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

Release information

Diamonds 2015

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 - maillage - malla - uniones - radier

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1. System requirements

Diamonds 2015 requires CodeMeter version 5.22, so please install this new CodeMeter first.

2. Work environment

2.1. Configurations

The content of the configuration can be adjusted in two ways in Diamonds 2015:

- Either by clicking on the button (already present in previous versions of Diamonds)
- Either by clicking in the drawing field with the right mouse button (while no elements are selected)

The grid settings can be adjusted in two ways in Diamonds 2015:

- Either by clicking on the button (already present in previous versions of Diamonds)
- Either by double-clicking in the drawing field with the left mouse button (while no elements are selected)

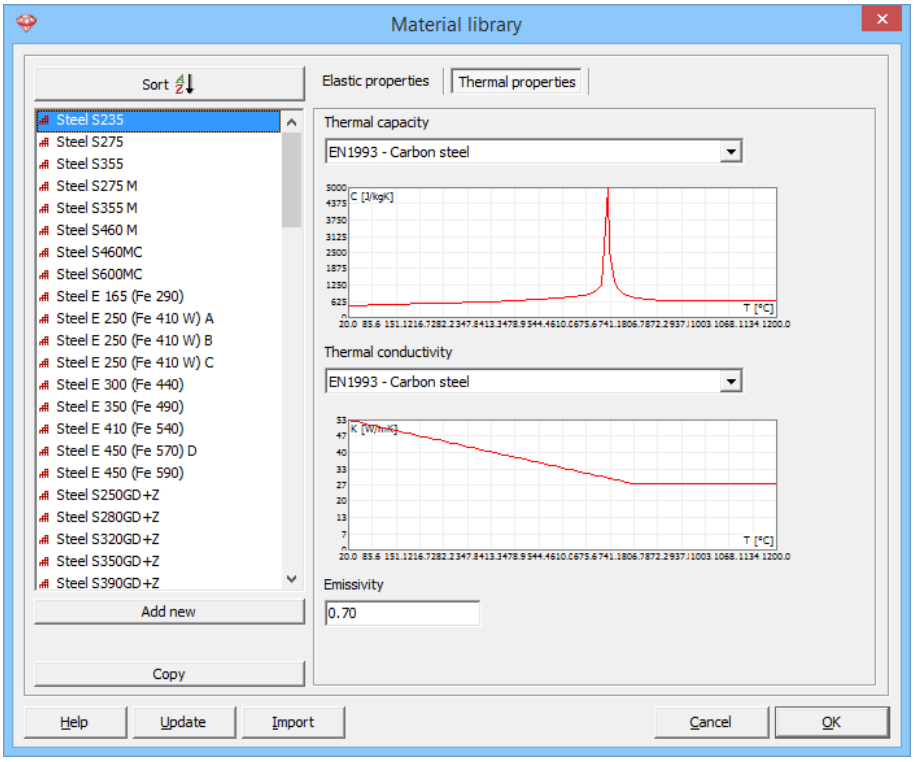
2.2. Material library

The material properties are now sorted into two tab pages:

- One with the elastic properties
- One with the thermal properties

The elastic properties are used in the structural analysis, the thermal properties are used in a thermal analysis. Among the thermal properties fall the following parameters:

- Thermal capacity
- Thermal conductivity
- Emissivity



The thermal capacity and the thermal conductivity depend on the temperature. This relation is known for all default materials in the standard library (recognizable through the BuildSoft icon in front). For concrete these two properties depend also on the concrete composition.

Note: if you wish to perform a fire analysis, you need to update the material library to add the thermal properties to the existing materials!

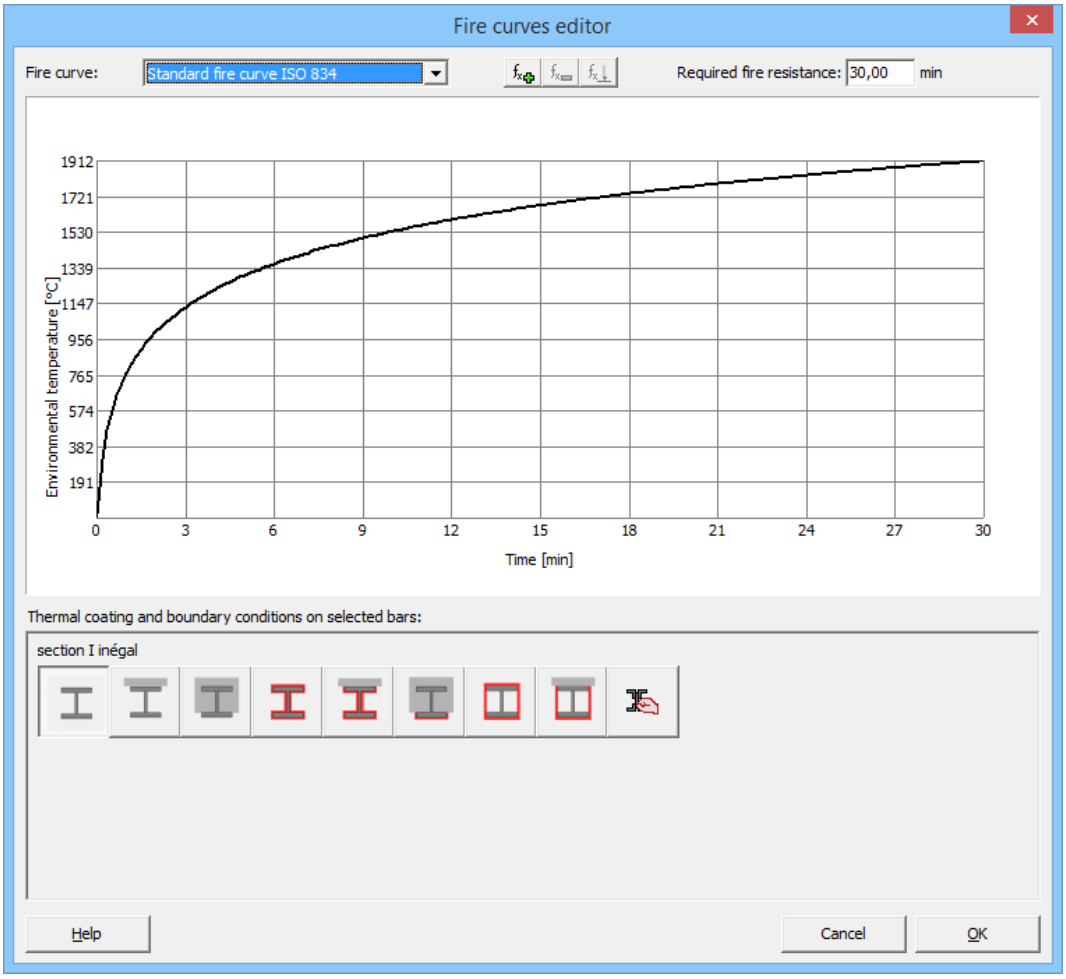
- **Go to 'Edit' in the tool bar**
- **Choose 'Material Library'**
- **Click on the button 'Update'**
- **Select the option 'Replace my library by default library' and hit 'OK'**

3. Geometry

3.1. Definition of fire curve and fire protection

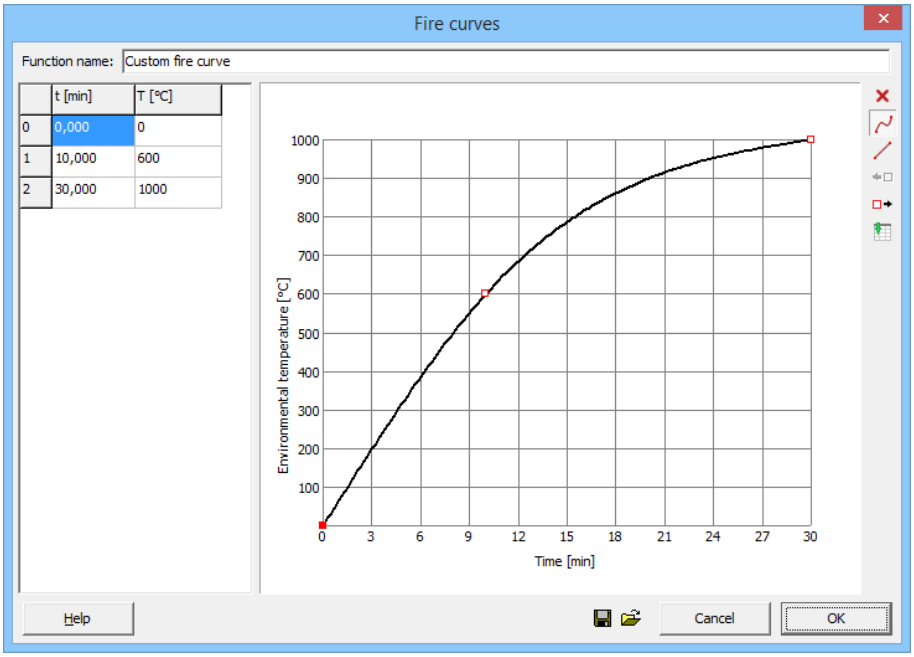
To define a fire curve, follow these steps:

