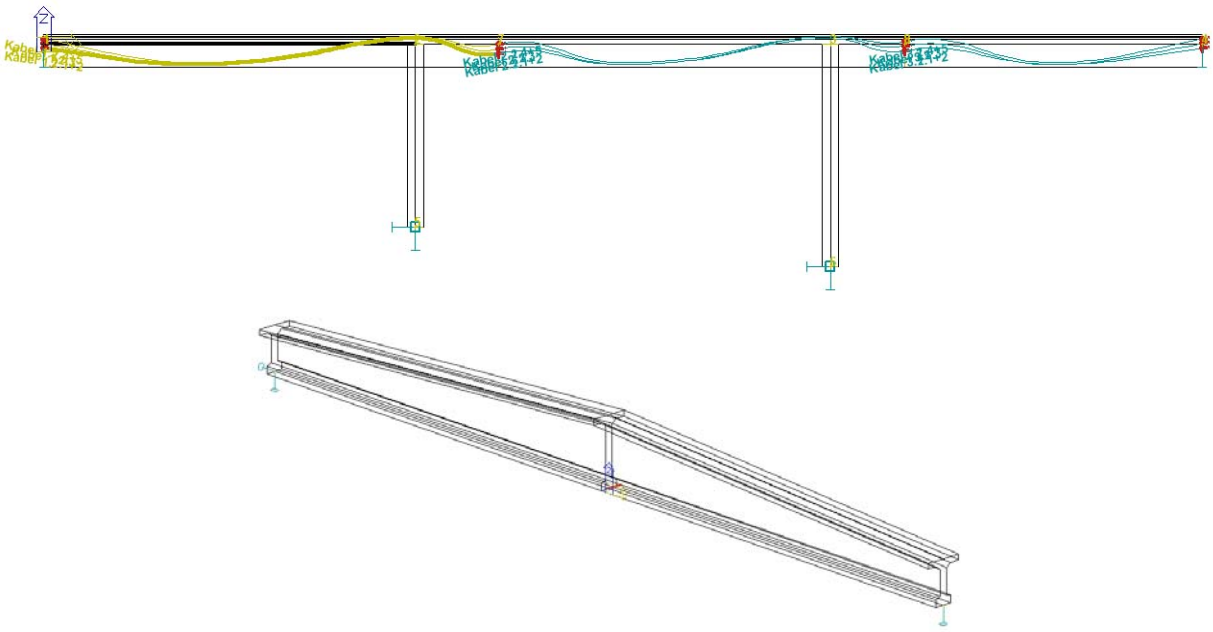
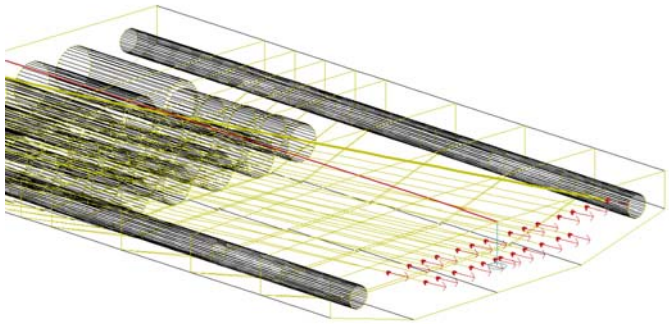
SCIA releases a new module 'Prestress Checks' for NEN 6720



Several years ago SCIA started an adventure that would take several years. **It was decided to implement prestressed concrete in ESA-Prima Win**. It was immediately clear that such a task would take several major steps or 'leaps'.

Firstly it was allowed to input a tendon, either posttensioned or pretensioned, for any structure. Secondly the module 'construction stages' was introduced allowing the user to analyse individual construction stages for any construction. Thirdly the time dependant analysis was introduced for 2D frames allowing the user to model aging of concrete, creep, shrinkage and long-term relaxation. Today many customers use our software for their analysis of prestressed structures, e.g. beams, bridges, frames or finite element slabs.



