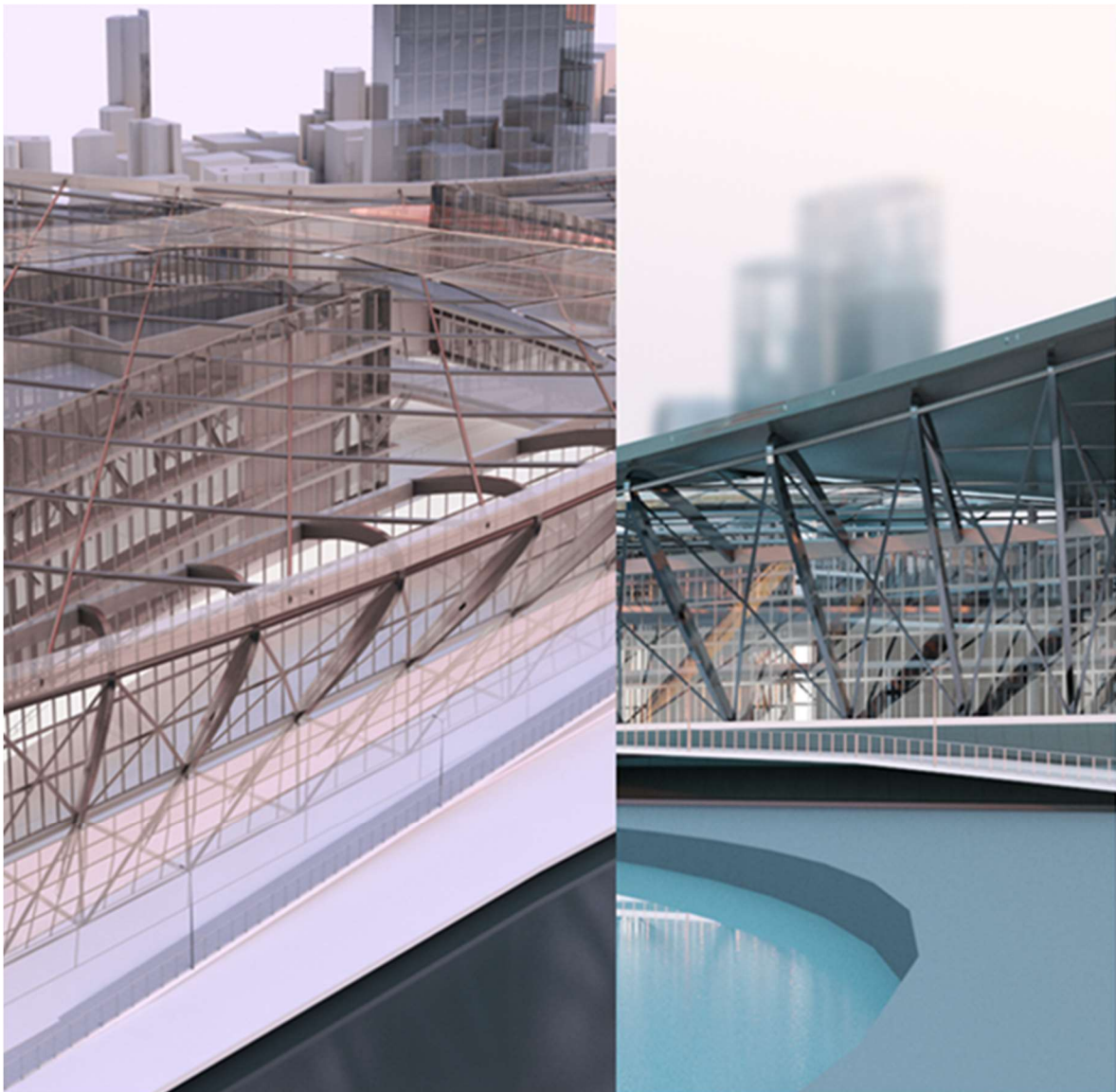




# Advantages of Advance Design for Steel Users



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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 from 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 annexes and North American codes:

ANSI/AISC 360 (ASD & LRFD) USA

CAN/CSA S16 Canada

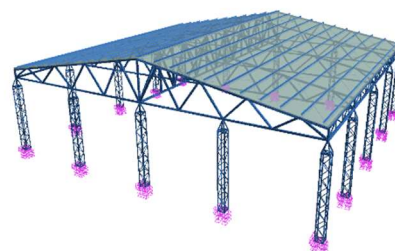
CM66 France

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.

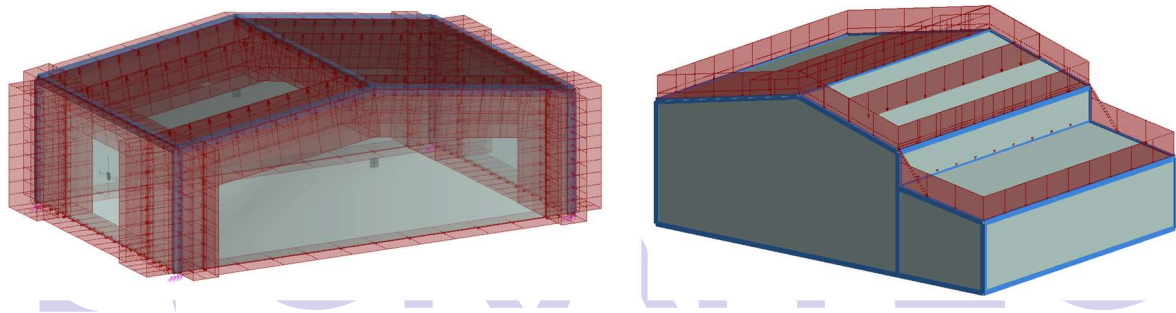


Moreover, the data grid function allows the user to customize the geometry of model elements, supports and loads, in a quick and easy way.

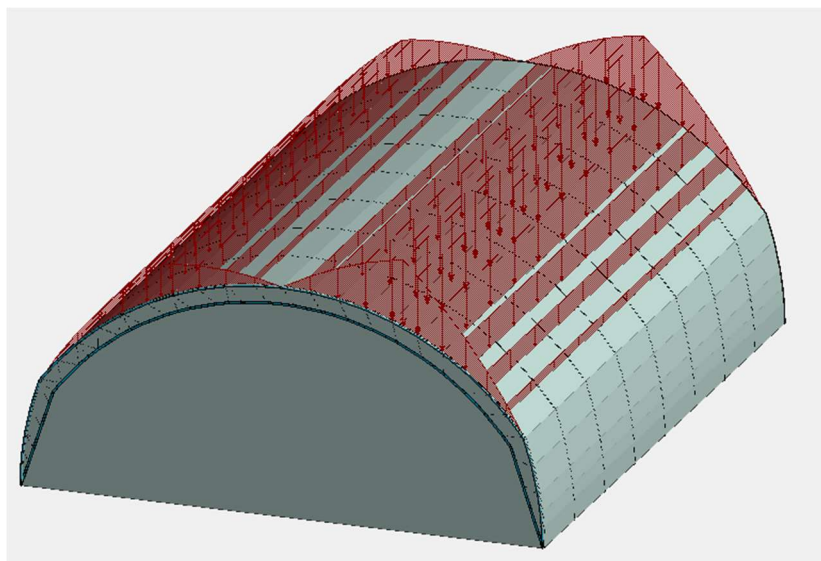
#### 4. Climatic Loads Generator

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)