1. Go the geometry configuration
2. Select the bar on which the fire load takes action.
3. Click on the button . You'll see the following window:



4. From the pull down list on the left top, you can choose between a number of predefined fire curves (see EN 1991-1-2 §3.2), namely:

    - The standard fire curve (ISO 834)
    - External fire curve
    - Hydrocarbon fire curve
    - User-defined fire curve:
        - Click on . This dialog will appear:

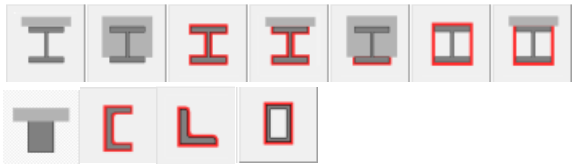


- Name the fire curve.
- Define the function by dragging the red points.
  - deletes a point
  - 'fluent' interpolation between points. The points are being connected through a cubic spline.
  - linear interpolation between points. The points are being connected through straight.
  - adds a point, before the current and half way with the previous one.
  - adds a point, after the current and half way with the next one.
  - pastes an external table with value from the clipboard. In an external table (for example MS Excel), you need to have 2 columns: one with the time values and a second one with the temperatures. Select both columns with values and copy these to the clipboard (via CTRL+C) and paste the values in Diamonds with .
- With the buttons and you can import or export a fire curve.

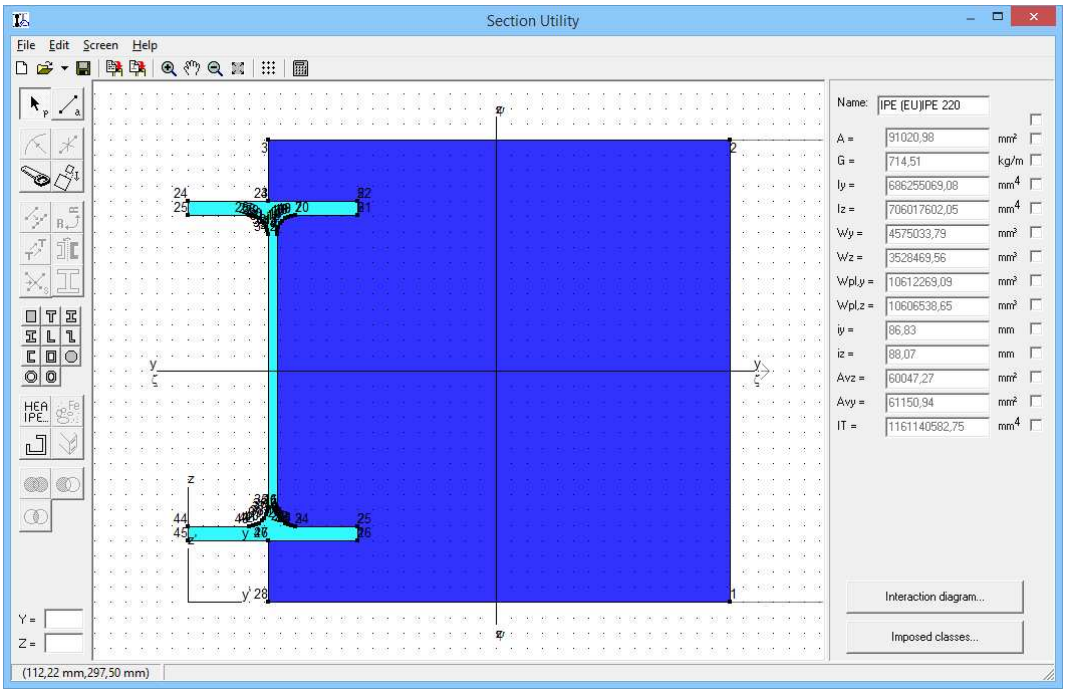
- Click to remove a self-defined fire curve.
- Click to edit a self-defined fire curve.

5. Enter the required fire resistance [min].
6. Choose the fire protection. You can choose between:

- An unprotected section
- A protected section according to common standard cases. Select the desired case by clicking on it.



- A protected section for which you define the protection yourself.
  - Click . A window opens allowing you to make multiple versions of one section in Section Utility.
  - Add a section with , remove a section with and use to edit a user defined profile in Section Utility.

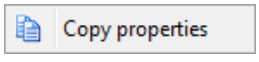


To remove the fire curve from a line:

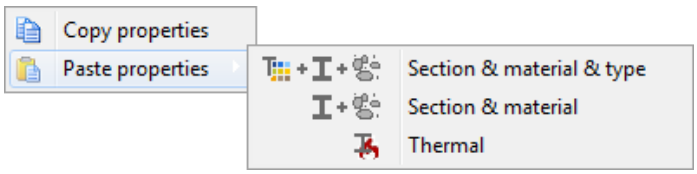
- Select the line.
- Click on .
- Choose as fire curve ‘No fire curve’.

If you wish you copy the section properties, material, supports, type or thermal properties to another element, proceed as follows:

- Select the object with properties to copy
- Click the right mouse button followed by ‘Copy properties’



- Select the elements to paste the properties
- Click the right mouse button, then ‘Paste properties’ and choose the correct option:



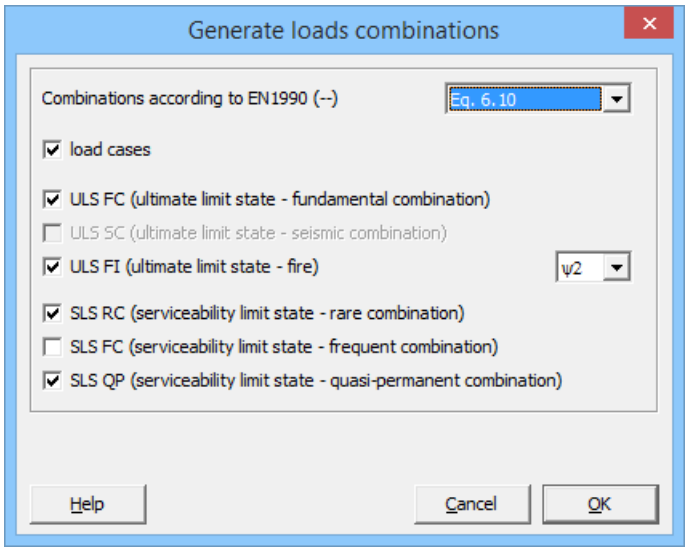
If you copy elements with fire load via , the fire load will be copied too.

Notes:

- A fire curve on a bar without section or material has no meaning.
- A fire curve can only act on bars, not on plates.
- A fire curve and fire resistance [min] are linked to one or more bars, not to the project. So, one project can contain multiple bars that are subject to different fire curves and require different fire resistances.
- Calculating a model with a fire load/curve, requires the license 'Fire safety analysis'.

4. Loads

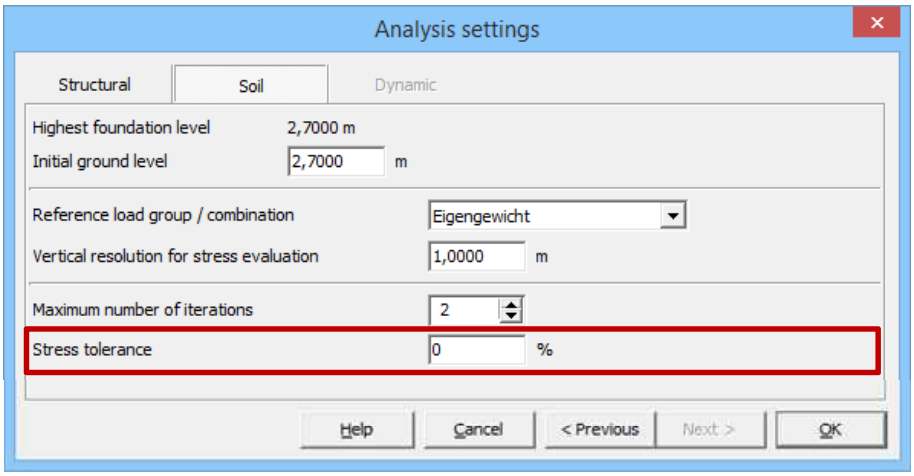
4.1. Generation of the load combinations



Due to the presence of a fire hazard, you can now generate the combinations for the ultimate limit state fire ULS FI. More information is given in EN 1991-1 §6.4.3.3.