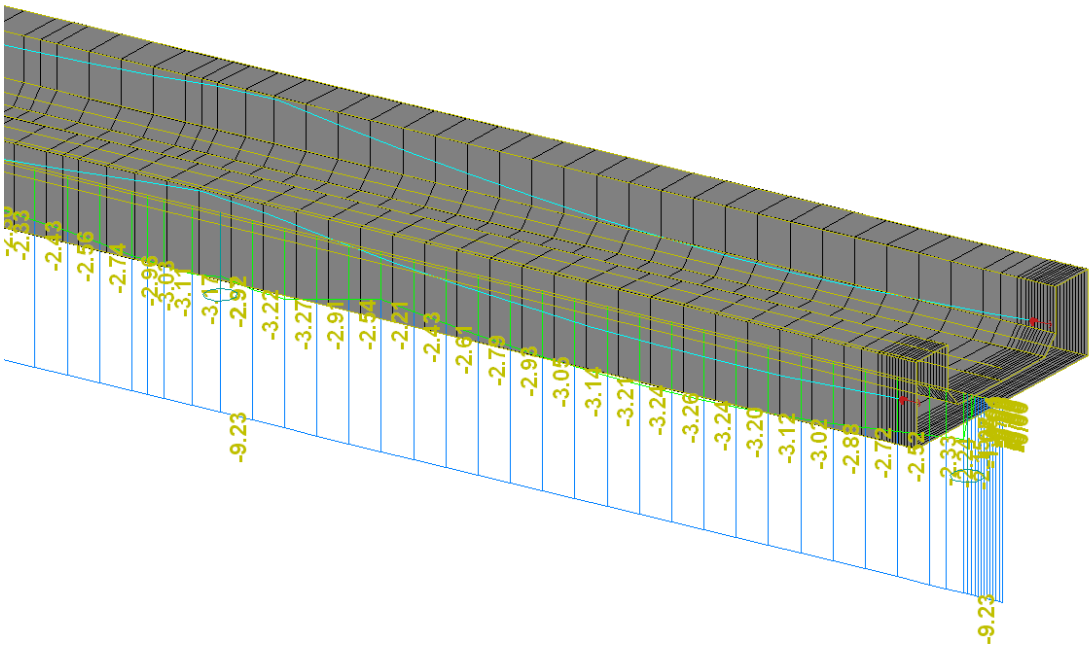
By the end of March SCIA will introduce a new leap in ESA-Prima Win. The code-dependant checks of the pretensioned prestressing will be introduced according NEN 6720. This means that the user will be able to check the response and capacity of prestressed, pretensioned cross-sections with or without additional

soft-steel reinforcement. Additionally the allowable stresses and crack widths can be checked. Finally the user is able to design additional main, shear and connection reinforcement.

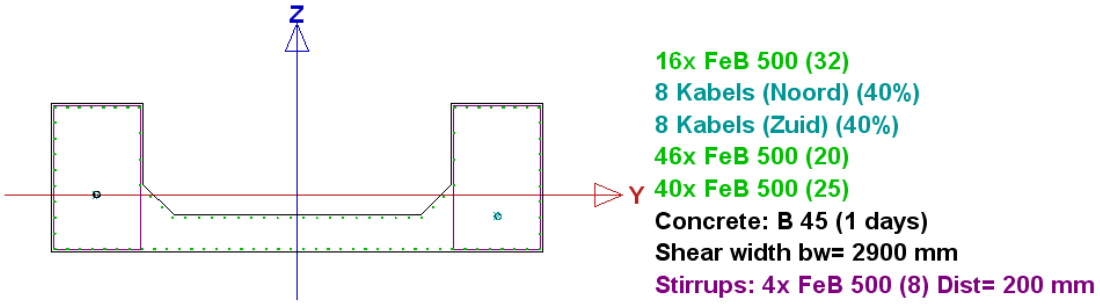
In practice the user has to check the results of a time-dependant analysis for their consistency with the code. NEN 6720 has special rules for the checks of prestressed cross-sections. Initially the allowable compression stress during the prestressing stage has to be checked according clause 8.1.7. The maximum compression stress in any fibre of the cross-section is then compared with the maximum allowable compression stress at the time of prestressing. Since the aging of the concrete is included in the model of ESA-Prima Win, the correct stiffness and strength of the concrete will be taken into account.

