JUMBO BLOCK ENGINEERING SUITE

JUMBO BLOCK Static

User Manual · Version 9.1.2

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1. Overview

JUMBO BLOCK Static is the structural pre-design tool of the JUMBO BLOCK Engineering Suite. It assesses an installation layout taken over from PLAN from a Eurocode-oriented perspective: the structural model (modules, raster, plates, frames, supports, ground), verifications (bending, shear, punching, serviceability, uplift, EC7 indicators), and production data (reinforcement, material quantities, weights).

STATIC is an extended technical pre-design tool. It does not replace a certifiable execution structural design by a licensed structural engineer — this notice appears directly in the tool at the Engineering table (chapter 19) and is upheld consistently throughout.

The program runs entirely locally in the browser as a single HTML file. There is no cloud connection, no server, and no user account. STATIC reads in a PLAN layout, calculates all verifications and key figures from it, and writes certain results (e.g. reconciled plate thicknesses) bidirectionally back into the suite's shared data model via the same project.dbm.

STATIC is one of several standalone tools in the suite (including HYDRO, PLAN, BUDGET, TEMP, Project). By content, it is by far the most extensive tool, covering a wide range of EC2/EC7-oriented pre-design indicators.

2. Getting Started

When static.html is opened for the first time, all input fields are pre-filled with technical default values (see also chapter 21, “Reset Static”, which restores the same values), and the import status shows “No project.dbm imported yet.”

The typical workflow: define the installation layout (modules, plates, joints) in PLAN and export it as project.dbm, then import that file into STATIC. STATIC automatically takes over module count, raster and plate thicknesses and calculates all verifications. Load cases, ground parameters and reinforcement approaches can then be refined project-specifically.

There is no persistent storage in the browser. The current working state exists only in the memory of the open page until it is deliberately saved as a project.dbm file via “Export” (chapter 3).

3. Import / Export (project.dbm)

The project.dbm is the suite's shared data format. “Import” opens the file selection dialog and reads a project.dbm, typically one exported from PLAN, but equally one previously exported by STATIC itself.

On import, STATIC takes over module count and side plate count from the shared data model. If no explicit X×Y raster is present, STATIC automatically determines the most likely raster via the outer-edge logic 2X + 2Y (side plate count = 2 × raster length + 2 × raster width) — this is explained directly in a highlighted box in the “PLAN Data” section (chapter 5). Floor, side and cover plate thickness as well as the plate concrete class are also taken over if present in the file.

“Export” calculates an updated SHA-256 hash over the entire stored dataset and downloads the file named YYYYMMDD_HHMMSS_project.dbm. The export is bidirectional: alongside STATIC's own fields (load cases, ground parameters, reinforcement approaches, all calculated verification values), STATIC also updates shared PLAN fields such as module count, raster, and floor/side/cover plate thickness — changes made to these values within STATIC therefore become visible in PLAN on the next import.

The hash status notice and the import status notice each show the current processing state. If the hash of an imported file is missing or does not match, a corresponding warning or error notice appears; the import still proceeds as long as the file is readable in content.

4. Project Information

Captures project name, organisation/municipality/office, contact person, project location, email, phone, and a remark. All entries are purely for documentation in the report and export and do not enter into any structural calculation. These fields are editable (unlike, for example, in BUDGET) and are written into the project.dbm on export.

5. PLAN Data / Installation Geometry

Shows module count, side plate count, raster X and raster Y, plus net storage volume and gross excavation volume. These values are usually taken over from PLAN via import, but can also be entered or adjusted manually.

A highlighted notice explains the automatic raster detection: if PLAN supplies only module and side plate count (without an explicit raster), STATIC determines the most likely X×Y raster via the outer-edge logic 2X + 2Y. These values form the geometric basis for all subsequent verifications (composite logic, support loads, plate models).

