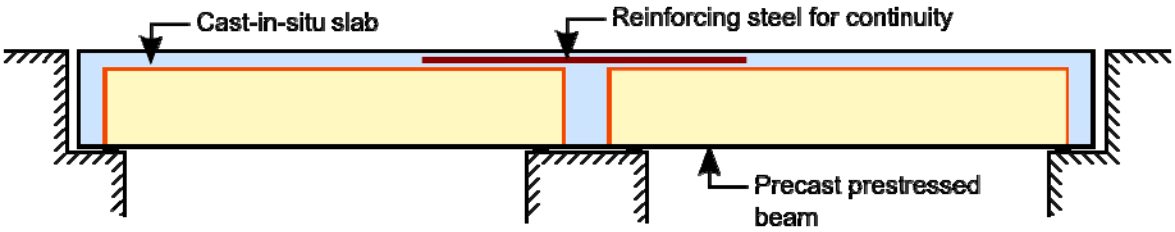
IDEA StatiCa Release News

version 5.4

IDEA StatiCa Prestressing 5.3 - Continuous Composite Beam

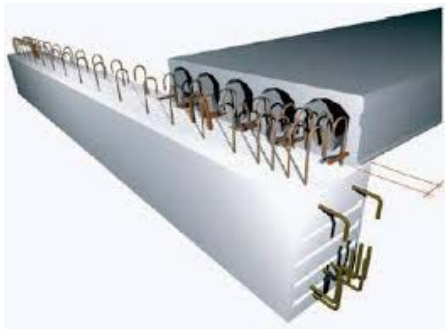
Continuous Construction

Major achievement of version 5 in concrete and prestressed concrete is the module for analysis and design of continuous composite 2D and 3D beams made from pre- or post-tensioned prefabricated or cast-in-situ elements made subsequently monolithic above supports by diaphragms and cast-in-situ slab. The module contains the tools for simple input, structural analysis with respect to construction stages, creep, shrinkage and concrete ageing, and code assessment, and it is an extension of existing functionality for precast and composite beams.

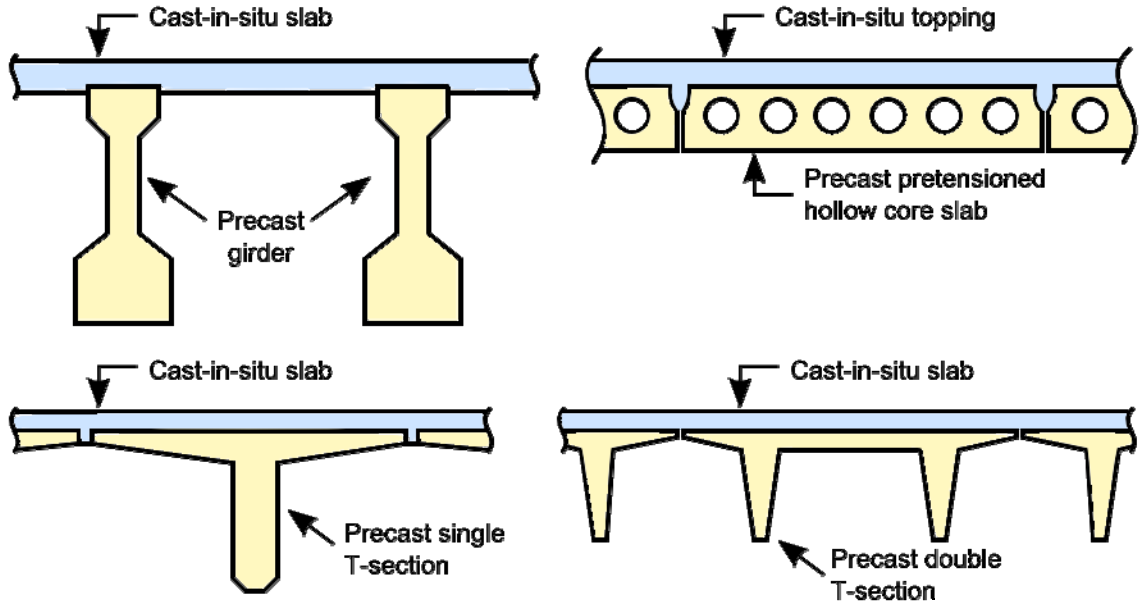


Range of Application

New module is suitable for EN and SIA code design of various types of reinforced or prestressed beams with composite slab, floors composed of prefabricated beams made subsequently monolithic by cast-in-place concrete, permanent shuttering floor systems, composite bridge beams, and repair and strengthening old structures.



Predefined catalogue cross-sections or fully general cross-sections can be used for the analysis.

