

lateral buckling restraint - attaches - steel check - creep - charges climatiques - dynamic analysis - lateral buckling - brandweerstandsanalyse - timber - 1st order - verstijvers - buisverbinding - diseño de planos de armaduras - pandeo lateral - verbindingen - shear connection - verificación - armatures longitudinales - pórtico - unión base columna - voorontwerp - unión tubular - haunch - connexion moment - cimbras - vérification acier - unity check - Eurocode 2 - mesh - retaining wall - raidisseur - Eurocode 3 - longitudes de pandeo - connections - ACI 318 - acero - 2nd ordre - portal frame - Eurocode 8 - andamios - kip - dwarskrachtverbinding - BS 8110 - dalle de fondation - seismische analyse - armaduras longitudinales - BIM - gelaste verbinding - 2de orde - buckling - funderingszool - poutre sur plusieurs appuis - maillage - malla - uniones - 2D raamwerken - fire resistance analysis - voiles - cracked deformation - gescheurde doorbuiging - longueurs de flambement - pandeo - reinforcement - unity check - cantonera - dynamische analyse - hout - ossatures 3D - koudgevormde profielen - placa de extreme - 1er orden - continuous beam - connexion soudée - momentverbinding - praktische wapening - renforts au déversement - fluencia - estribos - déformation fissurée - CE21 - beugels - Eurocódigo 3 - platine de bout - análisis dinámico - column base plate - kruip - rigid link - welded connection - charpente métallique - moment connections - estructuras 2D - kniestuk - assemblage métallique - 3D raamwerken - second ordre - beam grid - cargas climáticas - Eurocode 2 - Eurocode 5 - wall - deformación fisurada - lien rigide - enlace rígido - 2D frames - estructuras 3D - éléments finis - vloerplaat - steel connection - scheurvorming - integrated connection design - armatures pratiques - analyse sismique - nieve y viento - practical reinforcement - charges mobiles - dalle - wapening - perfiles conformados en frío - Eurocode 3 - connexion tubulaire - unión a momento - 3D frames - treillis de poutres - roof truss - practical reinforcement design - portique - kipsteunen - análisis sísmico - Eurocode 8 - seismic analysis - B.A.E.L 91 - uniones atornilladas - bolts - ossatures 2D - eindige elementen - losa de cimentación - restricciones para el pandeo lateral - optimisation - wand - kniklengtes - end plate - dakspanten - kolomvoetverbinding - stirrups - acier - staalcontrole - cálculo de uniones integrado - paroi - dessin du plan de ferrailage - stiffeners - mobiele lasten - Eurocódigo 8 - Eurocódigo 5 - longitudinal reinforcement - doorlopende liggers - rigidizador - beton armé - fluage - CTE - connexion pied de poteau - langswapening - connexions - hormigón - neige et vent - elementos

Release information

Diamonds 2022

finitos - armaduras - cold formed steel - jarret - uittekenen wapening - puente grúa - analyse dynamique - flambement - keerwanden - optimisation - steel - cercha - 2º orden - slab on grade foundation - entramado de vigas - Eurocode 5 - prédimensionnement - multi span beam - bouten - armatures - floor slab - poutre continue - pared - staal - 1er ordre - NEN 6770-6771 - connexion cisaillement - losa - déversement - viga continua - predimensionering - 1ste orde - unión metálica - CM 66 - madera - análisis resistencia al fuego - verbindingen - 2nd order - bois - Eurocode 2 - profilés formés à froid - verificación acero - predesign - unión soldada - fisuración - beton - muro de contención - optimalisatie - foundation pads - fissuration - concrete - AISC-LRFD - HCSS - assemblage métallique - Eurocode 3 - viga con varios apoyos - armaduras prácticas - balkenroosters - unión a cortante - buckling length - boulons - cracking - Eurocode 8 - knik - Eurocode 2 - radier - eindplaat - Eurocódigo 2 - FEM - tornillos - NEN 6720 - moving loads - balk op meerdere steunpunten - cargas móviles - funderingsplaat - étriers - analyse resistance au feu - cercha - globale knikfactor - dynamische analyse - wapening - unión soldada - profilés formés - cercha - 2º orden - slab on grade foundation - análisis

Table of contents

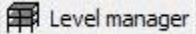
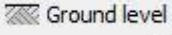


