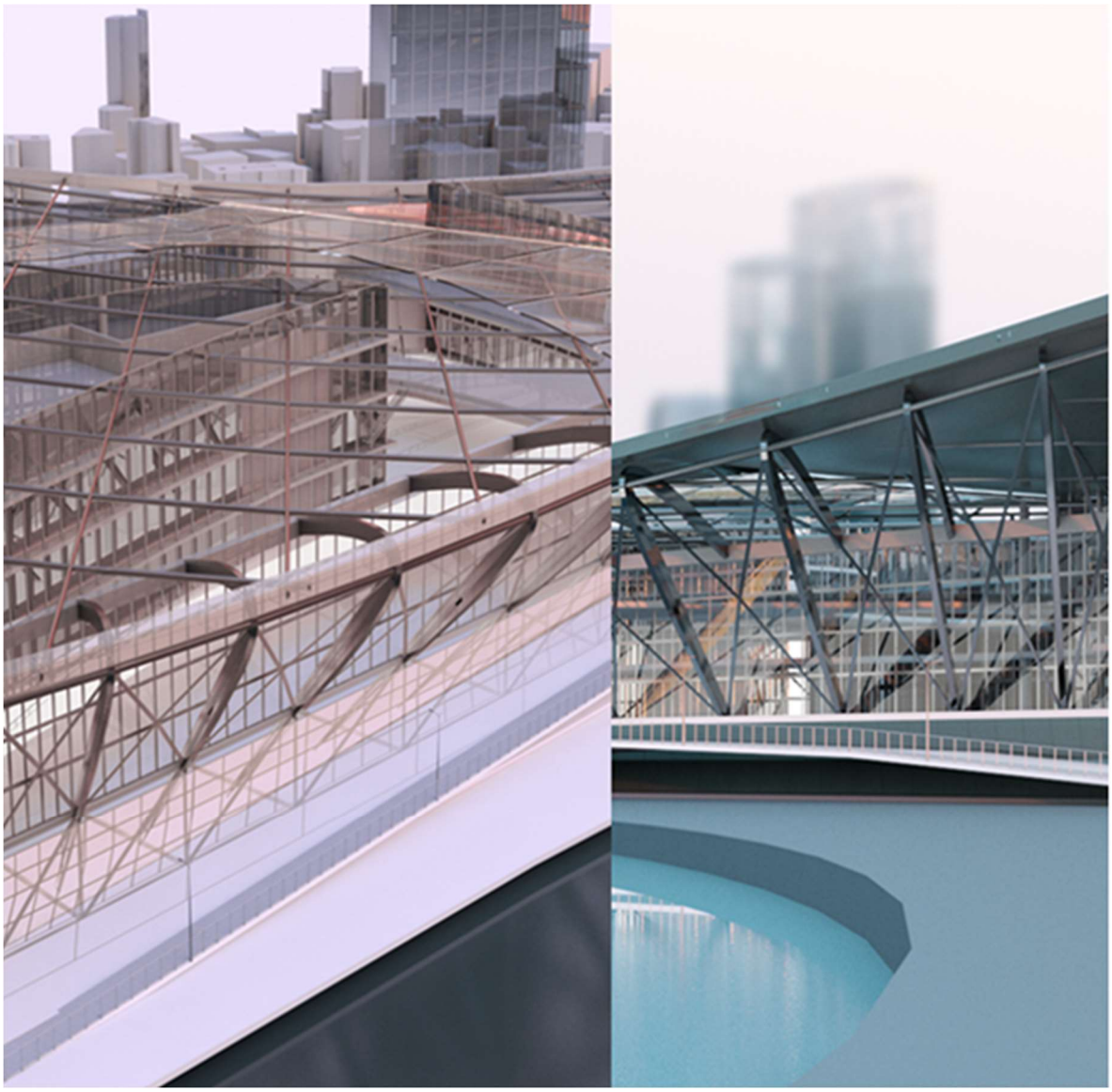
ADVANCE DESIGN

Advantages of Advance Design for Steel Users



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1. Advance Design advantages for Steel users

In terms of Modelling, analysing and optimizing the steel structures, Advance Design is a high-end solution that integrates all these processes within the same modern and easy-to-use interface. It meets the highest standards of the industry aiming to increase users' productivity and smoother workflow.

The best-in-class BIM interoperability and synchronization with Autodesk Advance Steel is also another aspect of the solution. Steel designers and detailers can easily export/import or synchronize their Advance Steel models with Advance Design which will help them to apply loads and code check or optimize the steel sections even at the preliminary stages of the project before engineers get involved.

The other benefit here is, the structural models form Advance Design can be synchronized back to Advance Steel, so detailers will have all the possible changes and modification due to structural design, automatically applied to their model using Graitec BIM connect tool.

Below we are discussing some of the main benefits of Advance Design for steel users:

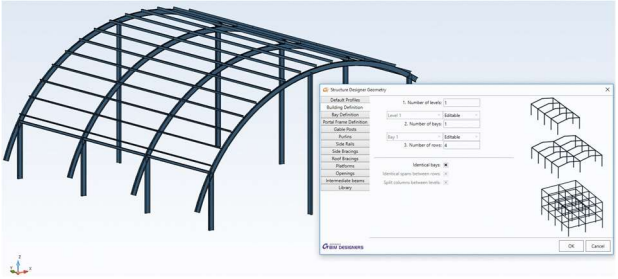
2. Support for International codes

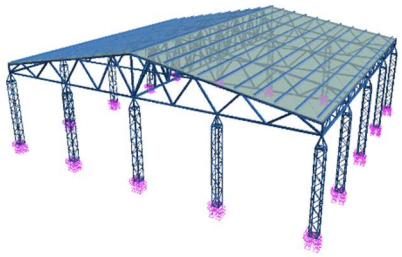
Advance Design integrates the latest Eurocode publications with several national appendixes and North American codes:

ANSI/AISC 360 (ASD & LRFD) USA
CAN/CSA S16 Canada
CM66 France
EC3 - With national Appendix for France, Great Britain, Romania, Germany, Poland, Slovakia and Czech Republic.
NTC2018 Italy

3. Fast and Easy Modelling

A complete set of modelling tools and CAD functions are available to easily model complex 3D steel structures directly in Advance Design. In addition, it is possible to automatically create trusses, portal frames and vaults which are available using the corresponding structure generator.



