

GT STRUDL®

User Guide



CAD Modeler
Getting Started Guide

Release Date: December 2017



HEXAGON
PPM

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GT STRUDL® CAD MODELER

Getting Started Guide

1. Getting Started

CAD Modeler is an add-on to AutoCAD® or BricsCAD®, which allows you to create GT STRUDL Input Files (GTI) graphically using their powerful CAD tools and graphical display capabilities and also graphically review GT STRUDL results from an analysis and steel code check. AutoCAD® or BricsCAD® must be installed in your computer before installing and running CAD Modeler. It is highly recommended that you have AutoCAD/BricsCAD experience before using CAD Modeler.

1.1. Introduction

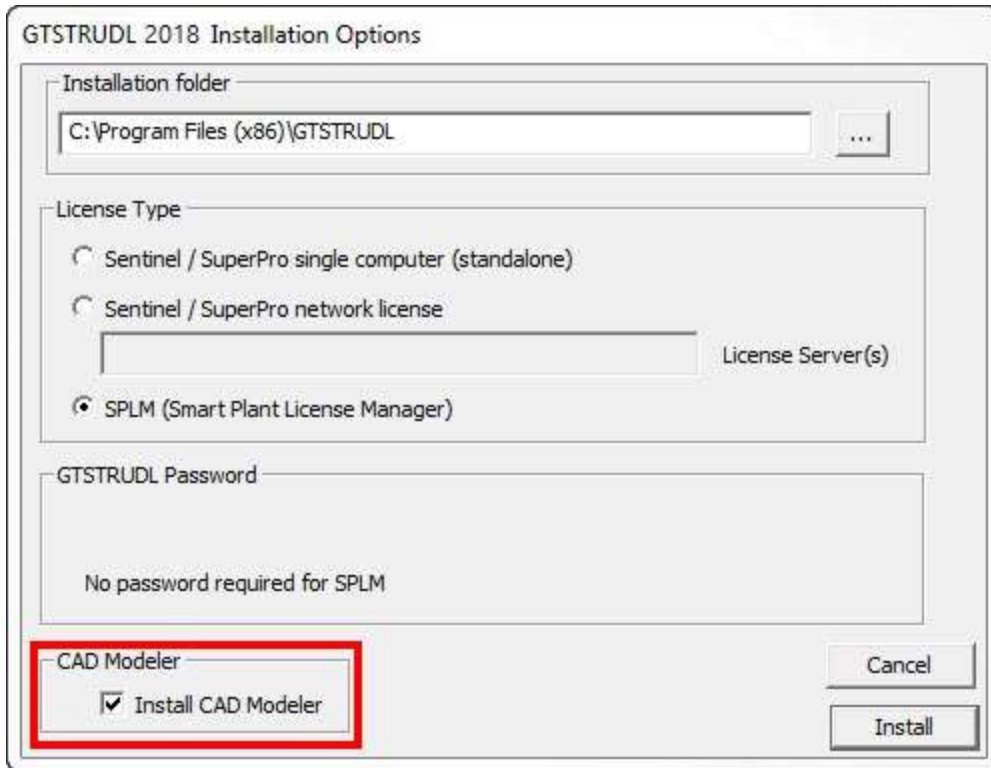
This document contains information about:

- Installing CAD Modeler
- Configuring AutoCAD/BricsCAD and running CAD Modeler for first time
- List of CAD Modeler Functions with detailed explanation for each one
- Tutorial examples
- Summary of CAD Modeler commands

1.2. Installing CAD Modeler under Windows 10 and 7

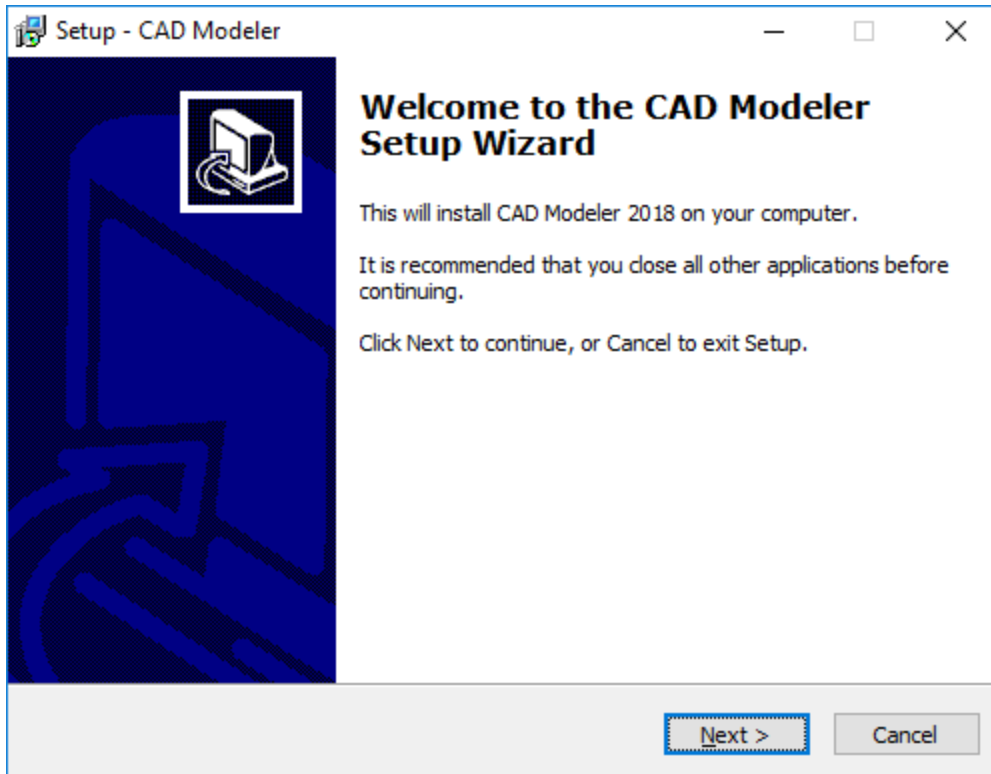
In order to install CAD Modeler check the box “Install CAD Modeler” on the form shown on the next page during the GT STRUDL main installation procedure.

An AutoCAD version (2012-2018) or a BricsCAD version (Platinum or Pro, 16.2.x, 17.1.x or 18.1.x) has to be installed in the computer prior to CAD Modeler installation.

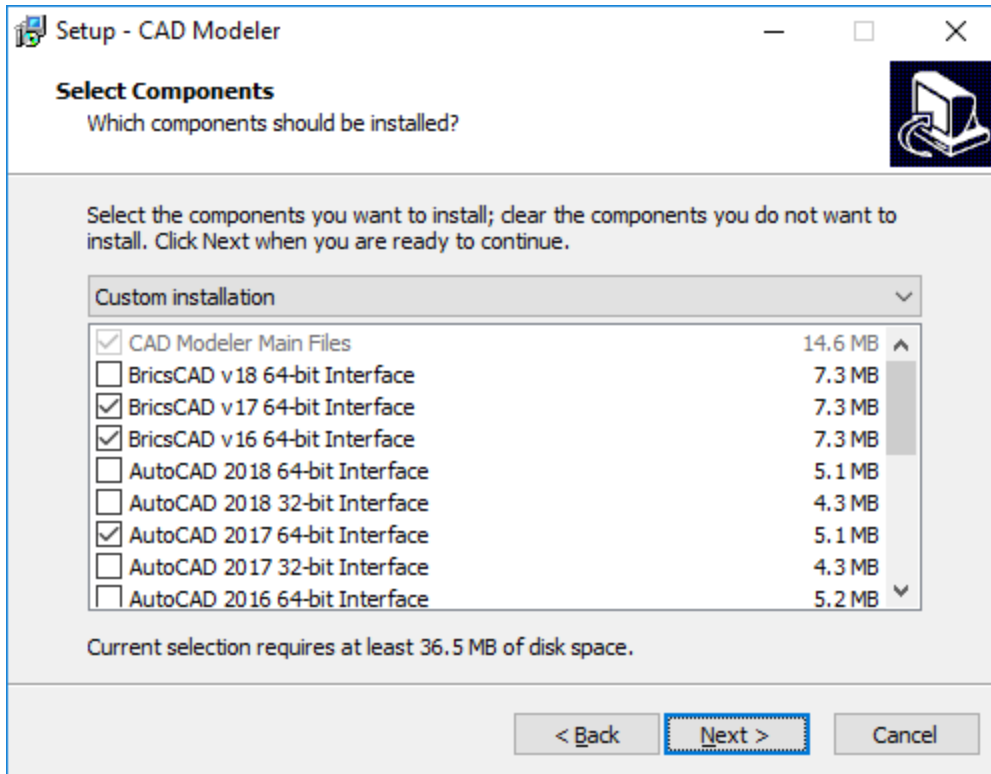


CAD Modeler Installation can also be launched independently, after GT STRUDL installation, by executing the file “CADM_setup.exe” which is located in the CADModeler folder in the GTStrudl 2018 installation directory. The following steps are common regardless if the installation was launched from the GT STRUDL main installation or independently.

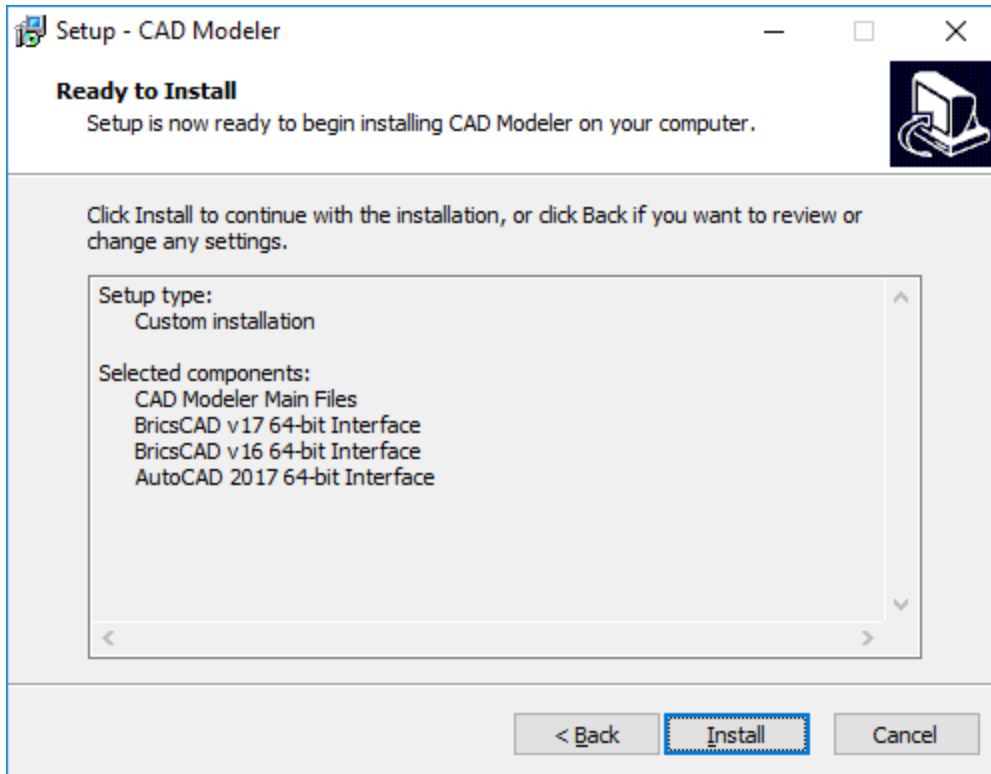
The first screen is a welcome dialog that prompts you to close all other applications before continuing the installation. It is essential to close any running instances of GT STRUDL, CAD Modeler, AutoCAD or BricsCAD before continuing the installation.



The next step is to select the components to be installed. The CAD Modeler Main Files are installed by default, and in addition you have to choose at least one version of the AutoCAD or BricsCAD CAD Modeler Interface to be installed depending on the version of AutoCAD or BricsCAD that is currently installed in your computer.

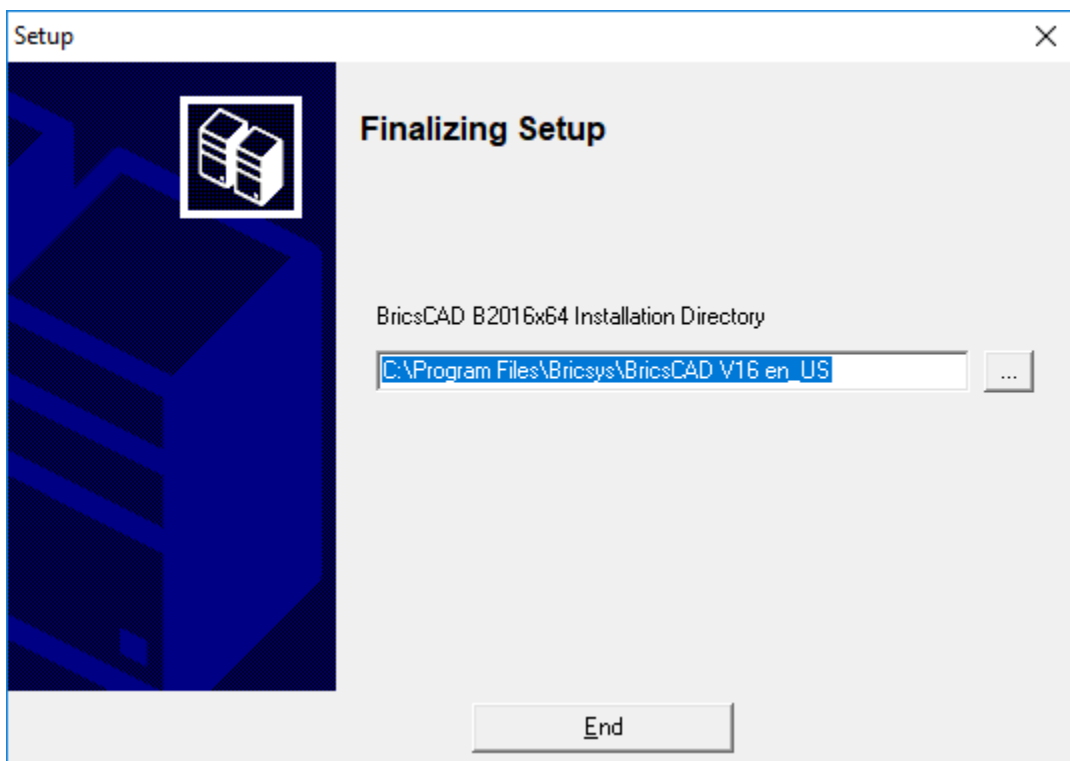
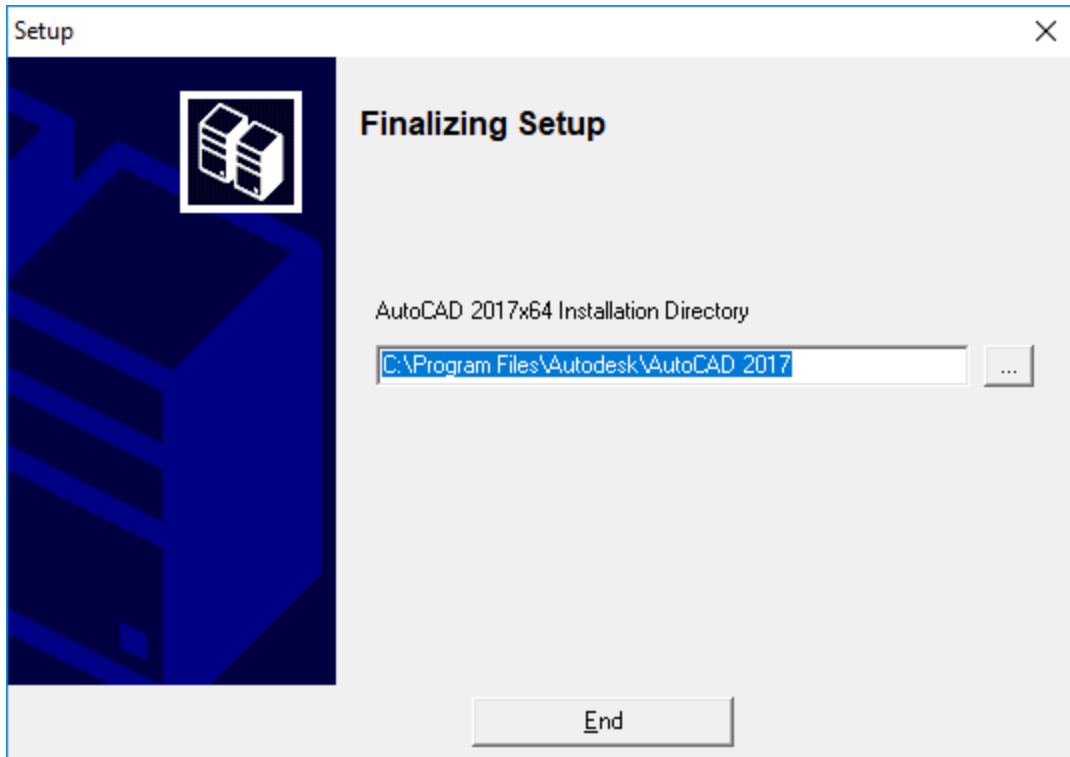


The last screen summarizes your selection and by pressing “Install” the installation procedure starts.

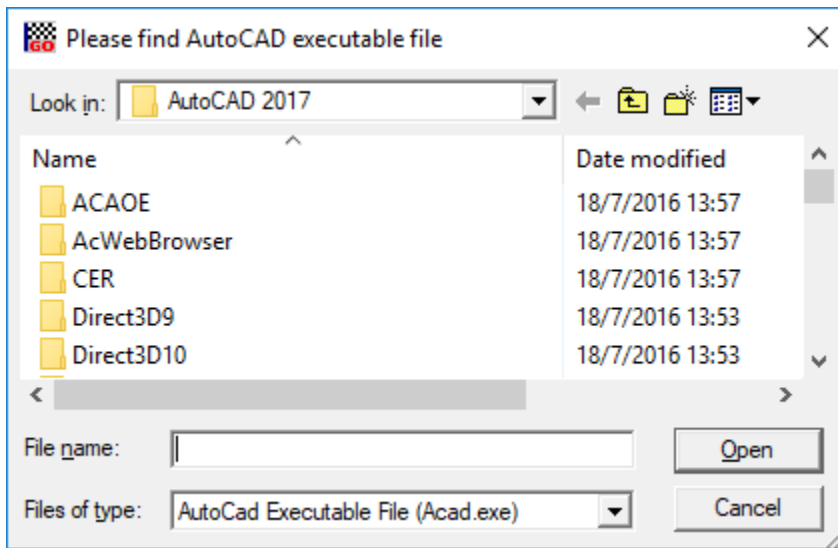


CAD Modeler is installed in the same installation directory with GT STRUDL, under the sub-directory "CADModeler". For example, "c:\Program Files (x86)\GTStrudl\2018\CADModeler" is a typical CADModeler installation directory.

When the copy process is completed, a new dialog named "Finalizing Setup" appears and you are prompted to enter the corresponding AutoCAD and/or BricsCAD Installation Directories.



Press the browse “...” button to find and select the file “acad.exe” or “bricscad.exe”, in the AutoCAD or BricsCAD installation directory, and press “Open”. The name of the directory is copied to the corresponding edit box, and by pressing “End”, the installation is complete.



2. Using CAD Modeler

2.1. Overview of Using CAD Modeler and configuring AutoCAD/BricsCAD

CAD Modeler can only be launched directly by GT STRUDL; by initializing an instance of AutoCAD or BricsCAD and automatically loading CAD Modeler ARX/BRX Application (CADModeler) in the same instance. CAD Modeler creates a separate AutoCAD/BricsCAD user profile, named "CADModeler", so the CAD Modeler menus, icons and ribbons do not affect your standard AutoCAD or BricsCAD environment, or other applications running on the top of them.

CAD Modeler commands can be accessed from the menu, from the ribbon area, or by typing the specific command in the command prompt.

- If AutoCAD/BricsCAD Menu is not turned ON, you have to type "MENUBAR" in the command prompt, and then enter 1.
- If AutoCAD/BricsCAD Ribbon is not turned ON, you have to type "RIBBON" in the command prompt.

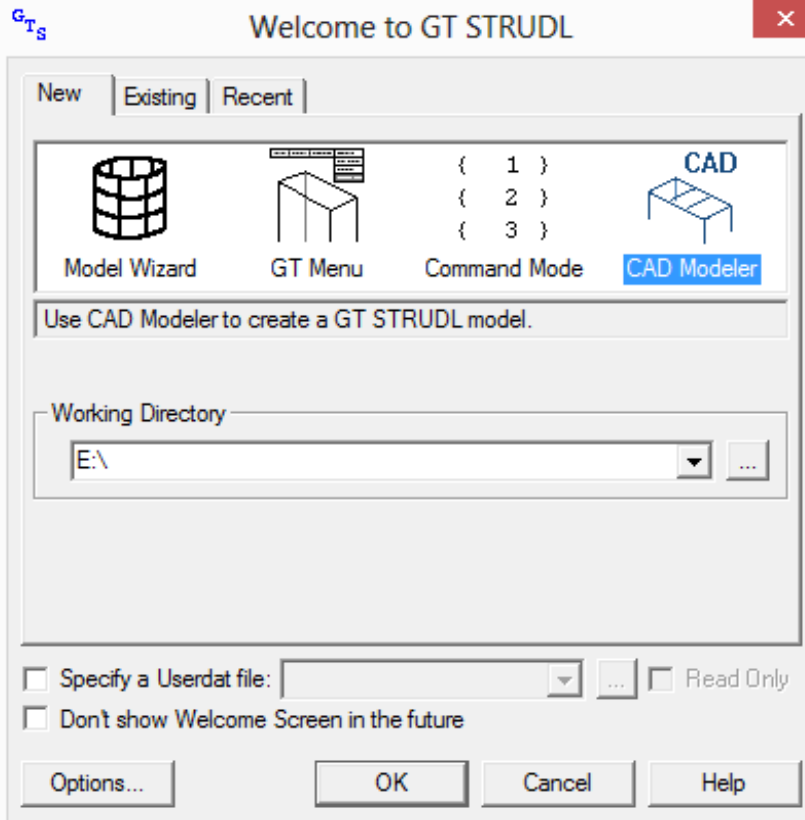
All GT STRUDL structural data, which are created using CAD Modeler, are stored in two files: the .dwg file which contains the AutoCAD/BricsCAD information, and the .db file which contains the structural data. The two files have the same filename (only the extension is different) and they are linked together by CAD Modeler.

CAD Modeler creates a GT STRUDL Input File (.gti) and is able to send this .gti file to the main instance of GT STRUDL, which sits on the background. When analysis is performed in GT STRUDL and results are available for reading, CAD Modeler is able to load them from GT STRUDL DBX (data base exchange) files.

Since CAD Modeler is launched and licensed by the main GT STRUDL application you are not allowed to close the main GT STRUDL window. If GT STRUDL is closed, CAD Modeler outputs a warning and CAD Modeler commands are no longer functional.

2.2. Running CAD Modeler

CAD Modeler is launched from the GT STRUDL Welcome dialog by selecting the "CAD Modeler" icon. A new instance of AutoCAD or BricsCAD, having CAD Modeler automatically loaded, is created. You will be able to identify that CAD Modeler is loaded successfully by having two additional menus ("GTS Modeling" and "GTS Display") next to the AutoCAD or BricsCAD main menus and the "GTS CAD Modeler" and "GTS Display" tabs in the ribbon area.

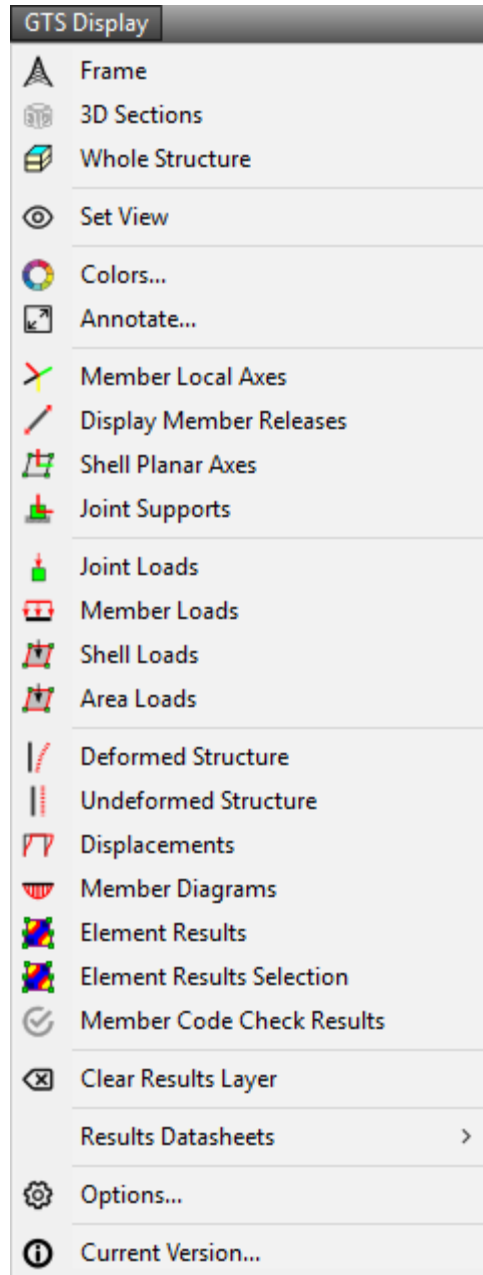
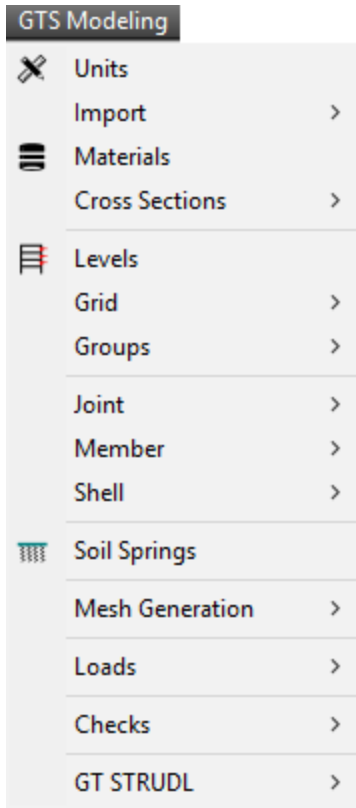


2.3. Menu Bar and Ribbon Area

CAD Modeler commands can be accessed from AutoCAD's or BricsCAD's Ribbon Area at the top of the window by selecting the two tabs at the right: GTS CAD Modeler and GTS Display:



If the AutoCAD or BricsCAD menu is visible, then CAD Modeler commands can be accessed from the Menu Area at the top of the window by selecting GTS Modeling or GTS Display.



2.4. AutoCAD/BricsCAD Commands

You can use AutoCAD or BricsCAD commands, such as Move, Copy, Rotate, Mirror and Delete to generate your model faster. The assumptions made in the use of each command are:

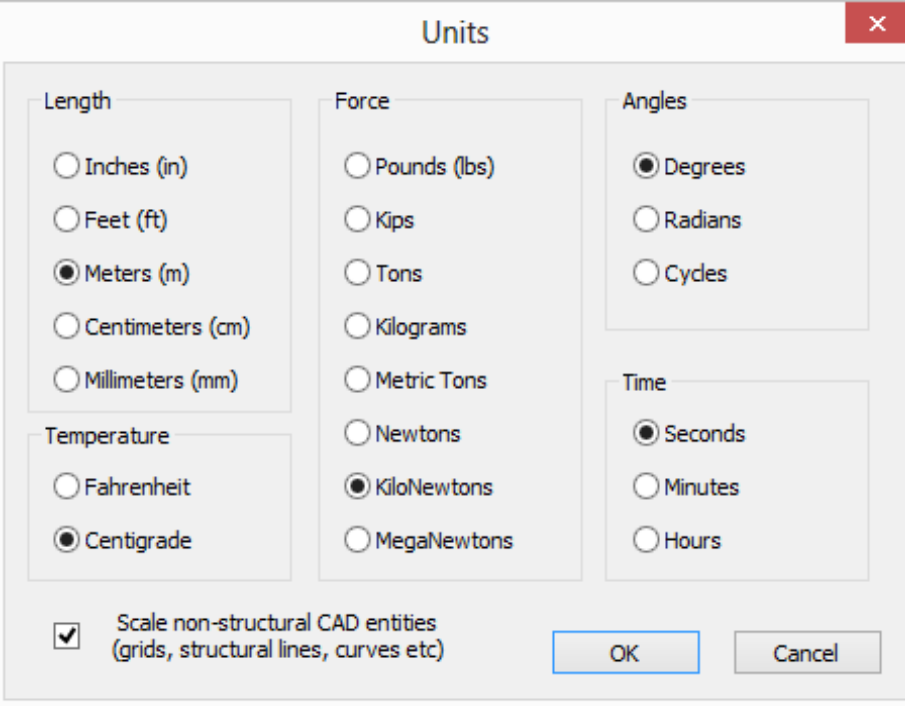
- Move: By moving a joint, the members and finite elements connected to the joint “follow” this movement
- Copy: Joint, Member and Element Loads and Supports are not copied
- Mirror: Joint, Member and Element Loads and Supports are not copied or mirrored. The Beta Angle of members is not mirrored. Element incidence order is mirrored so that element’s orientation, that defines the Z Planar Axis, remains the same.

- Delete: If a joint is deleted, there is a prompt that asks for confirmation since members and elements connected to this joint will automatically be deleted as well.

2.5. CAD Modeler Commands

2.5.1. Units

The following form is used to define the active units, either from ribbon command  **Units** or from the menu “*GTS Modeling>Units*” or by typing `GTSUnits` at the command prompt.



The image shows a dialog box titled "Units" with a close button (X) in the top right corner. The dialog is divided into several sections for selecting units:

- Length:** Radio buttons for Inches (in), Feet (ft), Meters (m) (selected), Centimeters (cm), and Millimeters (mm).
- Force:** Radio buttons for Pounds (lbs), Kips, Tons, Kilograms, Metric Tons, Newtons, KiloNewtons (selected), and MegaNewtons.
- Angles:** Radio buttons for Degrees (selected), Radians, and Cycles.
- Temperature:** Radio buttons for Fahrenheit and Centigrade (selected).
- Time:** Radio buttons for Seconds (selected), Minutes, and Hours.
- Scale non-structural CAD entities (grids, structural lines, curves etc):** A checked checkbox.

At the bottom right, there are "OK" and "Cancel" buttons.

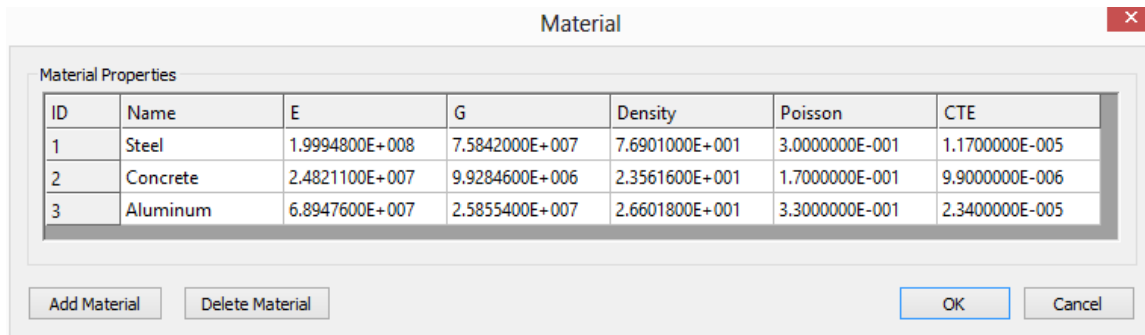
You can change the Units any time during working in CAD Modeler. Moreover, you can choose if the non-structural AutoCAD/BricsCAD entities, such as grids, structural lines, curves, polylines, etc will be scaled together with the structure whenever you change the length units.

The current units appear at the top of the main CAD Modeler window:

GTS CAD Modeler | M KN DEG FAH SEC | Drawing1.dwg

2.5.2. Materials

The following form is used to modify existing material properties or create new materials. You can select this command either from the ribbon command  **Materials** or from the menu “*GTS Modeling>Materials*” or by typing `GTSMaterials` at the command prompt.



The Material Properties dialog box contains a table with the following data:

ID	Name	E	G	Density	Poisson	CTE
1	Steel	1.9994800E+008	7.5842000E+007	7.6901000E+001	3.0000000E-001	1.1700000E-005
2	Concrete	2.4821100E+007	9.9284600E+006	2.3561600E+001	1.7000000E-001	9.9000000E-006
3	Aluminum	6.8947600E+007	2.5855400E+007	2.6601800E+001	3.3000000E-001	2.3400000E-005

Buttons at the bottom: Add Material, Delete Material, OK, Cancel.

2.5.3. Levels

It is optional to define Levels (stories) in your structure. However, it is recommended that you do so when modeling industrial or other building-like structures as this will save you time during the creation of your model. You can access the level properties dialog from the ribbon icon



Levels or from the menu “*GTS Modeling>Levels*” or by typing `GTSLevels` at the command prompt.

Using the *Level Properties* form you can:

- Set the *Height* for each level, in current length units
- Define the visible status of each level: if *Visible* or not
- *Add Levels* to the model
- *Delete Levels* from the model
- *Detect Levels Automatically* using an algorithm to detect levels along the height of the structure by identifying locations having at least four horizontal members.
- *Merge Levels*, by selecting two or more levels and merging them to one.
- Define if the *Vertical Axis* is the global Z or global Y.
- *Update Levels for All Entities*, in order to assign the correct Level to each entity (joint, member or finite element) depending on its coordinates along the height of the structure.

X

Level Properties

Level Heights

Levels	Height	Elevation	Visible
1	4	4.000000	☒
2	3.000000	7.000000	☒
3	3.000000	10.000000	☒

Options

Add Level

Delete Level

Detect Levels Automaticaly

Merge Levels

Base Elevation

0.0000

☒ Z Vertical Axis (else Y)

☐ Update Levels for All Entities

OK

Cancel

After defining Levels, you can switch between levels by either using the “Visible” check boxes from the Level Properties form, or using the ▲ Higher Level and ▼ Lower Level icons in the ribbon area. You can also type `GTSLevelUp` and `GTSLevelDown` at the command prompt.

Moreover, you can define a grid system and/or generate vertical members (Columns) with a single click. These commands will be explained below.

Finally, the current level, if defined, appears at the top of CAD Modeler window, next to the Current Units.

GTS CAD Modeler | M KN DEG CEN SEC | Level: 2

2.5.4. Grid

A Grid system can be defined and used as a pattern for entering beams and columns. In order to be able to enter a Grid, you must first specify Levels in your structure (see the Levels command above). You can access the Grid dialog by expanding the “Levels” tab from the ribbon icon

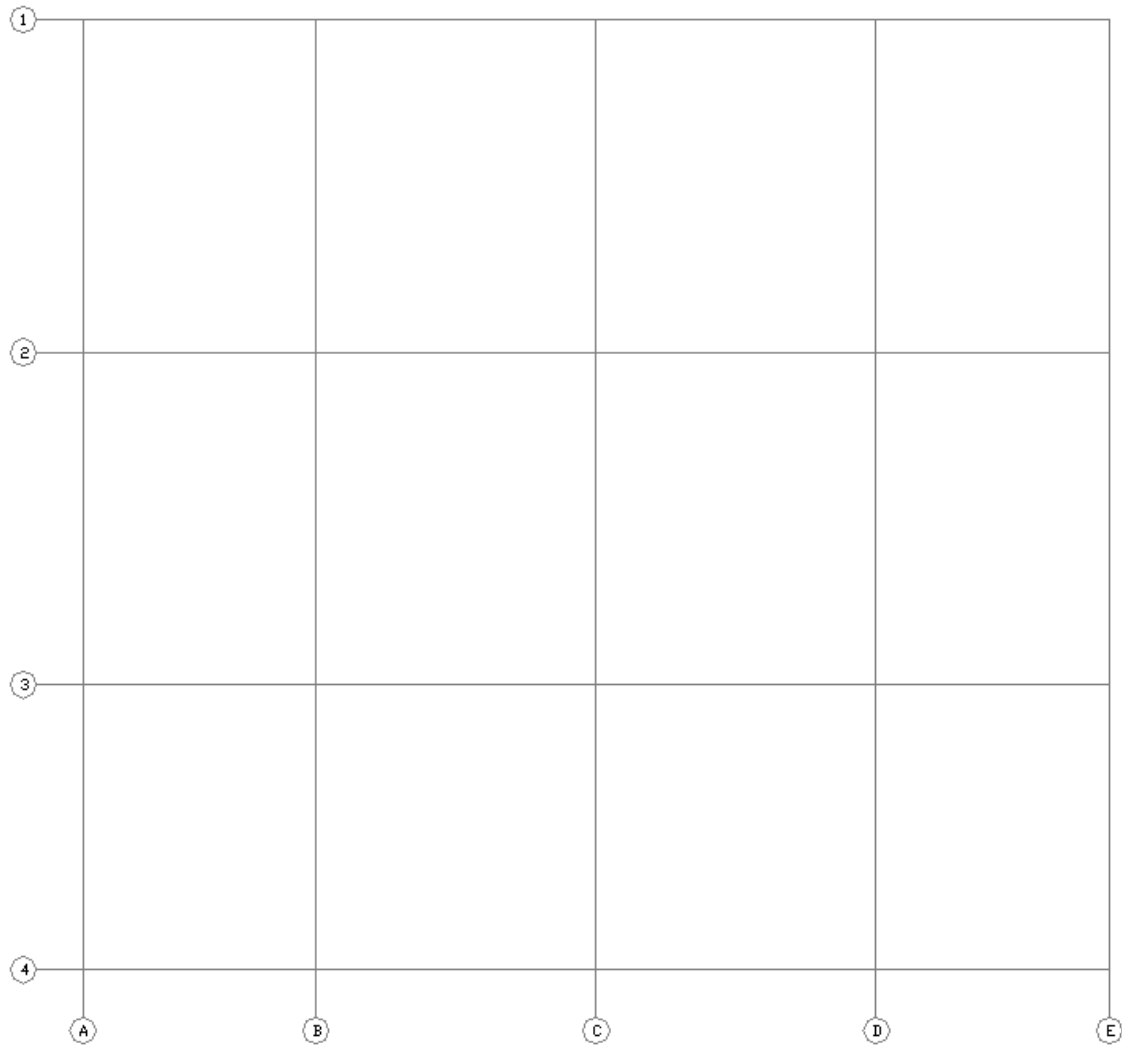


Grid, or from the menu “*GTS Modeling>Grid>Create*” or by typing `GTSGrid` at the command prompt.

Using the *Grid* form you can:

- Set different parameters for the *Horizontal* and *Sidelong* directions of the grid.
- Define and control the spacing in each direction, by entering the desired spacing – *Distance* of the new grid line and pressing *Add* button. Later on you can edit a specified spacing or delete it, using the corresponding buttons *Edit* and *Delete*.
- Define the *Angle* between the *Grid X-Axis* and the global X-axis
- The *Angle* between the *Horizontal* and *Sidelong* lines (default equal to 90 degrees)
- Control the *Height* of fonts
- Control the *Position* of the labels
- Control the *Type* of identification to be either Number or Letters
- Control the *Starting From* item, which can be a number or letter depending on the *Type*.
- Select the levels that this grid will be applied to. You can apply the grid to more than one levels and/or have multiple grids per level.

By pressing OK, you are prompted to enter the *Insert Point* of the grid, meaning the coordinates of the lower left corner of the grid. The grid lines are then created as shown in the figure on the next page.



You can also change the properties of an existing grid by expanding the “Levels” tab and selecting the ribbon icon  **Change Grid**, or from the menu “*GTS Modeling>Grid>Change*” or by typing `GTSGridChange` at the command prompt, and then selecting the Grid to be edited.

2.5.5. Creating Joints

You can generate individual joints from the ribbon command  **Generate** or from the menu “*GTS Modeling>Joint>Generate Joint*” or by typing `GTSJoint` at the command prompt. You then must enter the X,Y,Z coordinates (separated by comma) or click at the corresponding point at the screen. However, for frame structures, it is recommended to start generating members (and joints will be automatically generated at their ends).

If you have already defined Levels at the structure, you can generate individual joints at the current lever from the ribbon command  **At Level** or from the menu “*GTS Modeling>Joint>Generate Joint at Level*” or by typing `GTSJointLevel` at the command

prompt. You then have to enter only X and Y coordinate (Z will be calculated using the current Level's Elevation)

2.5.6. Finding Joints

You can find an individual joint from the ribbon command  **Find Joint** or from the menu “*GTS Modeling>Joint>Find*” or by typing `GTSFJID` at the command prompt and enter the name of the Joint. If the joint name exists, the joint will be selected (by clicking on “change”, you can modify it without making a new selection).

2.5.7. Joint Supports

You can find an individual joint from the ribbon command  **Support** or from the menu “*GTS Modeling>Joint>Support*” or by typing `GTSJointSupport` at the command prompt and select the joint or the joints to be supported. The Joint Properties form then appears, where you can define which degrees of freedom are fixed and also enter a *spring* value in case of elastic supports. Using the *Quick Selection*, you can quickly define a Fixed, Pinned or Free Joint (by default all joints are free)

Restraints & Spring values

Quick Selection : Pin ▼

Restraint	Spring	Restraint	Spring
☒ Fx	0	☐ Mx	0
☒ Fy	0	☐ My	0
☒ Fz	0	☐ Mz	0

2.5.8. Joint Properties

You can change the properties of a joint from the ribbon command  **Change Joint** or from the menu “*GTS Modeling>Joint>Change*” or by typing `GTSJointChange` at the command prompt and select the joint or the joints to be edited or by double-clicking on an existing joint.

Joint Properties

Model **Joint Generalized Loads**

General

Name : 1

Level : 1

dbHandler : 1

Rotation

theta X : 0

theta Y : 0

theta Z : 0

Groups

☐ Inactive Remove

Groups that joint belongs

Joint Coordinates and Offsets

Coordinates		Offset	
X :	10.1116	DX :	
Y :	7.86615	DY :	
Z :	0	DZ :	0

Restrains & Spring values

Quick Selection : ▼

Restraint	Spring	Restraint	Spring
☐ Fx	0	☐ Mx	0
☐ Fy	0	☐ My	0
☐ Fz	0	☐ Mz	0

OK Cancel Apply Help

The “*Joint Properties*” form appears, and at the “*Model*” tab you can enter the *Name* of the Joint (up to 8 characters) the *Level* that the joint belongs (optional), the *theta rotation* angles for rotated support joints, the *Groups* that the joints belongs to, the *coordinates* of the joint in the current unit system, the *restraints* of the joint and the *spring* values.

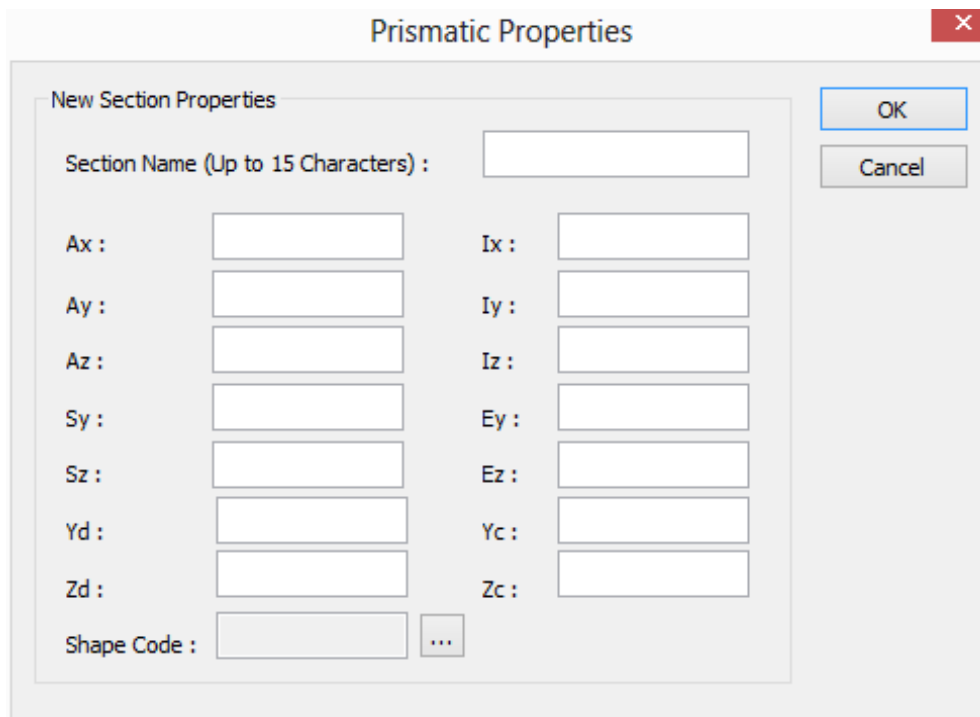
If you select more than one joint, then “*Multiple Selection*” appears at the top of the Joint Properties form, and all data entered in the form will be applied to all selected joints.

2.5.9. Sections

For models which contain frame members, you should select the cross sections to be added to your project either from the default cross section library or by creating user defined prismatic cross-sections or by importing user defined cross sections that have been created in GTSTRUDL.

Prismatic cross sections can be created from the Menu “*GTS Modeling >Cross Sections>Prismatic*” or by typing `GTSPismatic` at the command prompt.

In the dialog shown below, you enter the cross sectional properties in the current unit system.



The image shows a software dialog box titled "Prismatic Properties" with a red close button in the top right corner. Inside the dialog, there is a sub-section titled "New Section Properties". This section contains a text input field for "Section Name (Up to 15 Characters) :". Below this, there are two columns of input fields for various properties: Ax, Ay, Az, Sy, Sz, Yd, Zd on the left, and Ix, Iy, Iz, Ey, Ez, Yc, Zc on the right. At the bottom left of the sub-section is a "Shape Code" field followed by a button with three dots "...". To the right of the "New Section Properties" sub-section are two buttons: "OK" and "Cancel".

You can access the existing cross section library (GT STRUDL tables) from the ribbon command



Sections, or from the Menu "*GTS Modeling>Cross Sections>Table*" or by typing `GTSPARAMS` at the command prompt.

Using the following form, where all GT STRUDL built-in TABLES are available, you select the cross sections for your project by double clicking on them, at the right part of the screen. The list of selected cross-section profiles appears at the left part of the screen and the selected profiles have a large black dot in front of them.

User defined cross sections, that have been created in GT STRUDL, can be imported in CAD Modeler from the Menu "*GTS Modeling >Cross Sections>Import from User Dataset*" or by typing `GTSOPENDS` at the command prompt. Using the "Select User Dataset DS File" dialog you can select the dataset file (*.ds) that includes the user defined cross sections to be imported. By pressing "Open", the cross sections of the selected .ds file are added to the available built-in TABLES, presented in the previous paragraph.

2.5.10. Creating Members



You can generate individual members from the ribbon command **Generate** or from the menu “*GTS Modeling>Members>Generate Beam Members*” or by typing `GTSCBeam` at the command prompt. You must then enter the X,Y,Z coordinates (separated by commas or click at the corresponding point at the screen) of the member start and then of the member end. Joints are automatically generated at both member ends, unless a joint already exists at the specific point. If so, the member is connected to the existing joint(s).

If you have already defined Levels at the structure, you can generate vertical members



(columns) at the current level from the ribbon command **Vertical** or from the menu “*GTS Modeling>Member>Generate Vertical Member*” or by typing `GTSCColumn` at the command prompt. You then have to enter only one point (starting top point) in the floor plan. The ending bottom point will be automatically calculated, having the same X and Y coordinates, and Z coordinate will be calculated by the current level’s height.

After giving the command the “*Place Member*” form appears, where you define the properties of the member.

Note: Each time you create a member, the orientation of the cross section will appear in the middle of the element, unless you clear it with command “Clear” (see 2.5.71).

Cross Section

Table Section:
 <Select Table Section> ▼ ...

or Member Dimensions:
 Pipe ▼

or Same as Member:
 <Select Existing Member> ▼

Material
 Steel ▼ ...

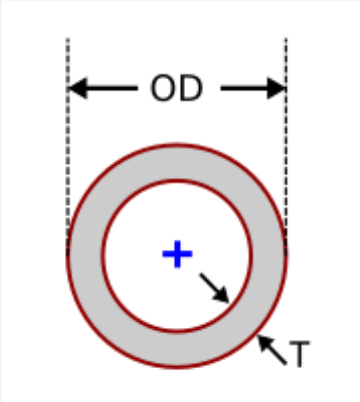
Releases
 11 Fix-Fix ▼

Beta (o)
 0 ▼

☒ Split Intersecting Members
☒ Split Ending Members

Place Member(s) >>

Section Properties



OD : 0.8
 T : 0.02

You can select:

- A Table Section from the list of available sections in the project, **or** give the dimensions of the typical shapes available **or** match the section properties of one existing member to save time typing the values.
- The Material from the list of available materials in the project
- Common Member
Releases configuration
- Beta angle (in degrees)
- To split intersecting members, along new member's length, including the new member
- To split ending members, if the member starting and/or ending joints are placed along existing members.

Then, you must click on the "Place Member(s) >>" button and start placing members.

You can change the properties while the command is active, and the next member(s) will be placed using the new values.

When you are done, press ESC to exit from the command. The form is hidden automatically.

2.5.11. Finding Members

You can find an individual member from the ribbon command  **Find Member** or from the menu "GTS Modeling>Member>Find" or by typing `GTSEFMID` at the command prompt and

enter the name of the Member. If member name exists, the member will be selected (by clicking on “change” you can modify it without making a new selection).

2.5.12. Splitting Members



You can split a member into two or more parts from the ribbon command **Split** or from the menu “*GTS Modeling>Member>Split Member*” or by typing `GTSSplitMember` at the command prompt and select the Member to be split. You then define “*Distance for splitting the member or the number of equal parts (negative number)*”, entering:

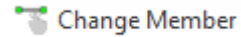
- the position of the split, meaning the length of the 1st part starting from starting joints, or
- the number of equal parts that will be generated after the split, by typing a negative number. For instance, entering -3 means to split the original member into 3 equal parts.

2.5.13. Merging Members



You can merge two members to one member from the ribbon command **Merge** or from the menu “*GTS Modeling>Member>Merge Members*” or by typing `GTSMergeMembers` at the command prompt and select two members. The two members must have a common joint (middle). After merging the middle joint is NOT deleted and you have to delete it manually. This joint can be removed manually, using AutoCAD’s/BricsCAD’s erase command, or by using CAD Modeler’s “Remove Floating Joints” Command.

2.5.14. Member Properties



You can change the properties of a member from the ribbon command **Change Member** or from the menu “*GTS Modeling>Member>Change*” or by typing `GTSBeamChange` at the command prompt and select the member or the members to be edited or by double-clicking on an existing member.

The “*Member Properties*” form appears, and at the “*Model*” tab you can enter the *Name* of the Member (up to 8 characters), the *Level* that the member belongs to (optional), the *Type* of the Member (Space Frame or Space Truss), *Starting* and *Ending* Joints, *Beta Angle*, the *Groups* that the member belongs to, the *Cross-Section* applied to this member and the corresponding section properties, the *Material* of the member, member *releases* and *elastic end connection* spring values, *End Sizes* and global *Member Eccentricities*.

Member Properties

Model | **Section Properties** | Member Loads | Member Temperature Loads | Member Distortions

General

Name : 163

Level : 1

Type - Incidences

Type : SPACE FRAME

Start : 196

End : 197

Beta Angle : 90

Physical Member

Groups

☐ Inactive ... Remove

Groups that Member belongs

Section Properties

Section : W4x13 STEELW AISC 7th Edit ...

Ax : 3.82 Ix : 0.154

Ay : 1.165 Iy : 3.76

Az : 1.868 Iz : 11.3

Sy : 1.85 Ey : 0

Sz : 5.45 Ez : 0

Yd : 4.16 Yc : 2.08

Zd : 4.06 Zc : 2.03

Shape Code : 1.0

Material Properties

Material : Steel ...

E : 2.9e+07 Density : 0.2833

G : 1.1e+07 CTE : 6.49865e-06

Poisson : 0.3

Releases & Elastic Connection spring values

Quick Selection :

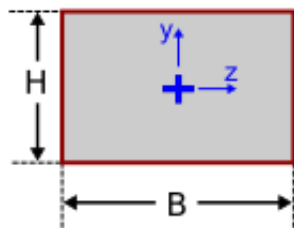
	Start	Spring	End	Spring
☐ Fx	0		☐ Fx	0
☐ Fy	0		☐ Fy	0
☐ Fz	0		☐ Fz	0
☐ Mx	0		☐ Mx	0
☐ My	0		☐ My	0
☐ Mz	0		☐ Mz	0

End Sizes OR Member Eccentricities (Offsets)

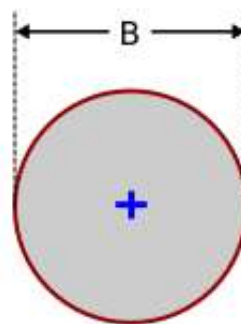
	Start	End
Sizes :	0	0
X :	0	X : 0
Y :	0	Y : 0
Z :	0	Z : 0

OK Cancel Apply Help

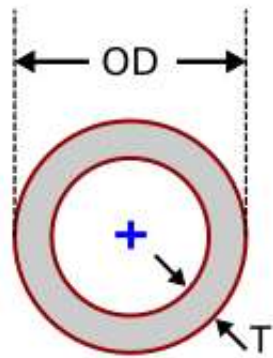
Using the “Section Properties” tab, you can define typical concrete shapes or other shapes that appear in the next image. Shapes having the identifier “Concrete” should be used for thick sections.