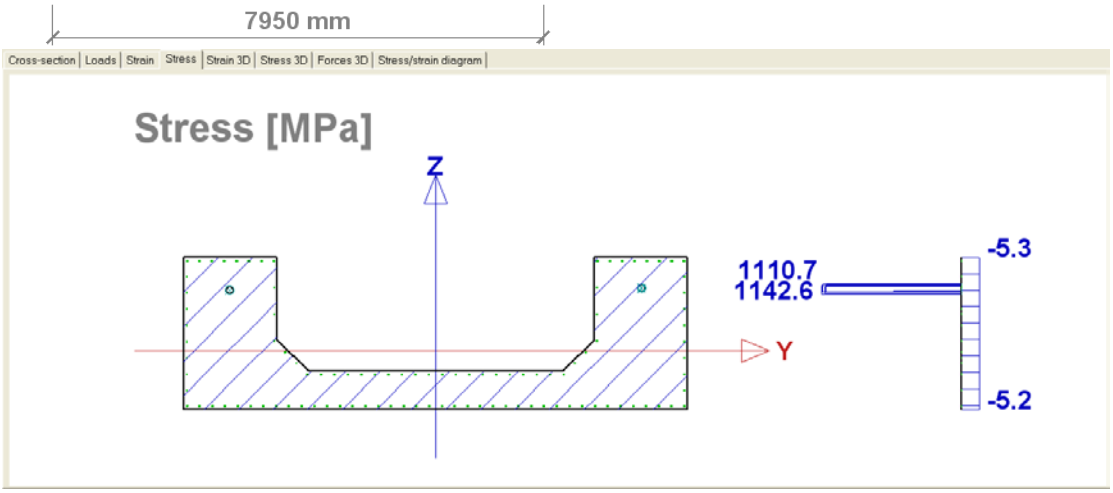
Concrete characteristics

	B 25	B 25 1 days
f'ck	25.00 MPa	8.55 MPa
f'b	15.00 MPa	5.13 MPa
fb	1.15 MPa	0.39 MPa
fbm	2.30 MPa	0.79 MPa
E'b	28500.00 MPa	16667.59 MPa



The capacity and the response of a cross-section can easily be checked for the initial and resultant state of the cross-section, i.e. the state with only prestress plus dead loads or the states with all loads including the life load. Understandable, self-explaining diagrams and figures will help the user in reviewing the status of the loaded cross-section. When using interaction diagrams, the user is able to calculate the maximum allowable capacity for M_y, M_z or a combination of M_y and M_z.





The capacity for the beam can easily be compared with the operating forces. Additional soft steel reinforcement can be included in the calculation of the capacity. Any applied stirrup will be used in the calculation the shear capacity.

Results for construction/serviceability stage 3 (18250.0 days)
Selected force extrem Vz+

