FAST+MORE

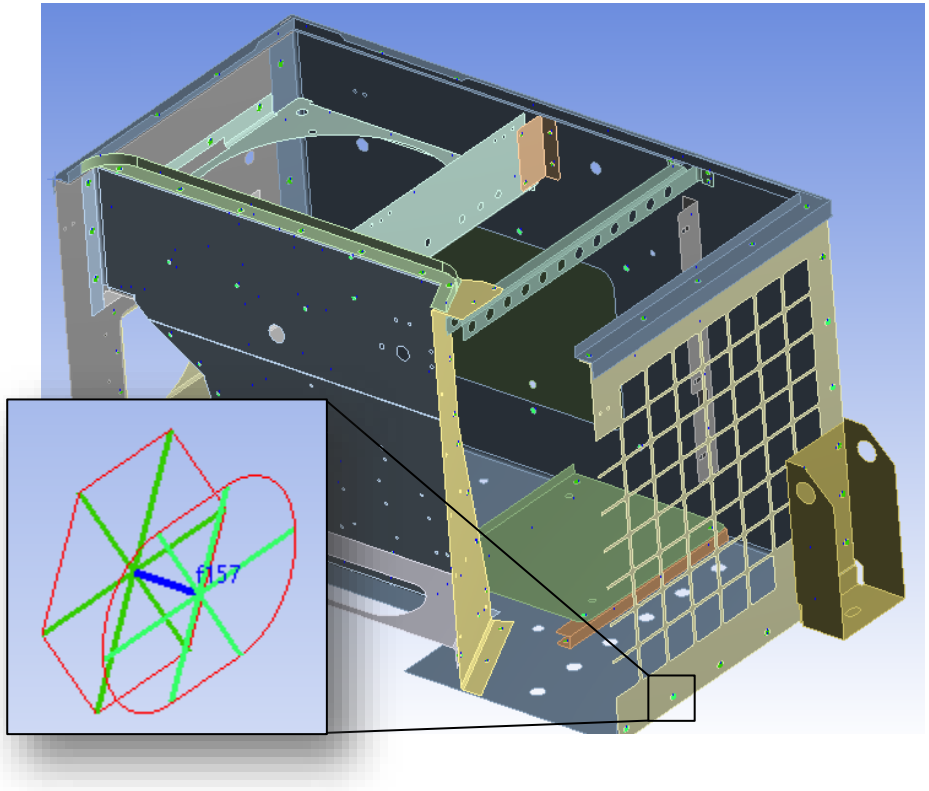
Documentation

table of contents:

1 Aim of the Software

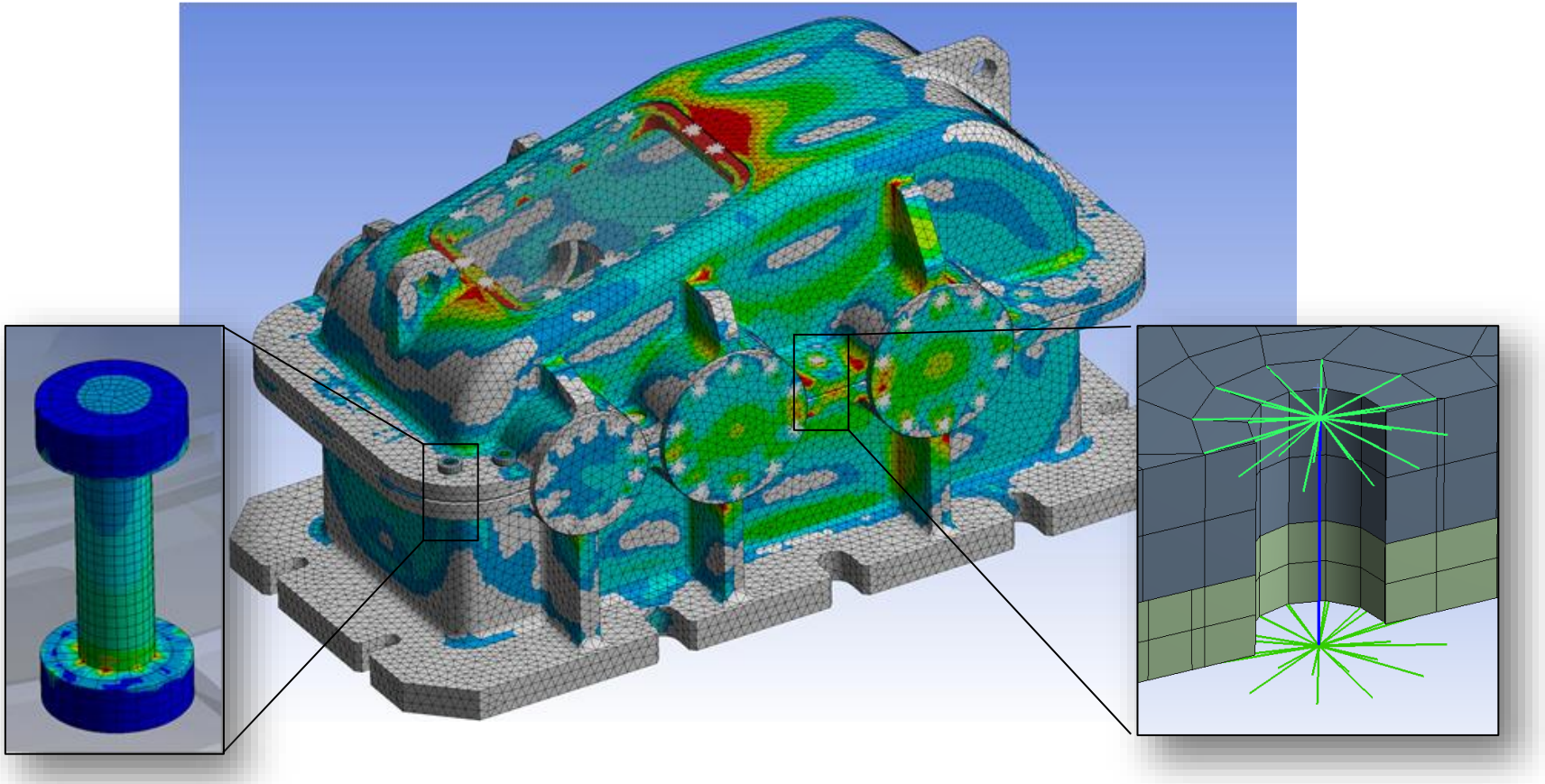
This Extension for ANSYS Mechanical provides a very efficient way for modeling, calculation and postprocessing of all kinds of fasteners (screws, rivets, spotwelds ...) - even for a very large number in complex FE-Models. With just a few clicks (a few minutes) all of the different Fasteners are detected and generated and after solve a streamlined postprocessing is provided.

See also Video of the capabilities on: www.fast-and-more.com



The **free Demo-Version** is limited to **max. 10 Fasteners**. For full capability a license is required.

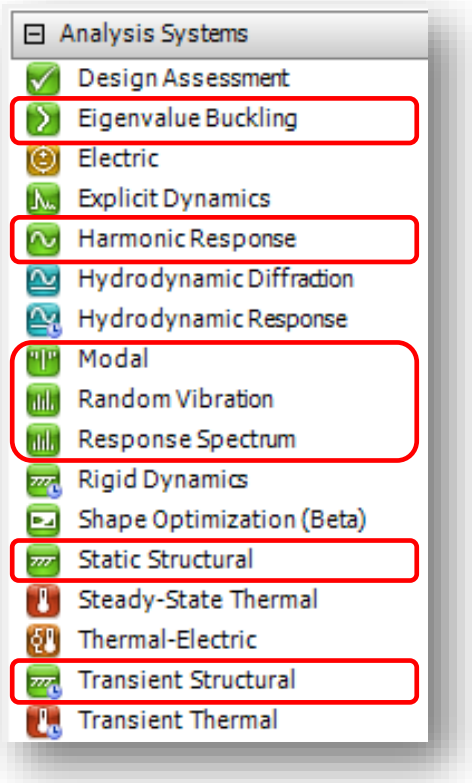
Fast+More is made for Shell-Models as well as for Volume Models.
The Fasteners are modeled with Beam or Volume Elements:



model source: grabcad.com „Reductor“ by Mateusz Szab

2 Area of Application

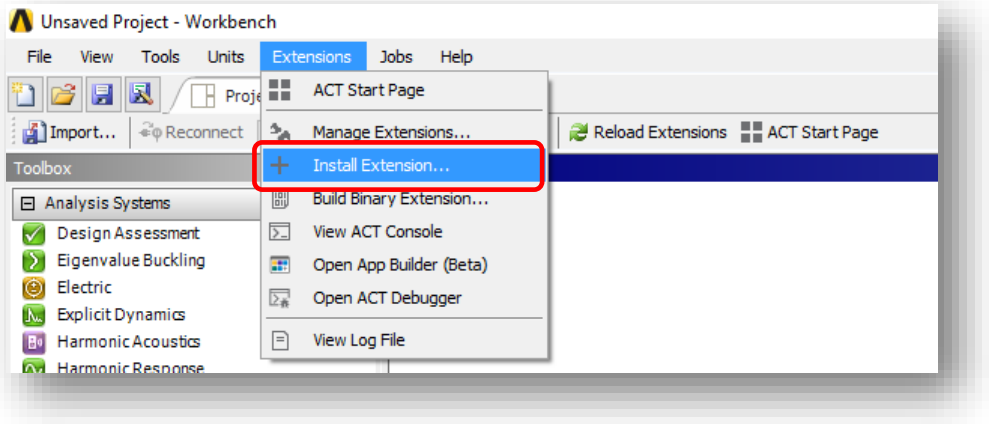
Target application:	ANSYS Mechanical (Workbench)
Compatible ANSYS version:	2019 R1
Target Analysis Types:	see right picture
Target Operating System:	Microsoft Windows