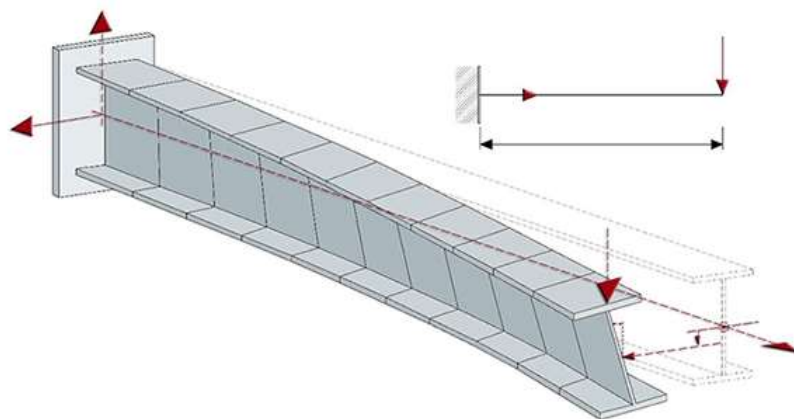
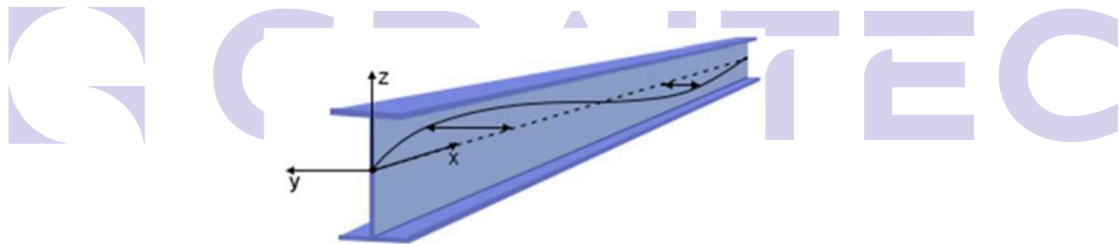
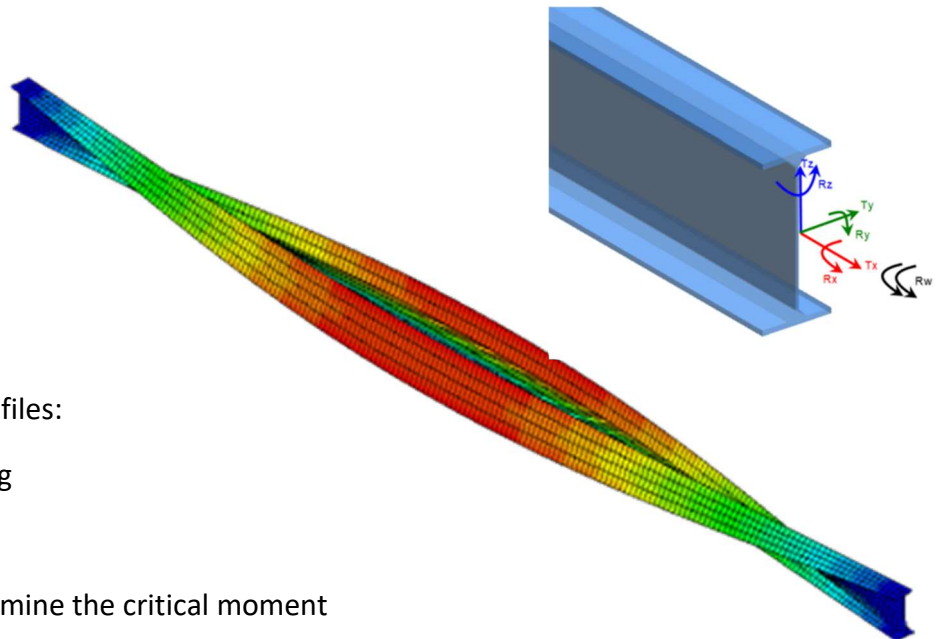
## 5. Advanced stability analysis - 2<sup>nd</sup> order analysis with 7 degrees of freedom

Possible for Sections:

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

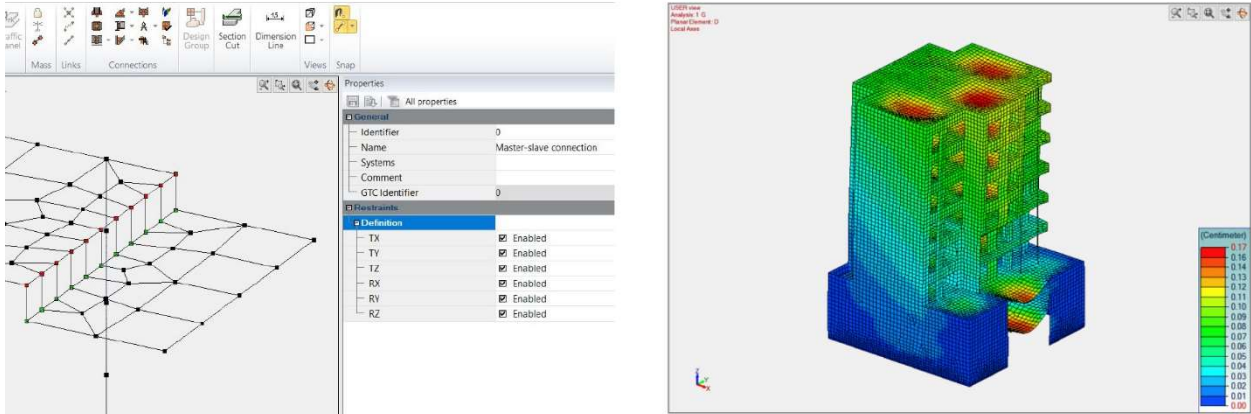
Especially useful for profiles:

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



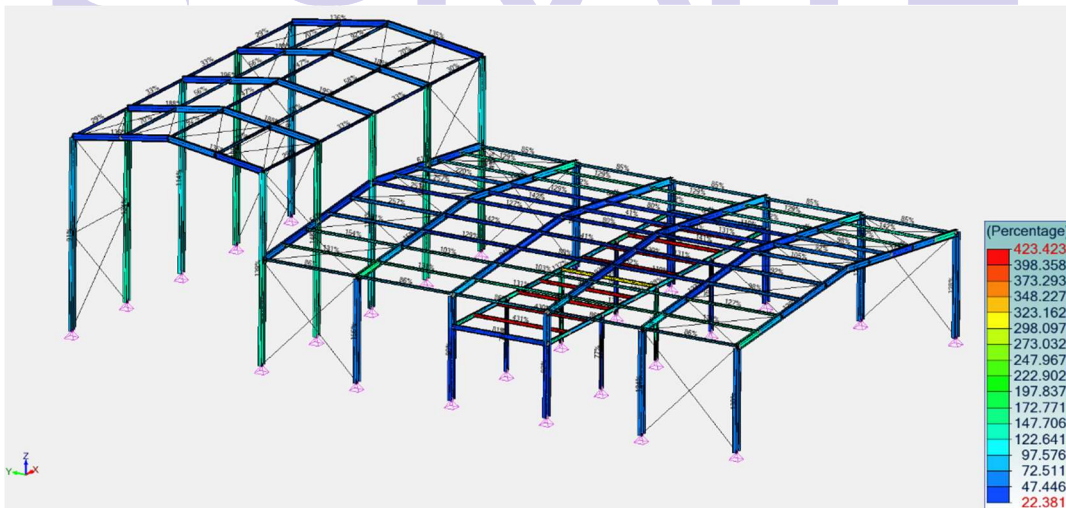
## 6. Seismic generator

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.334

Unfavorable case	Verification	Work ratio
Tension Compression n°205	$Cf < Cr$ (13.3.2) 71.019 < 610.182 kN	11.639%
Shear y direction n°204	$Vf < Vr$ (13.4) 0.545 < 315.997 kN	0.172%
Shear z direction n°207	$Vf < Vr$ (13.4) 0.798 < 315.997 kN	0.253%
Bending y n°205	$Mf < Mr$ (13.5) 0.955 < 40.426 kN/m	2.363%
Bending z n°205	$Mf < Mr$ (13.5) 1.312 < 40.426 kN/m	3.245%
Combined forces n°205	$Cf/Cr + (U1x/Mfx)/Mrx + (U1y/Mfy)/Mry < 1$ (13.8.3) 0.169 < 1.000	16.873%