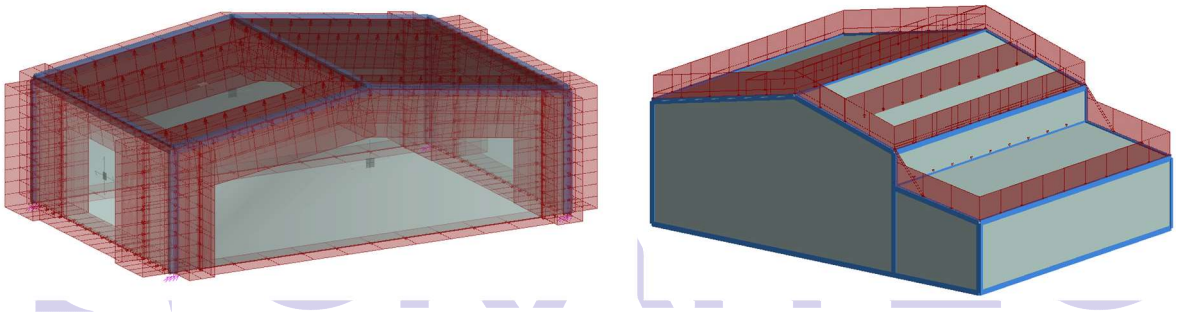


Moreover, the data grid function allows the user to customize the geometry of model elements, supports and loads, in a quick and easy way.

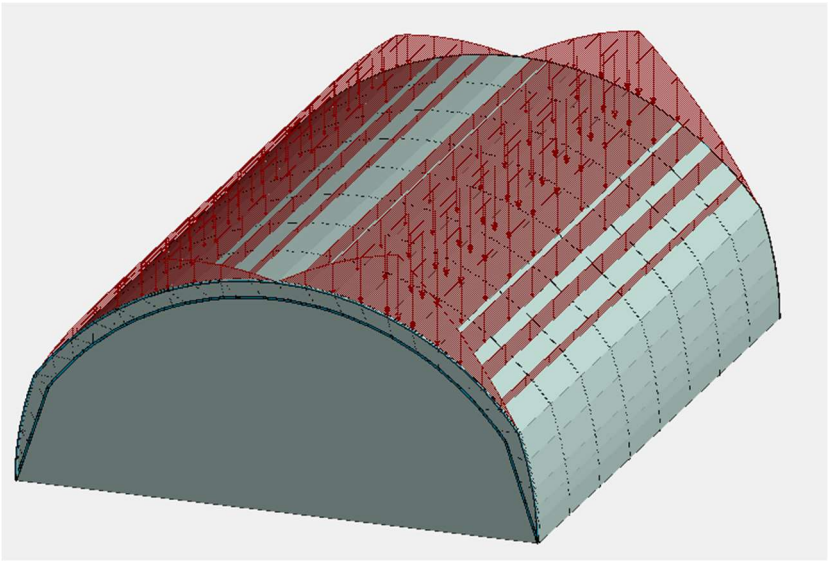
4. Climatic Loads Generator

Modelling and defining the values of all climatic loads is a time-consuming process and a source of possible errors. Using the 3d wind and snow generator in Advance design can increase your productivity by reducing the time spent calculating the loads and provide more accurate results. Advance Design also includes a crane load generator for moving loads. This new generator uses special load cases with successive vehicle positions to automatically generate loads from bridge or mono cranes.

The climatic loads generator supports various geometry types:



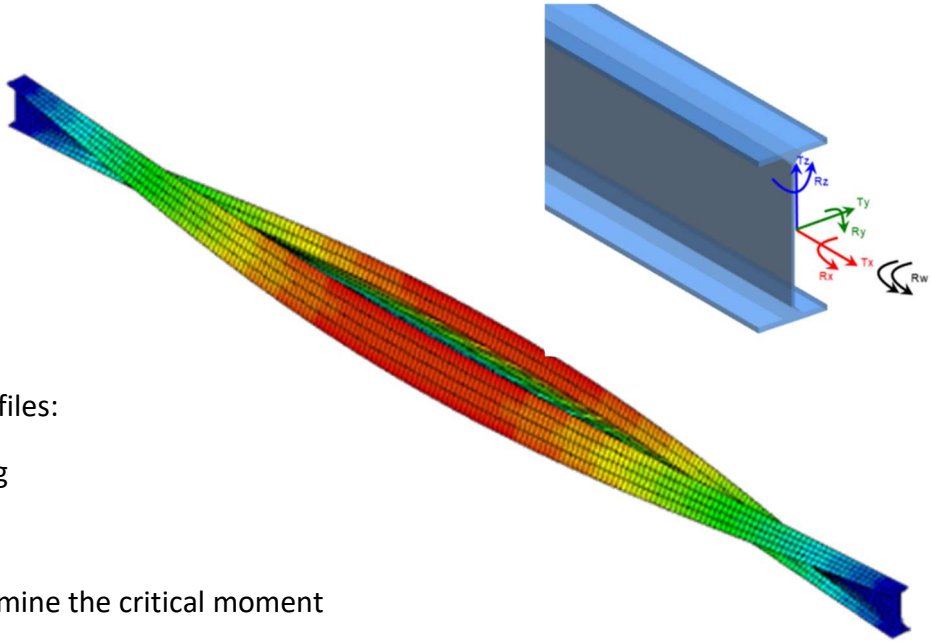
Drifted snow distribution on a vaulted roof (greenhouse)



