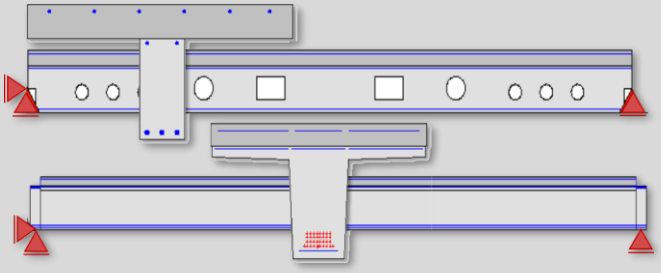
Product Information **Structural engineering**

Product Information PB 429 | 09.2018

FERMO

11.10.582 FERMO-building
11.10.583 FERMO-bridge
11.10.584 FERMO-buckling
11.10.585 FERMO-post-tensioning
11.10.586 FERMO-FLSdesign



Prefabricated girders in building and bridge construction

- **Quick & integrated software for prefabricated girders**
- **Efficient and practice-oriented optimisation of reinforcing and prestressing steel**
- **Design for SLS, ULS and FLS for all construction stages alongside the global time axis**
- **1- and 2-stage preload with immediate and subsequent bonding**
- **Lateral buckling analysis in the cracked state with ultimate load capacity analysis**
- **Material-saving & economical design for all girder types**

With FERMO it is possible to analyse and design prestressed and non-prestressed prefabricated and composite girders with subsequent cast-in-place concrete slabs for structural and bridge engineering. The calculation is carried out for the entire life cycle, taking into account the entire system, cross-section, load and stress history. A modern working environment with multiple adaptation possibilities is available for the input and a report with configuration and filter options.

Tel: +49 711 7873-157
E-Mail: structuralengineering[at]rib-software.com
www.rib-software.com/structural-engineering

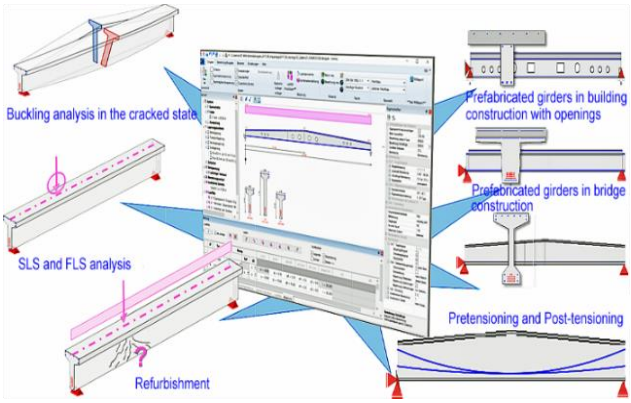
RIB Software SE, Headquarters Stuttgart, Local Court Stuttgart HRB 76045.
Managing Directors: Thomas Wolf, Michael Sauer, Mads Bording.
Chairman of Executive Board: Thomas Wolf.

FERMO Options and Features

FERMO is a Windows® program for the calculation and design of prestressed and non-prestressed precast girders as well as composite precast girders with a subsequently applied in-situ concrete slab for building and bridge construction. The calculation is carried out for the entire life cycle. The complete system, cross-section, loading and stress history is hereby being considered. A modern graphic interactive work environment is available for the input and output.

FERMO is a multi-purpose structural member design program and has the following advantages:

- modern interface with ribbon bar, quick start bar, tree view and property grids as well as 2D and 3D graphics
- graphics with sensitive elements and dimension lines and immediate display of all modifications
- analyses according to DIN and EN with national annexes for DE, AT, SK/CZ and UK
- efficient input via the quick input, from a template or user-defined files
- centric or eccentric loading input in y- and z-direction
- load transfer from other positions
- well-arranged program control / configuration and independent language settings (DE, UK and CZ) for the input and output
- modern table-oriented result list with integrated graphics, respectively, diagrams which is reproducible at any time
- result output with configuration and filter options
- clear result output as pre-design list, short list, long list and detailed list
- user-defined templates



With FERMO you are using a structural member design application, which has proven itself in many cases both in the day-to-day routine and in the solution of complex problems.