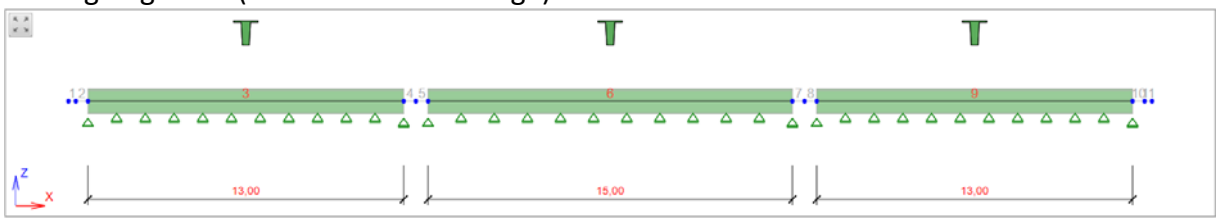


Easy to Use, Correct and Complete Solution

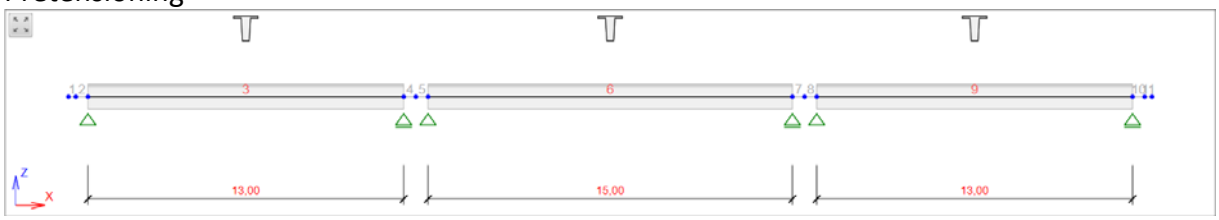
Distinctive features of composite design module are **completeness, comprehensiveness**. Design methods fully comply with complex Eurocode and SIA code requirements. At the same time the solution is **easy to use and effective** for daily needs of industry professionals. Fast and simple input is done with help of **specialized wizard**. All data related to the analysis of construction stages is generated automatically and they are presented in terms well known to the engineers, such as loadcases, combinations etc. Therefore they need not to adapt their workflow and logic to the complex method of analysis. The objective was to provide correct and complete solution & make it easy. So the program is focused, simple, and fast tool rather than generic and complicated puzzle.

Construction Stages

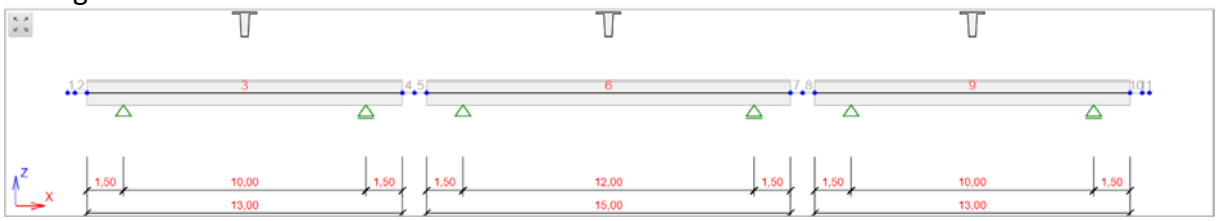
Casting of girders (can be of different age)



