project** tile and open the **Analysis** tab.
- Pick a tool card. The Studio opens over the map with the project name.
- Choose a location (e.g. **WTG-06**) and use **Show on map** to locate it.
- A status line confirms the seed, e.g. `WD 32.4 m · soil seeded from BH-xx (350 m).`

The Studio inside a project



Schematic of the project view. The tool selected below the bar takes up the rest of the panel.

What is pre-filled from the project. For leg penetration and pile capacity: water depth, the nearest borehole's soil profile, the nearest CPT (pile capacity), and the project, client and site names. If the nearest borehole is more than 500 m away, the status line adds **"extrapolated"**.

Ask instead of clicking. The project's Ask box also opens tools, e.g. *"Pile capacity at WTG-06"* or *"Run LPA at WTG-11"*. The reply opens the Studio at that location, already seeded with the nearest borehole and CPT.

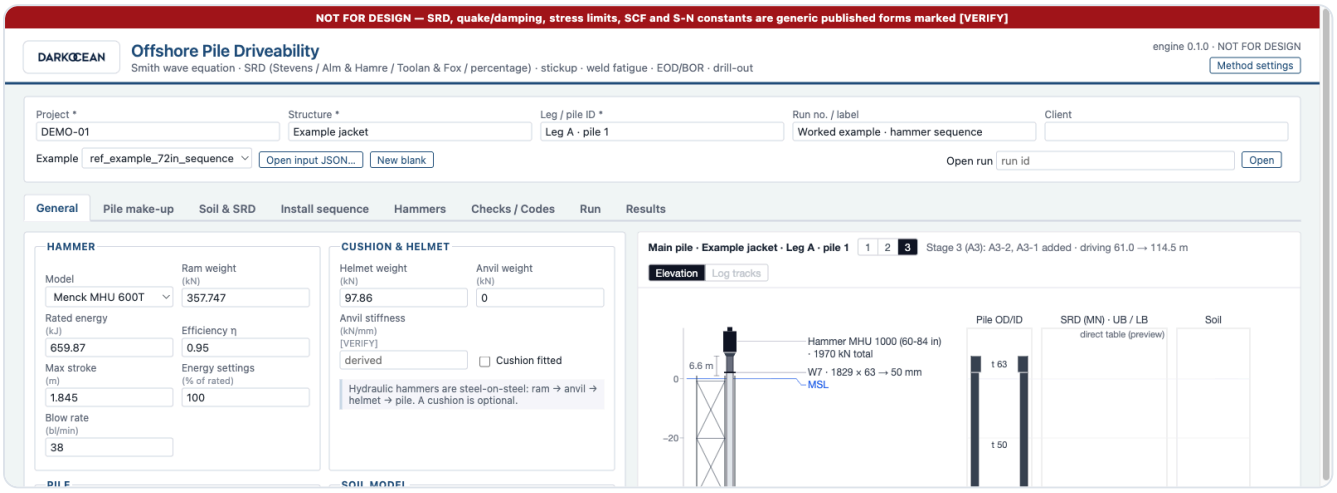
Who sees what

ACCOUNT	TOOLS	REPORTS & EXPORTS	METHOD SETTINGS	RUNS
Full access	All four, standalone and in projects	PDF, Word, CSV	View; changes by authorised engineers	Your team's runs
15-day trial	All four, in the standalone Studio	DISABLED	Hidden	Your own runs only
Signed out / trial ended	Sent to the trial page. After a trial ends, write to your Darkocean contact to continue.			

HOW EVERY TOOL IS LAID OUT

One workbench, four tools

Once you have learned one tool, you can use all four. The screen below is the pile driveability tool, loaded with its worked example.



The workbench. Red status banner, then the run header, the input tabs, the input panels (left) and the live elevation, to scale, with its depth tracks (right).

① Status banner

A red bar names which method values are still unverified. The same status is printed on every report page.

② Run header

Project, structure, leg/pile and run label. Load an example, open a saved input, start blank, or reopen any earlier run by its id.

③ Method settings

Top right. Opens the editable table of factors and coefficients used by that tool.

④ Input tabs

Left to right in the order you would work. Large tables have their own tab. **Validate** checks the input before you run.

⑤ Live drawing

Elevation to true vertical scale, with water, mudline, soil, the structure and the pile or spudcan. It updates as you type.

⑥ Results & downloads

Plots, depth tables, checks, ranking, warnings and assumptions, plus PDF, Word and CSV downloads.

