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 138 - 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 - EHE - 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 ferraillage - stiffeners - mobiele lasten - Eurocódigo 8 - Eurocódigo 5 - longitudinal reinorcement - doorlopende liggers - rigidizador - beton armé - fluage - CTE - connexion pied de poteau - langswapening - connexions - hormigón - neige et vent - elementos finitos -

Release information

Diamonds 2020

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

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1. General

1.1. New database system

Diamonds, PowerConnect and BIM Expert 2020 come with, as usual, a new Gateway installation, version 2.0. This version of Gateway includes a new database system, called “LiteDB”. “LiteDB” is more lightweight and easier to install compared to the previous used database system MS SQL Server Express 2014.

The new database is remarkable faster

- in installation of the BuildSoft libraries, such as the cross-section and the materials.
- in loading the BuildSoft libraries into Diamonds, PowerConnect or BIM Expert.
- in conversions from and to BuildSoft cross-sections and materials with BIM Expert.

Both Gateway 2.0 and LiteDB will be installed automatically upon the installation of Diamonds, PowerConnect or BIM Expert 2020.

1.2. Transfer of existing libraries

All user-defined cross-sections and materials will be automatically converted and included in the new database system. There is no action from the user required.

1.3. Compatibility with older versions

Diamonds and PowerConnect 2020 can be installed next to version 2017, 2018 and 2019. It is not necessary to remove the old versions. With the installation of 2020, the older versions will also start working with the new database LiteDB.

2. Work environment

2.1. Material and section library

2.1.1. Default save

As from Diamonds 2020, user defined materials and cross-sections will be automatically saved in the library. This makes them available for future projects, although the user can change this.

2.1.2. New materials added

The material library has additional materials included (both since Diamonds 2019r02):

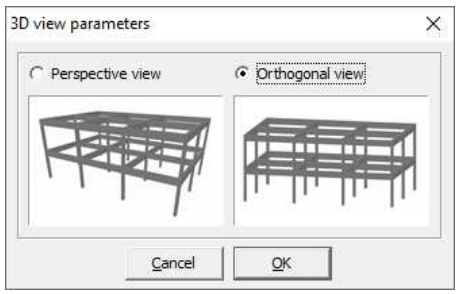
- **Sherwin-Williams fire resistant paints** were added. The new paints are FX2004, FX2005, FX5090 FX5120 and FX6002.
  Since the fire resistance of these paints is given based on tables, no thermal properties can be requested.

- **High strength concrete** (C55/67 to C90/105) were added for EN 1992-1-1.

2.2. Changed default view

The orthogonal view is now the default Diamonds view for new installations. In the orthogonal view there is (almost) no limit in the zooming capacity, while there is a zooming limit in the perspective view.

You can switch between the two using *View* > *Perspective*.



2.3. File consistency checks

Diamonds 2020 contains significant improvements in checking the file's consistency, when saving locally and when saving over network.

The default settings we have chosen should provide you with the best possible Diamonds experience. However, each situation is different and therefore you can personalize the options and their settings via the Diamonds preference file:

- **CheckXmlSave**: default = true

After saving a file, the file is checked for having a valid XML format. Files that are broken off prematurely or files with missing tags are discovered this way.