5. Analysis

5.1. Soil calculation



In the tab page 'Soil' the option 'Stress tolerance' is added. This option allows you to end the soil calculations at a certain depth z for which the specified accuracy for $\frac{\Delta p}{p}$ is reached:

- Δp is the effective vertical stress increase at depth z as a result of the surface load
- p is the original effective vertical stress at depth z

Notes:

- According to EN 1997-1-1 §6.6.2. (5) and (6) you may use a tolerance of 20%.
- Soil investigation firms usually use a tolerance of 10% for the calculation of the soil settlement.

5.2. Fire

To perform a fire analysis, follow these steps (the order is important):

- Draw the geometry of the structure as usual
- Define the fire curves (see 3.1)
- Calculate the response
    - Thermal response (see §5.2.1)
    - Elastic response
        - Generate the combinations (see §4.1)
        - Global elastic analysis (or F9)
- Verification (at the moment only available for steel) (see §6.1.2)

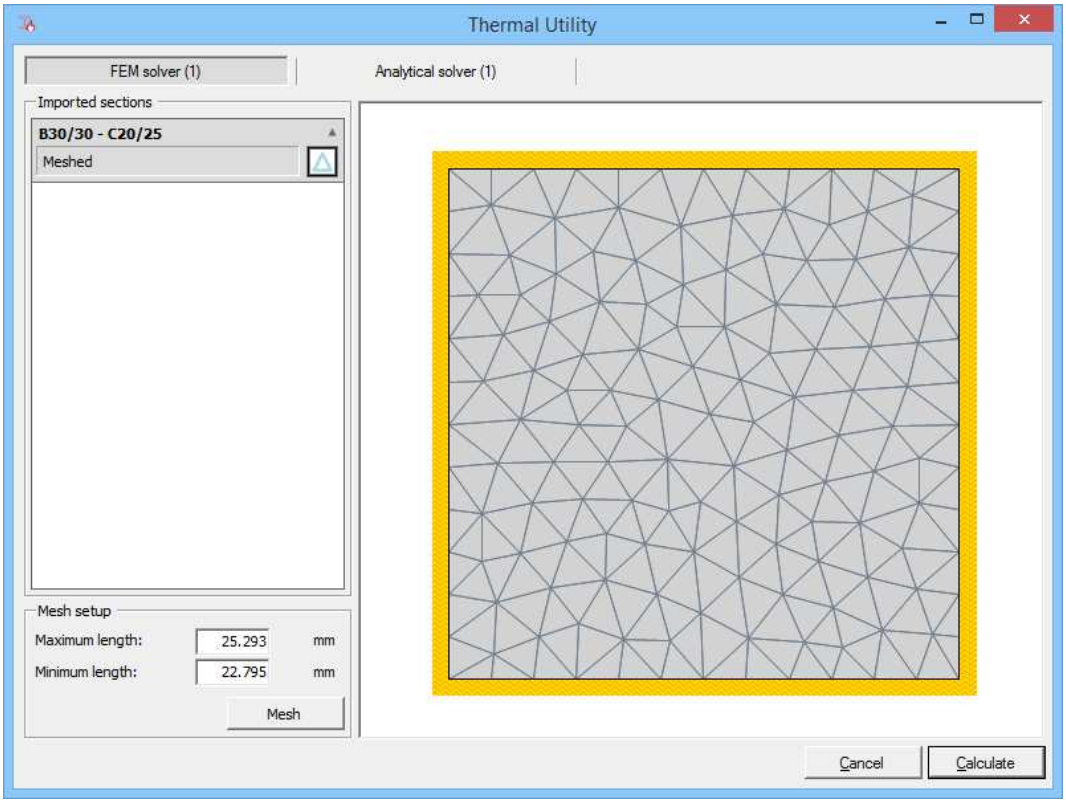
Notes:

- More information about the thermal calculations can be found in the document about EN 199x-1-2 on the Buildsoft website → Support → About Eurocodes.
- When importing a PowerFrame model it is recommended to redefine the fire load and vice versa.

5.2.1. Thermal response calculation

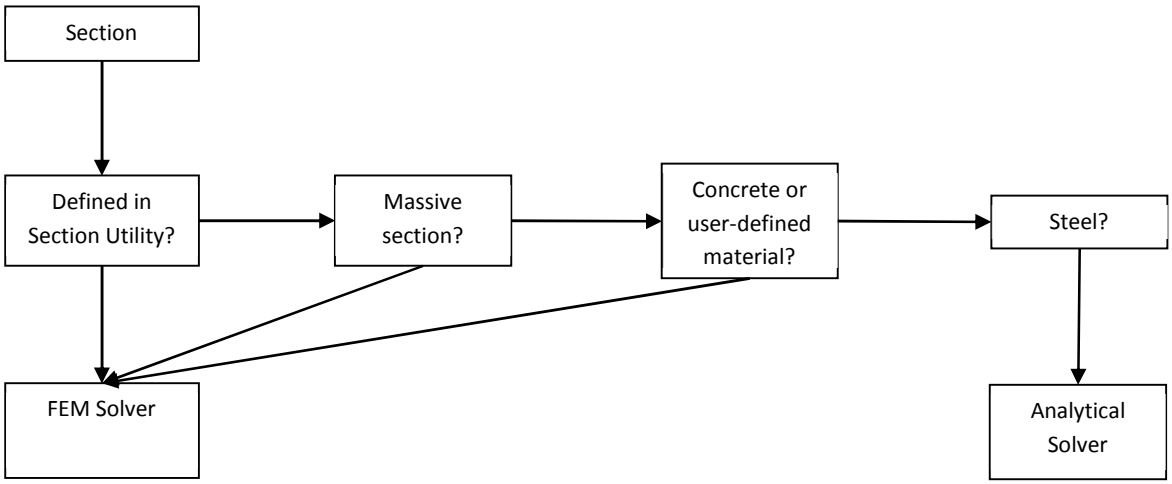
A fire load will result in an increase the temperature of the cross section. A thermal response calculation will calculate this increase.

Click on the button to open the thermal response window.

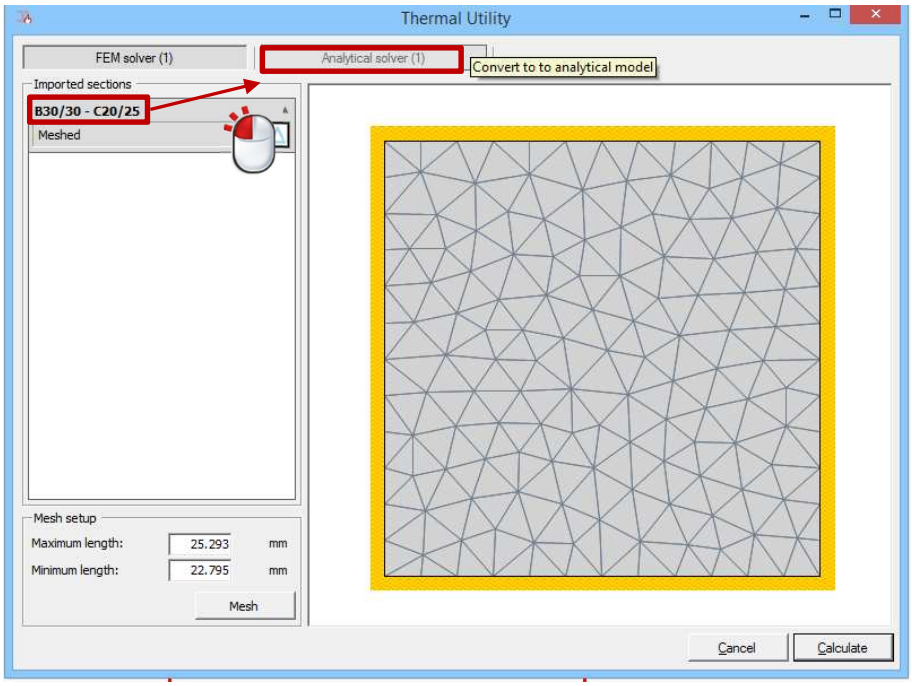


- At the top, there are two tab pages: 'FEM solver' and 'Analytical solver'.
    - FEM solver
        - will be solved with FEM (Finite Element Method)
        - is adequate for massive cross-section (usually in concrete)
    - Analytical solver
        - will be solved with the formulas of EN 1993-1-2
        - is adequate for slender sections (steel)

  Diamonds will determine automatically whether a section should be calculated using the analytical solver or FEM solver with following scheme:



You can, if you wish to, convert a FEM case to an analytical case and visa versa. This can be done by dragging the profile by its name to the desired solver.