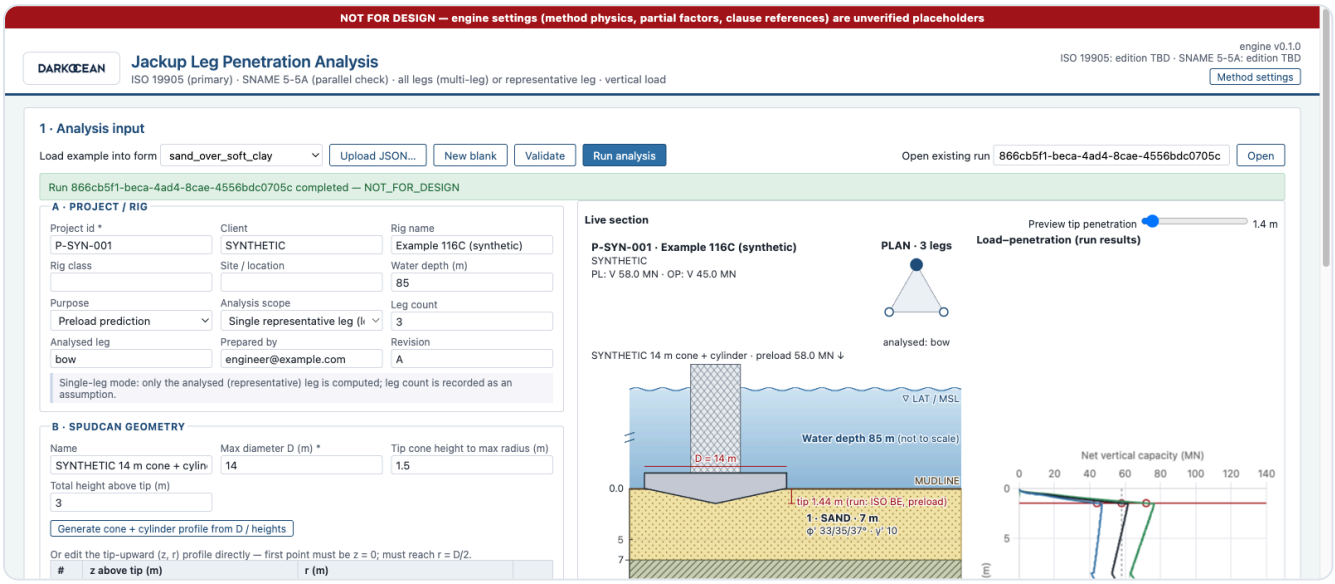
Conventions you can rely on

CONVENTION	WHAT IT MEANS FOR YOU
Soil symbols	Soil is drawn with **BS 5930** log symbols (clay hatching, sand stipple, gravel circles, peat, made ground, rock) and conventional tints. A key strip is shown under every drawing.
Bounds	Soil strengths are entered as **LB / BE / UB** (lower bound, best estimate, upper bound). Curves for each bound can be switched on and off.
Methods & colour	The governing method is drawn solid and the check method dashed; tables list both with the difference. Orange and red are used only for failures and warnings.
Units & datum	SI units. Elevations in m (MSL or project datum, positive up). Penetration in m below mudline or ground; for battered piles, measured along the pile axis.
Traceability	Each run has an id, a time stamp and fingerprints of its inputs, settings and results. Reopen any run by id and it shows exactly what was calculated.

TOOL 1 · LEG PENETRATION ANALYSIS (LPA)

How deep will the spudcans go, and is there punch-through risk?

Load–penetration curves for jack-up spudcans to **ISO 19905-1** (governing), with **SNAME 5-5A** run in parallel as a check. Analyse one representative leg or all legs of a 3- or 4-leg rig. Used for preload predictions, site-specific assessments and post-installation reviews.



Leg penetration workbench. Inputs on the left; on the right, the live section with water, layers and the spudcan to scale, a plan of the legs, and the load–penetration curves. The **Preview tip penetration** slider moves the spudcan and lists each curve's capacity at that depth.

Workflow

#	SECTION AND WHAT YOU ENTER
A	**Project / rig**: rig name and class, water depth, purpose, all legs or one representative leg.
A2–3	**Legs & footprints**: 3- or 4-leg preset, shared or per-leg soil, Δ-penetration and inclination limits, existing footprints, installation order, leg interaction.
B	**Spudcan**: D, tip cone and total height, or your own (z, r) profile.
C	**Load cases**: preload, operating, storm (V, H, M), with fixity, VHM and RPD inputs.
D	**Soil**: layers of clay, sand, carbonate clay or carbonate sand with LB/BE/UB strengths. A clay layer can be filled from a CPT CSV file.
E–F	**Run options** (methods, depth step, backflow) and **client report** fields such as document control, unit data, site data and geohazards.

Engineering covered

- General shear, partial embedment and clay backflow
- Sand over clay (load spread) and clay over softer clay (punching)
- Squeezing of soft clay; simplified carbonate treatment, always flagged
- Punch-through graded NONE WATCH RISK CRITICAL with the uncontrolled range
- Rig screening: differential penetration, inclination, footprint influence, load redistribution, VHM envelope, fixity and RPD

Read the curve, not just the number. Where the curve doubles back, the tool reports all equilibrium depths and marks the punch-through band in red.

TOOL 1 · RESULTS

Curves, a penetration table and a report ready for review



Load–penetration curves. ISO 19905 solid and SNAME 5-5A dashed, with LB/BE/UB in separate colours. The vertical dashed lines are the factored preload and operating targets. The red band shows a critical punch-through on the lower bound. The load axis can be shown in MN or kN.

What the results give you

OUTPUT	USE IT FOR
Predicted penetration	Penetration per load case and bound (ISO, SNAME and the difference), plus every equilibrium depth.
Utilisation	Capacity against the factored load at the installed penetration.
Punch-through	Severity, depth range and the governing layer interface.
Rig summary	Per-leg results, footprint influence, load sharing, V–H–M and RPD, differential penetration.
Warnings	E.g. target not reached, no preload case, carbonate simplified.

Downloads

Client report · PDF and Word

Twelve sections: document control, executive summary, scope, unit description, site and geotechnical data review, stratigraphy, back-analysis and calibration, geohazards, discussion and recommendations, limitations, references, and appendices with curves for every load case.