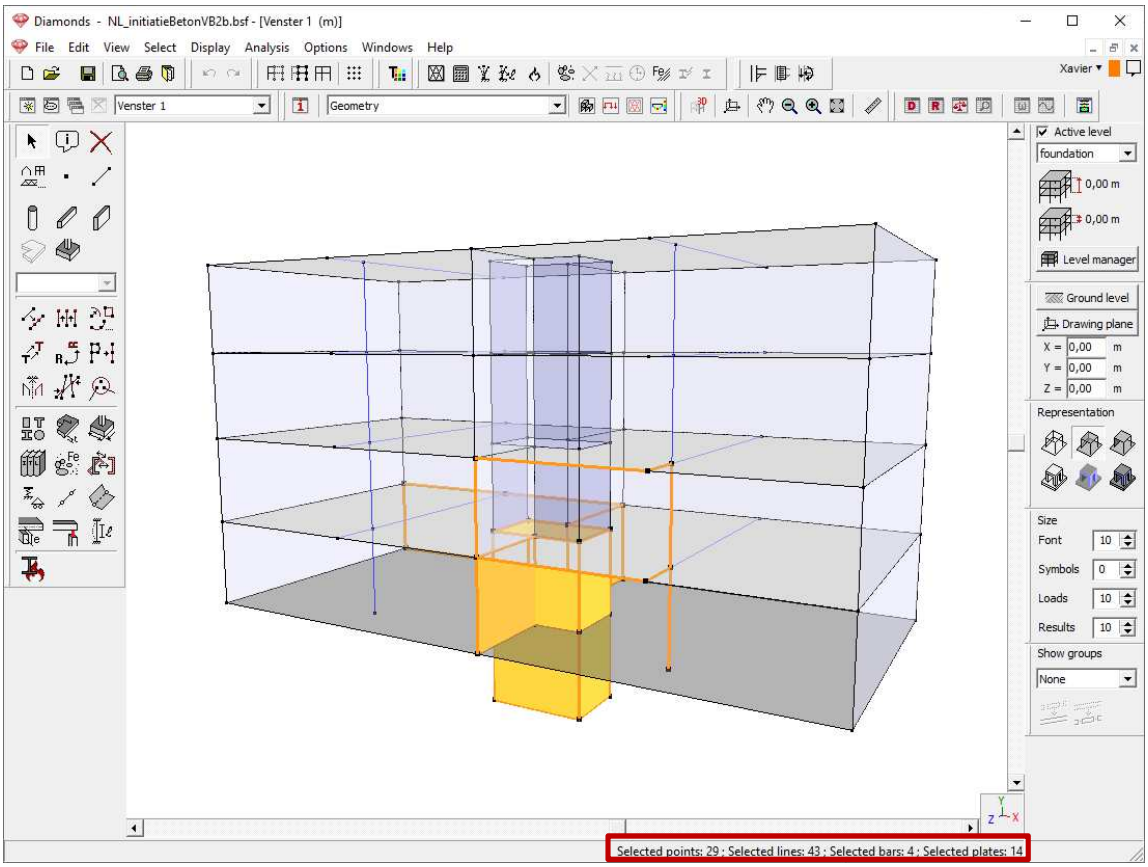
- **CheckXmlSaveNrRetries**: default = 4
  This is the number of times Diamonds tries to save the file again if the XML check fails. After that, Diamonds will give a notification to the user.
- **KeepNetworkTemporaryDays**: default = 7
  When saving a file over network, Diamonds will now first save that file locally in a subfolder of the preferences folder. The subfolder is called "TempNetworkFiles". Then a copy is made to the location on the network. The local files will be deleted over time – in order to not take up too much space on your local disk. When Diamonds launches, the date of each file in the folder "TempNetworkFiles" is checked. If it is more than "KeepNetworkTemporaryDays", the file will be deleted.
- **CheckNetworkCopy**: default = false
  When you save a file to network, Diamonds makes a checksum of both the local and network file and see if both values are the same. If they differ, the (network) copy was not (completely) successful. This is an extra security, because Windows already does a file check when saving to network. It should be noted that this is a time consuming procedure for large files and should normally not be required, therefore it is disabled by default.

To modify the settings:

1. Close all Diamonds sessions
2. Go to *My Documents* > *Diamonds* > *Version2020r0*
3. Open the file *Diamonds.ini* with Notepad
4. Look (CTRL + F) for [TGENERALPREFERENCES_PREF]
5. Modify the options of your choice.
6. Save and close the file.

2.4. Number of selected elements

Upon selection of whole model or just a part, Diamonds will show the number of selected elements in the footer at right hand side. You see the number of selected points, lines (having no cross-section), bars (with cross-section) and plates.



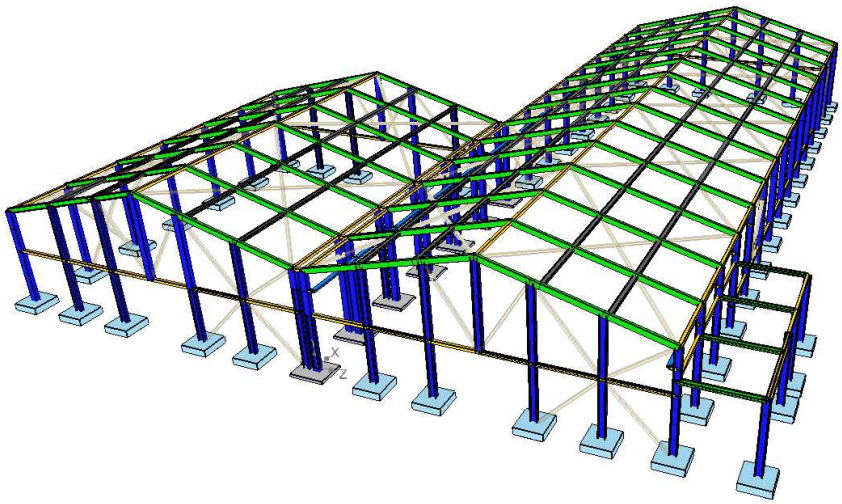
2.5. Design types

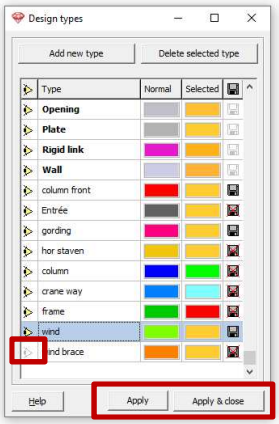
Design types are commonly used for model management. Not only you can select elements belonging to the same type with CTRL button, it allows you also to show and hide certain elements.

In order to improve the general Diamonds workflow, you can now **leave the Design types window open** during use. This allows you to instantly set the visibility of a group of elements belonging to the same design type. You can now show, hide & modify types at any moment in time, faster than ever before.

