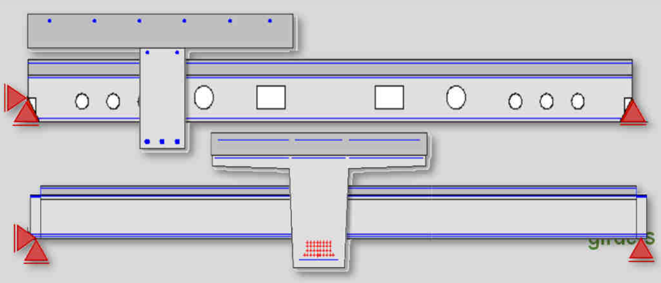
Product information **RIBTEC Systeme GmbH**

Product information as of 07.2026

FERMO

FERMO Basic Module	Precast building girder
FERMO Buckling	Lateral torsional buckling
FERMO Post-tensioning	Continuous prestressing cables
FERMO FLS	Fatigue limit state design
FERMO Bridge	Precast bridge girder

Prefabricated in building and bridge construction



- **Fast and comprehensive processing of precast girders subject to bending**
- **Design for ULS, SLS and FLS for all construction stages along the global timeline**
- **1- and 2-stage prestressing with immediate and subsequent bonding**
- **Lateral torsional buckling verification in cracked state with nonlinear load capacity analysis**
- **Deformation verification with nonlinear analysis considering creep**
- **Material-saving and economical design for all girder types**

With FERMO, you can calculate and design prestressed and non-prestressed precast and composite girders with cast in place concrete slabs for building and bridge construction. The calculation is performed for the entire life cycle, taking into account the entire system, cross-section, load and stress history. A modern working environment with multiple customisation options and an output list with configuration and filter options is available for input and output.

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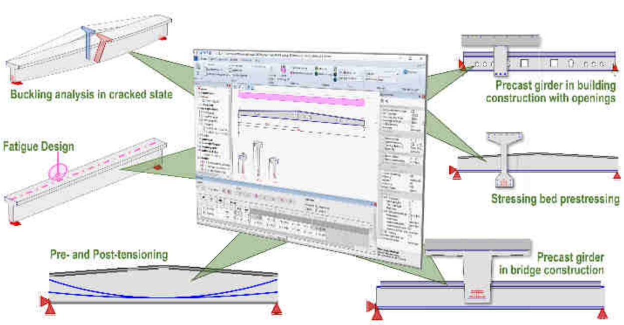


Versatile application

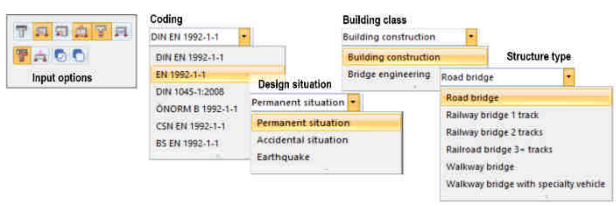
Prefabricated members are among the components that can be manufactured and installed quickly and efficiently. FERMO supports this high standard by keeping the planning and production process short and thus economical. The program specifically addresses the high requirements of structural engineers in order to optimally calculate prestressed precast girders with or without an in-situ concrete slab that has been concreted on later. In the calculation and design, the entire system history is recorded. This includes all storage, transport and construction states with auxiliary supports as well as the final state. The design can be carried out either according to DIN, DIN FB and EN with NAs for DE, AT, SK/CZ and UK. Input is made in a modern program environment with a ribbon bar, object tree, property table and graphic-interactive editing window. The system graphics are immediately adjusted with each input, so that there is always a direct visual control. Both the input and the output are configurable and tailored to the essential information.

Free configuration of the program environment

With just a few mouse clicks, the FERMO program can be functionally adapted to the given engineering task in precast construction. The following input options can be selected:

- Standard or composite cross-section
- Tension bed or optional post-tensioning
- Detailed verifications for recesses and notches
- Additional, user-defined design sections
- Optional lateral torsional buckling and fatigue proof

Further setting options are available for the selection of the standard and the design situation as well as for the building class "Building Construction" or "Bridge Construction" with all associated structure types. With each setting, the entire program environment immediately adapts to the selected range of functions.



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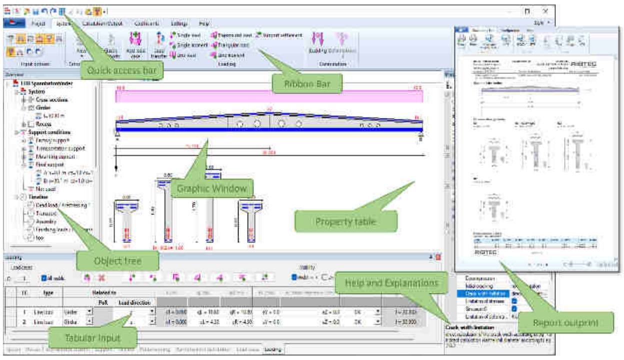


Consistent graphical interface

FERMO is a completely newly developed program application for the calculation and design of prestressed precast girders in building and bridge construction. With the new program version, system changes due to construction conditions such as a subsequently concreted in-situ concrete slab can be taken into account as well as influences from creep, shrinkage and relaxation. Various types of beams such as parallel girders, saddle and monopitch roof girders with cantilever arms, notches and recesses as well as

- section-by-section linearly variable cross-section,
- bed prestressing and post-tensioning with subsequent bonding,
- Pre-tensioning effect in storage, end or composite condition

can be processed quickly and efficiently.