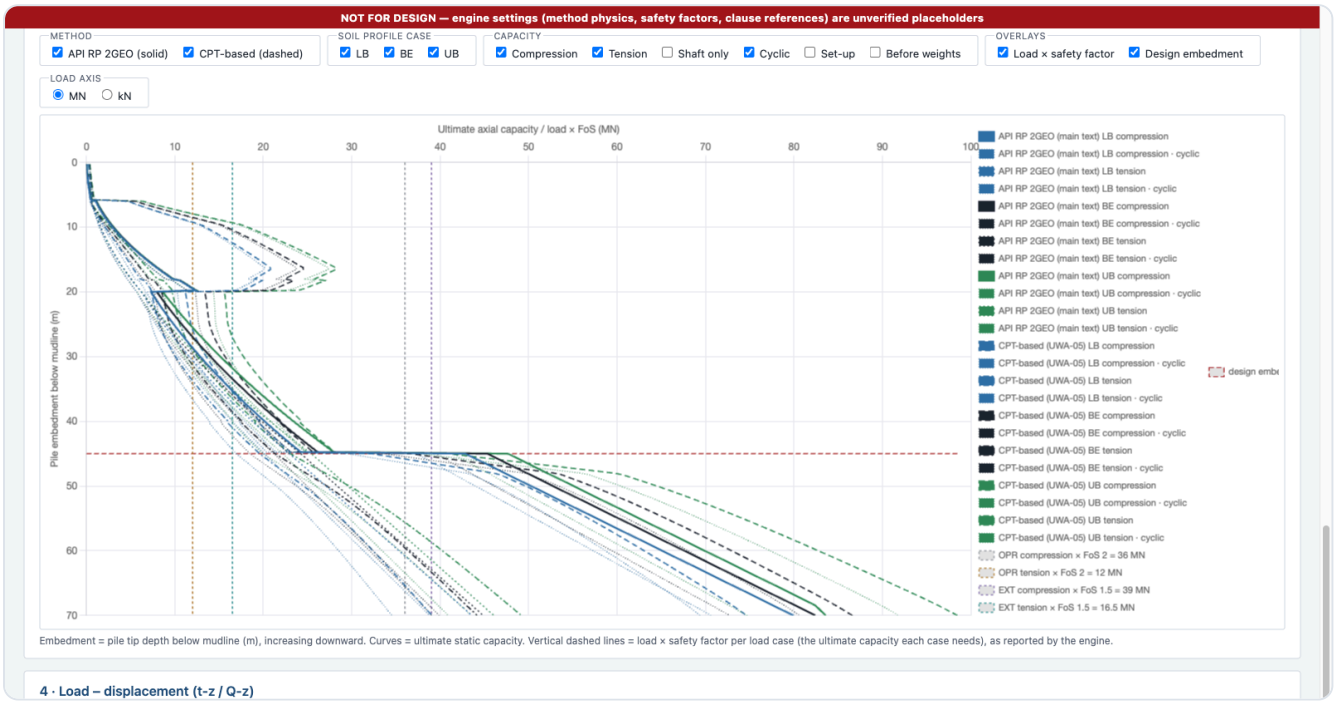
Also available: **curves (CSV)**, the **input file** (to re-run or share), a **report package**, and a **structural export** of the spudcan reactions for your rig model.

Discussion and recommendations are drafted automatically if left blank. Edit them before you issue the report.

TOOL 2 · OFFSHORE PILE AXIAL CAPACITY

How deep must the pile go to carry its loads?

Static axial capacity in compression and tension against embedment, for **driven** and **drilled & grouted** piles. The governing method is the **API RP 2GEO** main text. For driven piles in siliceous sand, a **CPT-based (UWA-05)** check runs in parallel.



Capacity–embedment curves. API solid and CPT dashed, LB/BE/UB, compression and tension, with cyclic variants. The vertical dashed lines are load × safety factor for each case; the red dashed line is the design embedment. Toggles show shaft only, set-up, or capacity before pile and plug weights.

Workflow

A Project · B Geometry · B2 Make-up · C Loads · D Soil · D2 CPT · E Run options · F Scour · set-up · group

- **Driven**: open or closed toe, OD, wall, plug mode (auto takes the lower of plugged and unplugged), design embedment.
- **Drilled & grouted**: construction sequence, hole diameter, grouted length, grout UCS, optional end bearing.
- **Soil**: clay (su LB/BE/UB), sand (description and density), rock (UCS), carbonate options. CPT from a CSV file or pasted.
- **Effects**: general and local scour, set-up (reported, credited only if you ask), group, weights, load–displacement.

Results

OUTPUT	WHAT IT SHOWS
Required embedment	Per load case and bound
Utilisation	At the design embedment
Shaft by layer	Including the governing grout or rock interface
Load–displacement	Head load–settlement, t-z per soil unit, Q-z at the tip
API vs CPT	Comparison with review flags