Shape sheet - Linear element No. 4 Wet

<b>1) Cross section</b>	
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)	Ix = 4.34 Iy = 2890 Iz = 123
Inertia(cm6)	Ixy = 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
<b>2) Section classification</b>	
Class	Lower wing : Class COMPACT Center : Class COMPACT Upper wing : Class COMPACT Cross section : Class COMPACT
<b>3) Deflections</b>	
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 %)
<b>4) Cross sections strength</b>	
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 %) $\phi_v = 0.90$ $C_{v2} = 1.00$ $A_{v2} = 14.08$ cm <sup>2</sup>
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 %) $\phi_v = 1.00$ $C_{v1} = 1.00$ $A_{v1} = 14.73$ cm <sup>2</sup>
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) : 88.75 > 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 $M_u = 24.56$ kN/m $M_n = 92.03$ kN, 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 $M_u = 13.33$ kN/m
Torsion (Chapter H)	not done (-)
Composred Forces (Chapter H)	not done (-)
<b>5) Elements stability</b>	
Buckling on Y-Y	Lfy = 19.99 m $\lambda_y = 198.498$
Buckling on Z-Z	Lfy = 19.99 m $\lambda_z = 962.173$
Lateral-torsional buckling	Lbi = 5.00 m Lbs = 5.00 m $\lambda_{1T} = 49.653$



### 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.

NOT FOR RESALE version - Calculation Settings

Verification

- Optimisation
- Sort profiles
- Buckling
- Angle verification
- Calculation Sequence

**Optimisation**

Optimisation mode

- by element
- by design template
- per system

by sections  by name

Optimisation criteria

- if the strength/stability work ratio is greater than: 100 %
- if the strength/stability work ratio is less than: 50 %
- if the max./all deflection ratio is greater than: 100 %

Search range

- Automatically determined
- Automatically determined with a maximum limit: 0

OK Cancel Help

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.

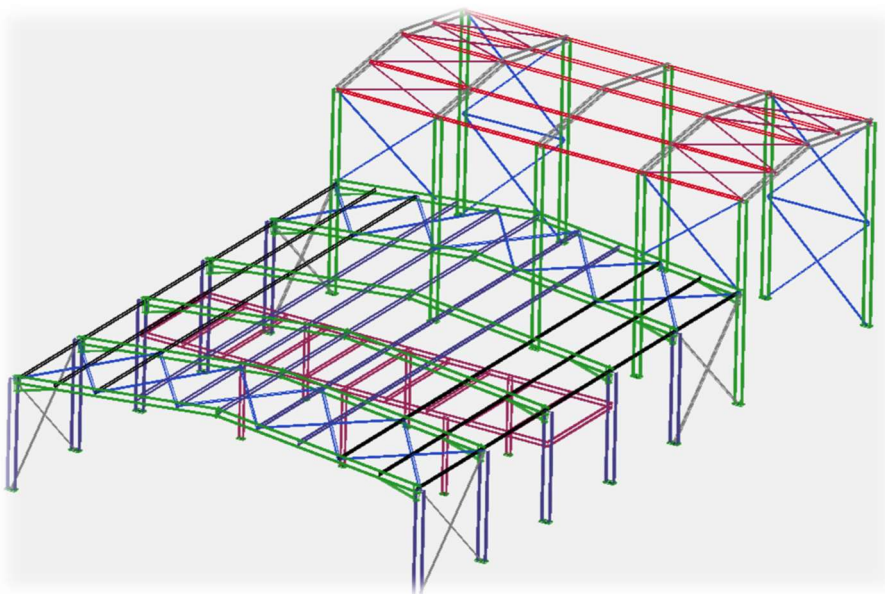
NOT FOR RESALE version - Suggested Shapes