All necessary functions are offered in a consistent interface. The program application simultaneously combines a nonlinear FEM technology for system analysis, the processing and determination of the time-dependent stress redistribution and the graphically interactive processing of the tendon arrangement with direct visual control. If necessary, the program application can be extended to a second screen, e.g. for the processing of loads, for load transfer or for the configuration of the results.

The best of both worlds

The merger of the software applications RTfermo and FETT for the design of precast beams to form the successor program FERMO, was carried out using modern user interface technology.

The module concept for FERMO enables the design of complex, long-span components, whereby the use of highperformance concrete, fire protection verification and the verifications of details are integrated into the basic module Precast Girders for Building Construction.

Module	Bed prestressing for buildings	Lateral torsional buckling	FLS	Subsequent prestressing	Bridges
Basic prefab girder	X				
Building design	X				
SLS verifications	X				
Bed prestressing	X				
Detail verifications	X				
Refurbishment	X				
Tilting proof		X			
FLS proof			X		
Subseq. prestressing				X	
Bridge design					X

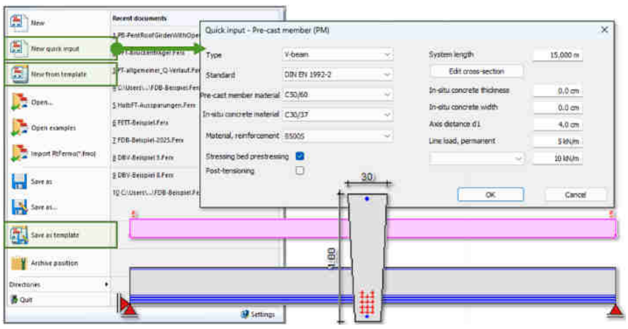
The extended possibilities of post-tensioning, fatigue and bridge construction verifications as well as integrated stability analysis for several load case combinations and construction stages open up additional application perspectives compared to FETT.

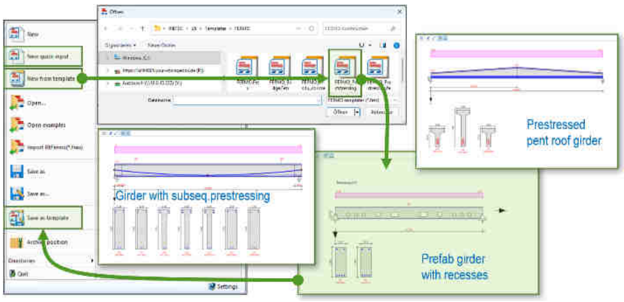
New features for RTfermo and FETT	RTfermo	FETT
Configurable program environment	New	New
Output list with masks and filters (pre-design, short, long & detail list)	New	New
Load transfer and take over	New	New
Reinforcement specification as in FETT	New	
Compact input for preload bed prestressing as in FETT	New	
1-stage prestressing with immediate or subsequent bonding		New
2-stage prestressing with immediate and subsequent bonding		New
Girder refurbishment with specified reinforcement/prestressing	New	New
Timeline with up to 8 time points and storage states	New	New
Consideration of large/small recesses and post design	New	
Verification of bridge construction		New
Integrated non-linear lateral torsional buckling check with extensions		New
Typified cross-sectional sections	New	New
Extension for the handling of the tensile and shear cover line	New	New

Get started quickly

Although the new FERMO program environment enables the solution of versatile and complex engineering tasks in precast construction, the application can be reduced to the essential topics with just a few mouse clicks. A quick entry allows the definition of a complete prefab girder with just a few parameters:

- System dimensions and cross-section if necessary with composite characteristic
- Code and material settings
- Type of prestressing
- Basic load for dead and live load





Template technology helps to solve recurring project tasks quickly and reliably with minimal effort, especially in precast construction. All functional and technical settings as well as the specifications for a special reporting are adopted.

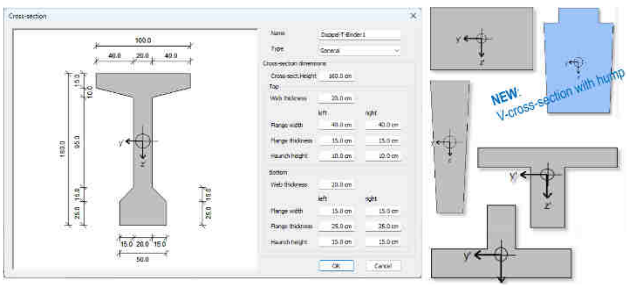
High-quality range of services

In detail, the following tasks can be solved with FERMO:

- Time-dependent cross-sectional structure with variable cross-section composition (cross-sectional history)
- Construction stages with determination of stress resultants due to arbitrary supports and loads (system and load history)
- Consideration of the system history with determination of stress resultants as a result of one- or two-stage prestressing (stress history)
- Prestressed concrete design taking into account creep, shrinkage and relaxation for any point in time

Practice-oriented cross-section types

The description of the cross-section structure is based on partial cross-sections and their position in relation to the reference axis of the total cross-section. In principle, a composite cross-section can be composed of two partial cross-sections, which take effect at different times and can have different concrete materials. In the simplest case, the composite cross-sections can be composed of typified partial cross-sections such as rectangles, slab beams or double-T cross-sections.



Static systems and girder types

The system is generally assumed to be a single-span beam, with or without cantilever arms. Any cross-sectional profile is permitted for the beams:

- Parallel-webbed girders
- Symmetrical and asymmetrical girders with saddle or
- Monopitch roof girders including support bracing

Separate systems are only used for factory, transport and auxiliary supports with a maximum of two auxiliary supports.