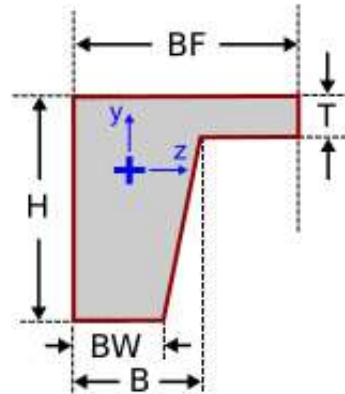
Rectangle (Concrete)



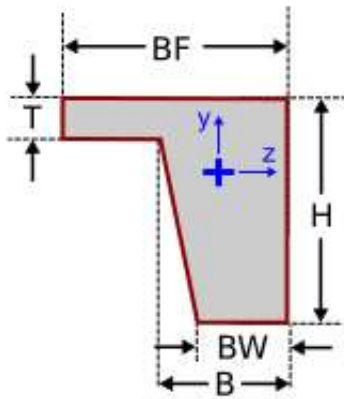
Circle (Concrete)



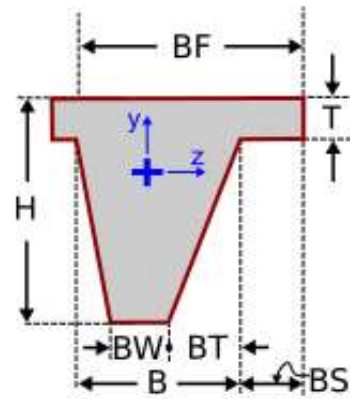
Pipe



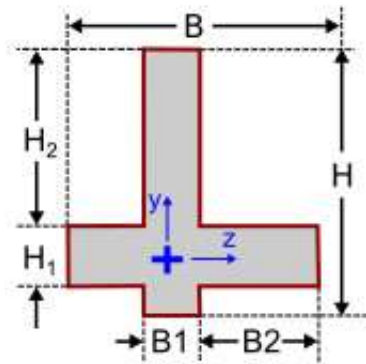
Right L (Concrete)



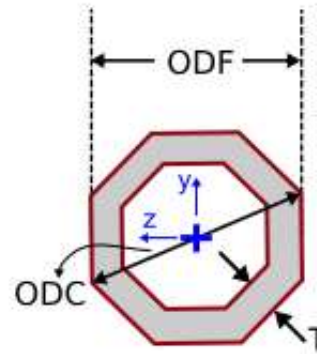
Left L (Concrete)



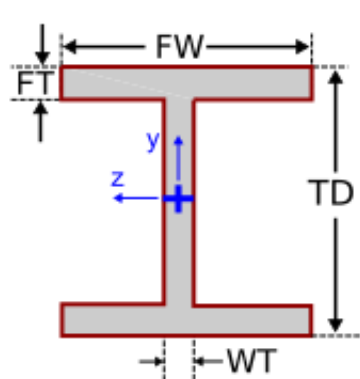
T Shape (Concrete)



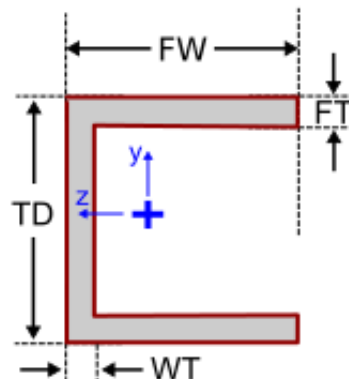
Cross (Concrete)



Polygon



I Shape



Channel

If you select more than one member, then “*Multiple Selection*” appears at the top of the Member Properties form, and all data entered in the form will be applied to all selected members.

2.5.15. Member Filters

You can select members of the structure, that fulfill several criteria, using the icon  **Filter** or from the menu “*GTS Modeling>Member>Filter*” or by typing `GTSFilterMembers` at the command prompt.

Members can be filtered forming queries of three different categories:

- **Their Properties**, that can be: Name, Level, Section, Material, Beta Angle, Group, Release Statues, Kf values, Eccentricities and End Sizes
- **Their Loading Data**, that can be: Load Case, Load Type, Load Direction, Load Values and Location.
- **Their Analysis Results**, that can be: Load Case, Member Forces $F_x - F_y - F_z - M_x - M_y - M_z$ for both ends and section forces $F_x - F_y - F_z - M_x - M_y - M_z$.

You can set multiple (up to 5) conditions of the same category using logical expressions (AND, OR). For example, filter members that their section is IPE330 AND they belong to level < 3 AND their beta angle is greater than or equal to 90.

After the query is formed, your press “Execute >>” and the IDs of the members fulfilling the criteria appear in the “Results” list.

Filtered members may be:

- Added to any Group
- Selected as AutoCAD’s/BricsCAD’s selection (to be edited, moved, copied, moved etc), using the option “*Keep Selected after closing form*”
- Made the only visible entities of the structure, by hiding all other entities, using the option “*Make them the only visible*”

Filter Members

SELECT Members

	Section	=	IPE330 IPE European
AND	Level	<	3
AND	Beta Angle	>=	90
		=	
		=	

Member Loads (Units: kN, m)

SQL Query (WHERE)

```
(nSection = 'Z')
AND (nLevel < '3')
AND (betaAngle >= '90')
```

[Execute >>](#) [Clear](#)

[OK](#)

[Cancel](#)

Member Results / Section Forces

Action

Items Selected: 70

[ADD To Group >>](#) ...

☐ Keep Selected after closing form ☐ Make them the only Members Visible

Result

- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 17
- 18
- 19
- 20
- 21
- 22
- 23
- 24
- 25
- 26
- 33
- 24

2.5.16. Creating Shell Finite Elements

Shell finite elements are generated automatically using the meshing functions described below. However, you can generate individual quadrilateral or triangle shell elements one by one.

Quadrilateral elements can be created using the icon  **Quad** or from the menu “*GTS Modeling>Shell>Generate quad at joints*” or by typing `GTSShell` at the command prompt. You must then enter the X,Y,Z coordinates (separated by commas or click at the corresponding point at the screen) of the four corners of the quad element. Joints are automatically generated unless a joint already exists at the specific point. If so, the element is connected to the existing joint(s).

Triangular elements can be created using the icon  Triangle or from the menu “GTS Modeling>Shell>Generate triangle at joints” or by typing GTSShellT at the command prompt. You must then enter the X,Y,Z coordinates (separated by commas or click at the corresponding point at the screen) of the three corners of the triangular element. Joints are

automatically generated unless a joint already exists at the specific point. If so, the element is connected to the existing joint(s).

2.5.17. Reverse Incidence Order

The Incidence Order (clockwise or counterclockwise) of selected shell elements can be reversed using the icon  **Reverse** or from the menu “*GTS Modeling>Shell>Reverse Incidence Order*” or by typing `GTSShellReverse` at the command prompt. The Incidence Order defines the orientation of the Element’s Planar Z and Local Z Axes which then also affects the Local and Planar X and Y Axes.

2.5.18. Finding Shells

You can find an individual shell element from the icon  **Find Shell** or the menu “*GTS Modeling>Shell>Find*” or by typing `GTSFEID` at the command prompt and enter the name of the element. If the element name exists, the shell element will be selected (by clicking on “change” you can modify it without making a new selection).

2.5.19. Shell Properties

You can change the properties of a shell finite element from the icon  **Change Shell** or the menu “*GTS Modeling>Shell>Change*” or by typing `GTSShellChange` at the command prompt and select the shell or the shells to be edited or by double-clicking on an existing shell element.

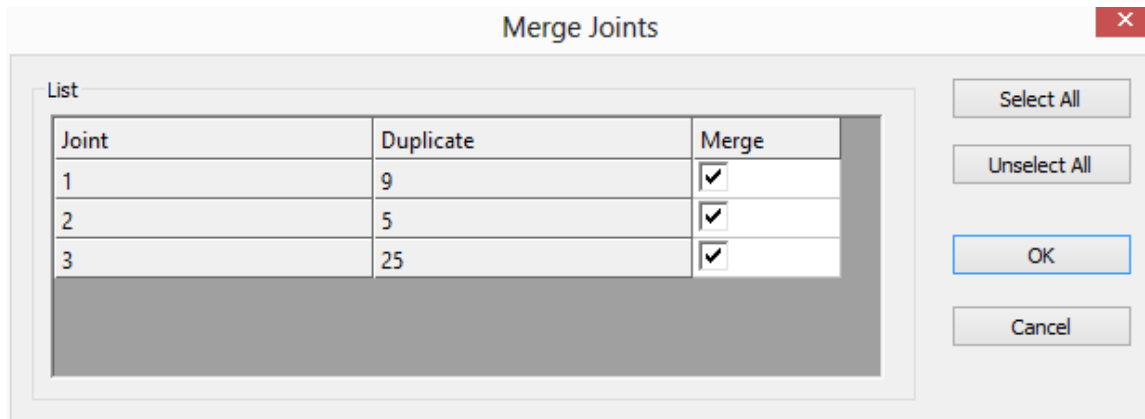
The “*Element Properties*” form appears as shown below, and from the “*Model*” tab, you can enter the *Name* of the Element (up to 8 characters), the *Level* that the element belongs to (optional), the *Type* of the Element, *Joint Incidences*, the *Thickness* of the shell, the *Groups* that the element belongs to and the *Material* of the element.

If you select more than one element, then “*Multiple Selection*” appears at the top of the Element Properties form, and all data entered in the form will be applied to all selected elements.

2.5.20. Joints Duplicates

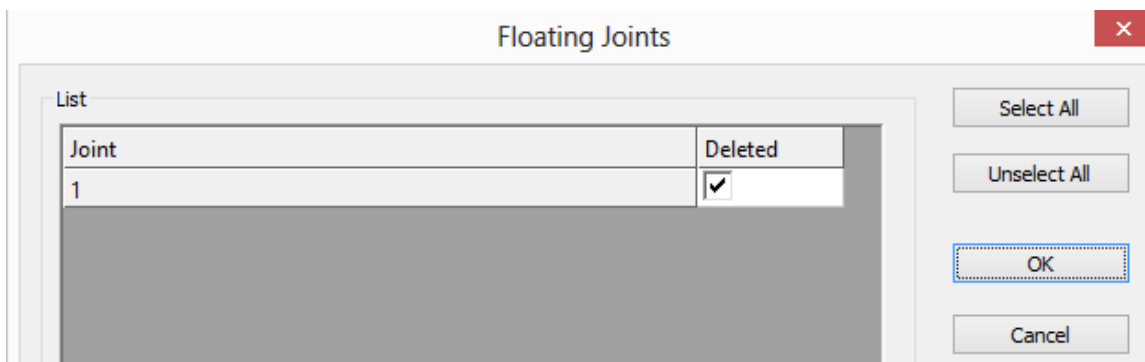
In order to erase joints that have the same coordinates (one on the top of the other) that may have been generated by mesh generation functions, you have to check the model for duplicate

joints from the ribbon command  **Joints Duplicates** in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Joint Duplicates*” from the menu or type `GTSCheckDuplicateJoints` at the command prompt. You then must enter the desired merge accuracy (*Enter Merge Accuracy <0.001000>*). If duplicate joints exist in the structure, a new dialog appears having the full set of duplicate pairs, where you can select the joints to be merged or not as shown on the next page:



2.5.21. Joints Floatings

Floating Joints are the joints that are not connected to any member or finite element, therefore they may cause instability in the solution of the mathematical model. Use the ribbon command  **Joints Floatings** in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Joint Floatings*” from the Menu or type `GTSCheckFloatingJoints` at the command prompt, floating joints are automatically identified, and using the corresponding dialog as shown below, they can be deleted.



2.5.22. Joints Interference

In order to check in order to search for joints close to a member, not connected to it, you can use the ribbon command  **Joints Interference** in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Joints Interference*” from the Menu or type `GTSCheckInteferenceJoints` at the command prompt. You then must enter the desired tolerance (Enter Check Tolerance <0.050800>).

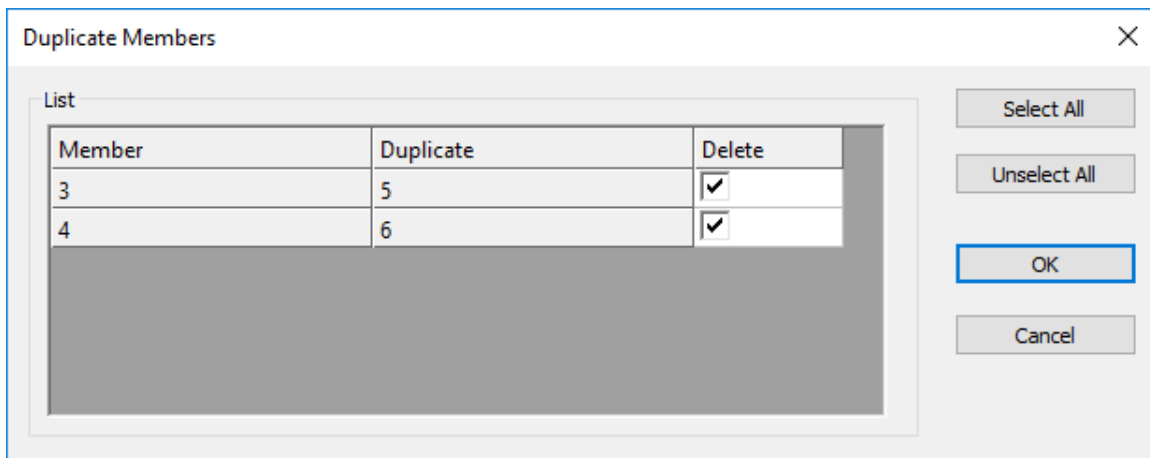
2.5.23. Members Duplicates

In order to check if two members are one on the top of the other (having common joints in any order), you must check the model for duplicate members from the ribbon command



Members Duplicates

in the “Find/Change/Check” panel or select “GTS Modeling>Checks>Members Duplicates” from the menu or type `GTSCheckDuplicateMembers` at the command prompt. If duplicate members exist in the structure, a new dialog appears having the full set of duplicate pairs, where you can select the members to be merged or not as shown in the following figure. For all the selected pairs, one member is deleted (the member was first created is kept).



2.5.24. Members Zero Length

In order to check if a member has zero length, you can use the ribbon command



Members Zero Length

in the “Find/Change/Check” panel or select “GTS Modeling>Checks>Members Zero Length” from the Menu or type `GTSCheckMembersZeroLength` at the command prompt. Following the command execution, you must enter the desired tolerance (Enter Check Tolerance <0.001000>) and then a list of zero length members appears from where you can select which to delete.

2.5.25. Physical Members

Physical members in a frame model are consisted using two or more analytical members. In order to check if physical members exist in the structural entities, you can use the ribbon



Physical Members

command in the “Find/Change/Check” panel or select “GTS Modeling>Checks>Physical Members” from the Menu or type `GTSCheckPhysicalMembers` at the command prompt. The five (5) checks that are performed with their corresponding errors are as follows:

#1. Check that all members have the same Euler angle. If not, there is an error message:

Physical Member %s: Member %s has inconsistent BETA angle

#2. Check that all members have the same cross section. If not, there is an error message:

Physical Member %s: Member %s has inconsistent CROSS SECTION

#3. Checks that all member do not have internal releases. If not, there is an error messages:

Physical Member %s: Member %s has internal RELEASES

Physical Member %s: Starting Member %s has internal RELEASES at its end

Physical Member %s: Ending Member %s has internal RELEASES at its start

#4. Checks that there is a sequential order of members. If not, there is an error message:

Physical Member %s: Members %s (end) and %s (start) do not have common joint (are not SEQUENTIAL)

#5. Check that all members form a straight line. . If not, there is an error message:

Physical Member %s: Member %s is not LINEAR with the physical member

If all 5 checks are successful an informative message appears:

Physical Member %s: OK

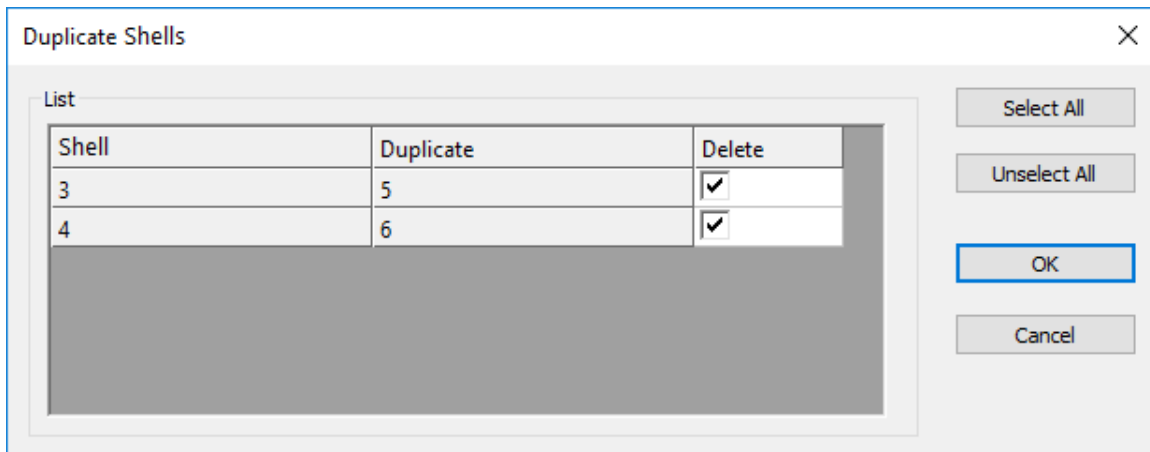
2.5.26. Shells Duplicates

In order to erase shells that coincide (one on the top of the other) that may have been generated by mesh generation functions, you have to check the model for duplicate shells from



Shells Duplicates

the ribbon command in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Shells Duplicates*” from the Menu or type `GTSCheckDuplicateShells` at the command prompt. If duplicate shells exist in the structure, a new dialog appears having the full set of duplicate pairs, where you can select the shells to be merged or not as shown in the following figure. For all the selected pairs, one shell is deleted (the shell first created is kept).



2.5.27. Names Duplicates

In order to check if two joints have the same name or two members have the same name or a member and a shell have the same name, you can use the ribbon command



Names Duplicates

in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Names Duplicates*” from the Menu or type `GTSCheckNames` at the command prompt. If duplicate names exist in the structural elements, a message appears in the command prompt as follows:

```
Joints 4 and 4 have the same Name
Joints 5 and 5 have the same Name
2 Duplicate Names Found
```

2.5.28. Renumber Names

It is often convenient to have continuous numbering (labeling) of joints members and elements. In order to renumber the names of structural entities in ascending order (only if their name is an



Renumber Names

integer), you can use the ribbon command in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Names Duplicates*” from the Menu or type `GTSRenumber` at the command prompt. Following the command execution, you must decide whether or not you want to renumber joints and members/elements by typing yes or no (y or n) to the following questions:

```
Renumber Joints? (Yes/No)
Renumber Members and Elements? (Yes/No)
```

2.5.29. Database Integrity

In order to check that all CADM entities in a DWG have a unique database record, you can use



Database Integrity

the ribbon command in the “Find/Change/Check” panel or select “*GTS Modeling>Checks>Database Integrity*” from the Menu or type `GTSCheckDatabase` at the command prompt. There may be database records, without a dwg entity, or the opposite, dwg entities without a database record. This may happen in very extreme cases (for example, a power supply failure while saving, or out of disk space, etc). Entities/records with a problem are deleted and you get an information message such as the one below:

```
Error Fixed: Joint %s deleted from DWG
Error: Joint %s does not exist in database
```

2.5.30. Soil Springs



You can create soil springs on individual/multiple shell element(s) from the icon **Soil Springs** or by typing `GTSFoundationSprings` at the command prompt and select the corresponding shell element(s). After selection the “Soil Springs” dialog appears, where you can:

- Define in-plane spring ratio of K_s value if the “in-plane (orthogonal) springs” option is checked. The in-plane spring ratio will be applied to the two remaining directions, other than the selected.
- Define the direction of springs (in global system).
- Append new spring values in case of keeping the existing ones and adding the new ones. Else, the new values replace the existing ones
- Define the value of modulus of subgrade reaction K_s .

After pressing “Place Springs”, a legend appears showing the K_s values distribution on the shell elements. By double clicking on each node, you can see the value of K_s in “Restrains and Spring Values” section of the Model tab in the “Joint Properties” dialog box. Note that if the spring’s degree of freedom is not restrained by the user then it is restrained automatically.

General Information

☐ In-plane (orthogonal) springs

In-plane Spring Ratio :

Direction

☐ Global X ☐ Global Y ☒ Global Z

☒ Append Existing Spring Values

Modulus of Subgrade Reaction

K_s :

Place Springs >>

Ks Values

	-0.00 ... 0.08
	0.08 ... 0.15
	0.15 ... 0.23
	0.23 ... 0.31
	0.31 ... 0.38
	0.38 ... 0.46
	0.46 ... 0.54
	0.54 ... 0.62
	0.62 ... 0.69
	0.69 ... 0.77
	0.77 ... 0.85
	0.85 ... 0.92
	0.92 ... 1.00

2.5.31. Meshing along a curve

You can create several members along any selected AutoCAD/BricsCAD linear entity, that can be



a Line, an Arc or a Circle, from the ribbon command **Curve** or from the menu “GTS

Modeling>Mesh Generation>1D Along Line or Curve or Circle” or by typing `GTSMesh1D` at the command prompt.

Select Mesh Properties

Generate
☒ Members ☐ Elements
 Material: Steel

Element Attributes
 Type: BPHQ Thickness: 0.20

Member Attributes
 Type: FRAME Beta: 0.0
 Section:

Spacing U Direction
☒ Uniform 4
☐ Variable
☐ Defined by Line/Curve

Spacing V Direction
☒ Uniform 4
☐ Variable
☐ Defined by Line/Curve

Spacing W Direction
☒ Uniform 4
☐ Variable
☐ Defined by Line/Curve

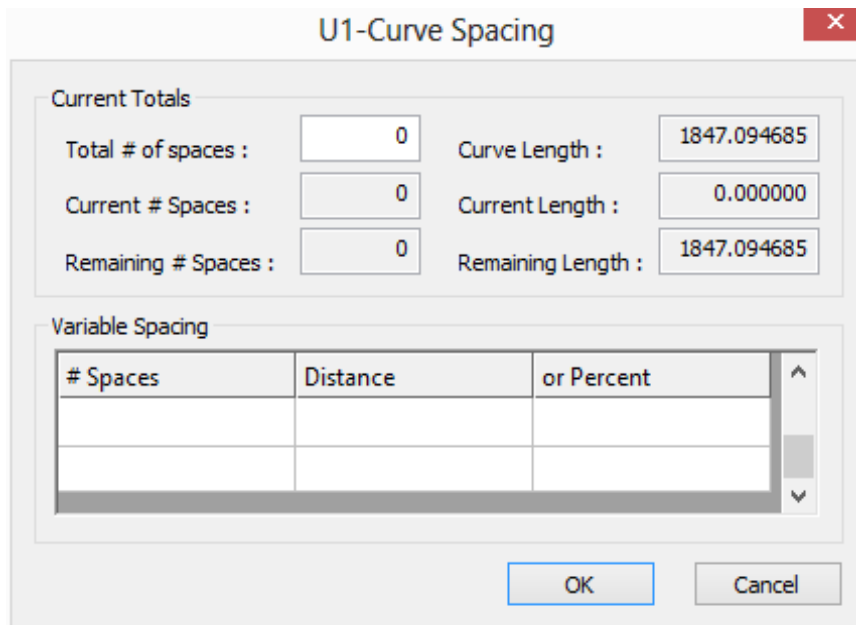
Labeling
 More >> ☐ U Primary Direction

Preview Create Close

After selecting the AutoCAD/BricsCAD linear entity the Mesh Properties dialog appears, where you can define:

- The *Material* of the members to be generated.
- The *Type* of the members (FRAME or TRUSS)
- The *Cross-Section* of the members from a list of previously selected project sections.
- The *Beta* angle that defines the orientation of the cross-section in 3D space.
- The number of members, to be generated, that can be equally spaced (*uniform*) or may have *variable* spacing.
- The *Labeling* (optional) of the joints and members to be generated (“Enter Labeling Rules” form), where you can set the First ID for joints and members and their labeling prefix.
- By clicking “Preview” you are able to preview the members to be generated (without creating any entities).
- By clicking “Create” the members are generated and the *Mesh Properties* form is closed.

By selecting Variable spacing, the “U1-Curve Spacing” form appears, where you can enter the *Total Number of Spaces*, and the *Length* of each part, either in absolute distance or as a percentage of the line or curve’s total length using the dialog shown on the next page.



The "U1-Curve Spacing" dialog box is titled "U1-Curve Spacing" and has a red close button in the top right corner. It contains two main sections: "Current Totals" and "Variable Spacing".

Current Totals:

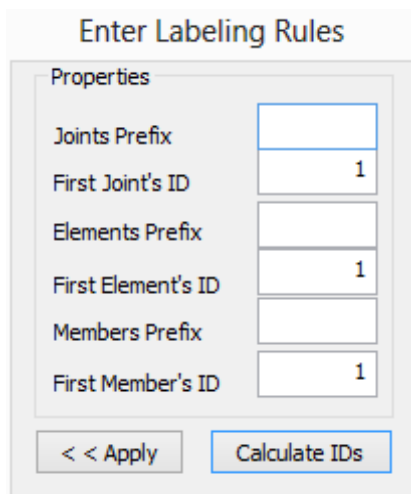
Total # of spaces :	0	Curve Length :	1847.094685
Current # Spaces :	0	Current Length :	0.000000
Remaining # Spaces :	0	Remaining Length :	1847.094685

Variable Spacing:

# Spaces	Distance	or Percent

At the bottom of the dialog are "OK" and "Cancel" buttons.

The “Enter Labeling Rules” form allows you to set the First ID for joints and members to be created and their labeling prefix. Note that the total length of the label cannot be more than 8 characters.



The "Enter Labeling Rules" dialog box is titled "Enter Labeling Rules" and has a "Properties" section. It contains input fields for Joints Prefix, First Joint's ID, Elements Prefix, First Element's ID, Members Prefix, and First Member's ID. At the bottom are "< < Apply" and "Calculate IDs" buttons.

Properties:

Joints Prefix	
First Joint's ID	1
Elements Prefix	
First Element's ID	1
Members Prefix	
First Member's ID	1

Buttons: "< < Apply", "Calculate IDs"

2.5.32. Meshing between two lines

You can create Members or Finite Elements between two selected AutoCAD/BricsCAD linear



entities such as Lines or Arcs, from the ribbon command **2Curves** or from the menu “GTS

Modeling>Mesh Generation>2D Between 2 Lines or Curves” or by typing `GTSMesh2D2L` at the command prompt. You are then asked to select two AutoCAD/BricsCAD curves that will define the U and V boundaries of the Mesh.

The dialog has the same options as in the 1D mesh command and in addition you can also define:

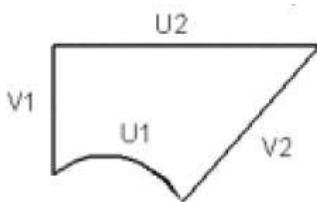
- Members or Elements to be generated (for Members the options are the same as in 1D)
- *Type* of Finite Elements, from the available GT STRUDL Finite Element library
- *Thickness* of Finite Elements
- Spacing in both the U and V directions

2.5.33. Meshing between four lines

You can create Members OR Finite Elements between four selected AutoCAD/BricsCAD linear



entities, that can be Lines or Arcs, from the ribbon command `4Curves` or from the menu “*GTS Modeling>Mesh Generation>2D Between 4 Lines or Curves*” or by typing `GTSMesh2D4L` at the command prompt. You are then asked to select four AutoCAD/BricsCAD curves that will define the U1, U2, V1 and V2 boundaries of the Mesh as shown in the figure below with U2 opposite U1 and V2 opposite V1:



The dialog has the same options as in the 2D mesh between two curves command.

2.5.34. Meshing inside a polyline

You can create Finite Elements inside an AutoCAD/BricsCAD closed curve, that can be a Polyline



or a Circle, from the ribbon command `Area` or from the menu “*GTS Modeling>Mesh Generation>Inside Polyline*” or by typing `GTSMesh2DPoly` at the command prompt. You are then prompted to select the closed AutoCAD/BricsCAD polyline or circular curve.

Select Mesh Properties [X]

Generate

Material: [v] [...]

Element Attributes

Type: [v] Thickness:

Mesh Geometry

External Boundary: [v] [...]

Boundary Maximum Edge Size:

☒ Do not split boundary more than Max

Element Maximum Area:

Mesh Quality: [v]

Internal Boundaries

Add + Remove -

Multi+ Multi -

Internal Joints

Add Remove

Spacing Extrude Direction

☒ Uniform [v]

☐ Variable [v] [...]

☐ Defined by Curve, Size:

Labeling

After selecting the AutoCAD/BricsCAD entity the *Mesh Properties* dialog appears, where you define:

- The *Material* of the elements to be generated
- *Type* of Finite Elements from the available GT STRUDL Finite Element library
- *Thickness* of Finite Elements
- The *Maximum Edge Size* along the Boundary. CAD Modeler will generate additional joints along the boundaries so that there is no finite element edge, along the boundary curve, longer than the entered value.
- You can have the boundary curve to be split in smaller parts than the Max, or not. Additional splitting may be required if you try to increase the quality of the finite element mesh or if you try to control the maximum area of the finite elements.
- The maximum area of each finite element.
- The quality of the triangles that are going to be generated.
- Add one or multiple (MultiA) internal closed boundaries (polylines or circles), or open boundaries (arcs or lines). If a closed internal boundary is selected there is a question asking if you want the elements inside the boundary to be removed (treat it as a hole) or not. Moreover, you will be asked a question regarding the size of elements along the internal boundary curve, that can be 0, so as to follow the current value of the "*Boundary Maximum Edge Size*", or it can be a positive number which defines the maximum length along the internal boundary, or it can be a negative integer which defines the number of equal parts that the internal boundary will be split. NOTE: Internal boundaries may intersect

the external mesh curves, but it is recommended that you manually split the external curve at this point.

- Add internal joints (points) that will be additional corners of the finite element mesh.
- Labeling, Preview and Create functions are identical to the ones of the previously described meshing forms.

2.5.35. Meshing by extruding a polyline

You can create Finite Elements by extruding an AutoCAD/BricsCAD closed curve, that can be a



Polyline or a Circle, from the ribbon command **Extrude** or from the menu “GTS Modeling>Mesh Generation>3D Extrude PolyLine” or by typing `GTSExtrudePoly` at the command prompt. You are then prompted to select AutoCAD/BricsCAD curves, first the extruded curve, and then the curve which defines the extrude direction which can be either a line or polyline. The finite elements will be generated on the extruded surface.

The “Mesh Properties” form is similar to the “Meshing inside a polyline” properties form but you must also define the “Spacing Extrude Direction”, meaning the parameters that control the size of elements along the extrude direction. *Uniform* and *Variable* options are suitable if the extrude entity is a line. “Defined by Curve, size” is suitable if the extrude entity is a polyline, so that it is enforced that joints will be generated at the intermediate points of the polyline.

Labeling, Preview and Create functions are identical to the ones of the previously described meshing forms.

2.5.36. Meshing using 3 curves

You can create Members OR Finite Elements between three selected AutoCAD/BricsCAD linear



entities, that can be Lines or Arcs, from the ribbon command **3Curves** or from the menu “GTS Modeling>Mesh Generation>3D Between 3 Lines or Curves” or by typing `GTSMesh3D3L` at the command prompt. You are then asked to select three AutoCAD/BricsCAD curves that will define the U, V and W boundaries of the Mesh.

The dialog has the same options as in the 2D mesh command, between 2 lines, with the extra parameters for the meshing in the W direction.

2.5.37. Groups

It is optional to define Groups in your model, but it is strongly advised to do so, since it will be easier to control the display and modeling of parts of your structure. Each Group is defined as a set of joints, members and finite elements. Each structural entity can belong in more than one

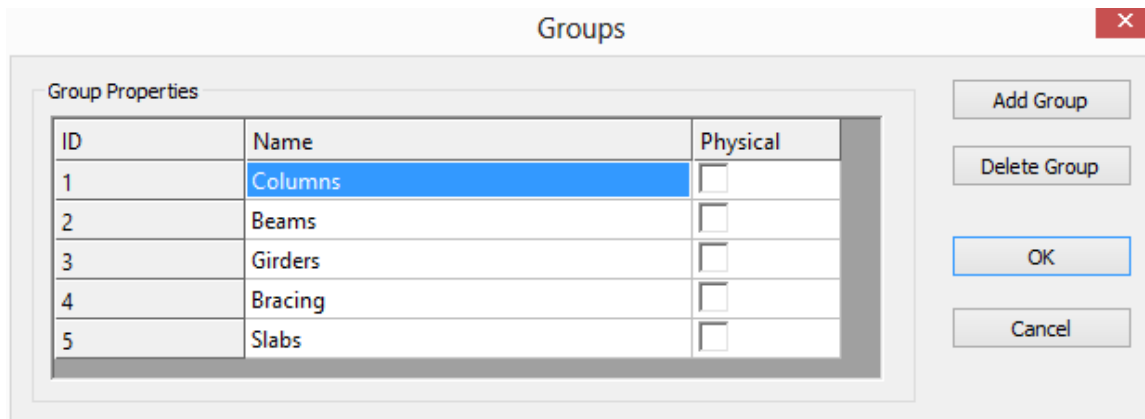
group. Moreover, Groups defined in CAD Modeler are exported to the GT STRUDL Input file (.gti), meaning you can also use them in GT STRUDL analysis and design commands.



You have to first define the name of each group from the ribbon icon  or from the menu “GTS Modeling>Groups>Manage” or by typing `GTSGroups` at the command prompt.

Using the Groups Form you can:

- Set the *Name* of each Group (NOTE: not larger than 8 characters, due to a GT STRUDL limitation)
- *Add Groups* to the model
- *Delete Groups* from the model
- Define if this Group is corresponding in a “Physical” member definition (used in Steel Design commands).



ID	Name	Physical
1	Columns	☐
2	Beams	☐
3	Girders	☐
4	Bracing	☐
5	Slabs	☐

After defining a group you can enter joints, members and shell elements to it using the commands:

 **+Joints** ribbon icon, or “GTS Modeling>Groups>Add Joints” or by typing `GTSGroupJoints` at the command prompt

 **+Members** ribbon icon, or “GTS Modeling>Groups>Add Members” or by typing `GTSGroupMembers` at the command prompt

 **+Shells** ribbon icon, or “GTS Modeling>Groups>Add Shells” or by typing `GTSGroupShells` at the command prompt

2.5.38. Self - Weight

The Self-weight load of the structure can be created from the ribbon command  **Self Weight** or from the menu “GTS Modeling>Loads>Self Weight” or by typing `GTSSelfWeight` at the command prompt.

The “*Self-Weight*” form appears where you can define:

- the global direction of the self-weight
- the load factor (default = 1.0) for the self-weight
- if the self-weight of finite elements will be taken into account or not

2.5.39. Load Cases

A new load case can be created from the ribbon command  **Load Cases** or from the menu “*GTS Modeling>Loads>Load Cases*” or by typing `GTSNewLoadCase` at the command prompt. The “*Load Case*” form appears as shown below where you can enter new load cases, modify existing ones, or delete them.

Load Case

Load Case Information

Load ID (up to 8 chars) : LL

Description : Live Load

Load ID List : LL
PL

Create New

Save / Modify

Delete

Exit

2.5.40. Joint Loads

A Joint Load can be entered from the ribbon command  **Joint** or from the menu “*GTS Modeling>Loads>Joint Load*” or by typing `GTSJointLoad` at the command prompt. You then have to select the joint or the joints that the load will be applied to.

At the “*Joint Generalized Loads*” tab you can apply joint loads or displacements. On the left part of the form, you can see a list of all available load cases: Load cases having loads already applied to the specific joint appear at the top list box. Load cases that do not have any loads applied to the specific joint appear at the bottom list box. Next to the name of each load case there is a \$ symbol followed by the total number of joints that are already loaded in the specific load case.

Joint Properties ✕

Model
Joint Generalized Loads

Applied Load Cases

PL \$[1]

Empty Load Cases

LL \$[0]

Loading

Load Case :

Description :

Loads in this Load Case :

Applied Load Values

Force X :

Force Y :

Force Z :

Moment X :

Moment Y :

Moment Z :

Applied Displacement Values

Tran X :

Tran Y :

Tran Z :

Rot X :

Rot Y :

Rot Z :

2.5.41. Member Loads

A Member Load can be entered from the ribbon command  **Member** or from the menu “*GTS Modeling>Loads>Member Load*” or by typing `GTSBeamLoad` at the command prompt. You then have to select the member or the members that the load will be applied to.

At the “*Member Loads*” tab or the Member Properties form as shown below, you can apply member loads. In the left part of the form you can see a list of all available load cases: Load cases having loads already applied to the specific member appear in the top list box. Load cases that do not have any loads applied to the specific member appear in the bottom list box. Next to the name of each load case there is a \$ symbol followed by the total number of members that are already loaded in the specific load case. The load distribution can be Concentrated, Uniform, Linear or Triangular and it can be applied in any local member or global direction. The Location can be entered in fractional terms (0: start, 1: end) or absolute terms in current length units measured from the start of the member.

Member Properties

Model
Section Properties
Member Loads
Member Temperature Loads
Member Distortions

Applied Load Cases

LL \$ Live Load \$(125)

Loading

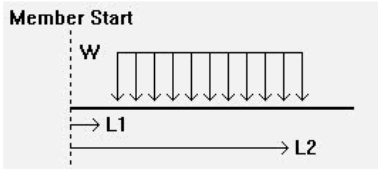
Load Case : Create New

Description : Save / Modify

Loads in this Load Case : Delete

Load Distribution

☐ Concentrated
☒ Uniform
☐ Linear
☐ Triangular



Empty Load Cases

PL \$ Point Load \$(0)

Load Type and Direction

☒ Force
☐ Moment

☐ X
☐ Y
☒ Z

☐ Local
☒ Global

Loading Magnitude

V1 :

V2 :

Loading Location from Start

☒ Fractional

L1 :
 L2 :

☐ Absolute

L1 :
 L2 :

OK
Cancel
Apply
Help

Using the “*Member Temperature Loads*” tab, you can define Axial or Bending temperature change along a part of the member, similar to the “*Member Loads*” tab as shown on the next page.

Finally, using the “*Member Distortions*” tab, you can define concentrated or uniform distortion of the member in any direction along the member as shown on the next page.

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Member Properties

✕

Model

Section Properties

Member Loads

Member Temperature Loads

Member Distortions

Applied Load Cases

Loading

Load Case :

Description :

Loads in this Load Case :

Temperature Change

☒ X Axial Uniform through cross-section
☐ Y Bending Vary through depth Change :
☐ Z Bending Vary through width

Location: Length experiencing temperature change

☒ Fractional (% 0-1) Starting Location :
☐ Absolute (len) Ending Location :

Member Properties

✕

Model

Section Properties

Member Loads

Member Temperature Loads

Member Distortions

Applied Load Cases

Loading

Load Case :

Description :

Loads in this Load Case :

Distortion Type

☐ Concentrated
☒ Uniform

Distortion Direction - Value

☒ Displacement ☒ X
☐ Rotation ☐ Y Value :
☐ ☐ Z

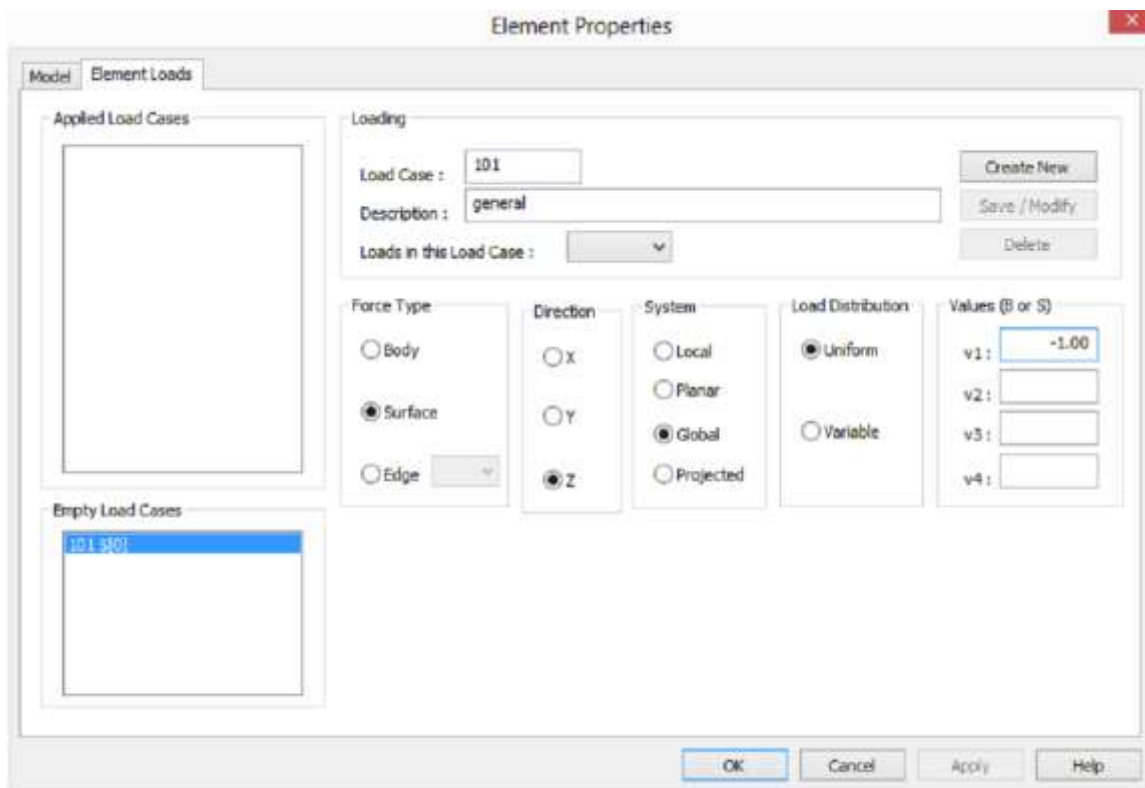
Distortion Location

☒ Fractional (% 0-1) LA :
☐ Absolute (Len) LB :

2.5.42. Shell Loads

A Shell Load can be entered from the ribbon command  **Shell** or from the menu “GTS Modeling>Loads>Shell Load” or by typing `GTSShellLoad` at the command prompt. You then have to select the shell or the shells that the load will be applied to.

Using the “*Element Loads*” tab of the Element Properties form, you can apply element loads. In the left part of the form, you can see a list of all available load cases: Load cases having loads already applied to the specific element appear in the top list box. Load cases that do not have any loads applied to the specific element appear in the bottom list box. Next to the name of each load case there is a \$ symbol followed by the total number of elements that are already loaded in the specific load case. The Force type can be Body, Surface or Edge, in any Local, Planar, Global or Projected direction with uniform or variable values.



The screenshot shows the "Element Properties" dialog box with the "Element Loads" tab selected. The dialog is divided into several sections:

- Applied Load Cases:** A large empty list box for load cases already applied to the element.
- Empty Load Cases:** A list box containing one entry: "101 \$500".
- Loading:** Fields for "Load Case:" (containing "101"), "Description:" (containing "general"), and "Loads in this Load Case:" (a dropdown menu). Buttons for "Create New", "Save / Modify", and "Delete" are on the right.
- Force Type:** Radio buttons for "Body", "Surface" (selected), and "Edge".
- Direction:** Radio buttons for "X", "Y", and "Z" (selected).
- System:** Radio buttons for "Local", "Planar", "Global" (selected), and "Projected".
- Load Distribution:** Radio buttons for "Uniform" (selected) and "Variable".
- Values (B or S):** Input fields for v1 (containing "-1.00"), v2, v3, and v4.

At the bottom are buttons for "OK", "Cancel", "Apply", and "Help".

2.5.43. Area Load

An Area Load can be entered from the ribbon command  **Area** or from the menu “GTS Modeling>Loads>Area Load” or by typing `GTSAreaLoad` at the command prompt.

Area Load ✕

Generate

Name : ▼

Description :

Load - Direction

Load Value :

Global Direction Perpendicular to the Loading Plane :

☐ X
 ☐ Y
 ☒ Z

Plane Tolerance :

Elevation

Plane Perpendicular at :

☒ Value (coordinate)

☐ Joint ▼

Distribution

☒ Two way
 ☐ X
 ☐ One way
 ☐ Y
 ☐ Custom
 X
 Y

Advanced Features

Using the Area Load form you can define:

- The Name of the Load (up to 8 characters)
- The description of the load
- The Loading Value in current units (force/length²). A positive value is applied in the negative global DIRECTION
- The Global direction of the loading plane (X, Y or Z) and the tolerance
- The position (Elevation) of the plane, defined by a coordinate or an existing Joint. All members belonging to the plane having this elevation are located and loaded by GT STRUDL.
- The Distribution of the load (one way or two way)

Advanced Optional Features:

- Outline Region: Select the members that form the closed perimeter of the loaded area. If an Outline Region is defined then the area load is applied ONLY to the selected area and NOT to the whole plane having the elevation defined above.
- Exclude Area: Internal openings or islands not being loaded may be specified by selecting the members that define the perimeter of the excluded area.

- Ignore Members: Select members that you do not want to be loaded (eg bracing members)

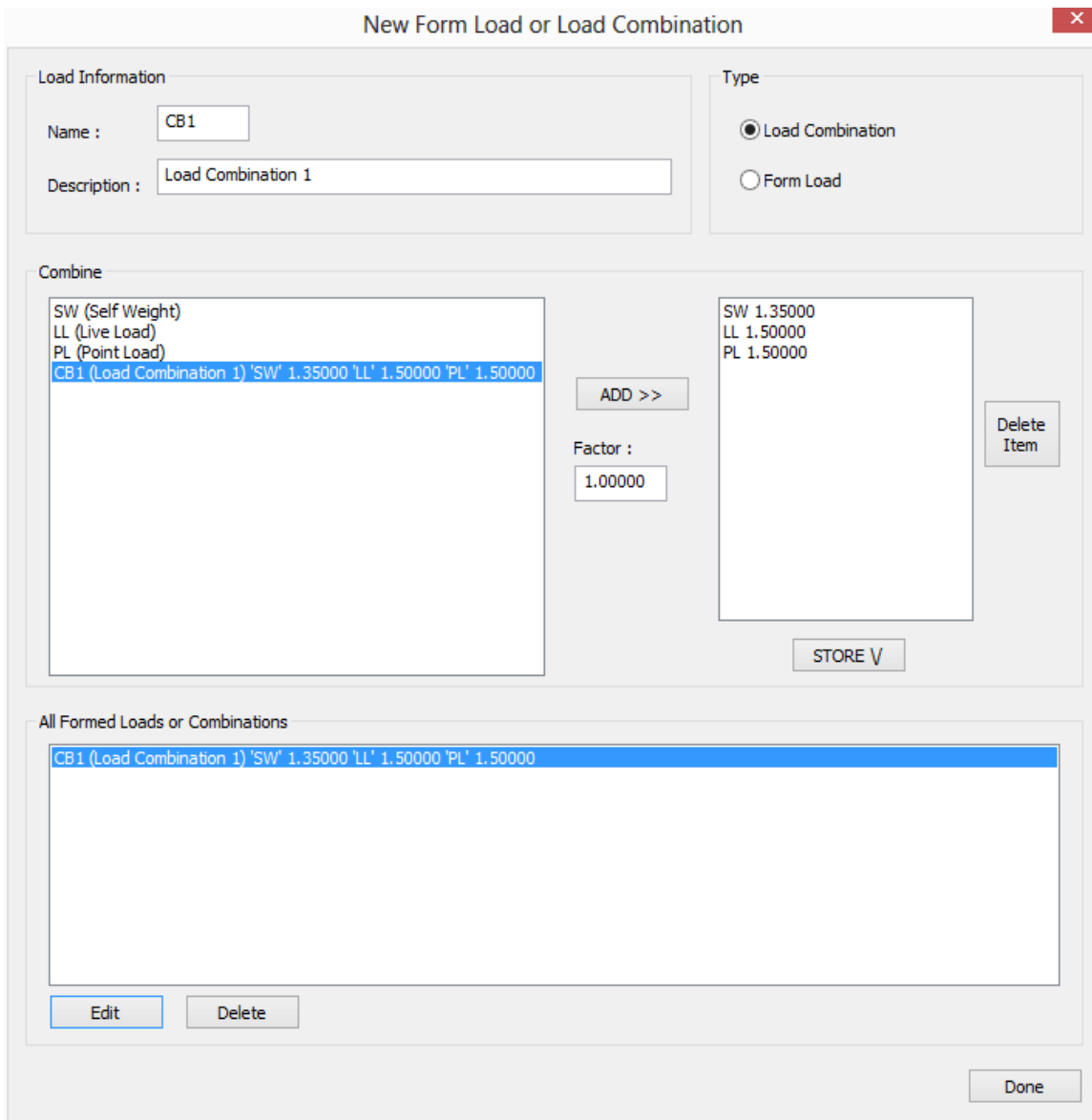
By selecting "Display >>" you are able to graphically view the loaded area, marked with a yellow hatch pattern.

2.5.44. Load Combinations

A new load combination can be created from the ribbon command  **Combinations** or from the menu “*GTS Modeling>Loads>Load Combinations*” or by typing `GTSLoadCombination` at the command prompt. The “*New Load Combination*” form appears where you can enter new load combinations. For each Load Case or Load Combination, that appears in the left list box, you define a factor and using the “*ADD>>*” button the selected load case is added in the combination.

When all load cases are added, press the “*STORE*” button to store the load combination.

Using the same form, you can also Edit an Existing Load Combination (remember to press “*STORE*” after you are done with the modifications). You can also Delete an Existing Load Combination using this form.

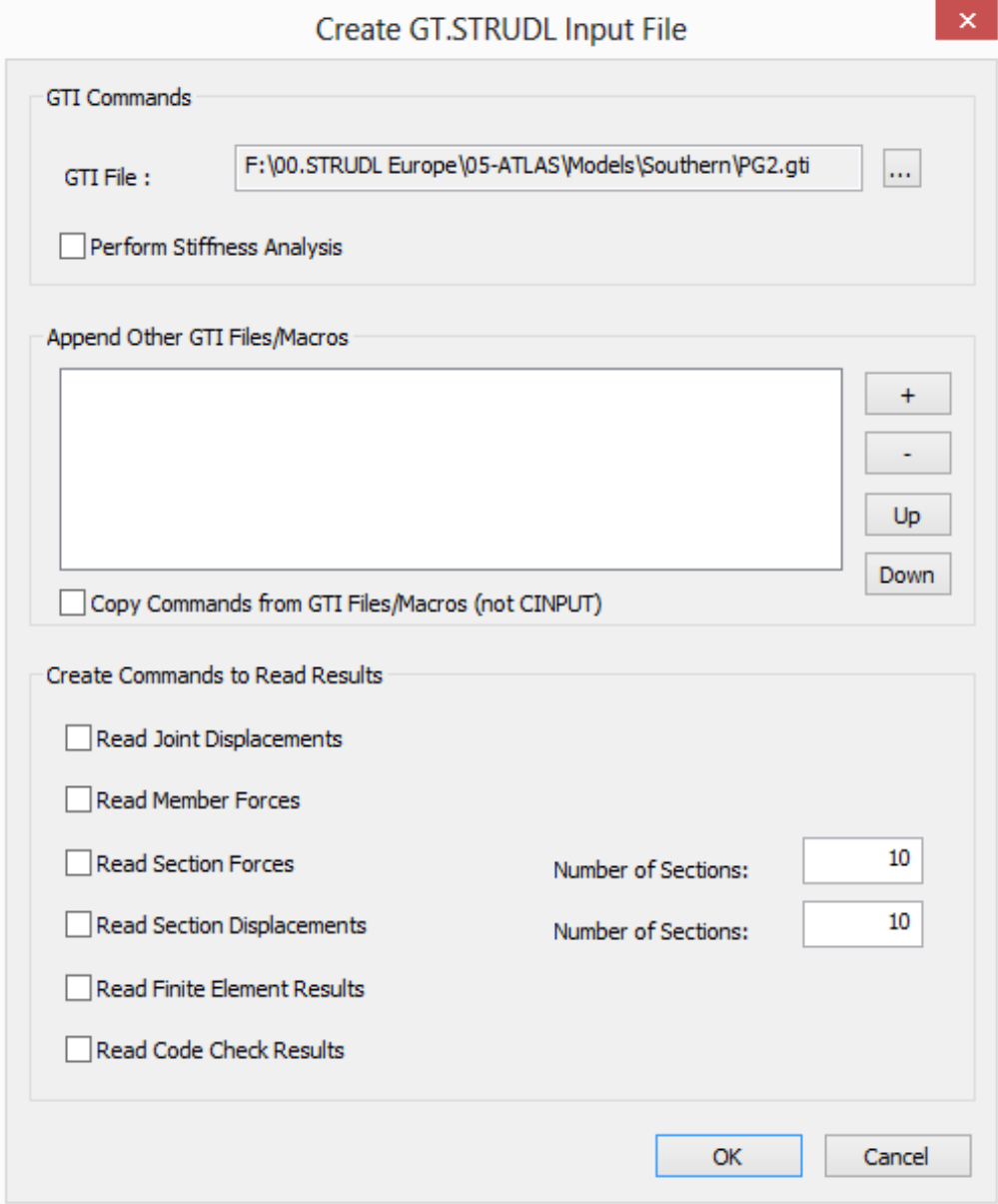


The dialog box is titled "New Form Load or Load Combination" and contains the following sections:

- Load Information:**
 - Name:
 - Description:
- Type:**
 - ☒ Load Combination
 - ☐ Form Load
- Combine:**
 - Left list box: SW (Self Weight), LL (Live Load), PL (Point Load), **CB1 (Load Combination 1) 'SW' 1.35000 'LL' 1.50000 'PL' 1.50000**
 - ADD >> button
 - Factor:
 - Right list box: SW 1.35000, LL 1.50000, PL 1.50000
 - Delete Item button
 - STORE button
- All Formed Loads or Combinations:**
 - List box: **CB1 (Load Combination 1) 'SW' 1.35000 'LL' 1.50000 'PL' 1.50000**
 - Edit button
 - Delete button
- Done button

2.5.45. Create GTI

A GT STRUDL Text Input file can be generated from the ribbon command  or from the menu “GTS Modeling>Create GT.STRUDL GTI” or by typing `GTSEXPORGTGI` at the command prompt. In the “Create GTSTRUDL Input File” dialog, you can enter the filename of the GTI File and add additional commands to your GTI file, such as the Stiffness Analysis command to perform a static analysis automatically and commands which control the analysis results data that can be imported into CAD Modeler immediately after the analysis is complete.