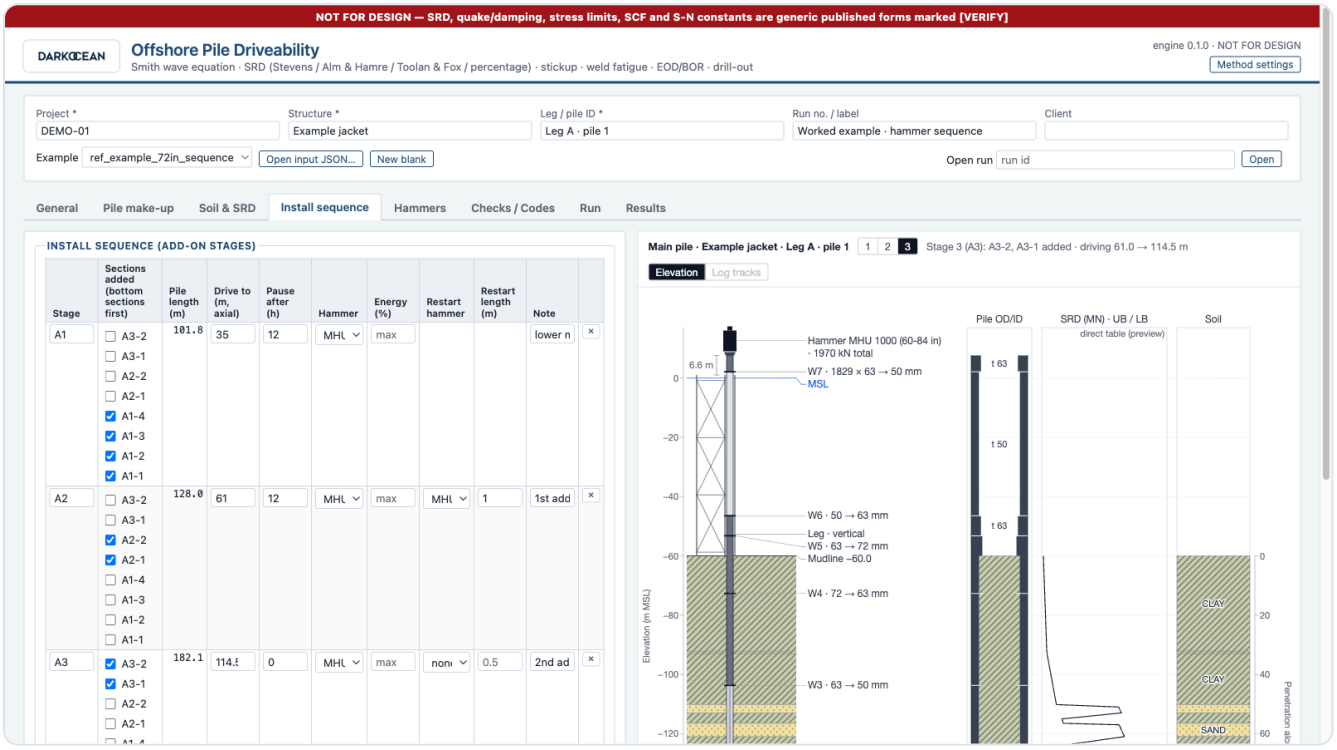
Downloads: PDF and Word report, curves CSV, input file. A run can also feed the driveability tools as their soil profile.

TOOL 3 · OFFSHORE PILE DRIVEABILITY (IMPACT HAMMERS)

Can this hammer drive this pile to target, safely?

A one-dimensional **Smith wave equation** analysis for tubular piles: a battered main pile through a jacket leg, or a vertical skirt pile. Compare hammers, plan the add-on sequence, and check stickup, driving stress, weld fatigue and refusal before mobilising.

1 General | 2 Pile make-up | 3 Soil & SRD | 4 Install sequence | 5 Hammers | 6 Checks / Codes | 7 Run | 8 Results



Install sequence. Each stage adds sections, drives to a depth, pauses (which sets up the soil before the next restart), and can use its own hammer plus a restart hammer for the first metre after a pause. The elevation shows the jacket leg, welds W1–W7 with their wall changes, stickup above the guide, and the soil log.

Section naming

Leg letter + add-on number: **A1** is the first section installed, then A2, A3. Cans within an add-on are numbered from the bottom: A1-1 is the toe can. Names are generated for you and can be edited.

Soil, three ways

Import one of your **pile capacity runs**, upload a **borehole log PDF** and accept or reject each proposed layer (with page and source quote), or type or paste a **manual table**. Required capacity is never imported: you enter it from your structural engineer.

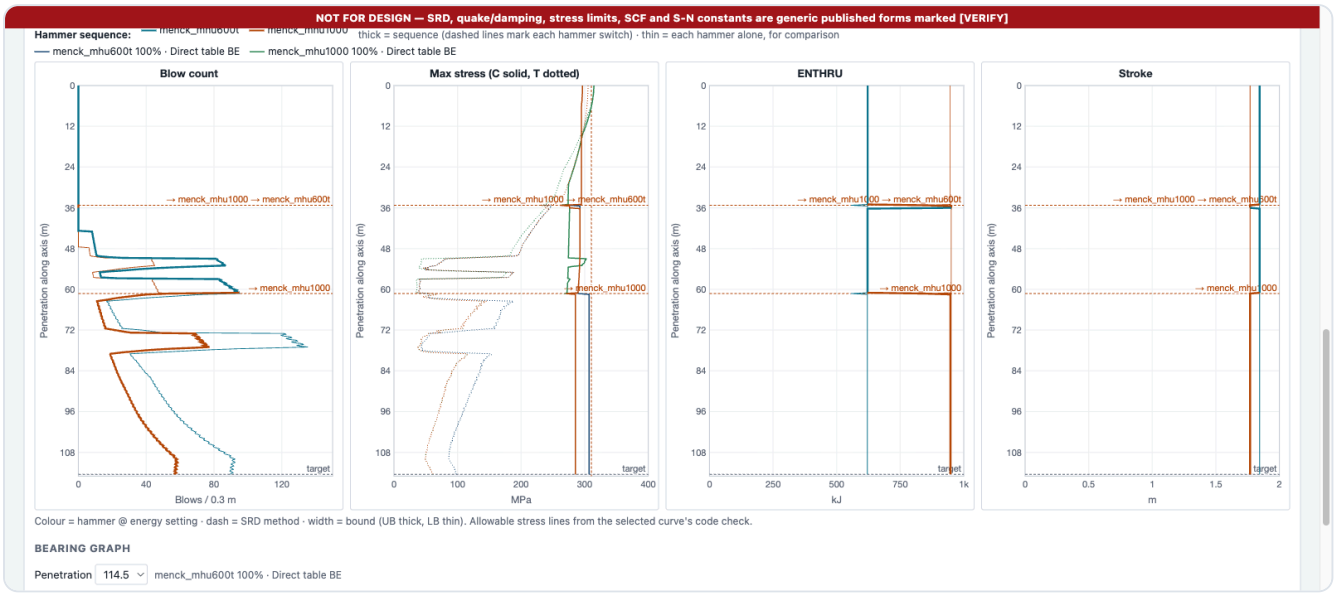
Hammer database

Hydraulic impact hammers with ram, anvil, helmet, sleeve and in-air/in-water weights. Compare several hammers in one run, add a custom hammer, or save one to the database with a change note.