5. Advanced stability analysis - 2nd order analysis with 7 degrees of freedom

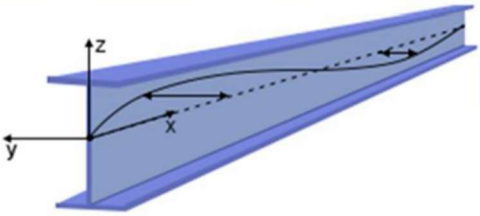
Possible for Sections:

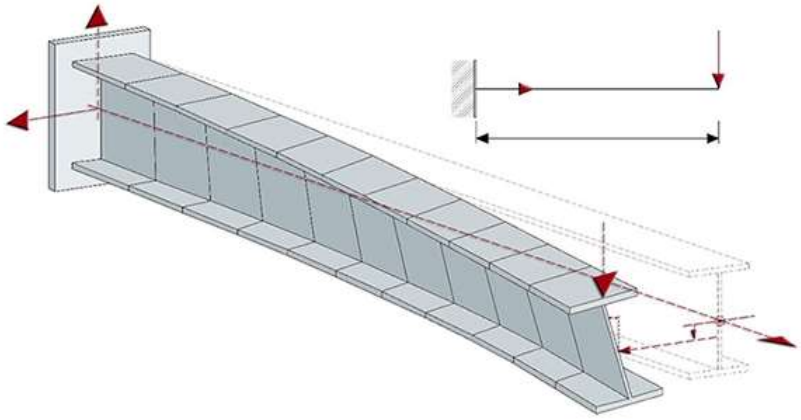
- bisymmetric
- monosymmetric
- asymmetric
- variables
- thin-walled



Especially useful for profiles:

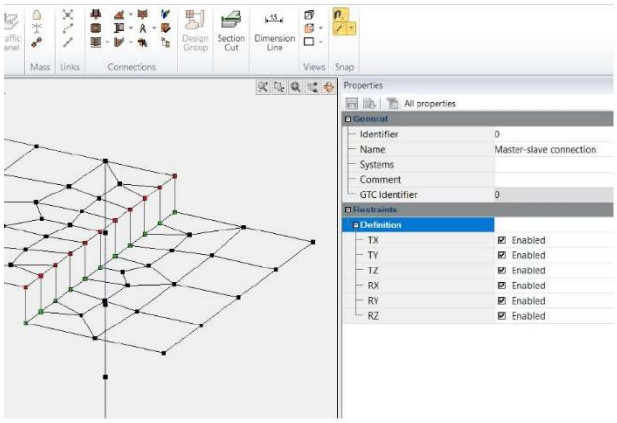
- prone to warping
- prone to torsion
- difficult to determine the critical moment

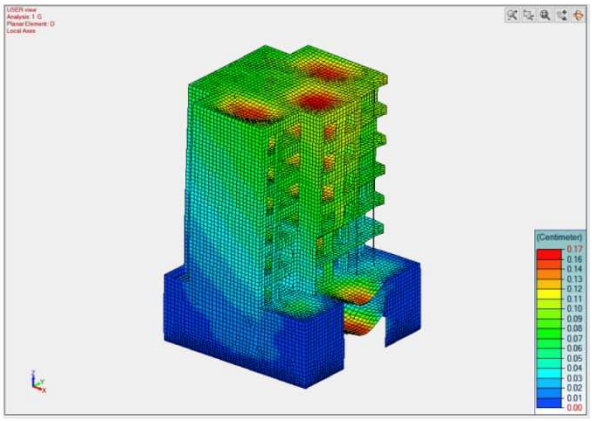




6. Seismic generator

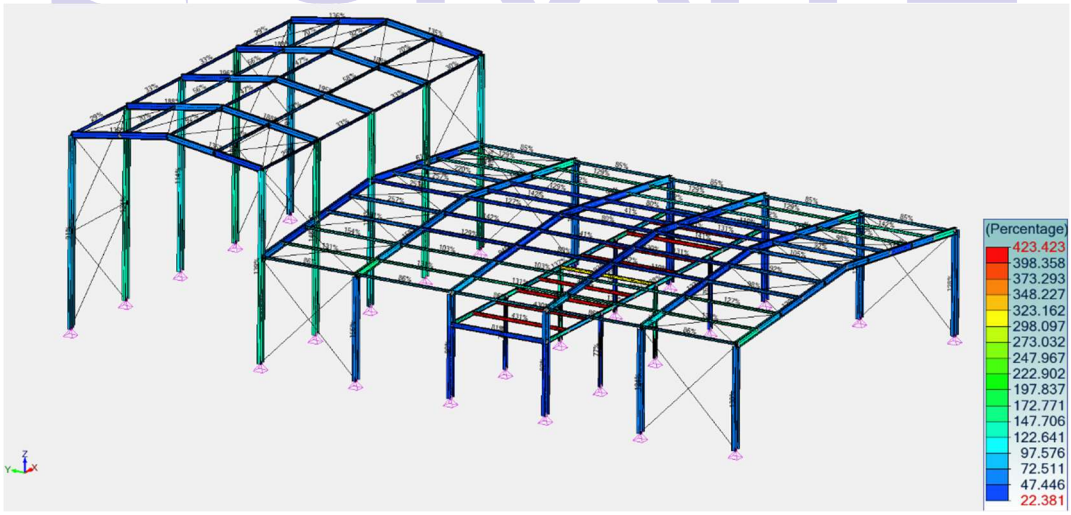
Save computation time by using the RITZ solver for modal, seismic and time history analysis.