The dialog box is titled "Create GT.STRUDL Input File" and contains the following sections:

- GTI Commands**
 - GTI File :
 - ☐ Perform Stiffness Analysis
- Append Other GTI Files/Macros**
 -
 -
 - ☐ Copy Commands from GTI Files/Macros (not CINPUT)
- Create Commands to Read Results**
 - ☐ Read Joint Displacements
 - ☐ Read Member Forces
 - ☐ Read Section Forces Number of Sections:
 - ☐ Read Section Displacements Number of Sections:
 - ☐ Read Finite Element Results
 - ☐ Read Code Check Results

Buttons:

Moreover, you can append additional GTI Files or Macros at the end of the GTI file of the model. For example, additional GTI files may include static or dynamic analysis commands, result output commands or member design commands. If you check “Copy Commands from GTI

Files/Macros (not CINPUT) then the above mentioned files or macros will be copied in your GTI file. Otherwise, there will be a reference to them, with a CINPUT command.

2.5.46. Edit GTI

The GT STRUDL Text Input file can be edited from the ribbon command  **Edit Input File** or from the menu “*GTS Modeling>Edit GT.STRUDL GTI*” or by typing `GTSEditGTI` at the command prompt. The previously created GTI is opened for editing using the default text editor.

2.5.47. Execute GT STRUDL

GTSTRUDL can be launched, to process the previously created GTI, from the ribbon command  or from the menu “*GTS Modeling>Edit GT.STRUDL GTI*” or by typing `GTSExecuteGTI` at the command prompt.

2.5.48. Read Analysis Results

After performing the stiffness analysis in GT STRUDL, results can be read back to CAD Modeler, from the ribbon command  **Read Results** or from the menu “*GTS Modeling>Read GTSTRUDL Results*” or by typing `GTSResultsGTI` at the command prompt.

“*Read GTSTRUDL Results*” form appears, where you can choose to import Displacements, Member Forces, Section Forces, Section Displacements, Finite Element Results and Code Check Results. Depending on your selection a set of GTI DBX commands are created in the edit boxes shown below. If you have selected the same options in “Generate GTI” command, then the DBX commands are already included in your GTI file. Else, they should be copied and pasted into GT STRUDL main window. Do not press OK before the writing of the files in the GT STRUDL main window has completed.

Read GT.STRU DL Results ✕

Read DBX Results

GTI Directory : ...

☒ Read Joint Displacements

☒ Read Member Forces

☒ Read Section Forces Number of Sections:

☒ Read Section Displacements Number of Sections:

☐ Read Finite Element Results

Type of element result : ▾

Surface : ▾

☐ Read Code Check Results

GTI Commands

Corresponding GT STRU DL commands:

```

DBX BINARY
WRITE REPLACE JOINT RESULTS JOINTS EXISTING
WRITE REPLACE MEMBER RESULTS MEMBERS EXISTING
WRITE REPLACE SECTION FORCES NS 10 MEMBERS EXISTING
WRITE REPLACE SECTION DISPLACEMENTS GLOBAL NS 10 MEMBERS EXISTING

```

By pressing OK you will get the confirmation message “Results Loaded Successfully” at the command prompt. Else, you will get an error message informing you about the type of analysis results that are missing and the corresponding DBX full path file names.

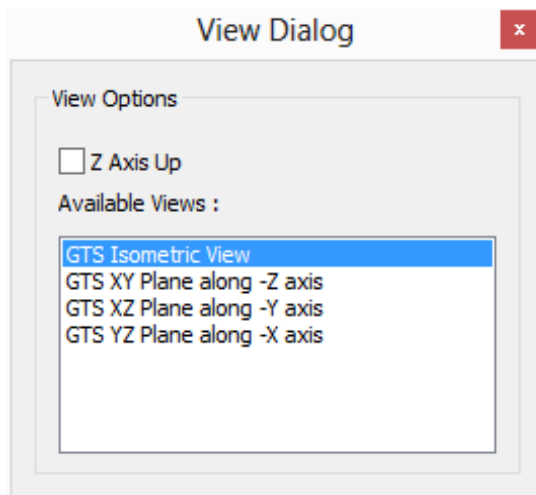
2.5.49. Import GTI

An existing GTI file can be imported it into CAD Modeler from the menu “*GTS Modeling>Import>GT.STRU DL GTI*” or by typing `GTSGTIRead` at the command prompt. Note that the GTI should be generated by the command “File>Save>Text Input File...” from GT STRU DL main menu.

2.5.50. Set Views

You can switch between different 2D or 3D views of the structure from the ribbon command  **Set View** or from the menu “*GTS Display>Set View*” or by typing `GTSSetView` at the command prompt.

It is strongly recommended to use Z as the vertical axis, so as to be able to use all built-in AutoCAD or BricsCAD functions for Views (Top, Bottom, Left, Right, Isometric, etc). However, if you use Y as the vertical axis, you can use this form to have identical 2D and 3D views, as in GTMenu.



2.5.51. 3D or Wireframe View of the Structure

You can switch between the 3D view or wireframe view of the structure.

You can view the 3D display of your model from the ribbon command  or from the menu “*GTS Display>3D Sections*” or by typing `GTSSet3D` at the command prompt. When 3D view is selected, all members appear as solid cross sections and shell elements are displayed in 3D view taking into account their thickness.

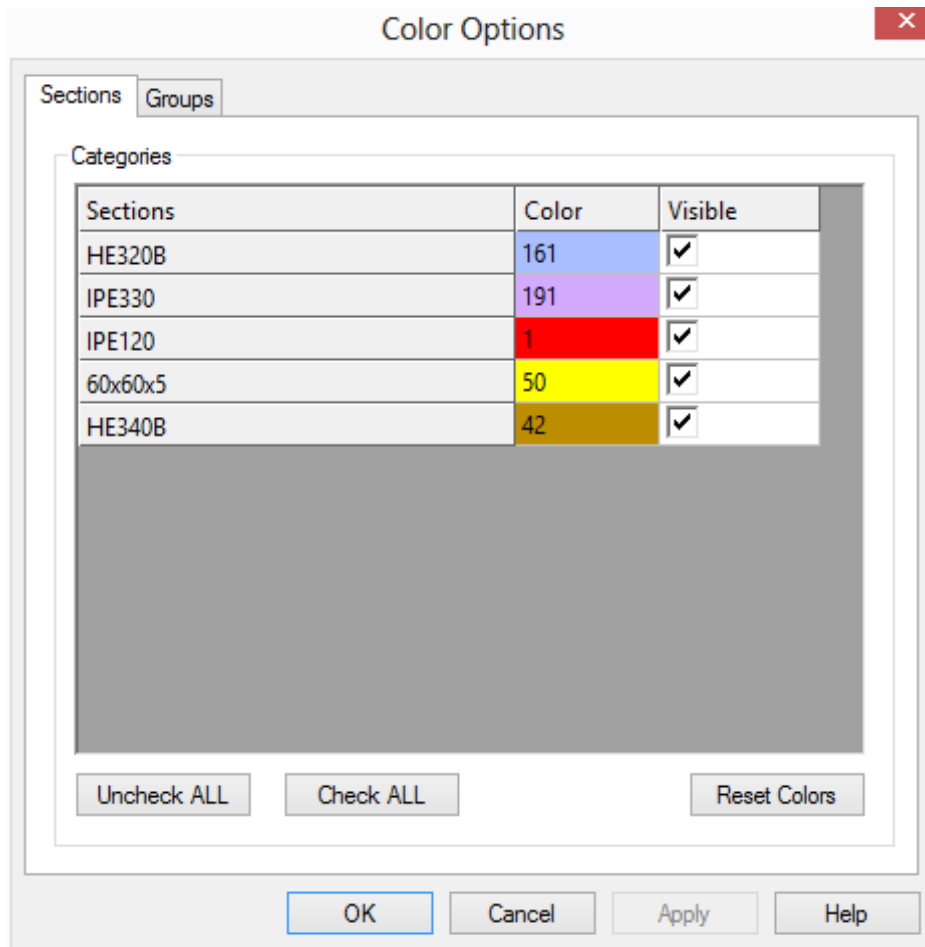
You can view the wireframe display of your model from the ribbon command  **Frame** or from the menu “*GTS Display>Frame*” or by typing `GTSSet1D` at the command prompt. When the wireframe view is selected, all members and shell edges are displayed as lines.

If some parts of the structure are hidden (i.e. using Level's form) you can display the whole structure from the ribbon command  **All** or from the menu “*GTS Display>Whole Structure*” or by typing `GTSSetAllVisible` at the command prompt.

2.5.52. Colors and Visible Elements

You can control the color of each member or element, and its visibility from the ribbon command  **Colors** or from the menu “GTS Display>Colors” or by typing `GTSColorView` at the command prompt.

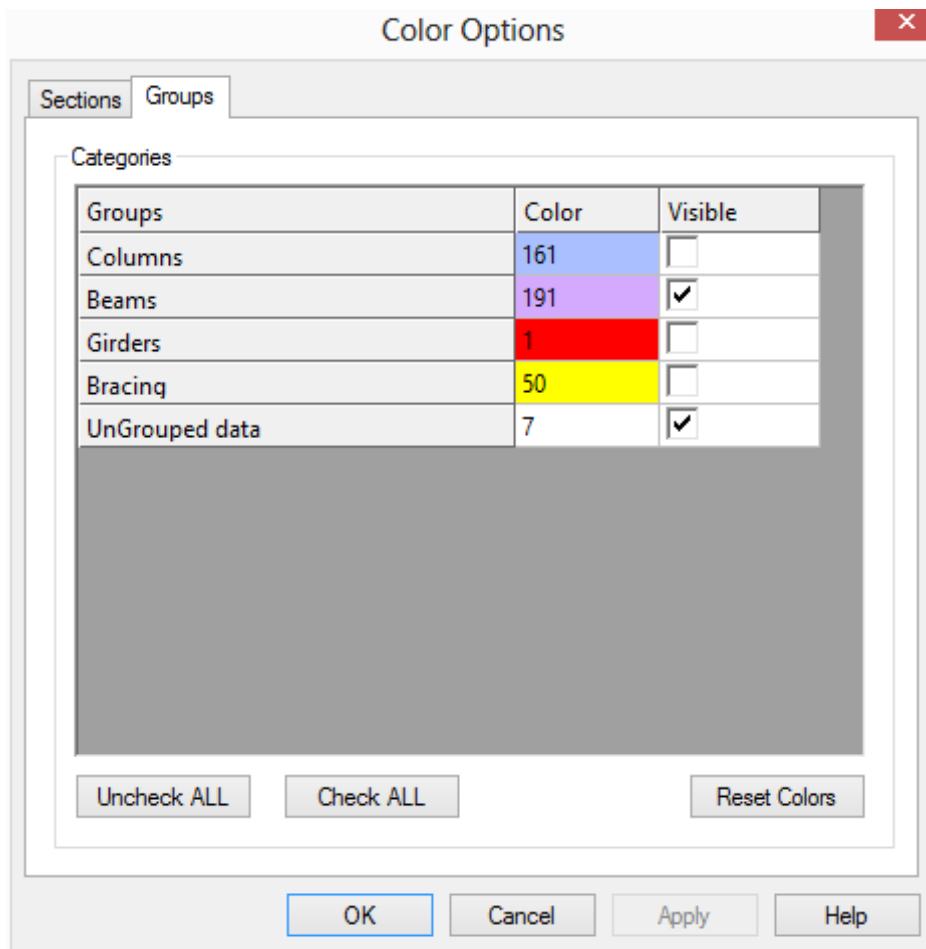
Using the tab “Sections” in the “Color Options” form shown below, you can assign a different color for each cross-section profile and set its visibility to ON or OFF. By pressing “Reset Colors”, all colors are set to defaults.



The image shows the "Color Options" dialog box with the "Sections" tab selected. The dialog has a title bar with a close button (X). Inside, there are two tabs: "Sections" and "Groups". The "Sections" tab is active, showing a table with columns "Sections", "Color", and "Visible". The table lists five sections: HE320B, IPE330, IPE120, 60x60x5, and HE340B. Each section has a corresponding color and a checked "Visible" checkbox. Below the table are three buttons: "Uncheck ALL", "Check ALL", and "Reset Colors". At the bottom of the dialog are four buttons: "OK", "Cancel", "Apply", and "Help".

Sections	Color	Visible
HE320B	161	☒
IPE330	191	☒
IPE120	1	☒
60x60x5	50	☒
HE340B	42	☒

Using the tab “Groups” in the “Color Options” form, you can assign a different color for each group and set its visibility to ON or OFF. Moreover, you can set a color for entities that do not belong to any group (*UnGrouped data*). For entities belonging to more than one group, only the 1st group is taken into account.



Note, that if the “Sections” tab is active when pressing “OK”, then the colors will be selected according to the “Sections” tab. If the “Groups” tab is active when pressing “OK”, then the colors will be selected according to the “Groups” tab.

2.5.53. Display Options

You can set the display options from the ribbon command  **Options** or from the menu “GTS Display>Options” or by typing `GTSDisplay` at the command prompt. Using the “Display Options” form shown below, you can:

- set which objects will be visible or not
- set object colors
- set which labels will be visible or not
- set font sizes for labels. NOTE: Font sizes are defined in length units, except Annotation fonts that are entered in Points.
- set object sizes
- set the shrink factor for finite elements and members. This option makes it is easier for you to detect members that lie along finite element edges.

- Do Not Display Thickness in 3D. If you check this option, elements will be displayed as being 2D instead of a 3D display which shows the thickness of the elements. This option may increase the display speed in very large finite element models.

Display Options

Visible Objects

- ☒ Joints
- ☒ Members
- ☒ 2D Elements
- ☒ 3D Elements

Visible Labels

- ☐ Joints
- ☐ Members
- ☐ 2D Elements
- ☒ 3D Elements

Label Settings - Font Sizes

Joints : 0.250000

Members : 0.250000

2D Elements : 0.250000

3D Elements : 0.250000

Annotation (pts) : 8.000000

Object Sizes

Joint : 0.050000

Load Arrowhead (pts): 10.000000

Display Members / Elements

Shrink Factor : 1.0

☐ Do Not Display Thickness in 3D

Scale Factors

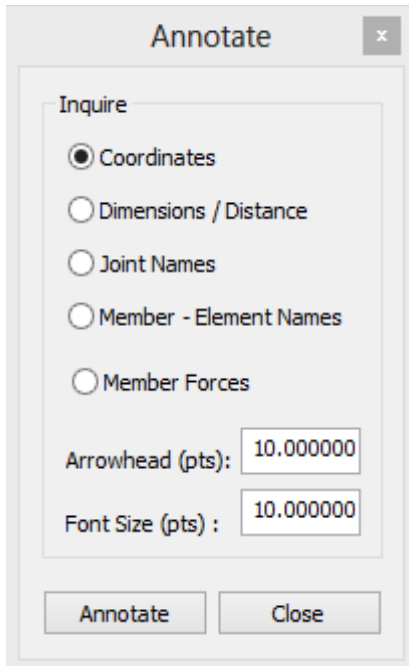
Concentrated Load (pts): 72.000000

Distributed Load (pts): 72.000000

OK Cancel

2.5.54. Annotate

You can display information related to your model from the ribbon command  **Annotate** or by typing `GTSAnnotate` at the command prompt. The “Annotate” form appears where you choose the type information needed, press the “Annotate” button and select the corresponding entities.

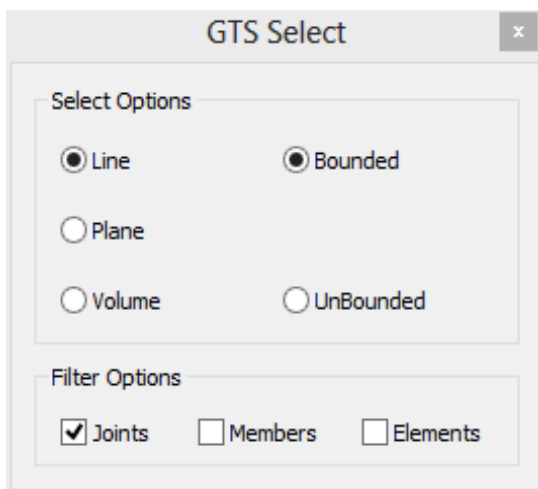


The available inquire options are:

- *Coordinates* of a specific Joint or AutoCAD/BricsCAD Point. Immediately after selecting this you have to select one Joint or Point.
- *Dimension/Distance* between two Joints or AutoCAD/BricsCAD points. Immediately after selecting this you have to select two Joints or Points.
- *Joint Names* to display the name of a specific joint. Immediately after selecting this you have to select one Joint.
- *Member or Element Names*. Immediately after selecting this you have to select one Member or Shell.
- You can also control the size of the fonts (in points) and the arrowhead.

2.5.55. Select CAD Modeler's entities

You can use all AutoCAD's/BricsCAD's selection functions (window, crossing, pick, etc) to select CAD Modeler's structural entities. In addition, there is a command to help you selecting entities, having functionality similar to GTMENU. You can access this command from the ribbon command  **Select** or by typing `GTSSelect` at the command prompt. The "GTS Select" form appears where you can set the selection options.



- Bounded Line Selection: All entities that lie on a Line
- UnBounded Line Selection: All entities that lie on a Line or its extension
- Bounded Plane Selection: All entities that lie on a Plane
- UnBounded Plane Selection: All entities that lie on a Plane or its extension
- Bounded Volume Selection: All entities that are located inside a Volume
- UnBounded Volume Selection: All entities that are located inside a Volume or its extension

Moreover, you can choose to filter only Joint, Members and Elements during the selection.

2.5.56. Display Member Local Axes

You can view the local axes of all members from the icon  **Member Local Axes** (Ribbon GTS Display) or from the menu “*GTS Display>Member Local Axes*” or by typing `GTSDisplayLocalAxes` at the command prompt and immediately after you click at the point where you want the legend to be displayed.

In the legend, the X axis is displayed in cyan, Y axis in red and Z axis in yellow. The size of the arrow and its arrowhead is controlled by the value given at Display Options > Object Sizes > Load Arrowhead and the size of the legend fonts is controlled by the value given at Display Options > Label Settings – Font Sizes > Annotation (pts) (shown in [2.5.53](#)).

2.5.57. Display Member Releases

You can view the member end releases of all members from the icon  **Releases** (Ribbon GTS Display) or from the menu “*GTS Display>Member Releases*” or by typing `GTSDisplayReleases` at the command prompt.

A text identifying the released degrees of freedom appears next to members having releases. No text appears for members that do not have releases. The size of the legend fonts is controlled by the value given at Display Options > Label Settings – Font Sizes > Annotation (pts) (shown in [2.5.53](#)).

2.5.58. Display Shell Planar Axes

You can view the planar axes of all shell elements from the icon  **Shell Planar Axes** (Ribbon GTS Display) or from the menu “*GTS Display>Shell Planar Axes*” or by typing `GTSDisplayPlanarAxes` at the command prompt and immediately after you click at the point where you want the legend to be displayed.

In the legend, the X axis is displayed in cyan, Y axis in red and Z axis in yellow. The size of the arrow and its arrowhead is controlled by the value given at Display Options > Object Sizes > Load Arrowhead and the size of the legend fonts is controlled by the value given at Display Options > Label Settings – Font Sizes > Annotation (pts) (shown in [2.5.53](#)).

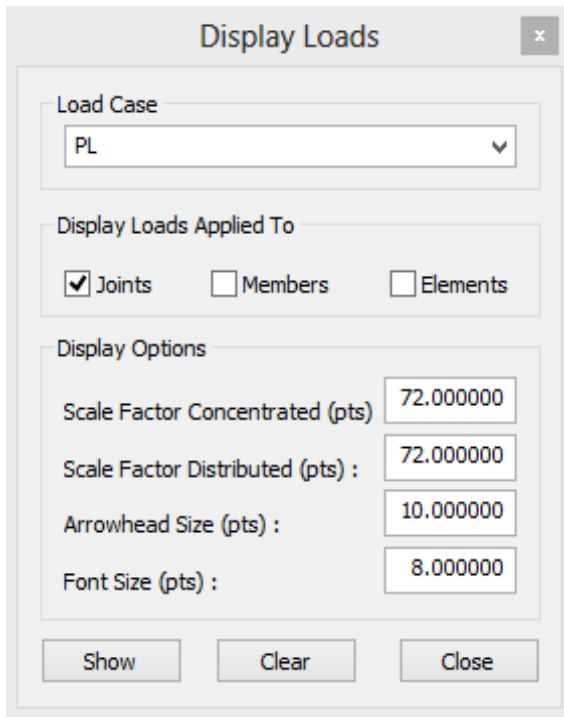
2.5.59. Display Joint Supports

You can view the support status of each joint from the icon  **Joint Supports** (Ribbon GTS Display) or from the menu “*GTS Display>Joint Supports*” or by typing `GTSDisplaySupports` at the command prompt.

A red arrow is displayed for the translational restrained degrees of freedom and a yellow arrow is displayed for the rotational restrained degrees of freedom. The size of the arrow and its arrowhead is controlled by the value given at Display Options > Object Sizes > Load Arrowhead and the size of the legend fonts is controlled by the value given at Display Options > Label Settings – Font Sizes > Annotation (pts) (shown in [2.5.53](#)).

2.5.60. Display Joint Loads

You can view the joint loads applied in the structure from the icon  **Joint** (Ribbon GTS Display) or from the menu “GTS Display>Joint Loads” or by typing `GTSDisplayJointLoads` at the command prompt.



The "Display Loads" dialog box is shown. It has a title bar "Display Loads" with a close button. The dialog is divided into three sections: "Load Case" with a dropdown menu showing "PL"; "Display Loads Applied To" with three checkboxes: "Joints" (checked), "Members" (unchecked), and "Elements" (unchecked); and "Display Options" with four input fields: "Scale Factor Concentrated (pts)" (72.000000), "Scale Factor Distributed (pts) :" (72.000000), "Arrowhead Size (pts) :" (10.000000), and "Font Size (pts) :" (8.000000). At the bottom are three buttons: "Show", "Clear", and "Close".

The “Display Loads” form appears where you can select the desired *Load Case*, the *Scale Factor* for Joint Loads, *Arrowhead Size* and the *Font Size*. The “Show” button displays the load arrows, and the “Clear” button erases them.

2.5.61. Display Member Loads

You can view the member loads applied in the structure from the icon  **Member** (Ribbon GTS Display) or from the menu “GTS Display>Member Loads” or by typing `GTSDisplayMemberLoads` at the command prompt.

The “Display Loads” form appears where you can select the desired Load Case, the Scale factor for Concentrated or Distributed Member Loads, Arrowhead Size and the *Font Size*. The “Show” button displays the load arrow, and the “Clear” button erases them.

2.5.62. Display Shell Loads

You can view the finite element loads applied in the structure from the icon  **Area** (Ribbon GTS Display) or from the menu “GTS Display>Shell Loads” or by typing GTSDisplayElementLoads at the command prompt.

The “Display Loads” form appears where you can select the desired Load Case, the Scale factor for Concentrated or Distributed Member Loads, Arrowhead Size and the *Font Size*. The “Show” button displays the load arrow, and the “Clear” button erases them.

2.5.63. Display Area Loads

You can view the area loads applied in the structure from the icon  **Area** (Ribbon GTS Display) or from the menu “*GTS Display>Area Loads*” or by typing `GTSDisplayAreaLoads` at the command prompt. Loaded areas appear in yellow solid hatch. If you want to display only one area load, you can use the area load command (2.5.43) to bring up the area load dialog, select the specific area load and click “Display >>”.

2.5.64. Display Deformed Structure

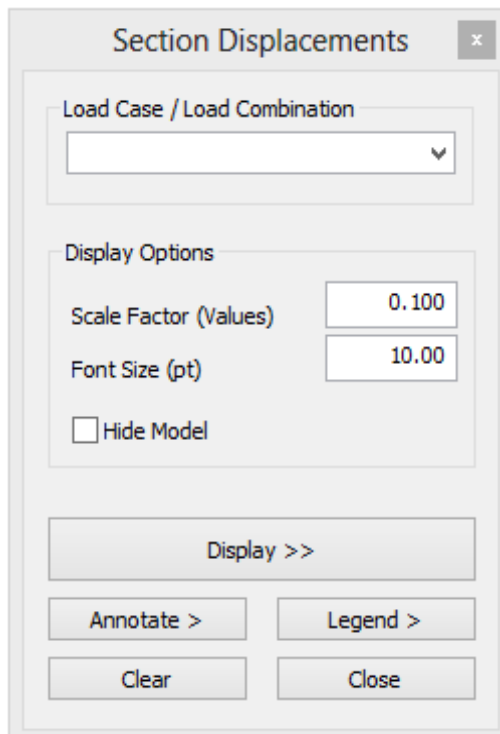
You can view the deformed shape of the structure from the icon  **Deformed** (Ribbon GTS Display) or from the menu “*GTS Display>Deformed Structure*” or by typing `GTSDisplayJointDisplacements` at the command prompt. You must then immediately select the load case, press ENTER, and then give the desired scale factor.

You can switch back to original view from the icon  **Undeformed** (Ribbon GTS Display) or from the menu “*GTS Display>Undeformed Structure*” or by typing `GTSResetJointDisplacements` at the command prompt.

Note that Deformed Structure can be displayed in both 3D and Wireframe views of your model and that you can also switch between levels using the Levels Form or the Upper Level, Lower Level icons.

2.5.65. Display Section Displacements

You can view the displacements of each cross section (including deformation between joints) from the icon  **Displacements** (Ribbon GTS Display) or from the menu “GTS Display>Displacements” or by typing `GTSDisplaySectionDisplacements` at the command prompt.



The “Section Displacement” form appears where you can select:

- The desired Load Case or Combination
 - The Scale factor
 - The *Font Size* (in pts) for Annotations
 - Choose to display the model or Hide it, so that the deformed shape is clearer.
 - The “Display >>” button displays the deformed shape for the visible members. If there are any hidden members their deformed shapes are not displayed.
 - The “Annotate >” button allows you to annotate any value on the deformed shape by first clicking on the deformed shape curve and then at the position that annotation will be placed.
- The “Legend >” button allows you to place a legend on screen, having information about the load case.

2.5.66. Display Member Diagrams

You can view the force and moment diagrams from the icon  **Diagrams** (Ribbon GTS Display) or from the menu “GTS Display>Member Diagrams” or by typing `GTSDisplayMemberForces` at the command prompt.

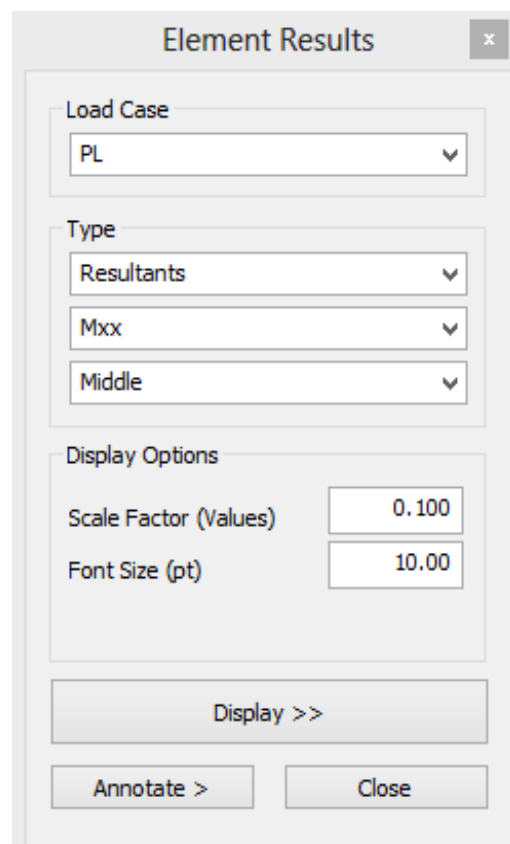
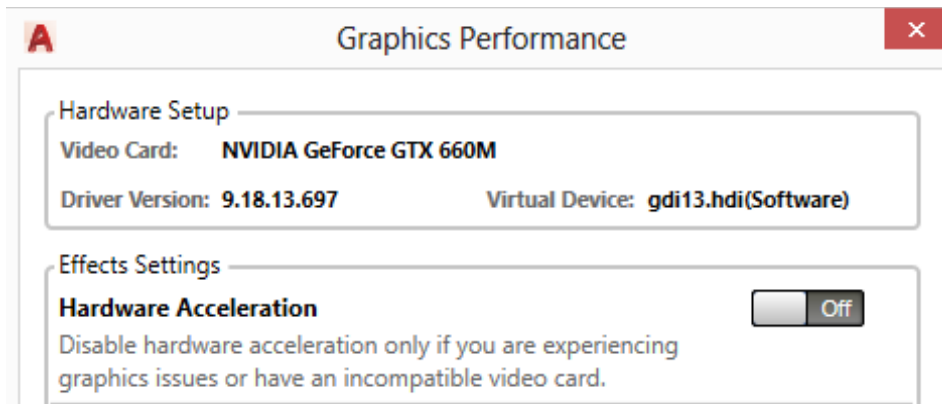
The “Member Diagrams” form appears where you can select:

- The desired Load Case or Combination
 - The Envelope option and the load cases that form the envelope.
 - The Forces or Moments to be displayed (FX, FY, FZ, MX, MY, MZ)
 - The Scale factor
 - The *Font Size* (in pts) for Annotations
 - Automatically *Label Maximum and Minimum* values for each diagram
 - Choose the direction of the diagrams by switching the *Positive Sign*.
 - The “*Display >>*” button creates the diagram for the visible members. If there are any hidden members their diagrams are not displayed.
 - The “*Annotate >*” button allows you to annotate any value of the diagram by first clicking on the member diagram curve and then at the position that annotation will be placed.
- The “*Legend >*” button allows you to place a legend on the screen, having information about the load case and member diagram.

2.5.67. Display Finite Element Results

You can view the finite element results from the icon  **Elements** (Ribbon GTS Display) or from the menu “*GTS Display>Element Results*” or by typing `GTSDisplayElementResults` at the command prompt.

NOTE: Hardware graphics acceleration may cause AutoCAD to incorrectly display the colors of the contour. In such a case it is recommended that you turn OFF Hardware Acceleration, during displaying the stress contours, by typing the command `GRAPHICSCONFIG`. You can turn it back ON afterwards.



The “Element Results” form appears where you can select:

- The desired Load Case
- The desired item to be displayed: Stress, Strain, Resultants, Principal Stress, Principal Strain, Principal Membrane Resultant, Principal Bending Resultant, Von Misses
- The component of the desired item to be displayed, i.e. Sxx, Syy, Szz
- The Location: Top, Middle or Bottom surface of the element which is defined by the local or planar z axes of the shell element. The top surface is in the positive z direction.
- The “Annotate >” button allows you to annotate any value of the diagram by first clicking on a joint and then at the position that annotation will be placed.
- The “Display >>” button creates the contour and a popup legend showing the limits of each color.

2.5.68. Display Finite Element Selection Results

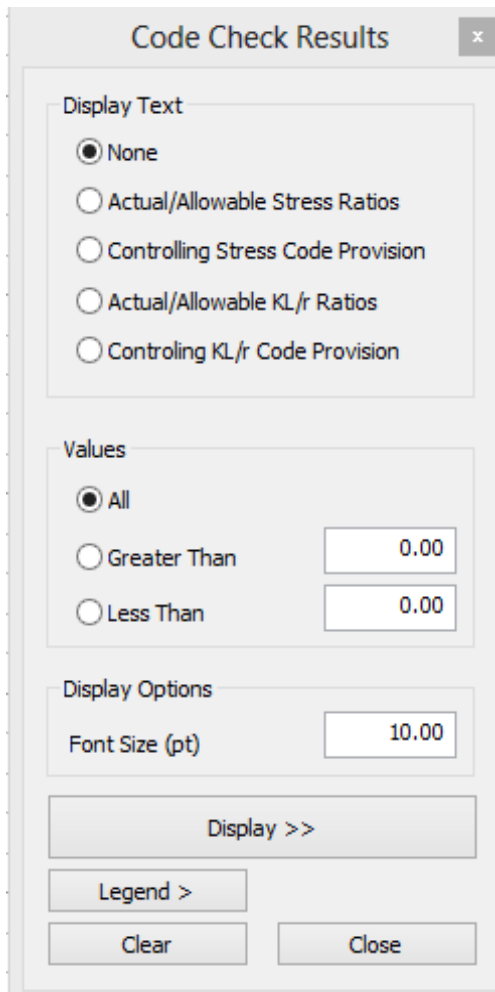
You can view the finite element results of selected elements from the icon  Selection (Ribbon GTS Display) or from the menu “GTS Display>Element Results Selection” or by typing `GTSDisplayElementResultsSel` at the command prompt.

This command is similar to the “Display Finite Element Results” of the previous paragraph. The only difference is that you have to give a selection of members for the contours. This is useful in cases where you want to examine only one surface of the structure, so display the limits of the specific area. Or, if you do not want to take into account stresses from elements not belonging to a specific plane.

NOTE: An “Execute GTI” command, including stiffness analysis, must be given prior to this command.

2.5.69. Display Member Code Check Results

You can view the pass/fail result of a Steel Code check or design from the icon  Code Check (Ribbon GTS Display) or from the menu “GTS Display>Member Code Check Results” or by typing `GTSCoiorCodeCheck` at the command prompt. You must then select the members to be displayed (or “ALL” for all of them).



The dialog box titled "Code Check Results" contains the following sections:

- Display Text:**
 - ☒ None
 - ☐ Actual/Allowable Stress Ratios
 - ☐ Controlling Stress Code Provision
 - ☐ Actual/Allowable KL/r Ratios
 - ☐ Controlling KL/r Code Provision
- Values:**
 - ☒ All
 - ☐ Greater Than
 - ☐ Less Than
- Display Options:**
 - Font Size (pt)
- Buttons:**
 - Display >>
 - Legend >
 - Clear
 - Close

The “Code Check Results” form appears where you can select:

- The text to be displayed for each member, giving additional information such as stress ratios, controlling provisions and KL/r ratios.
- The *Font Size* (in pts)
- Limits for the Values to be displayed (in example All of them, or Greater Than a given value, or Less Than a given value).
- The “Display >>” button regenerates the view and members which passed the code check will appear in blue, those that fail the code check will appear in red and those that were not included in the code check will appear in white
- The “Legend >” button allows you to place a legend on screen, having information about the colors used.

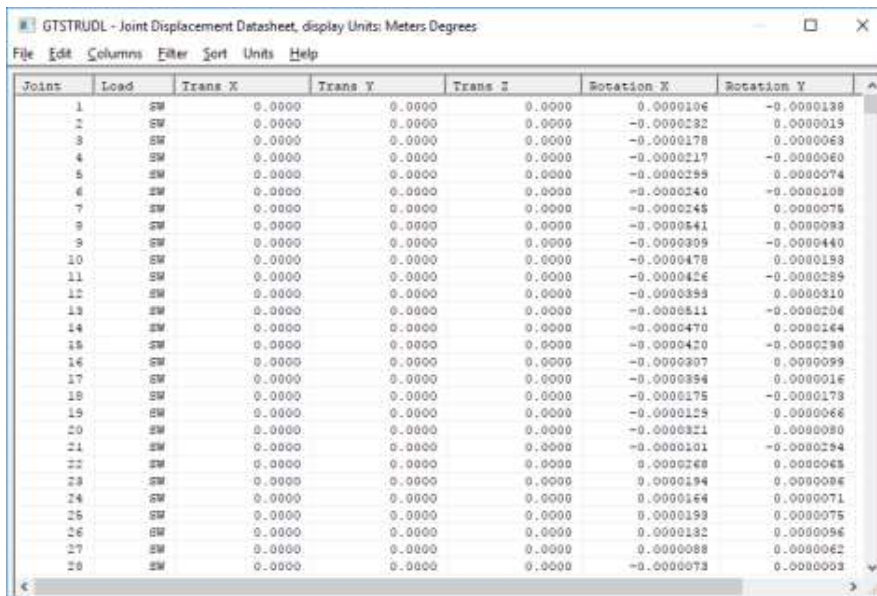
When you press the clear button, member colors remain blue and red for your convenience. If you want to change them go to GTS Display > Colors.

2.5.70. Results Datasheets

In addition to the graphical display of results, you can also view the results in datasheets from item “Results Datasheets” of the menu or ribbon tab “GTS Display”. In the table below, you can find all the available results that can be viewed in datasheets and the corresponding command.

Description	Menu Item	Command
Displacements	<i>GTS Display>Results Datasheets> Displacements</i>	GTSDatasheetJointDisp
Member Forces	<i>GTS Display>Results Datasheets> Member Forces</i>	GTSDatasheetMemberForces
Section Forces	<i>GTS Display>Results Datasheets> Section Forces</i>	GTSDatasheetMemberForces
Reactions	<i>GTS Display>Results Datasheets> Reactions</i>	GTSDatasheetReactions
Stresses	<i>GTS Display>Results Datasheets> Stresses</i>	GTSDatasheetStresses
Code Check	<i>GTS Display>Results Datasheets> Code Check</i>	GTSDatasheetCodeCheck

For example, click on the icon  Displacements (Ribbon GTS Display) or from the menu “GTS Display>Results Datasheets>Displacements” or by typing GTSDatasheetJointDisp and the “GTSTRU DL – Joint Displacement Datasheet” dialog appears where you can filter, sort, write results to text file or change results units as shown in figure below:



Joint	Load	Trans X	Trans Y	Trans Z	Rotation X	Rotation Y
1	SW	0.0000	0.0000	0.0000	0.0000104	-0.0000138
2	SW	0.0000	0.0000	0.0000	-0.0000132	0.0000019
3	SW	0.0000	0.0000	0.0000	-0.0000178	0.0000063
4	SW	0.0000	0.0000	0.0000	-0.0000217	-0.0000060
5	SW	0.0000	0.0000	0.0000	-0.0000299	0.0000074
6	SW	0.0000	0.0000	0.0000	-0.0000240	-0.0000108
7	SW	0.0000	0.0000	0.0000	-0.0000245	0.0000075
8	SW	0.0000	0.0000	0.0000	-0.0000541	0.0000093
9	SW	0.0000	0.0000	0.0000	-0.0000309	-0.0000440
10	SW	0.0000	0.0000	0.0000	-0.0000478	0.0000193
11	SW	0.0000	0.0000	0.0000	-0.0000426	-0.0000289
12	SW	0.0000	0.0000	0.0000	-0.0000393	0.0000310
13	SW	0.0000	0.0000	0.0000	-0.0000511	-0.0000206
14	SW	0.0000	0.0000	0.0000	-0.0000470	0.0000164
15	SW	0.0000	0.0000	0.0000	-0.0000420	-0.0000290
16	SW	0.0000	0.0000	0.0000	-0.0000307	0.0000099
17	SW	0.0000	0.0000	0.0000	-0.0000394	0.0000016
18	SW	0.0000	0.0000	0.0000	-0.0000175	-0.0000173
19	SW	0.0000	0.0000	0.0000	-0.0000129	0.0000066
20	SW	0.0000	0.0000	0.0000	-0.0000321	0.0000080
21	SW	0.0000	0.0000	0.0000	-0.0000101	-0.0000294
22	SW	0.0000	0.0000	0.0000	0.0000268	0.0000065
23	SW	0.0000	0.0000	0.0000	0.0000194	0.0000086
24	SW	0.0000	0.0000	0.0000	0.0000164	0.0000071
25	SW	0.0000	0.0000	0.0000	0.0000193	0.0000075
26	SW	0.0000	0.0000	0.0000	0.0000132	0.0000096
27	SW	0.0000	0.0000	0.0000	0.0000088	0.0000062
28	SW	0.0000	0.0000	0.0000	-0.0000073	0.0000053

2.5.71. Clear Results Layer

You can clear the displayed output (Display Model, Display Loads, Display Results), hide the Legend form of the contours and return to model from the icon  **Clear** (Ribbon GTS Display) or from the menu “*GTS Display>Clear Results Layer*” or by typing `GTSDisplayResultsClear` at the command prompt. This command should be given after any of the previous “display” commands.

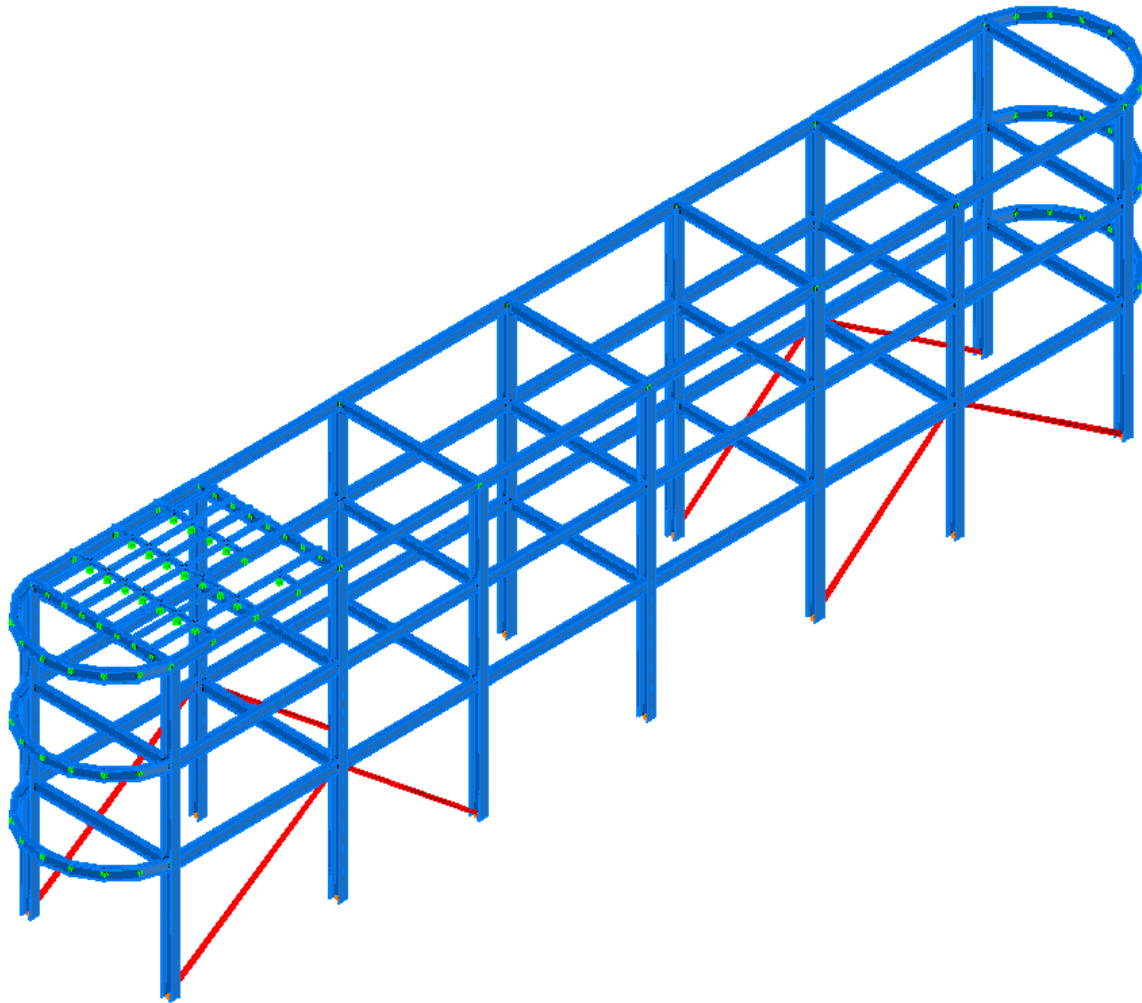
2.5.72. Version

The current version of CAD Modeler can be displayed by selecting from the menu “*GTS Display>Version*” or by typing `GTSVersion` at the command prompt. The current version will be displayed at the command line: The current version of CAD Modeler is
xxxxx

3. Tutorial Example #1

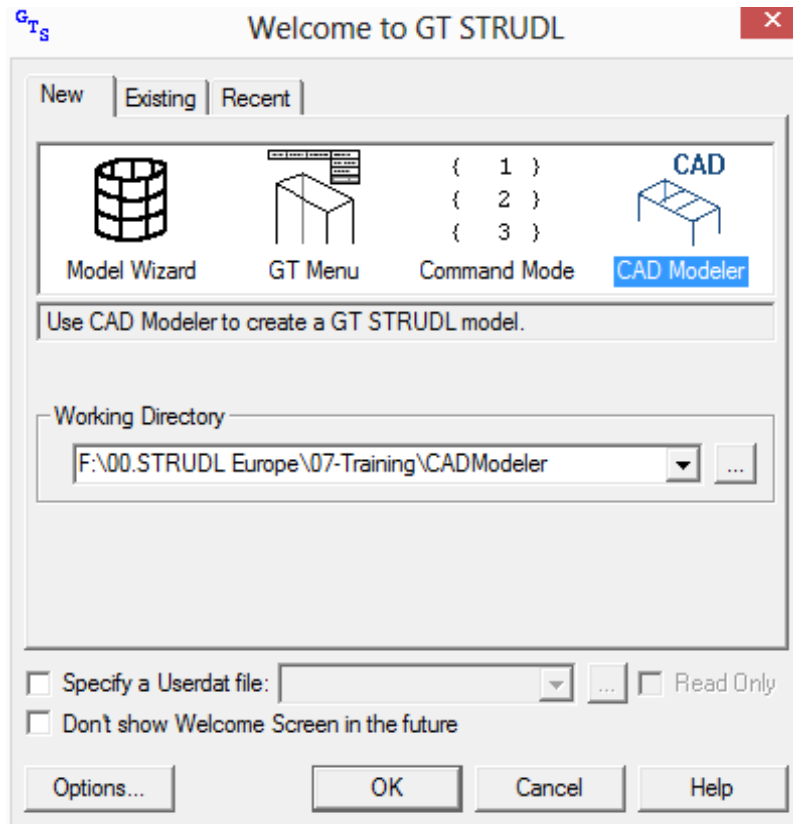
3.1. Introduction

The modeling of a three story building using CAD Modeler shown below is demonstrated in a step-by-step process.



3.2. Open CAD Modeler and start working

Step #1. Launch GT STRUDL by selecting the icon “CAD Modeler” in the Welcome to GT STRUDL dialog shown below. The version of AutoCAD/BricsCAD selected during the installation will be automatically launched, together with CAD Modeler’s menus and ribbons.



Step #2. Make sure that CAD Modeler's ribbons and menus are visible.



If AutoCAD's/BricsCAD's menu is not visible, type `MENUBAR` at AutoCAD's/BricsCAD's command prompt, then 1 and press `<ENTER>`.

If AutoCAD's/BricsCAD's ribbon area is not visible, type `RIBBON` and press `<ENTER>`.

Ribbon commands will be used in this tutorial example. However, since all ribbon commands appear in the menu area, you can use the menu bar as well.

3.3. Define the basic geometry of the model

Step #3. Define the correct Units by pressing the icon  and select *Meters (m)* and *KiloNewtons* in the *Units Form*.

Units
×

Length

☐ Inches (in)

☐ Feet (ft)

☒ Meters (m)

☐ Centimeters (cm)

☐ Millimeters (mm)

Force

☐ Pounds (lbs)

☐ Kips

☐ Tons

☐ Kilograms

☐ Metric Tons

☐ Newtons

☒ KiloNewtons

☐ MegaNewtons

Angles

☒ Degrees

☐ Radians

☐ Cycles

Temperature

☐ Fahrenheit

☒ Centigrade

Time

☒ Seconds

☐ Minutes

☐ Hours

☒ Scale non-structural CAD entities
(grids, structural lines, curves etc)

OK

Cancel

Step #4. Enter the cross-section profiles that will be used at the model by pressing the icon



Sections . Click on the *European* list and then on the *HEB* table of profiles. Select the profile *HE320B* that will be used for the columns, by double clicking on it.

M KN DEG CEN SEC

Member Sections

- ➔ AISC 14th Edition 2011
- ➔ AISC 14th Edition Metric
- ➔ AISC 13th Edition 2005
- ➔ AISC 13th Edition 2005 Metric
- ➔ AISC 9th Edition 1989
- ➔ AISC LRFD 3rd Edition
- ➔ AISC 9th Edition Metric
- ➔ AISC 8th Edition 1978
- ➔ AISC 7th Edition 1969
- ➔ AISC 6th Edition 1963
- ➔ ANSI Pipe
- ➔ Brazilian Standard, NBR 5884
- ➔ British Standard 5950
- ➔ European
- ➔ HEA
- ➔ **HEB**
- ➔ HEM
- ➔ IPE
- ➔ EUROPEAN
- ➔ U
- ➔ REHOLLOW
- ➔ SQHOLLOW
- ➔ CIHOLLOW
- ➔ BSEQANGL
- ➔ BSUNANGL
- ➔ BSEQDBAN
- ➔ BSSLDBAN
- ➔ BSLLDBAN
- ➔ Indian Standard Tables from IS
- ➔ Unistrut

HEB

NAME1	AX	AY	AZ	IX	IY	IZ	SY	SZ	SHAPE
HE100B	0.0026	0.00048	0.001333	9.29E-008	1.67E-006	4.5E-006	3.34E-005	9E-005	1.2
HE120B	0.0034	0.000637	0.00176	1.39E-007	3.18E-006	8.64E-006	5.3E-005	0.000144	1.2
HE140B	0.0043	0.000812	0.00224	2.01E-007	5.5E-006	1.51E-005	7.857E-005	0.0002157	1.2
HE160B	0.00543	0.001072	0.002773	3.14E-007	8.89E-006	2.49E-005	0.0001111	0.0003113	1.2
HE180B	0.00653	0.001292	0.00336	4.23E-007	1.36E-005	3.83E-005	0.0001511	0.0004256	1.2
HE200B	0.00781	0.00153	0.004	5.95E-007	2E-005	5.7E-005	0.0002	0.00057	1.2
HE220B	0.0091	0.001786	0.004693	7.68E-007	2.84E-005	8.09E-005	0.0002582	0.0007355	1.2
HE240B	0.0106	0.00206	0.00544	1.03E-006	3.92E-005	0.0001126	0.0003267	0.0009383	1.2
HE260B	0.0118	0.00225	0.006067	1.24E-006	5.13E-005	0.0001492	0.0003946	0.001148	1.2
HE280B	0.0131	0.002562	0.00672	1.44E-006	6.59E-005	0.0001927	0.0004707	0.001376	1.2
HE300B	0.0149	0.002882	0.0076	1.86E-006	8.56E-005	0.0002517	0.0005707	0.001678	1.2
HE320B	0.0161	0.003209	0.0082	2.26E-006	9.24E-005	0.0003082	0.000616	0.001926	1
HE340B	0.0171	0.003564	0.0086	2.58E-006	9.69E-005	0.0003666	0.000646	0.002157	1
HE360B	0.0181	0.003938	0.009	2.93E-006	0.0001014	0.0004319	0.000676	0.002399	1
HE400B	0.0198	0.004752	0.0096	3.57E-006	0.0001082	0.0005768	0.0007213	0.002884	1
HE450B	0.0218	0.005572	0.0104	4.42E-006	0.0001172	0.0007989	0.0007813	0.003551	1
HE500B	0.0239	0.006438	0.0112	5.4E-006	0.0001262	0.001072	0.0008413	0.004288	1
HE550B	0.0254	0.00738	0.0116	6.02E-006	0.0001308	0.001367	0.000872	0.004971	1
HE600B	0.027	0.00837	0.012	6.69E-006	0.0001353	0.00171	0.000902	0.0057	1
HE650B	0.0286	0.009408	0.0124	7.41E-006	0.0001398	0.002106	0.000932	0.00648	1
HE700B	0.0306	0.01081	0.0128	8.33E-006	0.0001444	0.002569	0.0009627	0.00734	1
HE800B	0.0334	0.01285	0.0132	9.49E-006	0.000149	0.003591	0.0009933	0.008978	1
HE900B	0.0371	0.01536	0.014	1.14E-005	0.0001582	0.004941	0.001055	0.01098	1
HE1000B	0.04	0.01763	0.0144	1.26E-005	0.0001628	0.006447	0.001085	0.01289	1

OK

Cancel

- ➔ European
- ➔ HEA
- ➔ HEB
- HE320B
- ➔ HEM
- ➔ IPE
- IPE330
- IPE120
- ➔ EUROPEAN
- ➔ U
- ➔ REHOLLOW
- ➔ SQHOLLOW
- ➔ CIHOLLOW
- ➔ BSEQANGL
- 60x60x5
- ➔ BSUNANGL
- ➔ BSEQDBAN
- ➔ BSSLDBAN
- ➔ BSLLDBAN

The profile is added to the project and it appears in the left list-box having a black dot in front of it.