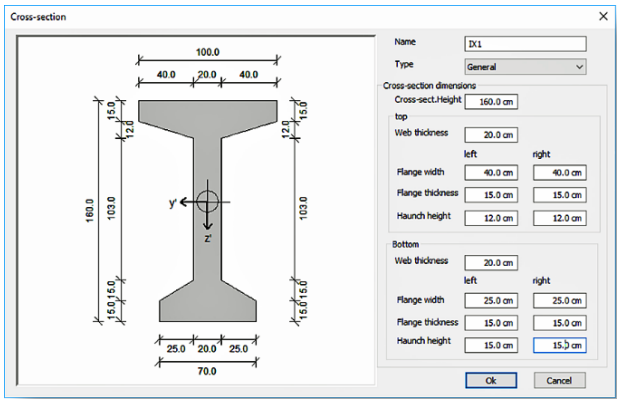
The basic modules “Building construction” and “Bridge construction” contain all options, which are at least required for a prestressed girder in the building or bridge construction. The possible add-ons are independent of

each other, i.e. they can be added individually. Furthermore, it is possible to extend the modules from building construction towards bridge construction and vice-versa.

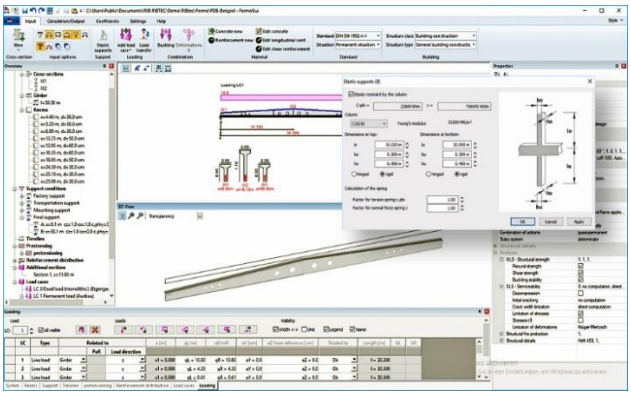
Concrete girder Basic Module

The reinforced concrete design is carried out uniaxial. In detail, the following tasks can be solved with FERMO:

- homogenous rectangular, T-beam, slab and H-sections with variable web and flange thicknesses as well as upstand-beam and trapezoidal sections
- typed symmetric and non-symmetric cross-sections in longitudinal direction
- arbitrary, variable cross-section layout including cross-section offsets
- single symmetric, in special cases also asymmetric cross-section shapes, are possible but are designed uniaxial
- subsequently applied in-situ concrete slab – i.e. composite cross-sections



- varying, statically determinate systems: factory support, transport support, assembly support, auxiliary support and final support
- maximum of 8 analysis moments along the timeline from the factoring up to the end of the lifecycle
- linear stress resultants and deformations with automatic consideration of the effective slab widths
- alternative consideration of normal strength concretes (up to C50/60), high strength concretes (C55/67 up to C 100/115), ultra-high strength concrete (UHC140)
- reinforcement (up to B550), high strength reinforcement (SAS670)
- edge related single reinforcement or distributed reinforcement
- multi-layer reinforcement for single reinforcement and single-layer reinforcement for distributed reinforcement
- minimum requirements for the concrete cover and durability
- fixed or elastic support with automatic calculation of the spring constants
- reliable generation of the design combinations with the aid of load case attributes
- automatic generation of load cases by copying or copying with a certain distance
- single loads, line loads, trapezoidal loads and triangular loads, temperature loads and support settlement



- loads can be arranged centric or eccentric
- linear stress resultant calculation with automatic generation of all design combinations
- optional consideration of the minimum restraint, direct / indirect support
- complete bearing capacity analyses in the ULS for the permanent, accidental and earthquake situation
- minimum and ductility reinforcement for building construction and earthquake
- minimum and robustness reinforcement for bridge construction
- minimum reinforcement due to construction regulations
- bending bearing capacity due to normal force / moment interaction
- combination of the bending reinforcement under consideration of the minimum reinforcement
- shear bearing capacity due to V-T-VT interaction with linear stress resultants
- flange connecting reinforcement
- composite joint reinforcement
- tabular fire protection for decisive combination of actions (quasi-permanent, frequent)
- additional analysis sections
- summary of the existing and required reinforcement
- summary of the material consumption (bill of quantities)