In the example below, we have hidden the wind brace type (greyed out now) by clicking the ‘eye’ icon and confirming with ‘Apply’. You can continue working while keeping this window open, you just put it aside. This new feature comes in really handy when going over the results.

With "Apply & Close" you use the window as before.





2.6. Selecting points

By means of CTRL + clicking on 1 point, all points will be selected (since Diamonds 2019r02).

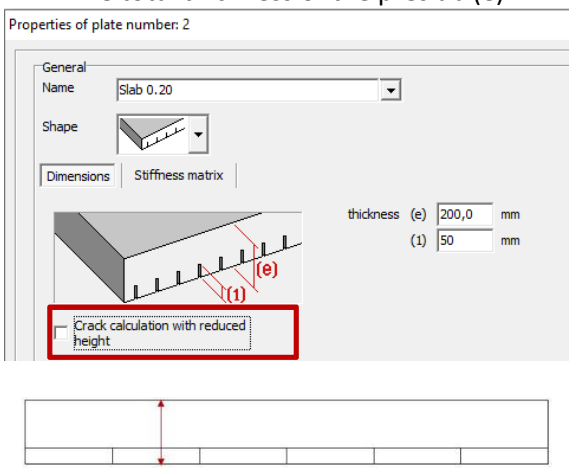
3. Geometry

3.1. Reduced height for cracking in preslabs

As from Diamonds 2019r02 you can choose whether the cracking in the secondary bearing direction of a preslab should be calculated based on:

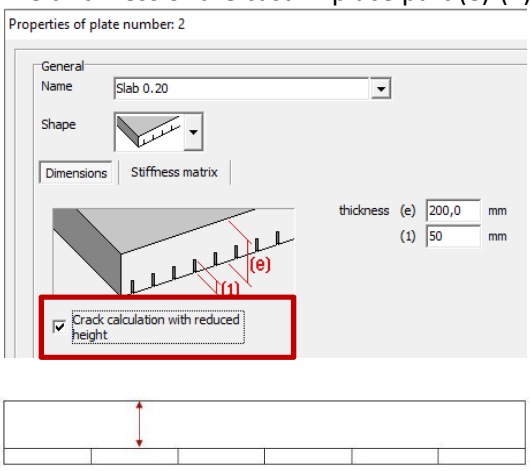
- Either the total thickness of the preslab (e)
- Either the thickness of the cast-in-place part (e)-(1)

The total thickness of the preslab (e)



This option is less conservative and is used when the prefabricated part (= the elements with

The thickness of the cast-in-place part (e)-(1)

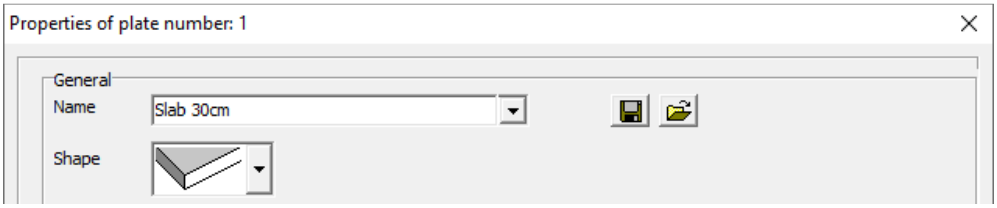


This option is the most conservative and will result in larger cracked deflections. It could be

thickness (1)) have a large width (≈ 240cm) and with joints far away from the critical zones.	used for a detailed calculation at the joints around critical zones, in a small model.

3.2. Import and export plate geometry

You can now import and export plate geometry data, meaning all of the dimensions of the plate and/or the stiffness matrix. This feature can come in quite handy when calculating CLT floors. Once entered, the CLT floor can be saved to file for import in future projects.

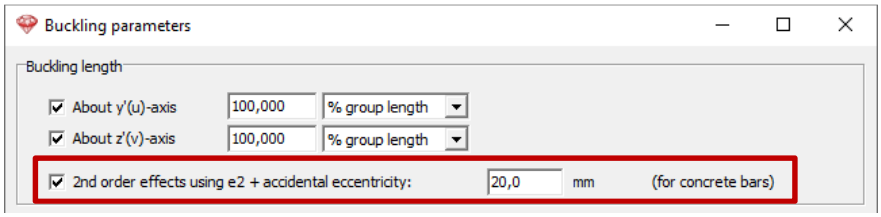


3.3. New shortcut key

The geometry shortcut key 'p' or 'P' will open the projection window .