Using the same procedure, add 3 additional profiles: *IPE330*, for beams, *IPE120* for the girders from table *IPE* and *60x60x5* for the bracing from the table *BSEQANGL*. Press **OK** to close the form.

Note: You can add additional profiles at any time by following this procedure and also view the full list of profiles used in your model and add more profiles if needed.



Step #5. Define the 3 levels of the model by pressing the icon **Levels**. Press the *Add Level* button 3 times to add 3 levels to your model. Modify the height of the 1st level by selecting the *Height* cell of the 1st Level and entering 4. Make sure that *Z Vertical Axis* option is checked and press OK to close the form.

Level Properties

Levels	Height	Elevation	Visible
1	4	4.000000	☒
2	3.000000	7.000000	☒
3	3.000000	10.000000	☒

Options

Base Elevation

☒ Z Vertical Axis (else Y)

☐ Update Levels for All Entities



Step #6. Enter a Grid that will help you enter the columns quickly by clicking on the icon **Grid**. The grid is going to have 3 spaces (6m, 5m, 6m) in the horizontal direction (X) and 1 space (5m) in the sidelong direction (Y). Enter 6 in the *Distance* text box and press the *Add* button. Repeat by entering 5 and *Add*, and 6 and *Add*.

Placement

☒ Horizontal ☐ Sidelong

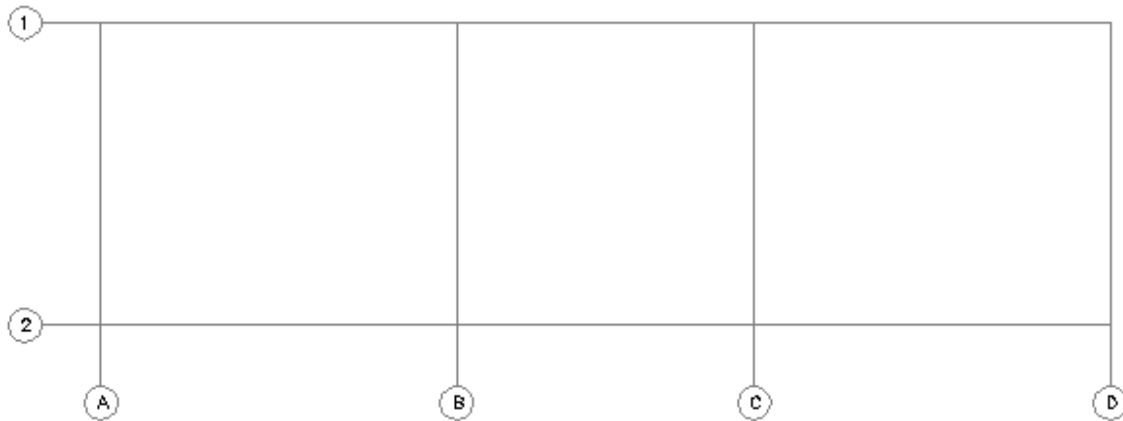
Spacing

Distance:

Then, click on *Sidelong* in the *Placement* area to enter the spacing in the Y direction, and enter 5 and *Add*.

By pressing OK you are prompted to enter the Insert Point for the grid. Type 0, 0, 0 and press <ENTER>.

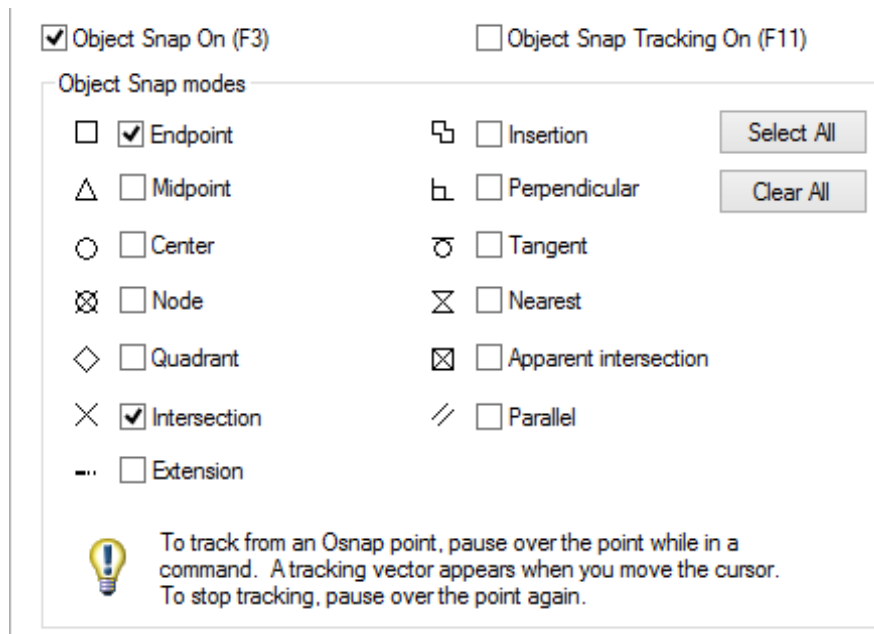
The grid is created, having its upper left corner A-1 at the point 0,0,0.



You will be able to view the grid by pressing the Top Icon in AutoCAD's View Cube, or preferably by typing Z (for Zoom), E (for Extents) and press <ENTER> .



Note: In order to be able to snap at the intersection of the grid lines, while placing columns, make sure that the AutoCAD's/BricsCAD's Object Snap is ON, and the Intersection mode is enabled. Type OSNAP in both AutoCAD and BricsCAD to set the various snap settings. Shown below is the ObjectSnap tab in AutoCAD's Drafting settings dialog.



3.4. Create the 1st floor



Step #7. Start entering the columns by clicking on the icon **Vertical**. The dialog *Place Member* appears that helps you to quickly select properties for the members that are going to be entered.

The 'Place Member' dialog box is shown with the following settings:

- Cross Section:**
 - Table Section: HE320B HEB European
 - or Member Dimensions: <Select Shape>
 - or Same as Member: <Select Existing Member>
- Material:** <Select Material>
- Releases:** 11 Fix-Fix
- Beta (o):** 0
- Button:** Place Member(s) >>

Select *HEB320B* as the cross section for the columns. Make sure that Material is set to *Steel*, Releases to *Fix-Fix* and the Beta angle is *0*. There is no need to close this dialog manually.

Press the “Place Member(s) >>” button.

Click at the intersection point between line A and line 1 (point A-1) and the column will be placed at this position.

Repeat the same procedure by clicking at the points B-1, C-1, D-1, A-2, B-2, C-2 and D-2.

When you are done, press ESC to exit the Vertical column command. The Place Member form is automatically hidden.



Note: Each time you create a member the orientation of the cross section will appear in the middle of the element, unless you clear it with command “Clear” (see 2.5.71).

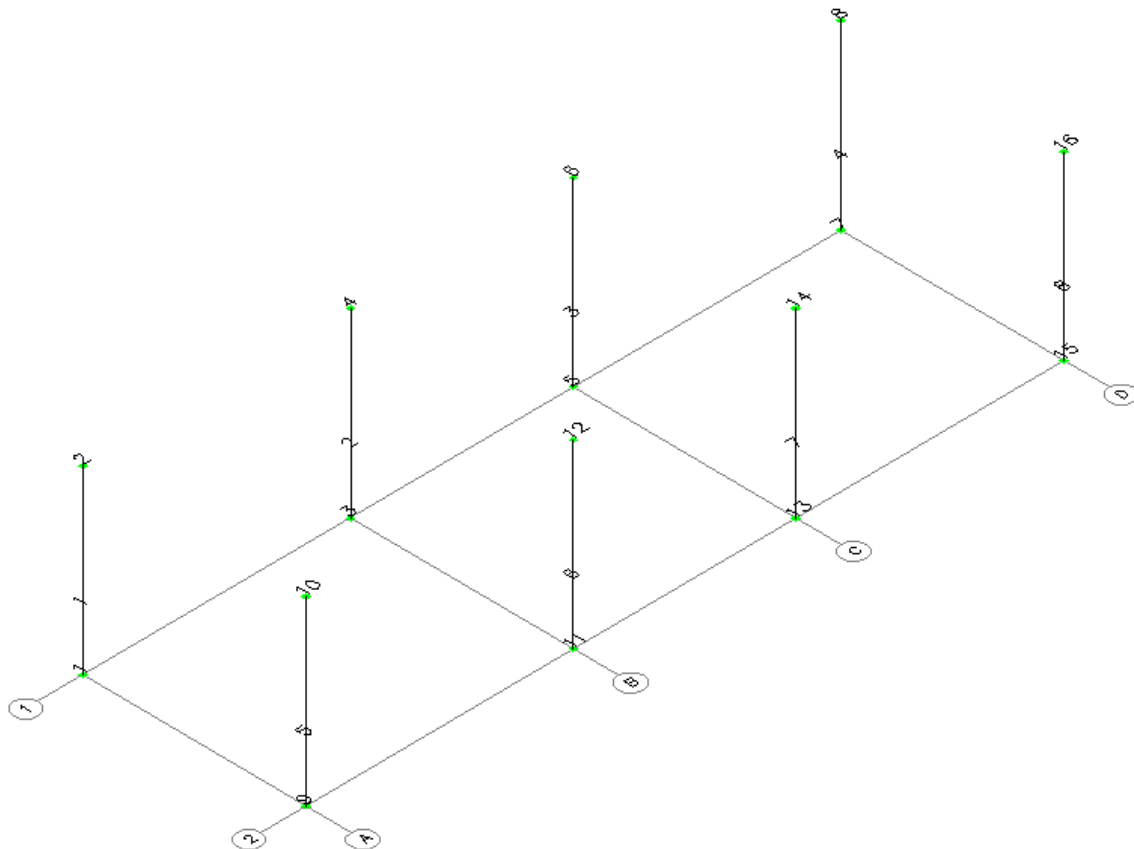
Step #8. You can easily change to an isometric view of the structure by pressing the small house icon in AutoCAD's or BricsCAD's View Cube. As you can see in the isometric view below, column members 1 to 8 were created together with joints 1 to 16 at their ends. Each column is 4.00m long, as defined in Level Properties (height of the first floor).



AutoCAD's View Cube for Isometric View



BricsCAD's View Cube for Isometric View





Step #9. Start entering the beams, along X axis, by clicking on the icon **Generate** . The *Place Member* form appears.

Cross Section

Table Section:
IPE330 IPE European

or Member Dimensions:
<Select Shape>

or Same as Member:
<Select Existing Member>

Material
Steel

Releases
11 Fix-Fix

Beta (o)
90

☒ Split Intersecting Members ☐ Physical Member

☐ Split Ending Members

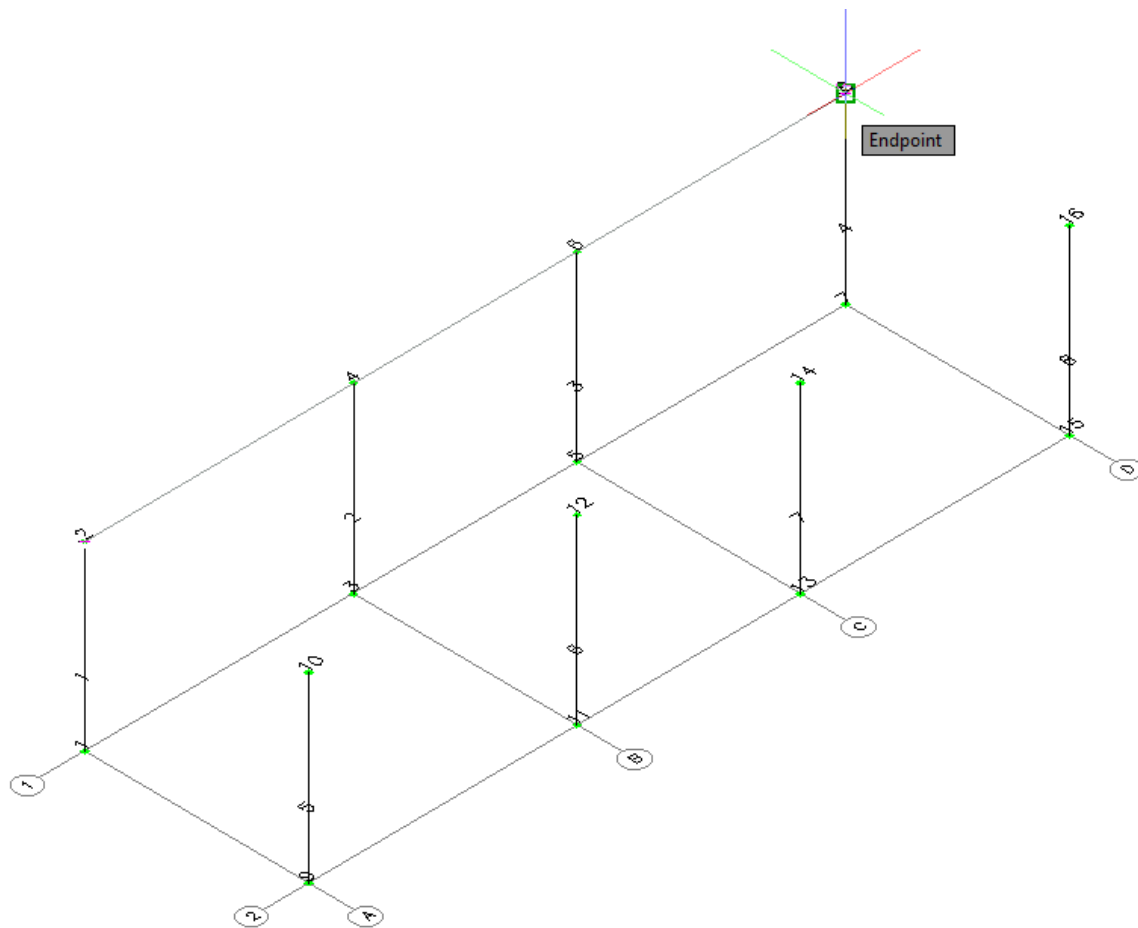
Place Member(s) >>

Select *IPE330* as the cross section and make sure that Material is set to *Steel*, Releases to *Fix-Fix* and the Beta angle is *90*. You have to set the Beta angle equal to 90 degrees in order to orientate the local Y axis of the IPE cross section along the Z global axis. Moreover, make sure that the option *Split Intersecting Members* is checked.

Press “Place Member(s) >>” button.

Starting Point (x,y,z) message appears, asking you to enter the coordinates or click on a specific point on screen. Click on Joint 2 at the top joint of column 1 at position A-1.

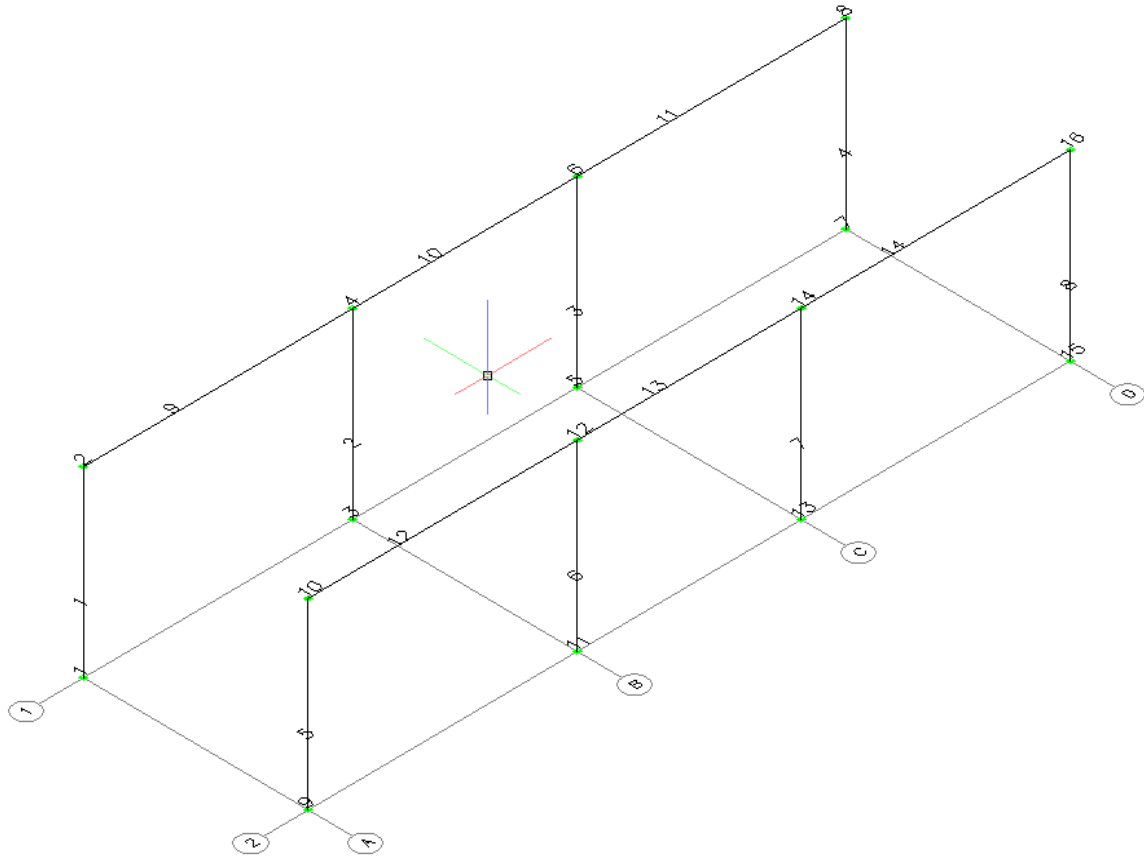
Then you have to define the *Ending Point (x,y,z)* so click on joint 8, as shown in the picture below.



Members 9, 10 and 11 will be created.

All three beams along X axis were generated with only two clicks of the mouse: at joints 2 and 8. The beam from joint 2 to joint 8, was split into three parts, between joints 2, 4, 6 and 8, since joints 4 and 6 (columns at positions B-1 and C-1) intersect this member.

Since the command is still active, you are prompted to enter the Starting Point (x,y,z), repeat the same procedure by clicking on joint 10 (top of column at position A-2), and then click at joint 16 (top of column at position D-2). Members 12, 13 and 14 will be created.



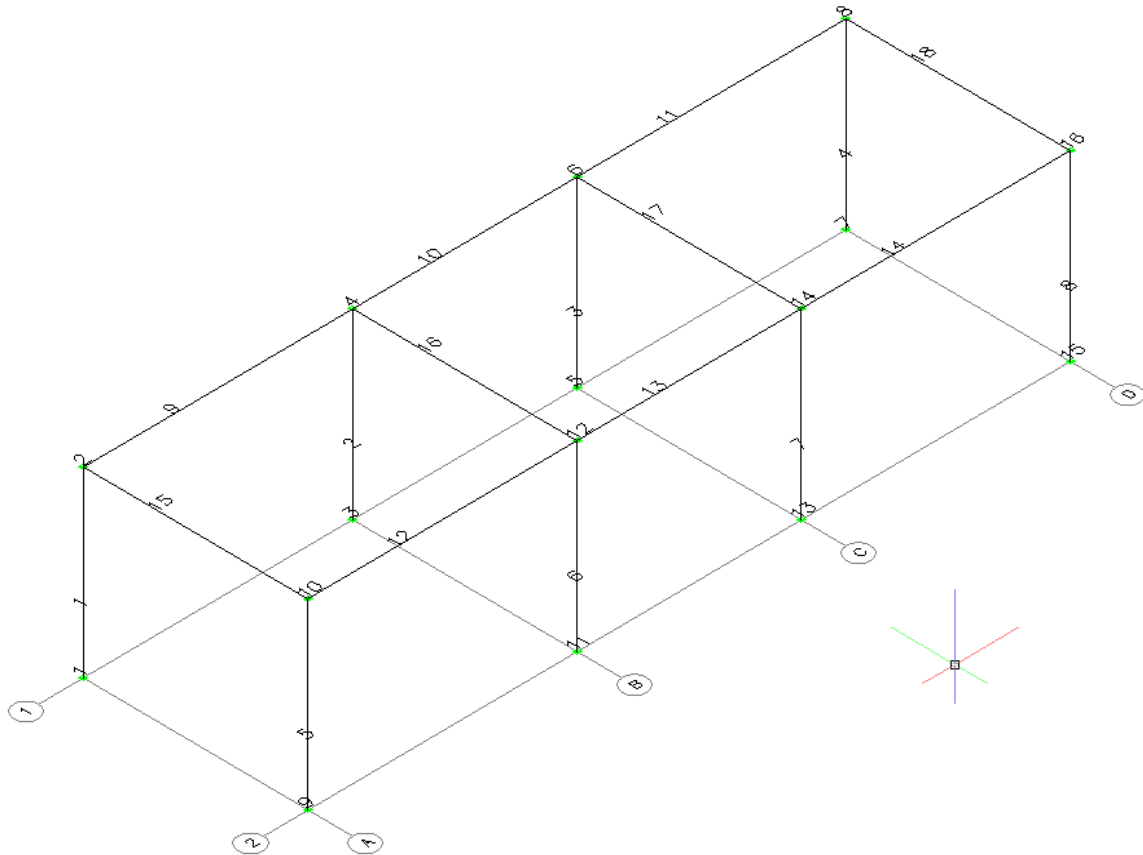
Step #10. Enter the beams, along Y axis. The command Generate Beams should be still active,



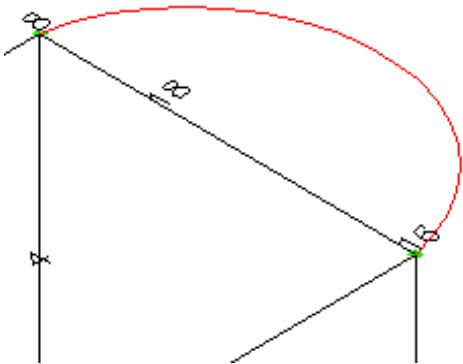
else you can call it again by clicking again on the icon **Generate**. Keep the same settings at the Place Member Form, as in the previous step, regarding the cross section and Beta angle, but do NOT click on *Split Intersecting Members*. Press the “Place Member(s) >>” button.

The prompt message *Starting Point (x,y,z)* appears, asking you to enter the coordinates or click on a specific point on screen. Click on the Joint 2, that is the top of column at position A-1. In order to define the *Ending Point (x,y,z)* click at joint 10 (top of column at position A-2). Member 15 is generated

Repeat the same procedure by clicking on the joints 4 and 12 to generate member 16, joints 6 and 14 to generate member 17 and joints 8 and 16 to generate member 18. Then, press ESC to terminate the command.



Step #11. Create an arc on the right side of the structure:

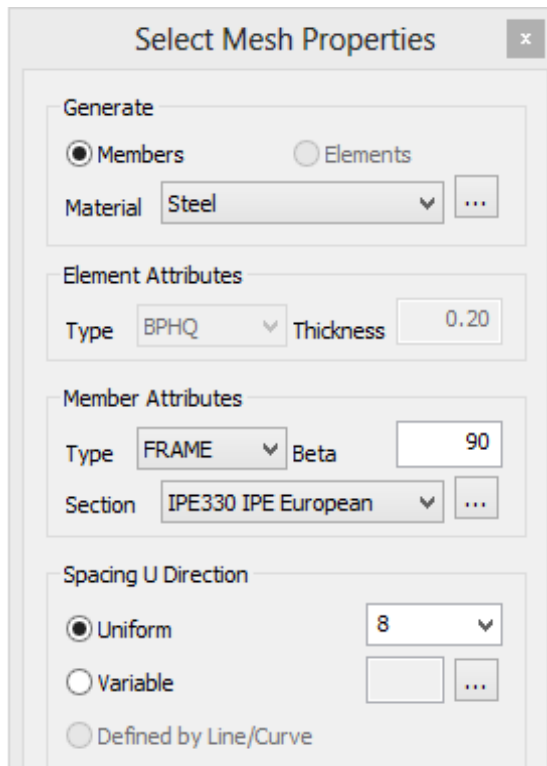


Type ARC and

- in order to *Specify start point of arc or [Center]*: click on joint 8,
- to *Specify second point of arc or [Center/End]*: type @2,-2 and press <ENTER> and
- to define the end point of arc: click on joint 16.



Step #12. Generate Members along the Arc: Click on the icon **1D Curve** and when the prompt message *Select Curve (Line or Arc)* appears, click on the Arc that you have created in the previous step.



The 'Select Mesh Properties' dialog box is shown with the following settings:

- Generate:** ☒ Members, ☐ Elements
- Material:** Steel
- Element Attributes:** Type: BPHQ, Thickness: 0.20
- Member Attributes:** Type: FRAME, Beta: 90, Section: IPE330 IPE European
- Spacing U Direction:** ☒ Uniform (8), ☐ Variable, ☐ Defined by Line/Curve

The Select Mesh Properties form appears where you enter:

- Material : Steel
- Beta Angle: 90
- Section: IPE330
- Spacing U Direction: Uniform 8

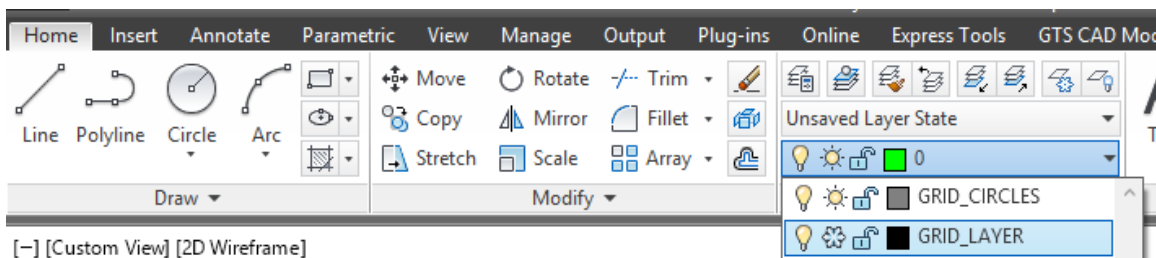
This command is going to generate 8 linear members equally spaced along the arc.

You can press the Preview button to see the members as they will be generated.

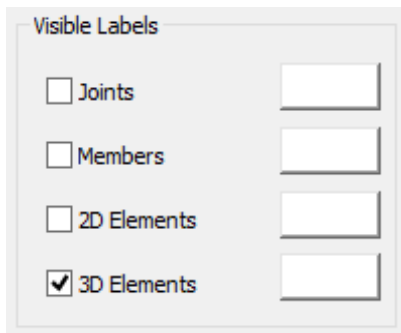
Press the Create button and 8 members, named 19 to 26, were created and 9 joints, named 17 to 25 were created along the arc.

Note that joints 17 and 25 are created on the top of joints 16 and 8 correspondingly. Later on, they are going to be merged together by deleting duplicate joints.

Step #13. Hide Grid: Since the Grid is no longer needed it can be hidden using AutoCAD/BricsCAD commands to freeze the layer GRID_LAYER. This can be done by clicking on the Home Tab and then selecting the GRID_LAYER from the drop down list of layers and clicking on its freeze icon.



Step #14. Turn OFF labeling:



Click on the icon  **Options** in the ribbon bar and then uncheck the Visible Labels option for Joints, Members and 2D Elements.

Now labeling is turned off and it is easier and faster to view and control the model.

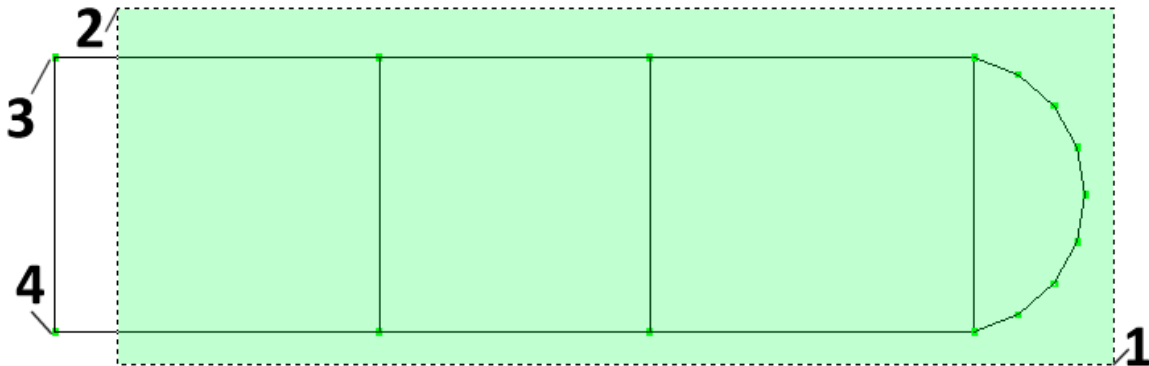
Note: You can also delete or hide the Arc line as it is no longer needed.

Step #15. Mirror the structure: Switch to a floor pan view, by pressing the TOP of AutoCAD's or BricsCAD's View Cube.

Then, type MIRROR and when you get the notification *Maintain incidence order (Yes/No)*. Press Yes to maintain the local coordinate system when mirroring.

NOTE: This option is very useful when mirroring structures having shell finite elements and the mirror line lies along the element's XY plane. If you choose to maintain the incidence order, then after the mirroring the local Z axis of the source and copied finite elements have the same orientation.

You are then immediately prompted to *Select objects*: select the right part of the structure, but not the members and joints that are on the mirror line. In order to make this selection, make the 1st and the 2nd click of the mouse at the points 1 and 2 as shown in the picture below and press <ENTER>. You will get a confirmation that 44 objects were found (or 45 if you still have the arc).



When you get the message *Specify second point of mirror line*, click on the joints at points 3 and 4 as shown in the picture above.

Then, press <ENTER> and reply to the question *Erase source objects? [Yes/No] <N>*: , so as not to delete the right part of the structure. The structure after the mirror command will look like the following picture:

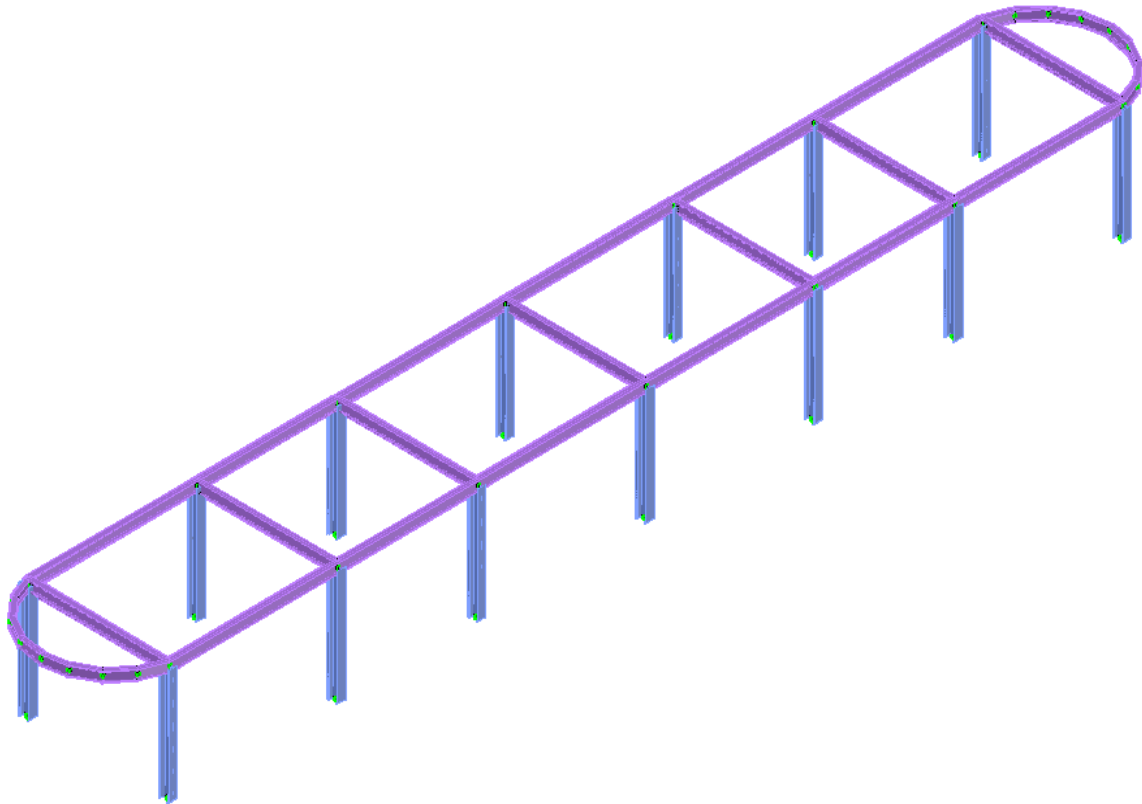


Step #16. Switch to 3D View: Press the house icon to change the view to Isometric, and type Z and E (Zoom, Extents). Click on the icon  Colors to set different colors for each profile.

Sections Groups		
Categories		
Sections	Color	Visible
HE320B	161	☒
IPE330	191	☒
IPE120	1	☒
60x60x5	50	☒

Press OK to close the Color Options Dialog. Each cross section will now have a different color.

Press the icon  to display the 3D solid view of the model, replacing the wireframe view:

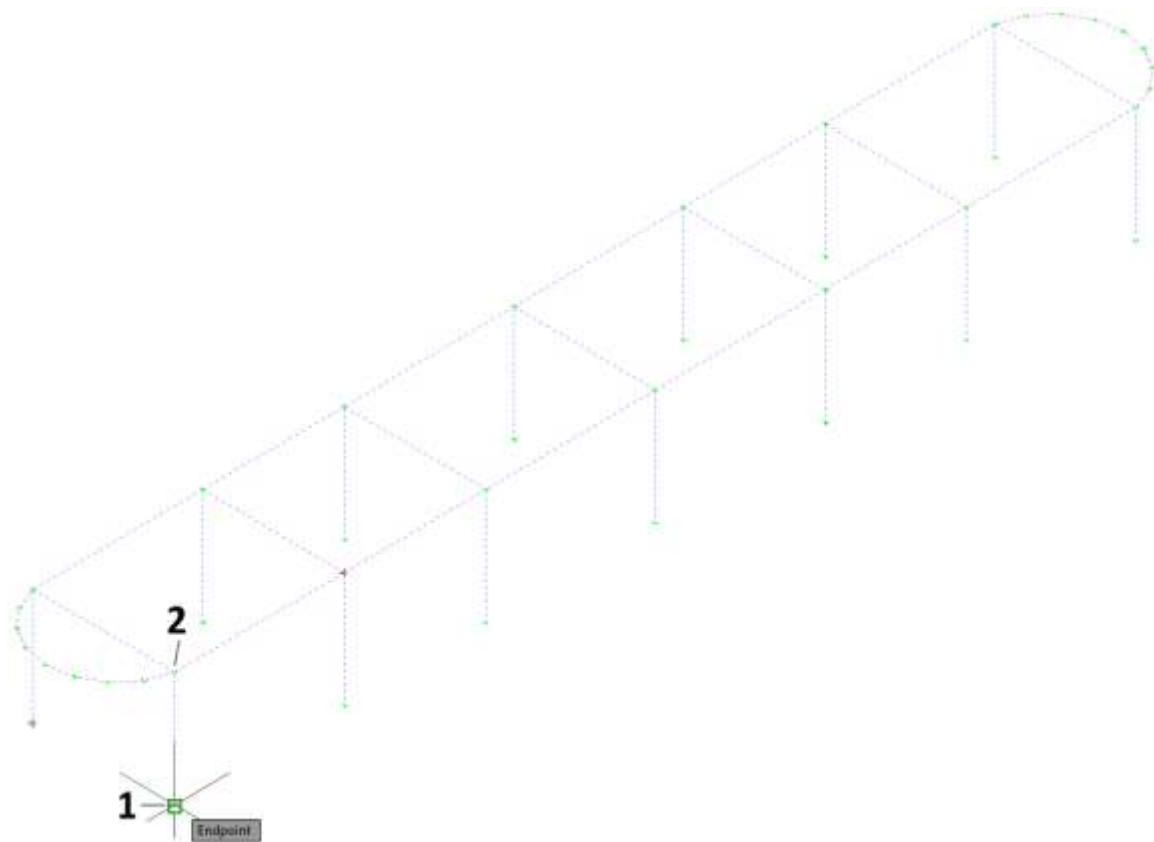


Press the icon  **Frame** to switch back to wireframe view to be able to process CAD Modeler's and AutoCAD's/BricsCAD's commands faster.

Step #17. Save your Model: In order to save your model just use AutoCAD's or BricsCAD's save command and store the DWG using any filename that you want.

3.5. Create the 2nd floor

Step #18. Copy the members and joints of the 1st floor to the 2nd: Type the command `COPY` and when asked to *Select objects*: type `ALL`, so that everything is selected. You will get a verification that 101 objects were found and then press `<ENTER>`.



In order to *Specify base point or [Displacement/mOde] <Displacement>*, click at the base of any column such as point 1 in the picture above.

In order to *Specify second point or [Array] <use first point as displacement>*: click at the top of the same column such as point 2 of the picture and then press `<ENTER>` in order to terminate the copy function.

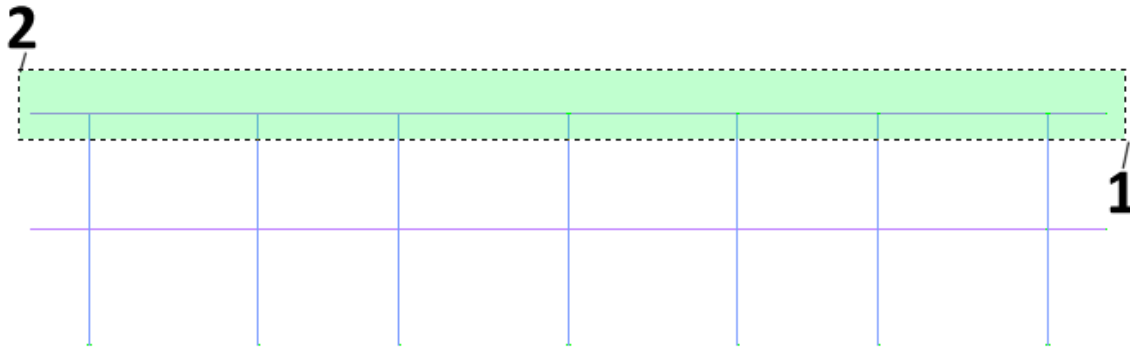
All entities of floor 1 are now copied to floor 2.

Step #19. Correct the Z coordinates of the 2nd floor: The copied columns are 4.00m long, since they were copied from the 1st floor. In addition, the Z coordinate of the beams is equal to 8.00m

instead of 7.00m. Therefore, all copied joints that have Z coordinate equal to 8.00m should be moved 1.00m lower.

Switch to FRONT View, by clicking on AutoCAD's or BricsCAD's view cube and make sure that you are in the World UCS by typing UCS and W.

Type MOVE in order to initiate AutoCAD's/BricsCAD's move command and when asked to Select objects, click on points 1 and 2, as shown in the picture below, selecting all the entities that belong to the top of the 2nd floor. You will get a notification that 77 objects were *found* and press <ENTER>.



In order to *Specify base point or [Displacement] <Displacement>*: click ANYWHERE on the screen. It makes no difference where you click since relative coordinates will be used to define the displacement.

In order to *Specify second point or <use first point as displacement>*: type @0, 0, -1 and press <ENTER>.

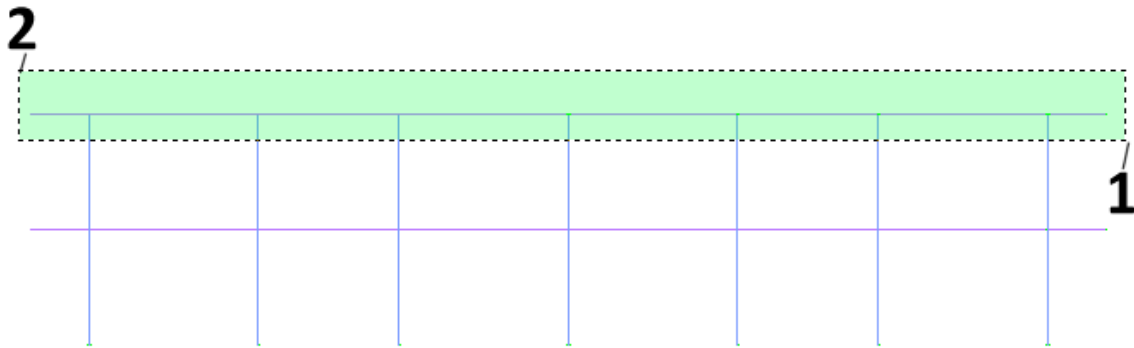
Now the height of the 2nd floor is correct and equal to 3.00 meters.



Note that you can reach the same result by switching to the 2nd Level using the icon  Higher Level and start entering the columns one-by-one, as you did in the 1st Level. Columns will then have the correct height (3.00m), since the height of the second Level is defined equal to 3.00m when the levels were defined in a previous step. Then, copy only the beams from the 1st Level to the correct position. However, it is somewhat faster to copy everything and then fix the Z coordinate with a simple MOVE command as you did in the previous steps.

3.6. Create the 3rd floor

Step #20. Copy the members and joints of the 2nd floor to the 3rd : Type the command `COPY` and when asked to *Select objects*: click on the same two points that were used in the previous `MOVE` command as shown in the following figure.



Since this is a crossing window, the columns are automatically selected. You will get a notification that 77 objects were *found* and press `<ENTER>`.

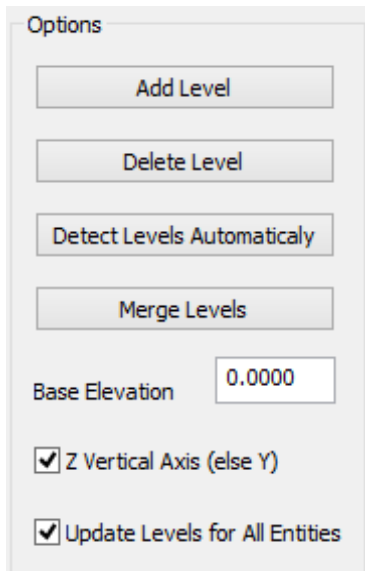
In order to *Specify base point or [Displacement] <Displacement>*: click ANYWHERE on the screen. It makes no difference where you click since relative coordinates will be used to define the displacement.

In order to *Specify second point or <use first point as displacement>*: type `@0,0,3` and press `<ENTER>`.

Now the 2nd floor is copied to the 3rd one. There is no need to correct the Z coordinates as was done when the 2nd floor was moved since the second and third levels have the same height. Press the `ESC` button to exit the Copy command.



Step #21. Assign Level Properties:



Since all members were created from Level 1 using COPY commands, all of them belong to level 1 and their correct Level property should be assigned.



Click at icon **Levels** , check the option Update Levels for All Entities and press OK.

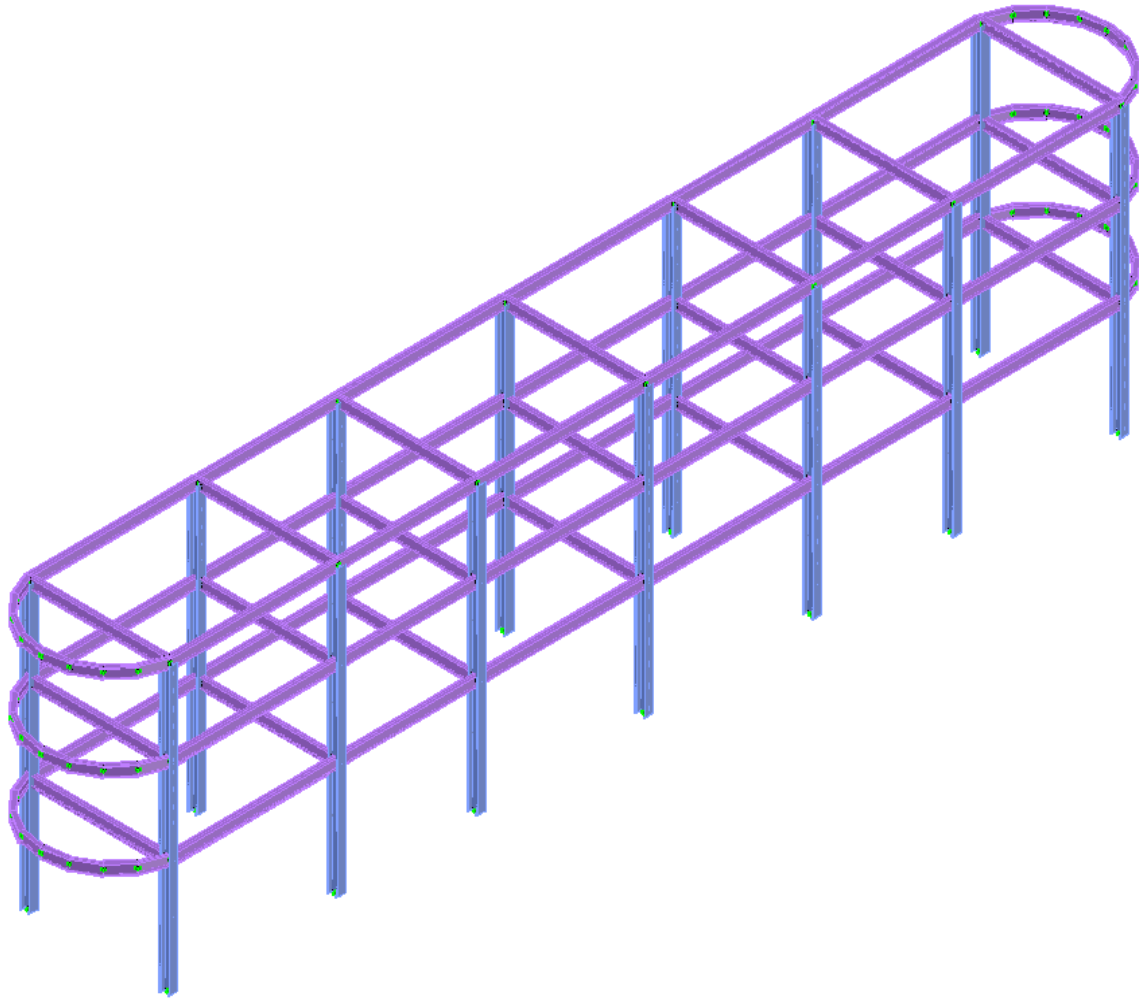
Now every Member or Joint has the correct Level property depending on its Z coordinate.

You can switch between the levels of the model using the **▲ Higher Level** and **▼ Lower Level** icons. The current level appears in the top caption of AutoCAD's screen.

You can make whole structure visible by clicking on the icon **📦 All** .

Step #22. View and Save your model: Press the house icon to change the view to Isometric, and type Z and E (Zoom, Extents).

Press the icon **📦** to display the 3D solid view of the model, replacing the wireframe view as shown in the following figure:



Save your model, using a different file name (Save As...). By saving your model with a different name each time, it is easier to back up to a previous state of the model.

3.7. Create bracing

Step #23. Place bracing members at the front:

Press the icon  **Frame** to switch back to wireframe view to be able to process CAD Modeler's and AutoCAD's/BricsCAD's commands faster.

Levels	Height	Elevation	Visible
1	4.000000	4.000000	☒
2	3.000000	7.000000	☐
3	3.000000	10.000000	☐



Click at icon **Levels**, check the visible property for level 1 and uncheck it for all other levels and press OK.



Now only Level 1 is visible and it is easier to add the bracing members. Click on the icon **Generate** and the Place Member form appears.

Select *60x60x5* as the cross section and make sure that Material is set to *Steel*, Releases to *Fix-Fix* and Beta angle is *0*.

Press the “Place Member(s)>>” button.

Click on the joint located at Point 1 of the following image.

Click on joint located at Point 2 and the first bracing member is created.

Click again on joint located at Point 2 and then on the joint located at Point 3 and the second bracing member is created

Cross Section

Table Section:
60x60x5 BSEQANGL European

or Member Dimensions:
<Select Shape>

or Same as Member:
<Select Existing Member>

Material
Steel

Releases
11 Fix-Fix

Beta (o)
0

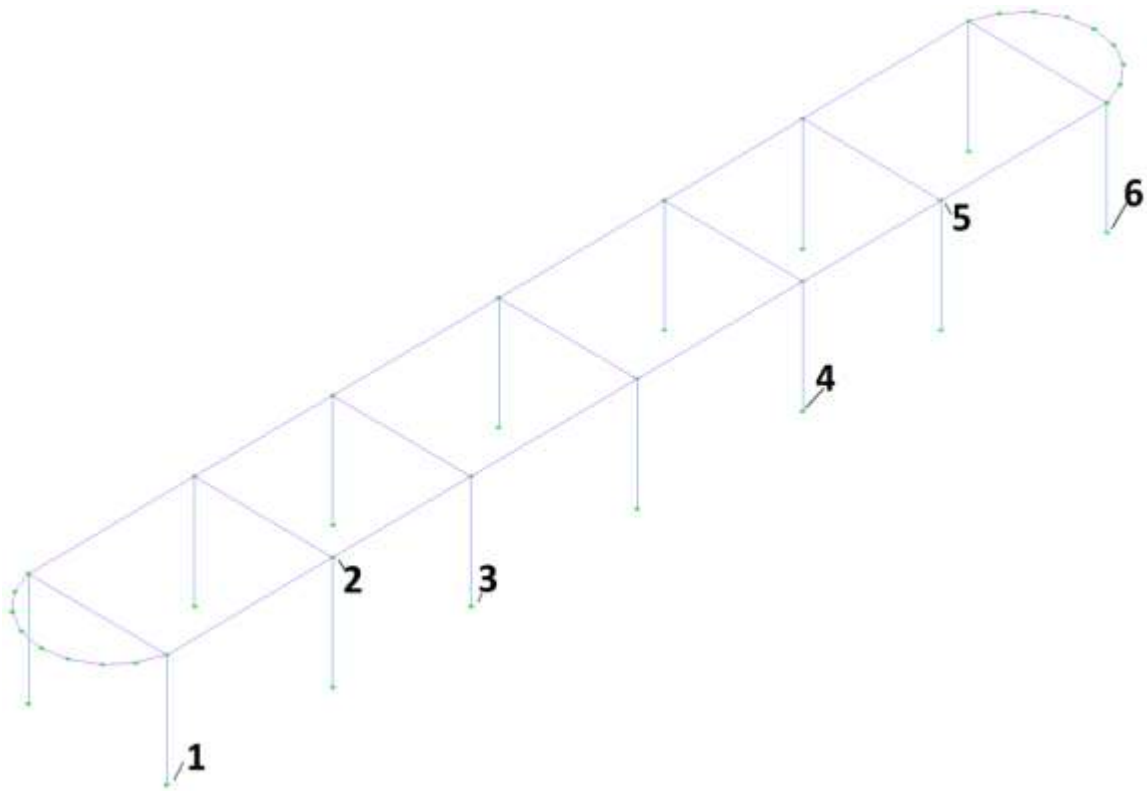
☒ Split Intersecting Members ☐ Physical Member

☒ Split Ending Members

Place Member(s) >>

Click on the joint located at Point 4, click on the joint located at Point 5 and the third bracing member is created.

Click again on the joint located at Point 5, click on the joint located at Point 6 and the fourth bracing member is created.



Press ESC to terminate the Generate Beam command.

Step #24. Change the properties of the Bracing Members: Click on the icon  Change Member in the Find/Change/Check panel and when asked to Select objects: click on the 4 bracing members created in a previous Step and press <ENTER>.

The Member Properties [Multiple Selection] form is displayed. Now, change the type to SPACE TRUSS and press OK.