6. Load Cases

This extensive section defines all actions on the installation:

- Traffic load: selection of the governing traffic load class (none, car, van, truck, SLW 12/30/60, LM1/Eurocode, F900). Determines the characteristic wheel load and thus a major part of the design load on the cover plate and modules.
- Overburden material and height: material selection (soil, gravel, rubble, rock, asphalt, concrete) and overburden height from 0 to 5.00 m in fine steps.
- Cover plate support: loosely resting, secured against displacement, or bonded/screwed all around — affects the boundary conditions of the numerical plate model (chapter 13).
- Custom additional load: a project-specific additional surface load in kN/m², independent of traffic and overburden.
- Local wheel-load spreading: characteristic local wheel load Qk (suggested from the selected traffic load class, overridable), load spread angle φ, dynamic factor ψ, partial safety factor γQ, and the tyre contact area a × b.
- Water state: empty, 50%, or 100% fill — determines water weight and uplift load.
- Target reserve factor: desired global safety margin for the pre-design.
- Design mode and load combination: pre-design (characteristic loads Gk + Qk) or EC verification mode with a selectable combination (characteristic, ULS, SLS rare/frequent/quasi-permanent) and the associated partial safety and combination factors γG, γQ, ψ0, ψ1, ψ2 and γWater.
- Groundwater/uplift: activation of the uplift verification, groundwater level relative to the structure's height (0–100%), and target safety factor against uplift (1.10/1.25/1.50).

A notice clarifies that traffic and earth loads are applied as surface loads, and that an additional local wheel-load-spreading check through the overburden remains to be verified project-specifically per EN 1991 and EN 1997. Depending on the selected load combination, results can differ considerably, and individual verifications can have different governing load cases, since a complete Eurocode design uses different combinations for different verifications.

7. Ground Conditions and Settlement

Captures the soil class (very soft to rock, with associated allowable soil pressure σzul from 100 to 1000 kN/m²) plus optional override values taken from a geotechnical report for the subgrade modulus ks (MN/m³) and the elastic modulus (MPa). If these fields are left blank, STATIC calculates conservatively using values automatically derived from the selected soil type.

From these inputs, STATIC derives an extensive group of geotechnical pre-design indicators: soil pressure σB and its utilization against σzul, a settlement indicator and settlement estimate, the subgrade modulus ks, an EC7 pre-indicator, and standalone verifications for bearing capacity failure (Ed/Rd), sliding (HEd/Rd safety), tipping (MEd/MRd safety), and eccentricity (e relative to the core width b/6), each with its own status. An overall geotechnical indicator summarises these individual assessments.

A clear notice states: this is a simplified pre-design approach. Geotechnical investigations and project-specific verifications remain required.

8. Plates

Defines the core geometry and material approach of the installation: floor, side and cover plate thickness (each selectable from a thickness tier of 10 to 100 cm), the plate concrete class (C40/50 or C80/95), and reinforcement factors for frames/beams (standard B500B 1.15 / reinforced 1.25 / high-performance 1.40 / custom) and for plates (standard 1.10 / reinforced 1.20 / high-performance 1.30 / custom).

The “Symmetric construction” option automatically sets the floor plate thickness equal to the selected cover plate thickness, analogous to the identically named option in PLAN.

Two additional percentage allowances control the quantity take-off: the FDM safety allowance for cover plate reinforcement (0–25%, affects only the calculated reinforcement demand from the numerical plate verification, not loads or the FDM solver itself), the general reinforcement allowance (0/5/10%, for the steel schedule in chapter 16), and the concrete allowance (0/5/10%, for the material overview in chapter 16).

A notice reminds that the JUMBO BLOCK module itself is, independent of the selected plate concrete class, always manufactured in concrete class C40/50 with a frame/beam structure of modules alternately rotated by 90° in composite action.

9. Durability and Supplementary Consistency Checks

These four interlinked sections are automatically recalculated as soon as plate thickness, concrete class, reinforcement approach, or exposure class change:

- Exposure class and durability: selection of an exposure class (XC1 to XC4, XD1, XF1) with an automatically derived minimum concrete cover cmin and nominal concrete cover cnom. A simplified pre-design approach; exposure classes, concrete cover and durability are to be determined project-specifically according to standards and execution planning.
- Consistency durability ↔ concrete class: an automatic plausibility check between the selected plate concrete class and the applied exposure class within the pre-design.
- EC2 detailing: shows EC2 detailing indicators as pre-design values — minimum reinforcement, anchorage length lb,rqd, lap length l0, and stirrup spacing.
- Robustness and accidental actions: derives robustness reinforcement, alternative load paths, and the system's symmetry from the available system data.