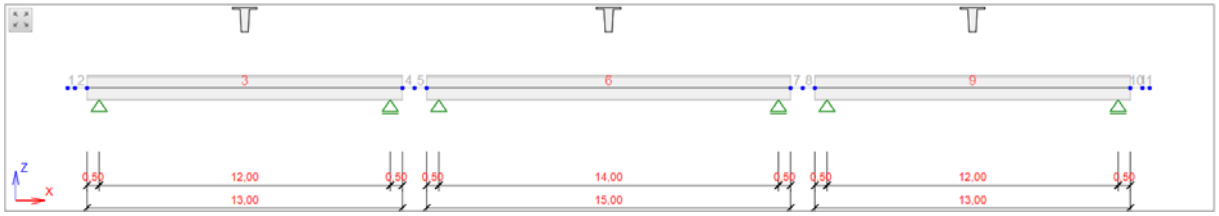
Pretensioning



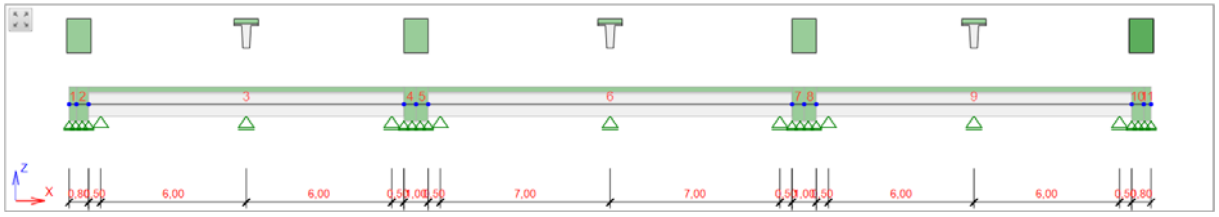
Storage



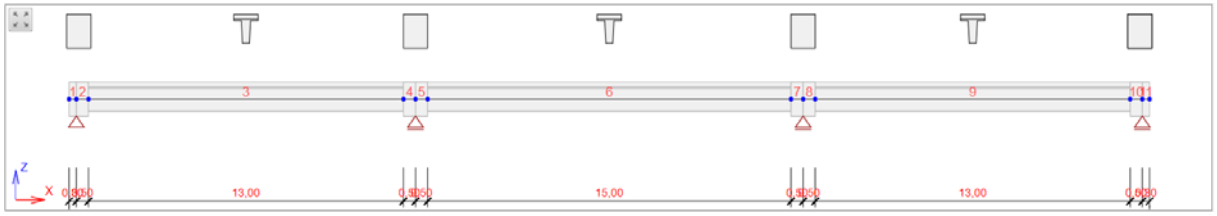
Temporary supports



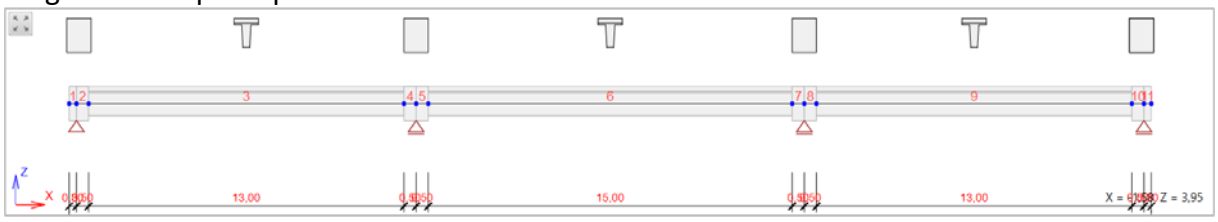
Casting of composite slab



Final supports and post-tensioning of continuity tendons

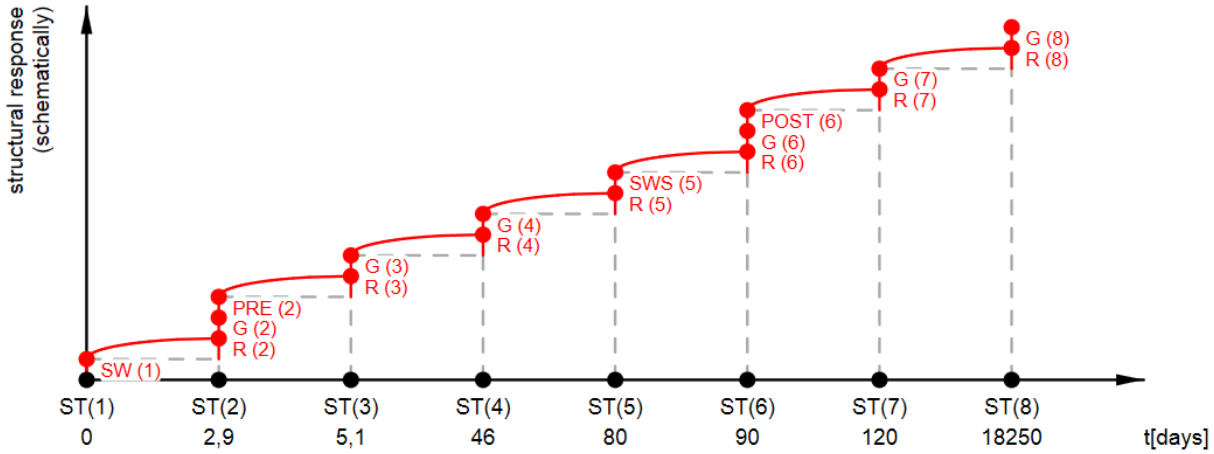


Stages from superimposed dead load until end of service life



Time Dependent Analysis (TDA)

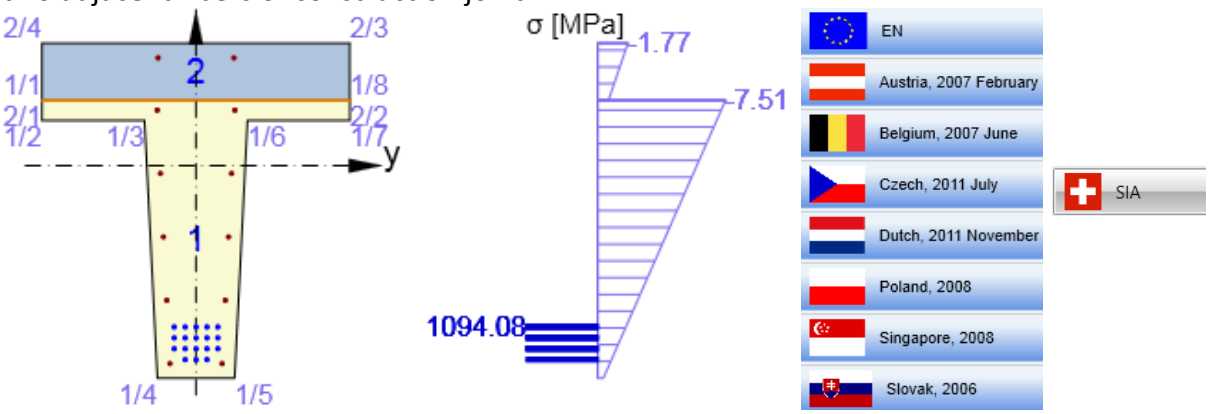
The changes of structural model, cross-sections or loads are modeled through construction stages. The effects of creep, shrinkage, and ageing have significant impact on stress redistribution in time, and therefore to stress-state of cross-sections at the moment of live load application. Those effects are calculated by IDEA StatiCa TDA module.



Time Dependent Analysis was extended to include the possibility of **non-linear calculation of creep** coefficient according to EN 1992-1-1, provision 3.1.4 (4) in the case that compressive stress in the concrete at an age t_0 exceeds the value $0{,}45\ f_{ck}(t_0)$. So far the value of concrete stress was limited to $0{,}45\ f_{ck}(t_0)$. This condition need not be satisfied after introducing creep non-linearity, which **increases economy of the design**.

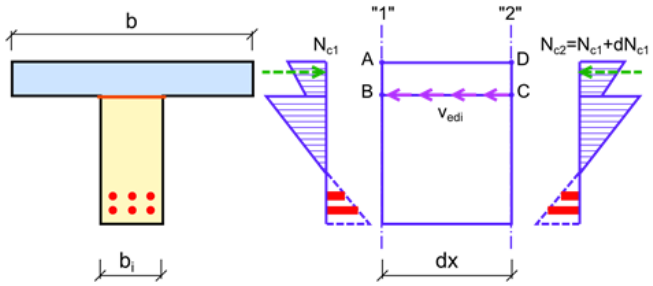
Design of Cross-Sections

The history of construction and service stages influences the ultimate resistance and serviceability limit state of these structures. Cross-sectional design according to EN and SIA codes have been adapted to comply with the fact that unequal strains and stresses appear in two adjacent fibers of construction joint.