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 %	CHS273x10C
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:

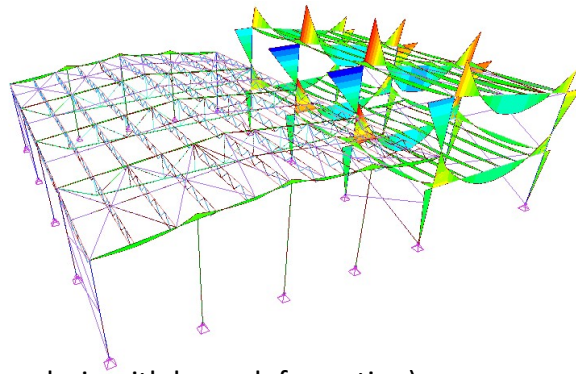
- Many linear element types (bars, beams, variable elements, tie, strut, cable, rigid)
- Advanced links
- Total / Elastic / Plastic hinges
- Clipping of forces
- Super-elements
- powerful meshing engine





### 10. Advanced FEM analyses

- Linear
- Nonlinear 
- Buckling 
- Seismic 
- Pushover 
- 2<sup>nd</sup> 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

Verification type	Objects	Combination	Force	Resistance	Work Ratio
Bolt shear	[Bolts] M16 10.9On gusset	[1]- ULS envelope 1	118,48 kN	62,8 kN	188,66%
Bolt shear and tension	[Bolts] M16 10.9On gusset	[1]- ULS envelope 1	1,26	1	126,25%
Bearing verification of bolts	[Plate] Gusset 10mm S235	[1]- ULS envelope 1	-117,9 kN	115,2 kN	102,34%
Weld seam	[Weld] 4mmOn first diag.	[1]- ULS envelope 1	522,44 kN/m	831,38 kN/m	62,84%
Block tearing	[Plate] Gusset 10mm S235	[1]- ULS envelope 1	107,18 kN	314,12 kN	34,12%
Tension yielding	[Plate] Gusset 10mm S235	[1]- ULS envelope 1	122 kN	583,2 kN	20,92%
Tension ultimate	[Plate] Gusset 10mm S235	[1]- ULS envelope 1	107,18 kN	516,33 kN	20,76%
Shear ultimate	[Plate] Gusset 10mm S235	[1]- ULS envelope 1	58,29 kN	465,36 kN	12,53%
Shear yielding	[Plate] Gusset 10mm S235	[1]- ULS envelope 1	58,29 kN	544,02 kN	10,71%
Bolt tension	[Bolts] M16 10.9On gusset	[1]- ULS envelope 1	5,37 kN	133,04 kN	4,75%

Calculation results: **Errors and warnings** Clash check

9.3 Block tearing verification

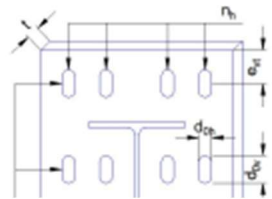
Check relation:  $V_{Ed} \leq V_{t,Rd}$

Combination: [2]: min(M)

For bolts that are not centered on members:

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

Net area subjected to tension



GRAITEC	C1	Column: HEA300 S235	Max. Work Ratio:	1
	Name:	Beams L80X10 L80X10 S235 L80X10 S235	0.00 %	1
	Project:	-Stage: -Date: -1 -File: -		
		GP:12M16 14388-4 (HV) 10.9, Ø hole: 18		