Global timeline

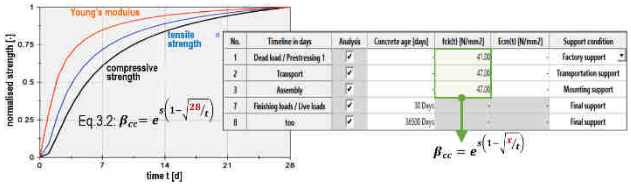
The time points on the global timeline are automatically determined by the cross-sectional, the stress and the system history. Each change in the timeline represents the beginning of a new creep interval. The number of creep intervals is limited to 8.

Creeping, shrinking and relaxation

In order to realistically account for the aging effect, a time-dependent material law is used as a s-e(t) relationship. All stress changes in the composite cross-section as a result of creep, shrinkage and relaxation are determined for concrete according to the approaches of DIN and EN with a high-performance module for stress redistribution in the cross-section.

Design for high-strength materials

The material properties of concrete, reinforcing steel and prestressing steel can be taken from a material database according to DIN and EN with according NAs. This also includes high-strength concrete. In addition, special material properties can be specified by the user.



Approach of material strengths determined at plant

The strength development of the concrete is specified in the code and is based on a reference concrete age of 28 days. As a rule, there is an accelerated development of strength in finished parts at the plant due to heat treatment. For an economical design, FERMO allows the use of alternative and, if necessary, higher material characteristics $f_{cm(t)}$, if appropriate material tests are available.

Loading

The external short-term and continuous loads are arbitrary and can be composed of individual point loads and any trapezoidal loads. Dead weight load cases can be activated on request. The relocation loads due to loosening of the auxiliary supports are generated automatically. The number of load cases is unlimited. The load history results from the determination of the effective times of all creep-generating loads that are marked as permanently acting. The corresponding superpositions are made automatically based on the load case attributes. For example, the relevant load combinations for all selected construction stages are automatically formed, calculated and dimensioned for the verifications in the ULS, SLS and FLS.

Storage

In the case of transport and final storage, a fork bearing is assumed at the location of the support. In addition, there is the possibility of taking into account the compliance of the fork bearing by means of a torsion spring. When assembled, the bearings can be moved vertically eccentrically into the suspension point. Inclined cable suspensions can also

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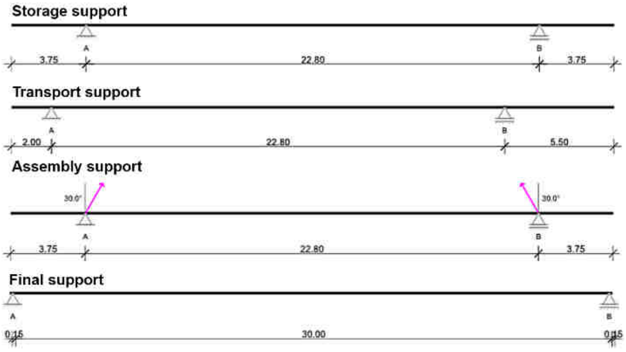
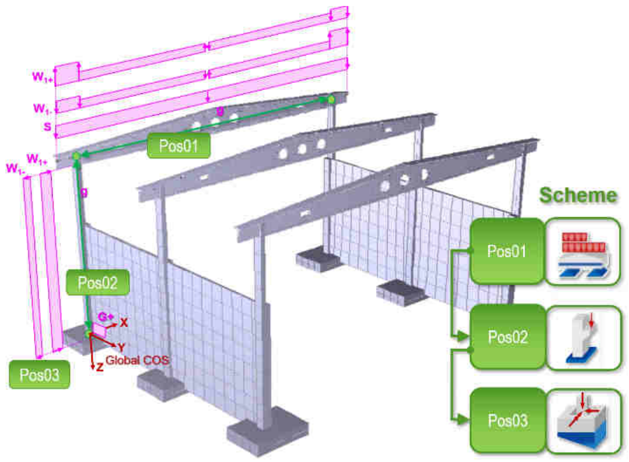
be taken into account, whereby the eccentric load application then results in additional compression and bending stresses. The following bearings are distinguished:

- Factory support
- Transport support
- Assembly support
- Auxiliary support
- Final support

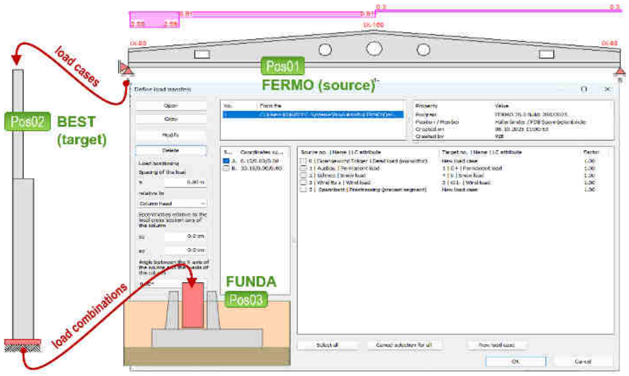


Load forwarding and load transfer

FERMO supports the forwarding or transfer of support forces from component to component. All new component programs automatically transfer loads, so that only the transfer of loads to a target system is supported by a component-specific dialog. As a rule, the scheme of load transfer is simple, so that if the coordinate systems of the components in the global coordinate system are aligned in the same way, there is no need for a transformation of the support forces. In the case of components that are not aligned in the same way, the transformation can be easily adjusted by specifying an angle.