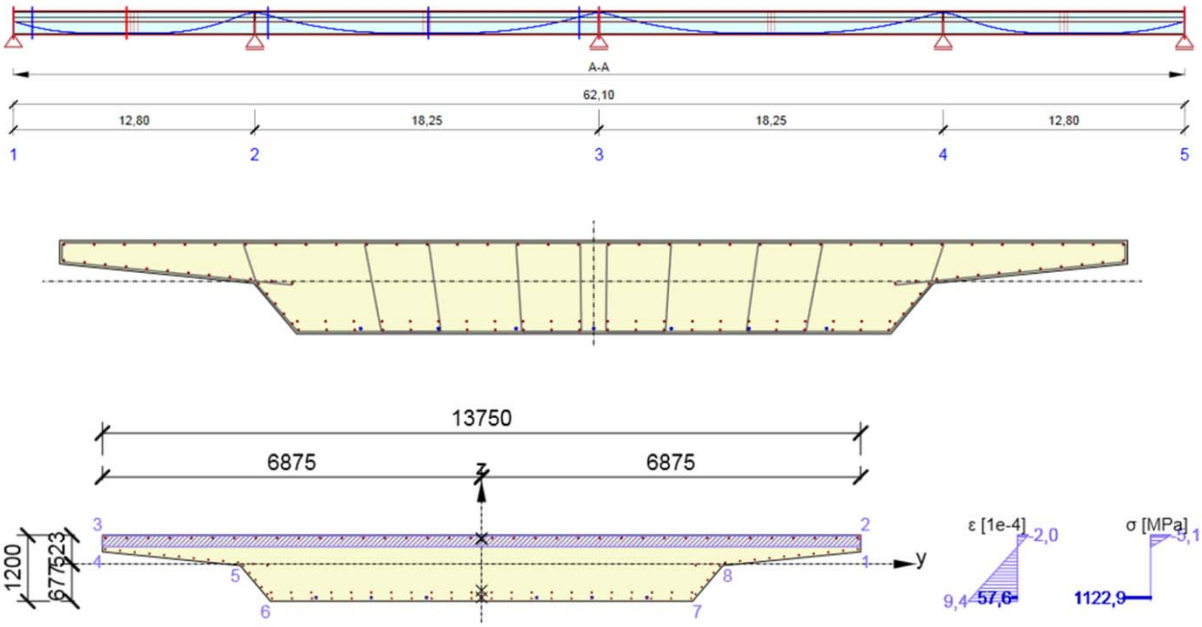
- *Ultimate limit states*
  - *Stress-strain response of cross-section loaded by any combination of internal forces*
  - *Strength in Flexure, Shear, Torsion*
  - *Interaction of all components of internal forces (N, My, Mz, Vy, Vz, T)*
  - *Shear resistance of sections with/without shear reinforcement, cracked/uncracked in bending*
  - *Fatigue*
  - *Shear in composite joint*
  - *Both nominal curvature and nominal stiffness methods for the calculation of second order effects*
- *Serviceability limit states*
  - *Stress limitation,*
  - *Crack width*
  - *Decompression condition*
  - *Brittle failure*
  - *Deflection control, stiffness, limits to span/depth ratio*

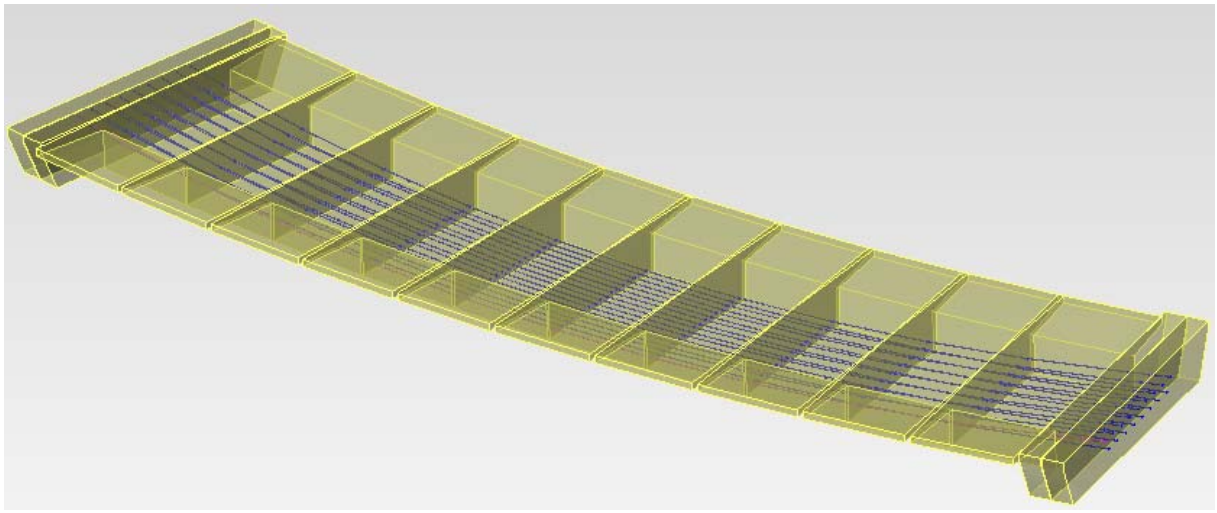
Eurocode 2 method is not suitable for shear stress calculation in the joint in the case of normal stress distributions, which are typical for concrete composite cross-section. The method does not reflect stress redistribution in the cross-section caused by consecutive construction, and differential creep and shrinkage of concrete of both composite parts of cross-section.