3.4. Concrete element - eccentricity

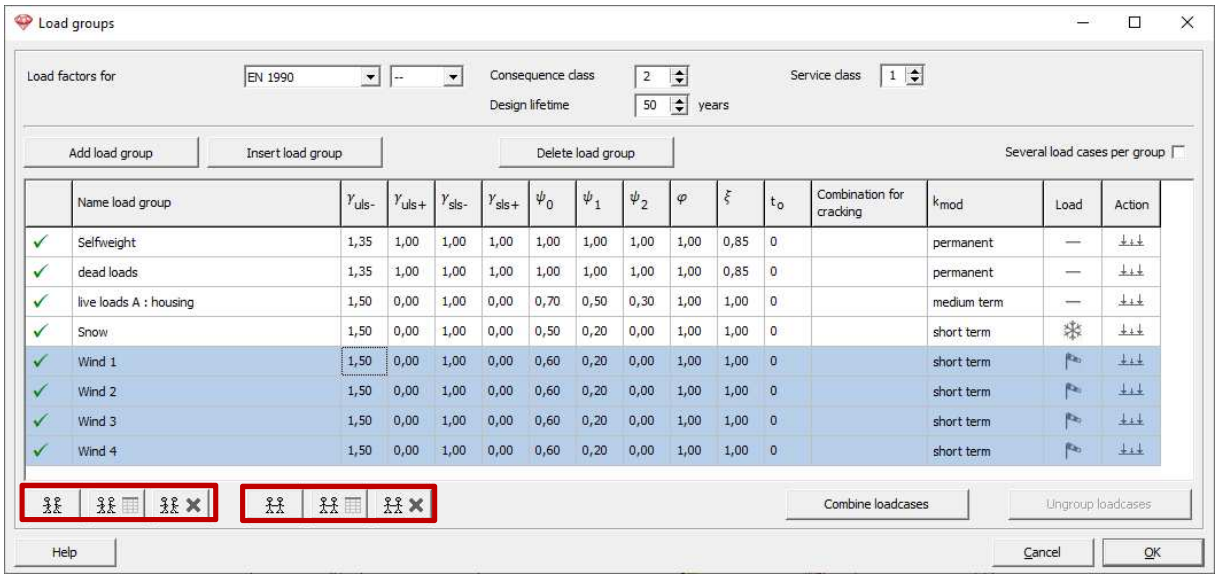
In the window 'Buckling parameters' for concrete bar elements, the label for the 2nd order effects and accidental eccentricity is now more clear. More information on this topic can be found on the support website.



4. Loads

4.1. Quickbuttons for incompatible loads and linked loads

In the 'Load groups' window, the existing buttons for incompatible and linked loads are replaced with 2 new sets of icons.



From left to right:

- Incompatible loads configuration:
  - o : make selected load groups (using CTRL button) mutual **incompatible**
  - o : open dialog window with all incompatible loads per load group
  - o : delete all incompatibilities for all load groups
- Linked loads configuration:
  - o : make selected load groups (using CTRL button) mutual **linked**
  - o : open dialog window with all linked loads per load group
  - o : delete all links for all load groups

You can now easily create or delete incompatible and linked loads without having to open the dialog window and manually go over each load group.

Remark: Clicking on the buttons or does not 'clear' existing incompatible or linked settings. Be careful not to just hit the buttons as test.

More information on incompatible load groups and linked load groups can be found on the support website.

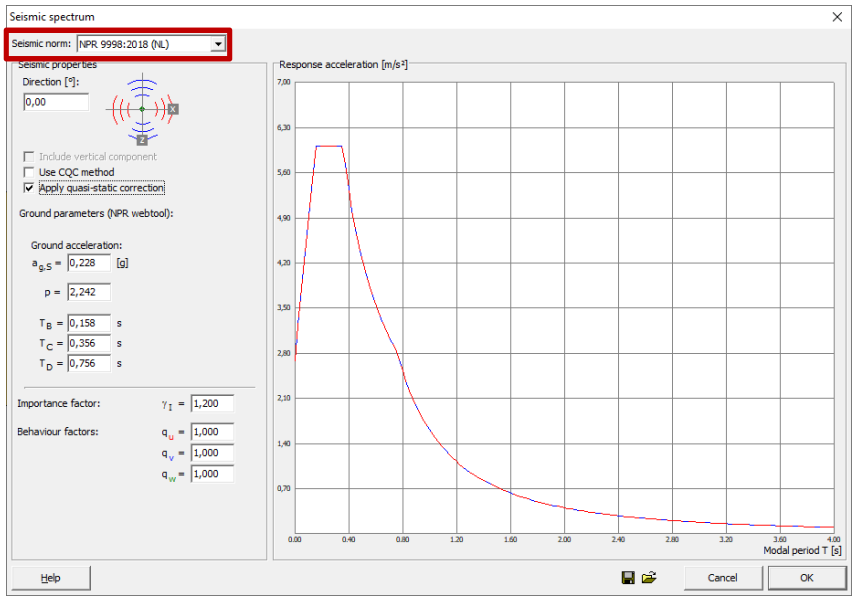
4.2. Add loads to loadgroup 'Fire'

In the load group "Fire" you can now also define temperature loads. That way you could take into account the heating of the elements due to the fire.

An example can be found on the support website.

4.3. Additional seismisc design code

The Dutch NPR 9998:2018 + C1:2020 is added to the list of seismic design codes.