1. Work environment.....	3
1.1. Templates.....	3
1.2. Select elements based on connection name	4
1.3. Show path next to file name	4
1.4. Short cuts	4
2. Geometry.....	5
2.1. Scale function	5
2.2. Merge plates	5
3. Loads	6
3.1. Load case for fire for ASCE 7 and NSR	6
3.2. Fire combinations according to ASCE 7 and NSR	6
4. Analysis and results.....	7
4.1. Cutlines	7
4.2. Meshcoordinates of plates in results table.....	8
4.3. Mean reaction over multiple support lines	8
5. Design.....	9
5.1. New standards	9
5.2. Stainless steel.....	10
5.2.1. General.....	10
5.2.2. Steel verification	10
5.2.3. Deformation	11
6. Reporting.....	13
6.1. Bitmap export.....	13

1. Work environment


1.1. Templates

A template is a file that serves as a starting point for a new project. When you open a template, the pre-formatted settings are loaded. For example: you could make a template with all Eurocode standards selected and one for all American standards selected.

The following parameters can(not) be saved in a template:

Parameters that will be saved in templates = project dependant settings	Parameters that will NOT be saved in templates = user dependant settings
<ul style="list-style-type: none">• selected standards• a (part of) structure and applied loads• defined load groups and user defined load coefficients• adjustments in the level manager • adjustments in the ground level • grid settings • adjustments in the windows• orientation of the global coordinate system• size of fonts, symbols, loads and results• page settings and reports• mesh, analyse settings, ... on the condition that a (random) structure first has been calculated using those settings. The (random) structure may (but should not) be removed before creating the *.bst.	<ul style="list-style-type: none">• units and decimals• language• adjustments in the configurations 

How to create a template:

- Start Diamonds or create a new project  .
- Set the parameters to the desired values.
- Go to File > Save as. Choose BuildSoft Template file *.bst as file type. The template is now created.

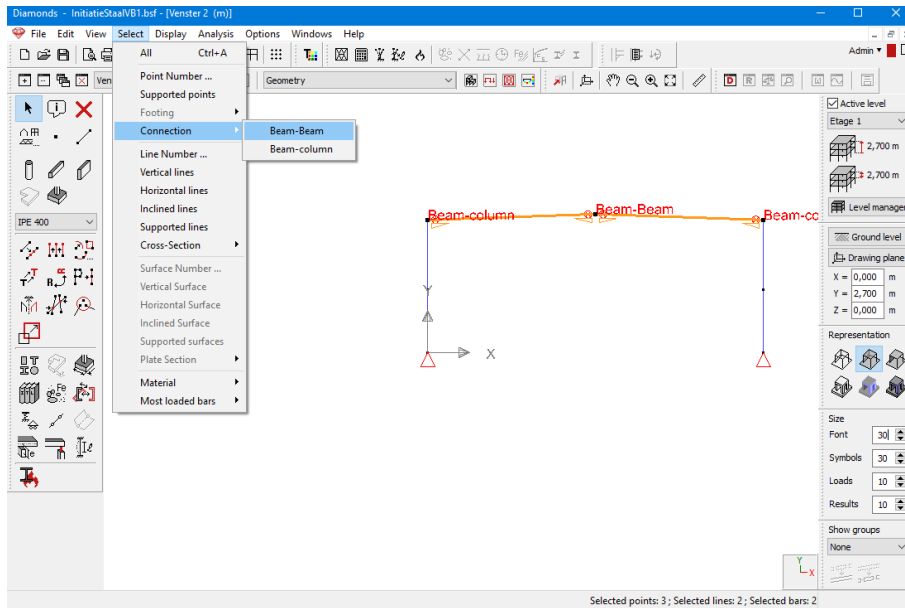
How to open a template:

- Start Diamonds.
- Go to File > Open. Choose BuildSoft Template file *.bst as file type. The template can now be selected and opened.

Note: the use of templates was already possible since Diamonds 2021r01.