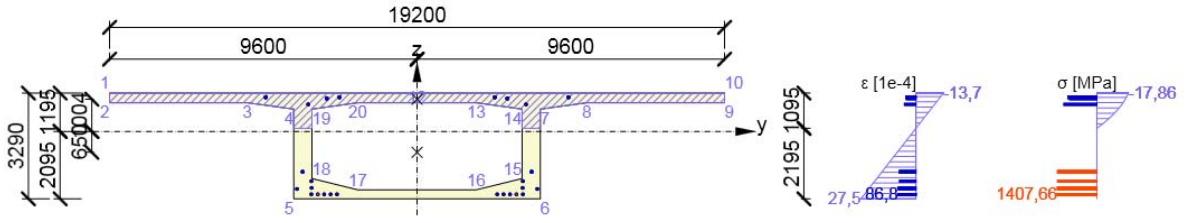


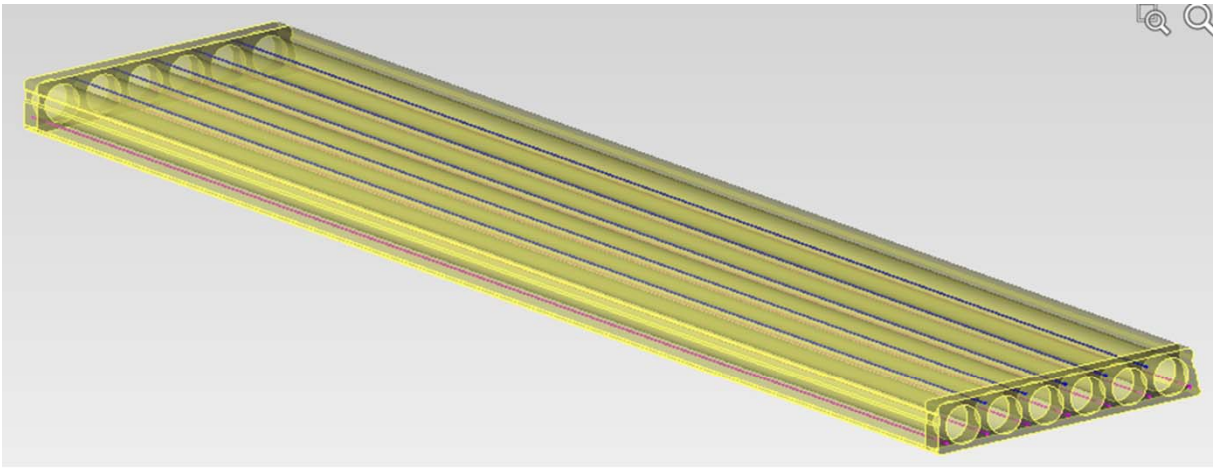
Calculation method alternative to Eurocode 2 method was proposed, tested, and implemented in the program. Shear stress is calculated from difference of normal forces acting on sectional components in two neighboring sections of the element. Numerical studies were performed based on real-life examples of composite beams. The method and the results were presented on international conferences and published in technical papers.

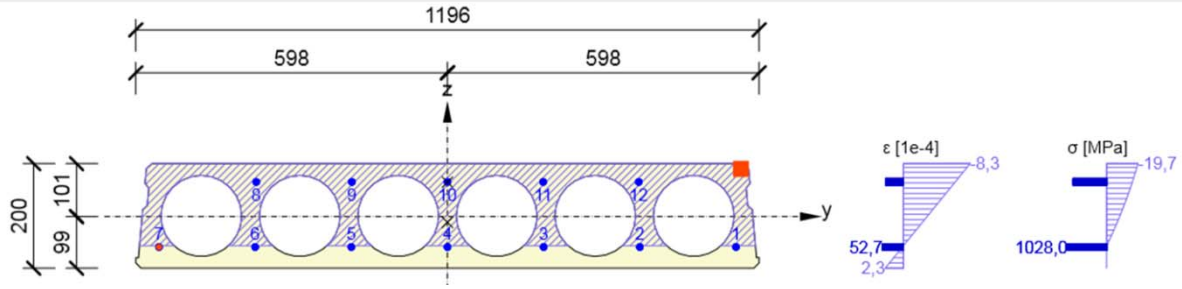
IDEA StatiCa Prestressing – other types of structures