5. Analysis and results

5.1. Extended fire analysis

The fire analysis possibilities are now extended with following cross-sections:

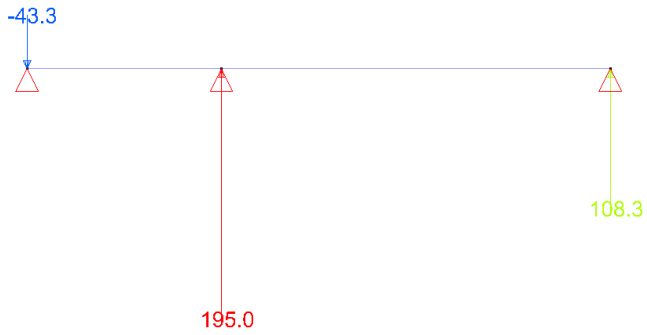
Each of these sections can have no coating, 4-sides coating or a Section Utility coating.

Fire resistant paints can now be applied, calculated and optimized for other section types than I, RHS and CHS.

5.2. Reaction forces displayed with sign in Results

Reactions forces now come with a sign in both Results window and Results table . The sign depends on the sense of that force:

- Upwards (following the Y-, X- or Z-axis) is positive ;
- Downwards (opposite to the Y-, X- or Z-axis) is negative.

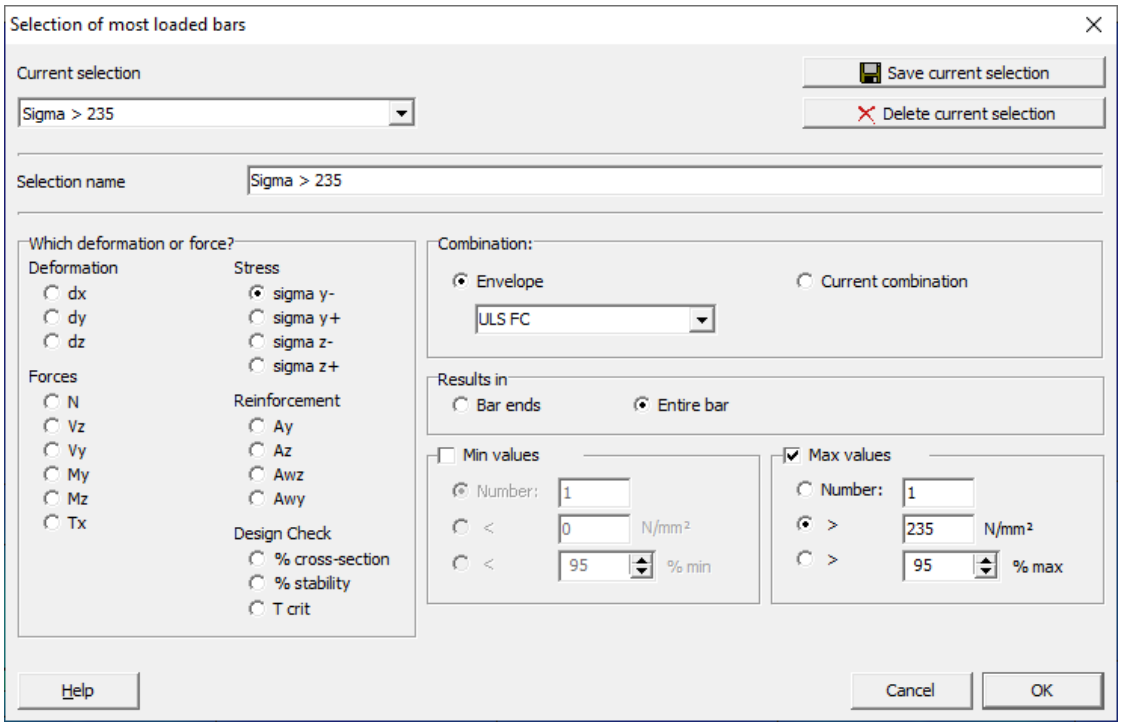


An example use: you can now print a foundation slab in a top view showing the reaction forces in the piles. Based on the sign you immediately know the sense of the reaction forces.

5.3. More selection possibilities using 'Most loaded bars'

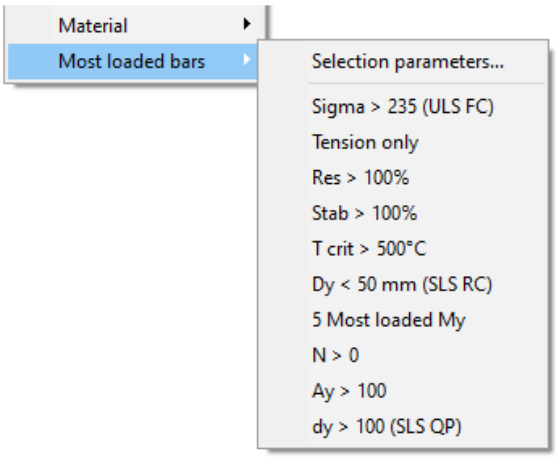
The window 'Most loaded bars' (menu *Select* > *Most loaded bars* > *Selection parameters*) has been upgraded with new possibilities. As from now, you can:

- Make and save selection criteria for bar elements.
- Select bar elements through selection criteria in the menu.