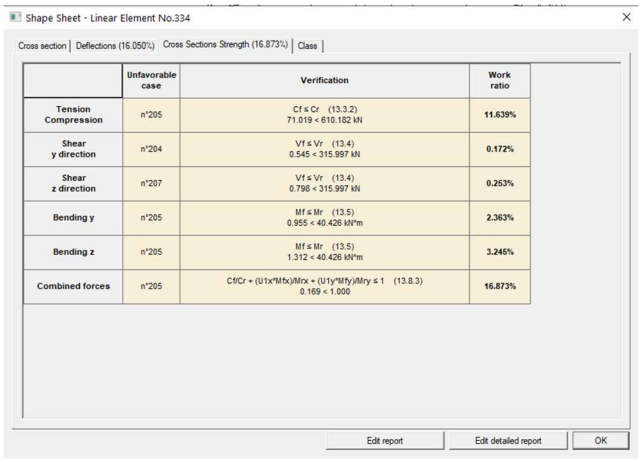
7. Detailed results and design calculation Reports

Internal forces and design results can be displayed directly on the structure in the 3D view with a wide range of options to customize how they are presented.



Advance design also offers detailed results and calculation reports. The shape sheet allows you to quickly view all the available results for a selected steel element: cross section properties, deflections, strength, stability, fire resistance and cross section class, etc. in one dialog box. You can also generate a detailed report with article references, formulas and intermediate values. The user may customize the design reports, while the saved views are

updated automatically. These features save hours of time when it comes to generating technical documentation.



Shape sheet - Linear element No. 4 Wet

1) Cross section

Shape	W250x22
Dimensions(cm)	h = 25.40 b = 10.20 tw = 0.58 tf = 0.69 r = 2.20 r1 = 0.00
Cross sections(cm2)	Area = 28.50 Sy = 15.69 Sz = 33.90
Inertia(cm4)	It = 4.34 Iy = 2890 Iz = 123
Inertia(cm6)	Iw = 18700
Modules(cm3)	Wply = 263 Wplz = 38.1
Material	G40.21M-350W E = 200000 MPa Nu = 0.3 G = 76923.1 MPa
Grade	fy = 350.00 MPa fu = 450.00 MPa

2) Section classification

Class	Lower wing : Class COMPACT Center : Class COMPACT Upper wing : Class COMPACT Cross section : Class COMPACT

3) Deflections

1st criterion	Element deflections: z : Case no 102 : 1.2x[1 D]+1.6x[2 L], Mesh No. 4.3 4/4 L/160 > L/360 (225 %)

4) Cross sections strength

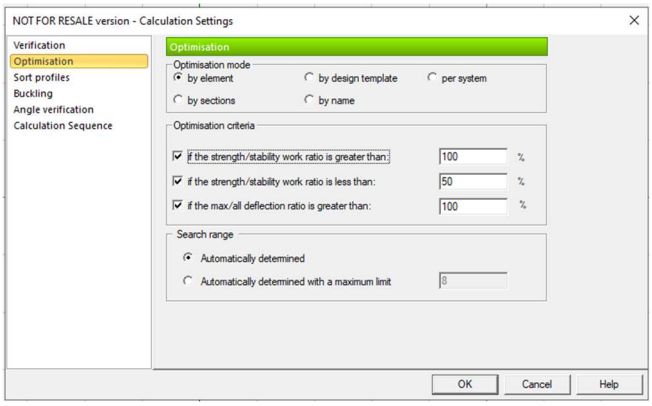
Tension Compression (Chapter D)	Case no 105 : 1x[1 D]+0.75x[2 L], Mesh No. 4.1 $P_u = \Phi_t \cdot P_n$ (D2-1, LRFD) : 0.00 < 897.52 kN (0 %) Tension : = 962.173 P_n = 997.24 kN
Shear in y direction (Chapter G)	Case no 102 : 1.2x[1 D]+1.6x[2 L], Mesh No. 4.1 $V_u = \Phi_v \cdot V_n$ (G6-1, LRFD) : 40.00 < 265.97 kN (15 %) Φ_v = 0.90 C_{v2} = 1.00 A_w = 14.08 cm²
Shear in z direction (Chapter G)	Case no 102 : 1.2x[1 D]+1.6x[2 L], Mesh No. 4.1 $V_u = \Phi_v \cdot V_n$ (G2-1, LRFD) : 55.00 < 309.29 kN (18 %) Φ_v = 1.00 C_{v1} = 1.00 A_w = 14.73 cm²
Bending /yy (Chapter F)	Case no 102 : 1.2x[1 D]+1.6x[2 L], Mesh No. 4.3 $M_u = \Phi_b \cdot M_n$ (F2, LRFD) : 68.75 > 22.10 kN*m (311 %) L_p = 0.87 m L_r = 2.62 m L_b = 5.00 m C_b = 1.14 F_{cr} = 108.21 MPa M_n = 24.56 kN*m M_n Y = 92.03 M_n LTB = 24.56 kN*m
Bending /zz (Chapter F)	Case no 102 : 1.2x[1 D]+1.6x[2 L], Mesh No. 4.3 $M_u = \Phi_b \cdot M_n$ (F6, LRFD) : 50.00 > 12.00 kN*m (417 %) L_p = 0.00 m L_r = 0.00 m L_b = 0.00 m F_{cr} = 0.00 MPa M_n = 13.33 kN*m
Torsion (Chapter H)	not done (-)
Composed Forces (Chapter H)	not done (-)