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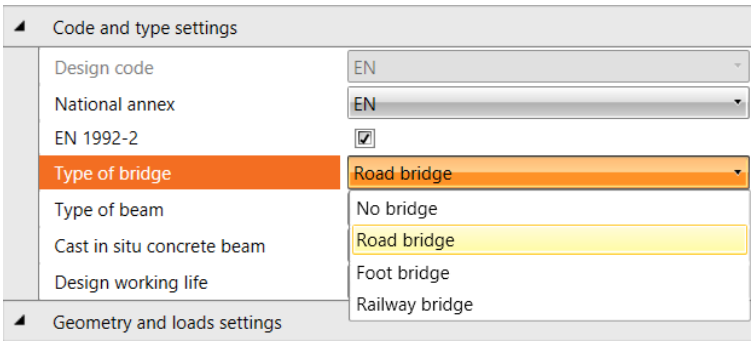
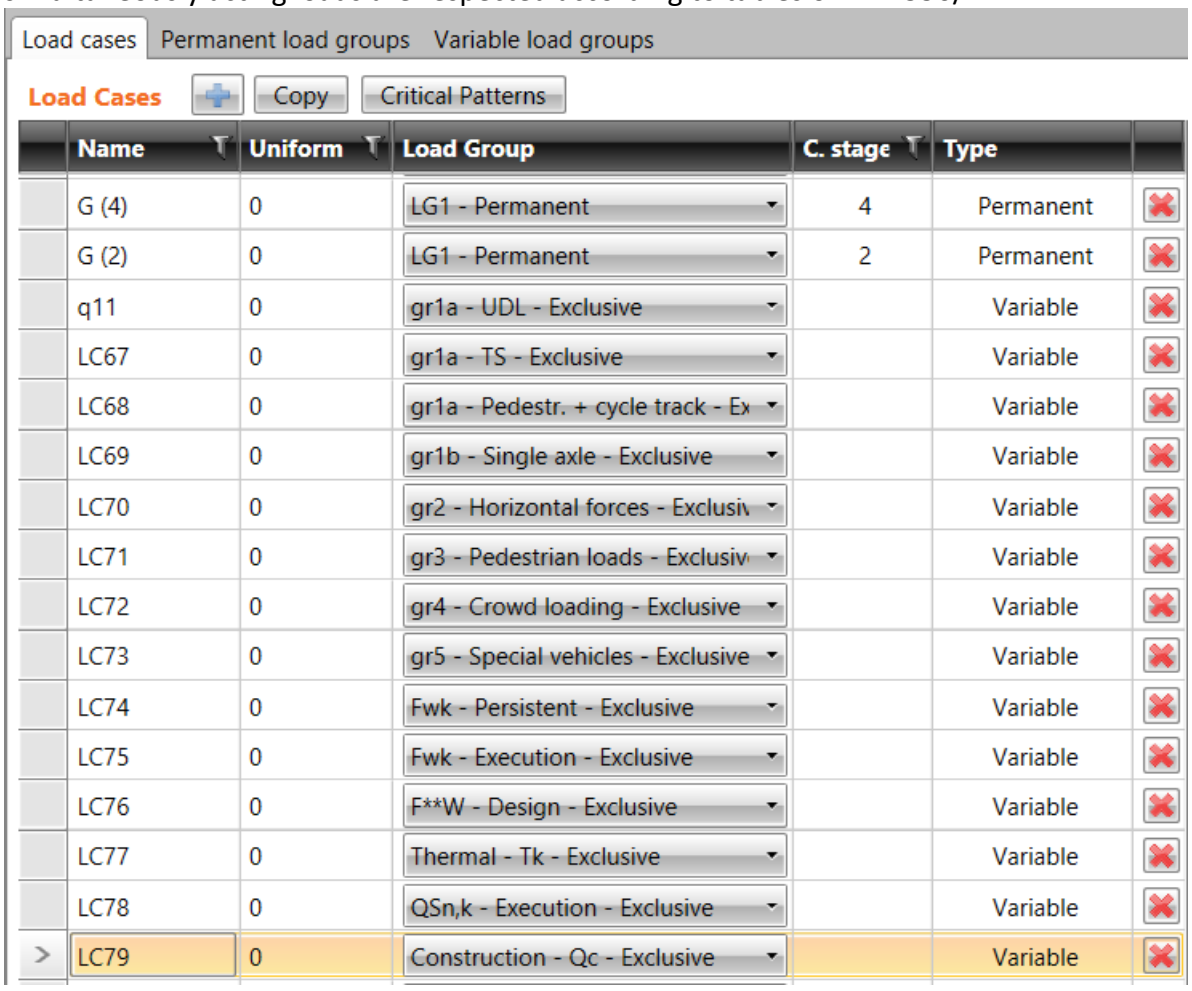
IDEA StatiCa Concrete a Prestressing – new features in 5.4

New features make IDEA StatiCa Prestressing **complete professional tool** for the analysis and design of concrete and prestressed structures.

Bridge Combinations acc. EN 1991-2



The introduction of load groups and the possibility of automatic generation of bridge combinations significantly improve the effectiveness and speed of design process, decrease its laboriousness, and help the designer to cope with complexity of Eurocode. Both road and railway load groups and combinations according to EN 1991-2, table 4.4a and 6.11 can be defined, analyzed, and evaluated. Different values of factors Ψ0, Ψ1 for different, but simultaneously acting loads are respected according to tables of EN 1990/A1.



	Name	Uniform	Load Group	C. stage	Type
	G (4)	0	LG1 - Permanent	4	Permanent
	G (2)	0	LG1 - Permanent	2	Permanent
	q11	0	gr1a - UDL - Exclusive		Variable
	LC67	0	gr1a - TS - Exclusive		Variable
	LC68	0	gr1a - Pedestr. + cycle track - Ex		Variable
	LC69	0	gr1b - Single axle - Exclusive		Variable
	LC70	0	gr2 - Horizontal forces - Exclusiv		Variable
	LC71	0	gr3 - Pedestrian loads - Exclusiv		Variable
	LC72	0	gr4 - Crowd loading - Exclusive		Variable
	LC73	0	gr5 - Special vehicles - Exclusive		Variable
	LC74	0	Fwk - Persistent - Exclusive		Variable
	LC75	0	Fwk - Execution - Exclusive		Variable
	LC76	0	F**W - Design - Exclusive		Variable
	LC77	0	Thermal - Tk - Exclusive		Variable
	LC78	0	QSn,k - Execution - Exclusive		Variable
>	LC79	0	Construction - Qc - Exclusive		Variable