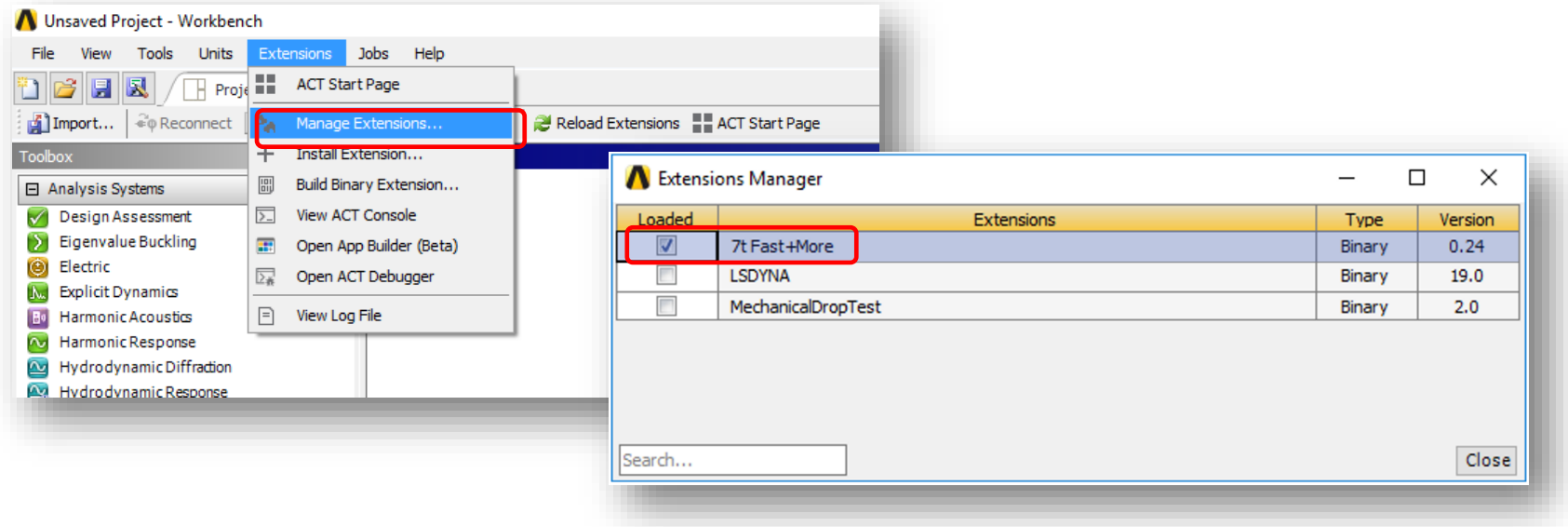
3 Installation and Licensing Information

3.1 Installation

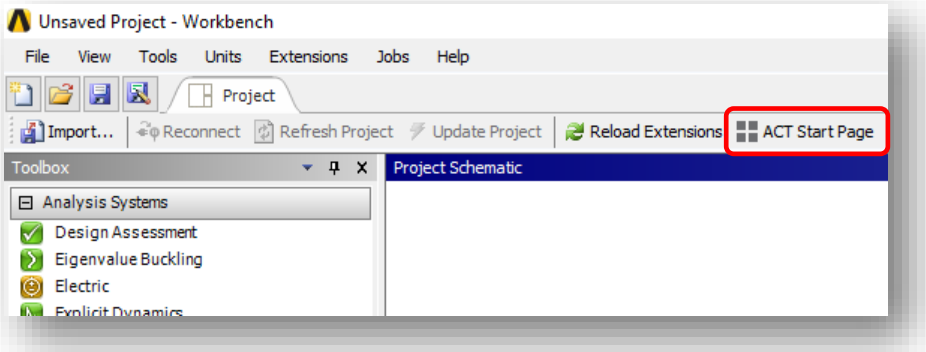
Open ANSYS Workbench and install the App via ***Extensions > Install Extension …*** :

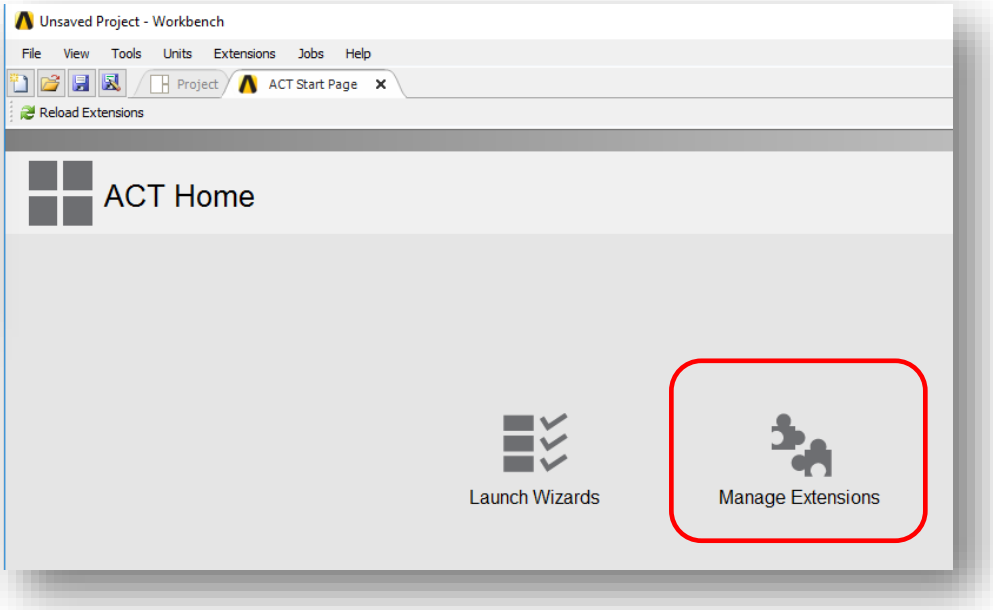


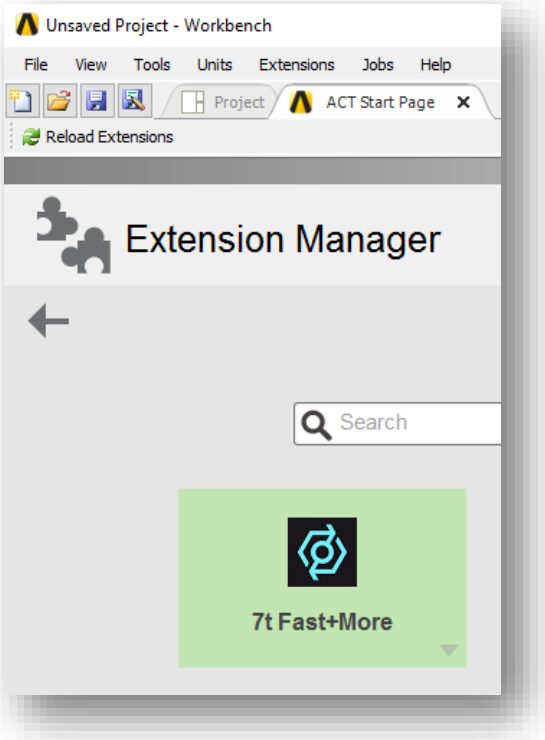
After Installation go to ***Extensions > Manage Extensions …*** and set the checkmark at "**7t Fast+More**":



Or alternatively open ***ACT Start Page > Manage Extensions*** and activate "***7t Fast+More***":







3.2 Licensing

To run Fast+More with full functionality you need a **license file**.

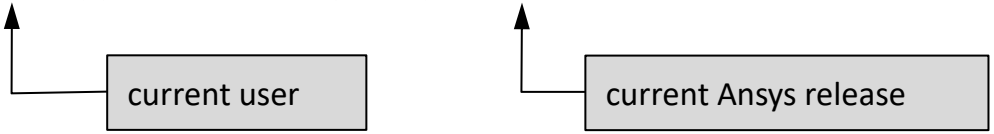
Without a proper license file the App runs in limited Demo-Mode! In Demo-Mode the App is limited to:

- create only 10 Fasteners and 1 Fast+More Preprocessing objects in tree.
- no Slip-Effect (in future releases no Pretension)

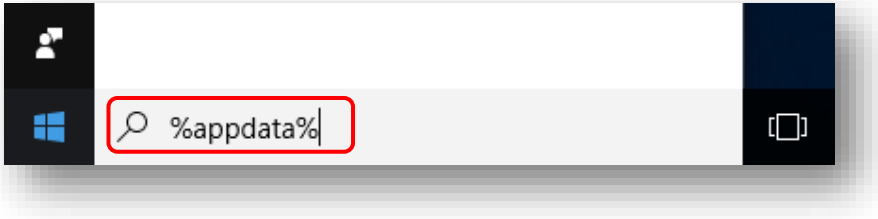
Request a license file via info@fast-and-more.com

Copy the received License-File in the current extensions directory:

C:\Users*User-xyz*\AppData\Roaming\Ansys*v192*\ACT\extensions



To quickly jump into the AppData directory, you can use the Windows-command: %appdata%



3.2.1 NodeLocked License

With a NodeLocked license Fast+More can be used only on the specified computer.

For a node locked license please collect the **Hostname** and the **MAC address** of the local workstation on which Fast+More should run and request with that data a license file via info@fast-and-more.com

Copy the received License-File in the current extensions directory:

C:\Users*User-xyz*\AppData\Roaming\Ansys*v192*\ACT\extensions

3.2.2 Floating License

With a floating license the software can to be operated from several different workstations located in the same network. Various users can use the software but only as many concurrent users as specified in license file. Each open ANSYS Workbench session pulls one Fast+More license – any number of Mechanical models can be operated within a workbench session with only one Fast+More license.