If the project has multiple bars having a fire load, all fire cases will be grouped per section and underneath the different boundary conditions.
The section border marked in yellow/orange are subjected to fire load.

Remarks:

- The analytical solver is not adequate to calculate massive sections!
- Not all FEM cases can be converted to an analytical case and the other way around. If it is not possible to convert, Diamonds will display a message.

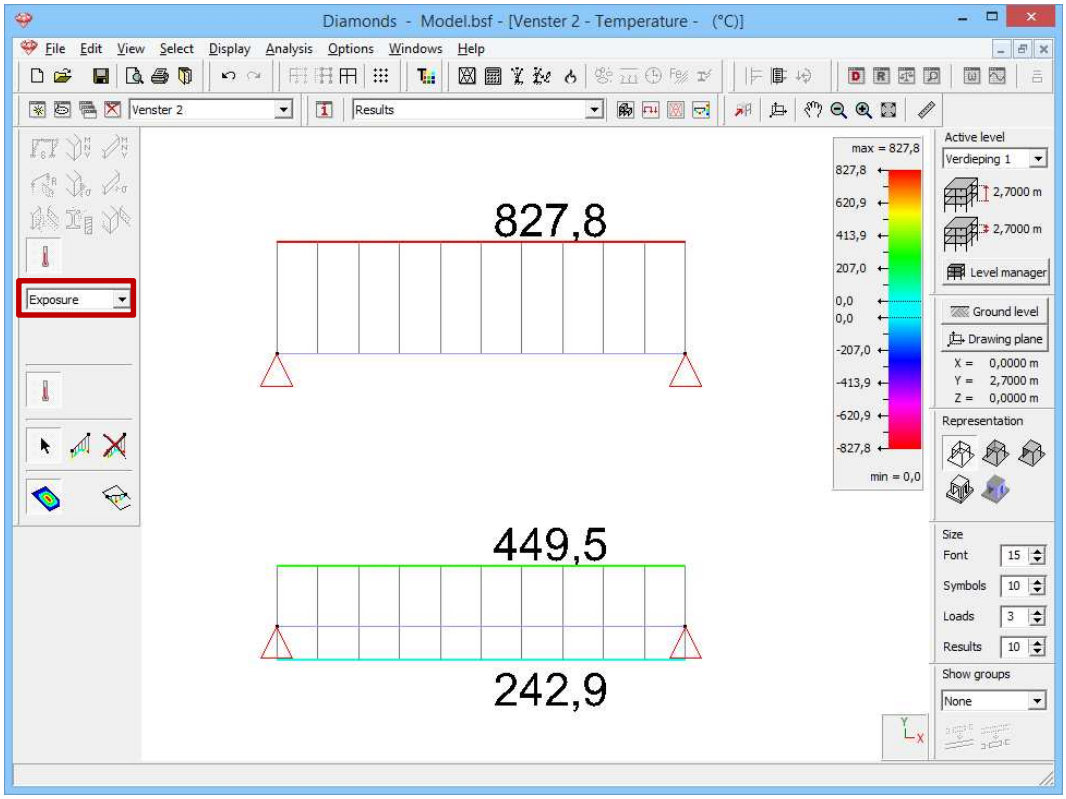
- An internal algorithm will calculate an appropriate **mesh**. The proposed values are in most of the cases just fine, so do not need to alter it. Only for cross section with a lot of difference

between the width of the parts, you could decide to adjust the mesh in order to obtain a proper distributed mesh.

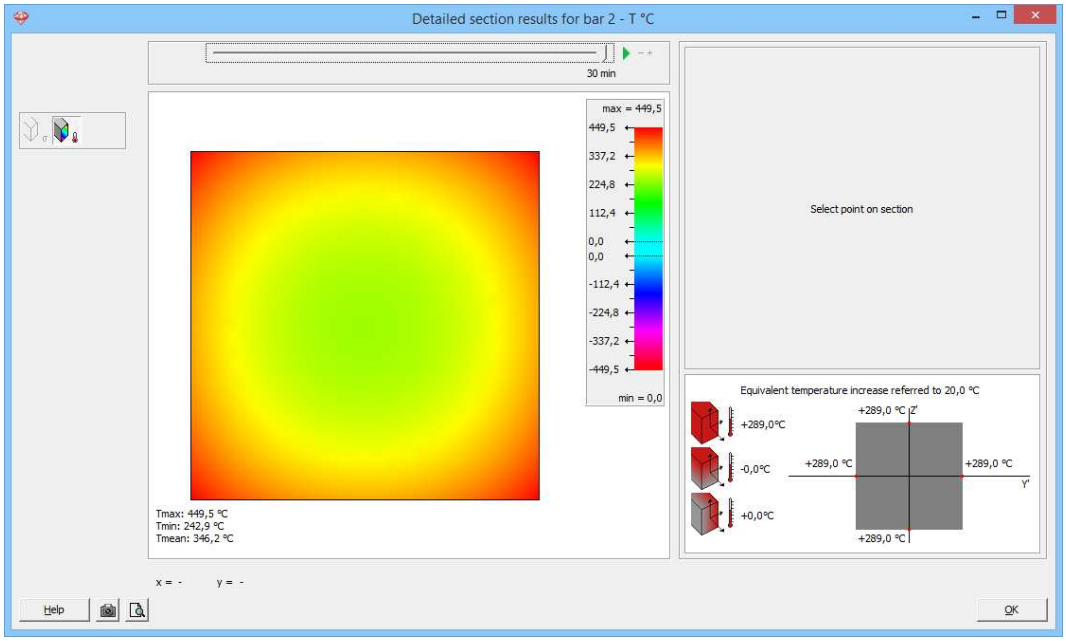
- Click to quite the calculations.

5.2.2. Thermal results

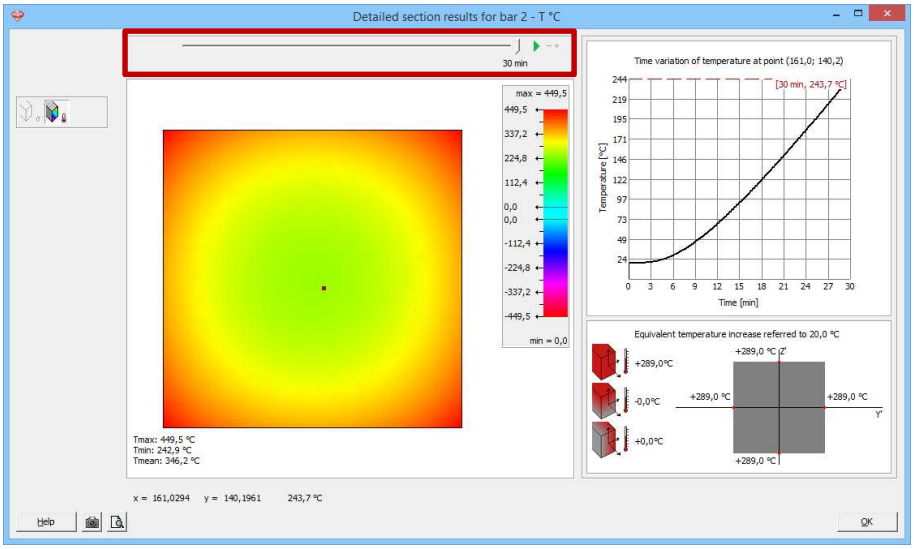
The results of the thermal calculation can be viewed in the results window with .