The “Assumptions, limitations and model status” section transparently documents what this pre-design tool does not cover: fire exposure, seismic verification, fatigue verification, dynamic actions, and execution planning with detail drawings are not part of the tool and can be added project-specifically if required. The current software status (STATIC 9.1.2) is also shown here.

10. Project Overview and Composite Logic

The project overview shows raster, real installation size, footprint and storage volume, plus a graphical layout with module, side plate, and composite column counts. The legend shows the alternating 0°/90° module rotation across the raster.

The composite logic distinguishes corner, edge, and inner modules, counts the 50×50 cm composite columns, and determines the effective support points. A notice explains the load-bearing principle: STATIC assesses the installation as an alternately rotated frame composite. The upright frames carry the main load; horizontal beams primarily act as spacers and geometry stabilisers.

11. Calculation Values

Summarises the central load figures: applied and effective traffic load on the cover plate, overburden load, water weight, module and plate weight, total vertical load, and uplift force with its associated safety.

In addition, the effective support points and two parallel support-load models are shown: a conservative model (load per 50×50 column and resulting compressive stress) and a realistic model (differentiated load per support type). Uplift safety for the three water states — empty, 50%, and full — plus a theoretical reinforced-concrete material comparison are shown as well. A summary assessment text classifies the overall condition.

12. Capacity Indicator

Compares the maximum calculated structural load with a theoretical material capacity, taking into account the reinforcement assumption, plate reinforcement, and plate model index. A bar chart shows utilization and remaining reserve.

Differentiated by support type, inner support (100% load share), edge support (50% load share) and corner support (25% load share) are shown with their respective load and the derived maximum support load and compressive stress.

Four individual indicators summarise the overall condition: the support indicator (compressive stress relative to the concrete reference, v2.0 base model), the frame/beam indicator (bending, shear, and bending stress as plate/beam figures), the plate indicator (maximum of side, floor and cover plate), and the global structural indicator (maximum of all three, with the governing verification indicated). A note clarifies: plate reinforcement is documented and conservatively accounted for in the plate bending reference value; the material comparison is based on the selected concrete class, a conservative support model, and standard B500B reinforcement.

13. Cover Plate – Numerical Plate Verification (FDM)

This section performs a numerical finite-difference model (FDM) of the JUMBO BLOCK cover plate: free opening 2.00 × 2.00 m, continuous loose line support on the 25 cm frame, no fixity, standard concrete C40/50. This numerical verification is governing for the cover plate — it replaces simplified analytical plate formulas here with an actual numerical solution.

Reported values include design load qd, load spreading, FDM plate model utilization, field moments mx and my with maximum value, line shear at the support, maximum deflection, the required reinforcement in field and support regions per direction (bottom/top, x/y), a minimum-thickness recommendation, and FDM status and convergence of the numerical solver.

The load model (FDM) accounts for load spreading through the overburden; the traffic load is introduced locally into the FDM grid. Reported values include traffic load, overburden, material, contact area, effective load-spread angle φeff, concentration factor κ, effective load area, and the introduced individual and total loads.

The support lines (FDM) show the line shear derived from the numerical model along the four surrounding support lines (north/south/west/east), with maximum value, critical side, average reaction, and design value.

A clear notice states: the numerical plate model is an FE-/FDM-based pre-design and does not replace a certifiable execution structural design. A detailed FE calculation by the responsible structural engineer remains required for the final design.

14. Structural Visualization and Key-Figure Charts

The structural visualization shows a schematic, proportional cross-sectional view of the JUMBO BLOCK frame with floor plate, overburden, water level, simplified load arrows, and the central result values — rendered on a canvas element directly in the browser.

The key-figure charts present six topic areas as bar charts: compressive stress compared to the C40/50 reference, differentiated load shares of the support areas (inner/edge/corner), the plate indicator (side, floor, cover plate, local wheel-load indicator), the governing plate value (bending moment mEd, shear vEd, bending stress σEd, contact/bearing indicator), uplift safety across the three water states, and the vertical load shares (traffic, overburden, water, dead load).