Design – building construction

- basics for the general building construction, respectively, structural engineering according to EN 1990 appendix A1 and corresponding national annexes for DE, AT, SK/CZ and UK
- live loads according to EN 1991-1
- complete reinforced concrete and prestressed concrete design according to DIN 1045-1, EN 1992 1 and corresponding national annexes for DE, AT, SK/CZ and UK
- specification of the longitudinal reinforcement as single or distributed reinforcement

Design – bridge construction

- basics for bridges according to EN 1990 appendix A2 and corresponding national basics for the general build-

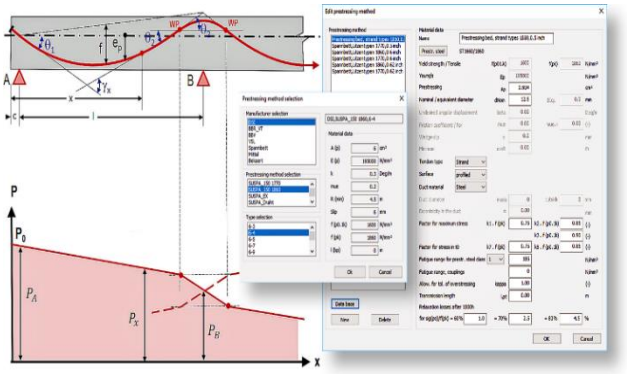
ing construction, respectively, structural engineering according to EN 1990 appendix A1 and corresponding national annexes for DE, AT, SK/CZ and UK
- live loads according to EN 1991-1
- complete reinforced concrete and prestressed concrete design according to DIN 1045-1, EN 1992 1 and corresponding national annexes for DE, AT, SK/CZ and UK
- specification of the longitudinal reinforcement as single or distributed reinforcement
- annexes for DE, AT, SK/CZ and UK
- bridge live loads according to EN 1991-2
- complete reinforced concrete and prestressed concrete design according to DIN Fachbericht 102, EN 1992 2 and corresponding national annexes for DE, AT, SK/CZ and UK
- input of the longitudinal reinforcement only as distributed reinforcement
- damage equivalent coefficients for the fatigue load model for road bridges
- main tensile stresses SLS

Stressing bed prestressing

- single-level prestressing
- database with all common prestressing methods in the stressing bed
- quick and easy input of the tendons with / without stripping
- concrete strain and prestressing steel strain trajectories
- prestressed concrete design under consideration of creep, shrinkage and short-term relaxation due to heat treatment
- transmission and anchorage lengths
- anchorage analysis of the stressing bed prestressing
- tensile force coverage graphic for reinforcing and prestressing steel
- bursting reinforcement for pretensioned tendons

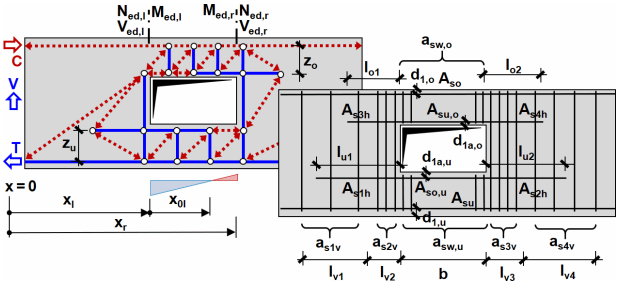
Post-tensioning

- single-level prestressing
- double-level prestressing, if stressing bed prestressing as 1. level
- database with all common prestressing methods
- quick and easy input of the tendons
- multiple prestressing conditions – prestress, release, post-tension per side
- anchorage with / without wedge slip
- losses due to friction
- prestressed concrete design under consideration of creep, shrinkage and relaxation