Presentation of internal forces in beam results

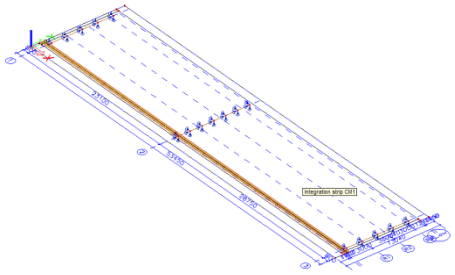
An improvement in understandability and lucidity of presentation of internal forces acting on composite cross-sections was introduced in beam results. Total resultant of internal force can newly be presented both to centroid of entire or current composite section. In the case of the option of current section, internal forces will be related to the centroid of transformed cross-section determined from currently existing phases of cross-section and their prestressing reinforcement. Change of modulus of elasticity due to concrete aging is considered in all phases of cross-section

Equivalent concrete age

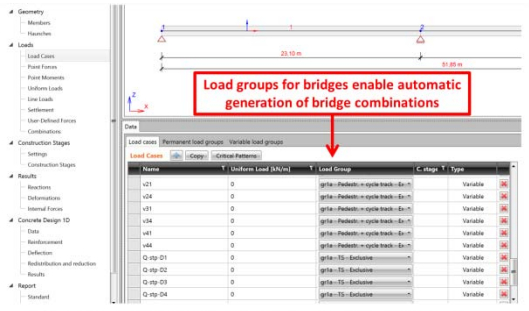
Demoulding of prefabricated elements and the transfer of prestressing are usually done at the age of concrete less than one day. Provision 3.1.2 (5) of EN 1992-1-1 code does not provide the formula for strength of concrete younger than 3 days, what virtually makes the load application impossible unless the strength is based on tests. New functionality of IDEA StatiCa enables the input of strength of concrete based on tests and the calculation of equivalent concrete age. The time of corresponding construction stage is modified accordingly.

User-defined internal forces

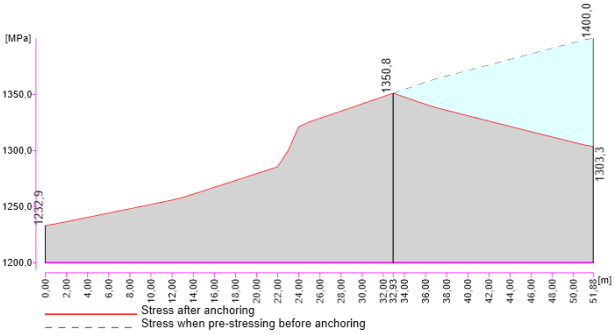
The objective was to enable an effective way of the design of prestressed (bridge) slabs / slab and rib systems / grillages in IDEA StatiCa.



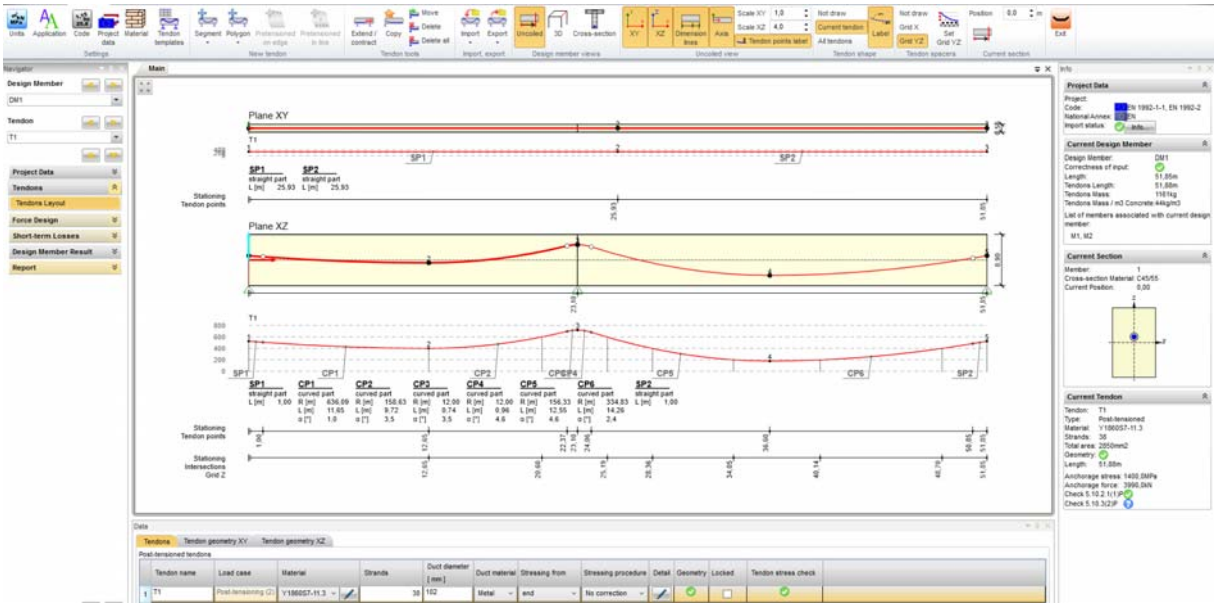
Let us assume that bridge slab is modeled by 2D elements in some 3D FEA system. “Integration strips” or “result beams” are defined in order to integrate 1D internal forces acting in strips. Only moving loads are defined and analyzed in 3D FEA system. The effects of moving loads are imported into IDEA Prestressing. Load groups for bridges are defined.