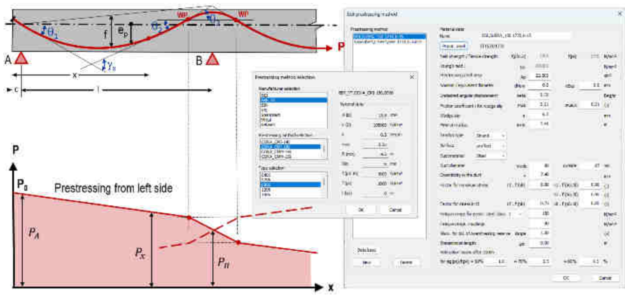
The references for load forwarding are retained in a given scheme. If the load values are changed in a previous position, changes in the support forces of the load source are always displayed and can be applied directly. This makes it possible to transfer the loads from the roof to the foundation (girder-column-foundation) throughout, if necessary. It is also easy to map a load transfer from different precast girders to a bracket girder. The load can come from different positions. In addition, it is possible to transfer the same beam layers at a distance or to convert them to a line support, for example, during the transfer.



Tendon placement

In addition to multi-strand prestressed bed post-tensioning, post-tensioning with subsequent bonding is also possible. By means of strand insulation, the prestressed bed prestressing can be adapted to the course of the girder load. The tendon geometry is entered as a straight line or any parabola point by point in the dialog.

Four prestressing conditions are possible for post-tensioning. The stress history results from the determination of the effective times of the individual tendons. The bond timing can be defined differently for each tendon.



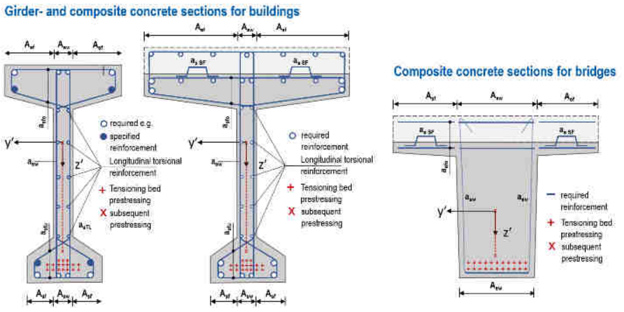
The material properties for the prestressing method can be specified by the user or taken from a database of all commercially available post-tensioning systems. The geometry of the tension strands is entered graphically interactively and can be easily changed. The prestressing conditions can be specified in a clear dialog, then the prestressing force losses can be displayed and checked in a diagram.

Verification control

In order to optimize the longitudinal reinforcement and prestressing in the girder, the position and size of the longitudinal reinforcement and the prestressing should be specified. Based on the tensile force coverage line, it is then easy to optimize the beam accordingly. In the verifications, all typified cross-sections are permissible, whereby these are guided on a single axis except for the lateral buckling verification. All necessary reinforced concrete and prestressed concrete verifications are carried out in the

- Limit states of the load-bearing capacity
- Limit states of serviceability
- Grenzzuständen der Ermüdung
- Discontinuity areas recess, notching, splitting tensile due to prestressed bed prestressing
- Anchoring design for prestressed bed tensioning
- Tabular fire protection
- Lateral buckling stability

taking into account the global timeline and the rearrangements of creep, shrinkage and relaxation



Practical reinforcement arrangement

The reinforcement arrangement and reinforcement distribution in the cross-section depends essentially on the reference edges of the cross-sectional contour and the center distances in the z-direction. This means that the reinforcement arrangement in the longitudinal direction remains largely independent of all cross-section changes. The definition of the reinforcement layers remains the same for the same laying area. With precast girders, there is usually only one laying area and then corresponds to the girder length. Only in the case of cross-sectional jumps can there be several laying areas.

Basically, a distinction is made between individual reinforcements (building construction cross-sections) and roadway reinforcements (bridge construction cross-sections).

Verifications in ultimate limit state (ULS)

The following standard verifications are carried out for the composite cross-section in the limit state of the load-bearing capacity, taking into account the minimum or robustness reinforcement:

- Bending with normal force
- Shear force load capacity for the web, the web connections and the shear joint
- Torsional load capacity
- Design of concrete compression and tensile struts

Verification for lateral buckling resistance (lateral buckling module)

Since precast girders in building construction can be very slim, proof against lateral torsional buckling is often decisive for dimensioning. It is precisely this sensitive stability behavior that FERMO reproduces very well! The tipping verification must be carried out if the requirements for tilt resistance are to be met during lifting, transport, assembly and in the final state. Since simplified verifications are us ally very uneconomical, FERMO uses a completely non-linear load capacity calculation to realistically depict the girder tilting

The nonlinear FE analysis is carried out on the sinusoidal preformed system (EN 1992-1-1:2010-12, 5.8.6) on the basis of a geometrically and physically nonlinear determination of stress resultants. The pronounced nonlinear material behaviour of reinforced concrete in the cracked state is recorded with the effective bending, strain and torsional stiffnesses. In addition, recesses and the involvement of the concrete between the cracks ("tension stiffening") are also taken into account.

The tilt stability can be investigated for a total of 4 detection points with different bearing and action conditions:

- Transport support
- Assembly support
- Final support during commissioning
- End of use

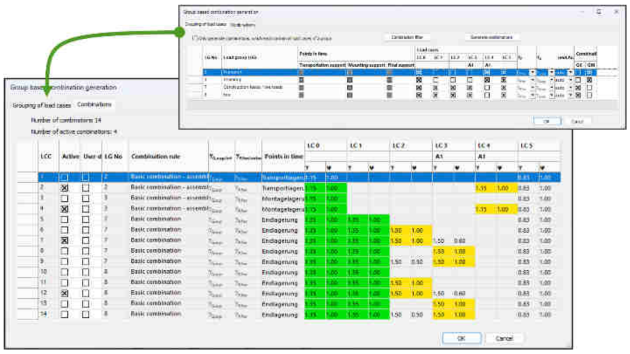
An eccentric point of contact is used for loads and suspensions. In the case of a fork bearing, the compliance of the bearing can also be applied if necessary. Since the lateral buckling verification is carried out using a non-linear analysis, the prestressing may be taken into account in an unfavourable or favourable way.