The hammer never passes through the leg. For a main pile, driving stops before the hammer sleeve reaches the jacket leg top (with a set clearance). The stage then shows *"hammer stop; planned X m"*, and a warning asks you to add the next section earlier or hold the hammer on the crane.

TOOL 3 · RESULTS

Blow counts, stresses and a hammer ranking



Driveability vs depth. Blow count, maximum stress (compression solid, tension dotted, with allowable lines), energy transferred and stroke. The thick line is your stage-by-stage **hammer sequence**, coloured by hammer, with a dashed line at each switch. The thin lines are each hammer on its own, for comparison.

Engineering covered

CHECK	HOW
Soil resistance (SRD)	Stevens et al. (four coring/plugged cases), Alm & Hamre, Toolan & Fox, percentage rule, or your own direct table; overlay any combination
Set-up	Log-time set-up on the shaft during each pause; end-of-drive (EOD) vs beginning-of-restrike (BOR)
Self-weight & pile run	Settlement of the pile, then pile + hammer; pile-run zones where resistance drops below weight
Stickup	Free length above the guide, hammer on and off, to API WSD or ISO 19902 forms
Weld fatigue	DNV-RP-C203 girth-weld SCF and S-N curves; Miner sum over all blows against a driving budget
Refusal	Your criteria table, plus flags where a weld or the thinnest wall sits at a hard layer
Capacity & drill-out	Long-term capacity vs your required value; three drill-out scenarios

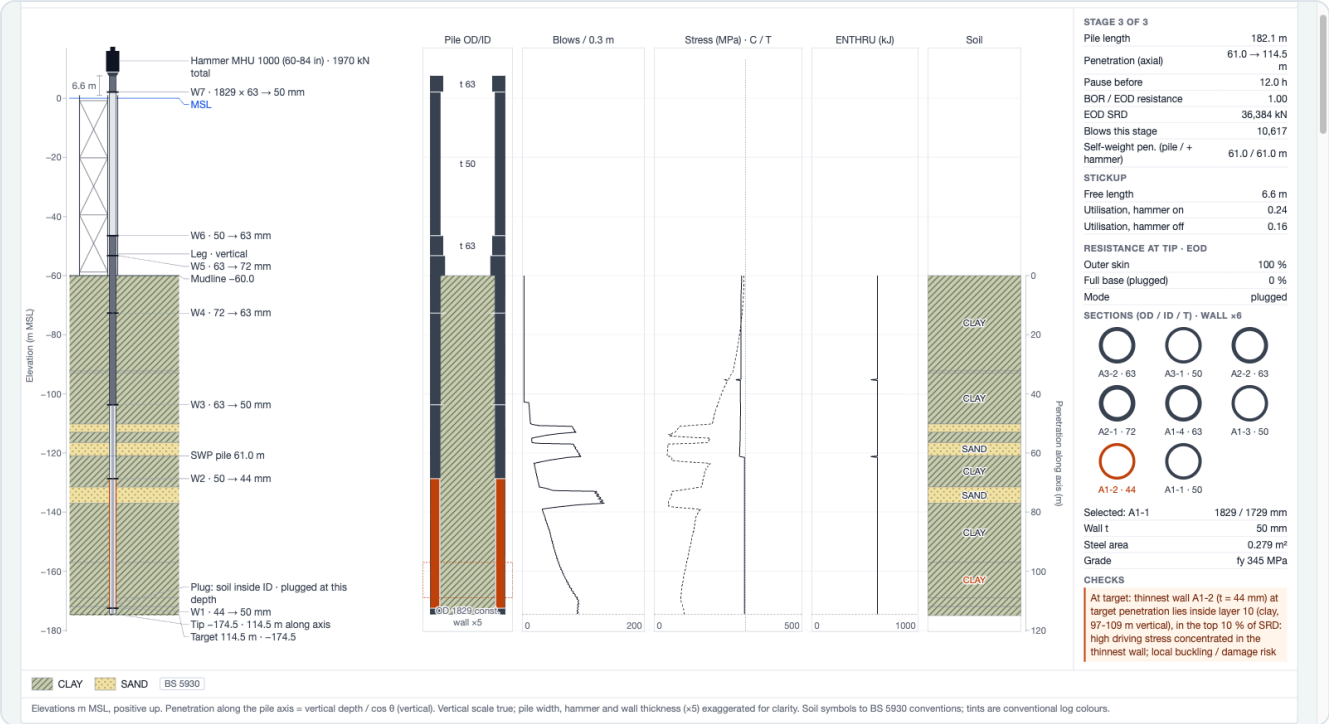
Reading the results

- **Depth table at 0.25 m**: stage, hammer, SRD, blows/0.3 m, stresses and where they occur, energy, stroke and cumulative blows.
- **Bearing graph**: resistance against blow count at any penetration.
- **Hammer ranking**: first whether the hammer reaches target, then stress utilisation, then fatigue damage, then total blows.
- **Log tracks**: switch the elevation to blows, stress and energy drawn next to the pile and soil.
- **Warnings**, each with a plain-language action (e.g. *"plan hammer placement and hold-back"*).