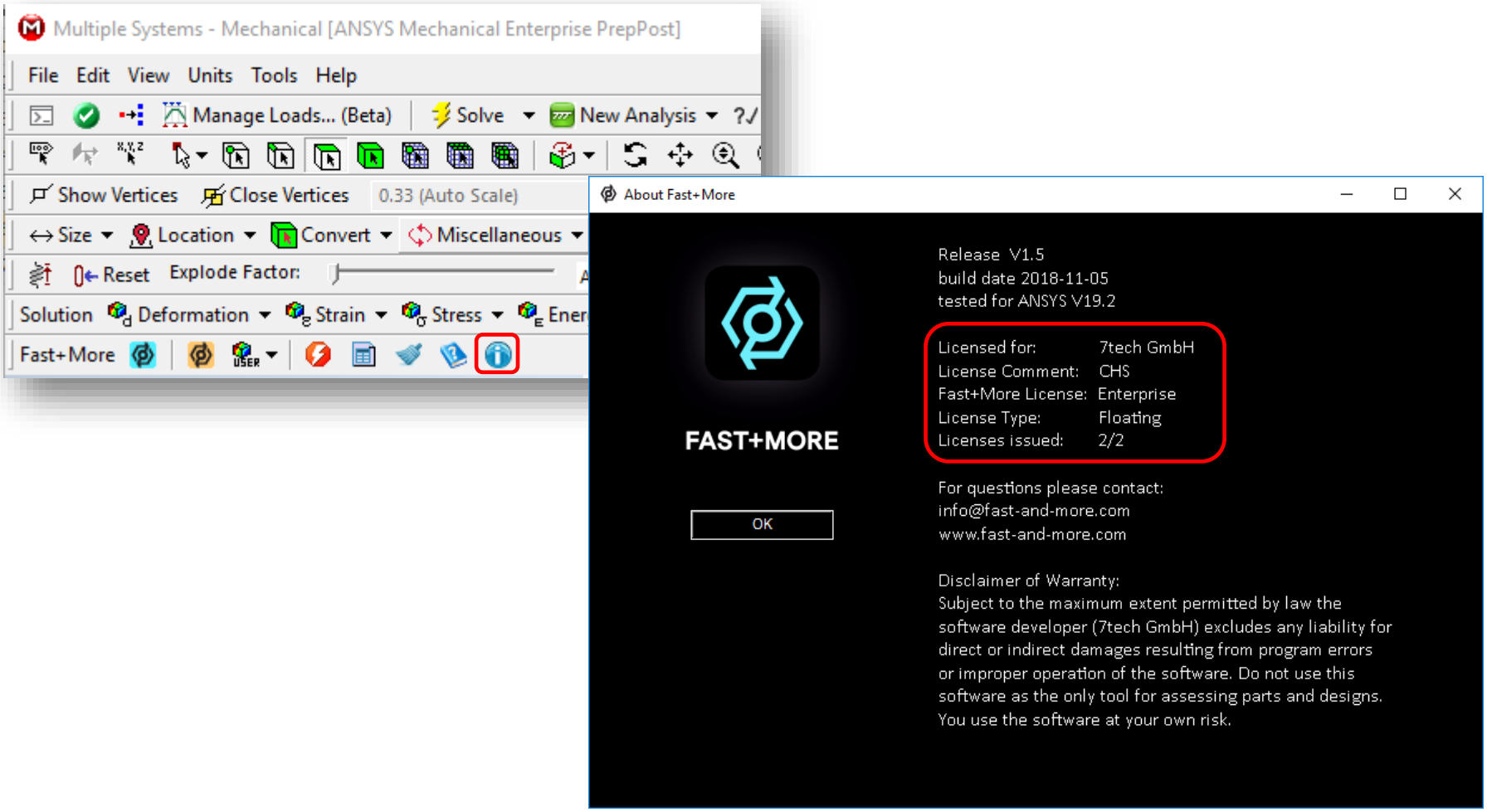
For this licensing method a computer that can be reached in the network is necessary (Server) and an empty folder must be set up on it that can be reached from all other computers in the network. This folder must be accessible from all other computers in the network and the users must have read and write access to the folder. Double-check if this licensing-folder can be reached via a dedicated network path - for instance: \\Testworkstation-01\Fast-and-More\Floating-Lic - and if all necessary users have write access. Request a license file while attaching this **licensing network-path** and the **MAC address** of the server via info@fast-and-more.com.
Copy the received License-File in the current extensions directory of each local computer which should use Fast+More:

C:\Users*User-xyz*\AppData\Roaming\Ansys*v192*\ACT\extensions

After an ANSYS crash or in some other cases it may happen that the licensing folder is not cleaned up correctly and therefore licenses are not released. In this case, simply delete the complete content of the licensing folder and restart ANSYS.

3.3 Check License

Use the FAST+MORE “**About**” button to check if the license is recognized correctly. The About Window shows the current FAST+MORE release and build version and the recognized license information. If no proper license is available, the window shows that FAST+MORE is running in demo mode.



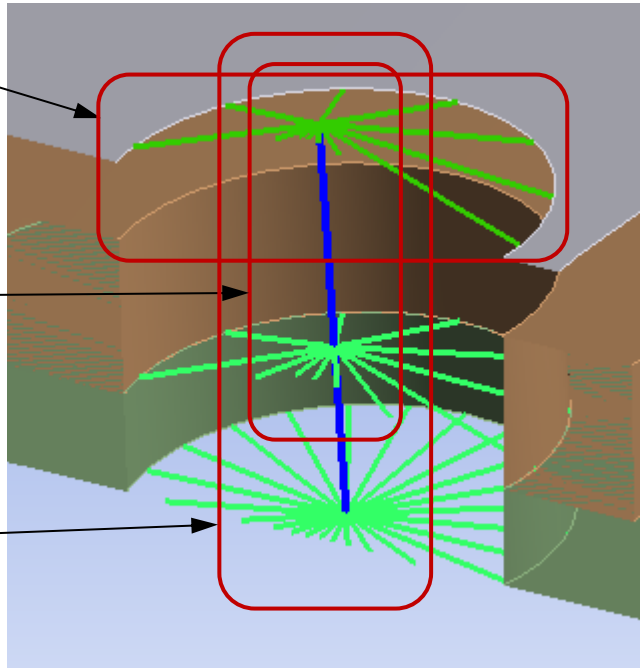
4 Used expressions

The following important expressions are used in the software.

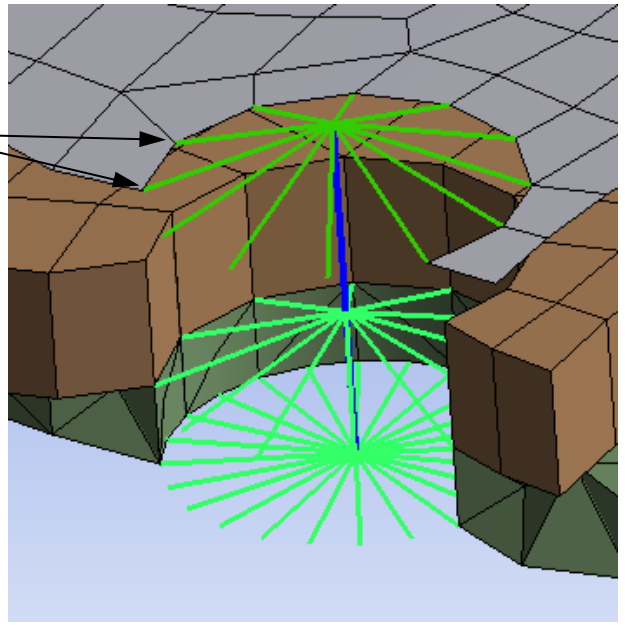
„**Hole**“
is a Position in space (Centre-Point and Normal-Vector)
and corresponding Geometry and Part-Properties

„**Intersection” (Isec.)**
is linked to exactly two “Holes” and one Fastener.
It carries reaction-forces and moments for this interface.

„**Fastener**“
is linked to two or more “Holes” (and corresponding “Intersections”) and defines all the mechanical properties of the Fastener.



„**HeadNodes**“
are Finite Element Nodes that connects the Centre-Point (HeadPoint) of a Hole with the surrounding Mesh

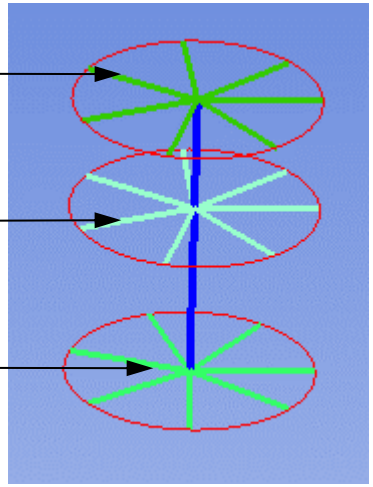


Color code of the Fasteners:

color used for TOP-Side of the Head-Beams (Side A)

color used for all intermediate Head-Beams

color used for BOTTOM-Side of the Head-Beams (Side B)



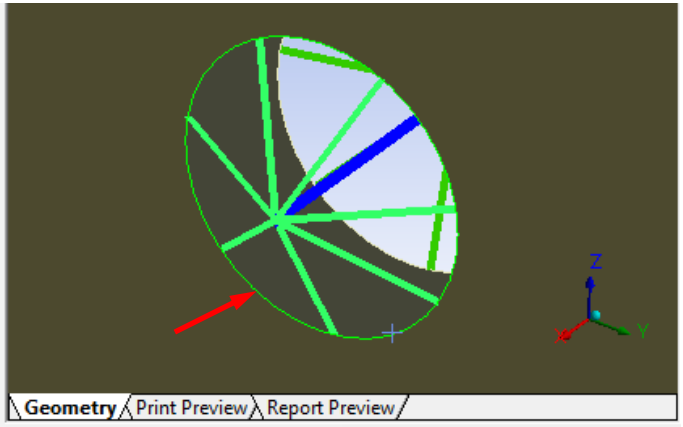
5 Preprocessing

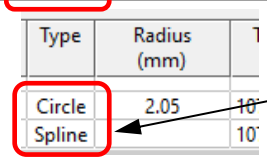
5.1 Geometry Requirements for Circular Holes

The App searches for holes and connects holes which are close to each other with fasteners.

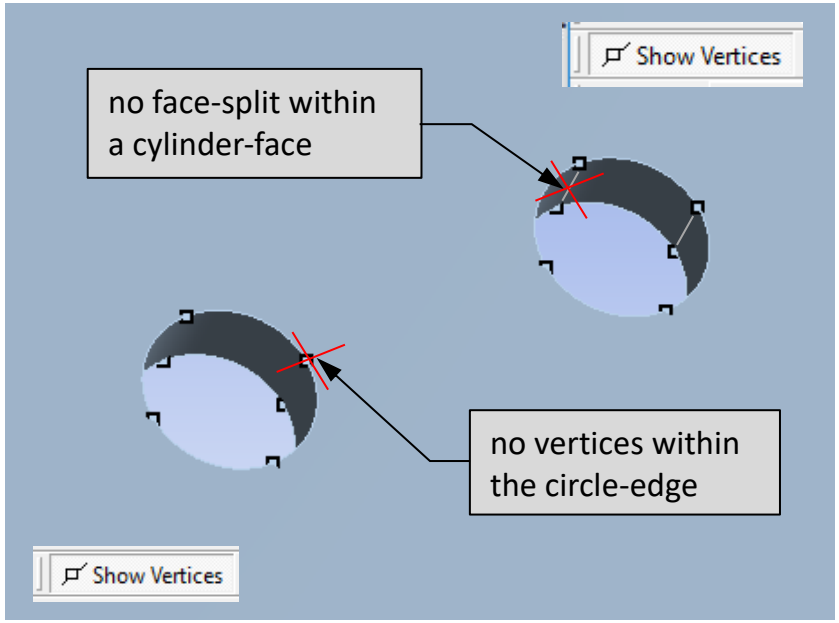
It can be either holes in a shell-body as well as in a volume-body.