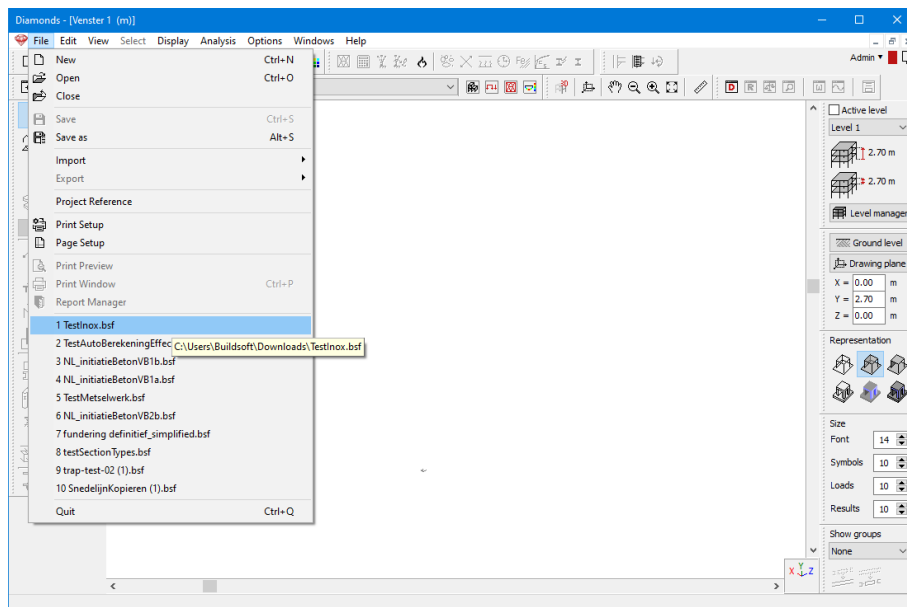
1.2. Select elements based on connection name

Via the menu *Select - Connection* you can select the elements (beams & columns) of which a certain connection is composed of.



1.3. Show path next to file name

If you hover the mouse over your recent projects, you can see the path to these projects.



1.4. Short cuts



The following short cuts were added:

- ALT + S Save as



- CTRL + R Turn ruler  on/off

2. Geometry

2.1. Scale function

Use the button  to scale the length of elements (beams, columns, lines, surfaces, ...) in the geometry configuration . This function comes in handy when a DXF-file is imported on the wrong scale.

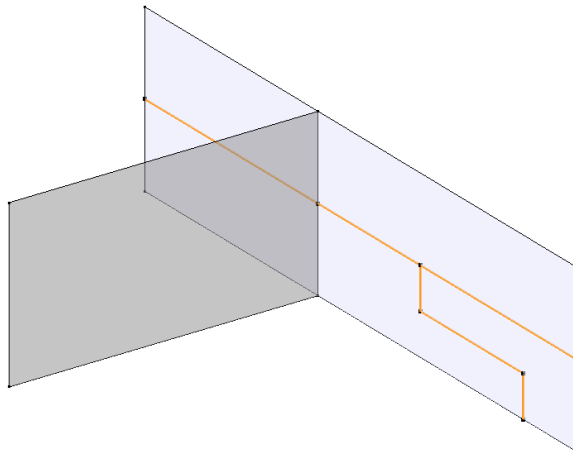
Notes:


- The scale function does not affect the dimensions of the cross-sections, only the length (for line-elements) and the length & width (for surface-elements).
- The scale function does not affect the value of the applied loads. If you want to scale the loads, use the button  in the Loads configuration .
- The scale function was added in Diamonds 2021r01.

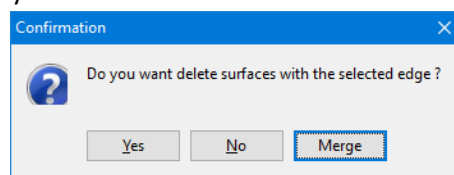
2.2. Merge plates

It is possible to merge two (or more) surfaces. This feature is particularly helpful when you have a model contain a lot of smaller plates which you want to join.

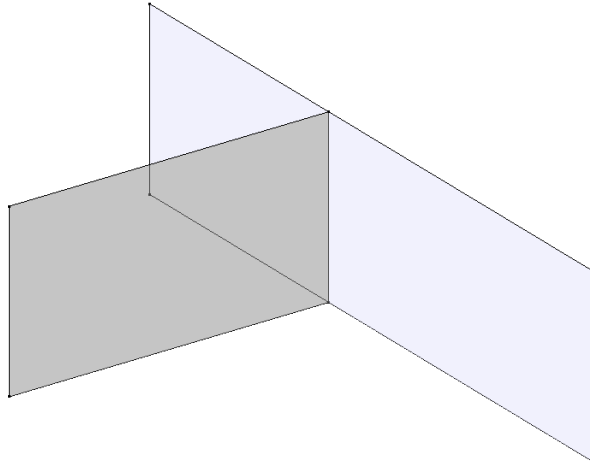
- Only select the edge(s) of the surfaces you would like to merge.