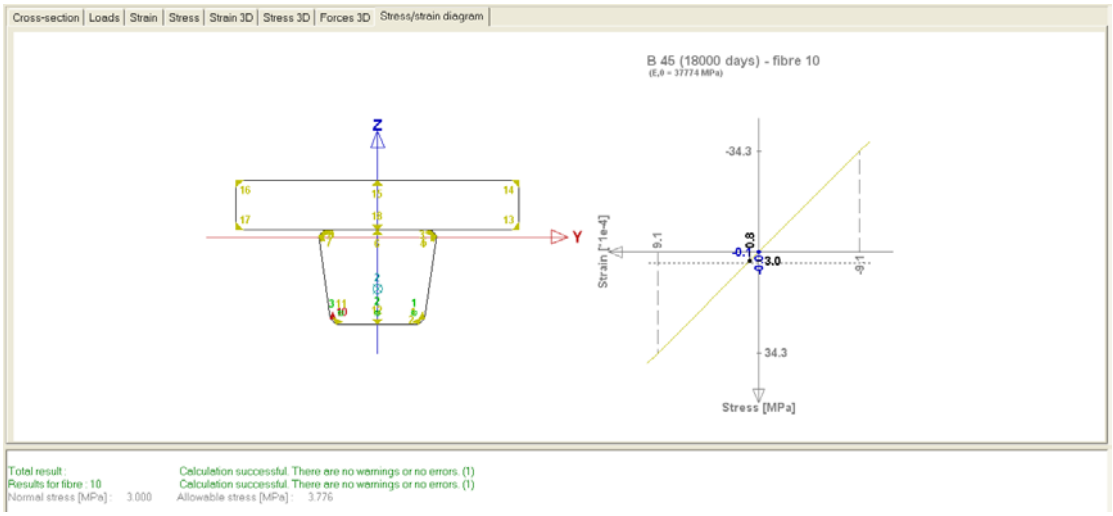
Result of shear check

elem	Combi Case	x loc. [m]	Vd [kN]	Nd [kN]	taud [MPa]	tau1 [MPa]	taun [MPa]	taus [MPa]	tauu [MPa]	tau2 [MPa]	Asv [mm^2/m]	Dist [mm]
1	C5	0.00	540.04	-111.05	1.69	1.91	0.05	0.98	2.94	6.60	1005	100

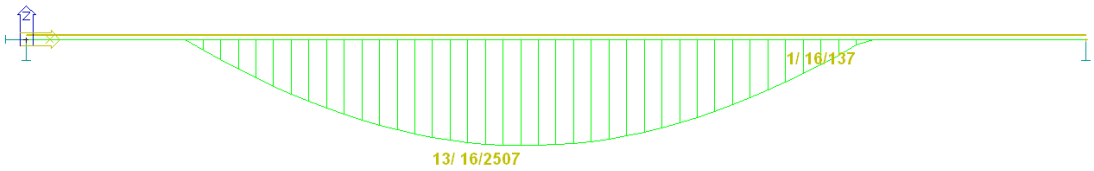
Explanation of shear reinforcement symbols

Abbreviation	Explanation
taud	Design shear stress
tau1	Concrete resistance shear stress
taun	Resistance shear stress caused by normal force
kh	Factor for beam height
w 0	omega 0
taus	Requiered shear stress for stirrup design
Dist	Required c.t.c. distance between stirrups
Asv	Shear reinforcement area

The check of the allowable concrete tensile stresses (8.7.4) and the crack widths (8.7.2. and 8.7.3.) can be performed with or without additional soft steel reinforcement. **The program will respect the structure's environmental class and special cover conditions. Again the user can easily review the operating forces, stresses and strains in the cross-section. As a fact the same engine for drawing as for the widely spread ESA-Concrete Section is being used**.



Finally a design of necessary area's, being longitudinal, shear or connection reinforcement, can be performed. For the calculation of necessary area's the same principals as for 'normal' concrete are used, i.e. the basic reinforcement or the predefined practical reinforcement will be respected in the calculation. The calculated theoretical reinforcement can be used in the check of stresses, crack proof, response, etc. The user has to set the roughness of the connection plane before calculating the necessary shear reinforcement.



Tendon characteristics

	s 1860 - 12.9
Diameter	12.90 mm
Area	100.00 mm^2
Fpk (Fpu_rep)	1860.00 MPa
E modulus	200000 MPa
Adhesion factor	0.75