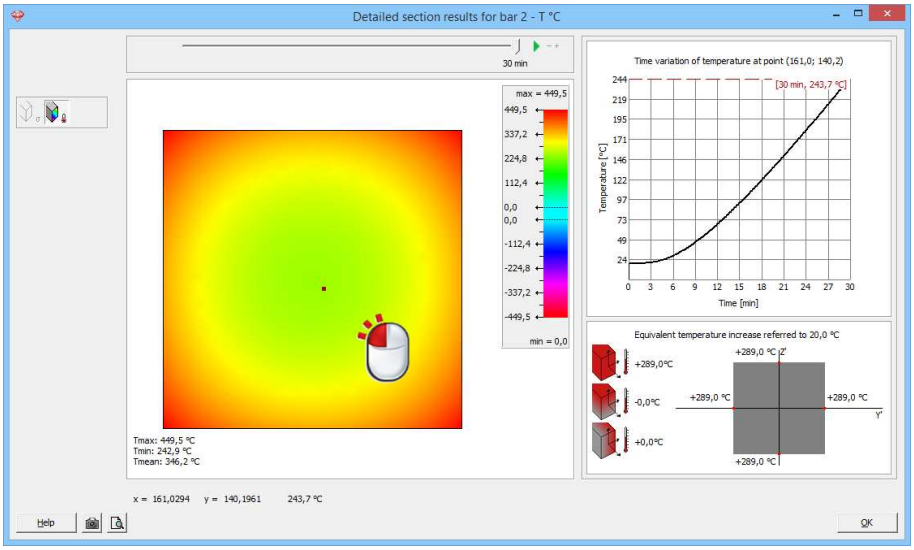
- The pull down list allows you to visualize the temperature in function of time for all elements. Diamonds will show the maximum temperature and minimum temperature (if relevant).
- Double-click on a bar to see the detail section thermal results:



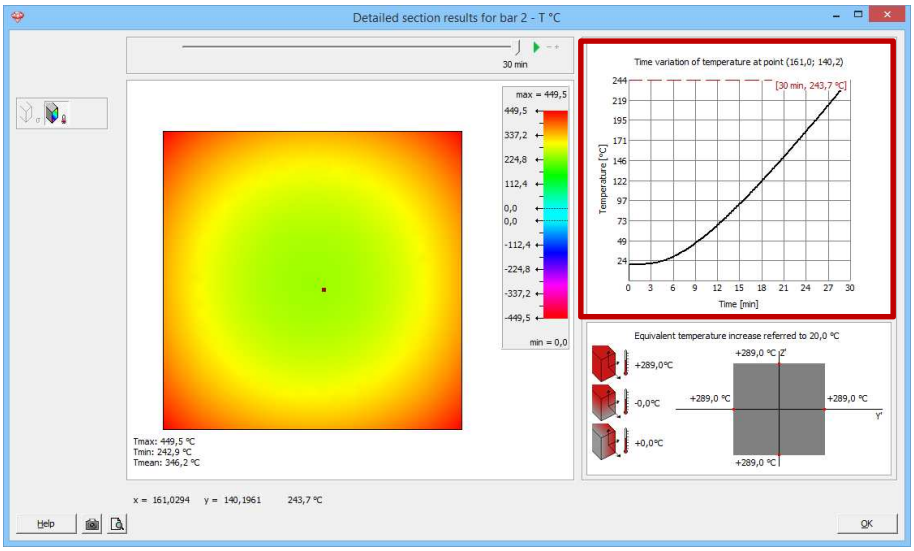
- Move the slider to see the temperature after x minutes. Press ▶ to play an animation of the temperature over time. Use ■ to stop the animation. With the buttons − and + you can accelerate or decelerate the animation.



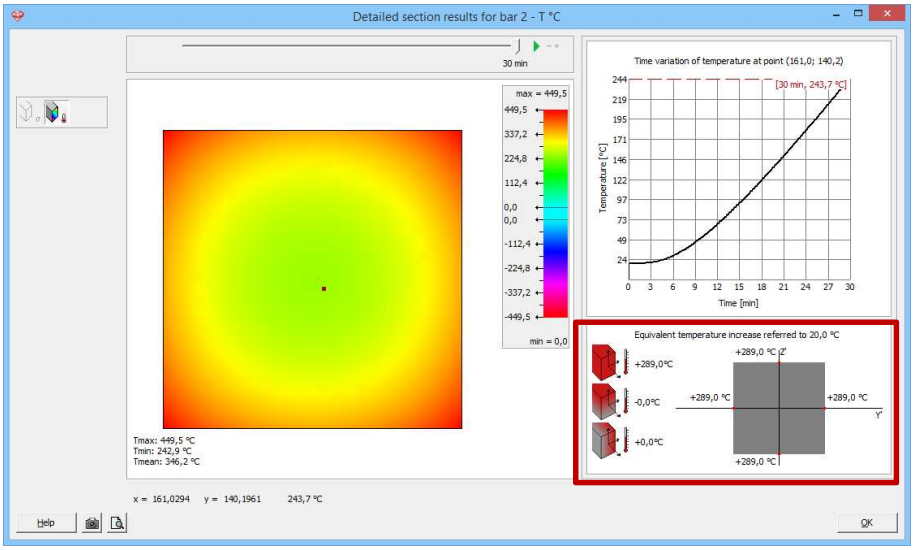
- Move the mouse over the section to see the temperature in function of the time on a certain position. Enter ‘x’ and ‘y’ coordinates to show the temperature at a point of your choice.



- On the right top side you see the temperature variation in function of time.



- On the right bottom side, you see the temperature gradient and the global temperature change resulting in the same thermal deformations as the calculated fire effect at a given time. This is particular interesting when you want to model the fire load as a thermal load.



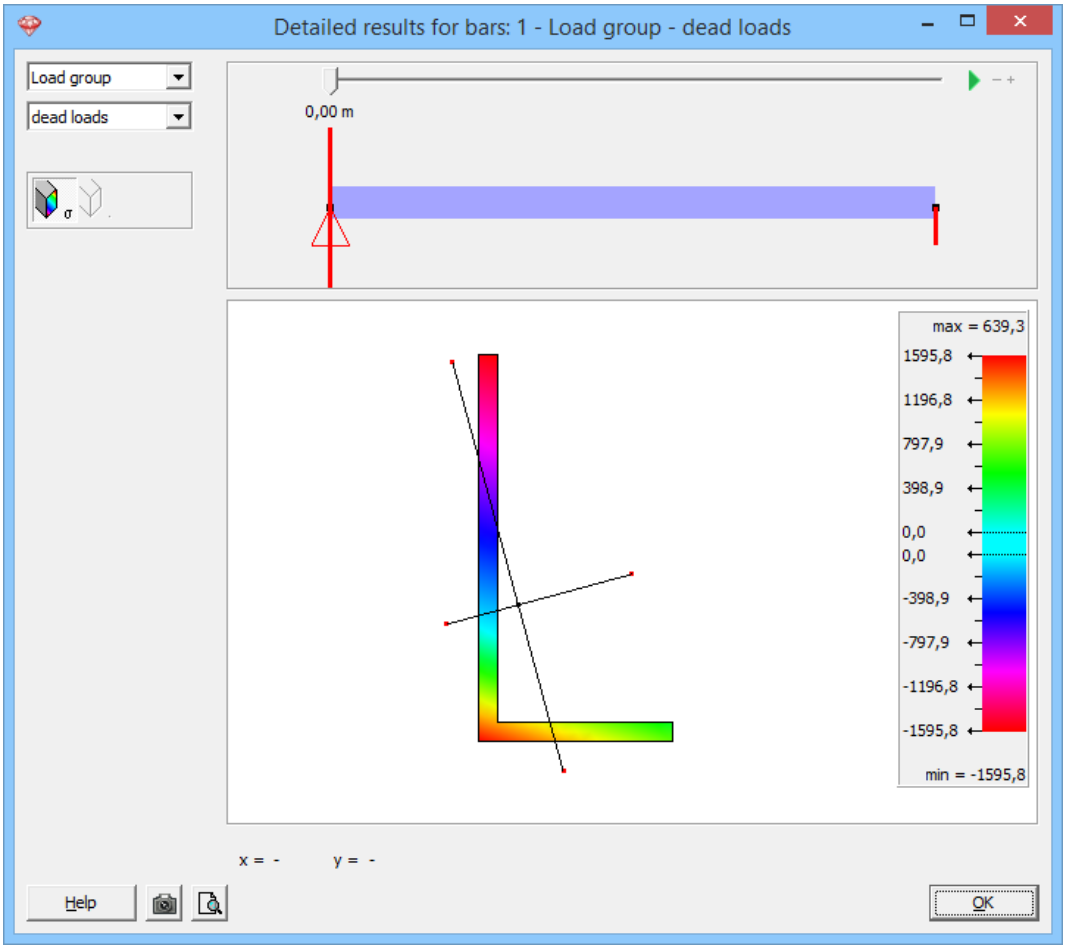
- With the button you make a print screen of the section with the temperature scale.
- With the button you make a print preview of the section with the temperature scale.