- Click  or DEL.
- A dialog box asks you what you want to do with the selection. Choose *Merge*.



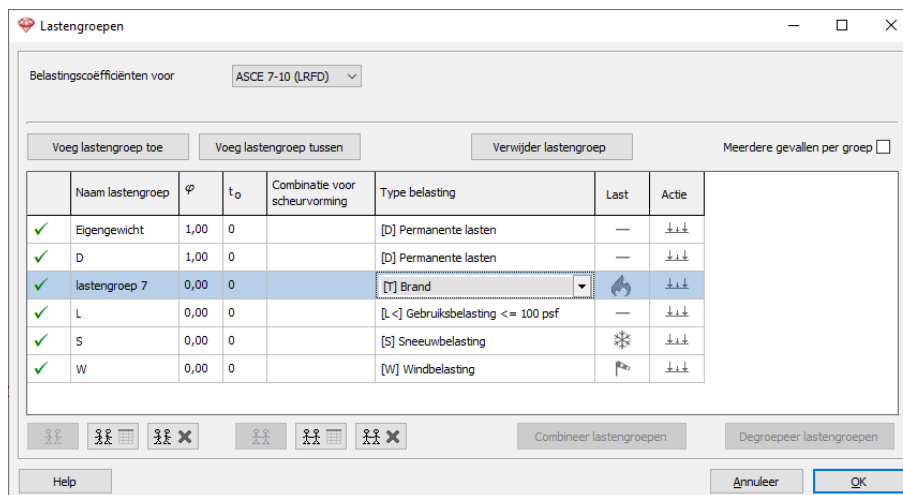
- Result:



3. Loads

3.1. Load case for fire for ASCE 7 and NSR-10

A load case for fire can be selected for the standard ASCE 7 and NSR. Note that a Diamonds project can contain only one load group for fire.



3.2. Fire combinations according to ASCE 7 and NSR-10

Diamonds is now able to generate the fire combinations according to ASCE 7 commentary §C2.5 and NSR.

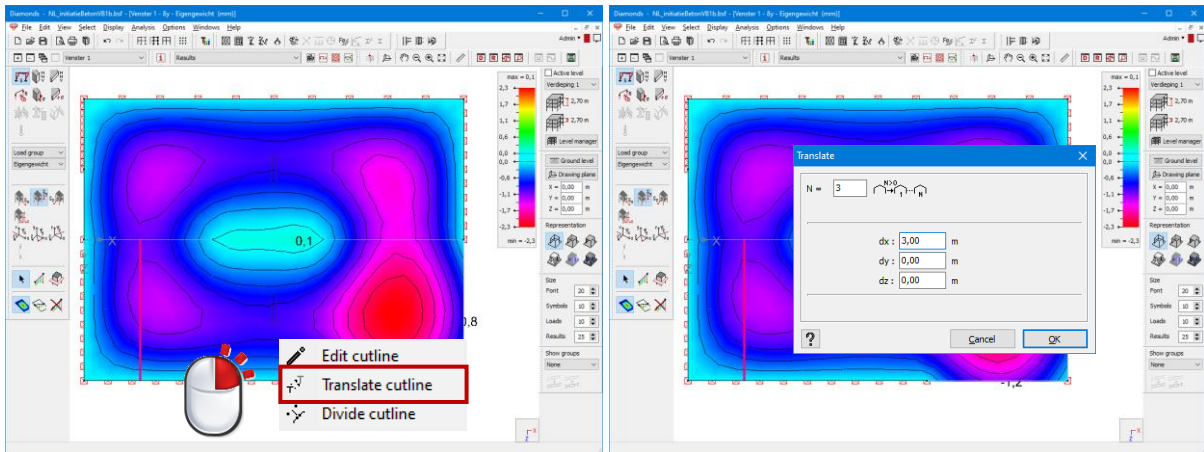
$$(0.9 \text{ or } 1.2)D + A_k + (0.5L \text{ or } 0.2S)$$

Where D = dead load, A_k = the load effect from the fire event, L = live load and S = snow load.