Member Properties [Multiple Selection]

Model
Section Properties
Member Loads
Member Temperature Loads
Member Distributions

General

Name :

Level :

Type - Incidences

Type : <Select Type>

Start : SPACE FRAME

End : SPACE TRUSS

Beta Angle :

Physical Member ...

Groups

☐ Inactive ... Remove

Groups that Member belongs

Section Properties

Section : <Select Section> ...

Ax : Ix :

Ay : Iy :

Az : Iz :

Sy : Ey :

Sz : Ez :

Yd : Yc :

Zd : Zc :

Shape Code :

Material Properties

Material : <Select Material> ...

E : Density :

G : CTE :

Poisson :

Releases & Elastic Connection spring values

Quick Selection : ...

Start	Spring	End	Spring
☐ Fx		☐ Fx	
☐ Fy		☐ Fy	
☐ Fz		☐ Fz	
☐ Mx		☐ Mx	
☐ My		☐ My	
☐ Mz		☐ Mz	

End Sizes OR Member Eccentricities (Offsets)

Start	End
Sizes :	
X :	X :
Y :	Y :
Z :	Z :

OK
Cancel
Apply
Help

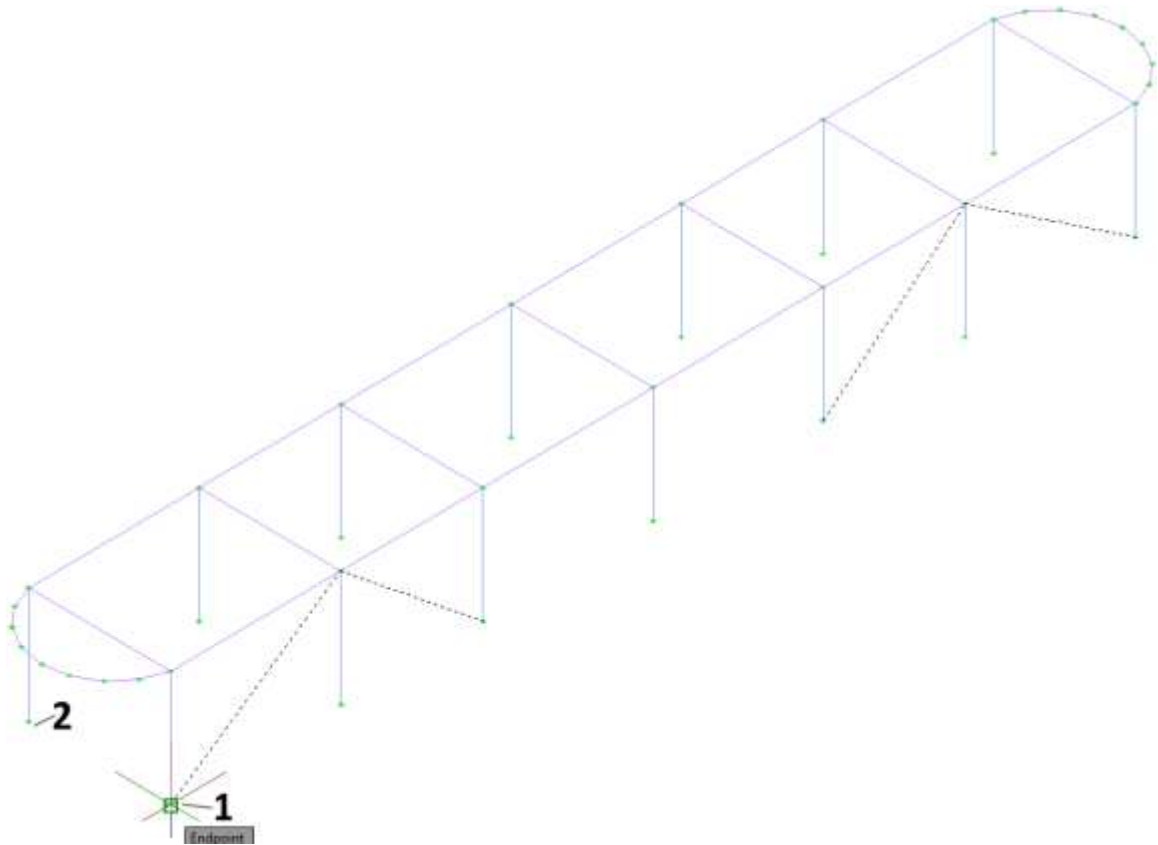
This modification applies to all selected members.

Step #25. Copy bracing member to the back: Type `COPY` and when asked to Select objects: click on the 4 bracing members created in a previous Step and press `<ENTER>`.

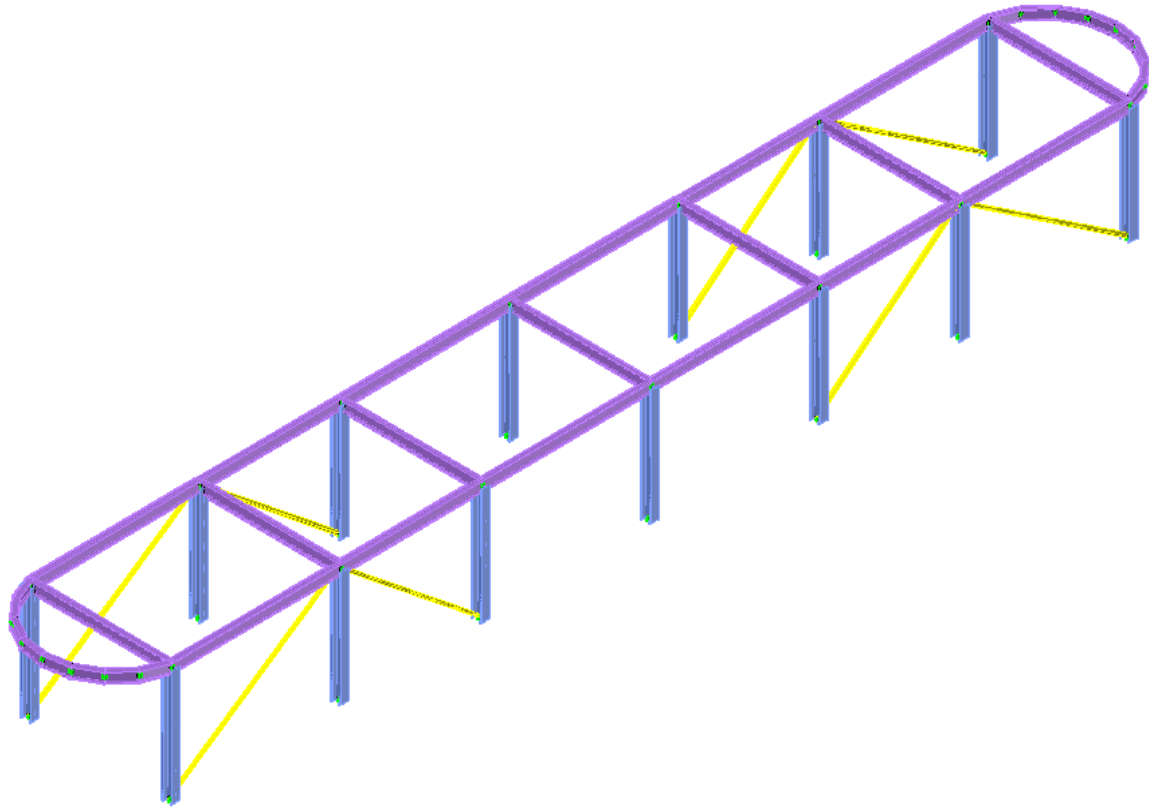
In order to define *Specify base point or [Displacement/mOde] <Displacement>*: click on the Joint at Point 1 of the following image.

In order to define *Specify second point or [Array] <use first point as displacement>*: click on the Joint at Point 2 inf the image on the next page.

Press `ESC` to terminate the `COPY` command.



Step #26. View and Save your model: Press the icon  to display the 3D solid view as shown in the following image:



Save your model, using a different file name (Save As...).

Make the entire structure visible by clicking on the icon  All .

Click on the icon  Frame to switch back to the wireframe view.

3.8. Create girders

Step #27. Split the beam members at the top level: Clicking on the  Higher Level icon move to level 3. The current level is displayed at the top caption of AutoCAD/BricsCAD:

GTS CAD Modeler | M KN DEG CEN SEC | Level: 3



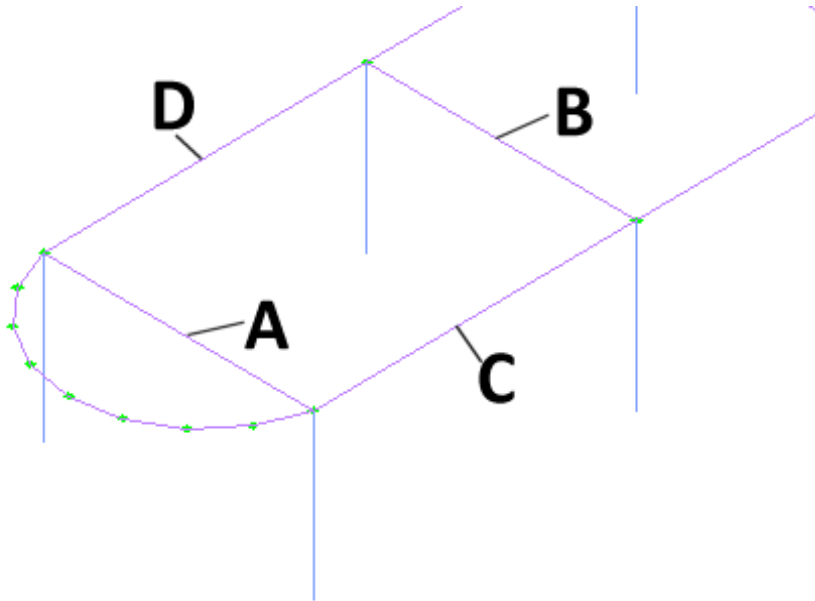
Click on the icon  Split and click on the members A and B as shown at the following image, and then press <ENTER>.

In order to define the Distance for splitting the member or the number of parts (negative number), enter -8 , so that the beams A and B will be split into 8 equal parts.



Click again on the icon  Split and click on the members C and D as shown at the following image, and then press <ENTER>.

In order to define the Distance for splitting the member or the number of parts (negative number), enter -4 , so that the beams C and D will be split into 4 equal parts.



Step #28. Place girder members at the top level: Click on the icon [Generate](#) and Place Member form appears.

Cross Section

Table Section:
IPE 120 IPE European

or Member Dimensions:
<Select Shape>

or Same as Member:
<Select Existing Member>

Material
Steel

Releases
11 Fix-Fix

Beta (o)
90

☒ Split Intersecting Members ☐ Physical Member

☐ Split Ending Members

Place Member(s) >>

Select *IPE120* as the cross section and make sure that Material is set to *Steel*, Releases to *Fix-Fix* and Beta angle is *90*.

Press the “Place Member >>” button .

Click on the joint located at the point 1 of the following image. Click on the joint at point 2 and the girder member is generated.

Having the command still active, click on the joints at points 3 and 4 and another girder member is generated.

Continue by clicking on joints at points 5 and 6 and another girder member is generated.

Continue by clicking on joints at points 7 and 8 and another girder member is generated.

Continue by clicking on joints at points 9 and 10 and another girder member is generated.

Continue by clicking on joints at points 11 and 12 and another girder member is generated.

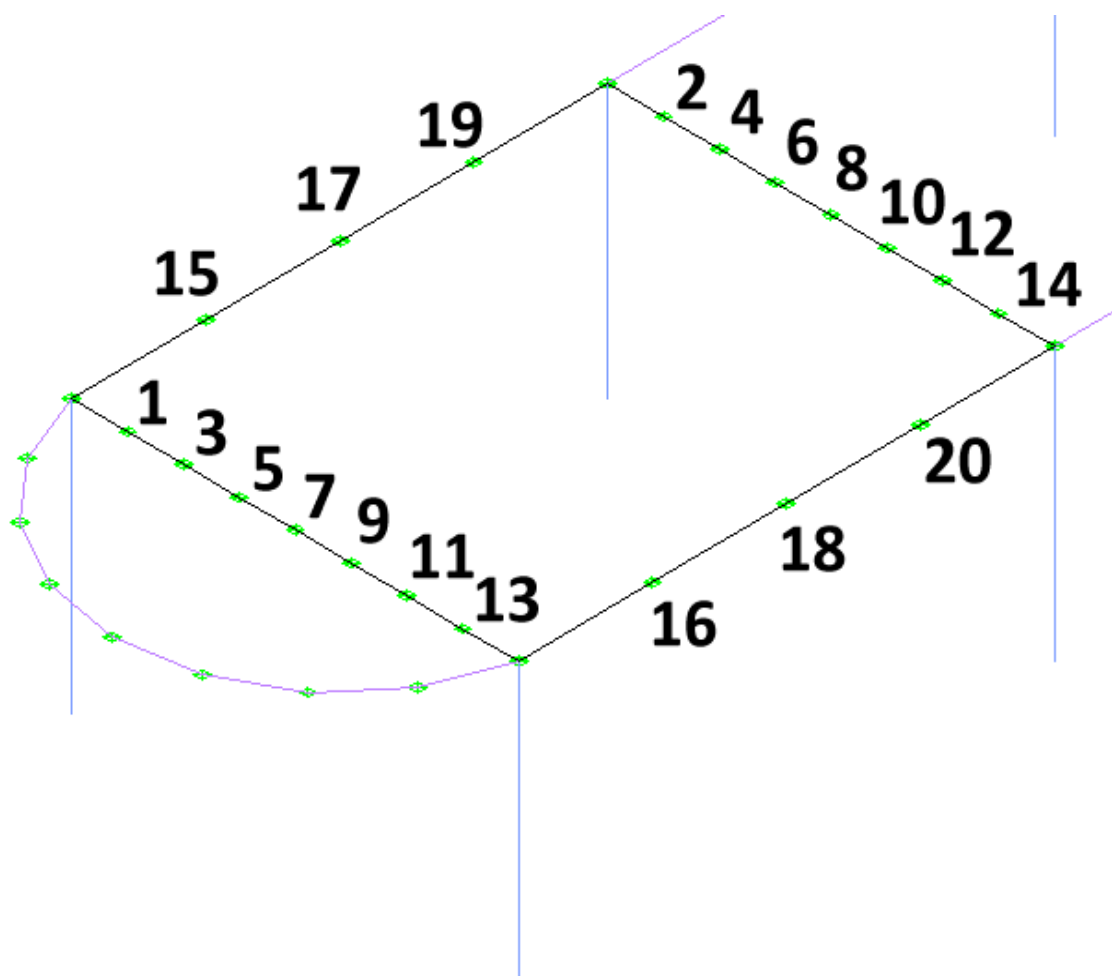
Continue by clicking on joints at points 13 and 14 and another girder member is generated.

Make sure that the option “Split Intersecting Members” is ON, so that common joints will be created along the previously created X-direction girders. Click on the joint located at point 15 and then click on joint at point 16 and the girder member is generated. Existing girders are split.

Repeat the procedure:

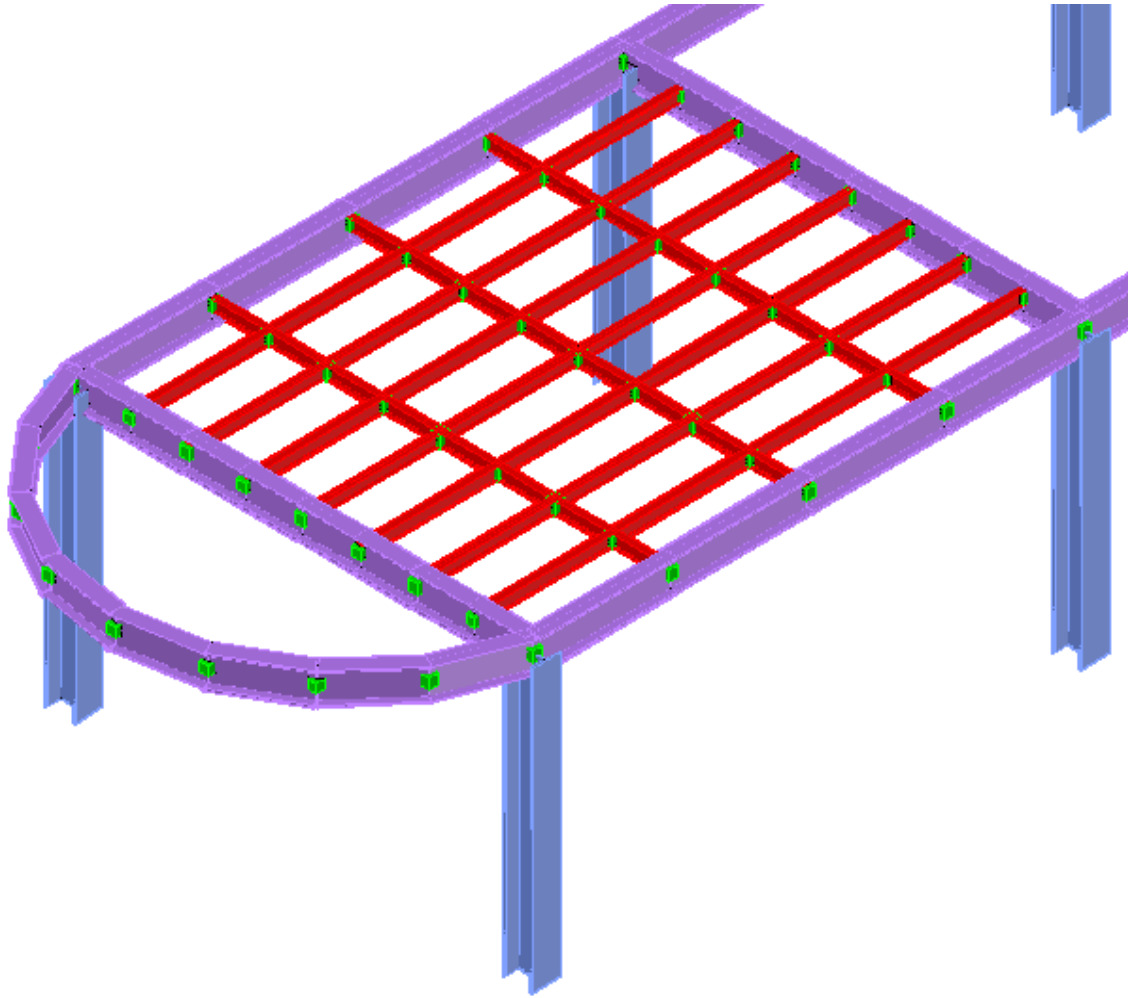
Click on the joint located at point 17 and then click on the joint at point 18 and the girder member is generated. Existing girders are split.

Click on the joint located at point 19 and then click on the joint at point 20 and the girder member is generated. Existing girders are split.



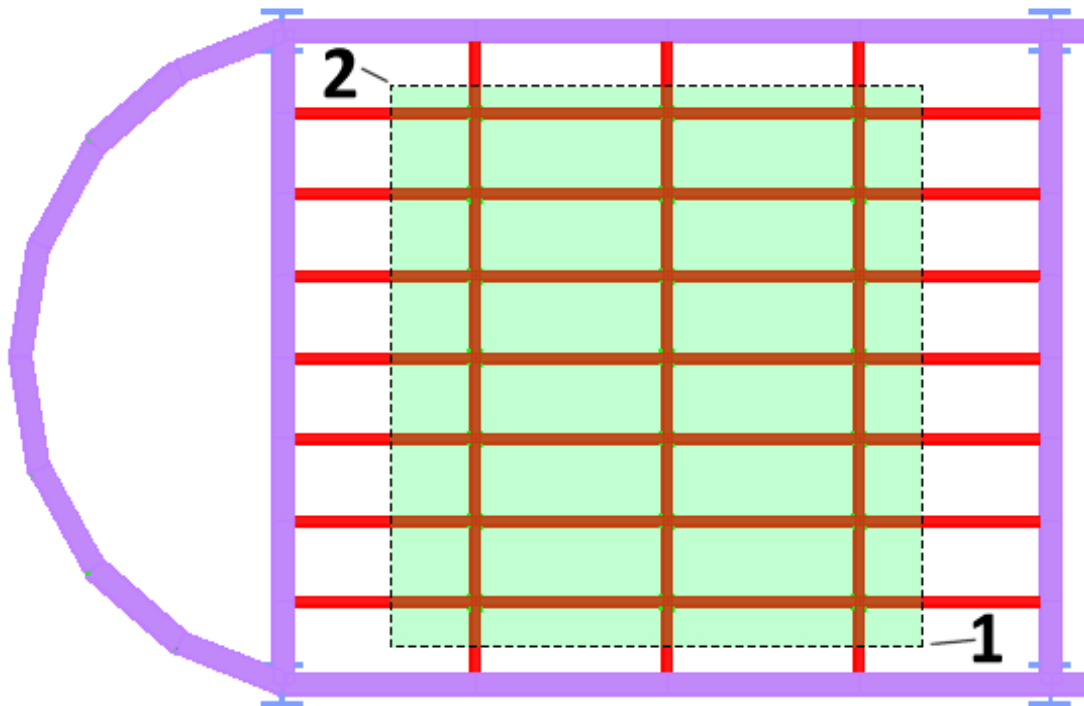
Press ESC to terminate the Generate Beam Command.

Step #29. Add eccentricities to the Girders: Press the icon  to display the 3D solid view:



Click on the Top Icon on AutoCAD's or BricsCAD's View Cube to switch to the top view in order to be able to select girder members easily.

Click on the icon  **Change Member** and when asked to Select objects: click on the 2 Points of the following image, to select all girder members, and press <ENTER>.



The *Member Properties [Multiple Selection]* form is displayed so you may now specify member eccentricities.

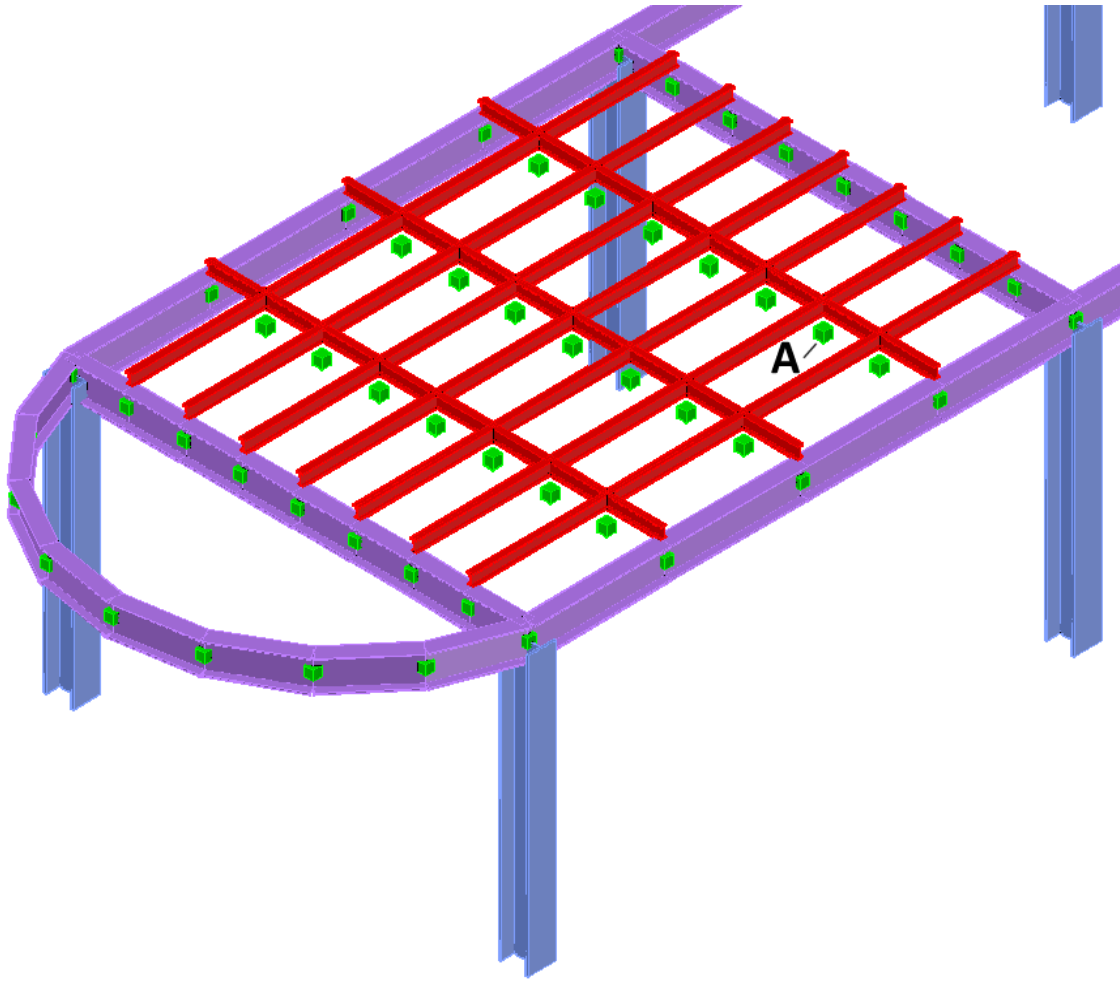
End Sizes OR Member Eccentricities (Offsets)			
	Start		End
Sizes :	0		0
X :	0	X :	0
Y :	0	Y :	0
Z :	0.25	Z :	0.25

Enter 0.25 for the Z Starting Eccentricity and 0.25 as the Z Ending Eccentricity.

Press OK.

Now the deformable axis of the girder members has been moved 0.25m up in the Z direction.

Switch back to the isometric view by clicking on the House icon on AutoCAD's or BricsCAD's view Cube to see the result. The girder members now sit on the upper flange of the beam members.

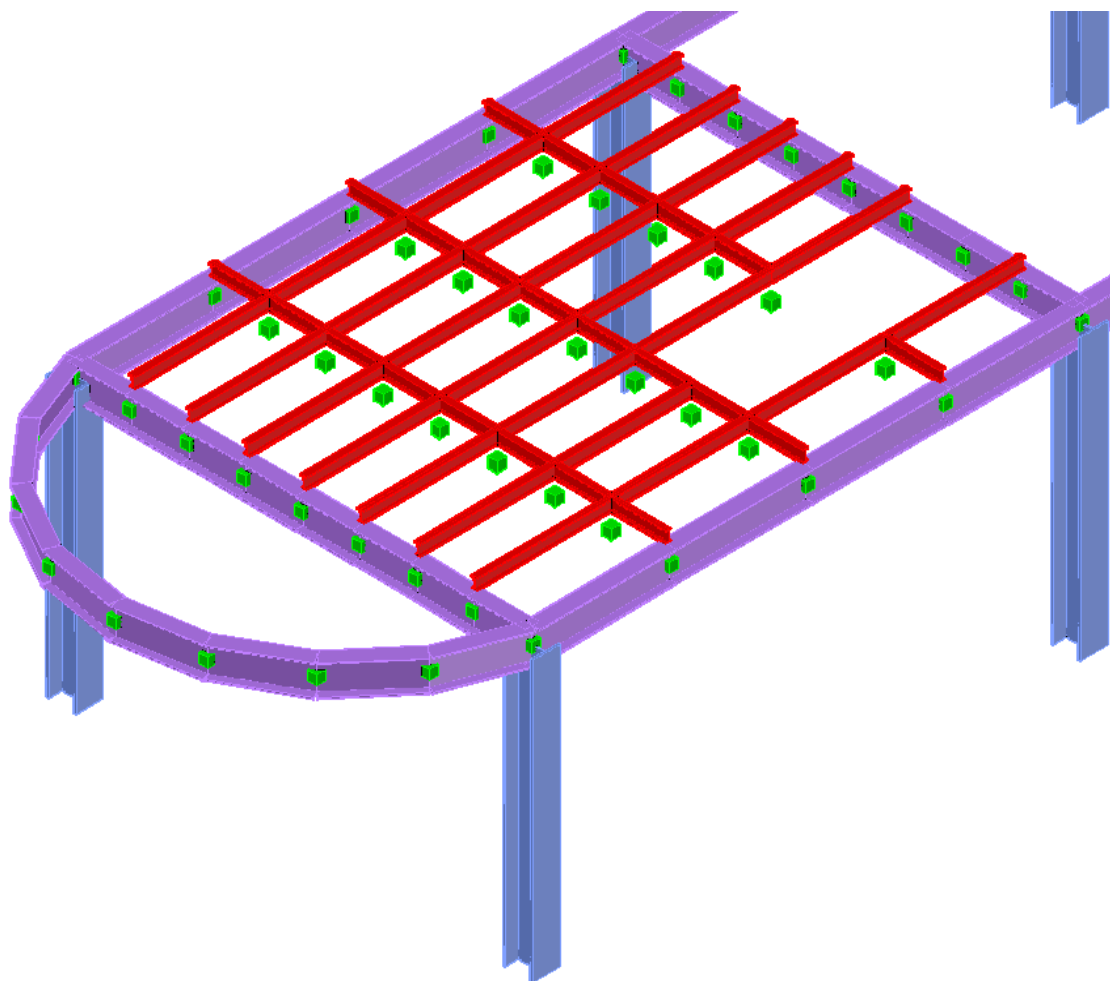


3.9. Create an opening

Step #30. Delete a joint to create an opening: Select the Joint Located in Point A of the image above and press the DEL key.

Warning: *All structural entities (members, elements, etc) connected to this Joint will also be deleted? (Yes/No)* appears and continue by pressing Y and <ENTER>.

The Joint is deleted together with all members connected to the joint.



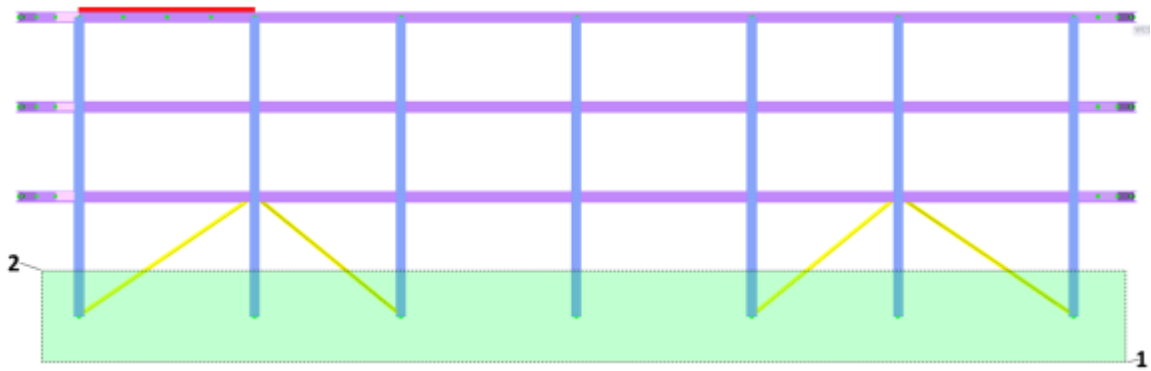
3.10. Create Supports

Step #31. Support the joints at the base of the model:

Make the entire structure visible by clicking on the icon  All and press Z and E (Zoom Extents).

Switch to the FRONT View, by clicking on Front on AutoCAD's or BricsCAD's view cube.

Click on the icon  Support and select the window by clicking at points 1 and 2 in the following image. All the bottom joints are selected and press OK to finish the selection.



Restraints & Spring values

Quick Selection : Pin

Restraint	Spring	Restraint	Spring
☒ Fx		☐ Mx	
☒ Fy		☐ My	
☒ Fz		☐ Mz	

The Joint Properties [Multiple Selection] form appears.

Select Pin using Quick Selection, and Fx, Fy and Fz are automatically checked.

Press OK.

All the bottom joints are now pinned and have an orange color instead of green to indicate that they are supported.

3.11. Check the model

Step #32. Check for duplicate joints: In order to check for joints having the same coordinates,

click on the icon  Joints Duplicates .

For the Merge Accuracy <0.001000>, just press <ENTER> to accept the default value.

The Merge Joints form appears where you can see the list of joints having the same coordinates. Make sure that Merge option is checked for all pairs and press OK.

Merge Joints

Joint	Duplicate	Merge
8	25	☒
16	17	☒

Select All
Unselect All
OK
Cancel

By entering the same command again, for the 2nd time, you should get the notification that *0 duplicate joints found*.

Step #33. Check for floating joints: In order to check for joints not connected to the model, click on the icon  Joints Floating. If your model was created as described so far, you should get a notification *0 floating joints found*.

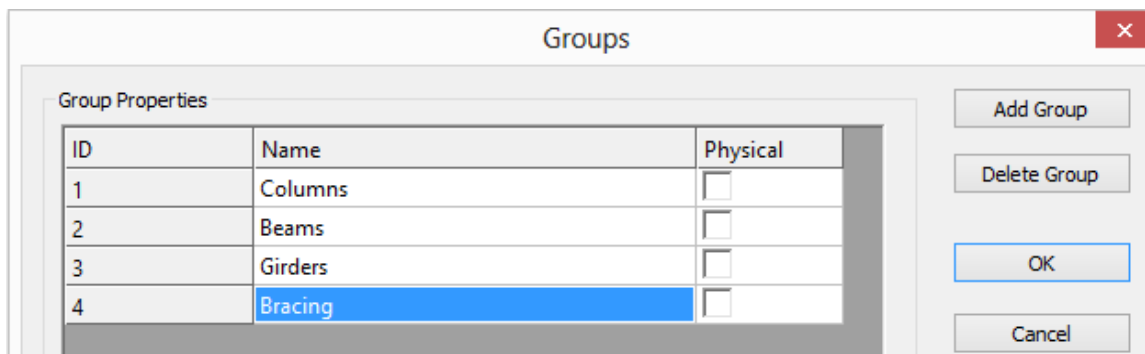
Note: You can also run all other checks of the same drop list, to check for Interference Joints, Duplicate Members, Zero Length Members, Duplicate Names and Database Integrity. You should not get any errors or warnings.

3.12. Define Groups

Step #34. Create Group Names: It is optional to define Groups in your model but it is strongly recommended to do so since it will be easier to control the display and selection for parts of your structure.



Click on the icon **List** in the Groups panel and the Group dialog appears.

A screenshot of the 'Groups' dialog box. It has a title bar with a close button (X). Inside, there's a 'Group Properties' section with a table. The table has three columns: 'ID', 'Name', and 'Physical'. There are four rows: 1 (Columns), 2 (Beams), 3 (Girders), and 4 (Bracing). The 'Bracing' row is highlighted. To the right of the table are four buttons: 'Add Group', 'Delete Group', 'OK', and 'Cancel'.

ID	Name	Physical
1	Columns	☐
2	Beams	☐
3	Girders	☐
4	Bracing	☐

Press the *Add Group* button and enter `Columns` as *Name* of the group.

Press the *Add Group* button and enter `Beams` as *Name* of the group.

Press the *Add Group* button and enter `Girders` as *Name* of the group.

Press the *Add Group* button and enter `Bracing` as *Name* of the group.

Press OK to close the form.

Step #35. Add Columns to their Group.

Click on the icon  Colors and make only profiles HE320B visible by unchecking all others.

Press OK.

Categories		
Sections	Color	Visible
HE320B	161	☒
IPE330	191	☐
IPE120	1	☐
60x60x5	50	☐

Select Group

Group

Columns

...

Click on the icon  +Members in the Groups panel and make sure that the Group Columns is selected as the active group.

Select everything on the screen in a full window and press the Enter key.

To verify that the group is applied correctly, you can double click on a column and in the Member Properties form, you will be able to see its Group definition.

Groups

Inactive

...

Remove

Groups that Member belongs

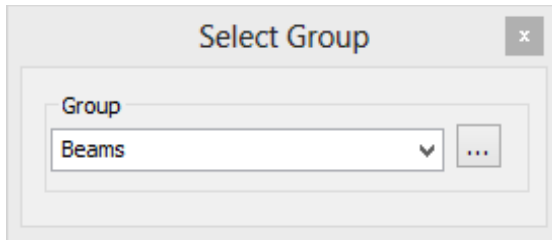
Columns

Step #36. Add Beams to their Group:

Click on the icon  Colors and make only profiles IPE330 visible by unchecking all others.

Press OK.

Categories		
Sections	Color	Visible
HE320B	161	☐
IPE330	191	☒
IPE120	1	☐
60x60x5	50	☐



Click on the icon  +Members and make sure that the Group Beams is selected as the active group.

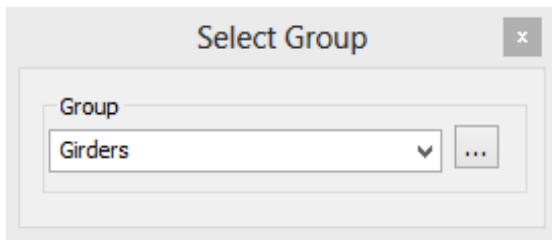
Select everything on the screen in a full window and press the Enter key.

Step #37. Add Girders to their Group:

Click on the icon  Colors and make only profiles IPE120 visible by unchecking all others.

Press OK.

Categories		
Sections	Color	Visible
HE320B	161	☐
IPE330	191	☐
IPE120	1	☒
60x60x5	50	☐



Click on the icon  +Members and make sure that the Group Girders is selected as the active group.

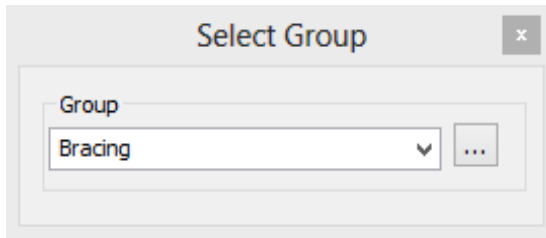
Select everything on the screen in a full window and press the Enter key.

Step #38. Add Bracing to their Group:

Click on the icon  Colors and make only profiles 60x60x5 to be visible by unchecking all others.

Press OK.

Categories		
Sections	Color	Visible
HE320B	161	☐
IPE330	191	☐
IPE120	1	☐
60x60x5	50	☒



Click on the icon  +Members and make sure that the Group Bracing is selected as the active group.

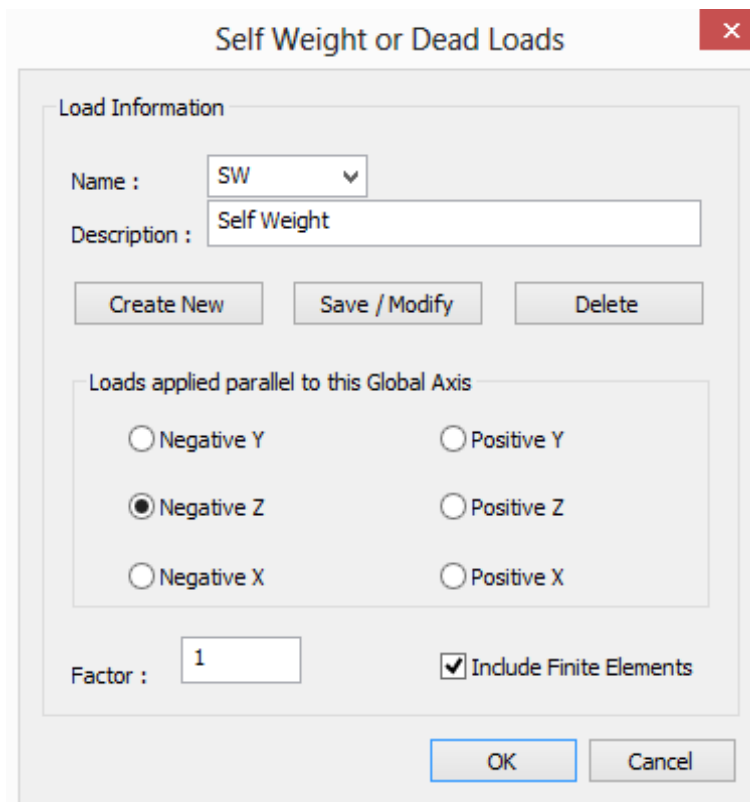
Select everything on the screen in a full window and press the Enter key.

3.13. Define Loads

Step #39. Define Self Weight: Click on the icon  Self Weight and the Self Weight dialog appears. Enter:

- SW as Name
- *Self Weight* as the Load Description
- *Negative Z* as the Global Axis for the direction of the load
- 1.0 as Factor
- Check Include finite elements

and press Create New to create the new loading and then OK to close the dialog.

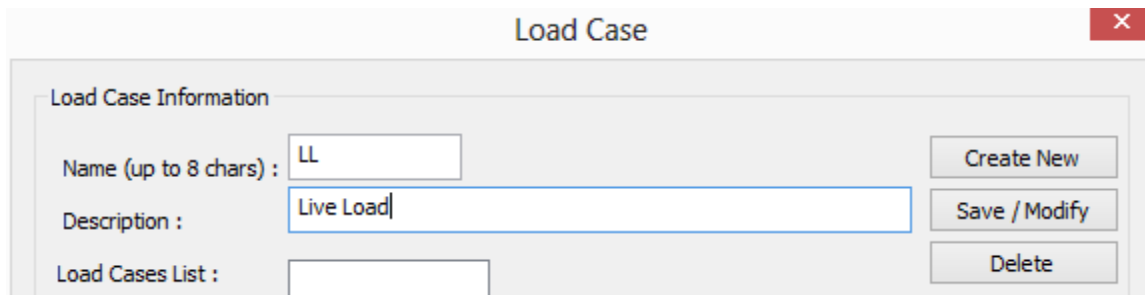


Step #40. Define Load Cases: Click on the icon  Load Cases and the Load dialog appears.

Enter:

- *LL* as Name
- *Live Load* as the Load Description

and press Create New.

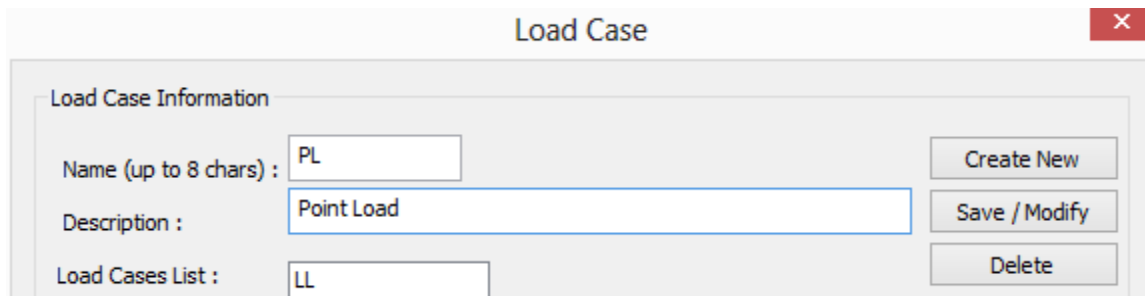


The image shows a 'Load Case' dialog box with a title bar and a close button. Inside, there is a section titled 'Load Case Information'. It contains three input fields: 'Name (up to 8 chars):' with the value 'LL', 'Description :' with the value 'Live Load', and 'Load Cases List :' which is empty. To the right of these fields are three buttons: 'Create New', 'Save / Modify', and 'Delete'.

Enter:

- *PL* as Name
- *Point Load* as the Load Description

and press Create New.



The image shows the same 'Load Case' dialog box. In this instance, the 'Name (up to 8 chars):' field contains 'PL' and the 'Description :' field contains 'Point Load'. The 'Load Cases List :' field now contains 'LL'. The 'Create New' button is highlighted, indicating it is the next step.

Press Exit to close the dialog.

Step #41. Apply Live Loads: Live Loads will be applied only to Beam Members, therefore click on the icon  Colors. Select the 2nd Tab in order to colorize members by their group and make only the Group Beams visible and press OK.

Sections Groups		
Categories		
Groups	Color	Visible
Columns	161	☐
Beams	191	☒
Girders	1	☐
Bracing	50	☐
UnGrouped data	7	☒

Click on the icon  **Member** . Using a full window, select all entities that appear on screen and press <ENTER> to finish with the selection.

The Member Properties [Multiple Selection] form appears having the tab “Member Loads” active.

Click on LL at the “Empty Load Cases” list box and then enter

- *Uniform* as the Load Distribution
- *Force* as Load Type
- *Z Global* as Direction
- -5 as V1
- Fractional as Location
- 0.0 as L1
- 1.0 as L2

Press Create New and the number 125 appears next to the \$ symbol the Empty Load Cases list box. This is a notification that 125 members are loaded in Load Case LL.

Member Properties

Model Section Properties **Member Loads** Member Temperature Loads Member Distortions

Applied Load Cases

Empty Load Cases

LL \$ Live Load \${0}
PL \$ Point Load \${0}

Loading

Load Case : LL Create New

Description : Live Load Save / Modify

Loads in this Load Case : ▼ Delete

Load Distribution

☐ Concentrated
☒ Uniform
☐ Linear
☐ Triangular

Member Start

Load Type and Direction

☒ Force ☐ X ☐ Local
☐ Y ☐ Z ☒ Global
☐ Moment

Loading Magnitude

V1 : -5

V2 :

Loading Location from Start

☒ Fractional L1 : 0.0
☐ Absolute L2 : 1.0

OK Cancel Apply Help

Press OK to close the dialog. Member Loads appear in red arrows. To clear the arrows select **Clear** from the GTS Display Ribbon Tab.

By double clicking on one beam and then selecting the Member Loads tab and clicking on LL at the Applied Load Cases List Box, you will be able to view and edit the existing loading values of the specific beam.

Click on the icon **Colors**, select the 1st Tab in order to colorize members by their section and then select everything to be visible and press OK.

Sections **Groups**

Categories

Sections	Color	Visible
HE320B	161	☒
IPE330	191	☒
IPE120	1	☒
60x60x5	50	☒

Step #42. View Live Loads: Click at the icon **Frame** to switch to the wireframe view.

On the Menu Bar, click on GTS Display>Display>Member Loads and the Display Loads form appears:

Display Loads

Load Case

LL

Display Loads Applied To

☐ Joints ☒ Members ☐ Elements

Display Options

Scale Factor Concentrated (pts) 30

Scale Factor Distributed (pts) : 30

Arrowhead Size (pts) : 10

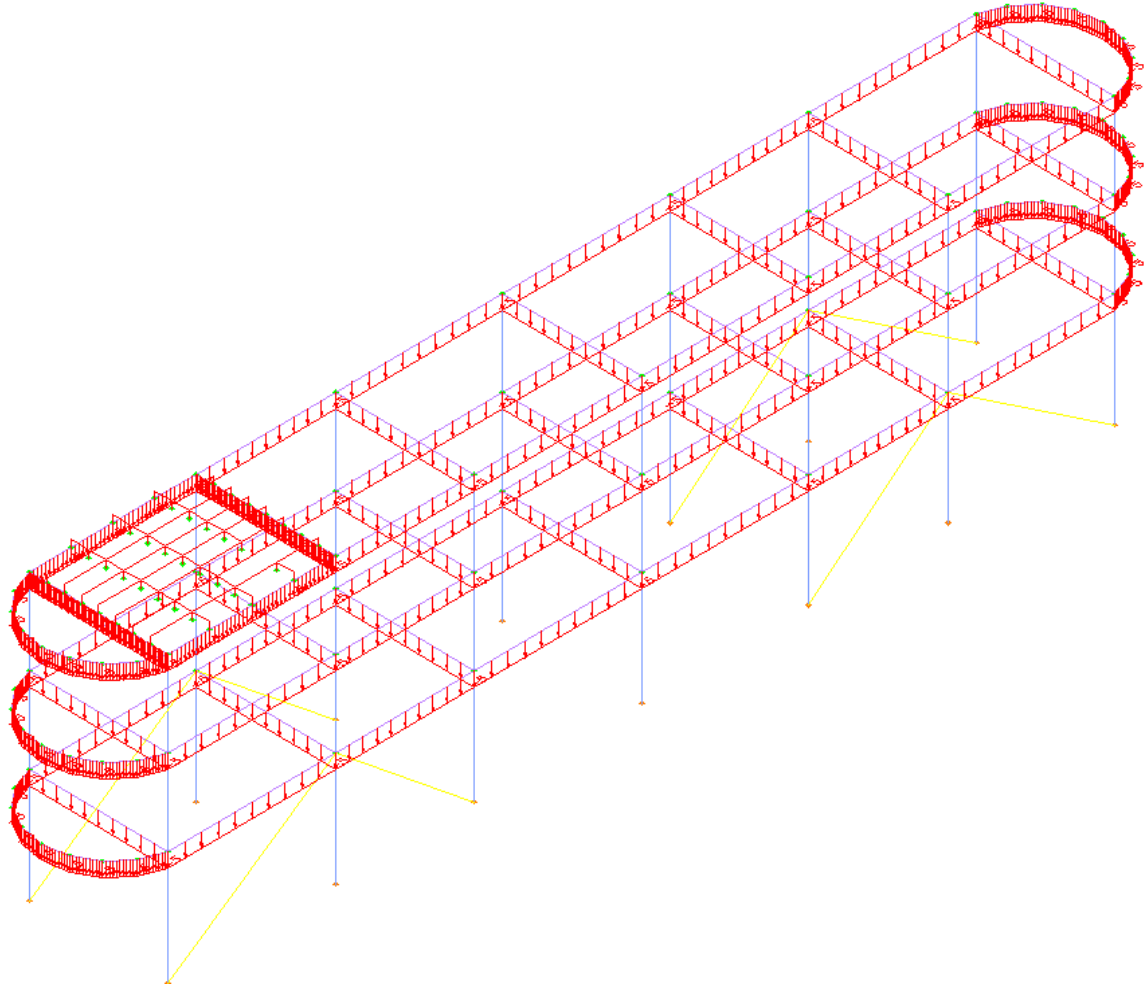
Font Size (pts) : 10

Show Clear Close

Select LL as the Load case and leave the other display options at their default values.

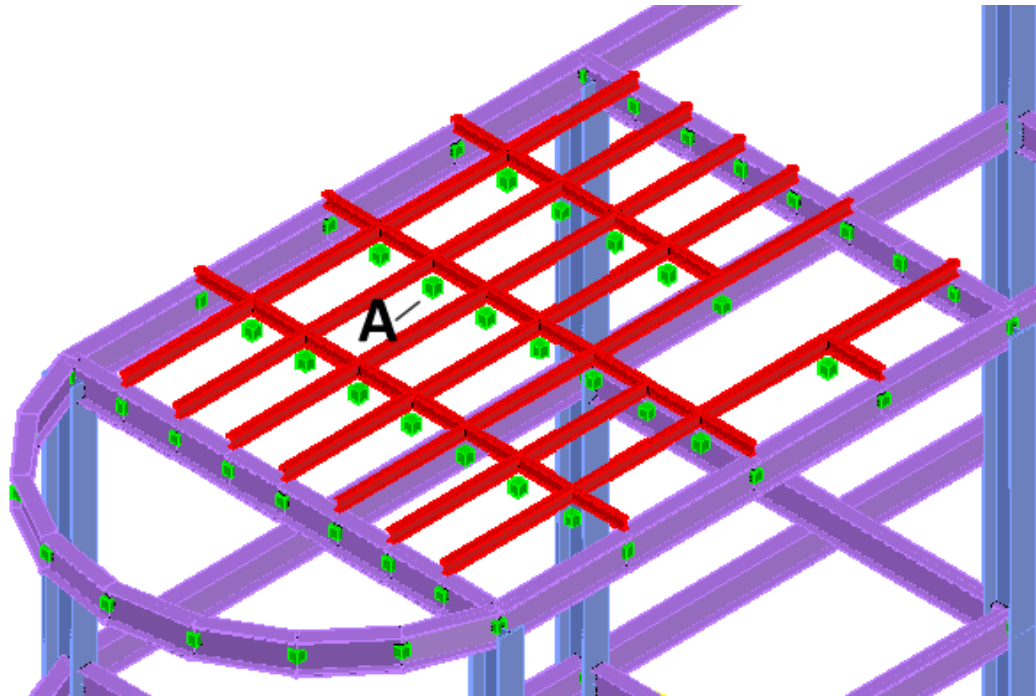
Press Show and the loading arrows are displayed.

Click on Clear when you are done and Close to exit from the dialog.



Click at the icon  to display the 3D solid view.

Step #43. Apply Joint Load: A Joint load will be applied to the Joint located at Point A of the following image.



Zoom closer to the specific point using AutoCAD's/BricsCAD's zooming functions.

Click on the icon  **Joint** , click on the joint at A and press <ENTER> to finish with the selection.

The Joint Properties form appears having the tab "Joint Generalized Loads" active.

Click on PL in the "Empty Load Cases" list box and then enter -3 for Force Z as shown in the Joint Properties form on the next page.

Press Create New, and the number 1 appears next to the \$ symbol in the Load Cases list box. This is a notification that 1 joint is loaded under the Load Case PL.