5) Elements stability

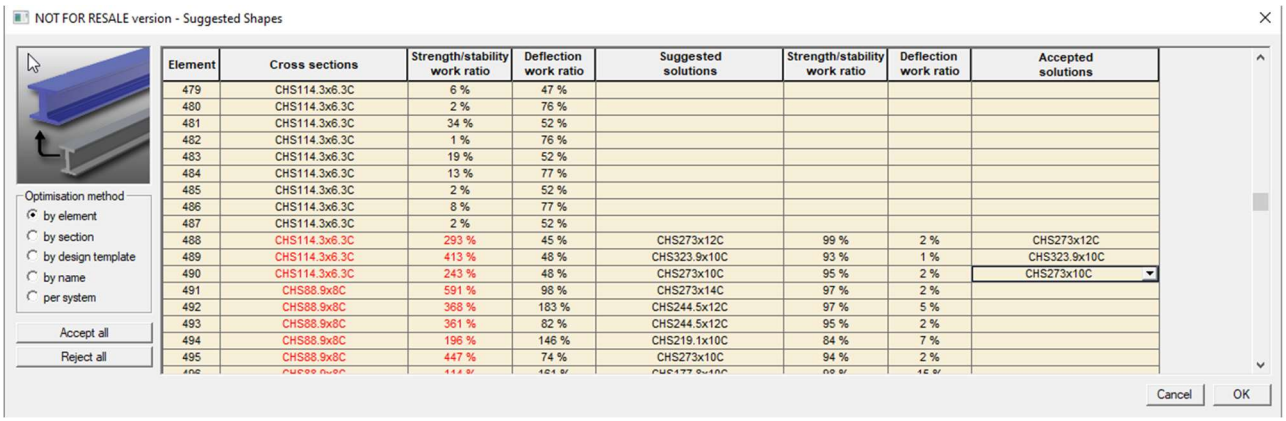
Buckling on Y-Y	Lfz = 19.99 m λ_y = 198.498
Buckling on Z-Z	Lfy = 19.99 m λ_z = 962.173
Lateral-torsional buckling	Lbi = 5.00 m Lbs = 5.00 m λ_{LT} = 49.653

8. Shape Optimization

Advance Design compares the work ratio of the steel elements and suggests (if necessary) more adequate cross sections, that would correspond to the defined conditions. The user has full control on the optimization conditions, the suggestion process and the list of available shapes.



With the suggested shapes dialog box, it is simple and easy to visualize what changes need to be made and select the best solution for a member or groups of members. The changes can also be applied automatically with the chained optimization process.

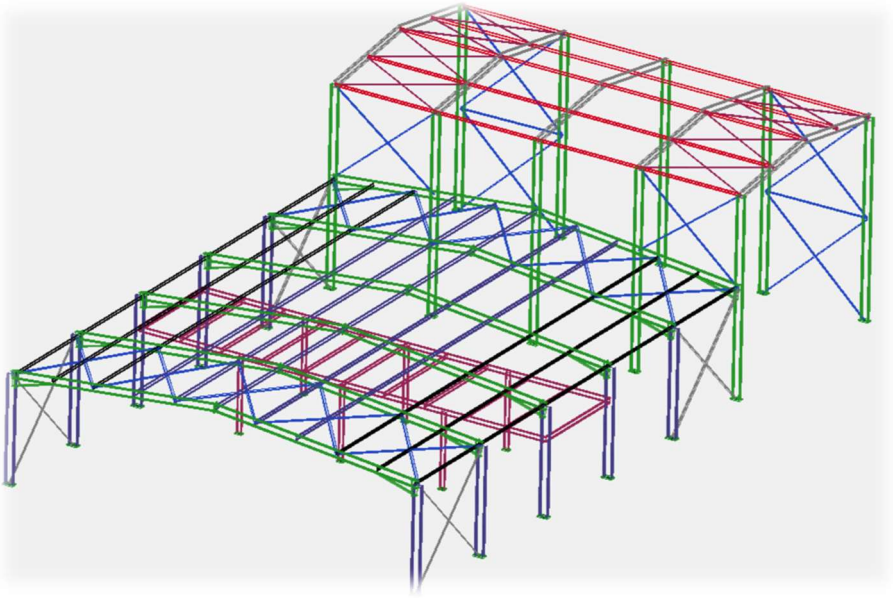


Element	Cross sections	Strength/stability work ratio	Deflection work ratio	Suggested solutions	Strength/stability work ratio	Deflection work ratio	Accepted solutions
479	CHS114.3x6.3C	6 %	47 %				
480	CHS114.3x6.3C	2 %	76 %				
481	CHS114.3x6.3C	34 %	52 %				
482	CHS114.3x6.3C	1 %	76 %				
483	CHS114.3x6.3C	19 %	52 %				
484	CHS114.3x6.3C	13 %	77 %				
485	CHS114.3x6.3C	2 %	52 %				
486	CHS114.3x6.3C	8 %	77 %				
487	CHS114.3x6.3C	2 %	52 %				
488	CHS114.3x6.3C	293 %	45 %	CHS273x12C	99 %	2 %	CHS273x12C
489	CHS114.3x6.3C	413 %	48 %	CHS323.9x10C	93 %	1 %	CHS323.9x10C
490	CHS114.3x6.3C	243 %	48 %	CHS273x10C	95 %	2 %	CHS273x10C
491	CHS88.9x8C	591 %	98 %	CHS273x14C	97 %	2 %	
492	CHS88.9x8C	368 %	183 %	CHS244.5x12C	97 %	5 %	
493	CHS88.9x8C	361 %	82 %	CHS244.5x12C	95 %	2 %	
494	CHS88.9x8C	196 %	146 %	CHS219.1x10C	84 %	7 %	
495	CHS88.9x8C	447 %	74 %	CHS273x10C	94 %	2 %	