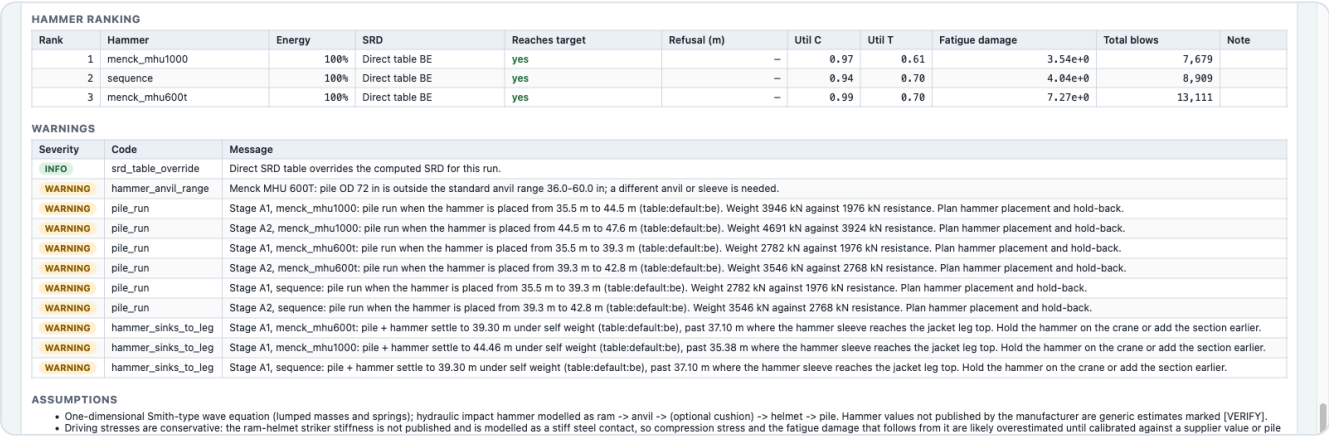
> **Conservative by design.** Where hammer manufacturers do not publish a value (such as striker stiffness), the tool takes a stiff assumption. Compression stress and fatigue therefore lean high until calibrated with your supplier's data.

TOOL 3 · RESULTS, CONTINUED

See the whole installation on one axis



Elevation with log tracks after a run. The pile drawn to scale through the soil (BS 5930 symbols), with welds W1–W7, and blows per 0.3 m, stress and energy plotted on the same penetration axis. The side panel summarises the selected stage: penetration, BOR/EOD resistance, blows, self-weight penetration, stickup utilisation, tip resistance split, section rings and checks. The weakest section is ringed in orange.



HAMMER RANKING

Rank	Hammer	Energy	SRD	Reaches target	Refusal (m)	Util C	Util T	Fatigue damage	Total blows	Note
1	menck_mhu1000	100%	Direct table BE	yes	–	0.97	0.61	3.54e+0	7,679	
2	sequence	100%	Direct table BE	yes	–	0.94	0.70	4.04e+0	8,909	
3	menck_mhu600t	100%	Direct table BE	yes	–	0.99	0.70	7.27e+0	13,111	

WARNINGS

Severity	Code	Message
INFO	srd_table_override	Direct SRD table overrides the computed SRD for this run.
WARNING	hammer_anvil_range	Menck MHU 600T: pile OD 72 in is outside the standard anvil range 36.0-60.0 in; a different anvil or sleeve is needed.
WARNING	pile_run	Stage A1, menck_mhu1000: pile run when the hammer is placed from 35.5 m to 44.5 m (table:default:be). Weight 3946 kN against 1976 kN resistance. Plan hammer placement and hold-back.
WARNING	pile_run	Stage A2, menck_mhu1000: pile run when the hammer is placed from 44.5 m to 47.6 m (table:default:be). Weight 4691 kN against 3924 kN resistance. Plan hammer placement and hold-back.
WARNING	pile_run	Stage A1, menck_mhu600t: pile run when the hammer is placed from 35.5 m to 39.3 m (table:default:be). Weight 2782 kN against 1976 kN resistance. Plan hammer placement and hold-back.
WARNING	pile_run	Stage A2, menck_mhu600t: pile run when the hammer is placed from 39.3 m to 42.8 m (table:default:be). Weight 3546 kN against 2768 kN resistance. Plan hammer placement and hold-back.
WARNING	pile_run	Stage A1, sequence: pile run when the hammer is placed from 35.5 m to 39.3 m (table:default:be). Weight 2782 kN against 1976 kN resistance. Plan hammer placement and hold-back.
WARNING	pile_run	Stage A2, sequence: pile run when the hammer is placed from 39.3 m to 42.8 m (table:default:be). Weight 3546 kN against 2768 kN resistance. Plan hammer placement and hold-back.
WARNING	hammer_sinks_to_leg	Stage A1, menck_mhu600t: pile + hammer settle to 39.30 m under self weight (table:default:be), past 37.10 m where the hammer sleeve reaches the jacket leg top. Hold the hammer on the crane or add the section earlier.
WARNING	hammer_sinks_to_leg	Stage A1, menck_mhu1000: pile + hammer settle to 44.46 m under self weight (table:default:be), past 35.38 m where the hammer sleeve reaches the jacket leg top. Hold the hammer on the crane or add the section earlier.
WARNING	hammer_sinks_to_leg	Stage A1, sequence: pile + hammer settle to 39.30 m under self weight (table:default:be), past 37.10 m where the hammer sleeve reaches the jacket leg top. Hold the hammer on the crane or add the section earlier.