Joint Properties ✕

Model

Joint Generalized Loads

Applied Load Cases

Empty Load Cases

LL \$[0]

PL \$[0]

Loading

Load Case :

Create New

Description :

Save / Modify

Loads in this Load Case :

Delete

Applied Load Values

Force X :

Force Y :

Force Z :

Moment X :

Moment Y :

Moment Z :

Applied Displacement Values

Tran X :

Tran Y :

Tran Z :

Rot X :

Rot Y :

Rot Z :

OK

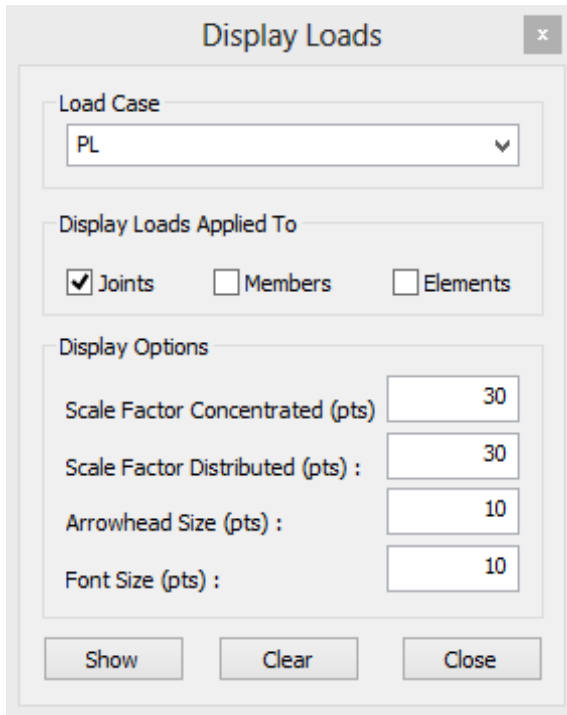
Cancel

Apply

Help

Step #44. View Joint Load: Click at the icon  **Frame** to switch to wireframe view.

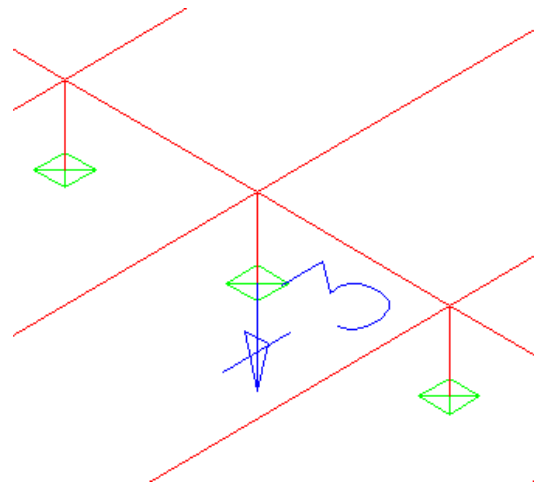
On the Menu Bar, click on GTS Display>Jont Loads and the Display Loads form appears:



Select PL as the Load case and leave the other display options at their default values.

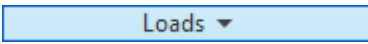
Press Show and the loading arrows are displayed.

Click on Clear when you are done and Close to exit from the dialog.



Click at the icon  to display the 3D solid view.

Step #45. Define Area Load for Level 1: An area load equal to 1.0kN/m^2 along the vertical direction will be applied to whole level. Switch to Level 1 by clicking on the icon  Lower Level until "Level 1" is displayed.

Click on the icon  Area under the  panel.

Area Load ✕

Generate

Name :

Description :

Load - Direction

Load Value :

Global Direction Perpendicular to the Loading Plane :

☐ X ☐ Y ☒ Z

Plane Tolerance :

Elevation

Plane Perpendicular at :

☒ Value (coordinate)

☐ Joint

Distribution

☒ Two way ☐ X

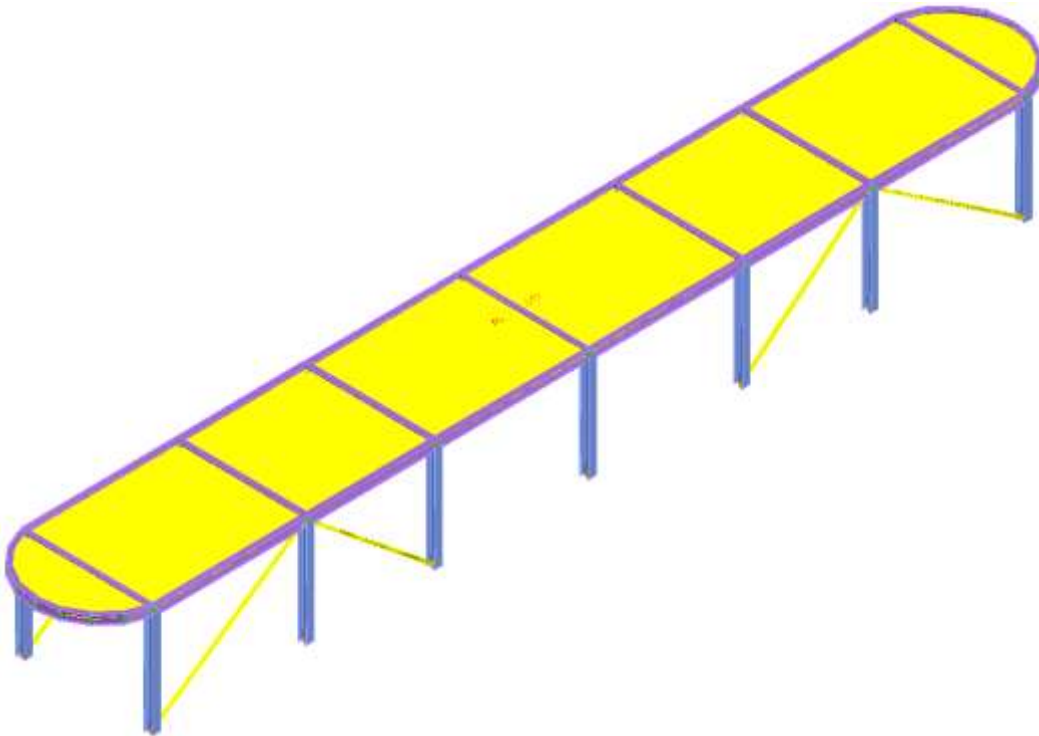
☐ One way ☐ Y

☐ Custom X Y

Type:

- *AL1* as Name
- *Area Load Level 1* as Description
- *1.0* as Load Value
- *Z* as Global Direction
- *4.0* as Elevation (the elevation of level 1)
- *Two way* as Distribution

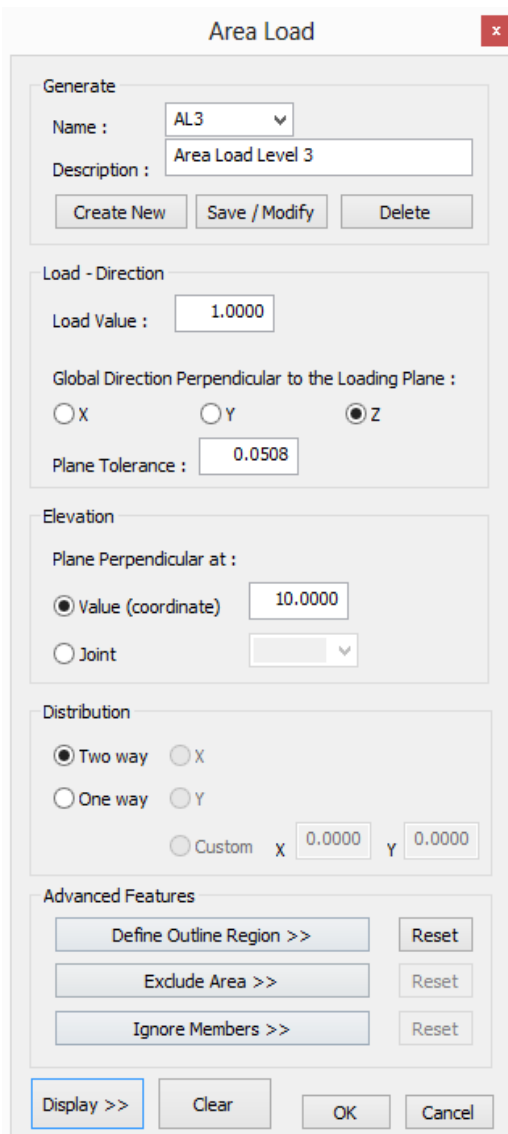
Press Display >> and the loaded areas that were automatically detected are displayed in yellow solid hatch, as shown below.



Press Clear to remove the solid hatch pattern and then OK to store the area load AL1.

Step #46. Define Area Load for Level 3: An area load equal to 1.0kN/m^2 along the vertical direction will be applied only to the two middle openings. Switch to Level 3 by clicking on the icon  **Higher Level** until “Level 3” is displayed.

Click on the icon  **Area** under the **Loads** panel.



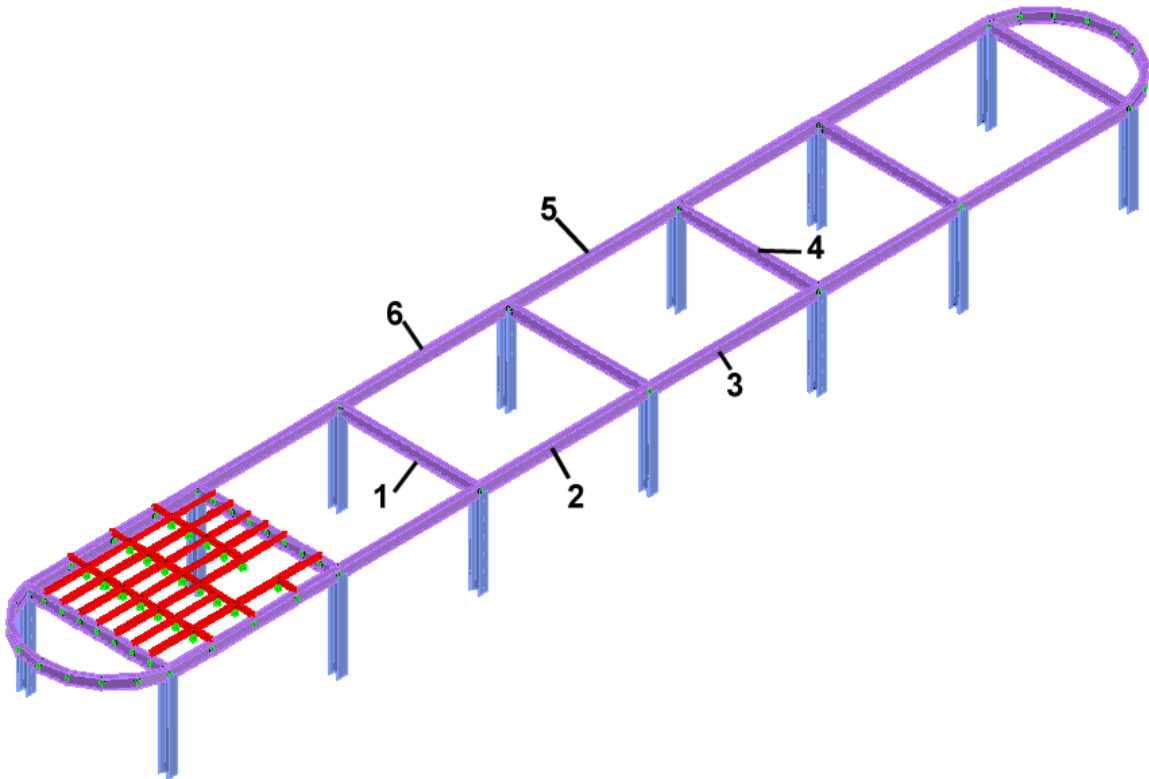
The dialog box is titled "Area Load" and contains the following sections:

- Generate:**
 - Name:
 - Description:
 - Buttons: Create New, Save / Modify, Delete
- Load - Direction:**
 - Load Value:
 - Global Direction Perpendicular to the Loading Plane:
 - ☐ X
 - ☐ Y
 - ☒ Z
 - Plane Tolerance:
- Elevation:**
 - Plane Perpendicular at:
 - ☒ Value (coordinate)
 - ☐ Joint
- Distribution:**
 - ☒ Two way ☐ X
 - ☐ One way ☐ Y
 - ☐ Custom X Y
- Advanced Features:**
 - Define Outline Region >>
 - Exclude Area >>
 - Ignore Members >>
- Buttons:** Display >>, Clear, OK, Cancel

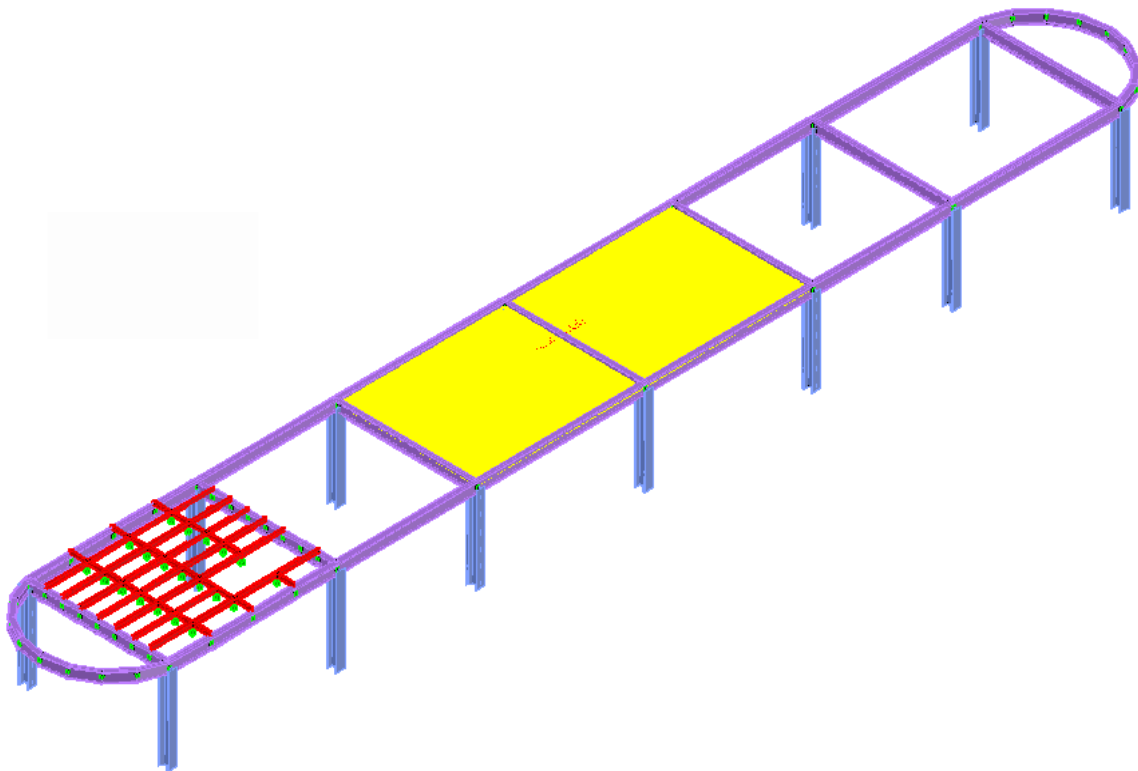
Type:

- *AL3* as Name
- *Area Load Level 3* as Description
- *1.0* as Load Value
- *Z* as Global Direction
- *10.0* as Elevation (the elevation of level 3)
- *Two way* as Distribution

Press “Define Outline Region >>” and you are prompted to select the members that define the outline region of the area load. Click on the 6 members at the perimeter of the two middle openings, as shown at the image below.



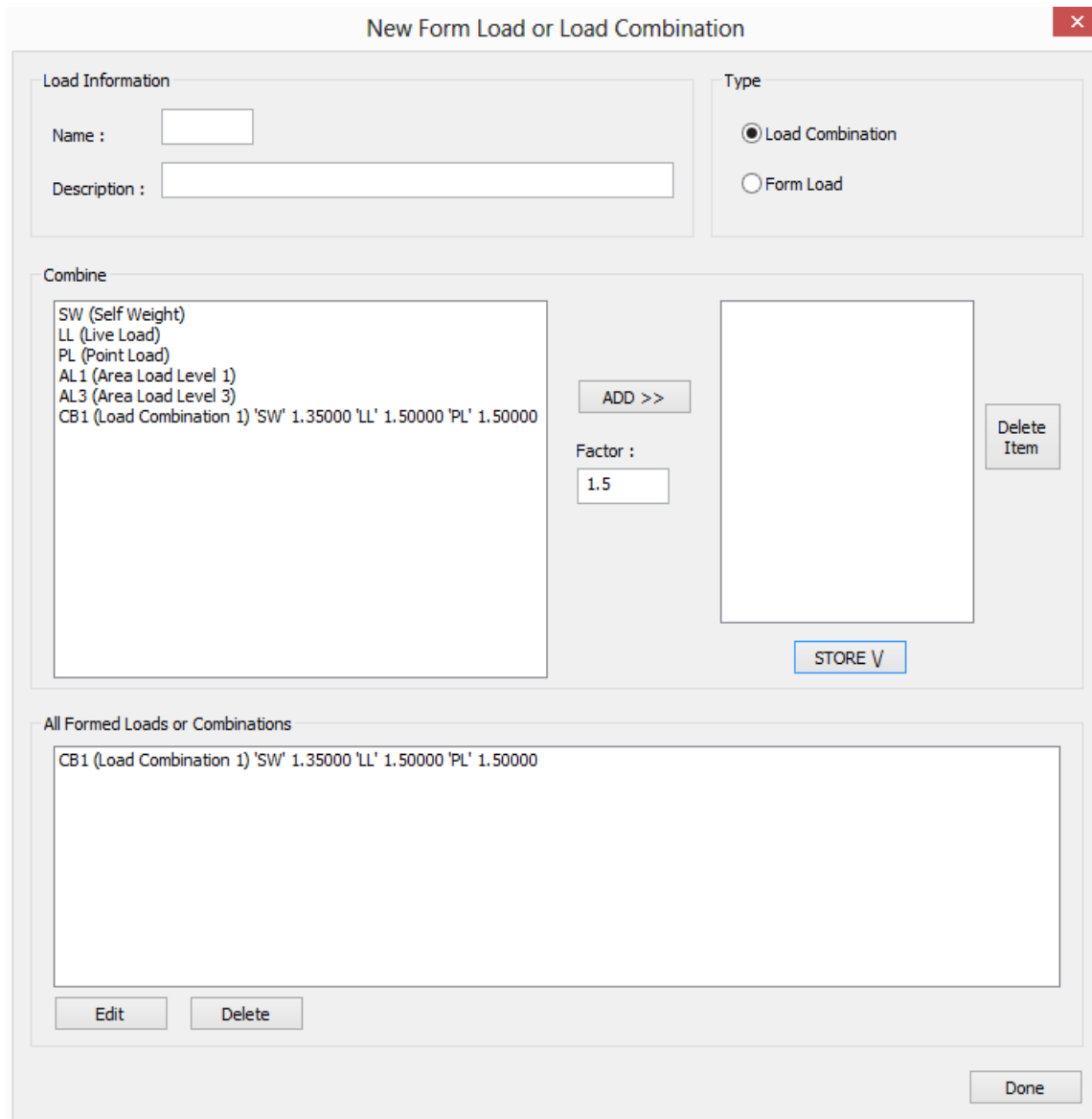
Press Display >> and the loaded area will be displayed in yellow solid hatch, as shown below.



Press Clear to remove the solid hatch pattern and then OK to store the area load AL3.

Step #47. Define Load Combinations: Click on the icon  **Combinations** and the Load Combination dialog appears. Enter:

- *CB1* as Name
- *Load Combination 1* for the Description of the Load Combination
- Click on SW, Enter 1.35 as the factor and press ADD>>
- Click on LL, Enter 1.5 as the factor and press ADD>>
- Click on PL, Enter 1.5 as the factor and press ADD>>
- Press Store
- Press Done to close the dialog.



New Form Load or Load Combination

Load Information

Name :

Description :

Type

☒ Load Combination

☐ Form Load

Combine

SW (Self Weight)
 LL (Live Load)
 PL (Point Load)
 AL1 (Area Load Level 1)
 AL3 (Area Load Level 3)
 CB1 (Load Combination 1) 'SW' 1.35000 'LL' 1.50000 'PL' 1.50000

ADD >>

Factor :

Delete Item

STORE ✓

All Formed Loads or Combinations

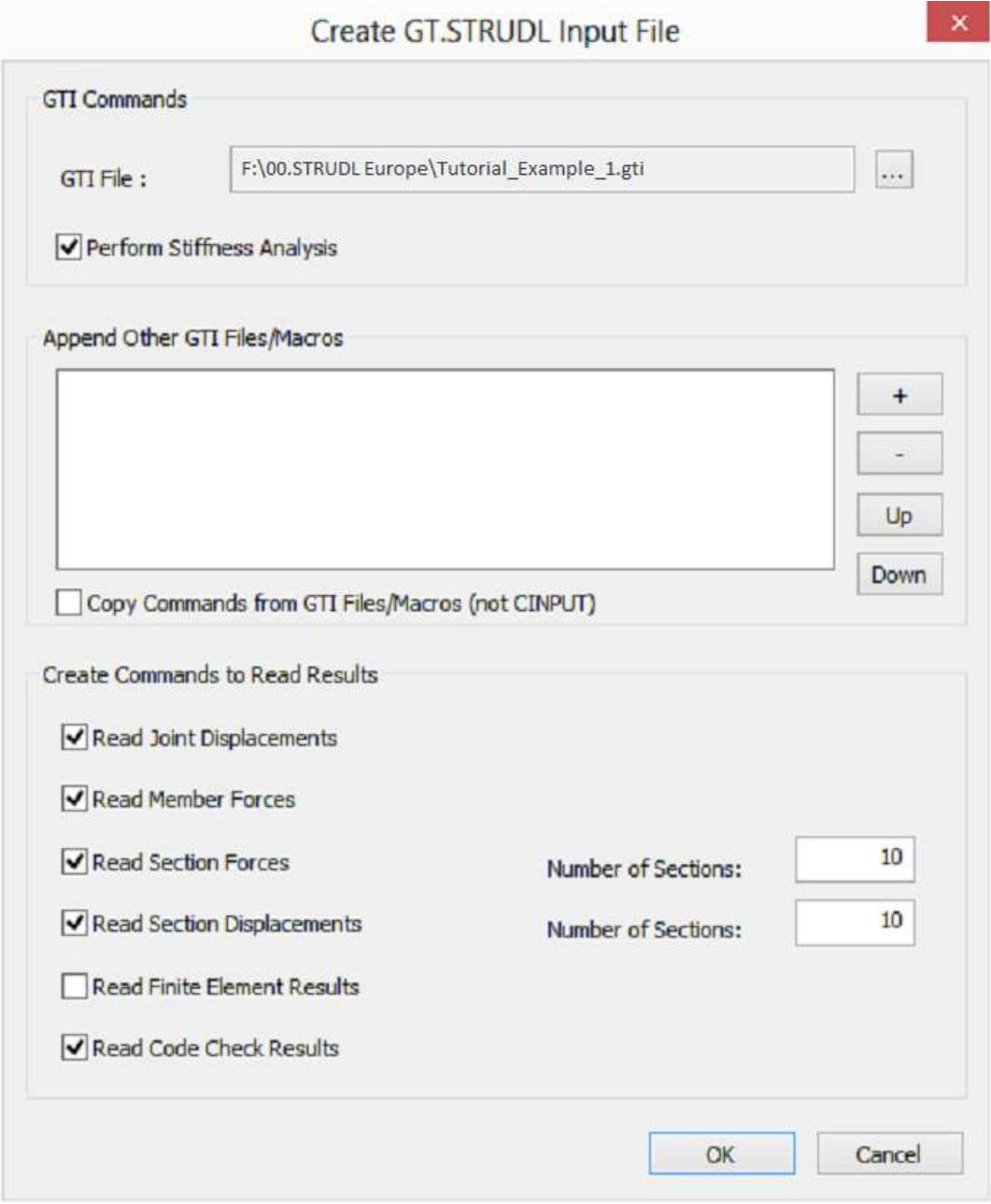
CB1 (Load Combination 1) 'SW' 1.35000 'LL' 1.50000 'PL' 1.50000

Edit **Delete**

Done

3.14. GT STRUDL Input File

Step #48. Create GTI: Save your model as “Tutorial_Example_1.dwg” and click on the icon  and the Create GT STRUDL Input file dialog appears. Keep the default GTI filename, check all options except “Read Finite Element Results” as shown in the following image and press OK.



The dialog box is titled "Create GT.STRUDL Input File" and contains the following sections:

- GTI Commands**
 - GTI File : F:\00.STRUDL Europe\Tutorial_Example_1.gti
 - ☒ Perform Stiffness Analysis
- Append Other GTI Files/Macros**
 - A list box for additional files.
 - Buttons: +, -, Up, Down.
 - ☐ Copy Commands from GTI Files/Macros (not CINPUT)
- Create Commands to Read Results**
 - ☒ Read Joint Displacements
 - ☒ Read Member Forces
 - ☒ Read Section Forces (Number of Sections: 10)
 - ☒ Read Section Displacements (Number of Sections: 10)
 - ☐ Read Finite Element Results
 - ☒ Read Code Check Results

Buttons: OK, Cancel

Step #49. View/Edit GTI: Click on the icon  Edit Input File and the GTI file created in the previous step will be opened by the system’s default text editor.

Step #50. Execute GT STRUDL: Click on the icon  and the GTI file created in the previous step will be sent to GT STRUDL main program that is waiting in the background.

Stiffness analysis is automatically performed and DBX result files are automatically created.

In order to demonstrate the use of the command that reads back design results, add the following commands into GT STRUDL main window (note that the steel design Parameters are incomplete)

```
PARAMETERS
```

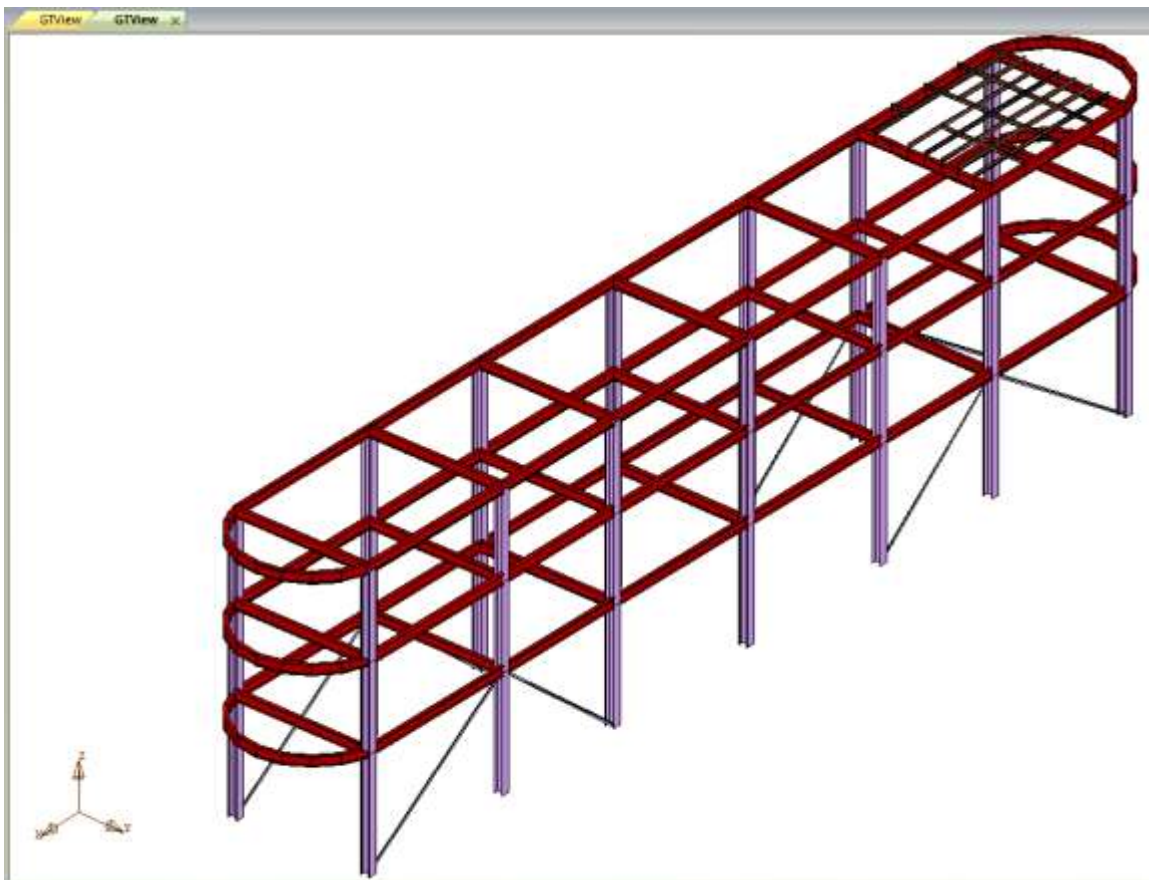
```
CODE EC3 ALL MEMBERS
```

```
CHECK ALL MEMBERS AS BEAM
```

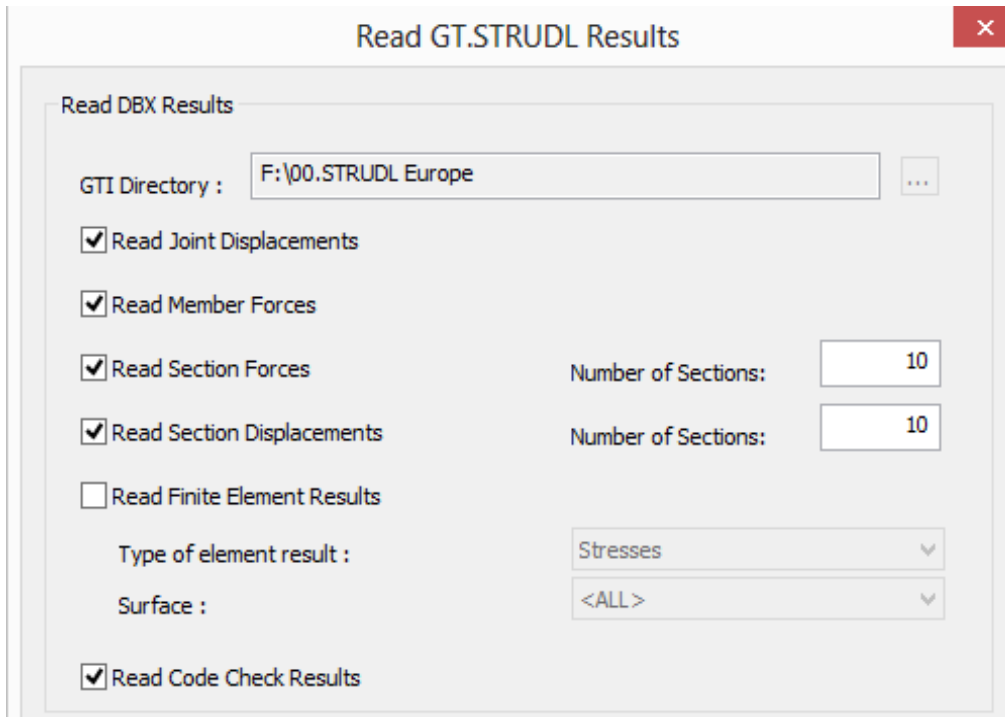
```
WRITE REPLACE CODE 'Tutorial_Example_1' MEMBERS EXISTING
```

The result of the CHECK ALL MEMBERS command shown above is that members 148 149
150 151 152 153 154 155 FAILED CODE CHECKS

In addition, you can enter GTMenu to view the model and the results as described in the GTMenu User Guide. After selecting the View button and checking Z-Up, and then selecting View 1, the structure is displayed in GTMenu as shown below.



Step #51. Read Results from GT STRUDL: In CAD Modeler, click on the icon  **Read Results** and the Read GT.STRUDL Results dialog appears. Check all options except “Read Finite Element Results” as shown below and press OK.



Read GT.STRUDL Results

Read DBX Results

GTI Directory : F:\00.STRUDL Europe

☒ Read Joint Displacements

☒ Read Member Forces

☒ Read Section Forces Number of Sections: 10

☒ Read Section Displacements Number of Sections: 10

☐ Read Finite Element Results

Type of element result : Stresses

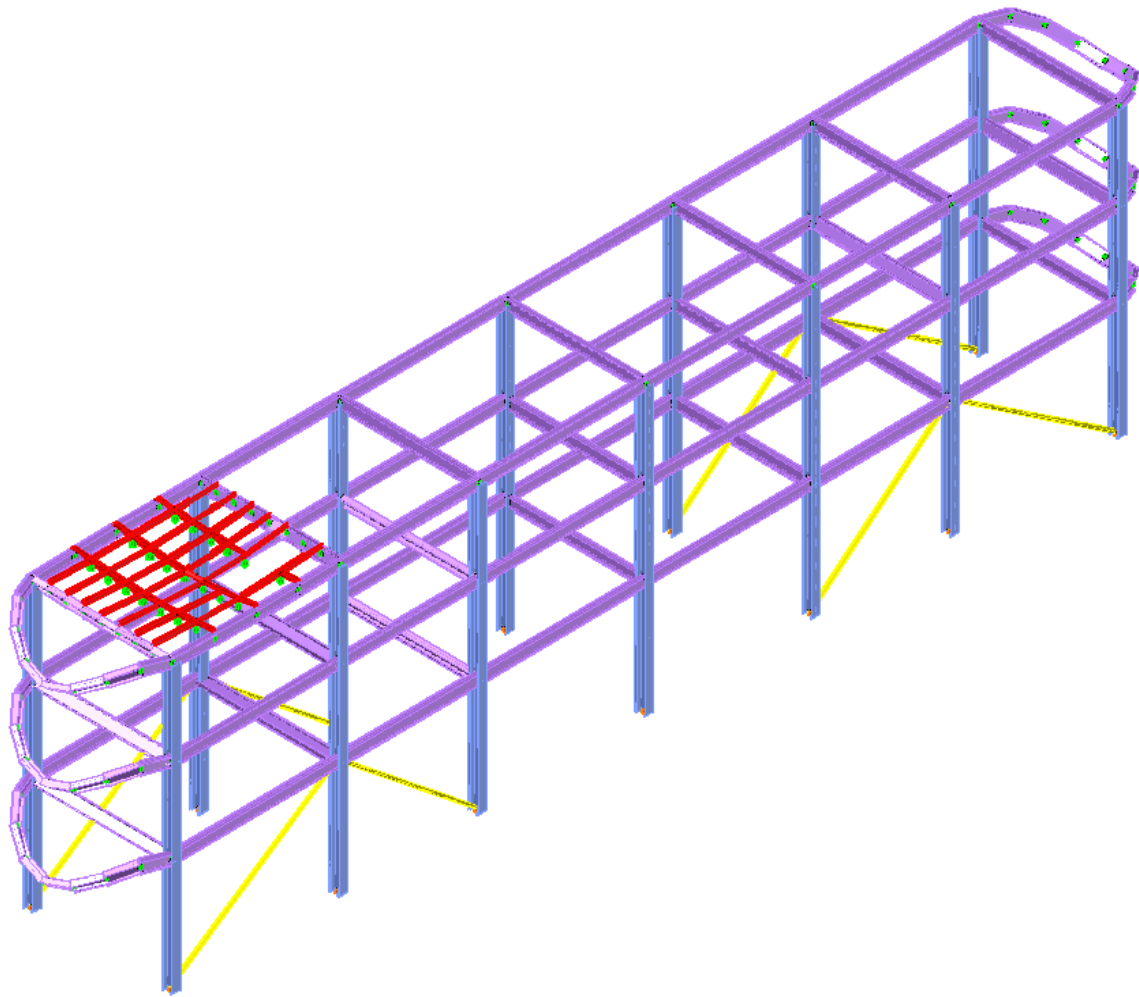
Surface : <ALL>

☒ Read Code Check Results

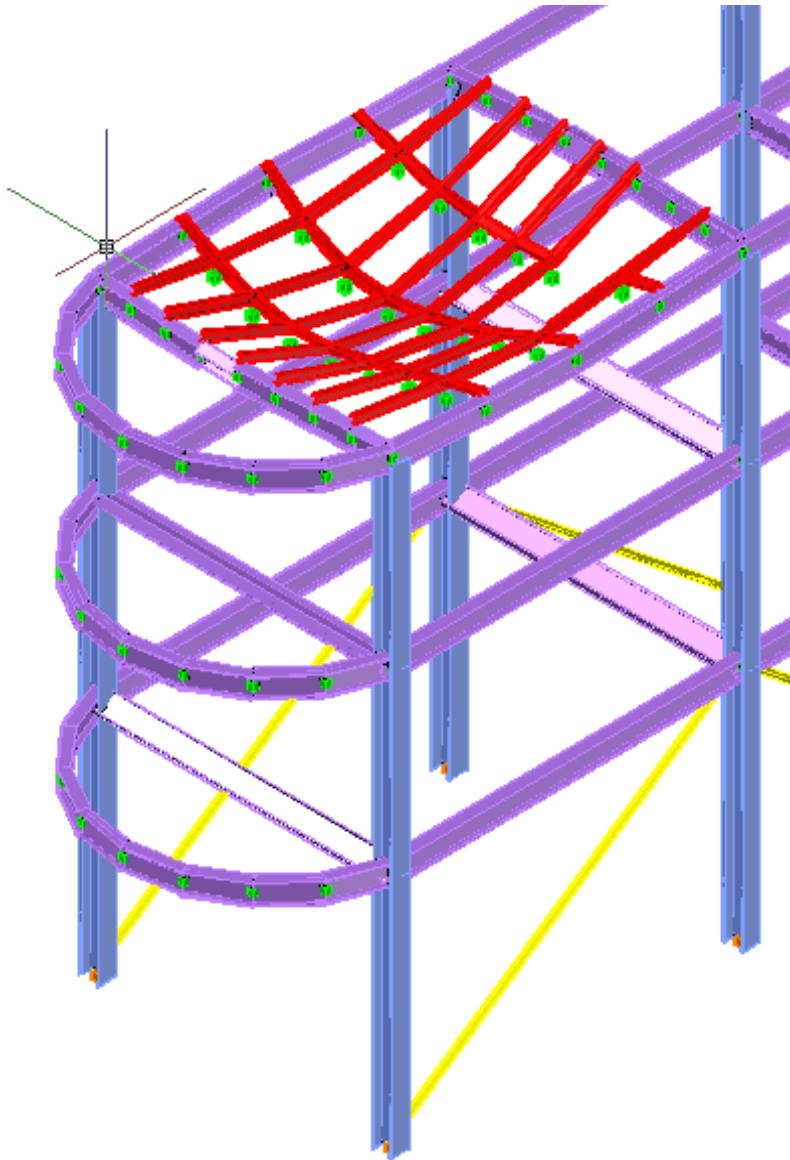
Note: You should get an information message “Results Loaded Successfully”

3.15. Display Results

Step #52. Display Deformed Model: on the Menu Bar, click on  **Deformed** (ribbon tab “GTS Display”) and then select SW as load Case and press ENTER twice. The deformed structure will be drawn as shown below.



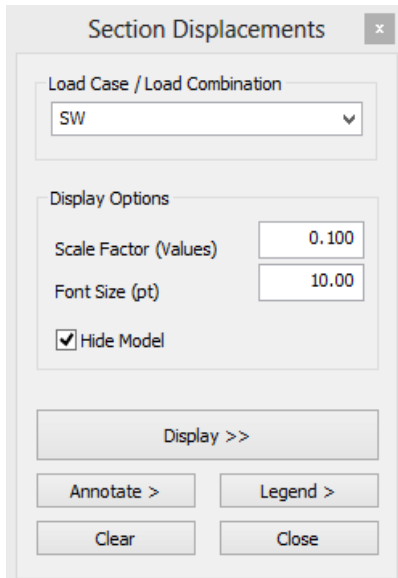
Repeat and select PL as the Load Case and the deformed structure appears as shown in the following image:



Click on  Undeformed (ribbon tab “GTS Display”) to return to the original undeformed position of the model.

Note: You can Annotate the Joint displacements by clicking on the “Annotate Displacements” icon and selecting a joint.

Step #53. Display Section Displacements: Click on the icon  Frame to switch back to the wireframe view. Click on  Displacements (ribbon tab “GTS Display”).



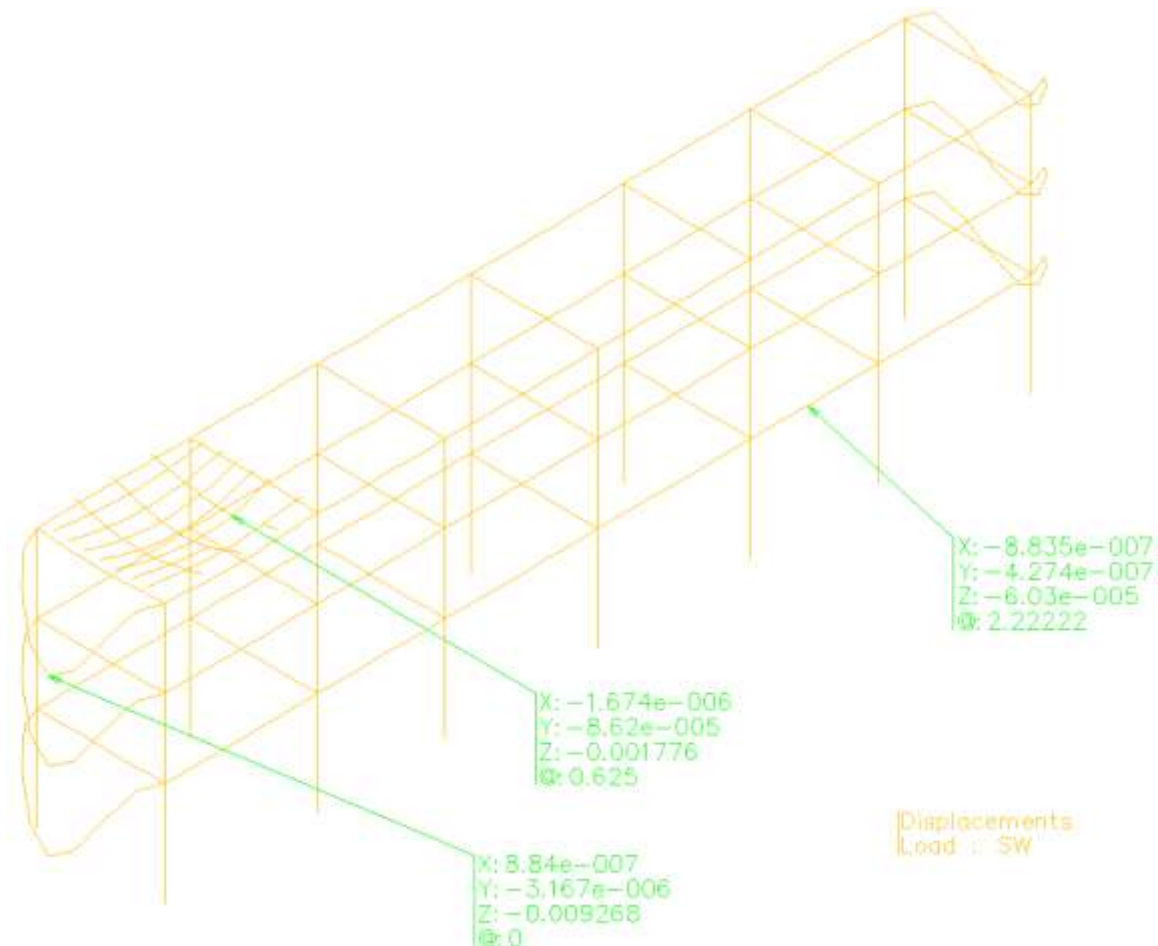
Select:

- SW as Load Case
- 0.1 as Scale Factor
- 10.00 as Font Size (default)
- Check *Hide Model*

Press “Display >>” and zoom at the upper left end of the structure as shown in the image below.

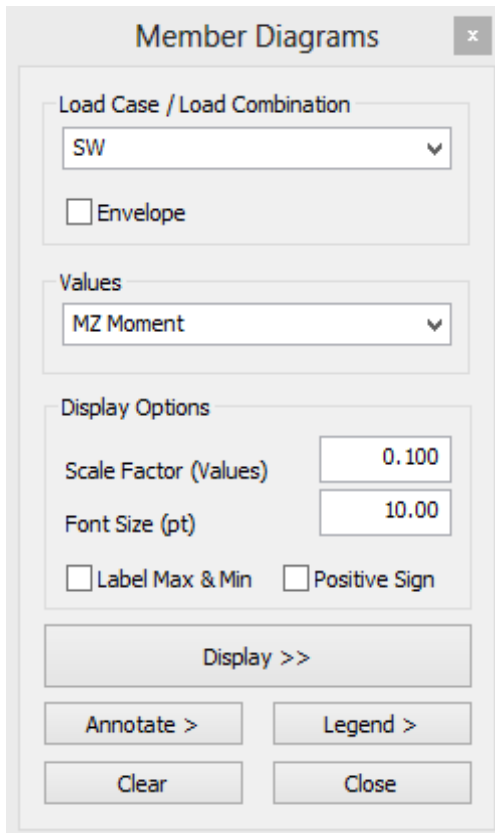
Press “Annotate >” and click on any part of the deformed shape curve and then at the position that you want the annotation to be displayed.

Press on “Legend >” and click at any part of the screen to place the legend of the diagram.



In order to exit the command, uncheck “Hide Model”, press “Clear” Button and “Close”.

Step #54. Display Member Diagrams: Click on  **Diagrams** (ribbon tab “GTS Display”).



The image shows a software dialog box titled "Member Diagrams". It contains several sections: "Load Case / Load Combination" with a dropdown menu showing "SW" and an unchecked "Envelope" checkbox; "Values" with a dropdown menu showing "MZ Moment"; "Display Options" with input fields for "Scale Factor (Values)" set to "0.100" and "Font Size (pt)" set to "10.00", and two unchecked checkboxes for "Label Max & Min" and "Positive Sign". At the bottom, there are four buttons: "Display >>", "Annotate >", "Legend >", "Clear", and "Close".

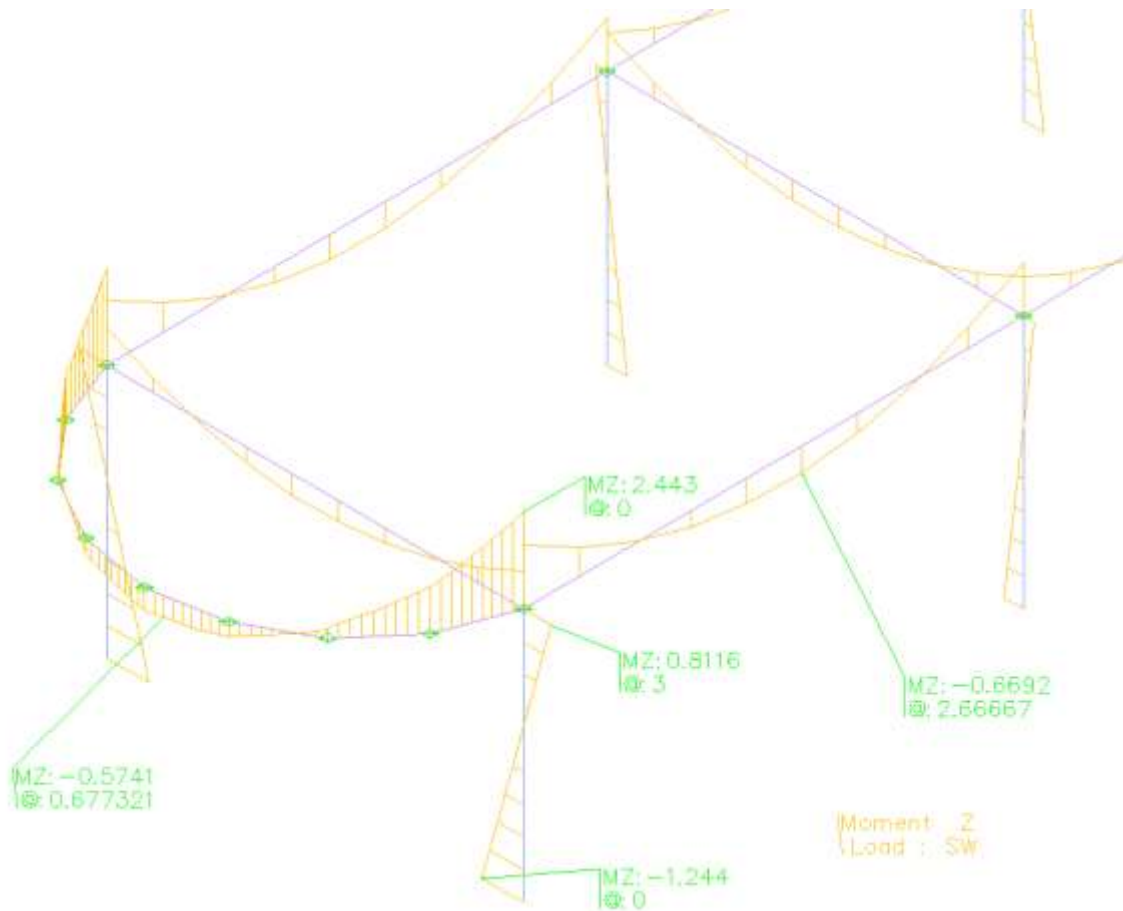
Select:

- *SW* as Load Case
- *MZ Moment* as Value to be displayed
- *0.1* as Scale Factor
- *10.00* as Font Size (default)

Press “Display >>” and zoom at the upper left end of the structure as shown in the image below.

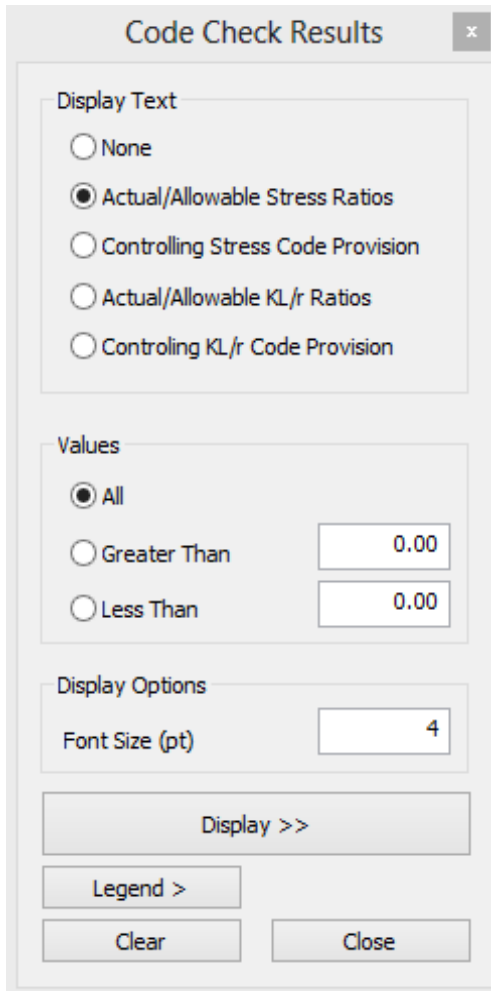
Press “Annotate >” and click on any part of the yellow MZ Moment curve and then at the position that you want the annotation to be displayed.

Press on “Legend >” and click at any part of the screen to place the legend of the diagram.



In order to exit the command, uncheck “Clear” Button and “Close”.

Step #55. Display Code Check Results: Click on  **Code Check** (ribbon tab “GTS Display”) and select all mebers by typing ALL and pressing <Enter> twice.



The image shows a software dialog box titled "Code Check Results". It contains several sections for configuring the output of a code check. The "Display Text" section has five radio button options: "None", "Actual/Allowable Stress Ratios" (which is selected), "Controlling Stress Code Provision", "Actual/Allowable KL/r Ratios", and "Controlling KL/r Code Provision". The "Values" section has three radio button options: "All" (selected), "Greater Than" (with an adjacent input field containing "0.00"), and "Less Than" (with an adjacent input field containing "0.00"). The "Display Options" section has a label "Font Size (pt)" and an adjacent input field containing "4". At the bottom, there are four buttons: "Display >>", "Legend >", "Clear", and "Close".