9. Advanced FEM modelling

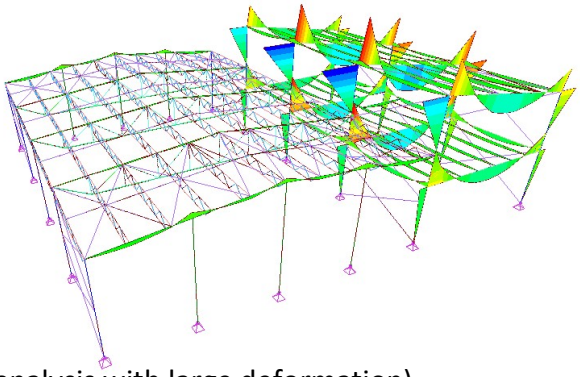
Advance Design provides users with:

- Many linear element types (bars, beams, variable elements, tie, strut, cable, rigid)
- Advanced links
- Total / Elastic / Plastic hinges
- Clipping of forces
- Super-elements
- powerful meshing engine



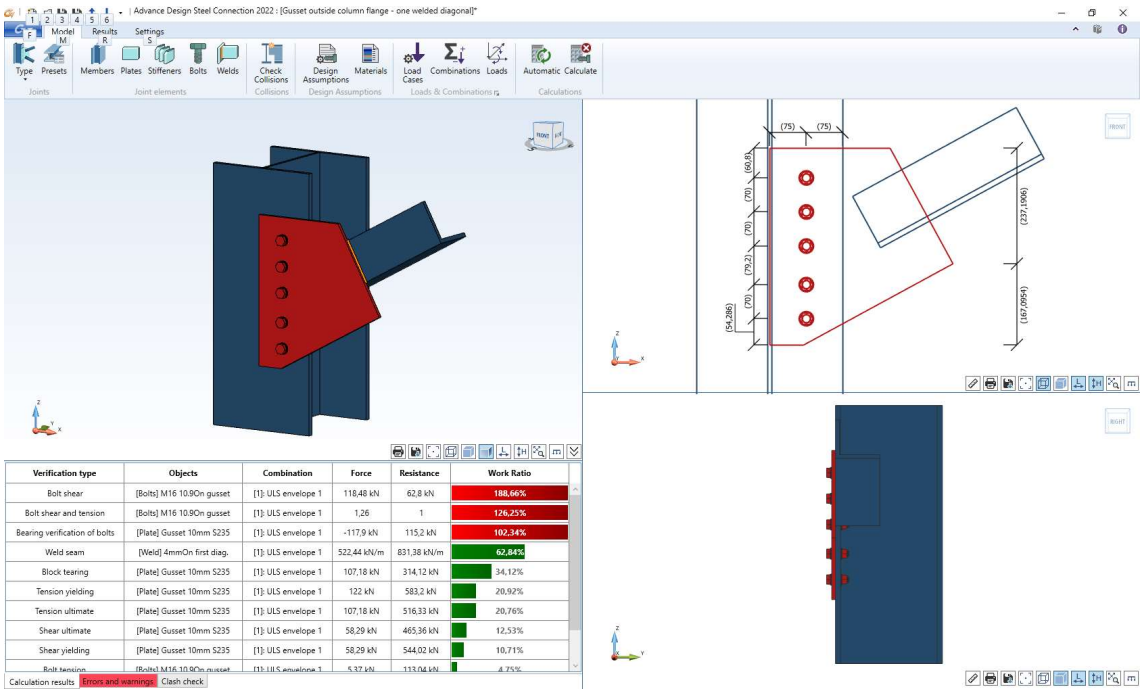
10.Advanced FEM analyses

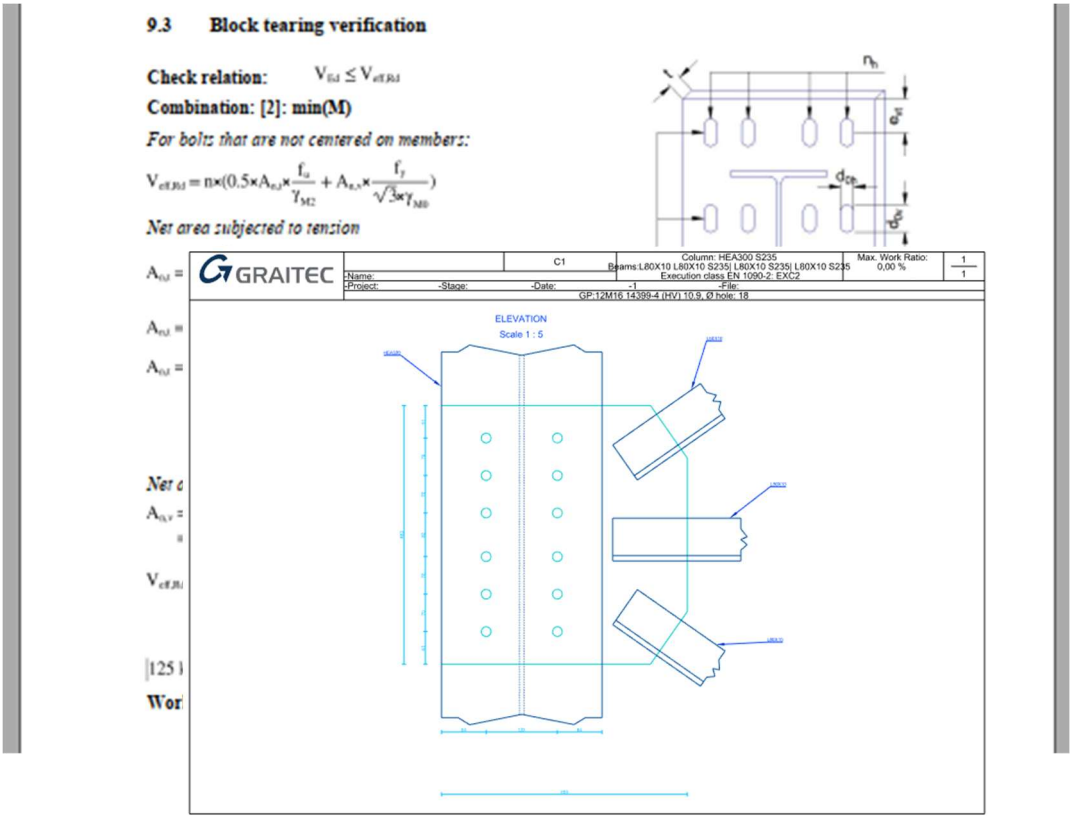
- Linear
- Nonlinear
- Buckling
- Seismic
- Pushover
- 2nd order calculation (nonlinear analysis with large deformation)