A circular hole has to have an edge without any interruption (no vertices within the circle-edge; no face-split within a cylinder-face) for volume bodies. For shell-bodies a circular hole can consist of one or a maximum of two edges.

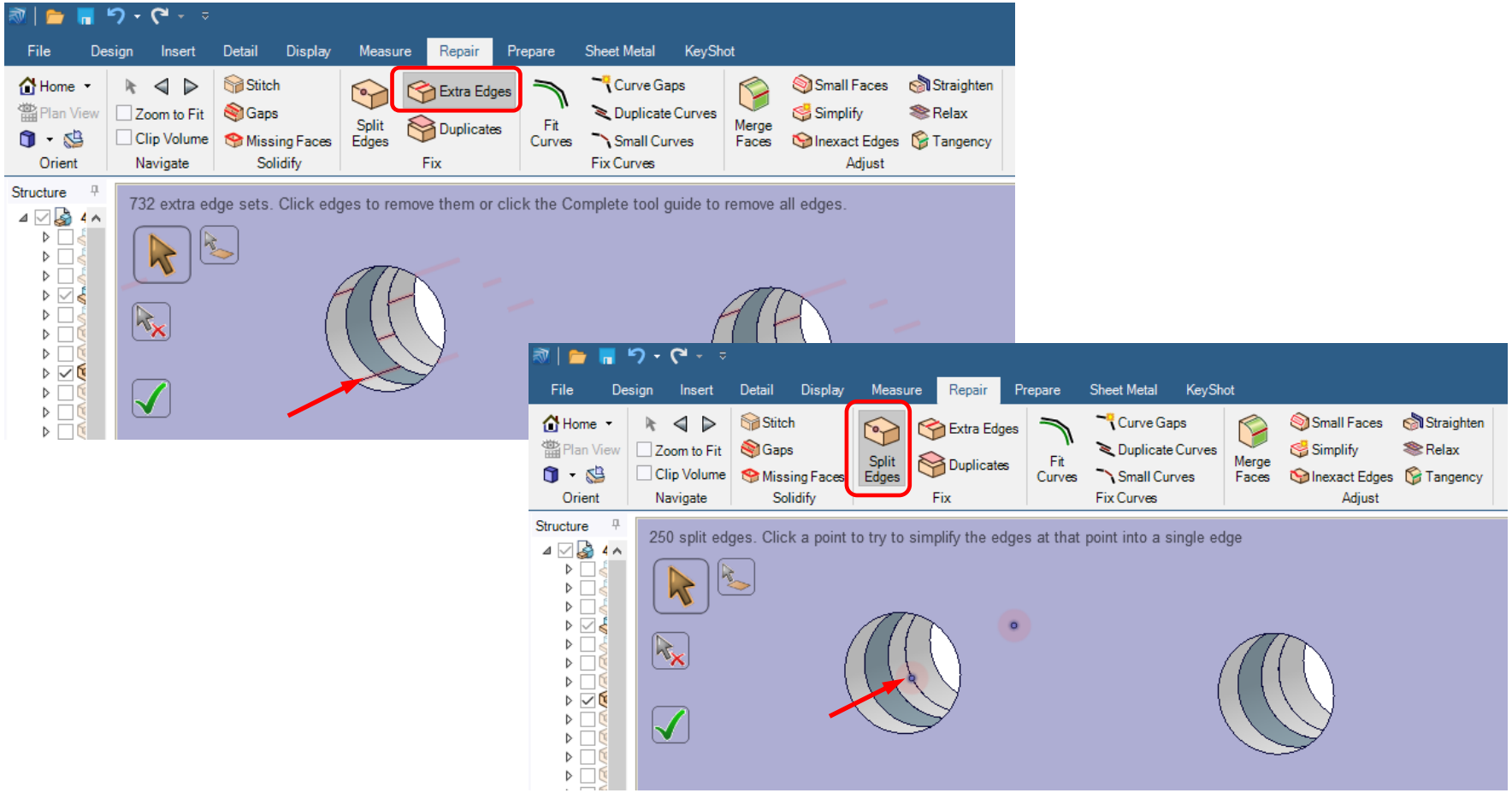




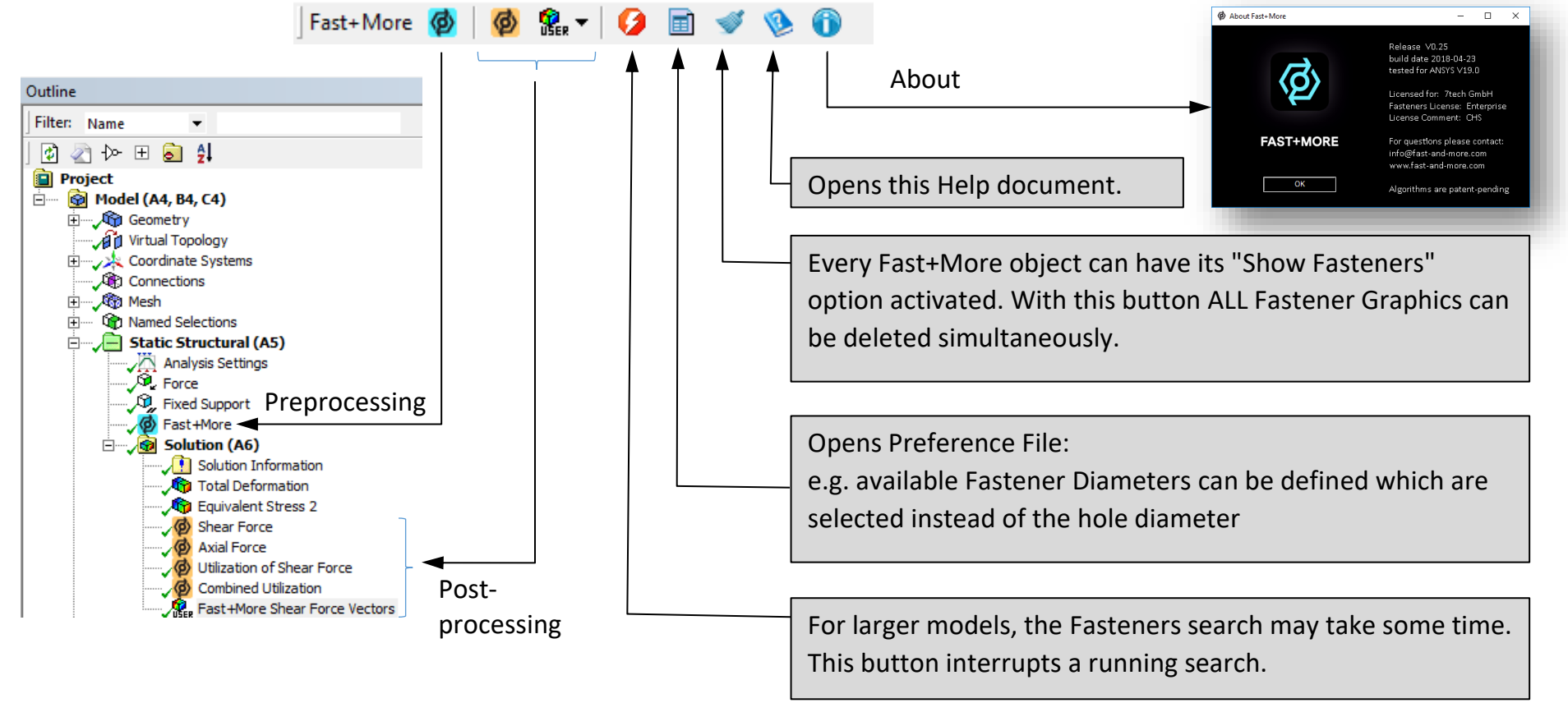
for shell-bodies are also Splines allowed



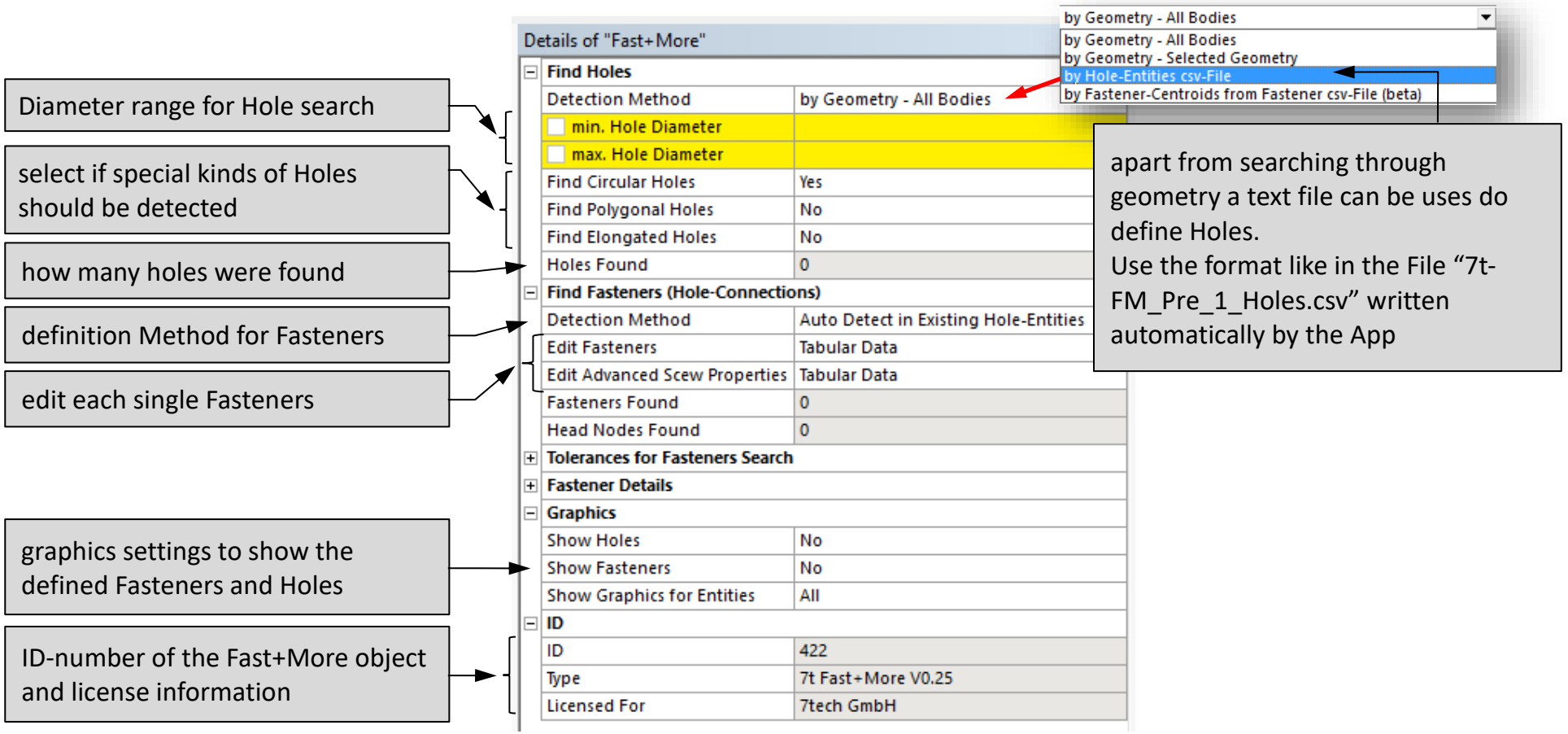
After importing CAD-Geometry in some cases holes are displayed with spited cylinder faces or edges. In this case the holes must be cleaned. This can be easily done in DesignModeler with the repair features or in SpaceClaim with the following functions:

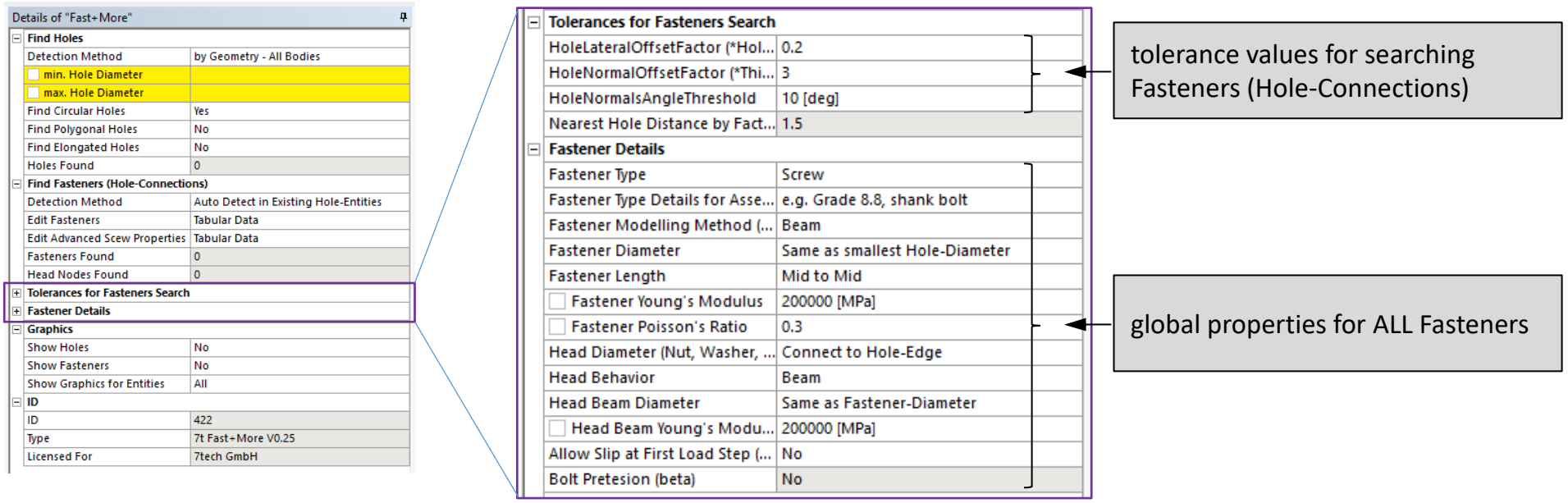


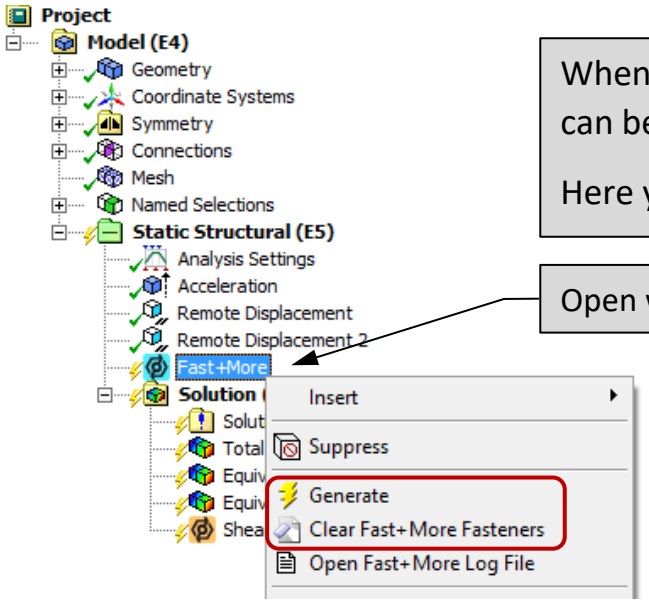
5.2 Fast+More Toolbar



5.3 Preprocessing Details Window







When all settings are done, the creation of the Fasteners can be started with the right mouse button and "*Generate*".

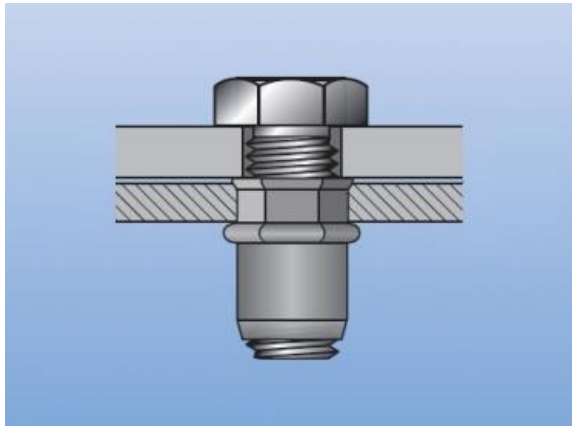
Here you can also delete the Fasteners

Open with the right mouse button

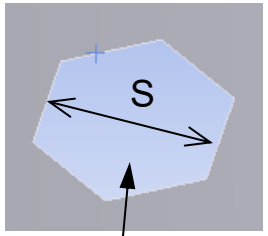
5.4 Find Polygonal Holes

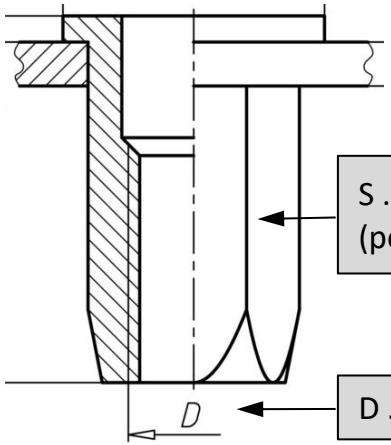
Commonly used pop rivet nuts (clinch nuts) with hexagonal shaft need hexagonal holes.
Fast+More allows to detect these kind of holes.

Details of "Fast+More"	
Find Holes	
Detection Method	by Geometry - All Bodies
min. Hole Diameter	
max. Hole Diameter	
Find Circular Holes	Yes
Find Polygonal Holes	No
Find Elongated Holes	No



http://www.maschinenhandel-sued.de/RIVKLE-Nietmuttern/RIVKLE--Einnietmuttern-Set-M3-M6-Senkkopf-209-Teile.html





S … width across flat
(polygon inscribed circle diameter)

D … Diameter of the bolt

Details of "Fasteners"	
Selection	
Search Region for Holes and Connections	All Bodies
min. Hole Diameter	3 [mm]
max. Hole Diameter	5 [mm]
Find Polygonal Holes	Yes - 6 Sides
Polygon-Inner-Diameter Factor of Bolt-Diameter	1.2