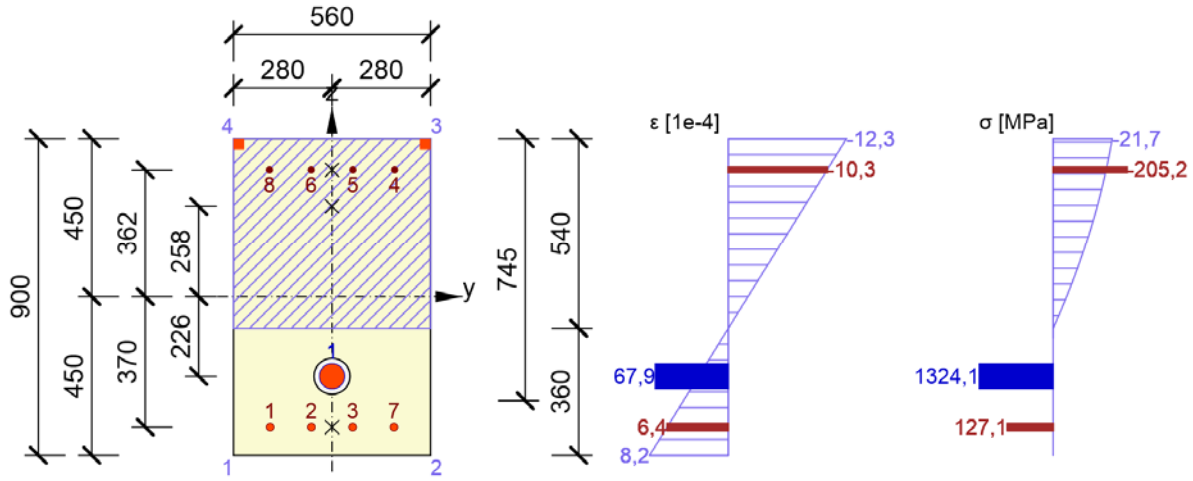
Imported loadcases with the effects of moving loads in IDEA Prestressing



All specialized features of IDEA StatiCa are used – tendon force and geometry is designed and construction stages are specified.



Prestressing losses and load equivalent to the effects of prestressing are calculated. Finite Element method in combination with TDA analysis is used to obtain internal forces caused by all loads except the effects of moving loads. Detail and comprehensive sectional design is performed in IDEA StatiCa.



New HTML report in IDEA StatiCa RCS

New form of report is available, which improves stability and speed of the report.

Angle of concrete compression diagonal

The angle of concrete compression diagonal (for the variable-angle truss model used in EN 1992-1-1) can be specified differently for different reinforced cross-sections. This new feature improves the variability of the input, which can make the design more economic.

Bent-up bars for shear reinforcement in RCS

New type of shear reinforcement in the form of bent-up bars can be defined to resist shear force, which extends the range of application of the program.

Presentation of reactions or bearing stress intensity

Except of the drawing of reactions in FEM nodes, three new possibilities of presentation of reactions are possible:

- Average bearing stress intensity, which falls on individual FEM nodes
- Linear bearing stress intensity along line support
- Constant bearing stress intensity along line support

Presentation of internal forces in IDEA StatiCa RCS

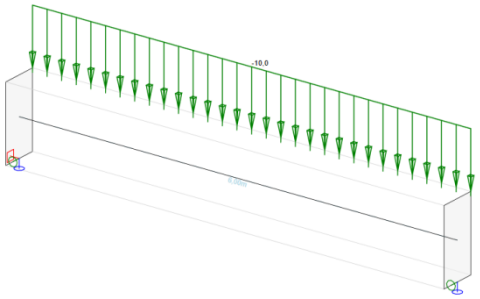
Similarly to beam results, see above, an improvement in understandability and lucidity of presentation of internal forces acting on composite cross-sections was introduced in IDEA StatiCa RCS.

Lambda 0

An improvement in the calculation of coefficient λ_0 according to EN 1992-2, annex NN 3.2 for concrete in compression (NN. 115) makes the assessment of fatique effects simple for the user. Related part of the report was extended.

Eccentricity of load impulses

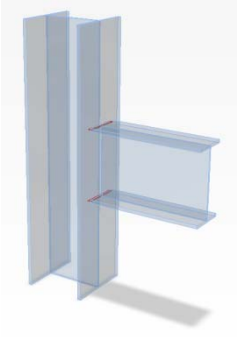
The possibility of the input and the analysis of the eccentricityof selected tyes of load impulses was introduced: (a) Point Forces, (b) Uniform Load, (c) Line Load.



Slovak Annex of EN

Changes and corrigenda of NA STN: Zmena NA V 03/07, Oprava AC V 05/08, Oprava AC2 V 01/11, Zmena NA/Z1 V 05/13

IDEA Connection



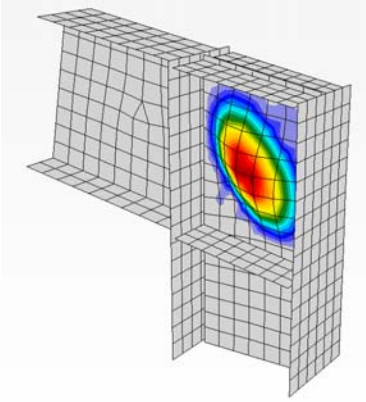
Model

New operation **weld** brings possibility of connection of all plates types. Of course all necessary weld properties can be defined.

Calculation

Calculation of projects in IDEA Connection are fast on the other hand complex joints need some time. New feature **save of results** speeds up the work with our application. Results are stored with the project and they are ready during the next opening of the project. This can save a lot of time, for example in the case of detailed protocol generating.

Checks



Stability analysis is the key feature of this version. Now it is possible to calculate local buckling for each load-case. Application will provide a multiple factor of a defined load which cause instability of some plate.

Rotational stiffness calculation of a member connection to the joint was available in the previous versions. Now it was complemented by calculation of **axial stiffness** of the connction element.