Main lower reinforcement in selected beams

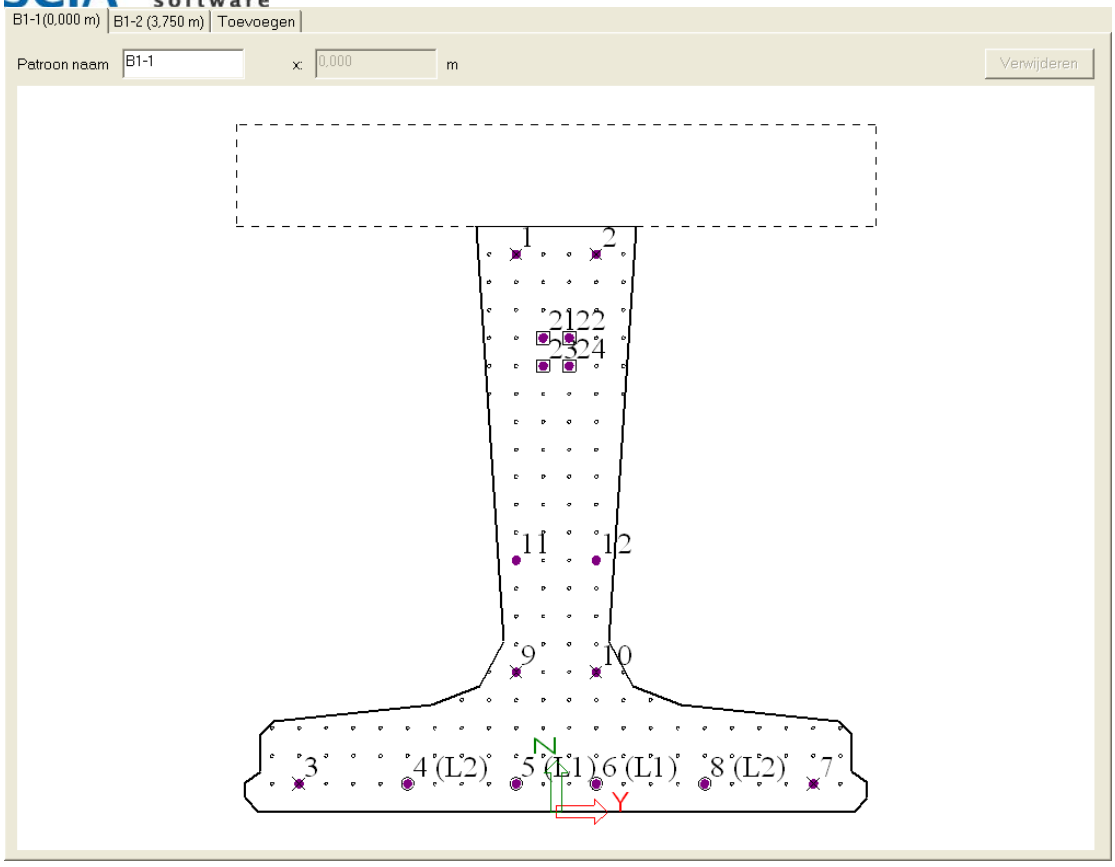
elem	Combi Case	x.loc [m]	Md [kNm]	Nd [kN]	Mp [kN]	xu [mm]	d [mm]	epss [/1e+4]	epsc [/1e+4]	As,theo [mm^2]	Reinforcement
1	C5	7.00	1720.86	-0.04	-393.24	253.1	749.0	69.28	-32.03	2507	13x16(2614)

Shear reinforcement in selected beams

elem	Combi Case	x loc. [m]	Vd [kN]	Nd [kN]	taud [MPa]	tau1 [MPa]	taun [MPa]	taus [MPa]	tau2 [MPa]	Asv [mm^2/m]	Dist [mm]
1	C5	0.00	540.04	-111.06	1.69	0.76	0.05	0.88	6.60	895	112

Manual bw	bw [mm]	tau1 [MPa]	Surfaces	ks	kb
☐	400	0.56	user defined	0	0
☒	300	0.56	deliberately textured by brushing the concrete		
☐	800	0.56	user defined	0	0

Now only one major leap remains for the customers using NEN code. This last step will be the 'design' of post-tensioned tendons or/and pre-tensioned strand patterns. Both developments will be carried out in SCIA.ESA PT. The design of strand patterns will be complete in version 5.2. Today SCIA and some strategic customers are working on improving the software more and more. Yet it is possible to easily define a strand pattern based upon the borehole pattern of the cross-section.



The user can easily drape, fix, change or debond any strand. All input data can be reviewed graphically using the superior graphical engine of SCIA.ESA PT.