The geometric imperfection is automatically applied within the program by a horizontal deflection in the center of the field and optionally with a pre-twist.

The effect of creep and shrinkage is taken into account in the tilt resistance verification. Likewise, the reduced torsional stiffness of the cross-section in the cracked state is integrated into the nonlinear calculation via various model approaches. The results were validated by comparison with numerous experiments.

Nonlinear combination formation

The action combinations for the nonlinear analysis of girder tilting are automatically formed in FERMO from the given load cases and load case attributes and supported by a corresponding user interface. All basic combinations and unusual combinations are offered for selection at each selected detection time. Manual adjustments of the partial safety and combination coefficients are possible at any time. The user selects the load case combinations required for the nonlinear calculation.



Design of recesses (basic module)

Recesses are entered in the dialog as a rectangular or circular recess. Openings in the web area interrupt the struts for the shear force transmission.

The member modeling and dimensioning of the recess is optionally carried out in the program according to

- Heft 399 DAfStb [Eligehausen, Gerster] or issue 599 DAfStb [Hegger, Empelmann et al.]
- Heft 459 DAfStb [Schlaich, Schäfer]

More detailed information on the procedures can be found in the respective DAfStb booklets as well as in the concrete calendar 2001 volume 2.

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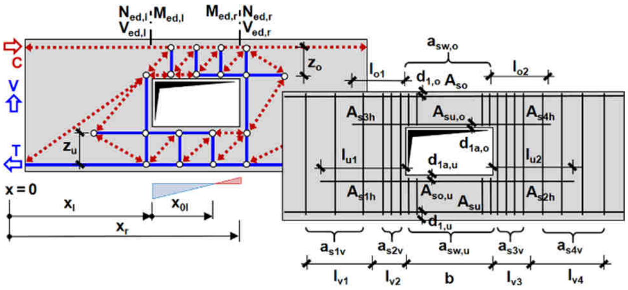
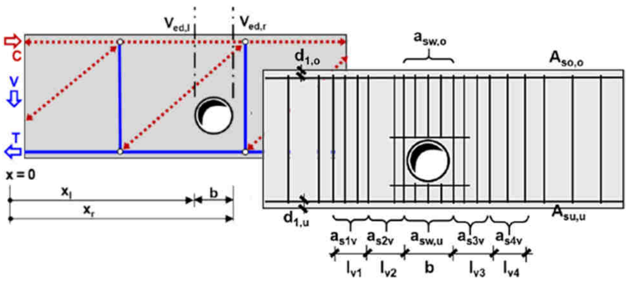
The verifications for the additional stress states are provided on the basis of framework models. The geometric size and position of the recess in relation to the component height, as well as the distance between the recesses are decisive. If there are several web recesses, their distance is also checked. For openings that are close to each other, a post design is available. In addition to the design results, the reinforcement details are also printed.

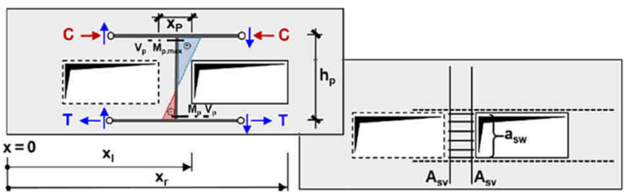
Truss model for "large" rectangular recesses:



Truss model for "small" recesses:

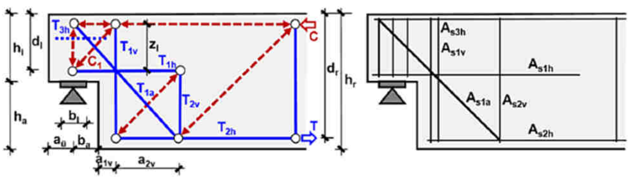


Post design:



Design of notches (Basic module)

Notches are specified by the height and width when defining the support points. The highest load-bearing capacity of a notched girder end results from a combination of vertical and oblique reinforcement arrangement. The splitting tensile forces resulting from the introduction of the bearing force are taken into account.



In addition to the design results, the reinforcement details are also output.

Verifications in state of serviceability (basic module)

In the combined design of components, the verifications of the service stresses, crack width limitation and deformation limitation are of great importance.

All verifications assume that concrete cannot absorb tensile stresses. The following standard verifications are kept:

- Decompression
- Limitation of concrete compressive stresses
- Limitation of reinforcing steel / prestressing steel stresses
- Surface and robustness reinforcement
- Minimum reinforcement to avoid wide individual cracks
- Final crack formation
- Limitation of deflection in uncracked/cracked state, taking into account creep, shrinkage & relaxation

The serviceability verifications are carried out for all construction stages on the timeline, taking into account the prestressing, the time-dependent material strengths, the type of aggregates and the type of cement.