ASSUMPTIONS

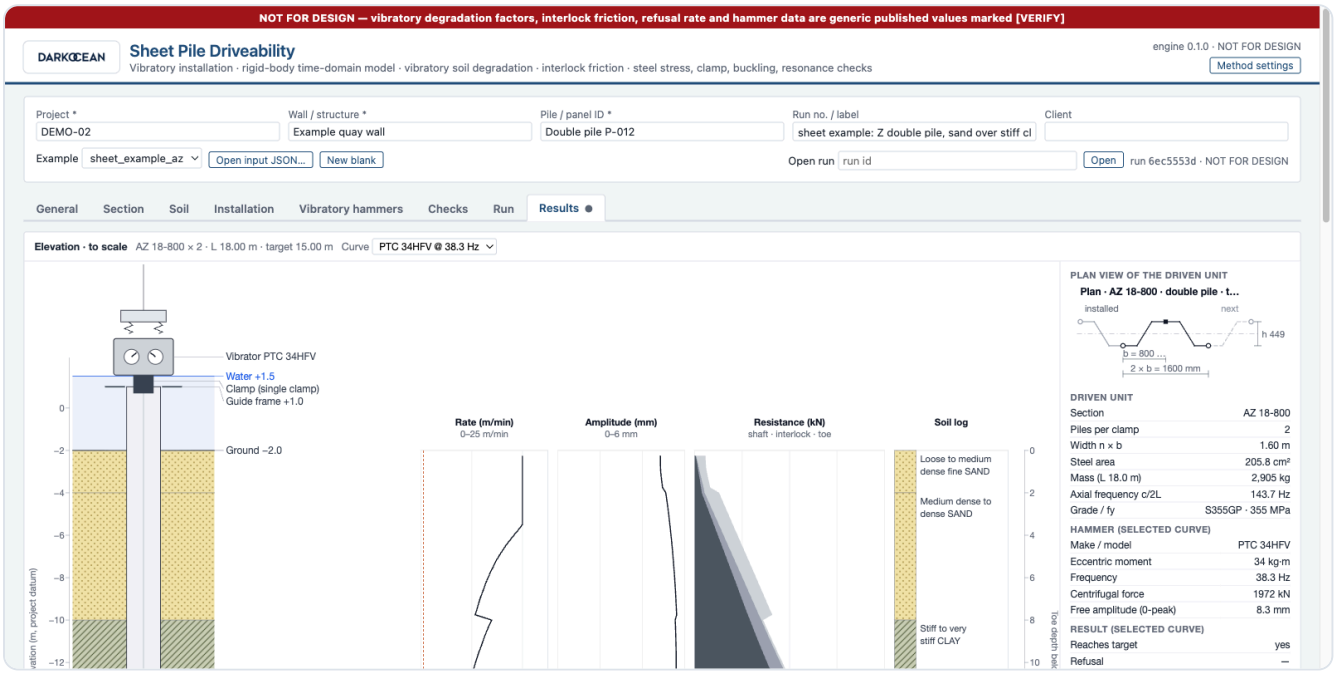
- One-dimensional Smith-type wave equation (lumped masses and springs); hydraulic impact hammer modelled as ram -> anvil -> (optional cushion) -> helmet -> pile. Hammer values not published by the manufacturer are generic estimates marked [VERIFY].
- Driving stresses are conservative: the ram-helmet striker stiffness is not published and is modelled as a stiff steel contact, so compression stress and the fatigue damage that follows from it are likely overestimated until calibrated against a supplier value or pile

Hammer ranking and warnings. Every hammer, and your sequence, ranked on the same criteria. Warnings tell you what to do, not just what failed.

TOOL 4 · SHEET PILE DRIVEABILITY (VIBRATORY)

Which vibro hammer reaches the toe level, and how fast?

Vibratory installation of steel sheet piles for quay walls and cofferdams. A rigid-body, time-domain model of vibrator, clamp and pile against degraded shaft, interlock and toe resistance gives penetration rate, amplitude and refusal at every 0.25 m.



Sheet pile workbench after a run. Elevation to scale with water, ground and guide-frame levels, vibrator and clamp, and the target toe. The tracks show rate (m/min), amplitude (mm) and resistance split into shaft, interlock and toe. The side panel shows the driven unit in plan (single, double or triple) and the checks.