The menu *Select* > *Most loaded bars* contains a list will all saved selection sets. If the load combination to check is an envelope, the name of that envelope is added at the back of the name of the selection set. That also means that selection sets with no name added, always apply on the current selected combination the results window.

Clicking one from the list will automatically select the bars that match the selection criteria. You can easily add more elements to the selection by holding the SHIFT button down while choosing one of the other selection sets.



5.3.1. Create a new selection criteria

1. Go to *Select > Most loaded bars > Selection parameters.*
2. Enter a name for the selection criteria.
3. Choose the bar result to filter: a deformation, an internal force, a stress, a reinforcement or a design check.
4. Choose the combination criteria – an ULS / SLS Envelope or the current selected combination the results window.
5. Decide whether you want check the values of the whole bar or only at the bar ends.
6. You can set for one or both minimum and maximum value:
    a. or a number of elements,
    b. or a value,
    c. or a percentage of the min/max calculated value in the whole model.
7. Click 'Save current selection'.

5.3.2. Modify an existing selection criteria

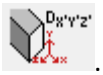
1. Go to *Select > Most loaded bars > Selection parameters.*
2. Choose the selection set from the list.
3. Modify which result, the combination and min/max value criteria.
4. Click 'Save current selection'.

5.3.3. Remove a selection criteria

1. Go to *Select > Most loaded bars > Selection parameters.*
2. Choose the selection set from the list.
   Note: the last item in the list cannot be removed. There must always be one selection criteria present.
3. Click 'Delete current selection'.

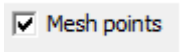
5.4. Relative deflections

Relative deflections can be shown for bars (having a cross-sections) or cut lines in a plate:

1. Select one or more bars/ cutlines (elements must be inline) and go to 'Detailed results' .
2. Select the deflection result  .
3. Thick the checkbox δ_{rel} .

The relative deflection is calculated using the distance between the **black** and **red** points, which are indicated on the total deflection line.

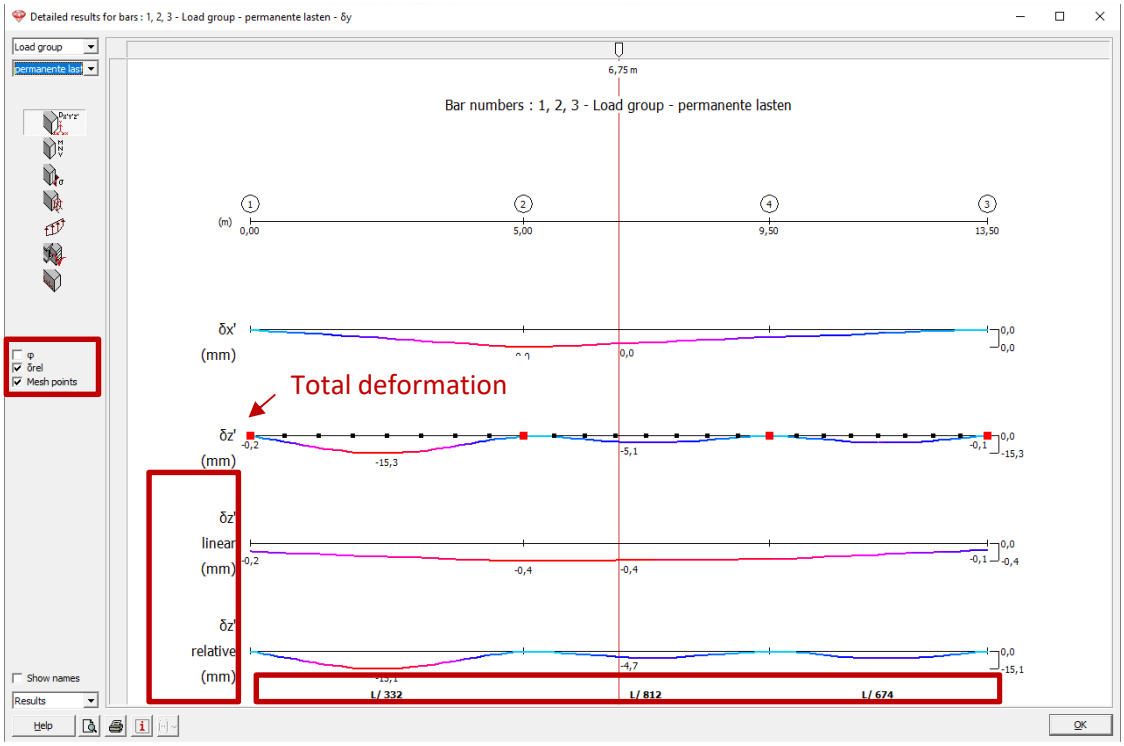
- The **red** points are existing supports or auto-recognized fixed points, such as a wall or a column. Red points can be turned into black (non-fixed) points, by clicking them.
- The **black** points are mesh nodes which can be turned into red (fixed) points, by clicking them.