5.3. Detailed window for stresses

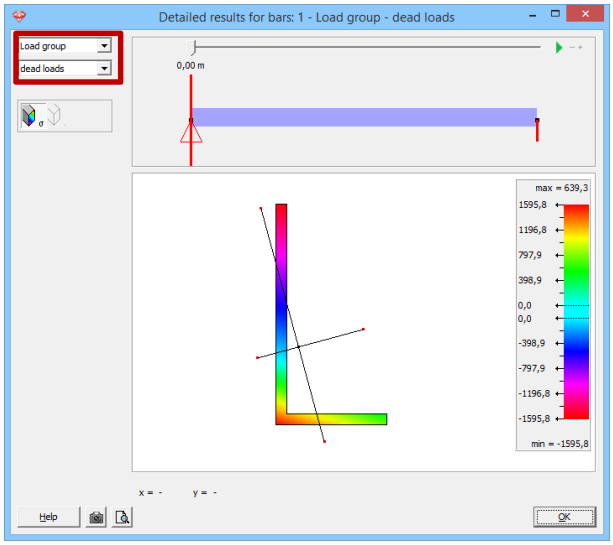
A detailed view of the stresses in a section can be obtained by:

- Either double-clicking a bar while having the results for the stresses visible
- Either by selecting a bar and clicking on in the tool bar, while having the results for the stresses visible

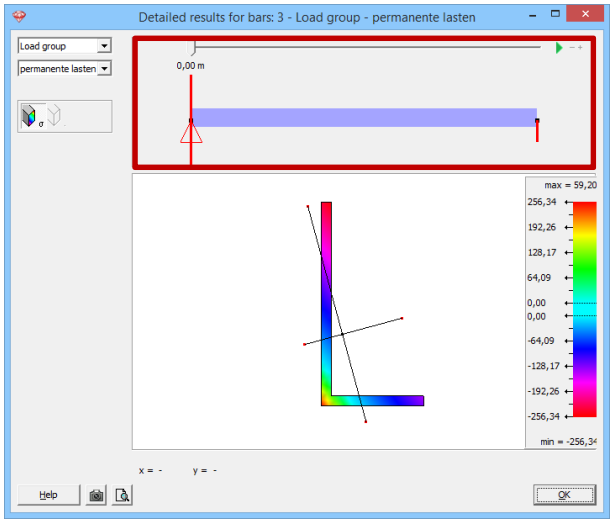
You will see following window:



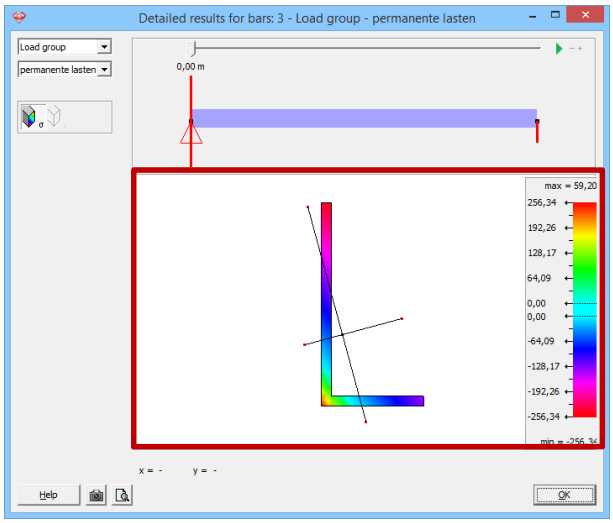
- Choose on the left top for which load group or load combination you would like to see the stresses.



- With the slider on top of the window you can set the section for which you would like to see a detail of the stresses. By clicking on the distance below the slider, you can enter a position of your choice. The play button ▶ allows you to walk automatically along the length of the bar while showing the stresses in the section for each position. Use ■ to stop the animation. With the buttons − and + you can go back or forward.



- Results field with scale



  - In the results field the selected profile is graphically represented together with its principal axes of inertia. When a cross section is double symmetric, these axes will coincide with the local axes.
  - On the principal axes you'll see red points. These are the points for which the stress results ($N + M_y$ and $N + M_z$) are presented in the global results window of Diamonds. The position of these points is determined as the intersection of the principal axes with the cross section's bounding box.
    When you come near these red points with the cursor, Diamonds will snap to them.
  - Move the mouse over the section to see the stresses at the desired place. Enter 'x' and 'y' coordinates to show the stresses at a point of your choice.
  - The stresses you find in this window are based on $N + M_y + M_z$
  - Compression is negative, tension is positive.
- With the button you can make a print screen of the results field.
- With the button you can make a print preview of the results field.

6. Design

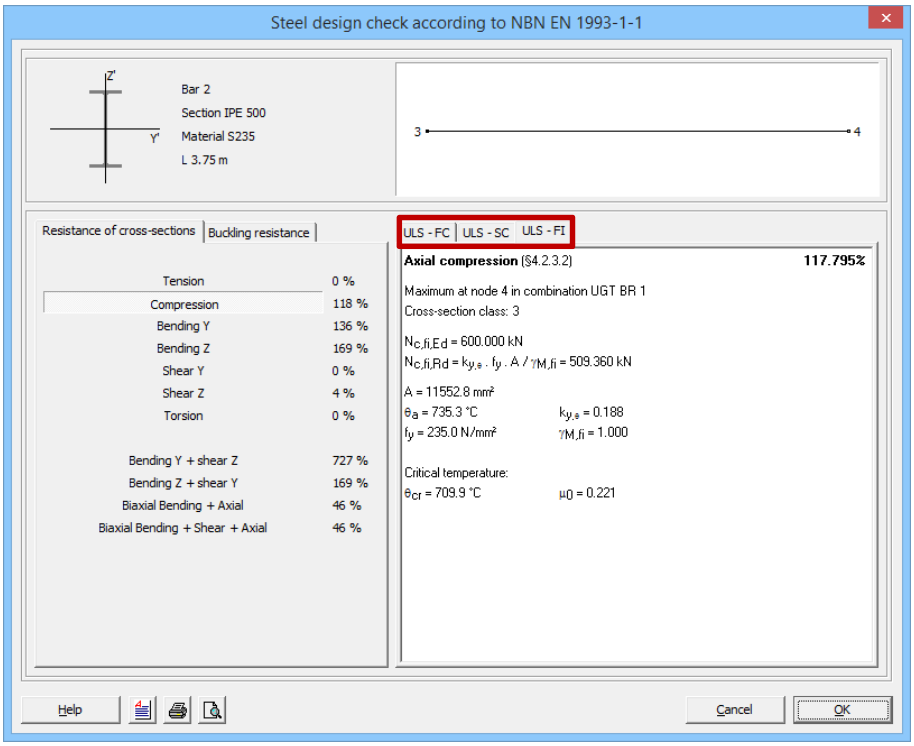
6.1. Steel

6.1.1. Optimization of steel verification speed

In Diamonds 2015 the speed of the steel verification is significantly improved.

6.1.2. Steel verification with fire

When a fire load and the associated combinations are present in a model, Diamonds will perform he steel verification for all ULS combinations. The results are shown in separate tab pages:



In addition to the detailed calculation steps of the steel check, you also can find the critical steel temperature. This is the temperature at which the profile is working at 100% of its capacity.