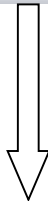
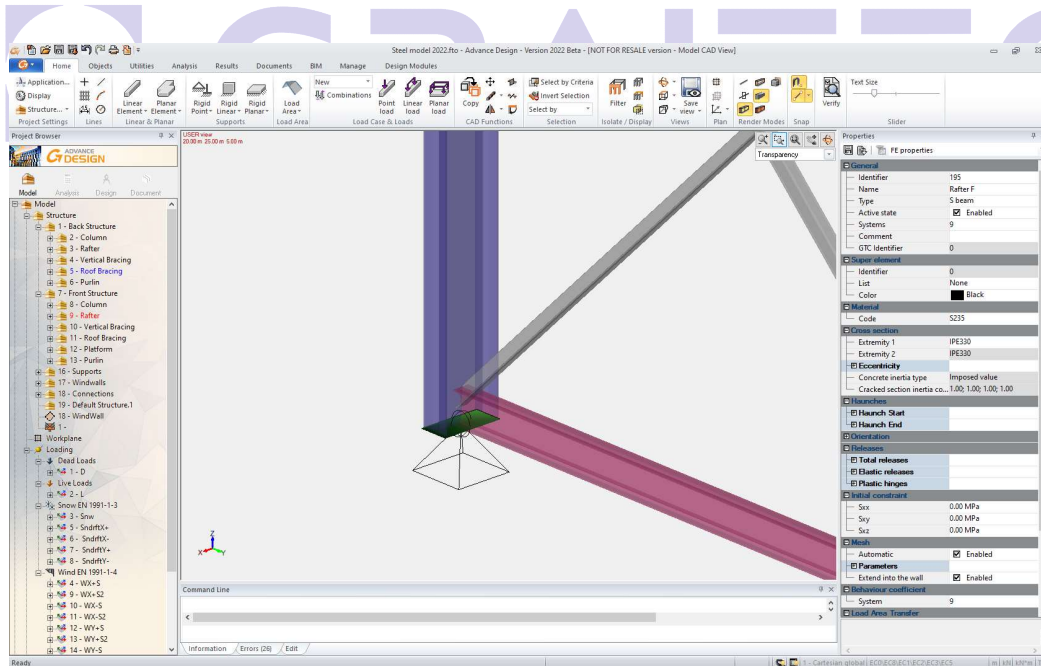
  