Fatigue verification (Module Fatigue limit state design)

If load-bearing components are subject to constant stress changes, fatigue verification must be carried out separately for concrete and reinforcing steel. The decisive design combinations for building and bridge construction components are composed differently. The following fatigue tests are performed:

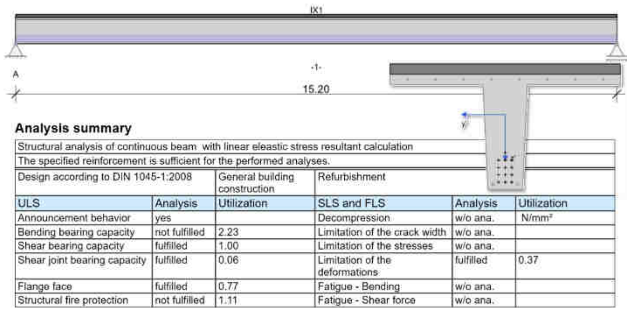
- Prestressing steel, reinforcing steel and concrete
- Concrete compression strut under shear force load
- Stirrup reinforcement under shear force stress
- Composite reinforcement in the shear joint

Tabular Fire Protection (Basic module)

The fire protection design is carried out according to the simplified, tabular procedures according to DIN and EN for statically determined bending members. In these processes, the reduction of the load-bearing capacity due to the temperature-dependent reduction of the cross-sectional dimensions and the temperature-related reduction of the material strengths is taken into account internally. The exceptional load combination is used as the design effect.

Refurbishment (Basic module)

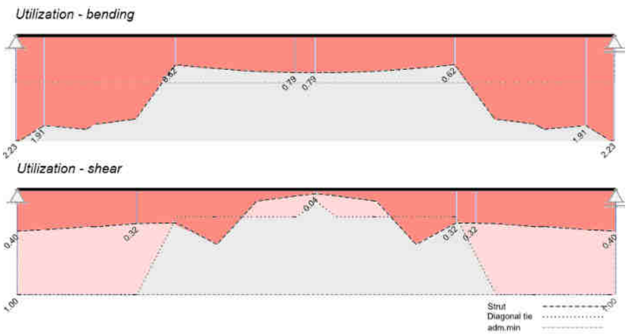
Compared to standard design, the most important feature of a recalculation is the damage modelling as a Interdisciplinary task, which influences all model levels (system, effects, design approaches). It makes sense for a recalculation to also take into account the aging of the material and the damage to the components.



Analysis summary

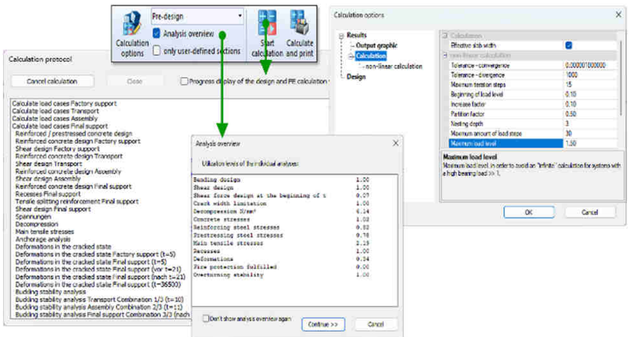
Structural analysis of continuous beam with linear eleastic stress resultant calculation					
The specified reinforcement is sufficient for the performed analyses.					
Design according to DIN 1045-1:2008		General building construction	Refurbishment		
ULS	Analysis	Utilization	SLS and FLS	Analysis	Utilization
Announcement behavior	yes		Decompression	w/o ana.	N/mm²
Bending bearing capacity	not fulfilled	2.23	Limitation of the crack width	w/o ana.	
Shear bearing capacity	fulfilled	1.00	Limitation of the stresses	w/o ana.	
Shear joint bearing capacity	fulfilled	0.06	Limitation of the deformations	fulfilled	0.37
Flange face	fulfilled	0.77	Fatigue - Bending	w/o ana.	
Structural fire protection	not fulfilled	1.11	Fatigue - Shear force	w/o ana.	

In the context with the recalculation of precast girders, only verifications in the limit state of the load-bearing capacity are kept. The existing longitudinal, stirrup and tension reinforcement is specified. There is no design, but proof of the load-bearing capacity via utilization rates, even if these are > 1.0 and in this case the calculated load-bearing capacity is exceeded.

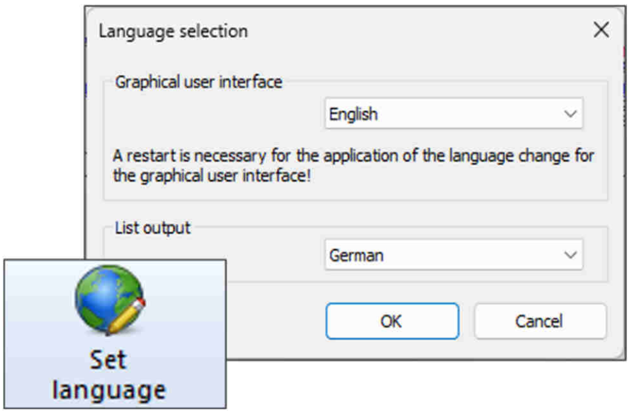


Presetting of the design / result output

Before the design and output of the result, the scope and display of the results can be adjusted. For example, in the dialog for the calculation options, you can specify which graphics are to be generated for the output. For individual specifications, an overview of the preliminary design and a list are available as short, long and detailed editions. At this point, a meaningful verification overview can also be activated.