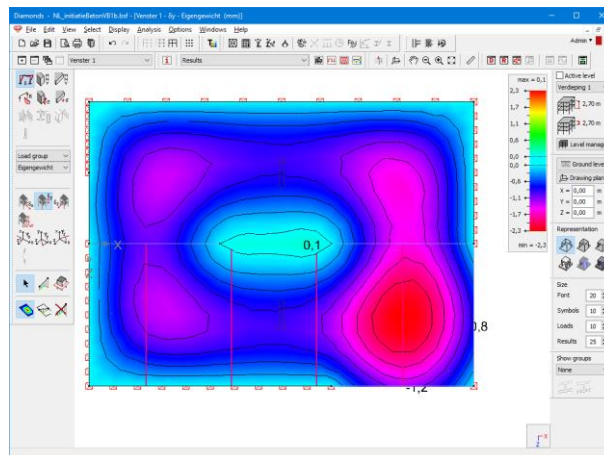
4. Analysis and results

4.1. Cutlines

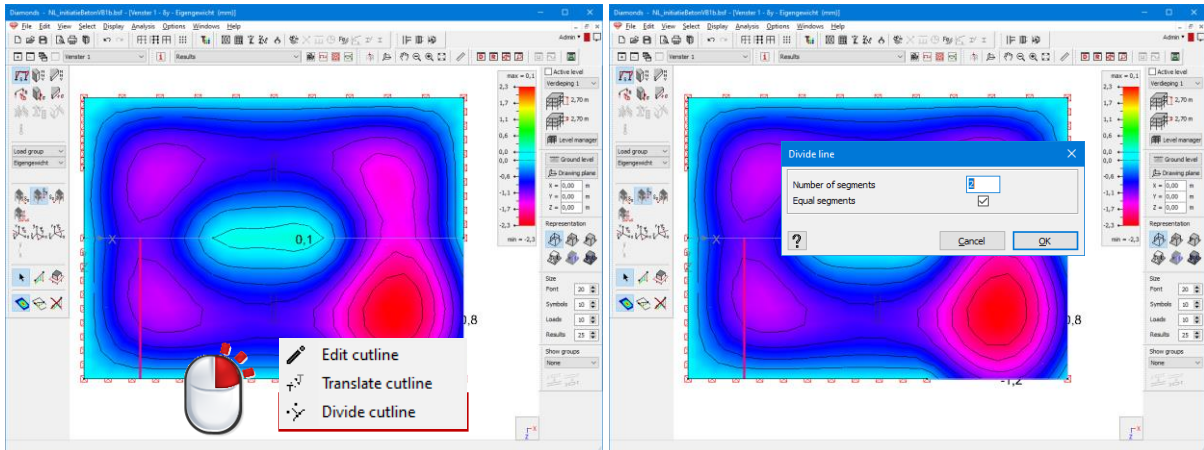
- When you select one cutline and click with the right mouse button, you can now copy the cutline.




Result:









- When you select one or more cutlines and click with the right mouse button, you now have the option to **divide** the cutlines.



4.2. Meshcoordinates of plates in results table


The results table  offers the possibility to show the coordinates of the mesh nodes in plates.

position	Label	x Coord	y Coord	z Coord	Dx (mm) (min)	Dx (mm) (max)	Dy (mm) (min)	Dy (mm) (max)	Dz (mm) (min)	Dz (mm) (max)
1 - 37	-	4,77	0,00	-3,34	0,0	0,0	-2,7	-1,3	0,0	0,0
1 - 36	-	6,67	0,00	-3,32	0,0	0,0	-2,6	-1,2	0,0	0,0
1 - 19	-	5,79	0,00	-5,00	0,0	0,0	0,0	0,0	0,0	0,0
1 - 20	-	7,71	0,00	-5,00	0,0	0,0	0,0	0,0	0,0	0,0
1 - 18	-	3,86	0,00	-5,00	0,0	0,0	0,0	0,0	0,0	0,0
1 - 38	-	5,64	0,00	-1,66	0,0	0,0	-1,8	-0,8	0,0	0,0
1 - 39	-	8,55	0,00	-3,28	0,0	0,0	-2,8	-1,3	0,0	0,0
1 - 40	-	3,01	0,00	-3,38	0,0	0,0	-3,1	-1,5	0,0	0,0
1 - 41	-	7,54	0,00	-1,54	0,0	0,0	-1,7	-0,8	0,0	0,0