15. Reinforcement Plans

STATIC generates four standalone reinforcement plans, each with a schematic SVG reinforcement sketch and a data table:

- Cover plate reinforcement plan: the most extensive of the four reinforcement sheets. Via “Use cover plate reinforcement”, a choice can be made between the pure engineering model (FDM) and the default engineering model (FDM) plus safety allowance (at least 15% for production reinforcement). Reported values include plate size, material, As,min, the calculated FDM reinforcement demand (raw and including safety allowance), the governing reinforcement including As,min, the FDM values for field bottom and support top per direction, the actually installed reinforcement per layer and in total, the selected reinforcement choice, utilization, reserve class, and the resulting steel weight.
- Frame/beam reinforcement plan 25×25 cm: shows component, material, longitudinal reinforcement, stirrups, the reinforcement model value As, and the utilization from bending and shear.
- Side plate reinforcement plan: shows plate size, material, the underlying load model, the differential pressure (from water fill versus earth load), As,min, As,req, As,prov, the selected reinforcement, utilization, and steel weight.
- Floor plate reinforcement plan: shows plate size, material, load model, bearing pressure, As,min, As,req, As,prov, selected reinforcement, utilization, and steel weight.

16. Reinforcement Schedule, Material and Weight Overview

The reinforcement schedule (steel list) summarises total steel weight, reinforcement allowance (from chapter 8), total weight including allowance, and steel weight per block. Two tables list in detail the mesh reinforcement used (position, component, mesh type, number of layers, component count, total meshes, total area, weight) and the bar reinforcement (position, component, reinforcement, piece count, length per piece, total length, weight without and with allowance).

The material and weight overview shows net concrete quantity, concrete allowance (from chapter 8), concrete including allowance, steel including allowance, and the total weight of all components. A table lists, per component (module, floor plate, side plate, cover plate), count, concrete weight, steel including allowance, and the gross component weight per piece and per line item — the latter being particularly relevant for transport and lifting planning.

17. Serviceability (Crack Width and Deflection)

The crack width section derives a simplified crack width indicator wk and the allowable value wk,zul for cover plate, floor plate, and frame/beam from the already existing SLS/utilization values, each with utilization and status. This is explicitly not a complete EC2 crack width verification, but a derivation from existing values.

The deflection section similarly derives a simplified deflection indicator f and the allowable value fzul for cover plate and floor plate from the existing plate span, plate thickness, and surface load, also with utilization f/fzul and status. This too is not a complete EC2 deflection verification.

18. Consistency Calculation ↔ Reinforcement Plan

This section automatically compares the already calculated required reinforcement (As,req) with the reinforcement actually applied in the reinforcement plans (chapter 15) (As,prov) for cover plate, floor plate, and frame/beam — each with the ratio As,prov/As,req and status. This is explicitly a comparison of existing values, not a new design formula.

19. Engineering Table

The central summary table lists all individual verifications with status, position, value, unit, verification type, utilization in %, governing load combination, and an explanatory note. It bundles all verifications described in the previous chapters in one place for a quick overall overview.

Directly below appears a clearly highlighted notice regarding ZANNI GROUP's engineering expertise: this tool provides an extended technical pre-design. It does not replace a certifiable structural design by a licensed structural engineer.

20. Print / PDF and Report Types

STATIC offers five different output formats, each tailored to a different audience:

- Print / PDF: prints the currently displayed screen view via the browser's print dialog (window.print()).
- Whitepaper Report (“Structural Calculation”): a formal, sign-off-ready calculation document with project data, basics, project and input data, structural visualization, complete verification summary, document integrity/traceability, and a signature block (prepared by/checked by/approved by).
- Engineering Report (“Complete calculation”): the most comprehensive report. In addition to the whitepaper report's content, it includes assumptions/limitations/model status, governing load combinations per verification, complete load assumptions, verification basis, detailed verification values, reinforcement values, the consistency check calculation↔reinforcement plan, durability and EC2 detailing data, robustness indicators, the material and weight overview, and a list of sources and standards used.
- Production Sheets (“Reinforcement drawings”): intended for manufacturing. Contains the steel list/reinforcement schedule, the material and weight overview, and document integrity — without the full verification discussion.
- Customer Report (“Project summary”): the least technical report, for clients and project partners. Contains an accessible project summary, information on the installation and its use, safety and trafficability, sustainability and added value, a summary status box, a note on further technical documentation, shortened hash values, and a signature block for client/project partner.