  These points can be visualized with the checkbox  on the left hand side.

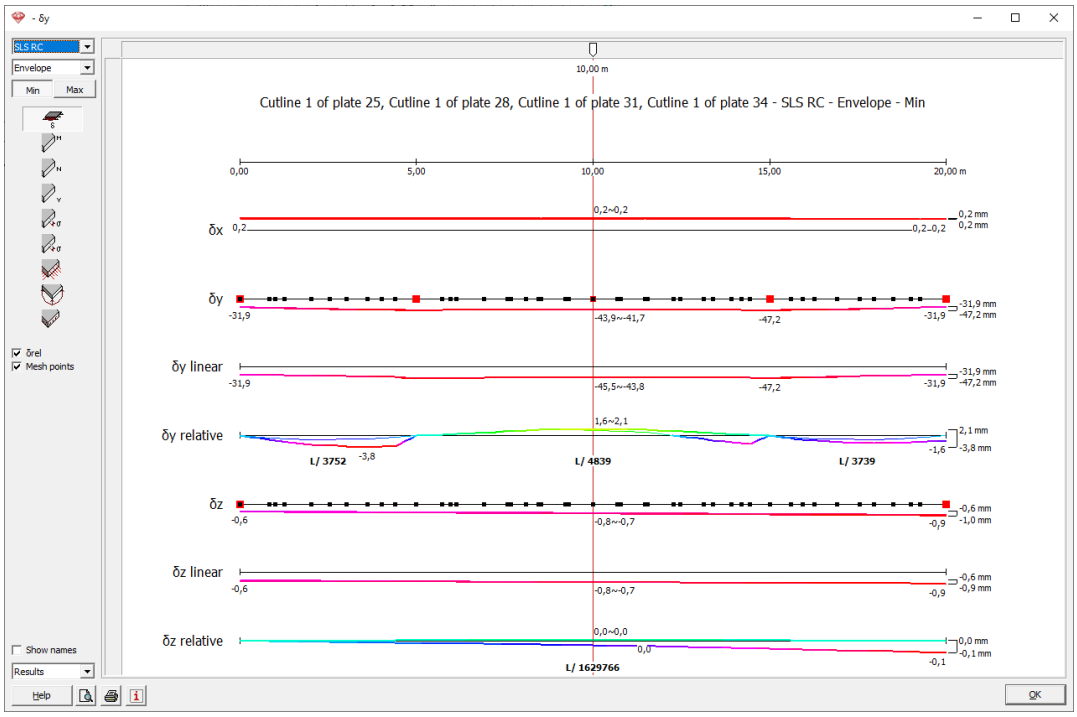
Below the total deflection, you see the linear and relative deformation.

- The **linear** deformation is the chord that connects the deformations at the red fixed points.
- The **relative** deformation equals the total deformation minus the linear deformation.

Since the span (= the length between the red points) is known to Diamonds, the relative deformation is indicated as *L/xxx* below it.



Beam detailed view



Cutline detailed view

Remarks:

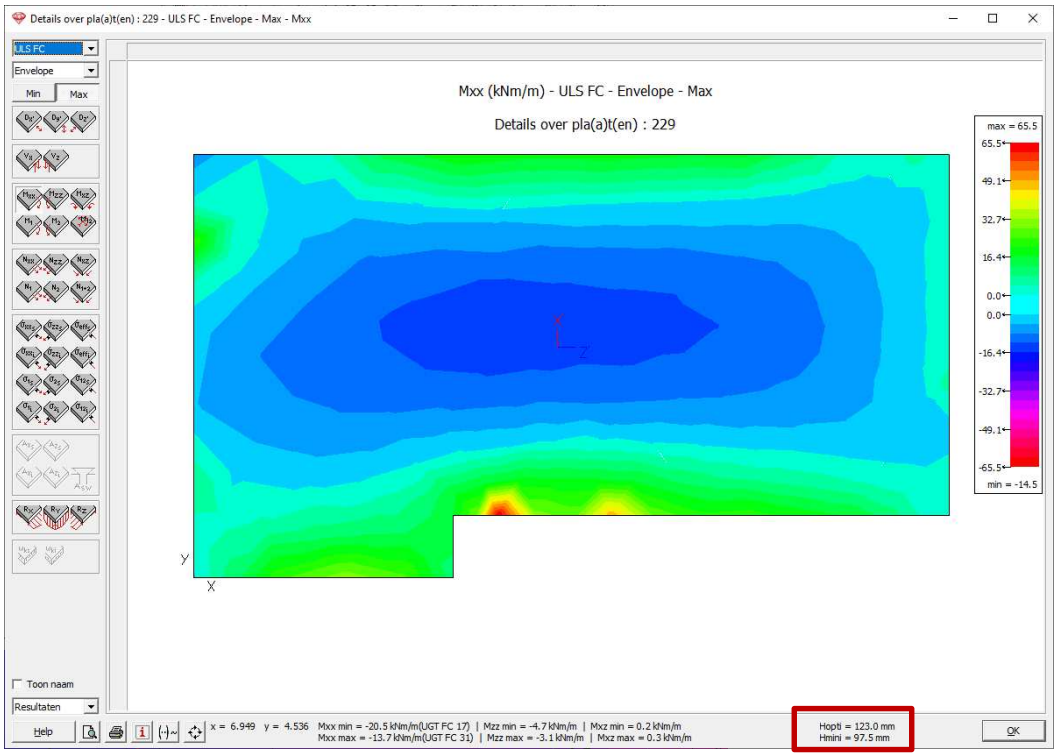
- For beams, δ_y deflections in the global results window correspond with local δ_z' results in the detailed window.
  For cutlines, δ_y deflections in the global results window correspond with global δ_y results in the detailed window.
- In case of deflections according to the local y-axis δ_y', Diamonds will split them accordingly.
- Thicking the option φ will display the angular rotations, only for beams.
- A print or print preview can be made with and . The relative deflections cannot be included in the general reporting , because it depends on the current selection of bars and red/black points.