- Click on  to hide/show certain columns of information.
- With the buttons , ,  and , you can respectively print the entire content of the table, make a print preview, generate an RTF or copy the values. The copied values can then be pasted into other software like Excel.
- It is **not possible** to request this extended table in the report manager .

4.3. Mean reaction over multiple support lines

In previous version of Diamonds, you had to double click a support line in the results to view the mean reaction. In Diamonds 2022,

- you can select multiple support lines,
- and open the data table .

- At the bottom of the table, you'll find an additional line showing the mean reaction in the selected support lines.

The screenshot shows the Diamonds software interface. A 'Results' window is open, displaying a table of reaction and moment values for selected support lines. The table is titled 'Lastengroep Eigengewicht' and contains the following data:

bar number	Label	R Fx (kN/m)	R Fy (kN/m)	R Fz (kN/m)	ΣR Fx (kN)	ΣR Fy (kN)	ΣR Fz (kN)	R Mx (kNm/m)	R My (kNm/m)	R Mz (kNm/m)	ΣR Mx (kNm)	ΣR My (kNm)	ΣR Mz (kNm)
7	-	0,0 ~ 0,0	-13,3 ~ 41,8	0,0 ~ 0,0	0,0	37,0	0,0	0,0 ~ 0,0	0,0 ~ 0,0	0,0 ~ 0,0	0,0	0,0	0,0
8	-	0,0 ~ 0,0	-15,3 ~ 131,7	0,0 ~ 0,0	0,0	97,7	0,0	0,0 ~ 0,0	0,0 ~ 0,0	0,0 ~ 0,0	0,0	0,0	0,0
total	-	-	-	-	0,0	134,7	0,0	-	-	-	0,0	0,0	0,0
Mean reaction (/m)	-	-	-	-	0,0	10,0	0,0	-	-	-	0,0	0,0	0,0

The 'Mean reaction' row is highlighted in red. The background shows a 3D model of a structure with reaction values like 41.8, 13.3, and -12.3.

- Click on to hide/show this line in the table.
- With the buttons , , and , you can respectively print the entire content of the table, make a print preview, generate an RTF or copy the values. The copied values can then be pasted into other software like Excel.
- It is **not possible** to request this extended table in the report manager .

5. Design





5.1. New standards

- The Spanish standard CE21 has been added for steel and concrete.
- The Spanish annex to Eurocode 2 (UNE EN 1992-1-1/NA:2015) has been added.
- The Spanish annex to Eurocode 3 (UNE EN 1993-1-1:2013/A1: 2014) has been added in Diamonds 2021r03.
- EN 1993-1-4 for stainless steel has been added (see §5.2)

5.2. Stainless steel

5.2.1. General

The workflow for designing stainless steel in Diamonds is:

1. Calculate the internal forces  and the buckling lengths  like you would normally do.
2. Click on  to start the verification (see §5.2.2).
3. Click on  to calculate the deformation (see §5.2.3)

Note:

- The calculations are based on EN 1993-1-4:2006, EN 1993-1-4:2006/A1: 2015 and EN 1993-1-4:2006/A2: 2021.
- The module *Stainless steel design* requires an additional license *Stainless steel*. Contact our sales department (sales@buildsoft.eu) for more information.
- The material library is expanded to support stainless steel qualities.
You'll notice that not all stainless steel qualities mentioned in EN 1993-1-4 are implemented. This is because some parameters for the design (like the yielding strength and/ or the parameter n) are not defined in some cases. If you did find a source for that information, you can always manually add a stainless steel quality to the material library.

5.2.2. Steel verification



The principle for verifying stainless steel is the same as for carbon steel (EN 1993-1-4 must be seen as an addition to EN 1993-1-1). Only some parameters have a different value, or some additional formulas need to be checked in comparison to EN 1993-1-1.

The table below gives an overview of the differences between carbon steel and stainless steel.