= D

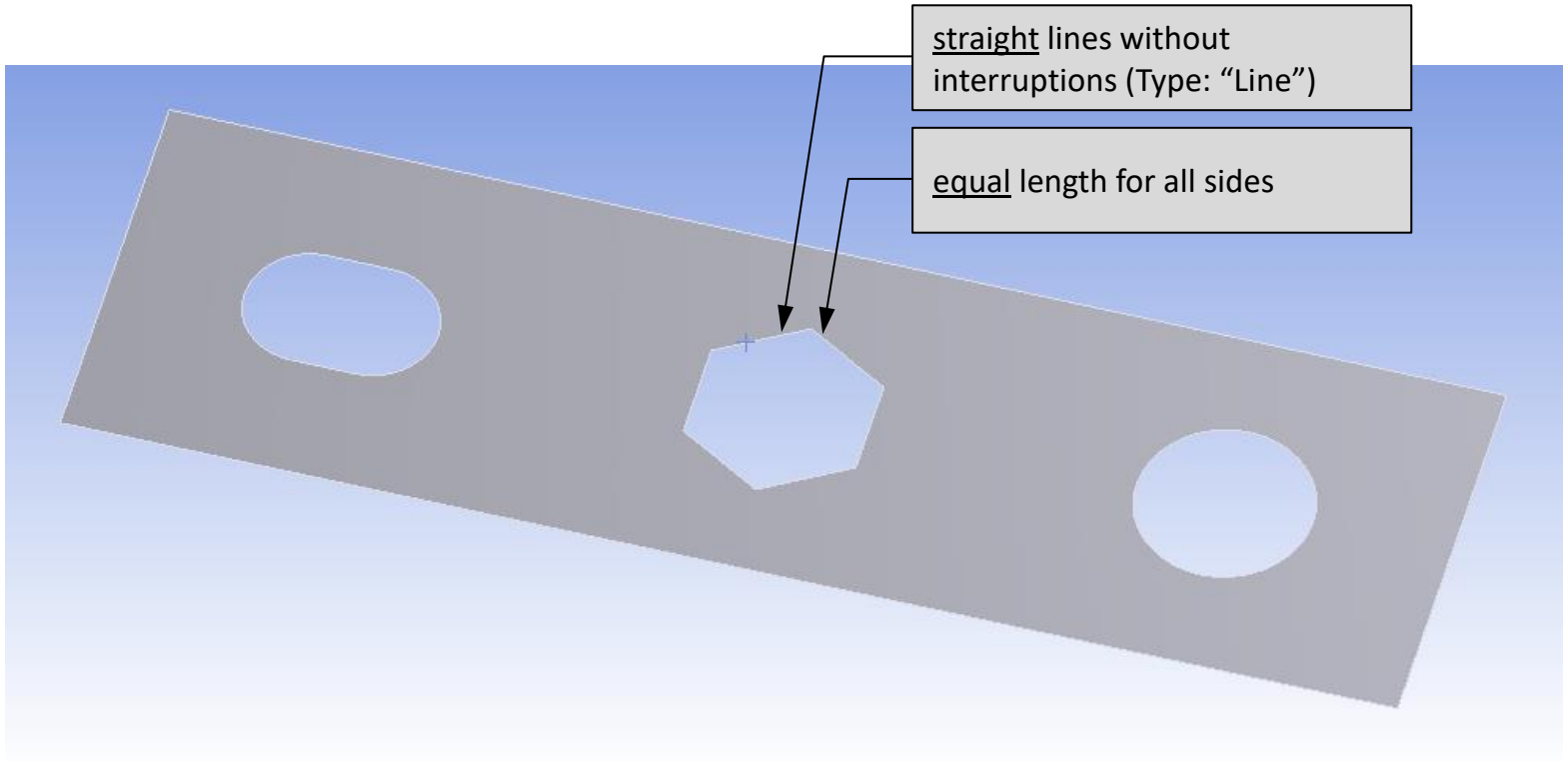
= Factor F

For polygons the search range for
S is the Hole-Diameter D * Factor F → **S = D * F**

Geometry requirements for polygonal Holes:

Selection	
Search Region for Holes and Connections	All Bodies
min. Hole Diameter	
max. Hole Diameter	
Find Polygonal Holes	Yes - User Defined Nb of Sides
Number of Polygon Sides	6
Polygon-Inner-Diameter Factor of Bolt-Diameter	1.2

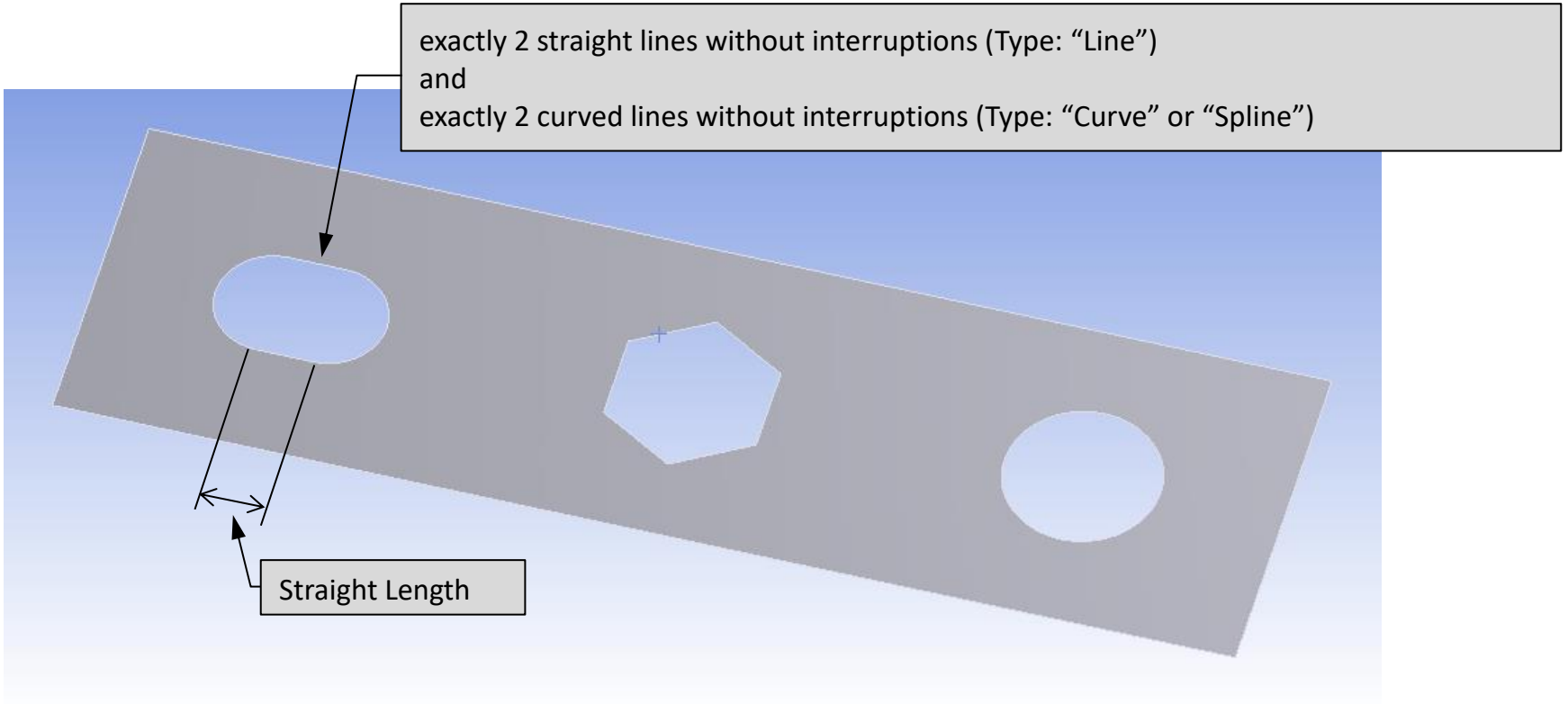
- No
- Yes - 6 Sides
- Yes - 4 to 8 Sides
- Yes - User Defined Nb of Sides



5.5 Find Elongated Holes

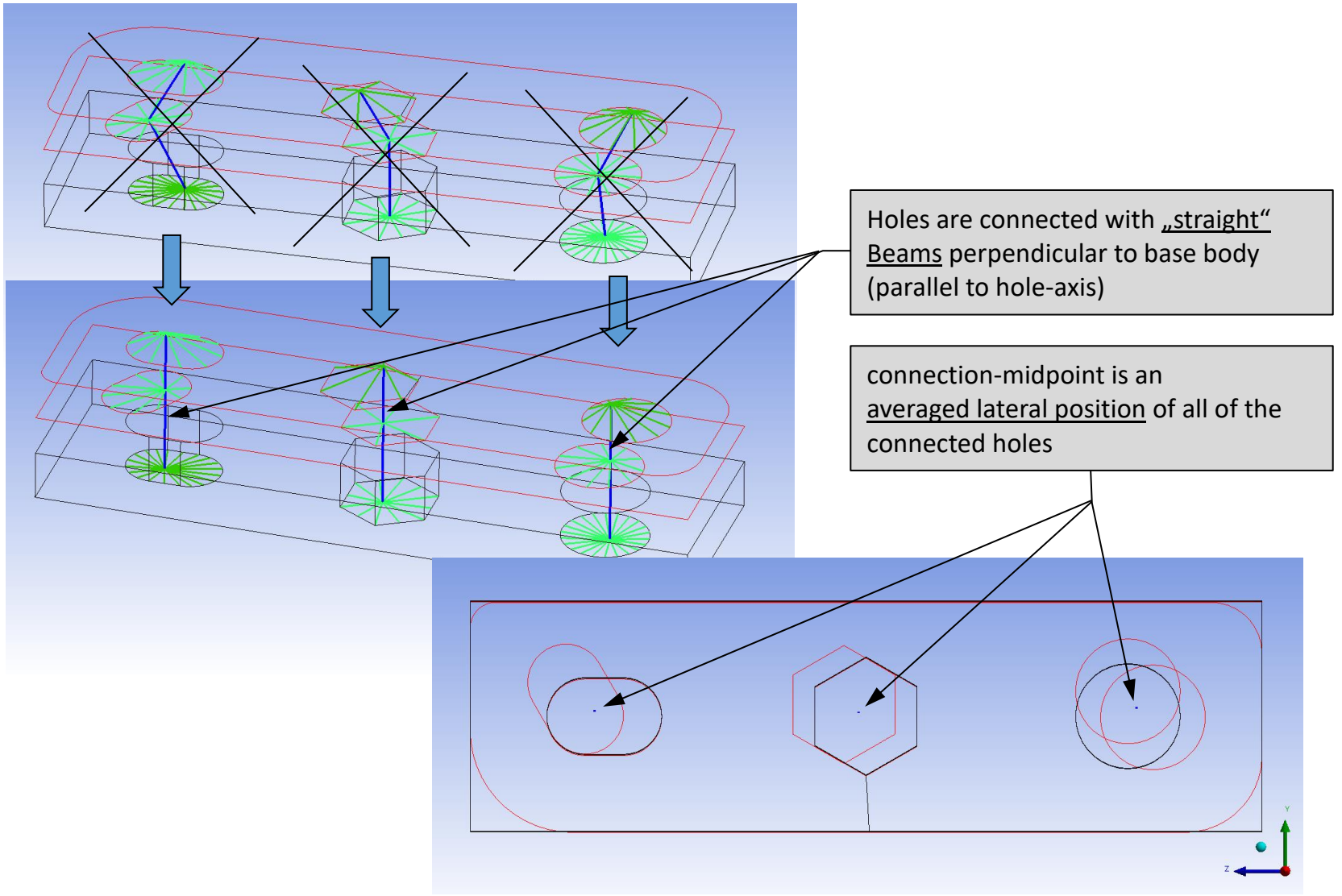
Selection	
Search Region for Holes and Connections	All Bodies
min. Hole Diameter	
max. Hole Diameter	
Find Polygonal Holes	No
Find Elongated Holes	Yes - Length by Value
Max straight Length by Value	1 [mm]