11.Steel connections (Eurocode)

The user has the possibility to model connections in Advance Design and then doing design calculations using Steel Connection module





9.3 Block tearing verification

Check relation: $V_{Ed} \leq V_{eff,Rd}$

Combination: [2]: min(M)

For bolts that are not centered on members:

$$V_{eff,Rd} = n \times (0.5 \times A_{nt} \times \frac{f_u}{\gamma_{M2}} + A_{nv} \times \frac{f_y}{\sqrt{3} \gamma_{M0}})$$

Net area subjected to tension

$A_{nt} =$

$A_{nt} =$

$A_{nt} =$

Net a

$A_{nv} =$

$V_{eff,Rd}$

[125]

Wor

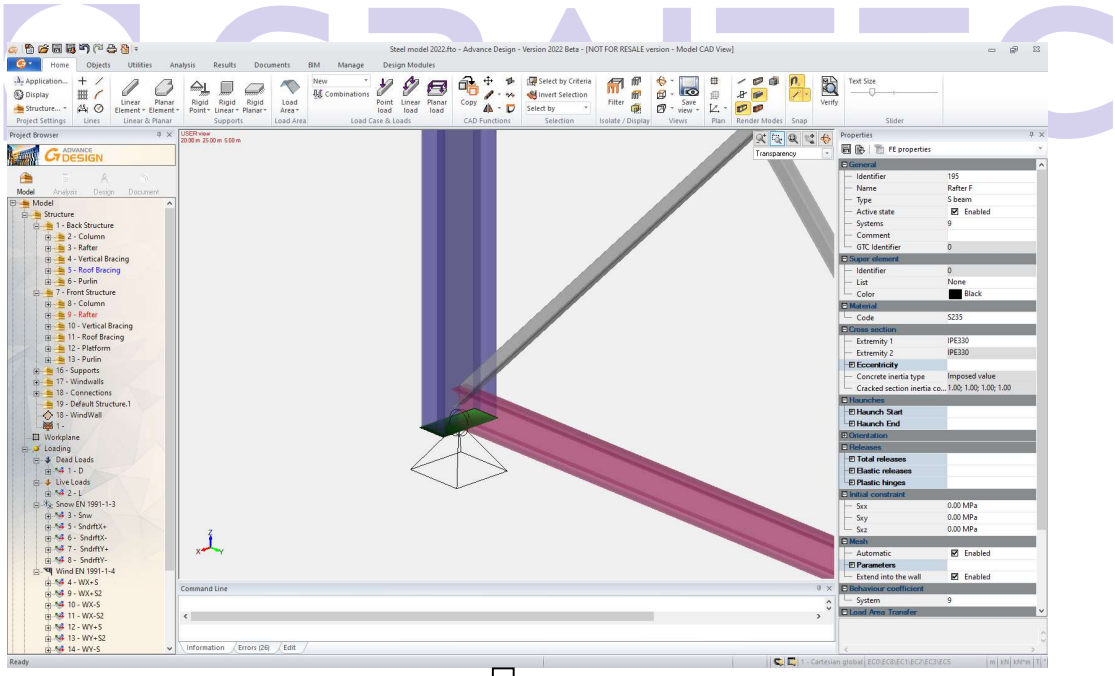
GRAITEC | C1 | Column: HEA300 S235 | Beams:L80X10 L80X10 S235| L80X10 S235| L80X10 S235 | Max. Work Ratio: 0,00 % | 1/1

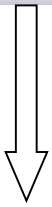
-Name: | -Project: | -Stage: | -Date: | -1 | -File: | Execution class EN 1090-2: EXC2