All reports are automatically recalculated before generation, open in a new window/tab, and are bilingual according to the current interface language. Each report contains its own document integrity hash values (input hash, result hash or document hash depending on the report type).

21. Reset Static

The “Reset Static” button first asks for confirmation (“Really reset STATIC?”) before resetting all inputs to the technical factory settings: traffic load SLW 60, overburden material soil, overburden height 1.00 m, cover plate support loosely resting, design mode pre-design with characteristic load combination and the default partial safety factors, water state 100%, groundwater activated at 25% level with target safety factor 1.25, ground condition medium-dense sand (200 kN/m²) without report override values, symmetric construction enabled with 15 cm floor/side/cover plate thickness, concrete class C40/50, standard reinforcement for frame/beam and plates, FDM safety allowance 20%, and reinforcement allowance 5%.

A previously imported PLAN reference is also discarded on reset. As with the other suite tools, exporting beforehand is recommended if the current state should be preserved.

22. Language (German/English)

Language switching is handled via the suite's global menu (menue.js) above the tool. STATIC fully switches all labels, notices, info content, and all five report types between German and English without altering any input values.

23. Data Integrity (SHA-256)

Every exported project.dbm file contains a SHA-256 hash over the entire stored dataset — the same procedure as in HYDRO, PLAN and BUDGET. On import, this hash is checked automatically; the hash status notice shows the current verification state (clean and valid, or modified/not reproducible with a detected hash mismatch, or a warning if an older or external file contains no hash data at all).

The formal reports (chapter 20) additionally contain their own document integrity hash values, documenting the underlying input data, calculation results, and quantity take-offs. Changes to input data, load assumptions, results, or quantities produce different hash values.

24. Info Buttons (Contextual Help)

Nearly every input field has a small **ℹ** button next to it. Clicking it opens an overlay window with a precise technical explanation of that specific field — with over 50 fields, one of the most extensive contextual help systems in the entire suite.

The overlay can be closed by clicking outside the window, via the close button, or with the Escape key. The info content follows the same language switch as the rest of the tool.

25. Limitations, Notes and Best Practices

- STATIC is an extended pre-design tool, not a certifiable execution structural design. This notice appears directly in the tool and applies without restriction to all verifications, reinforcement plans, and reports.
- Fire exposure, seismic verification, fatigue verification, dynamic actions, and execution planning with detail drawings are explicitly not part of the tool (chapter 9) and must be separately verified project-specifically if required.
- The numerical plate verification of the cover plate (FDM, chapter 13) is an FE-/FDM-based pre-design with specific boundary conditions (2.00 × 2.00 m free opening, loose line support, C40/50) — differing boundary conditions in the actual project require a separate check.
- The crack width and deflection indicators (chapter 17) are explicitly simplified derivations from existing SLS values, not a complete EC2 verification.
- Ground values without a report override (chapter 7) are derived conservatively from the selected soil type; geotechnical investigations and project-specific verifications remain required in every case.
- On export, STATIC bidirectionally writes certain values (module count, raster, plate thicknesses) back into the shared project.dbm — when making parallel changes in PLAN and STATIC, always use the most recently exported file as the shared basis.
- Without persistent browser storage, unsaved input is lost when the page is closed or reloaded — regular export is recommended.

26. Quick Reference of Icons and Buttons

Icon / Button	Meaning
ℹ Info	Opens the technical explanation for the respective field
Import	Reads in a project.dbm file (from PLAN or STATIC) and checks its hash
Export	Saves the current state as a project.dbm file, updates shared PLAN fields, and recalculates the hash
Print / PDF	Prints the current screen view via the browser's print dialog
Whitepaper Report	Formal, sign-off-ready calculation document with verification summary
Engineering Report	Most comprehensive report with all verification basis, details, and sources
Production Sheets	Reinforcement and material overview for manufacturing
Customer Report	Accessible project summary for clients
Reset Static	Resets all inputs to the factory settings after confirmation
🔒 Hash status	Current SHA-256 verification status of the project.dbm