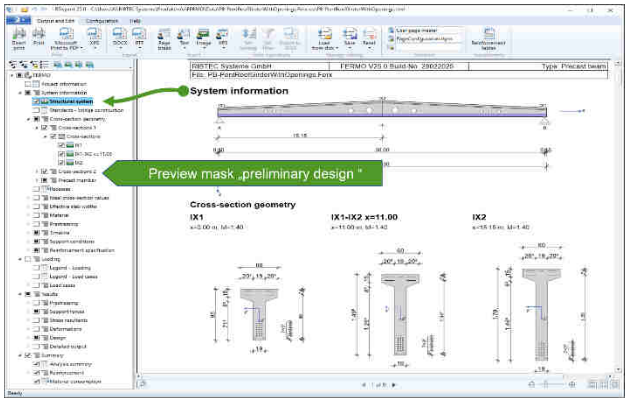


In addition, input and output can be done separately in different languages (DE, UK, CZ/SK).

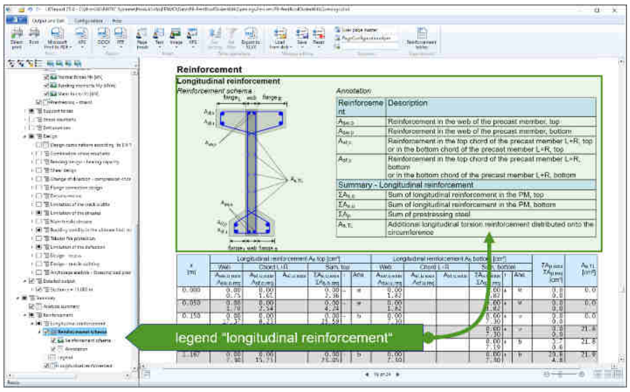


Configurable results list

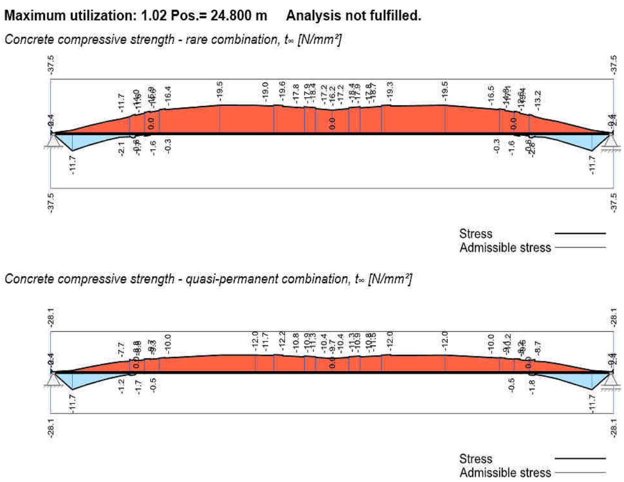
The list of results, including graphics, can be configured and output on a project, user, and office-specific basis. In this way, exactly what is important and desired is always printed. Output control is carried out in two stages. Globally, the output of input values, internal forces, deformations, etc. can be controlled. In a further stage, the output volume can be defined using various masks, e.g. for the "preliminary design". Since all results are always available, this selection can always be expanded or reduced in the result preview.



With a preview function, the entire document can be reviewed. Appropriate markings in the table of contents can be used to configure the list output with the included graphics. Filters can be used for tables to reduce the content to the essentials. This configuration is retained even after the data has been saved and can be used as a template if desired.



All tabular results are optionally supplemented by a legend that explains the output results and indicates the corresponding dimensions. Representative graphics are always output for result variables that are decisive for the assessment, in each case with the indication of existing and permissible values.



When optimising a slender precast beam, the tipping safety verification is often decisive for the design. In contrast to the previous programs, this verification can be carried out in

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FERMO for different load combinations. The list of results and the verification overview always indicate the relevant load combination.

Buckling stability in the ultimate limit state

Buckling stability geometrical and physical non-linear acc. to 5.8.6 with applying the pre-deformation acc. to 5.9 (load step method) as combined loading from biaxial bending, shear force with torsion				
Geometric imperfection	$L_{eff}/300$ =	10.0 cm	Stiffnesses condition I	()' uncracked, elastic
exis. top flange width	b_{Gurt} =	60.0 cm	Stiffnesses condition II	()'' cracked / effective
Tension stiffening in concrete	f_{ctm} =	4.1 N/mm²	Creep + Shrinkage	considered
Dynamic coefficient - transport	φ =	1.30	Obliquity	0.00 %
Safety coefficient - prestressing	$\gamma_{p,fav}$ =	0.83		

Load case combinations

LCC	Limit load factor	rel.	Time [d]	Combinations
1	1.50		10	LF0*1.15*1.30+LF4*1.15*1.30+LF5*0.83 (Transport)
2	1.50		11	LF0*1.15*1.30+LF4*1.15*1.30+LF5*0.83 (Montage)
3	1.02		21	LF0*1.35+LF1*1.35+LF2*1.50+LF3*0.90+LF5*0.83
4	1.00	*	36500	LF0*1.35+LF1*1.35+LF2*1.50+LF3*0.90+LF5*0.83

decisive LCC

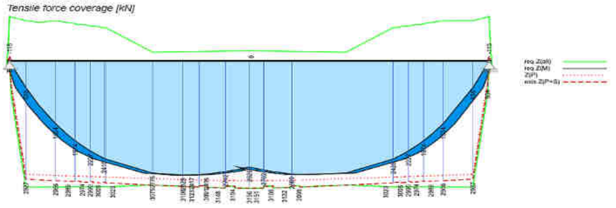
Based on the verification overview and the tensile force coverage line, beam optimisation can be carried out quickly and efficiently for a specified reinforced concrete, pre-stressed and post-tensioning reinforcement.