Code Check Results

Display Text

☐ None

☒ Actual/Allowable Stress Ratios

☐ Controlling Stress Code Provision

☐ Actual/Allowable KL/r Ratios

☐ Controlling KL/r Code Provision

Values

☒ All

☐ Greater Than

☐ Less Than

Display Options

Font Size (pt)

Display >>

Legend >

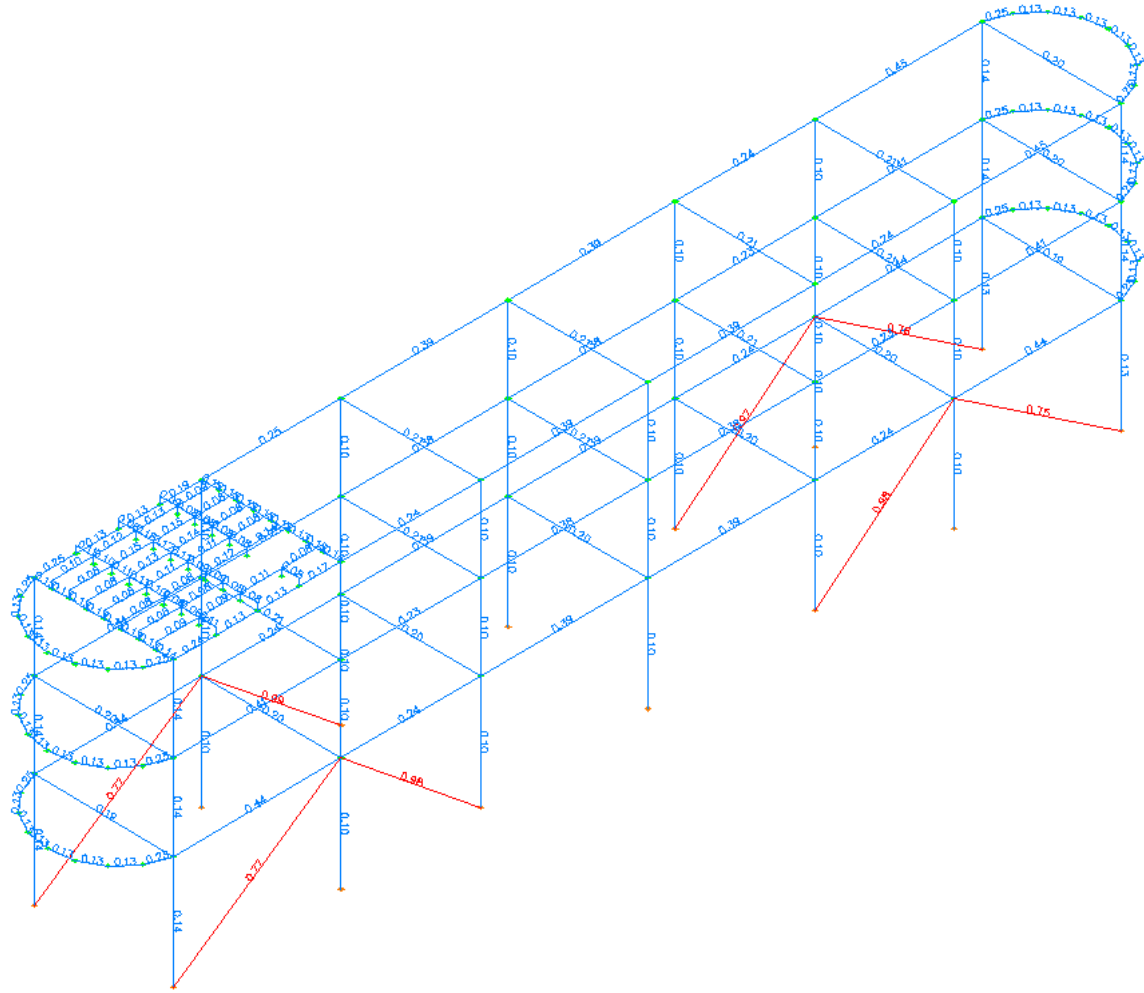
Clear Close

Select:

- *Display Text: Actual/Allowable Stress Ratios*
- *All Values*
- *4 as Font Size*

Press "Display >>" and the following image is drawn with the bracing members that failed the check (149 to 155) appearing in red and members that passed the check appearing in blue.

In order to exit the command, click the "Clear" Button and "Close".



3.16. Results Datasheets

Step #56. Except from the graphical display of results there is an option to view them in datasheets from the item “Results Datasheets” of the menu/ribbon tab “GTS Display”.

Click on the icon  **Displacements** and the “GTSTRUDL – Joint Displacement Datasheet” dialog appears where you can filter, sort, write results to text file or change results units as shown in figure below.

GTSTRUDL - Joint Displacement Datasheet, display Units: Meters Degrees

File Edit Columns Filter Sort Units Help

Joint	Load	Trans X	Trans Y	Trans Z	Rotation X	Rotation Y
1	SW	0.0000	0.0000	0.0000	-0.0002199	0.0000249
2	SW	0.0000	0.0000	-0.0000	0.0004223	0.0000347
3	SW	0.0000	0.0000	0.0000	-0.0002020	0.0001908
4	SW	0.0000	0.0000	-0.0000	0.0004311	-0.0003191
5	SW	0.0000	0.0000	0.0000	-0.0001981	-0.0001509
6	SW	0.0000	0.0000	-0.0000	0.0004329	0.0003413
7	SW	0.0000	0.0000	0.0000	-0.0003753	-0.0003670
8	SW	0.0000	-0.0000	-0.0000	0.0009405	0.0007478
9	SW	0.0000	0.0000	0.0000	0.0001757	-0.0000570
10	SW	-0.0000	0.0000	-0.0000	-0.0004446	-0.0000466
11	SW	0.0000	0.0000	0.0000	0.0001936	0.0001102
12	SW	-0.0000	-0.0000	-0.0000	-0.0004358	-0.0004006
13	SW	0.0000	0.0000	0.0000	0.0001975	-0.0002277
14	SW	-0.0000	-0.0000	-0.0000	-0.0004339	0.0002608
15	SW	0.0000	0.0000	0.0000	0.0004615	-0.0004304
16	SW	-0.0000	-0.0000	-0.0000	-0.0008937	0.0006344
18	SW	-0.0000	-0.0000	-0.0005	-0.5759841	-0.1616357
19	SW	-0.0000	-0.0000	-0.0046	-0.3254073	0.0838498
20	SW	-0.0000	-0.0000	-0.0095	-0.0569121	0.5516294
21	SW	-0.0000	-0.0000	-0.0117	-0.0000572	0.7820065
22	SW	-0.0000	-0.0000	-0.0095	0.0567759	0.5517620
23	SW	-0.0000	-0.0000	-0.0046	0.3252377	0.0840486
24	SW	-0.0000	-0.0000	-0.0005	0.5758479	-0.1614586
26	SW	0.0000	0.0000	0.0000	-0.0004927	-0.0005444
27	SW	0.0000	0.0000	-0.0000	0.0002704	0.0004355
28	SW	0.0000	0.0000	0.0000	-0.0007150	0.0001680
29	SW	0.0000	0.0000	-0.0000	0.0001630	-0.0002131
30	SW	0.0000	0.0000	0.0000	0.0003613	0.0003782

Click on the icon  **Reactions** and the “GTSTRUDL – Reactions Datasheet” dialog appears where you can filter, sort, write results to text file or change results units as shown in figure below.

GTSTRUDL - Joint Reactions Datasheet, display Units: Meters KiloNewtons

File Edit Columns Filter Sort Units Help

Joint	Load	Force X	Force Y	Force Z	Moment X	Moment Y
1	SW	0.000	-0.006	24.790	-0.000	-0.000
3	SW	0.206	-0.095	24.199	-0.000	-0.000
5	SW	0.020	-0.095	23.735	-0.000	-0.000
7	SW	-0.142	-0.177	25.869	0.000	0.000
9	SW	0.000	0.093	24.777	0.000	0.000
11	SW	0.247	0.095	24.261	0.000	0.000
13	SW	0.020	0.095	23.717	-0.000	-0.000
15	SW	-0.103	0.182	25.789	0.000	0.000
26	SW	-0.316	-0.103	24.309	0.000	0.000
28	SW	-0.015	-0.119	26.112	0.000	0.000
30	SW	0.149	-0.140	27.942	-0.000	-0.000
32	SW	-0.247	0.067	24.146	-0.000	-0.000
34	SW	-0.014	0.064	25.289	-0.000	-0.000
36	SW	0.199	0.227	27.381	-0.000	-0.000
1	LL	0.000	-0.881	120.774	-0.000	-0.000
3	LL	1.222	-0.881	120.888	-0.000	-0.000
5	LL	0.200	-0.881	116.237	-0.000	-0.000
7	LL	-0.475	-1.865	137.305	-0.000	-0.000
9	LL	0.000	0.881	120.774	0.000	0.000
11	LL	1.222	0.881	120.888	-0.000	-0.000
13	LL	0.200	0.881	116.237	0.000	0.000
15	LL	-0.475	1.865	137.303	0.000	0.000

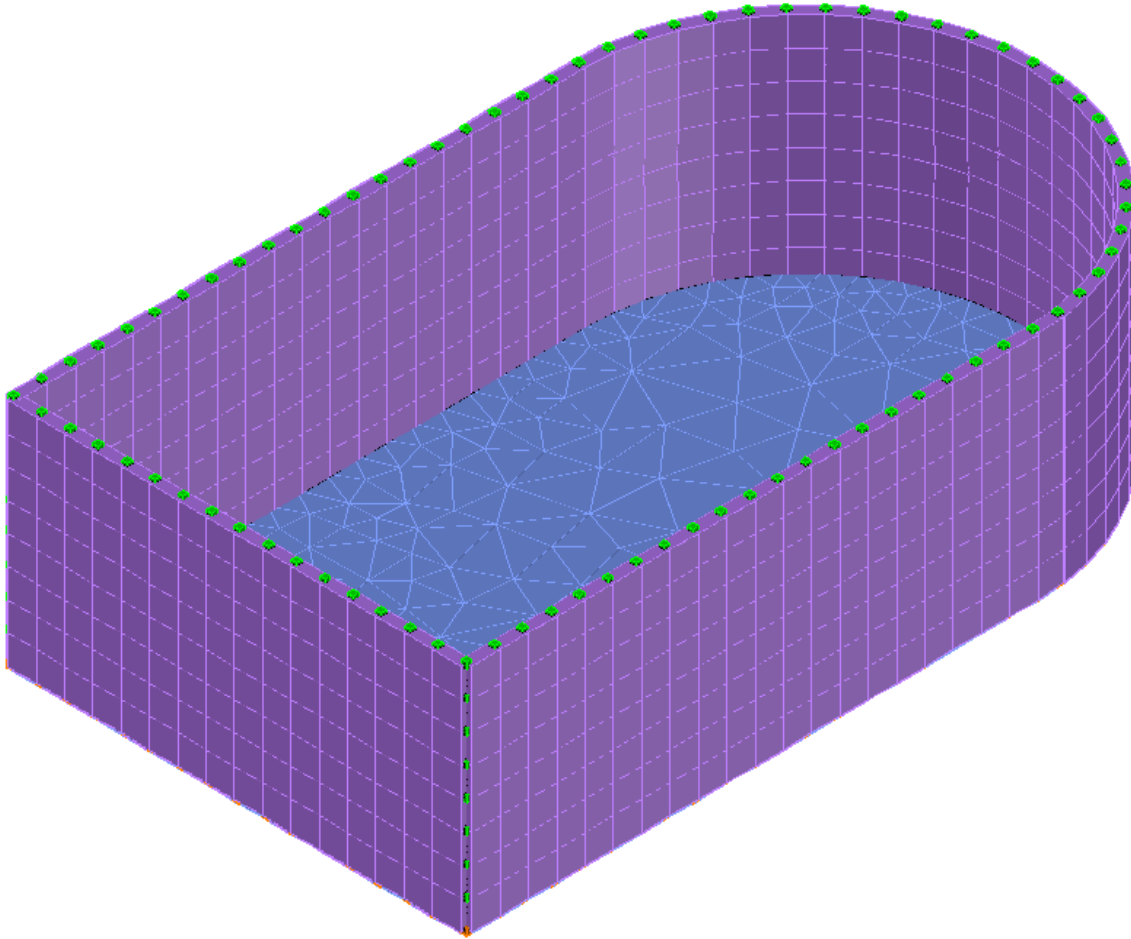
Click on the icon Results Datasheets > **Code Check** and the GT STRUDL Code Check Results” dialog appears

GT STRUDL Code Check Results										
File Edit Columns Filter Sort Not Checked Help										
Member	P/F	Load	Section Loc	Crit Ratio	Crit Prov	Stress Ratio	Stress Prov	KL/r Ratio	KL/r Prov	Properti
148	FAIL	CB1	7.211	3.395	KL/z	0.766	5.5.1	3.395	KL/z	60x60x5
149	FAIL	CB1	6.403	3.015	KL/z	0.981	5.5.1	3.015	KL/z	60x60x5
150	FAIL	CB1	6.403	3.015	KL/z	0.977	5.5.1	3.015	KL/z	60x60x5
151	FAIL	CB1	7.211	3.395	KL/z	0.751	5.5.1	3.395	KL/z	60x60x5
152	FAIL	CB1	7.211	3.395	KL/z	0.768	5.5.1	3.395	KL/z	60x60x5
153	FAIL	CB1	6.403	3.015	KL/z	0.992	5.5.1	3.015	KL/z	60x60x5
154	FAIL	CB1	6.403	3.015	KL/z	0.973	5.5.1	3.015	KL/z	60x60x5
155	FAIL	CB1	7.211	3.395	KL/z	0.755	5.5.1	3.395	KL/z	60x60x5
1	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
2	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
3	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
4	Pass	CB1	4.000	0.293	KL/z	0.134	5.5.4 (2)	0.293	KL/z	HE320B
5	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
6	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
7	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
8	Pass	CB1	4.000	0.293	KL/z	0.134	5.5.4 (2)	0.293	KL/z	HE320B
9	Pass	CB1	0.000	0.939	KL/z	0.391	5.5.4 (2)	0.939	KL/z	IPE330
10	Pass	CB1	0.000	0.782	KL/z	0.243	5.5.4 (2)	0.782	KL/z	IPE330
11	Pass	CB1	6.000	0.939	KL/z	0.439	5.5.4 (2)	0.939	KL/z	IPE330
12	Pass	CB1	0.000	0.939	KL/z	0.391	5.5.4 (2)	0.939	KL/z	IPE330
13	Pass	CB1	0.000	0.782	KL/z	0.243	5.5.4 (2)	0.782	KL/z	IPE330
14	Pass	CB1	6.000	0.939	KL/z	0.439	5.5.4 (2)	0.939	KL/z	IPE330
15	Pass	CB1	0.000	0.782	KL/z	0.205	5.5.2	0.782	KL/z	IPE330
16	Pass	CB1	0.000	0.782	KL/z	0.205	5.5.2	0.782	KL/z	IPE330
17	Pass	CB1	5.000	0.205	5.5.2	0.205	5.5.2	0.000	*****	IPE330
18	Pass	CB1	5.000	0.188	5.5.2	0.188	5.5.2	0.000	*****	IPE330
19	Pass	CB1	0.000	0.249	5.5.3	0.249	5.5.3	0.000	*****	IPE330
20	Pass	CB1	0.871	0.127	5.7.7	0.127	5.7.7	0.000	*****	IPE330
21	Pass	CB1	0.871	0.127	5.7.7	0.127	5.7.7	0.000	*****	IPE330
22	Pass	CB1	0.871	0.127	5.7.7	0.127	5.7.7	0.000	*****	IPE330
23	Pass	CB1	0.871	0.127	5.7.7	0.127	5.7.7	0.000	*****	IPE330
24	Pass	CB1	0.871	0.127	5.7.7	0.127	5.7.7	0.000	*****	IPE330
25	Pass	CB1	0.871	0.127	5.7.7	0.127	5.7.7	0.000	*****	IPE330
26	Pass	CB1	0.871	0.249	5.5.3	0.249	5.5.3	0.000	*****	IPE330
27	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
28	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
29	Pass	CB1	4.000	0.293	KL/z	0.135	5.5.4 (2)	0.293	KL/z	HE320B
30	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B
31	Pass	CB1	4.000	0.293	KL/z	0.102	5.7.7	0.293	KL/z	HE320B

4. Tutorial Example #2

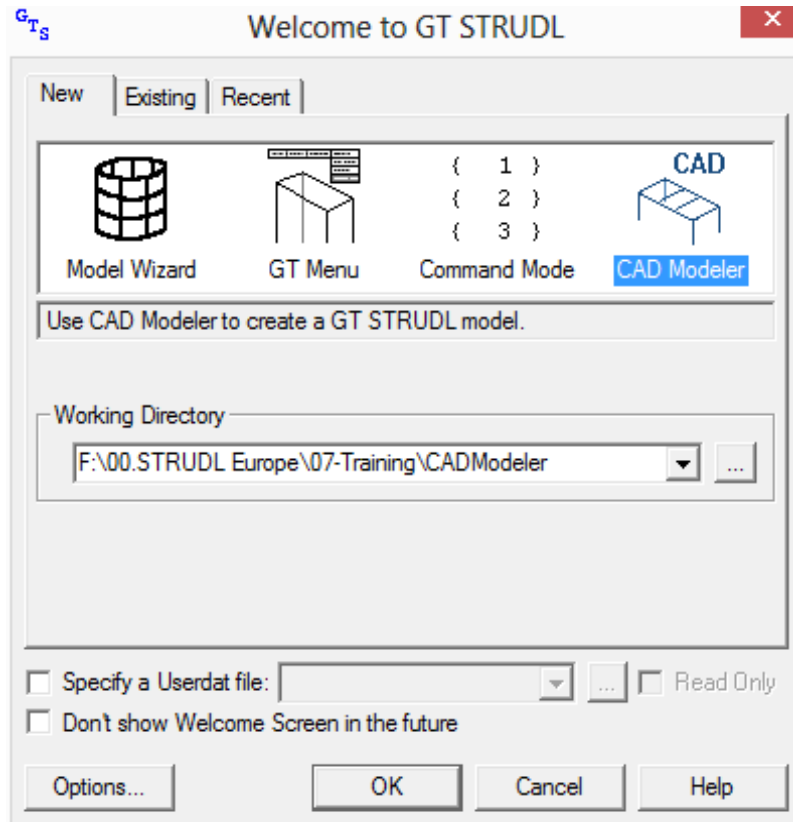
4.1. Introduction

The modeling and analysis of the tank shown below is demonstrated in a step-by-step process using CAD Modeler and GT STRUDL finite element analysis.



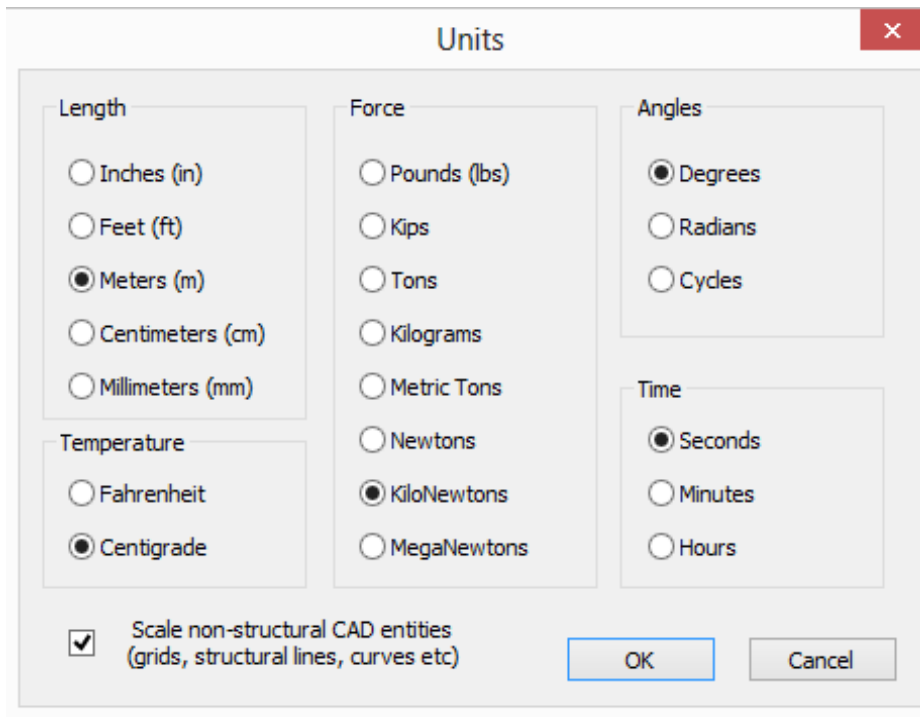
4.2. Open CAD Modeler and start working

Step #1. Launch GT STRUDL by selecting the icon “CAD Modeler” in the Welcome to GT STRUDL dialog shown below. The version of AutoCAD/BricsCAD selected during the installation will be automatically launched, together with CAD Modeler’s menus and ribbon bar.



4.3. Define the basic geometry of the model

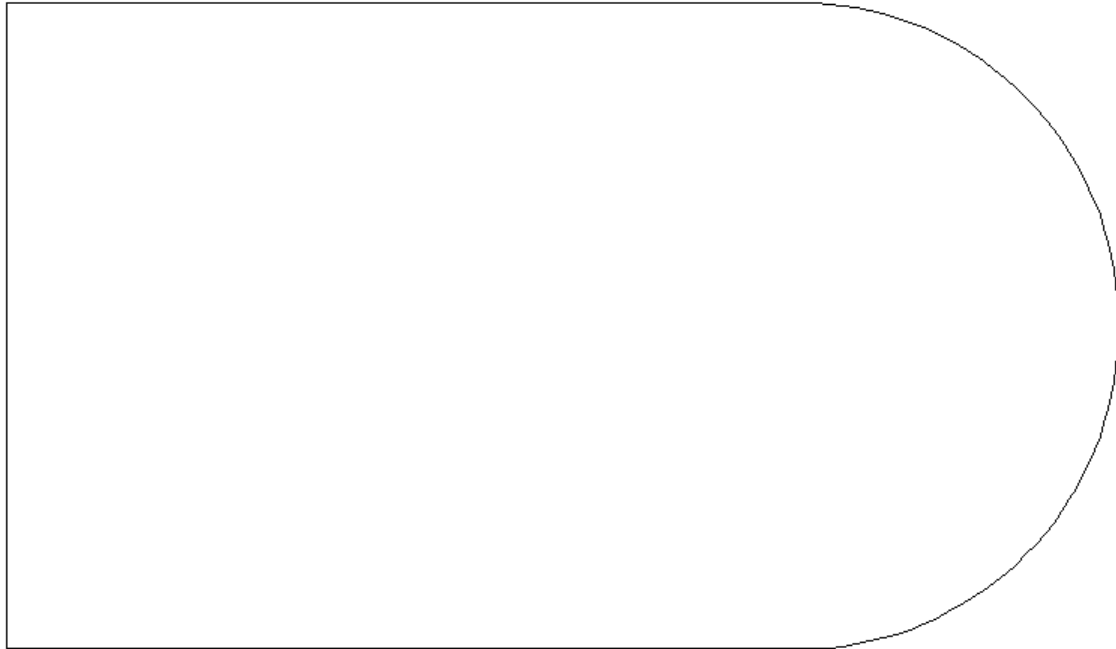
Step #2. Define the correct Units by pressing the icon  **Units** and select *Meters (m)* and *KiloNewtons* in the *Units Form*.



Step #3. Create an AutoCAD/BricsCAD Polyline that will describe the outline of the tank. Type the following commands at the command prompt (each command is followed by an <ENTER>):

```
PLINE
0,0,0
@10,0
ARC
@4,4
@-4,4
LINE
@-10,0
CLOSE
```

The polyline shown in the picture below is created after entering Zoom and Extents at the command prompt.



Step #4. Create a Line along the height of the tank: Switch to the isometric view of the structure by pressing the small house icon in AutoCAD's or BricsCAD's View Cube.



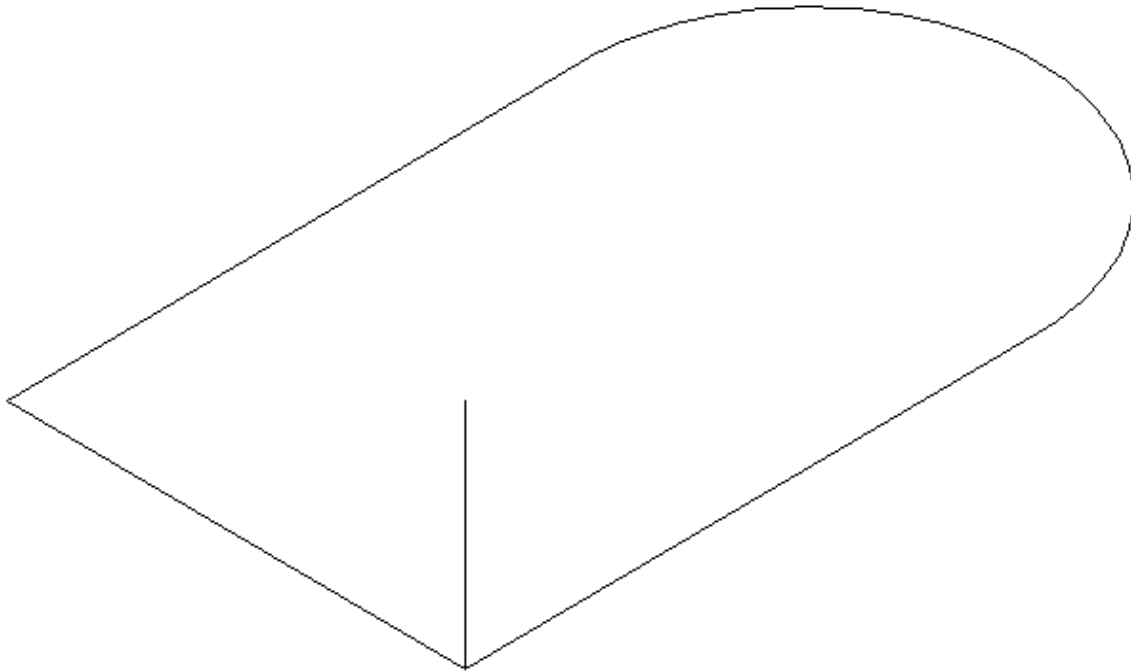
Type the following commands at the command prompt (each command is followed by an <ENTER>):

```
LINE
0,0,0
@0,0,4
<ENTER>
```



The line shown at the picture below is created.

Click on the TOP icon of the AutoCAD's / BricsCAD's View Cube in order to switch back to floor plan view.



4.4. Create the bottom of the tank

Step #5. Generate the Finite Elements inside the polyline, at the bottom of the Tank: Click on



the icon **Area** and when the prompt message *Poly Select Boundary Polyline or Circle* appears, click on the Polyline that you have created in the previous step.

Select Mesh Properties

Generate

Material Concrete

Element Attributes

Type SBHT6

Thickness 0.20

Mesh Geometry

External Boundary obj-563

Boundary Maximum Edge Size 0.50

☒ Do not split boundary more than Max

Element Maximum Area 10.513274

Mesh Quality High

Internal Boundaries

Add + Remove -

Multi+ Multi -

Internal Joints

Add Remove

Spacing Extrude Direction

☒ Uniform 4

☐ Variable

☐ Defined by Curve, Size: 3.242418

Labeling

More >>

Preview

Clear

Create

Close

The Select Mesh Properties form appears where you have to enter:

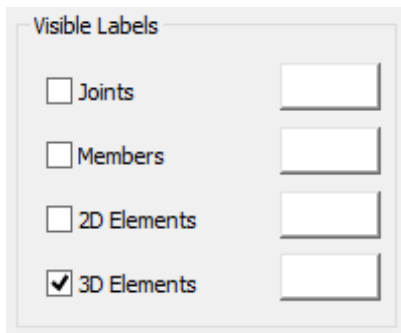
- Material : *Concrete*
- Type: *SBHT6*, meaning triangular elements having 6 degrees of freedom per node
- Thickness: *0.20*
- Boundary Maximum Edge Size: *0.50*
- Mesh Quality: *High*

You can press the Preview button to see the finite elements as they will be generated.

Press the Create button to create the finite elements and joints on the bottom of the tank.

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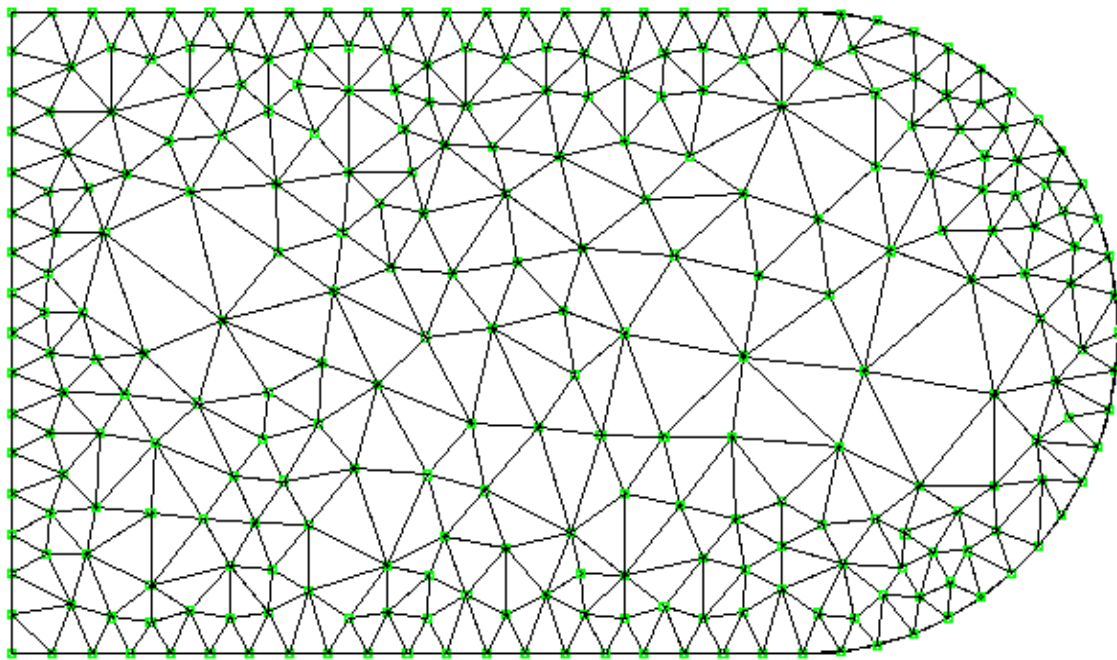
Step #6. Turn OFF labeling and view mesh:



Click on the icon  **Options** in the ribbon bar and then uncheck the Visible Labels option for Joints, Members and 2D Elements.

Now labeling is turned off and it is easier and faster to control the model.

The finite element mesh, without labeling, is shown in the image below.

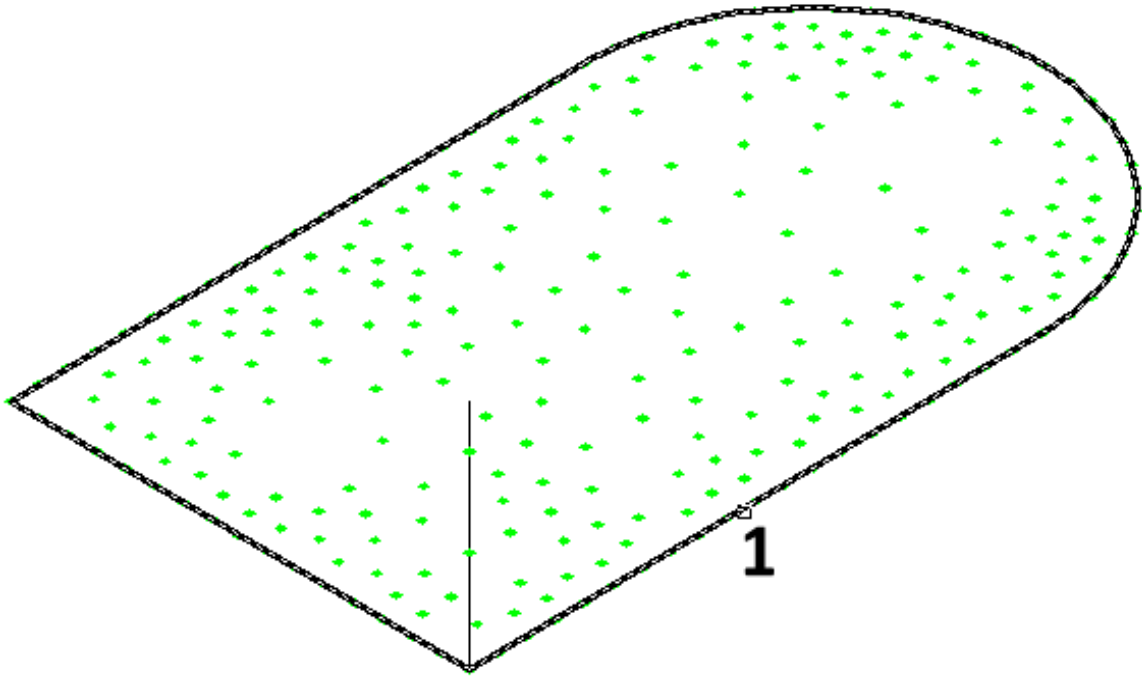


4.5. Create the walls of the tank

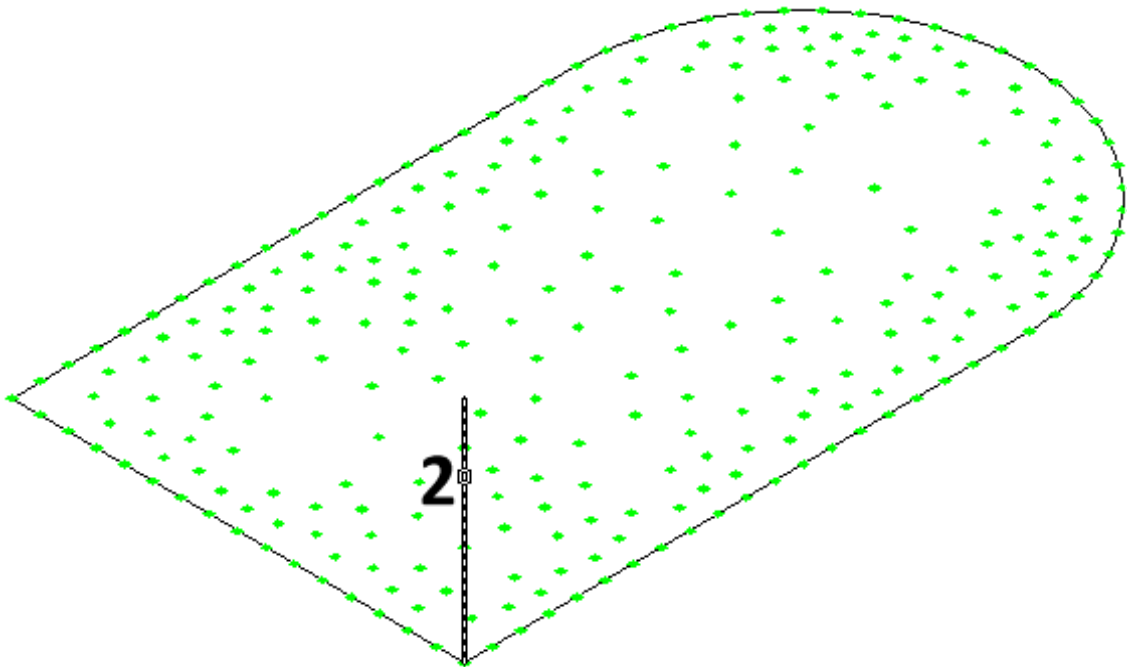
Step #7. Generate the finite elements that will model the Wall of the Tank by extruding the



polyline: Switch to Isometric view and click on the icon **Extrude** (Note: the display of joints and elements previously created is automatically turned off to make selection of the polyline and extrude line easier). When the prompt message *Select Line, Arc, Circle or PolyLine to be Extruded* appears, click on the Polyline that you have created in a previous step, as shown in the following picture (Click #1).



When the prompt message *Select Extrude Direction Curve (Line or Arc)* appears, click on the line that you have created in a previous step, as shown in the picture below (Click #2).



Select Mesh Properties [X]

Generate

Material: Concrete [v] [...]

Element Attributes

Type: SBHQ6 [v] Thickness: 0.20

Mesh Geometry

External Boundary: obj-563 [v] [...]

Boundary Maximum Edge Size: 0.50

☒ Do not split boundary more than Max

Element Maximum Area: 10.513274

Mesh Quality: Very Low [v]

Internal Boundaries

[Empty Box]

Add + Remove -

Multi+ Multi -

Internal Joints

[Empty Box]

Add Remove

Spacing Extrude Direction

☒ Uniform [8] [v]

☐ Variable [] [...]

☐ Defined by Curve, Size: 3.242418

Labeling

More >>

Preview Clear Create Close

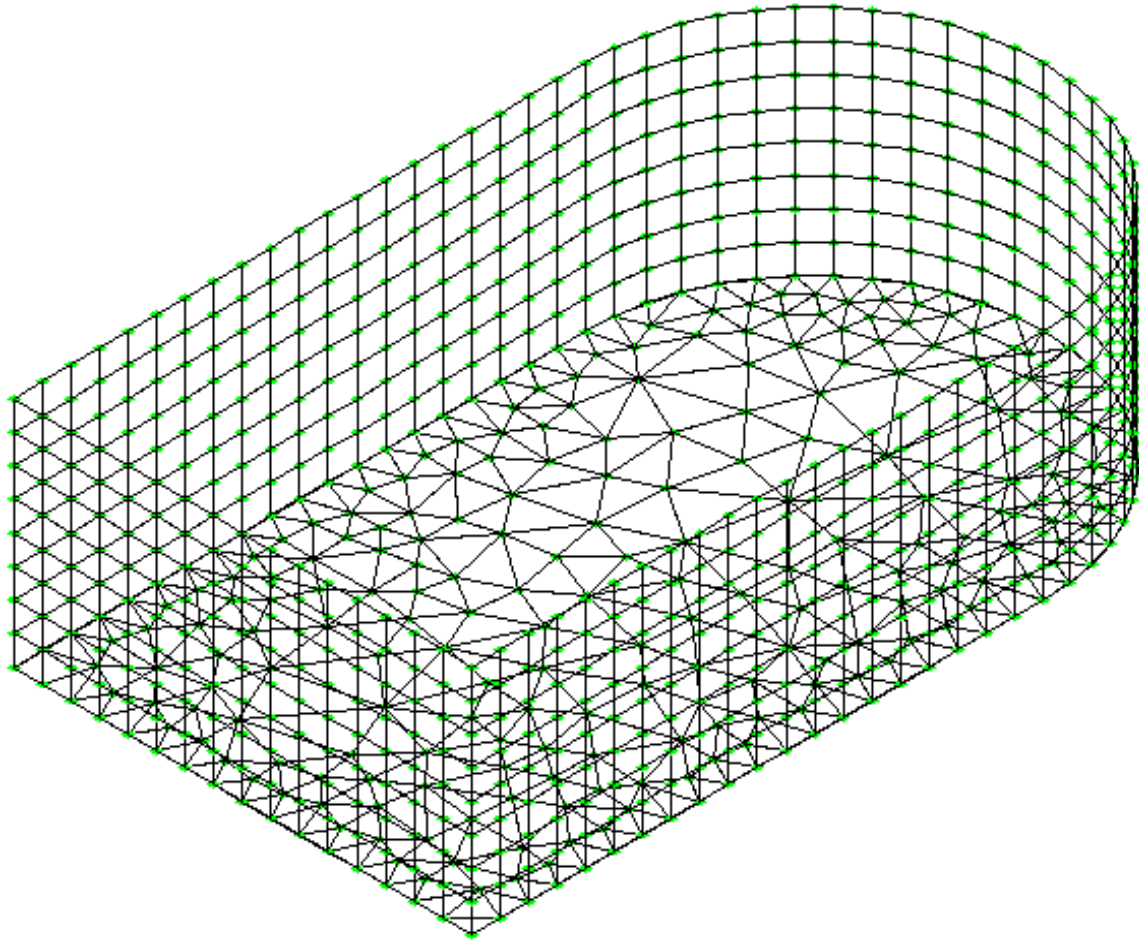
The Select Mesh Properties form appears where you have to enter:

- Material : *Concrete*
- Type: *SBHQ6*, meaning quad elements having 6 degrees of freedom per node
- Thickness: *0.2*
- Boundary Maximum Edge Size: *0.5*
(Note: This must be the same as when the mesh in the bottom of the tank was created so the mesh will be the same along the polyline)
- Spacing Extrude Direction: *Uniform* and select 8 spaces in the pulldown

You can press the Preview button to see the finite elements as they will be generated.

Press the Create button to generate the finite elements and joints on the wall of the tank

The finite element mesh is presented in the following image.



Step #8. Check for duplicate joints: Since both meshing functions described above generated joints along the polyline, pairs of joints having the same coordinates exist in the model and they have to be merged together. In order to check for joints having the same coordinates, click on the icon  Joints Duplicates .

For the *Merge Accuracy* $<0.001000>$, just press $<ENTER>$ to accept the default value.

The Duplicate Joints form appears where you can see the list of joints having the same coordinates. Make sure that Merge option is checked for all joint pairs and press OK.

×

Merge Joints

List

Joint	Duplicate	Merge
1	281	☒
1	363	☒
2	282	☒
3	283	☒
4	284	☒
5	285	☒
6	286	☒
7	287	☒
8	288	☒
9	289	☒
10	290	☒
11	291	☒
12	292	☒
13	293	☒
14	294	☒
15	295	☒
16	296	☒
17	297	☒
18	298	☒
19	299	☒
20	300	☒
21	301	☒
22	302	☒
23	303	☒
24	304	☒
25	305	☒
26	306	☒

Select All

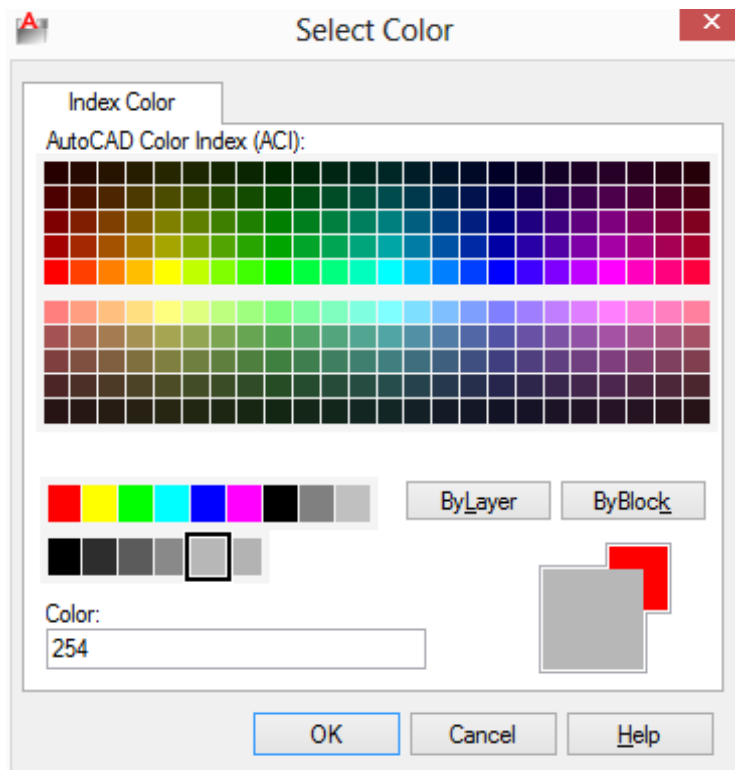
Unselect All

OK

Cancel

By entering the same command again for the 2nd time, you should get the notification that *0 duplicate joints found* .

Step #9. Switch to 3D View: Press the house icon to change the view to Isometric, and type Z and E (Zoom, Extents). Click on the icon **Options** to set a different color for 2D finite elements. When the Display Options form appears, click on the white button next to “2D Element”, to define a different color. Using this form you can also define Object Sizes in the current length units.



Press OK to close the Color Options Dialog. The elements will now have the color that you selected.

Press the icon  (and then type `Shade`) to display the 3D solid view of the model, replacing the wireframe view:

Display Options

Visible Objects

☒ Joints



☒ Members



☒ 2D Elements



☒ 3D Elements



Visible Labels

☐ Joints



☐ Members



☐ 2D Elements



☒ 3D Elements



Label Settings - Font Sizes

Joints :

0.250000

Members :

0.250000

2D Elements :

0.250000

3D Elements :

0.250000

Annotation (pts) :

10.000000

Object Sizes

Joint :

0.050000

Load Arrowhead (pts):

10.000000

Display Members / Elements

Shrink Factor :

1.0

☐ Do Not Display Thickness in 3D

Scale Factors

Concentrated Load (pts):

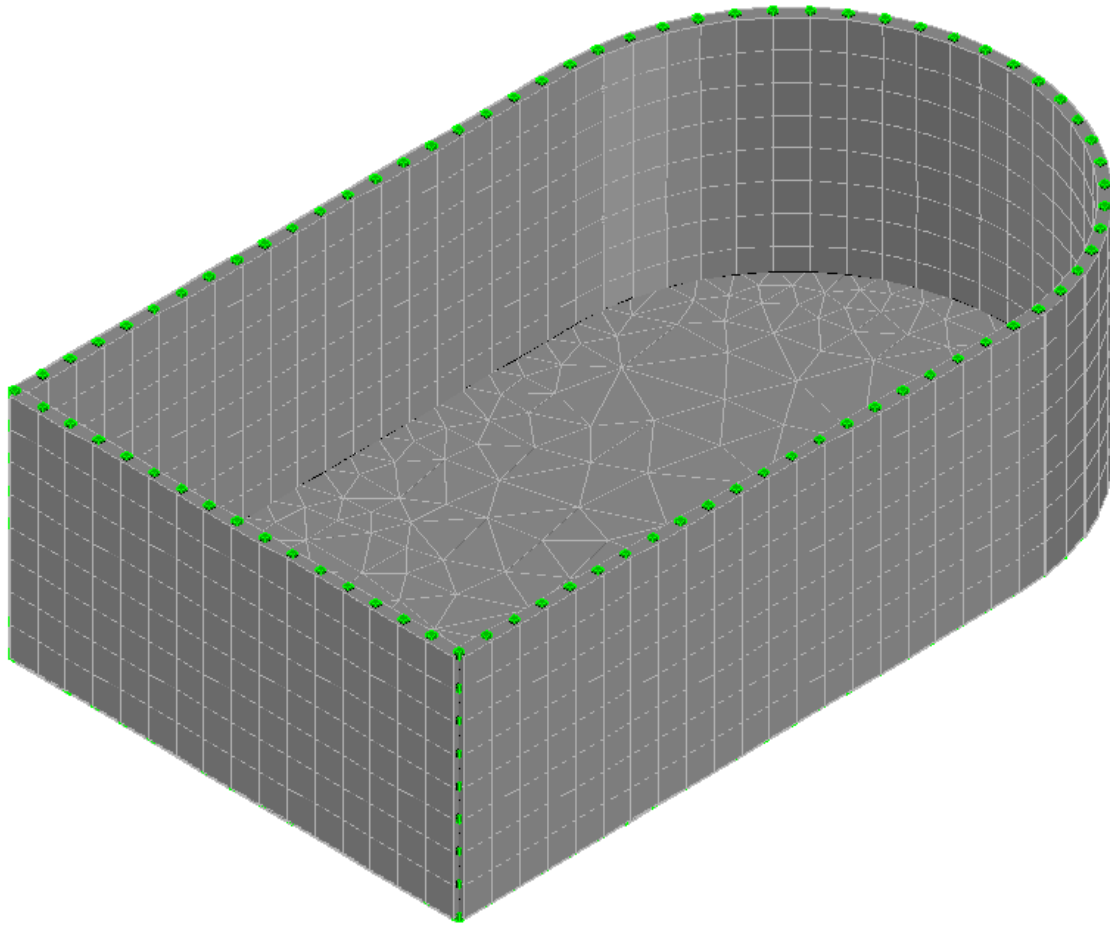
72.000000

Distributed Load (pts):

72.000000

OK

Cancel



Press the icon  **Frame** to switch back to wireframe view to be able to process CAD Modeler's and AutoCAD's/BricsCAD's commands faster.

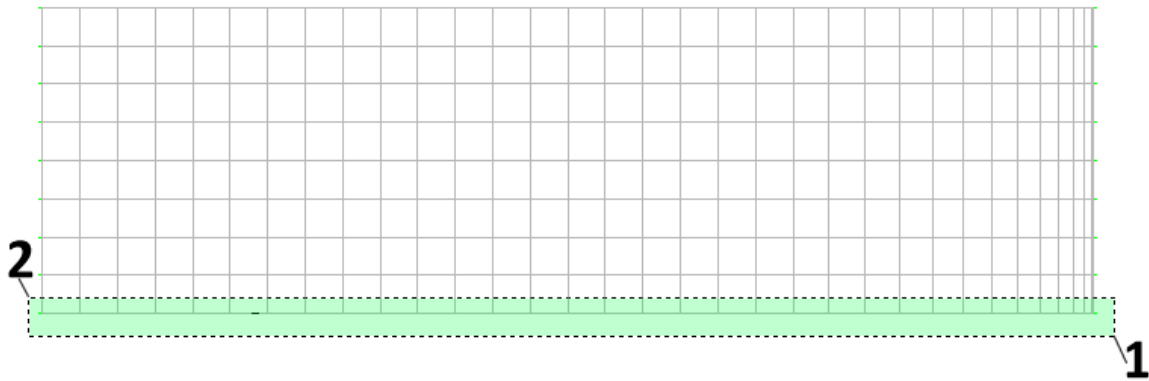
Step #10. Save your Model: In order to save your model, use AutoCAD's/BricsCAD's save command and store the DWG using any filename that you want.

4.6. Create Supports

Step #11. Support the joints at the base of the model:

Switch to the FRONT View, by clicking on Front on AutoCAD's or BricsCAD's view cube.

Click on the icon  **Support** and select the window by clicking at points 1 and 2 in the following image. All the bottom joints are selected and press ENTER to finish the selection.



Restraints & Spring values

Quick Selection : Pin ▼

Restraint	Spring	Restraint	Spring
☒ Fx		☐ Mx	
☒ Fy		☐ My	
☒ Fz		☐ Mz	

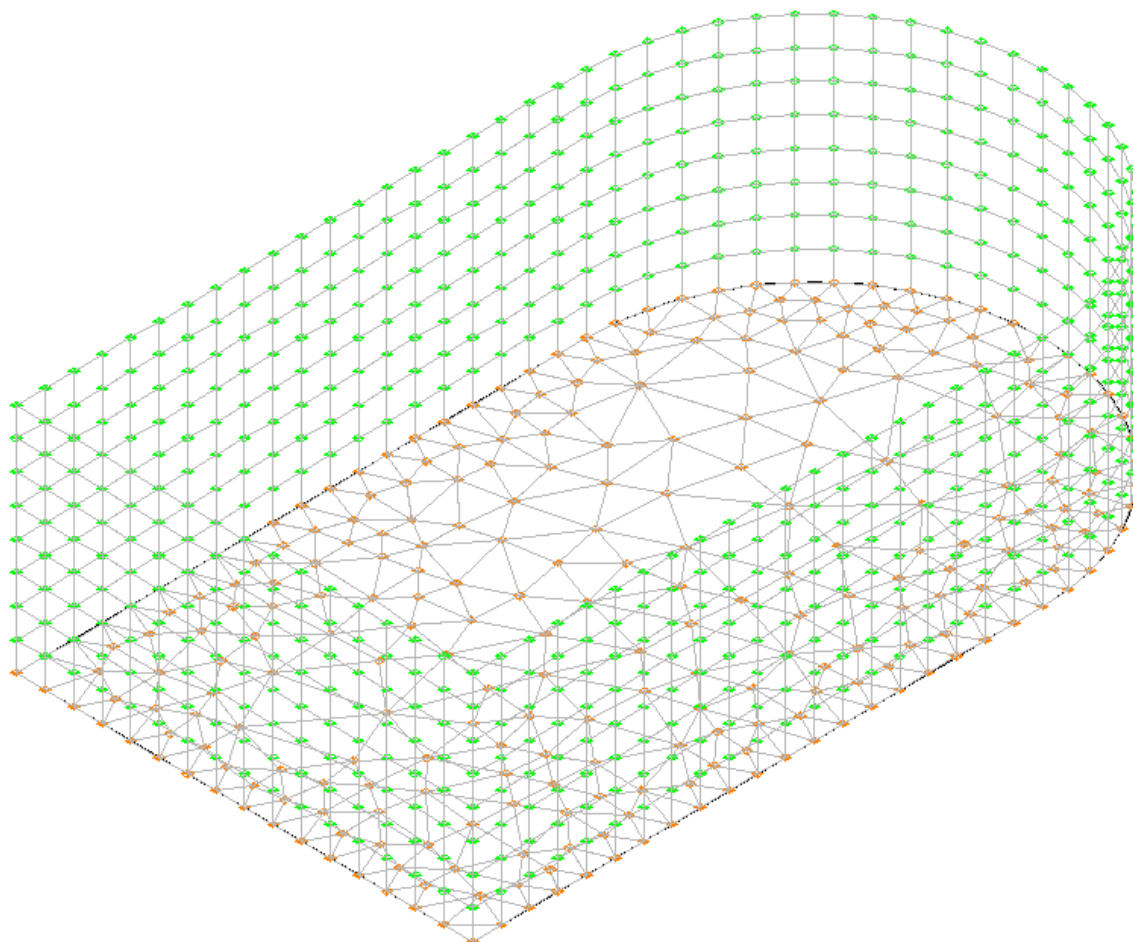
The Joint Properties [Multiple Selection] form appears.

Using the Quick Selection, select Pin and note that Fx, Fy and Fz are automatically checked.

Press OK.

Press the Isometric (Top Front Left) icon to change the view to Isometric, and type Z and E (Zoom, Extents).

All the bottom joints are now pinned and have an orange color instead of green to indicate that they are supported.



4.7. Check the model

Step #12. Check for duplicate joints: In order to check for joints having the same coordinates,

click on the icon  Joints Duplicates .