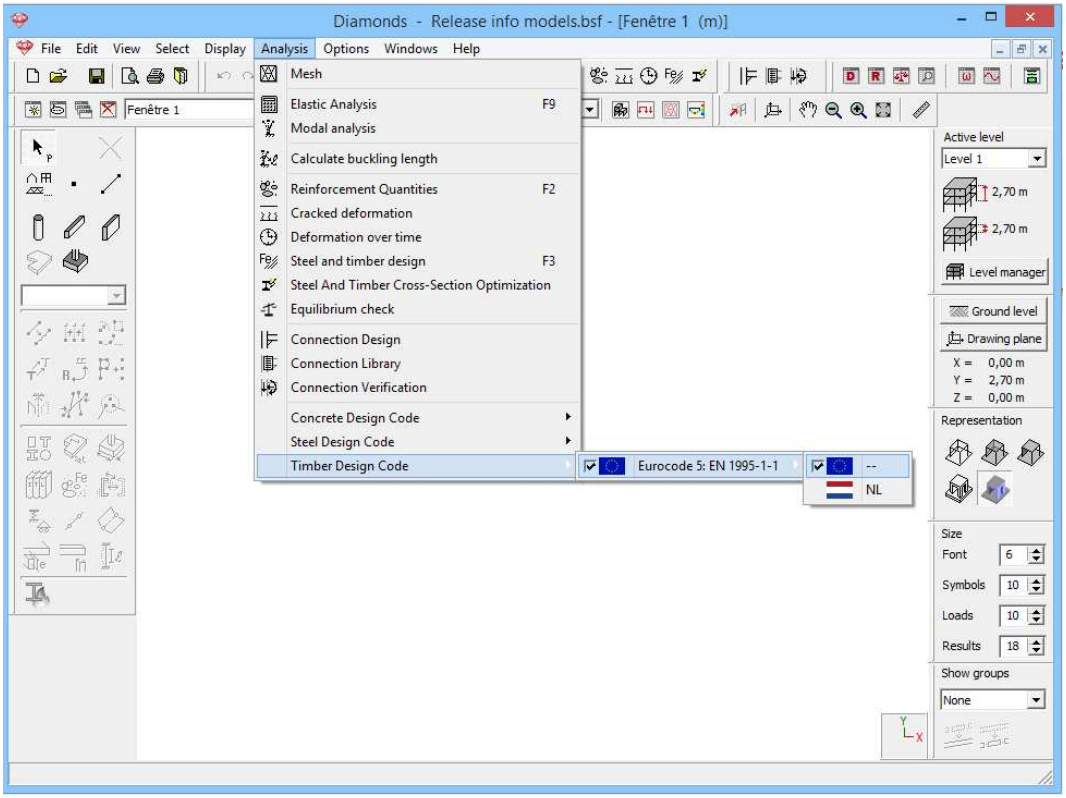
Note: the check 'Biaxial bending + compression' in the tab ‘stability’ is only relevant for combinations ULS FI, in other words, if a fire load is present on the bar.

6.2. Concrete

Reinforcement calculation taking into account fire combinations is expected in Diamonds 2016.

6.3. Timber

In Diamonds 2015 you can perform a timber verification according to EN 1995-1-1 plus the national annex of The Netherlands. Go to 'Analysis' → 'Timber standard' and choose the relevant annex:



Notes:

- Regarding the implemented calculation in Diamonds there's no difference between the Belgian annex and the main EN 1995 itself. So for Belgium you choose '- -'.
- Performing a timber verification while taking into account the fire combinations is not (yet) possible.

6.4. Connections

Welded box connections between open (I of H-profile) and closed sections (RHS, SHS and CHS) can be transfered from Diamonds to PowerConnect.

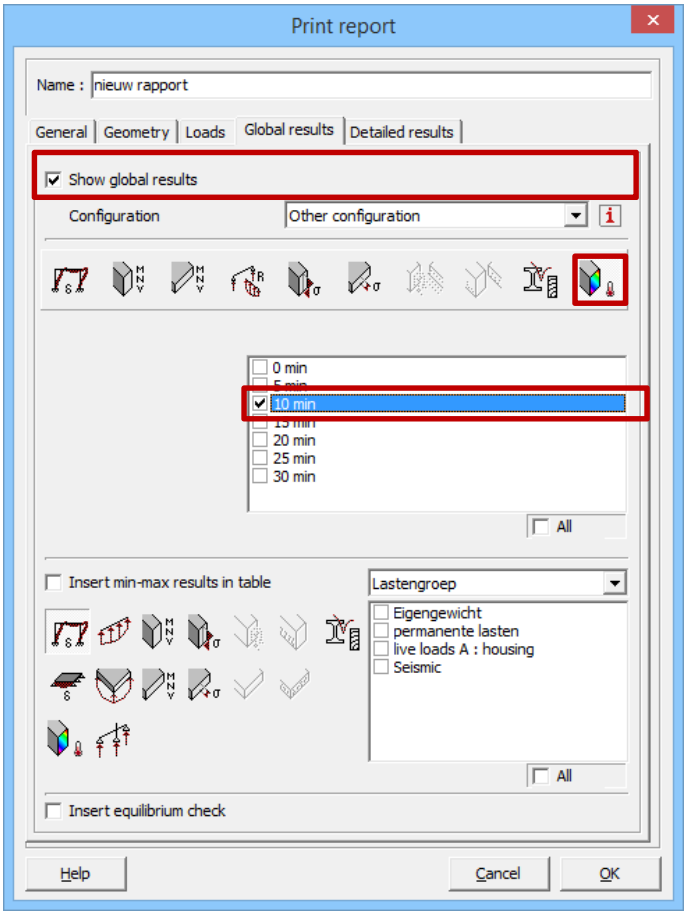
7. Report manager

7.1. Tab page 'Geometry'

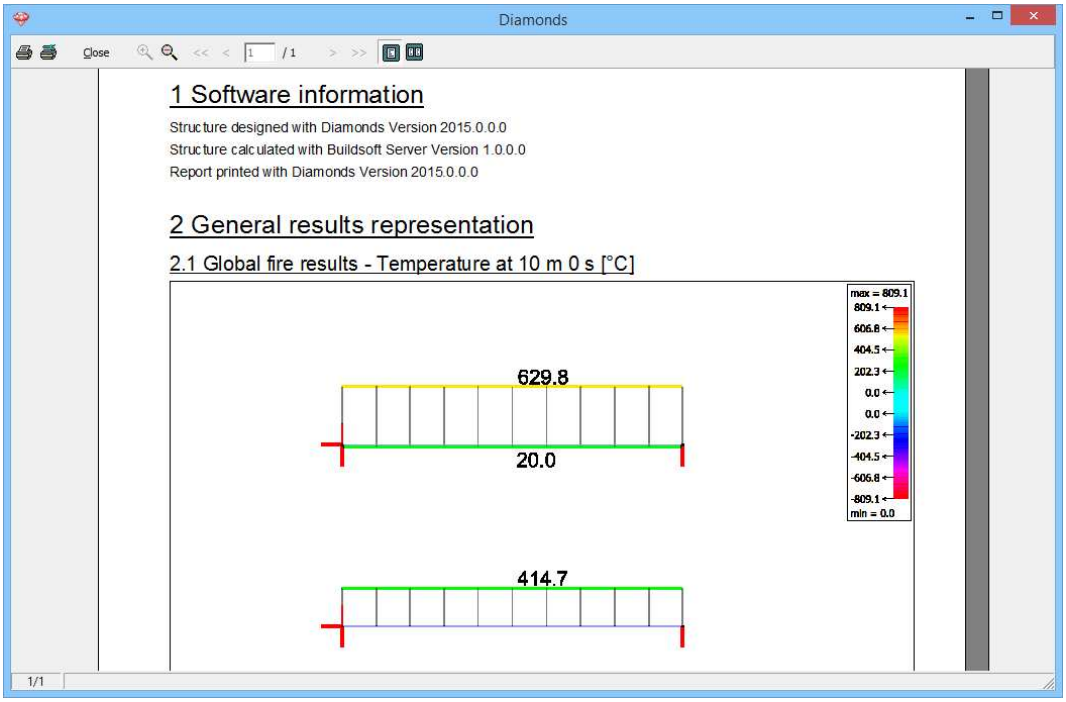
When printing the material properties, both the elastic and thermal characteristics will be printed.

7.2. Tab page ‘Global results’

In the tab page ‘Global results’, you can request a print of the temperatures in the global results window.