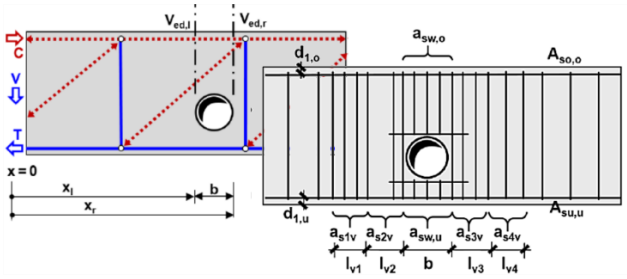


Detailed analysis

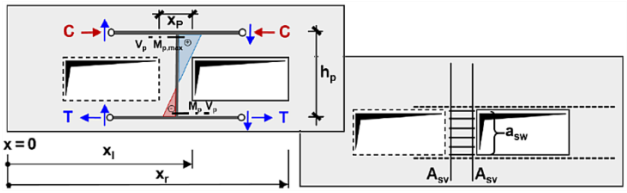
- circular / rectangular recesses and notches at the girder ends



- design of geometric discontinuity areas for small and large opening (recesses) according to DAfStb Heft 399/599 and DAfStb Heft 459



- post design for openings really close to each other < 0,8 * h



- design of geometric discontinuity areas for offset supports (notches)

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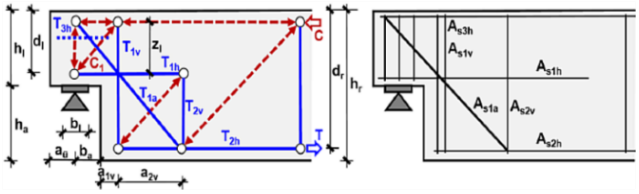

Buckling stability

- non-linear, biaxial analysis of the buckling stability according to EN 5.8.6
- geometric and physical non-linear calculation at the deformed system with the load step method
- consideration of the contribution of the concrete between the cracks (Tension Stiffening)
- consideration of varying load application points (BE, TE, neutral axis, arbitrary)
- horizontal imperfection user-defined or automatic affine to the 1. eigenmode
- the creep influence can be considered in the automatic calculation of the imperfection
- user-defined or automatic combination generation for up to 4 different points in time, respectively, support systems: transport support, assembly support, finishing and t∞ with final support
- separate reduction of the torsion stiffnesses in condition I and II
- output of all relevant system limit load factors
- output of the non-linear stress resultants for the 1,0-fold system limit load
- output of the effective stiffnesses due to the 1,0-fold system limit load
- shear force and torsion bearing capacity due to the 1,0-fold system limit load
- flange connecting reinforcement due to the 1,0-fold system limit load

Fatigue

- analysis against fatigue of the longitudinal reinforcement and the prestressing steel
- analysis against fatigue of the shear reinforcement and stirrups
- calculation of the fatigue strength by specifying the number of load cycles
- consideration of the dynamic factor in building construction
- consideration of the damage equivalent coefficients in bridge construction
- main tensile stresses FLS

Serviceability

- complete serviceability analyses in the SLS
- minimum reinforcement of the crack width for slim and thick structural members
- minimum reinforcement due to the run-off of the hydration heat in the in-situ concrete slab
- decompression analysis, if prestressing exists
- limitation of the concrete compressive stresses II
- limitation of the reinforcing and prestressing steel stresses II
- limitation of the crack width (direct and indirect method)
- limitation of the main tensile stresses in bridge construction
- limitation of the sagging to leff/250 (span) and to leff/100 (lever arm) in condition II (cracked state)
- limitation of the deflection difference in condition II (cracked state) to leff/500
- length changes and support rotation
- deformations optionally for quasi-permanent, frequent or rare combination of actions (CoA)

Refurbishment – building construction

- bearing capacity analysis for refurbishment with utilization levels for a specified longitudinal and shear reinforcement under consideration of possible corrosion damages
- no design – only the utilization levels, respectively, residual safeties are being determined

Formwork drawing and cable plan

- export to CAD: plan view and view of the girder in sections and cable plan (bracket from BE)
- to scale views and sections