- No
- Yes - Length by Value
- Yes - Length by Factor of Diameter

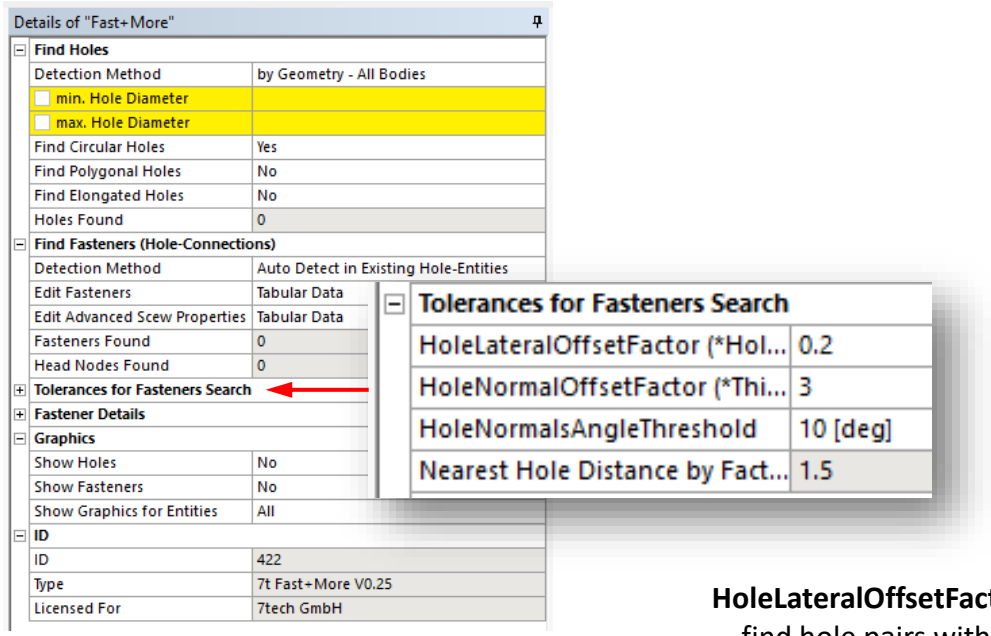


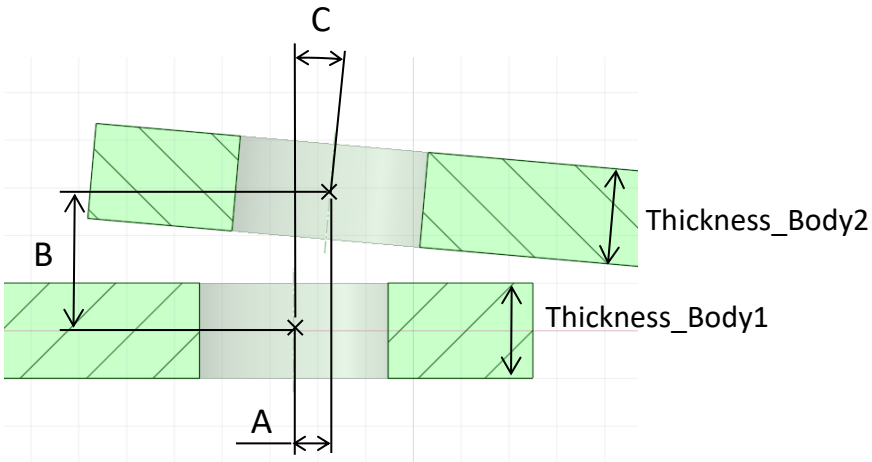
5.6 Holes connected with „straight“ Beams

If connected Holes have offset in their centroids the center Beam will stay „straight“ anyway::



5.7 Tolerances for Hole Connection Search

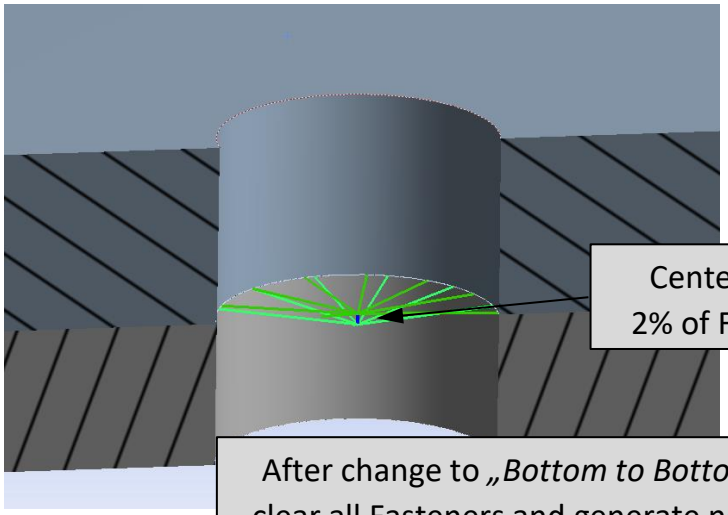




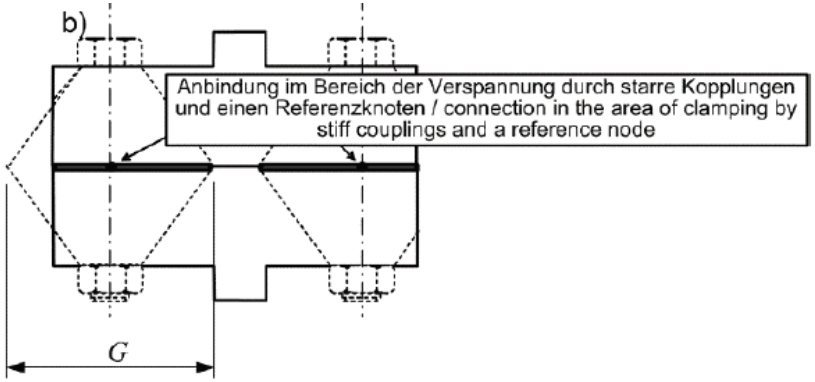
HoleLateralOffsetFactor:
… find hole pairs with lateral offset closer than
A = HoleDiameter * HoleLateralOffsetFactor
HoleNormalOffsetFactor:
… find hole pairs with axial centroid distance smaller than
B = (Thickness_Body1 + Thickness_Body2) / 2 * HoleNormalOffsetFactor
HoleNormalsAngleThreshold:
… find hole pairs with a axis deviation of less than **angle C**

5.8 Modelling Methods for Fasteners

Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Bottom to Bottom (Modelclass 1)
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Connect to Hole-Edge
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]
Allow Slip at First Load Step (beta)	No
Bolt Pretesion (beta)	No

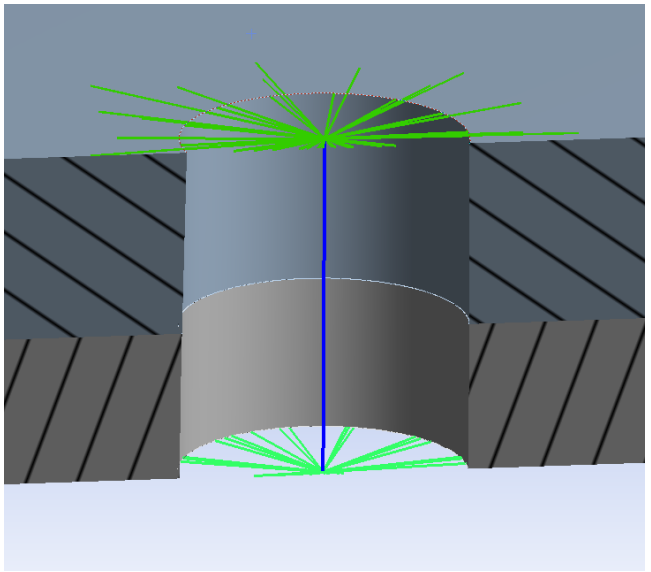


VDI 2230 Modelclass 1:

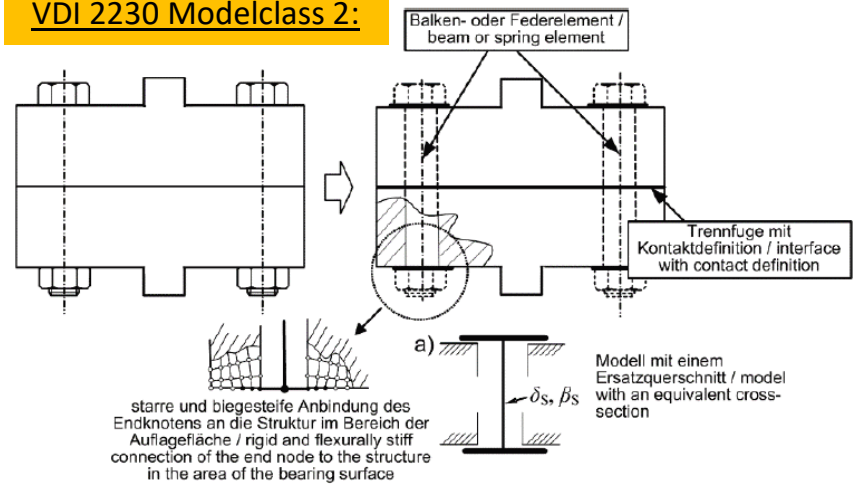


Source: VDI 2230 Part 2, Dec. 2014: Figure 55

Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Top to Top (Modelclass 2)
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Factor of Bolt Diameter
Head Diameter Factor	2
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]
Allow Slip at First Load Step (beta)	No
Bolt Pretesion (beta)	No

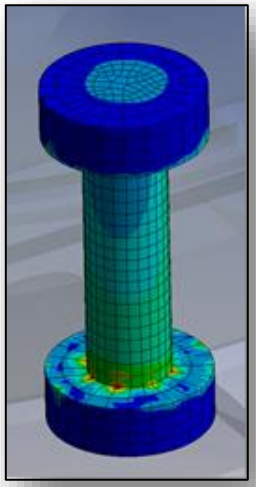


VDI 2230 Modelclass 2:

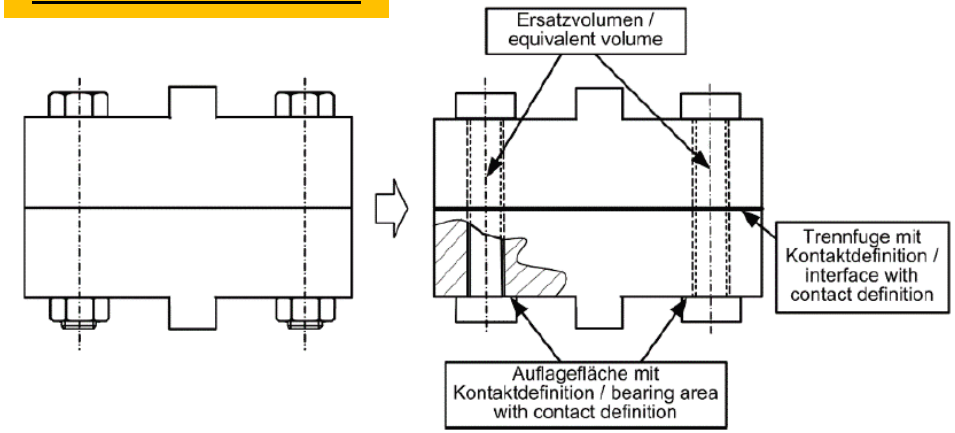


Source: VDI 2230 Part 2, Dec. 2014: Figure 56

Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Volume (beta)
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Top to Top (Modelclass 2)
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Connect to Hole-Edge
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]
Allow Slip at First Load Step (beta)	No
Bolt Pretesion (beta)	No