SUBJECT	CARBON STEEL (= CS)	STAINLESS STEEL (= SS)
Design values of material properties - Young modulus E (N/mm ²)	§3.2.1 210 000	§2.2.1 195 000 – 220 000
Characteristic values of strength f_y and f_u	Table 3.1	Table 2.1
Partial safety factors - Resistance of members and cross-sections - Stability of members and cross-sections	§6.1.3 $\gamma_{M0} = 1,0$ $\gamma_{M1} = 1,0$	§5.1 $\gamma_{M0} = 1,1$ $\gamma_{M1} = 1,1$
Classification of sections - c/t-ratio's - ε	Table 5.2 Limits given $\sqrt{\frac{235}{f_y}}$	§5.2.2, Table 5.2 Different limits given $\sqrt{\frac{235}{f_y} \frac{E}{210\,000}}$
Shear resistance	§6.2.6 $V_{Ed} \leq V_{pl,Rd}$, check $V_{b,Rd}$ in	§5.6 $V_{Ed} \leq V_{pl,Rd}$, check $V_{b,Rd}$ in some

	some cases	cases (different limit)
Buckling resistance - imperfection factor for buckling α $-\phi = 0,5[1 + \alpha(\bar{\lambda} - \bar{\lambda}_0) + \bar{\lambda}^2]$	§6.3.1, Table 6.2 0.13; 0.21; 0.34; 0.49 or 0.76 $\bar{\lambda}_0 = 0.2$	§5.4.2, Table 5.3 0.34; 0.49 or 0.76 $\bar{\lambda}_0 = 0.2 \text{ or } \bar{\lambda}_0 = 0.3$ Depending on the cross-section shape and material
Lateral torsional buckling resistance - imperfection factor for LTB α_{LT} $-\phi = 0,5[1 + \alpha_{LT}(\bar{\lambda} - \bar{\lambda}_0) + \bar{\lambda}^2]$	§6.3.2 0.34; 0.49 or 0.76 $\bar{\lambda}_0 = 0.2$	§5.4.3 0.34 or 0.76 $\bar{\lambda}_0 = 0.4$
Stability (Bending and compression)	§6.3.3	§5.5 Check the design forces using formulas 5.13 to 5.17
Deflections	§7 Use E	§4.2 Use secant modulus $E_{s,ser}$ because SS has a non-linear behaviour.

Notes:

- In Section Utility it is possible to compose custom sections from stainless steel. If you're interested in the secant deformation, make sure the custom section is mainly composed of stainless steel. Other materials (with different material behaviour/ modulus of elasticity) will affect the stresses and thus the calculation of the secant modulus (see §5.2.3).
- It is possible to run a thermal analysis  on cross-sections in stainless-steel, but it is not (yet) possible to do a steel verification of stainless steel in case of fire .
- A connection verification (PowerConnect) of elements in stainless-steel is not supported (yet).


5.2.3. Deformation

Because stainless steel is a non-linear material, the modulus of elasticity depends upon the stress level in the cross-section. Therefore EN 1993-1-4 §4.2 (5) states that deflections should be calculated using **the secant modulus** at the stress level (SLS state).

EN 1993-1-4 uses the Ramberg-Osgood model to calculate the secant modulus. As does Diamonds.

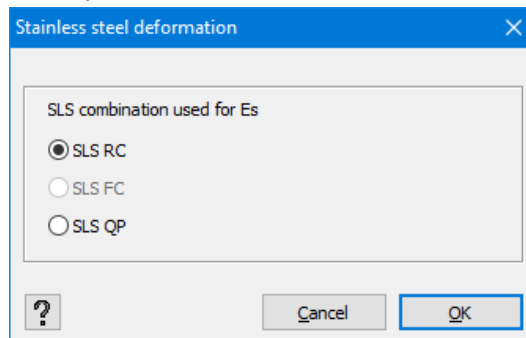
- Diamonds will calculate the secant modulus in each mesh node as the minimum value of the secant modulus along the strong and the weak principal axis of the cross-section.
- This will result in different secant moduli along the length of the member. The secant deflection is obtained by solving an integral over the length of the member.