For the Merge Accuracy <0.001000>, just press <ENTER> to accept the default value.

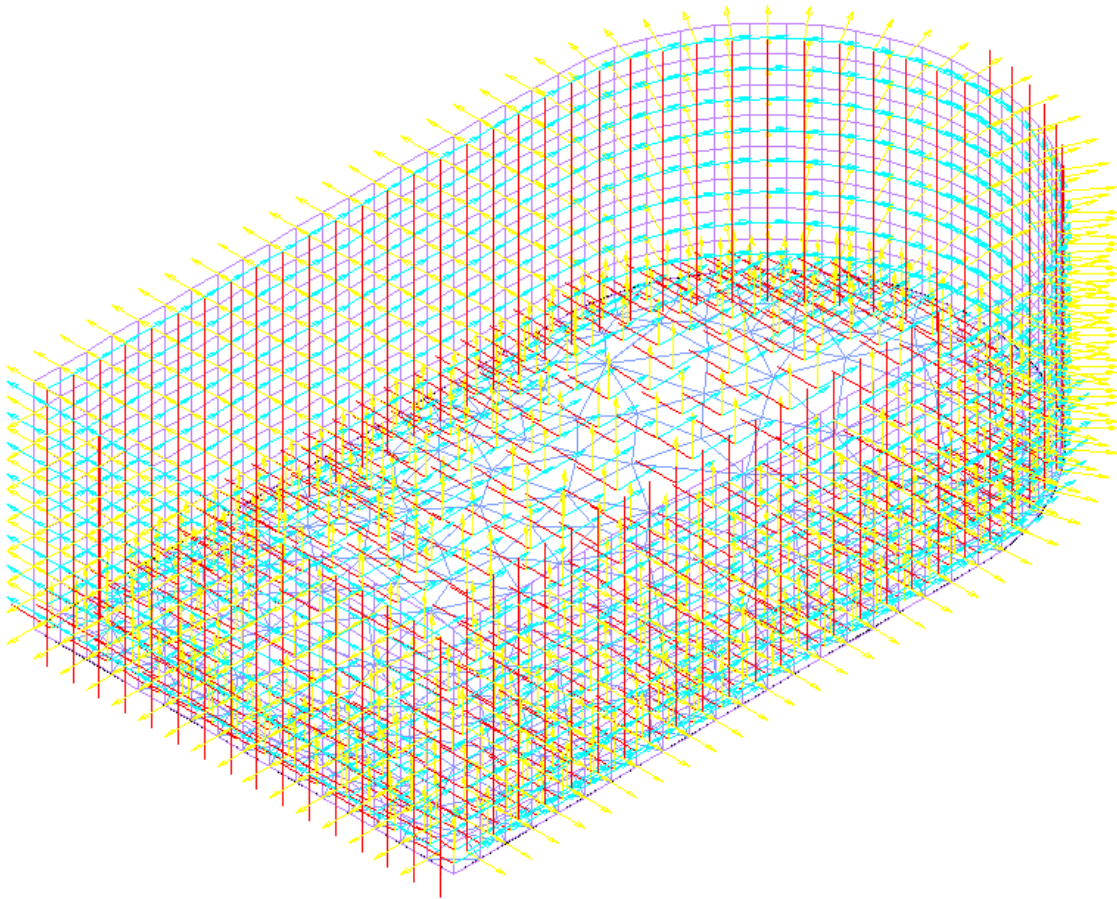
You should get the notification that *0 duplicate joints found* .

Step #13. Check for floating joints: In order to check for joints not connected to the model, click on the icon  Joints Floatings . If your model was created as described so far, you should get a notification that *0 floating joints found*.

Note: You can also run all other checks of the same drop list, to check for Interference Joints, Duplicate Shells, Duplicate Names and Database Integrity. You should not get any errors or warnings.

Step #14. View Planar Axes for Finite Elements: In order to check the direction of the planar axes of the Finite elements, click on the icon  Shell Planar Axes in the “GTS Display” Ribbon area and then *Enter Legend Coordinates(x,y,z):* or click at the point where you want the legend to be displayed.

In the legend, the X axis is displayed in cyan, Y axis in red and Z axis in yellow. The size of the arrow and its arrowhead is controlled by the value given in Display Options > Object Sizes > Load Arrowhead and the size of the legend font is controlled by the value given in Display Options > Label Settings – Font Sizes > Annotation (pts) (shown in [2.5.53](#)).



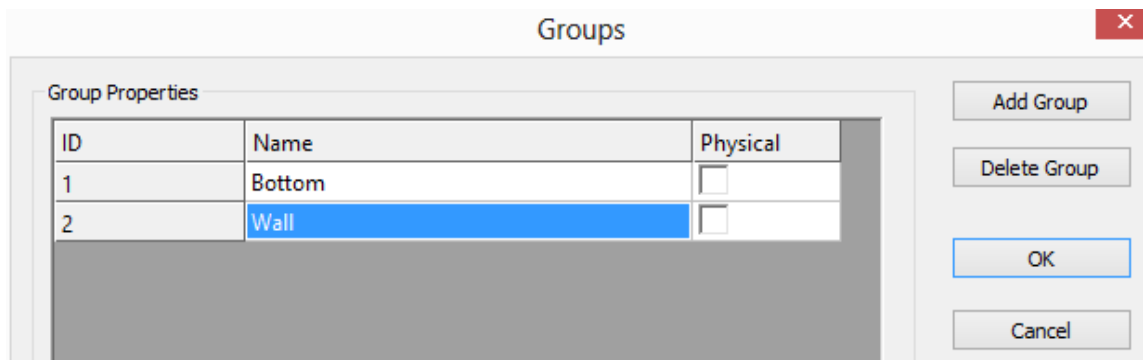
To clear the arrows select  Clear from the GTS Display Ribbon Tab.

4.8. Define Groups

Step #15. Create Group Names: It is optional to define Groups in your model but it is strongly recommended to do so since it will be easier to control the display and selection for parts of your structure.



In the Groups panel of GTS CAD Modeler ribbon, click on the icon  and the Group dialog appears.



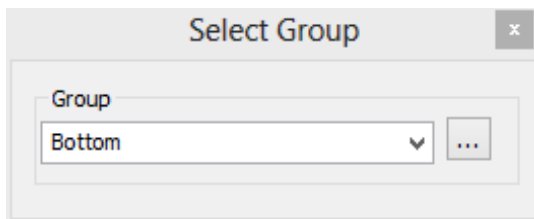
Press the *Add Group* button and enter `Bottom` as *Name* of the group.

Press the *Add Group* button and enter `Wall` as *Name* of the group.

Press OK to close the form.

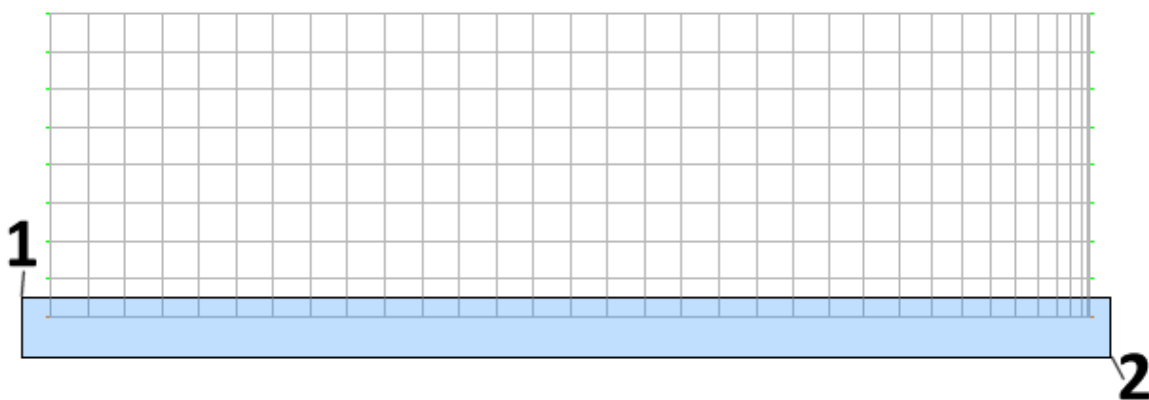
Step #16. Add the elements in the bottom of the tank to the Group Bottom:

Switch to the FRONT View, by clicking on Front on AutoCAD's or BricsCAD's view cube.



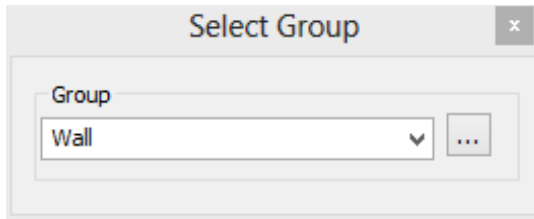
Click on the icon  in the Group panel and make sure that the Group Bottom is selected as the active group.

Make a selection by clicking at the points 1 and 2 of the following image and press the Enter key.



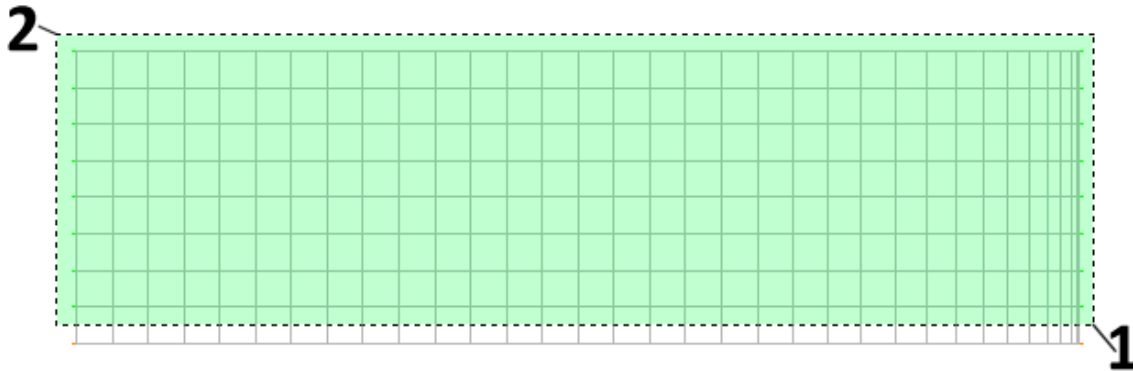
All the shell elements located in the bottom of the tank are now selected and added to group "Bottom".

Step #17. Add the elements in the tank wall to the Group Wall.



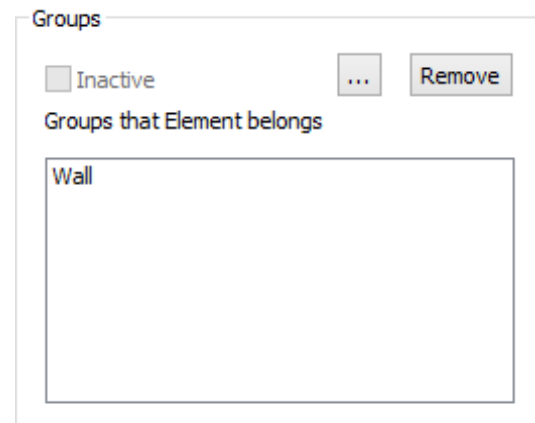
Click on the icon  +Shells and make sure that the Group Wall is selected as the active group.

Make a selection by clicking at the points 1 and 2 of the following image and press the Enter key.



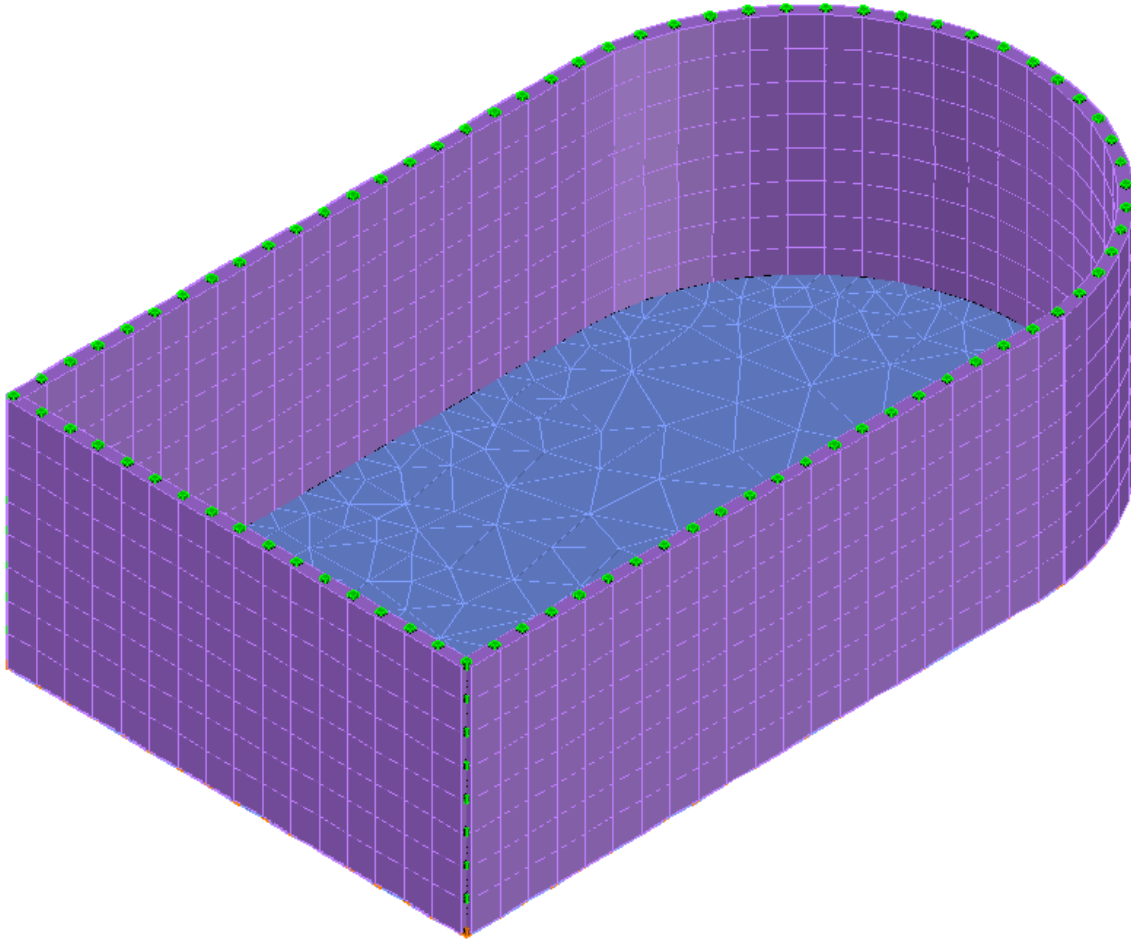
All shell elements located in the wall of the tank are now selected and added to group “Wall”.

To verify that the group is applied correctly, you can double click on a element in the wall and in the Shell Properties form, you will be able to see its Group definition in the Shell Properties form.



Press the house icon to change the view to Isometric, and type Z and E (Zoom, Extents).

Click at the icon  to display the 3D solid view as shown in the following image and save your model.

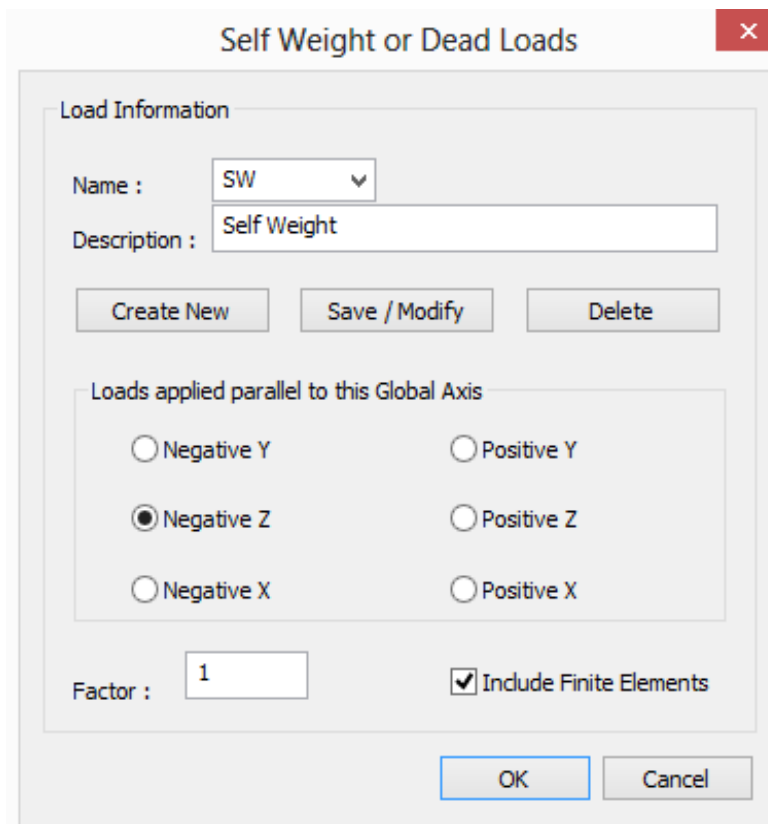


4.9. Define Loads

Step #18. Define Self Weight: Click on the icon  Self Weight and the Self Weight dialog appears. Enter:

- *SW* as Name
- *Self Weight* as the Load Description
- *Negative Z* as the Global Axis for the direction of the load
- 1.0 as Factor
- Check Include finite elements

and press OK to create the new loading and close the dialog.



Self Weight or Dead Loads

Load Information

Name : SW

Description : Self Weight

Create New Save / Modify Delete

Loads applied parallel to this Global Axis

☐ Negative Y
 ☐ Positive Y

☒ Negative Z
 ☐ Positive Z

☐ Negative X
 ☐ Positive X

Factor : 1 ☒ Include Finite Elements

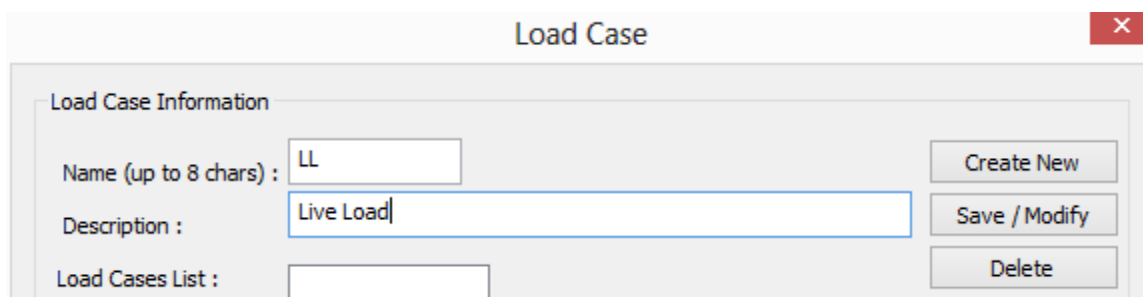
OK Cancel

Step #19. Define Load Cases: Click on the icon  **Load Cases** and the Load dialog appears.

Enter:

- *LL* as Name
- *Live Load* as the Load Description

and press Create New.



Load Case

Load Case Information

Name (up to 8 chars) : LL

Description : Live Load

Load Cases List :

Create New Save / Modify Delete

Enter:

- *PL* as Name
- *Pressure Load* as the Load Description

and press Create New.

Load Case ✕

Load Case Information

Load ID (up to 8 chars) : Create New

Description : Save / Modify

Load ID List : Delete

Press Exit to close the dialog.

Step #20. Apply Live Loads: Live Loads will be applied only to the bottom of the tank , therefore click on the icon  Colors . Select the 2nd Tab in order to colorize elements by their group and make only the Group Bottom visible and press OK.

Sections Groups

Categories

Groups	Color	Visible
Bottom	161	☒
Wall	191	☐
UnGrouped data	256	☐

Click on the icon  Shell in the Loads Panel. Using a full window, select all entities that appear on screen and press <ENTER> to finish with the selection.

The Element Properties [Multiple Selection] form appears having the tab “Element Loads” active.

Click on LL at the “Empty Load Cases” list box and then enter:

- *Surface* as the Force Type
- *Z* as Direction
- *Global* as System
- *Uniform* as Load Distribution
- *-40* as v1

Press Create New and the number 476 appears next to the \$ symbol the Empty Load Cases list box. This is a notification that 476 elements are loaded in Load Case LL.

Element Properties [Multiple Selection]

Model
Element Loads

Applied Load Cases

Empty Load Cases

LL \$[0]
PL \$[0]

Loading

Load Case : LL

Create New

Description : Live Load

Save / Modify

Loads in this Load Case :

▼

Delete

Force Type

☐ Body
☒ Surface
☐ Edge

▼

Direction

☐ X
☐ Y
☒ Z

System

☐ Local
☐ Planar
☒ Global
☐ Projected

Load Distribution

☒ Uniform
☐ Variable

Values (B or S)

v1 : -40
v2 :
v3 :
v4 :

OK

Cancel

Apply

Help

Press OK to close the dialog.

By double clicking on one element and then selecting the Element Loads tab and clicking on LL at the Applied Load Cases List Box, you will be able to view and edit the existing loading values of the specific shell.

To clear the arrows select  Clear from the GTS Display Ribbon Tab.

Step #21. Apply Pressure Load: Pressure Load will be applied only to elements in the Group Wall, therefore click on the icon  Colors . Select the 2nd Tab in order to colorize elements by their group and make only the Group Wall visible and press OK.

Sections
Groups

Categories

Groups	Color	Visible
Bottom	161	☐
Wall	191	☒
UnGrouped data	256	☐

Click on the icon  Shell in the Loads Panel. Using a full window, select all entities that appear on screen and press <ENTER> to finish with the selection.

The Shell Properties [Multiple Selection] form appears having the tab “Element Loads” active.

Click on PL at the “Empty Load Cases” list box and then enter:

- *Surface* as the Force Type
- *Z* as Direction
- *Local* as System
- *Uniform* as Load Distribution
- *5* as v1

Press Create New and the number 656 appears next to the \$ symbol the Empty Load Cases list box. This is a notification that 656 elements are loaded in Load Case PL.

The screenshot shows the 'Element Properties [Multiple Selection]' dialog box with the 'Element Loads' tab active. On the left, there are two list boxes: 'Applied Load Cases' (empty) and 'Empty Load Cases' (containing 'LL \$(476)' and 'PL \$(656)'). The 'PL \$(656)' entry is highlighted. On the right, the 'Loading' section has 'Load Case: PL', 'Description: Pressure Load', and a dropdown for 'Loads in this Load Case:'. Below this are five sections: 'Force Type' (with 'Surface' selected), 'Direction' (with 'Z' selected), 'System' (with 'Local' selected), 'Load Distribution' (with 'Uniform' selected), and 'Values (B or S)' (with 'v1: 5' and empty fields for v2, v3, and v4). At the bottom right are buttons for 'Create New', 'Save / Modify', and 'Delete'. At the bottom of the dialog are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

Press OK to close the dialog.

To clear the arrows select  **Clear** from the GTS Display Ribbon Tab.

Click on the icon  **Colors**. Select the 2nd Tab and make everything visible.

Step #22. Define a Load Combination: Click on the icon  **Combinations** and the Load Combination dialog appears. Enter:

- *CB1* as Name
- *Load Combination 1* for the Description of the Load Combination
- Click on SW, Enter 1.3 as the factor and press ADD>>
- Click on LL, Enter 1.5 as the factor and press ADD>>

- Click on PL, Enter 1.1 as the factor and press ADD>>
- Press Store
- Press Done to close the dialog.

New Form Load or Load Combination

Load Information

Name : CB1

Description : Load Combination 1

Type

☒ Load Combination

☐ Form Load

Combine

SW (Self Weight)

LL (Live Load)

PL (Pressure Load)

ADD >>

Factor : 1.1

SW 1.30000
LL 1.50000
PL 1.10000

Delete Item

STORE V

4.10. Create GT STRUDL Input File

Step #23. Create GTI: Click on the icon  and the Create GT STRUDL Input file dialog appears. Keep the default GTI filename, check the options “Perform Stiffness Analysis”, “Read Joint Displacements” and “Read Finite Element Results” as shown in the following image and press OK.

Create GT.STRUDL Input File ✕

GTI Commands

GTI File : ...

☒ Perform Stiffness Analysis

Append Other GTI Files/Macros

+
-
Up
Down

☐ Copy Commands from GTI Files/Macros (not CINPUT)

Create Commands to Read Results

☒ Read Joint Displacements

☐ Read Member Forces

☐ Read Section Forces Number of Sections:

☐ Read Section Displacements Number of Sections:

☒ Read Finite Element Results

☐ Read Code Check Results

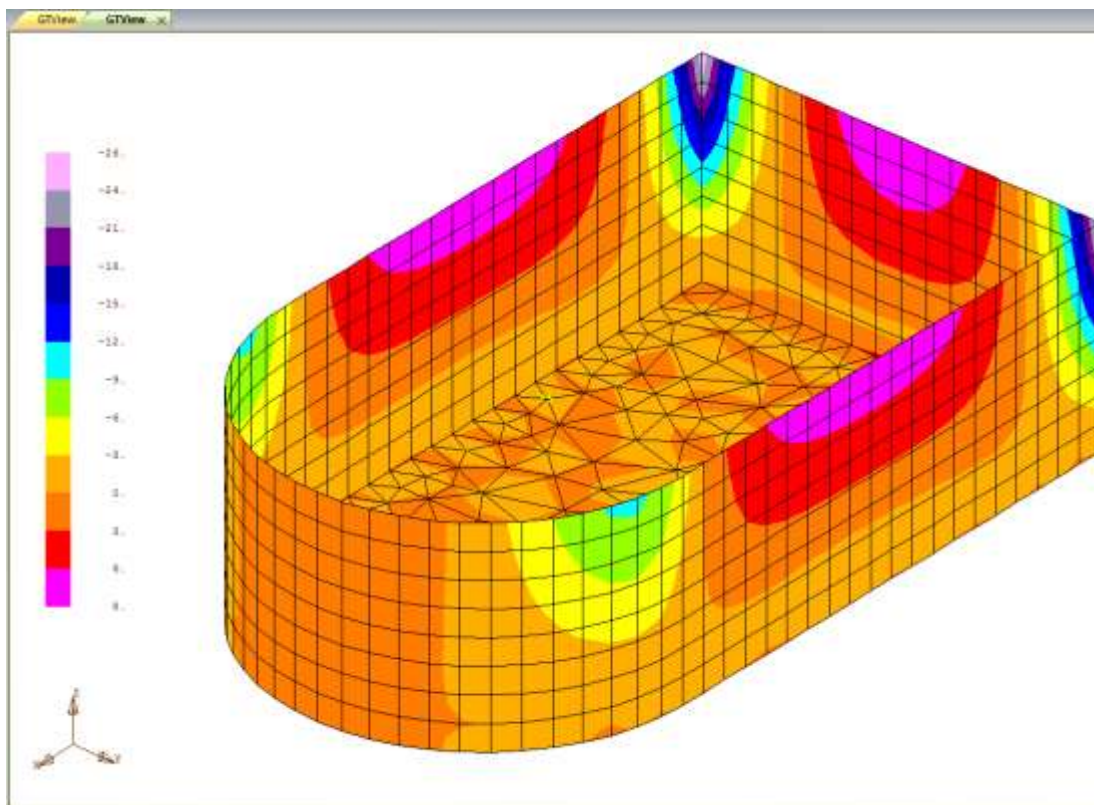
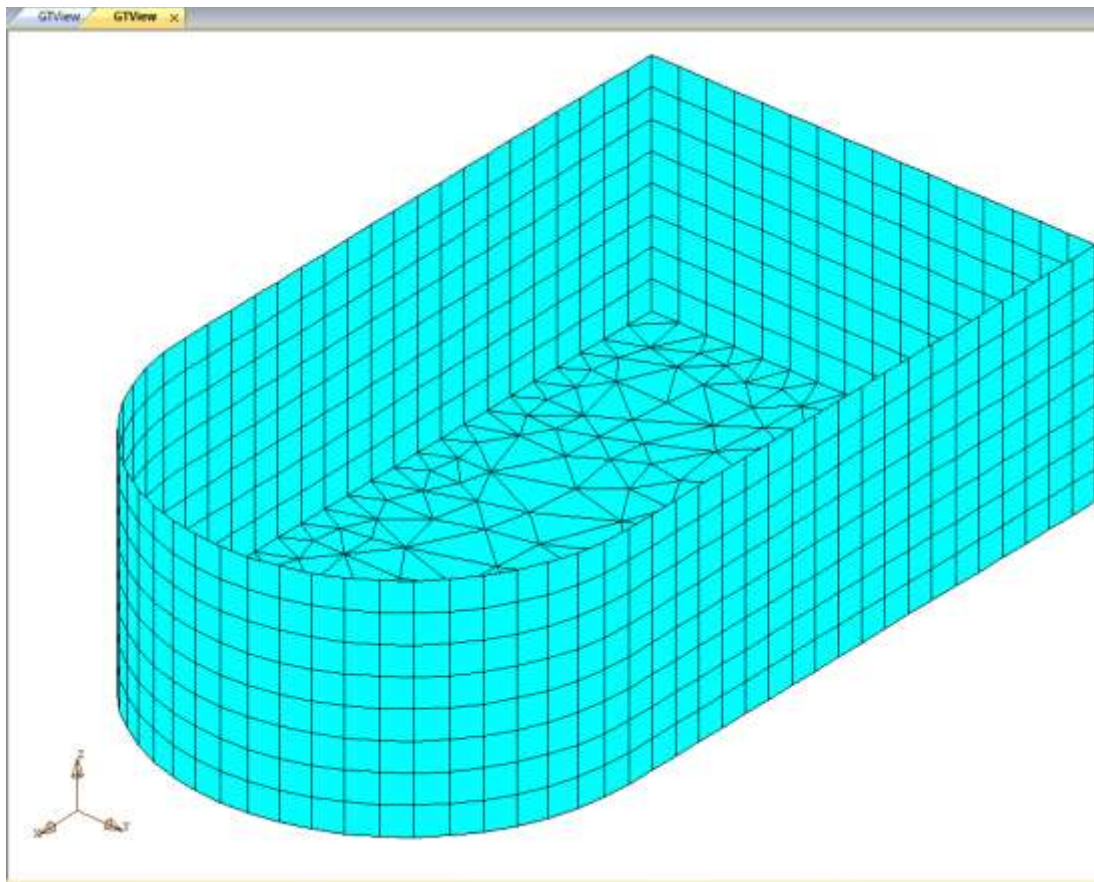
OK
Cancel

Step #24. View/Edit GTI: Click on the icon  **Edit Input File** and the GTI file created in the previous step will be opened by the system's default text editor.

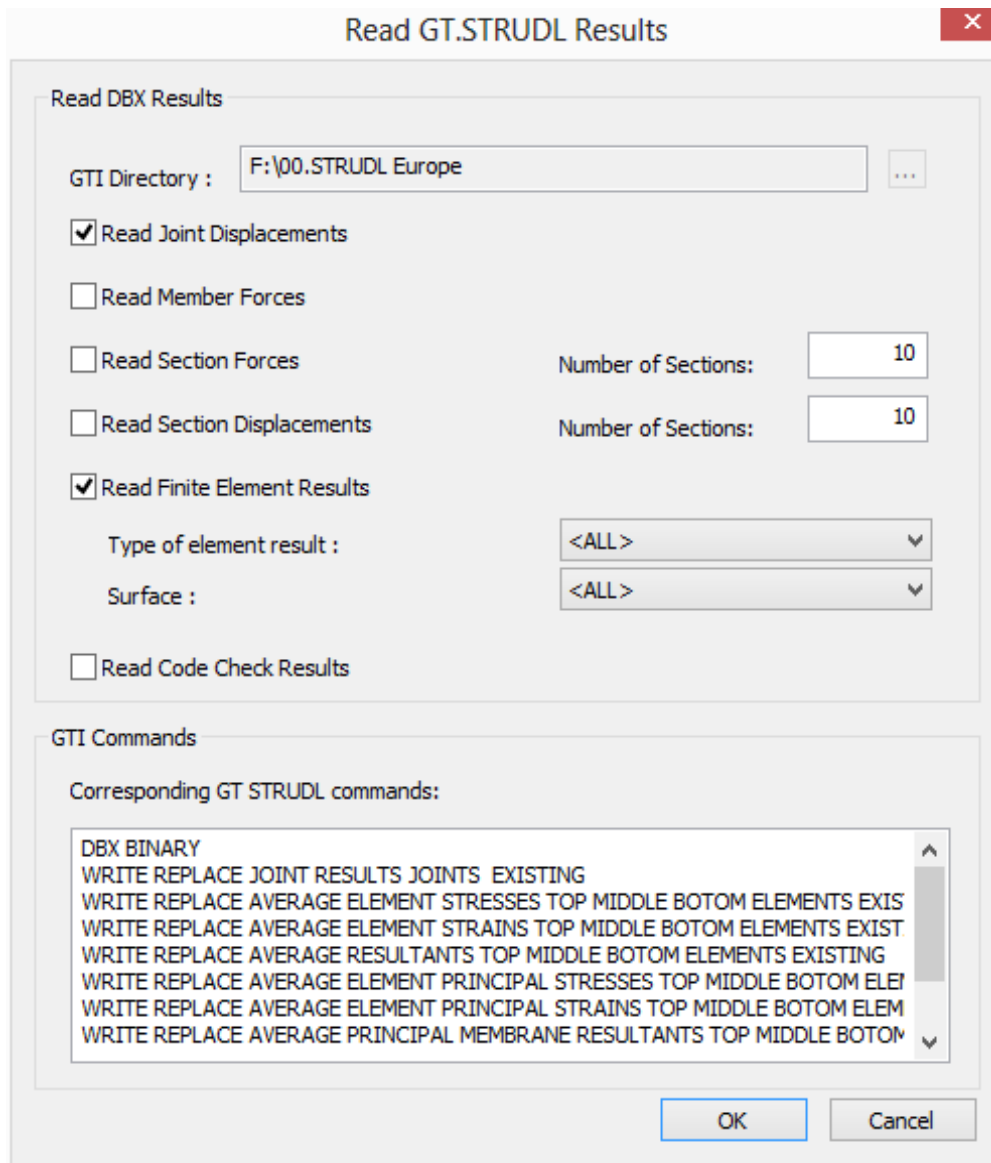
Step #25. Execute GT STRUDL: Click on the icon  and the GTI file created in the previous step will be sent to GT STRUDL main program that is waiting in the background.

Stiffness analysis is automatically performed and DBX result files are automatically created.

In addition, you can enter GTMENU to view the solid model and the results as described in the GTMENU User Guide. You can also click on Results > Finite Element Results > Contour Sresses, Strains, Displacement and display MXX Bending Resultants for load case PL as shown in the figures on the next page:



Step #26. Read Results from GT STRUDL: Click on the icon  **Read Results** and the Read GT.STRUDL Results dialog appears. Check the options “Read Joint Displacements” and “Read Finite Element Results” as shown below and press OK.



Read GT.STRUDL Results

Read DBX Results

GTI Directory : F:\00.STRUDL Europe

☒ Read Joint Displacements

☐ Read Member Forces

☐ Read Section Forces Number of Sections: 10

☐ Read Section Displacements Number of Sections: 10

☒ Read Finite Element Results

Type of element result : <ALL>

Surface : <ALL>

☐ Read Code Check Results

GTI Commands

Corresponding GT STRUDL commands:

DBX BINARY
 WRITE REPLACE JOINT RESULTS JOINTS EXISTING
 WRITE REPLACE AVERAGE ELEMENT STRESSES TOP MIDDLE BOTOM ELEMENTS EXIS
 WRITE REPLACE AVERAGE ELEMENT STRAINS TOP MIDDLE BOTOM ELEMENTS EXIST
 WRITE REPLACE AVERAGE RESULTANTS TOP MIDDLE BOTOM ELEMENTS EXISTING
 WRITE REPLACE AVERAGE ELEMENT PRINCIPAL STRESSES TOP MIDDLE BOTOM ELEI
 WRITE REPLACE AVERAGE ELEMENT PRINCIPAL STRAINS TOP MIDDLE BOTOM ELEM
 WRITE REPLACE AVERAGE PRINCIPAL MEMBRANE RESULTANTS TOP MIDDLE BOTOM

OK Cancel

If you get the following error message at the command prompt:

```
ERROR Loading Results: The following DBX files cannot be found:
```

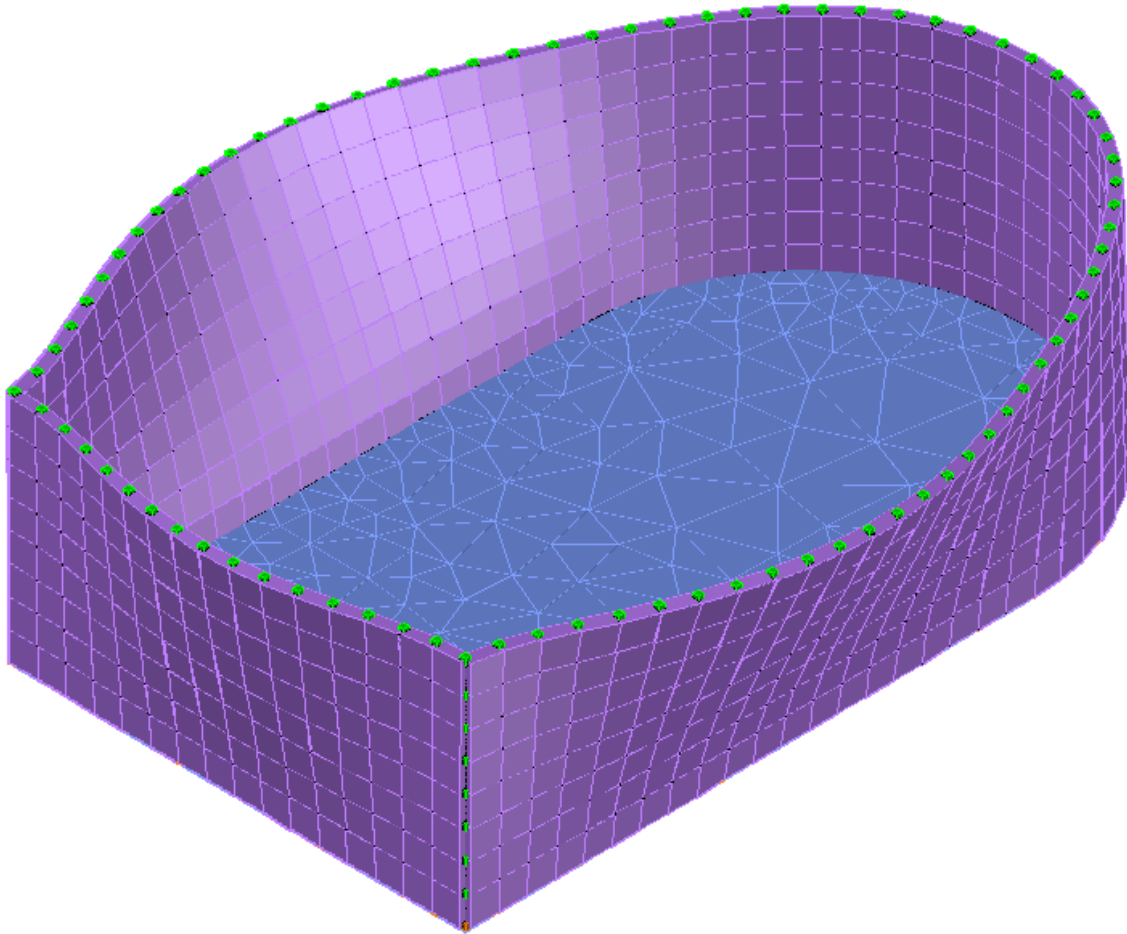
```
STDBX34 - Strains
```

```
STDBX37 - Principal Strains
```

This message informs you that no Strain results are available to be loaded. You can ignore this message, since the elements used (SBHQ6) do not give strains as output results.

4.11. Display Results

Step #27. Show Displacements: In the menu bar, click on GTS Display>Deformed Structure and then select PL as the load Case and press ENTER twice. The deformed structure will be drawn as shown below.



On the Menu Bar, click on GTS Display>Undeformed Structure to return to the original undeformed position of the model.

Step #28. Show Finite Element Results: On the Menu Bar, click on GTS Display>Element Results and the Element Results Form appears.

Select:

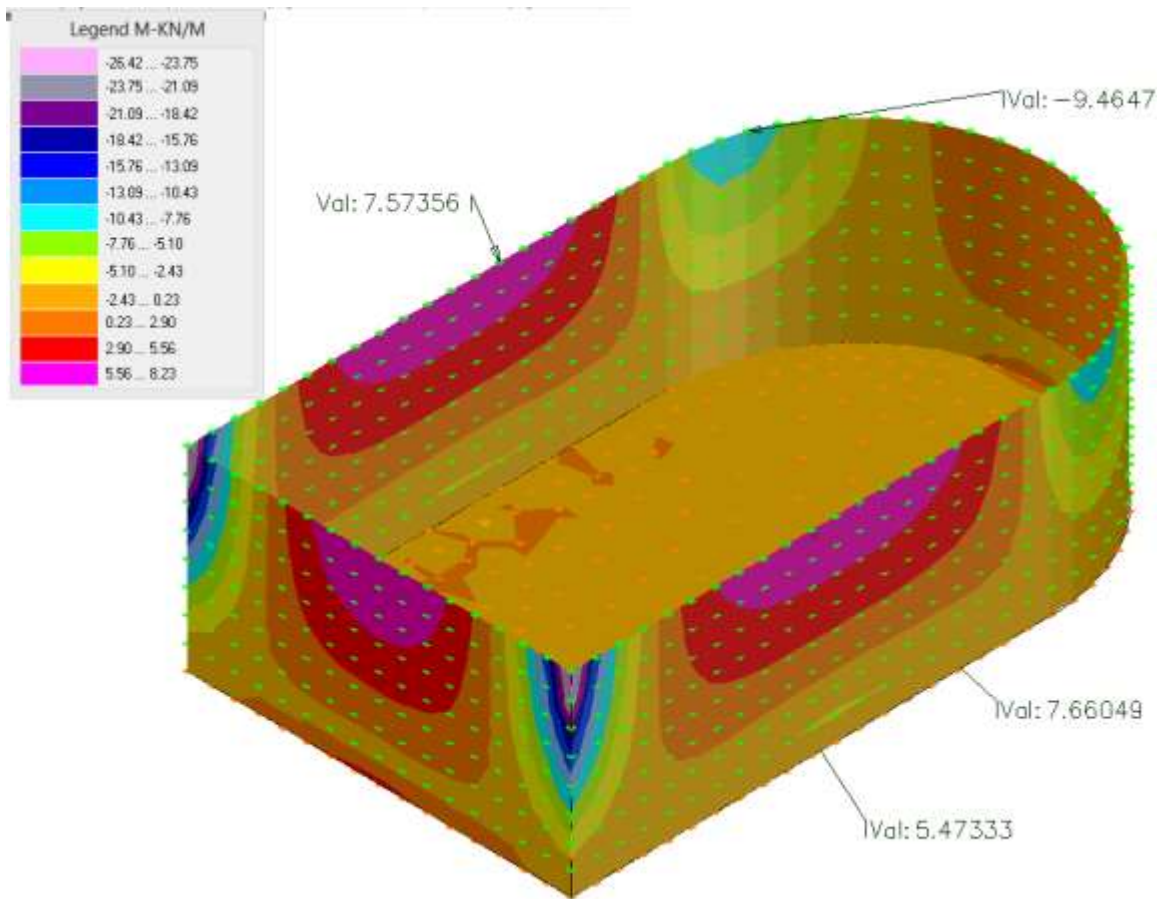
- *PL* as Load Case
- *Resultants* as the Type of element result
- *Mxx* as the Moment Resultant to display
- *Middle* as position (Resultants are only available for the middle surface of a 2D finite element)

and press “*Display >>*”

You can also press the “Annotate >” button and select joints to display the corresponding values.

The multi-colored contour image of the structure is displayed and each color corresponds to a range of *Mxx* values as shown in the Legend Form. Type *Shade* to view the contours in shaded mode as shown on the next page.

NOTE: Hardware graphics acceleration may cause AutoCAD to incorrectly display the colors of the contour. In such a case it is recommended that you turn OFF Hardware Acceleration, during displaying the stress contours, by typing the command `GRAPHICSCONFIG`. You can turn it back ON afterwards.



On the Menu Bar, click on GTS Display>Clear Results Layer and the contours and legend are cleared.

4.12. Results Datasheets

Step #29. In addition to the graphical display of results there is an option to view them in datasheets from the item “Results Datasheets” of the menu/ribbon tab “GTS Display”.

Click on the icon  **Displacements** and the “GTSTRUDL – Joint Displacement Datasheet” dialog appears where you can filter, sort, write results to text file or change results units as shown in figure below;

GTSTRU DL - Joint Displacement Datasheet, display Units: Meters Degrees

File Edit Columns Filter Sort Units Help

Joint	Load	Trans X	Trans Y	Trans Z	Rotation X	Rotation Y
1	SW	0.0000	0.0000	0.0000	0.0000106	-0.0000138
2	SW	0.0000	0.0000	0.0000	-0.0000232	0.0000019
3	SW	0.0000	0.0000	0.0000	-0.0000178	0.0000063
4	SW	0.0000	0.0000	0.0000	-0.0000217	-0.0000060
5	SW	0.0000	0.0000	0.0000	-0.0000259	0.0000074
6	SW	0.0000	0.0000	0.0000	-0.0000240	-0.0000108
7	SW	0.0000	0.0000	0.0000	-0.0000245	0.0000075
8	SW	0.0000	0.0000	0.0000	-0.0000541	0.0000093
9	SW	0.0000	0.0000	0.0000	-0.0000309	-0.0000440
10	SW	0.0000	0.0000	0.0000	-0.0000478	0.0000198
11	SW	0.0000	0.0000	0.0000	-0.0000426	-0.0000289
12	SW	0.0000	0.0000	0.0000	-0.0000353	0.0000310
13	SW	0.0000	0.0000	0.0000	-0.0000511	-0.0000206
14	SW	0.0000	0.0000	0.0000	-0.0000470	0.0000164
15	SW	0.0000	0.0000	0.0000	-0.0000420	-0.0000298
16	SW	0.0000	0.0000	0.0000	-0.0000307	0.0000099
17	SW	0.0000	0.0000	0.0000	-0.0000394	0.0000016
18	SW	0.0000	0.0000	0.0000	-0.0000175	-0.0000173
19	SW	0.0000	0.0000	0.0000	-0.0000129	0.0000066
20	SW	0.0000	0.0000	0.0000	-0.0000321	0.0000080
21	SW	0.0000	0.0000	0.0000	-0.0000101	-0.0000294
22	SW	0.0000	0.0000	0.0000	0.0000268	0.0000065
23	SW	0.0000	0.0000	0.0000	0.0000194	0.0000086
24	SW	0.0000	0.0000	0.0000	0.0000164	0.0000071
25	SW	0.0000	0.0000	0.0000	0.0000193	0.0000075
26	SW	0.0000	0.0000	0.0000	0.0000132	0.0000096
27	SW	0.0000	0.0000	0.0000	0.0000088	0.0000062
28	SW	0.0000	0.0000	0.0000	-0.0000073	0.0000003

Click on the icon  **Stresses** and the “GTSTRU DL – Average Stresses Datasheet” dialog appears where you can filter, sort, write results to text file or change results units as shown in figure below.

GTSTRU DL - Average Stresses Datasheet, display Units: KiloNewtons Meters Degrees

File Edit Columns Filter Sort Units Help

Sorted on: Not sorted Filter: None

Joint	Load	Surface	SXX	SYY	SXY	VonMises
1	SW	Top	-9.072	-79.302	1.757	43.439
1	SW	Middle	-10.035	-68.864	-0.187	37.202
1	SW	Bottom	-10.998	-58.427	-2.131	31.122
1	LL	Top	12.447	-9.762	16.378	19.803
1	LL	Middle	-0.211	-0.052	0.225	0.250
1	LL	Bottom	-12.868	9.658	-15.928	19.530
1	PL	Top	1.229	-32.917	-13.717	23.734
1	PL	Middle	-1.770	-39.660	3.729	22.713
1	PL	Bottom	-4.768	-46.403	21.175	33.166
2	SW	Top	-6.494	-41.199	-3.870	22.486
2	SW	Middle	-6.716	-36.815	-3.170	19.860
2	SW	Bottom	-6.939	-32.431	-2.470	17.255
2	LL	Top	-2.938	-40.908	-8.212	24.250
2	LL	Middle	-0.010	-0.434	1.038	1.067
2	LL	Bottom	2.918	40.039	10.288	24.578
2	PL	Top	26.386	-11.697	-30.198	35.951
2	PL	Middle	-2.172	-8.818	0.775	4.659
2	PL	Bottom	-30.731	-5.938	31.748	35.689
3	SW	Top	-2.867	-41.443	-2.248	23.253
3	SW	Middle	-6.252	-36.609	-2.432	19.733

5. Appendix – List of Commands

Command	Icon	Menu	Command Prompt	Link
Units	 Units	<i>GTS Modeling>Units</i>	GTSUnits	2.5.1
Materials	 Materials	<i>GTS Modeling>Materials</i>	GTSMaterials	2.5.2
Sections	 Sections	<i>GTS Modeling>Cross Sections>Table</i>	GTSParams	2.5.9
Prismatic Sections	-	<i>GTS Modeling>Cross Sections>Prismatic</i>	GTSPrismatic	2.5.9
Levels	 Levels	<i>GTS Modeling>Levels</i>	GTSLevels	2.5.3
Higher Level	 Higher Level	-	GTSLevelUp	2.5.3
Lower Level	 Lower Level	-	GTSLevelDown	2.5.3
Grid	 Grid	<i>GTS Modeling>Grid>Create</i>	GTSGrid	2.5.4
Change Grid	 Change Grid	<i>GTS Modeling>Grid>Change</i>	GTSGridChange	2.5.4
Generate Joint	 Generate	<i>GTS Modeling>Joint>Generate Joint</i>	GTSJoint	2.5.5
At Level (Joint)	 At Level	<i>GTS Modeling>Joint>Generate Joint at Level</i>	GTSJointLevel	2.5.5
Find (Joint)	 Find Joint	<i>GTS Modeling>Joint>Find</i>	GTSFJID	2.5.6
Support	 Support	<i>GTS Modeling>Joint>Support</i>	GTSJointSupport	2.5.7
Change (Joint)	 Change Joint	<i>GTS Modeling>Joint>Change</i>	GTSJointChange	2.5.8
Generate (Member)	 Generate	<i>GTS Modeling>Members>Generate Beam Members</i>	GTSBeam	2.5.10
Vertical (Member)	 Vertical	<i>GTS Modeling>Member>Generate Vertical Member</i>	GTSColumn	2.5.10

Find (Member)	 Find Member	GTS Modeling>Member>Find	GTSMFID	2.5.11
Split (Member)	 Split	GTS Modeling>Member>Split Member	GTSSplitMember	2.5.12
Merge (Member)	 Merge	GTS Modeling> Member>Merge Members	GTSMergeMembers	2.5.13
Change (Member)	 Change Member	GTS Modeling> Member>Change	GTSBeamChange	2.5.14
Generate Quad	 Quad	GTS Modeling>Shell>Generate quad at joints	GTSShell	2.5.16
Generate Triangle	 Triangle	GTS Modeling>Shell>Generate triangle at joints	GTSShellT	2.5.16
Reverse Incidence Order	 Reverse	GTS Modeling>Shell> Reverse Incidence Order	GTSShellReverse	2.5.17
Find (Shell)	 Find Shell	GTS Modeling>Shell>Find	GTSFeid	2.5.18
Change (Shell)	 Change Shell	GTS Modeling>Shell>Generate triangle at joints	GTSShellChange	2.5.19
Locate Duplicates	 Joints Duplicates	GTS Modeling>Checks>Joints Duplicates	GTSCheckDuplicateJoints	2.5.20
Locate Floating	 Joints Floatings	GTS Modeling>Checks>Joints Floatings	GTSCheckFloatingJoints	2.5.21
Joints Interference	 Joints Interference	GTS Modeling>Checks>Joints Interference	GTSCheckInteferenceJoints	2.5.22
Members Duplicates	 Members Duplicates	GTS Modeling>Checks>Members Duplicates	GTSCheckDuplicateMembers	2.5.23
Members Zero Length	 Members Zero Length	GTS Modeling>Checks>Members Zero Length	GTSCheckMembersZeroLength	2.5.24
Physical Members	 Physical Members	GTS Modeling>Checks>Physical Members	GTSCheckPhysicalMembers	2.5.25
Shells Duplicates	 Shells Duplicates	GTS Modeling>Checks>Shells Duplicates	GTSCheckDuplicateShells	2.5.26
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2D 4Curves (Meshing)	 2D 4Curves	<i>GTS Modeling>Mesh Generation>2D Between 4 Lines or Curves</i>	GTSMesh2D4L	2.5.33
2D Area (Meshing)	 2D Area	<i>GTS Modeling>Mesh Generation>2D Between 4 Lines or Curves</i>	GTSMesh2DPoly	2.5.34
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