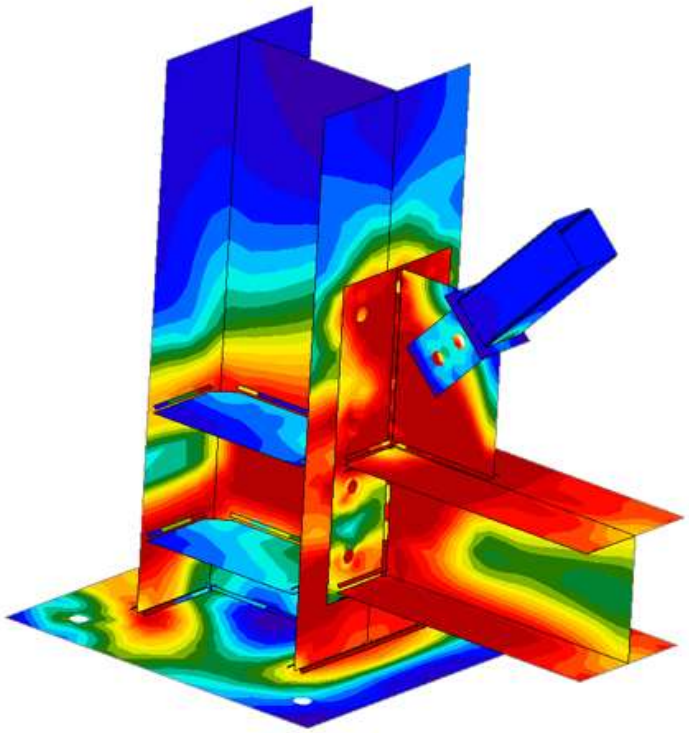
GP:12M16.14399-4 (HV) 10.9, Ø hole: 18

ELEVATION

Scale 1 : 5

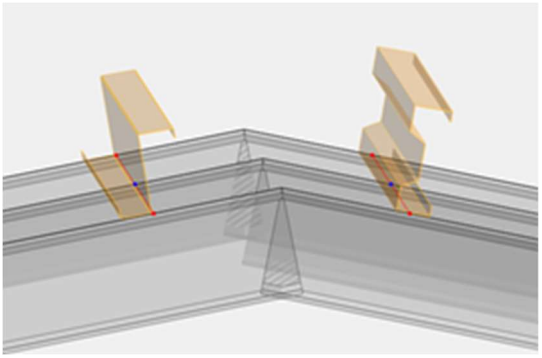




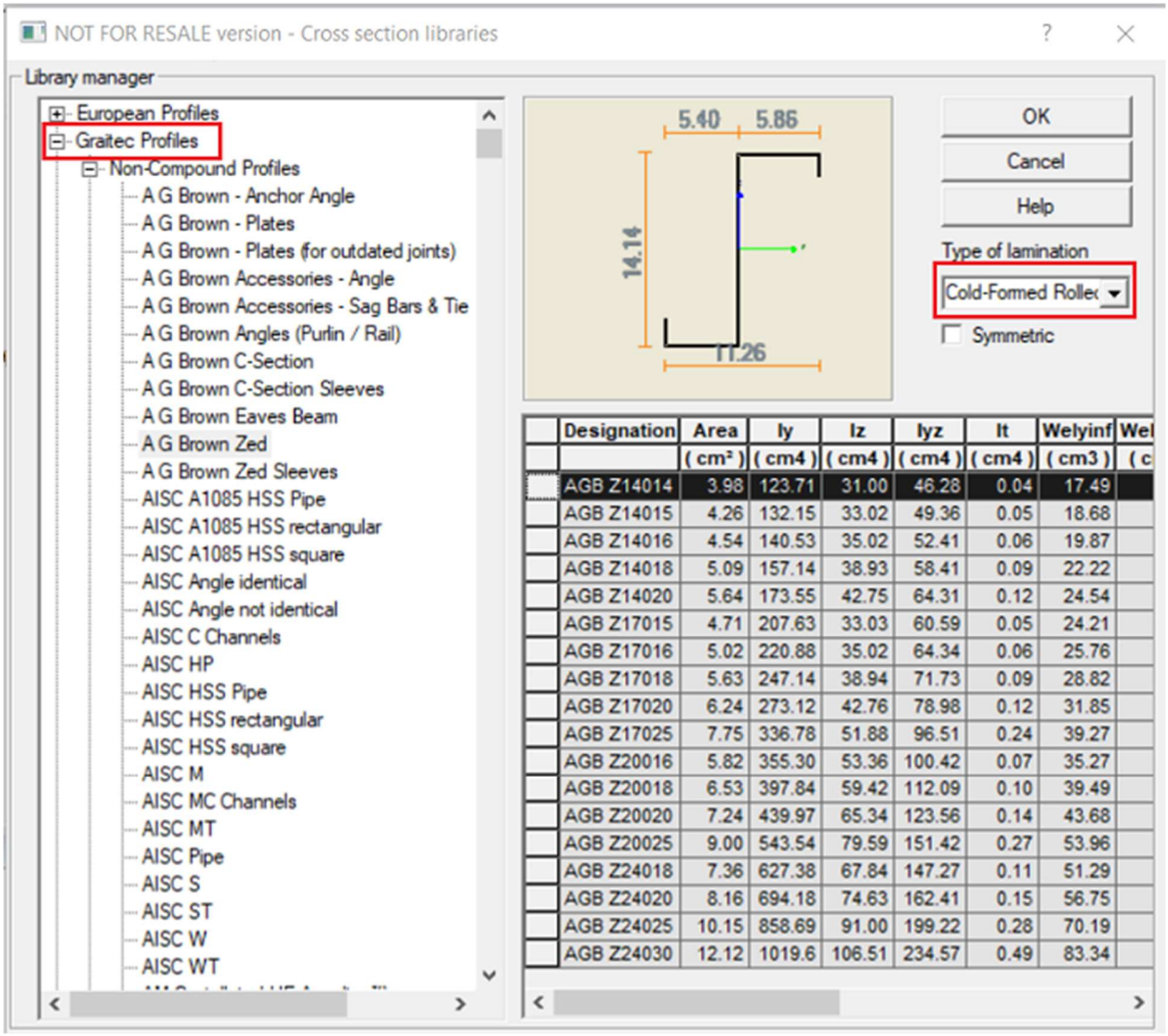


12. Design of cold-formed members (Eurocode)

Users can design cold-formed members, as per EN1993-1-3.



Cold-formed steel profiles



13. Maintenance and support

User may choose perpetual licenses or DTS, and benefits from a well-known technical support. With two updates per year, Advance design will remain up to date.

GRAITEC provides their clients with guarantees related to solid and international editor.