Analysis summary

Structural analysis of continuous beam with linear eleastic stress resultant calculation					
The specified reinforcement was increased in some areas					
Design according to DIN EN 1992-2		Road bridge	Design is carried out normative		
ULS	Analysis	Utilization	SLS and FLS	Analysis	Utilization
Announcement behavior	yes		Decompression	not fulfilled	6.14 N/mm²
Bending bearing capacity	fulfilled	1.00	Limitation of the crack width	fulfilled	1.00
Shear bearing capacity	fulfilled	1.00	Limitation of the stresses	not fulfilled	1.02
Shear joint bearing capacity	w/o ana.		Limitation of the deformations	fulfilled	0.34
Flange face	fulfilled	0.07	Fatigue - Bending	w/o ana.	
Structural fire protection	fulfilled	0.00	Fatigue - Shear force	w/o ana.	
Overturning stability	fulfilled	1.00	Fatigue - Concrete compression	w/o ana.	
Notches	w/o ana.	0.00			
Recesses	fulfilled	1.00			

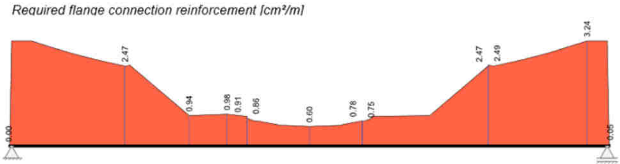
Reinforcement

Tensile force coverage [kN]

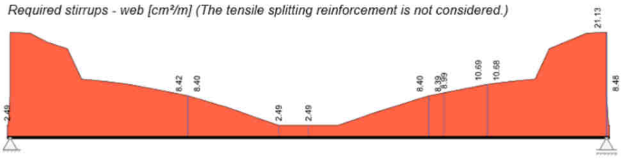


The specification of the required reinforcement supports the structural design of a precast girder with clear graphics.

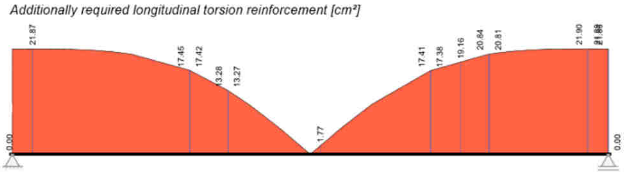
Required flange connection reinforcement [cm²/m]



Required stirrups - web [cm²/m] (The tensile splitting reinforcement is not considered.)



Additionally required longitudinal torsion reinforcement [cm²]



With the specification of the material consumption, the designer receives additional tender information.

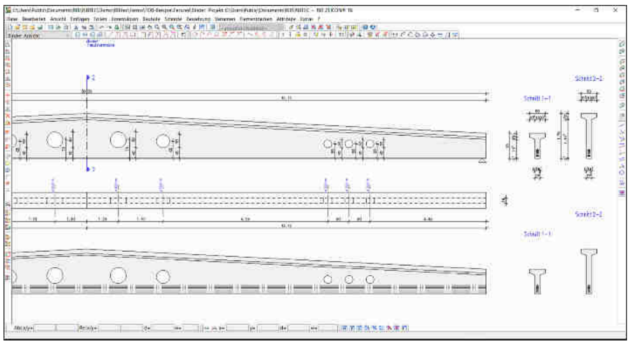
Material consumption

Material		Volume [m³]	Weight [kg]
Concrete - precast member	C50/60	9.670	24176
Concrete - in-situ concrete slab			
Reinforcing steel - Total	B500S	0.097	765
Reinf. steel - Longitudinal reinforcement	B500S	0.080	627
Reinforcing steel - Stirrups	B500S	0.014	113
Reinf. steel - Flange conn. reinforcement	B500S	0.003	24
Reinf. steel - Additions in the shear joint	B500S	-	-
Prestressing steel - stressing bed	ST1570/1770	0.062	489
Prestressing steel - post-tensioning			

The list layout can be adapted in a variety of ways in terms of format and design of the headers and footers and saved as a company and user template. Field functions can also be used to integrate project information, approvals, design notes or comments for the technical draughtsman or inspection engineer. With the export to MS Word/Excel, PDF, XPS and VCmaster, the documents can also be processed digitally.

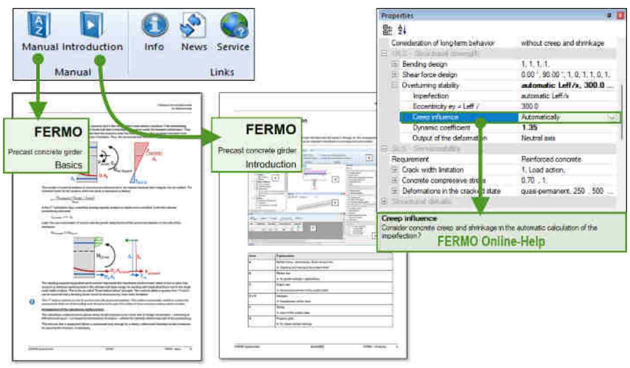
Formwork plan and prestressing reinforcement

Optionally, a formwork plan can be generated in FERMO from the data entered. In addition to the geometry of the beam, possibly with a tapered cross-section, the recesses are also shown. In addition, the position of the prestressed bed post-tensioning and, if available, the course of a variable pre-tensioning force are also displayed in the plan. The plan is exported to the CAD program ZEICON using the ZAC language (ZEICON ASCII Commands), if it is installed. From this CAD application, it can then be exported to other CAD systems via DXF or DWG format.



Manuals, online help and release notes

For each program version of FERMO, the current manuals are also available for the theoretical basics and for an introductory example. In addition, online help is offered in the properties table for all parameters and input fields, which supports the program application by providing appropriate hints.



In the change notices (release notes), all extensions and corrections of FERMO are displayed. This allows the user to find out about the current version at any time.