So, the steps to calculate the deformations in stainless steel in Diamonds are:

1. You run an elastic analysis .
This results in a deformation calculated with the modulus of elasticity defined in EN 1993-1-4 §2.1.3 (which are included in the Diamonds material library).
As said before, this deflection is not always accurate.
2. Either

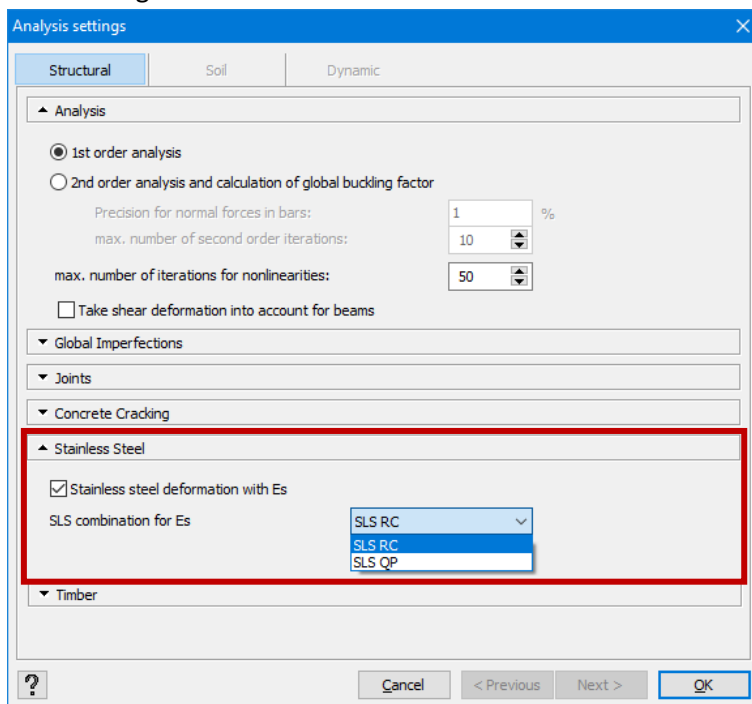
- a. Calculate the secant deformation E_s .

Choose a combination. Diamonds will calculate the secant modulus using the stresses in the combination you selected. Choose the same combination as the one in which you want to verify the deformations.



- b. Calculate the secant deformation and redivide the internal forces E_s .

This option does the same as option 'a', but it will also redistribute the internal forces using the secant moduli.



Notes:

- The secant moduli are calculated based on elastic stresses, regardless of the cross-section class of the member.
- The calculated deformation for stainless steel in Diamonds is only valid when the stresses in the cross-sections (in the selected SLS state) are below the yielding strength of the used stainless-steel quality. Diamonds doesn't literally check this condition, because it is supposed that when the steel verification is smaller than 100%, the stress requirement is also met.
- As a simplification, EN 1993-1-4 §4.2 (9) allows calculating the variation of $E_{s,ser}$ along the member and use the minimum value throughout its length. But for stress levels above 65%






of the yielding strength, this results in very high deflections. Thus this simplification is not used in Diamonds.

6. Reporting

6.1. Bitmap export

The best way to create a suitable image for A0 print, is using the Export to bitmap-function. Don't use the report manager for this. The images created with the report manager, are not of sufficient quality to be printed on A0-size.

To create an A0-sized print:

- Set the visualisation of the model as you would like it to be printed.
 - Hide/show the desired elements 
 - Rotate the model to the desired position
 - Select the desired representation ( ,  ,  , ...)
 - Hide/show the desired information on the model 
- Go to *File > Export > Export as bitmap*.
- Set the bitmap width to 14000 pixels.
This limit is increased from 8000 in Diamonds 2021r03 to 14000 in Diamonds 2022.
- Set the bitmap height to 14000 pixels/ 1,41 = 9929 pixels.
The W/H-ratio of an A0-paper is 1189mm/841mm \approx 1,41.
It is important that the W/H-ratio of the bitmap has the same W/H-ratio as the paper size. Otherwise, you risk that the image gets stretched while printing and thus lose image quality.
- Save the bitmap.
- Open the bitmap with Paint.
- Press CTRL + P and search for your PDF-printer.
Make sure the resolution of the PFD-printer is **not set higher than 300dpi**! If you choose a higher PDF-printer-resolution, you risk again losing image quality.
- The pdf you just created can be send to a plotter.