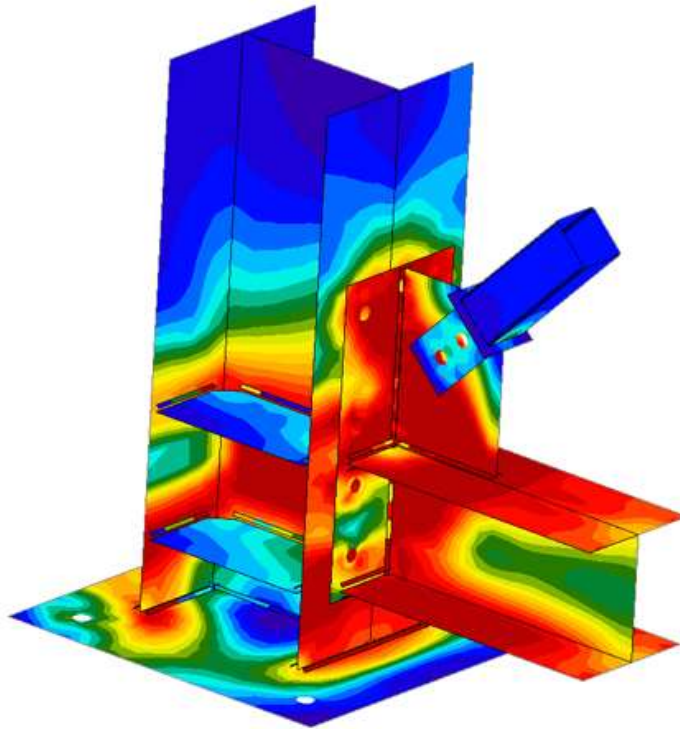
ELEVATION  
Scale 1 : 5

Net A<sub>b,t</sub> =

V<sub>t,Rd</sub> =

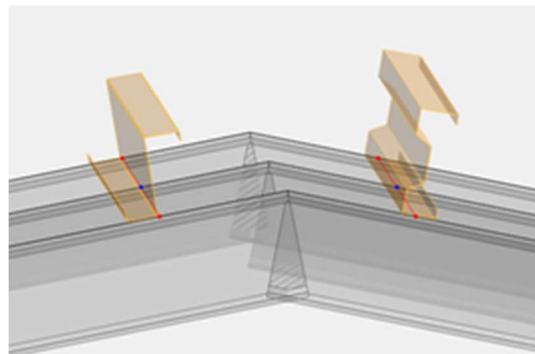
Wor





## 12. Design of cold-formed members (Eurocode)

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



*Cold-formed steel profiles*

NOT FOR RESALE version - Cross section libraries

Library manager

- European Profiles
- Graitec Profiles**
  - Non-Compound Profiles
    - A G Brown - Anchor Angle
    - A G Brown - Plates
    - A G Brown - Plates (for outdated joints)
    - A G Brown Accessories - Angle
    - A G Brown Accessories - Sag Bars & Tie
    - A G Brown Angles (Purlin / Rail)
    - A G Brown C-Section
    - A G Brown C-Section Sleeves
    - A G Brown Eaves Beam
    - A G Brown Zed
    - A G Brown Zed Sleeves
    - AISC A1085 HSS Pipe
    - AISC A1085 HSS rectangular
    - AISC A1085 HSS square
    - AISC Angle identical
    - AISC Angle not identical
    - AISC C Channels
    - AISC HP
    - AISC HSS Pipe
    - AISC HSS rectangular
    - AISC HSS square
    - AISC M
    - AISC MC Channels
    - AISC MT
    - AISC Pipe
    - AISC S
    - AISC ST
    - AISC W
    - AISC WT

OK  
Cancel  
Help

Type of lamination  
**Cold-Formed Roller**  
 Symmetric

Designation	Area (cm <sup>2</sup> )	Iy (cm <sup>4</sup> )	Iz (cm <sup>4</sup> )	Iyz (cm <sup>4</sup> )	It (cm <sup>4</sup> )	Welyinf (cm <sup>3</sup> )	Welzinf (cm <sup>3</sup> )
AGB Z14014	3.98	123.71	31.00	46.28	0.04	17.49	
AGB Z14015	4.26	132.15	33.02	49.36	0.05	18.68	
AGB Z14016	4.54	140.53	35.02	52.41	0.06	19.87	
AGB Z14018	5.09	157.14	38.93	58.41	0.09	22.22	
AGB Z14020	5.64	173.55	42.75	64.31	0.12	24.54	
AGB Z17015	4.71	207.63	33.03	60.59	0.05	24.21	
AGB Z17016	5.02	220.88	35.02	64.34	0.06	25.76	
AGB Z17018	5.63	247.14	38.94	71.73	0.09	28.82	
AGB Z17020	6.24	273.12	42.76	78.98	0.12	31.85	
AGB Z17025	7.75	336.78	51.88	96.51	0.24	39.27	
AGB Z20016	5.82	355.30	53.36	100.42	0.07	35.27	
AGB Z20018	6.53	397.84	59.42	112.09	0.10	39.49	
AGB Z20020	7.24	439.97	65.34	123.56	0.14	43.68	
AGB Z20025	9.00	543.54	79.59	151.42	0.27	53.96	
AGB Z24018	7.36	627.38	67.84	147.27	0.11	51.29	
AGB Z24020	8.16	694.18	74.63	162.41	0.15	56.75	
AGB Z24025	10.15	858.69	91.00	199.22	0.28	70.19	
AGB Z24030	12.12	1019.6	106.51	234.57	0.49	83.34	

### 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.