1 General **2** Section **3** Soil **4** Installation **5** Vibratory hammers **6** Checks **7** Run **8** Results

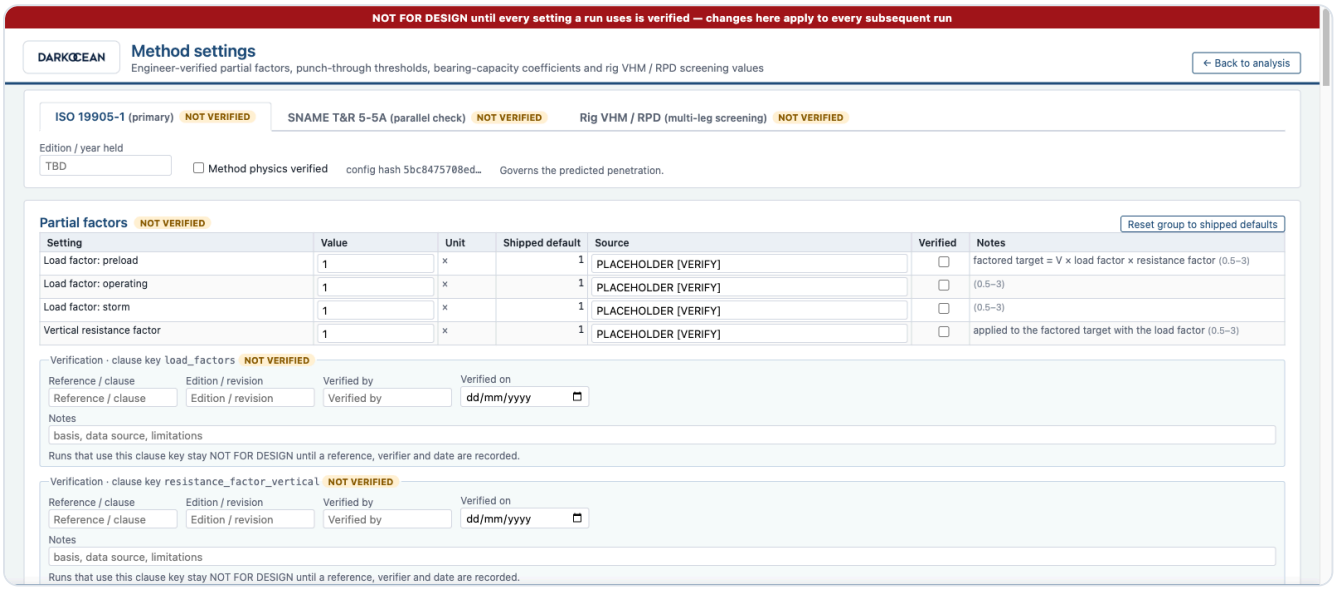
- **Section catalogue**: 170 Z, U, straight-web and combined-wall sections from a supplied steel sheet pile catalogue. Filter, search, see the profile in plan, or copy a section to edit it.
- **Installation**: pitch-and-drive or panel driving, piles per clamp, driving against an installed neighbour, sealed interlocks, crane hold-back, pre-augering or jetting ranges.
- **Hammers**: 20 vibratory hammers (eccentric moment, frequency, force, masses, clamp, line pull), plus your own.
- **Soil**: the same three sources as Tool 3.

CHECK	WHAT IT TELLS YOU
Refusal	Rate below your limit (default 0.5 m/min), with the governing component
Steel stress	At the clamp and the toe, against yield
Clamp & line pull	Clamp force needed vs available; extraction pull
Free-standing pile	Buckling under the vibrator before embedment
Toe damage / declutching	Hard or cemented layers, gravel and cobbles, high acceleration at low rate
Resonance	Near the pile's first axial frequency; re-run at a reduced frequency
Back-solve	Eccentric moment needed to reach target

METHOD SETTINGS & VERIFICATION

Your standards, your values, a full audit trail

The Studio comes with generic published values so it works from day one. Before results are used for design, your engineers replace them with values from your licensed standards, project guidelines and site data.



Method settings (leg penetration). Each value shows its shipped default, unit, source and a **Verified** box. Each clause records the reference, edition, verifier and date. Groups can be reset to shipped defaults.

STEP 1

Open Method settings

From the button at the top right of any tool.

STEP 2

Enter and cite

Change a value and record its source: the standard, clause and edition.

STEP 3

Verify and save

Tick verified, then save with your name and a change note.

STEP 4

Next runs use it

Earlier runs keep the settings fingerprint they were run with.

Built-in safeguards

- Every save records who, when, why, old and new values, and a fingerprint of the settings.
- Out-of-range values are refused, e.g. a punch-through *watch* margin must exceed the *risk* margin, and curves must start at zero and rise.
- A value cannot be marked verified while its source still reads *placeholder*.
- Only authorised engineers on your account can save changes.

NOT FOR DESIGN, and how it clears

A run is stamped NOT FOR DESIGN while any value it uses is unverified. The banner, results and every report page say so, and list the reasons.

Once your team has verified the settings a tool uses, its runs carry your verified fingerprint. The engineer of record still checks and signs off the result.

CURRENT LIMITS

Say them plainly

These tools support engineering judgement. These are the boundaries of each one.

TOOL	LIMIT
Leg penetration	Based on vertical load. Footprint, load redistribution, VHM and RPD are screening checks, not a full 3-D hull model. Uses two-layer mechanisms (the layer below is considered; deeper three-layer effects are not). Carbonate soil uses a simplified treatment and is always flagged.
Pile capacity	Static axial capacity only. The CPT method applies to driven piles in siliceous sand. No main-text values for loose sand; driven piles into rock are not covered. Carbonate values need engineering judgement.
Pile driveability	Hydraulic impact hammers with a one-dimensional Smith model. Stresses are conservative where hammer data is not published. Toe resistance is not aged by set-up. The structural engineer provides the required capacity; the tool does not calculate it.
Sheet pile driveability	Rigid-body model, valid well below the pile's first axial frequency. Vertical driving only. Degradation depends on soil type and frequency only. Rates near refusal are indicative. Hammer and section values not taken from a datasheet are flagged for checking.
All tools	SI units. Outputs are stamped NOT FOR DESIGN until the settings they use are verified by your engineers.

Trying the Studio: the 15-day trial

1 · START
Work email
Enter it at navbathy.com/studio/trial and we email a 6-digit sign-in code.

2 · ABOUT YOU
Name, company, project type
Tell us what you will use the Studio for, then read the trial declaration.

3 · SIGN
Sign and open the Studio
Agree, and sign by typing your full name. The Studio opens straight away.

During the trial you can use all four tools free for 15 days, one trial per email. Results are for evaluation only and are marked NOT FOR DESIGN. Report and file export is switched off.

Your data. Inputs and results of trial runs are recorded and used to improve the Studio. Please only enter data you are entitled to share.

Getting help

Each tool has worked examples in the **Example** list. Load one to see a complete, filled-in case before you start your own. For full access, verification support or custom hammer and section data, contact your Darkocean representative.