6. Design

6.1. Optimal and minimal plate thickness (concrete slabs only)

The optimal h_{opt} and minimal h_{min} plate thickness can be requested in the detailed results window:

1. Select the slabs and click on 'Detailed results' .
2. Select a bending moment result M_{xx} , M_{zz} or M_{xz}
3. Hoover over the slab. The optimal and minimal slab height will be displayed at the bottom.



Remarks:

- The optimal h_{opt} and minimal h_{min} plate thicknesses are only valid for pure bending. The calculation of these values does not take possible axial forces into account.
  If the plate is also submitted to normal forces, these values have no meaning.
- h_{opt} is calculated using a steel strain of 10‰ and a compressive strain in concrete of 3,5‰.
- h_{min} is calculated using a steel strain corresponding to the point where the steel reaches the yielding strength and a compressive strain in concrete of 3,5‰.
- This feature is available for two-way slabs (bearing in 2 directions) , preslabs and one-way slabs (bearing in 1 direction) .
- This option is available since Diamonds 2019r02.

6.2. Modified LTB verification following EC 3 NA NL

The LTB verification has been modified to be compliant with the remark in the additional paragraph 6.3.2.5 of the NL National Annex of Eurocode 3 EN 1993-1-1.

7. Report

7.1. Print selection of pages

In the print preview, you can choose to print a selection of pages instead of all pages.

7.2. Steel elements not complying are shown in red

If you request a table of the steel verification results, Diamonds will show the elements that do not comply in red.

3 General results

3.1 Bars verifications - Eurocode 3 : EN 1993-1-1/3 (--)

bar number	Resistance (%)	Stability (%)
1	25,560 ~ 141,005	331,545
2	25,560 ~ 141,005	331,548
3	16,567 ~ 59,881	120,191
4	14,565 ~ 45,156	91,989
5	27,579 ~ 86,381	183,147
6	21,135 ~ 85,300	176,975
7	9,733 ~ 44,379	89,113
8	14,160 ~ 50,676	110,867
9	25,560 ~ 141,633	322,239
10	25,560 ~ 141,634	322,240
11	5,659 ~ 49,989	79,340
12	5,420 ~ 16,877	22,416
13	10,677 ~ 32,725	43,736
14	11,780 ~ 40,639	40,639
15	5,140 ~ 19,721	19,721
16	5,438 ~ 17,308	22,896
17	10,692 ~ 33,108	44,115
18	16,600 ~ 31,436	36,934
19	3,929 ~ 10,317	10,720
20	3,804 ~ 13,015	13,015
21	9,481 ~ 11,999	16,948
22	10,090 ~ 34,851	56,198
23	4,603 ~ 12,715	20,627

bar number	Resistance (%)	Stability (%)
24	5,184 ~ 19,676	26,943
25	5,992 ~ 18,852	25,815
26	7,612 ~ 26,338	54,743
27	7,395 ~ 26,989	55,725
28	7,620 ~ 26,363	54,852
29	7,392 ~ 26,975	55,841
30	7,842 ~ 45,740	40,188
31	16,974 ~ 53,648	58,361
32	10,588 ~ 37,240	49,893
33	19,767 ~ 40,456	59,173
34	29,078 ~ 45,903	63,277
35	5,940 ~ 23,774	38,336
36	9,840 ~ 47,365	47,398
37	16,813 ~ 44,291	71,418
38	8,446 ~ 23,323	37,639
39	4,097 ~ 11,321	18,309
40	29,674 ~ 107,256	207,581
41	7,700 ~ 35,042	56,011
42	19,727 ~ 40,357	57,345
43	21,321 ~ 40,926	53,369
44	7,724 ~ 39,140	35,910
45	9,518 ~ 27,062	31,305
46	10,380 ~ 36,072	41,837