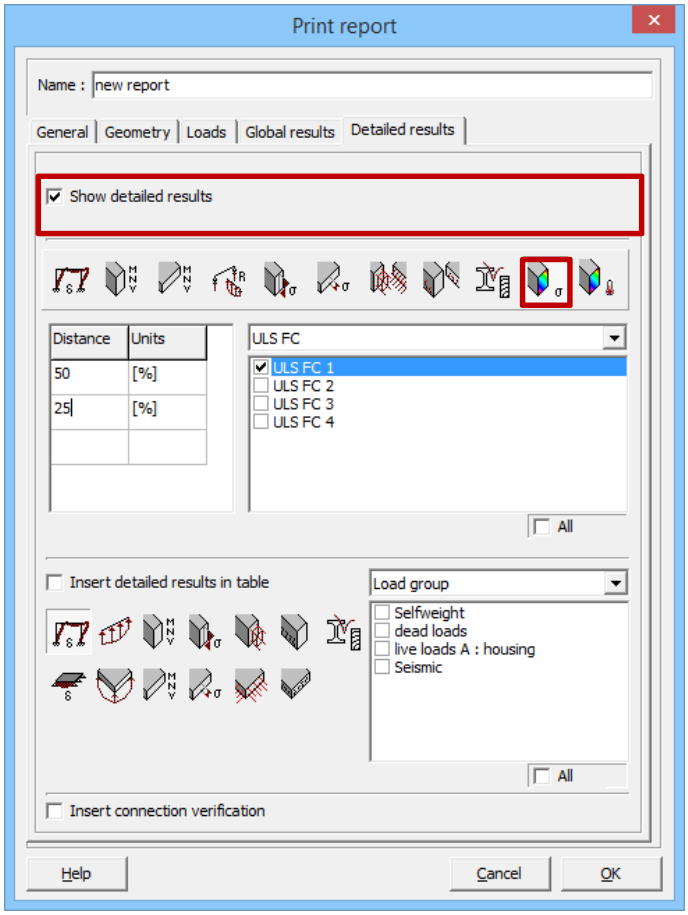
Result:



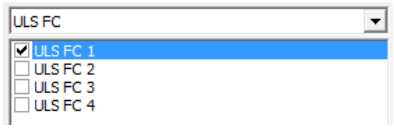
7.3. Tab page 'Detailed results'

7.3.1. Stresses

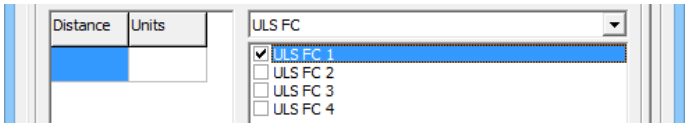
In the tab page 'Detailed results', you can request a print of the stresses in detailed section results window.



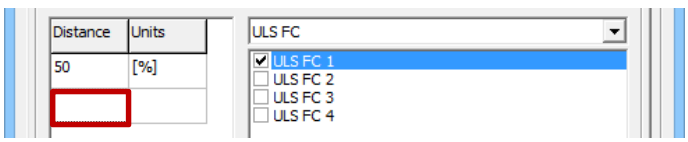
- Check for which load combination you want to see the stresses.



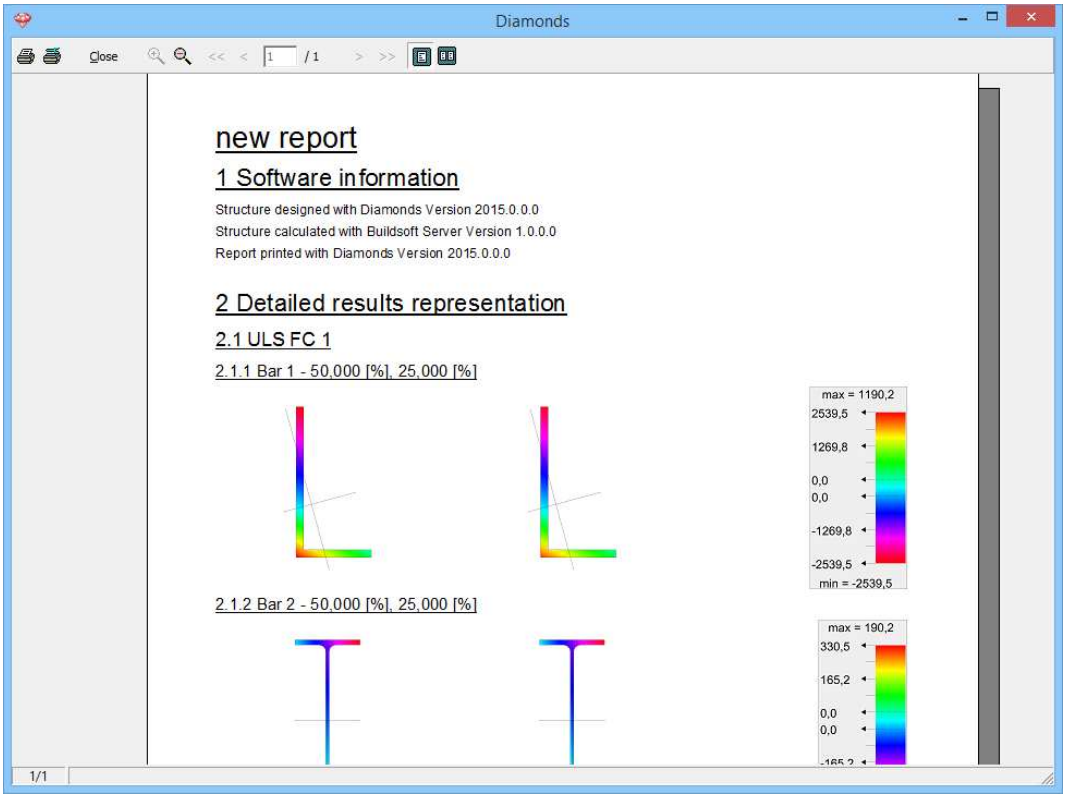
- Enter a distance to set the position for the results

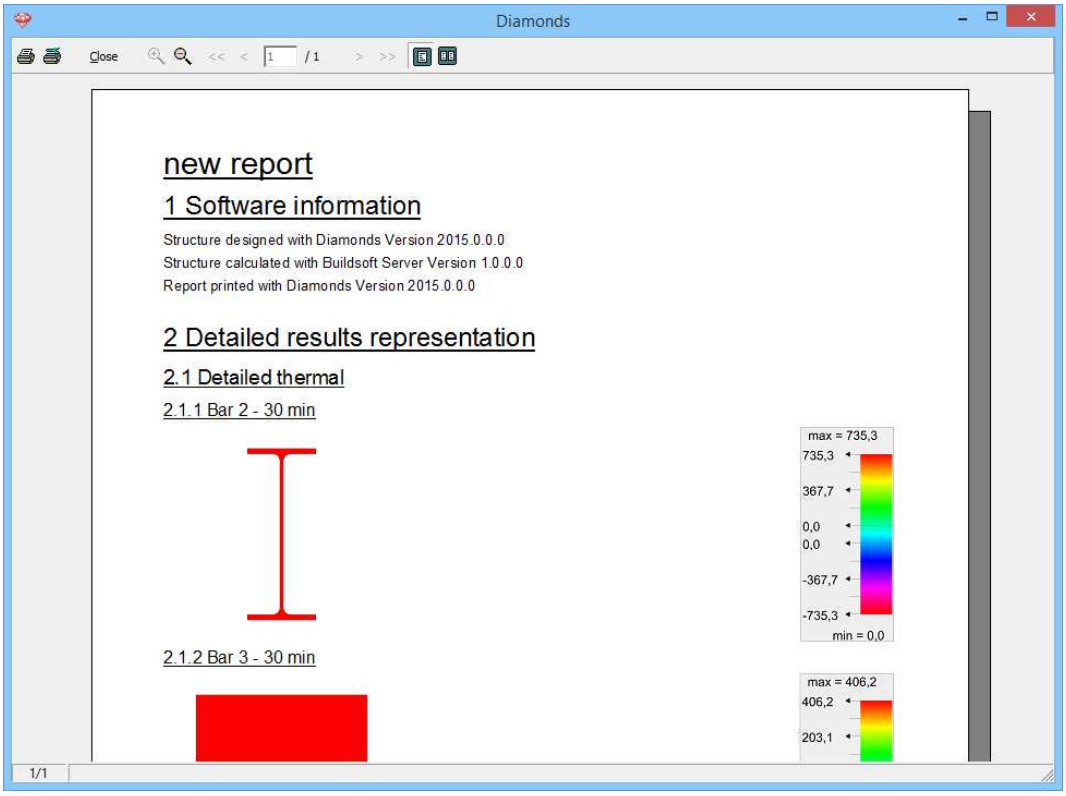


  - In the column ‘Units’, you can switch between an absolute distance [m] or a relative distance [%]
  - In the column ‘Distance’, you enter the distance, in accordance with units you have chosen
  - To report stresses at multiple positions, you just enter a distance and unit in the second row and so on. Diamonds will automatically create an extra row.



Result:



7.3.2. Thermal response

In the tab page 'Detailed results', you can request a print of the section temperature at one or multiple points of time. In order to do so, select the desired times. In the report, you will find a print with a scale of the detailed section results windows.