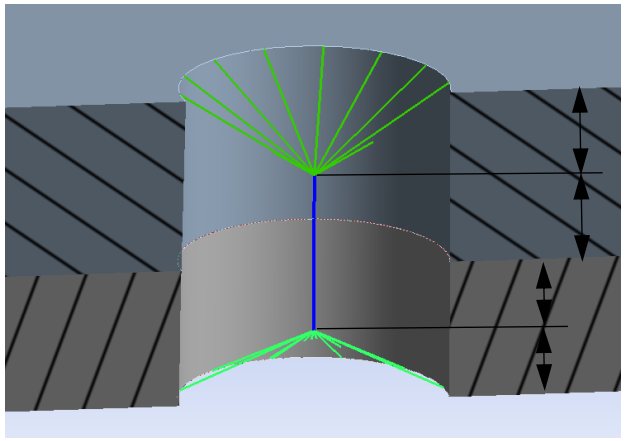


VDI 2230 Modelclass 3:

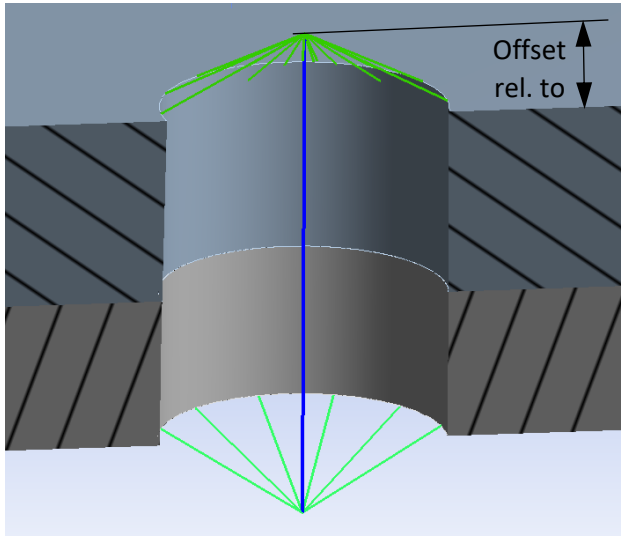


Source: VDI 2230 Part 2, Dec. 2014: Figure 57

Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Mid to Mid
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Connect to Hole-Edge
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]
Allow Slip at First Load Step (beta)	No
Bolt Pretesion (beta)	No



Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Manual Offset rel. to Top
Offset rel. to Top	4 [mm]
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Connect to Hole-Edge
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]
Allow Slip at First Load Step (beta)	No
Bolt Pretesion (beta)	No



5.9 Modelling Methods for Fastener Heads

Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Top to Top (Modelclass 2)
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Connect to Hole-Edge
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]

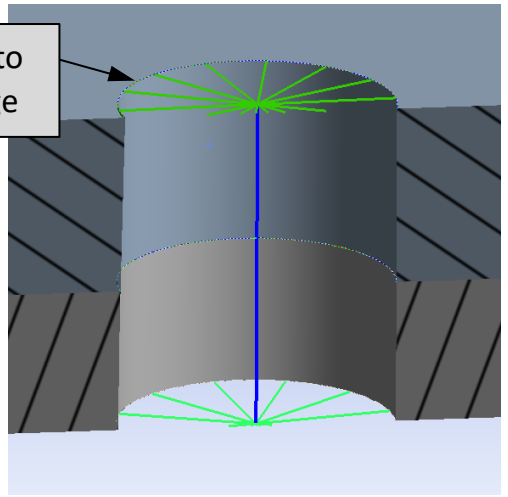
Settings for Fasteners Head Modelling

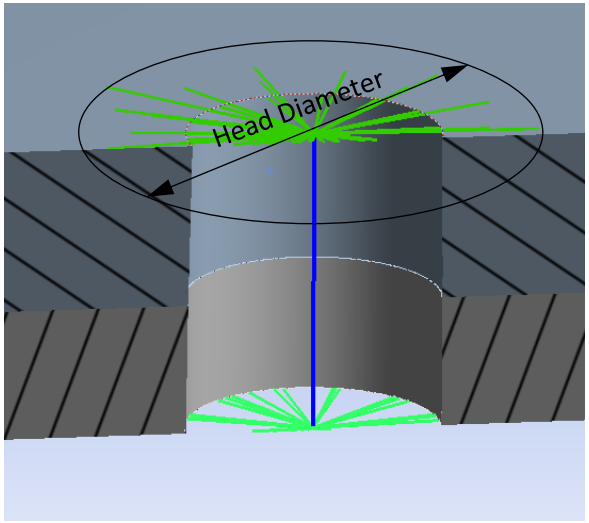
Beam
- Beam
- Rigid
- Deformable

Manual
- Same as Fastener-Diameter
- Manual

Head Diameter (Nut, Washer, ...)	Factor of Bolt Diameter
Head Diameter Factor	2

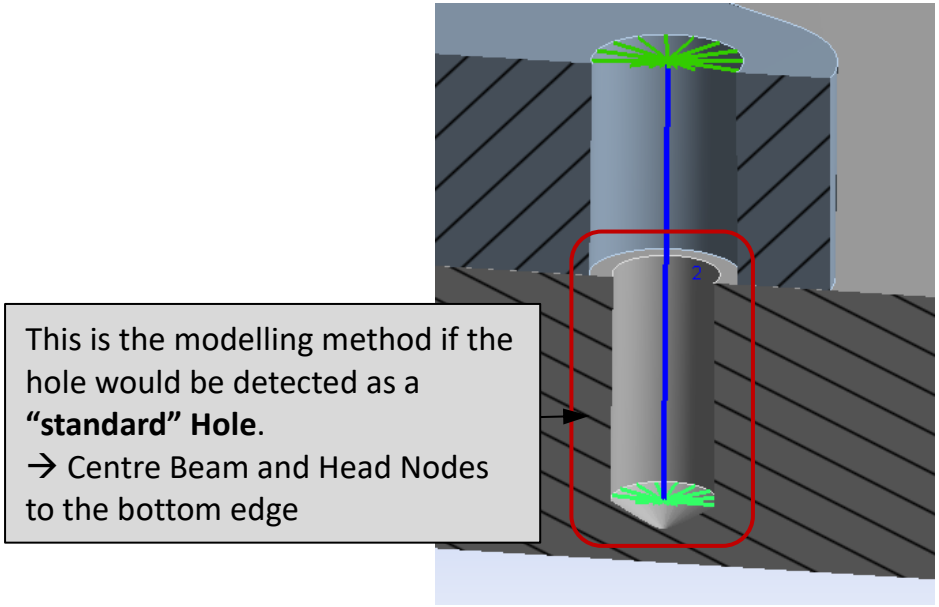
Head Diameter (Nut, Washer, ...)	Diameter Manual
Head Diameter	16 [mm]



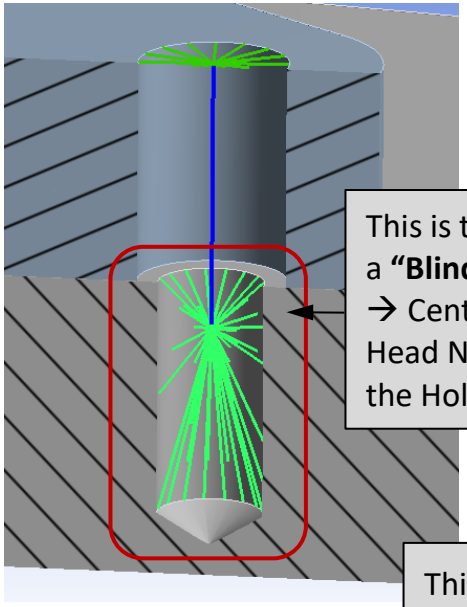


5.10 Threaded Blind Holes

It's automatically detected if a Hole is going fully through the material (standard Hole) or if it is a "Blind Hole". For "Blind Holes" the length of the blue center beam and the detection of the Head nodes are treated differently.



This is the modelling method if the hole would be detected as a **"standard" Hole**.
→ Centre Beam and Head Nodes to the bottom edge



This is the modelling method for a **"Blind Hole"**.
→ Centre Beam shorter and Head Nodes to the wall face of the Hole

This behavior can be changed for each single Hole in the Fasteners-Edit-Table

Details of "Fast+More"

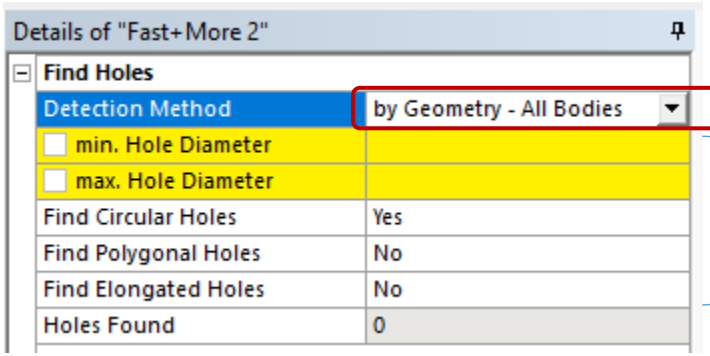
Find Holes	
Detection Method	by Geometry - All
min. Hole Diameter	
max. Hole Diameter	
Find Circular Holes	Yes
Find Polygonal Holes	No
Find Elongated Holes	No
Holes Found	0
Find Fasteners (Hole-Connections)	
Detection Method	Auto Detect in Exi
Edit Fasteners	Tabular Data
Edit Advanced Scew Properties	Tabular Data

Edit Fasteners

Id	Type	elling Met	Diameter	ength Type	Head-Offset	ung's Modul	on's R	HeadBehavior	to Hole-Ec	Hole Ids	Skip Hole Ids	Last Hole Threaded	X Centroid	Y Centroid	Z Centroid	Suppress
1	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[61, 0]	No	No	133 [mm]	7.7882 [mm]	153.8421 [mm]	No
2	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[62, 1]	No	No	133 [mm]	62.3025 [mm]	147.6937 [mm]	No
3	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[2, 42]	No	No	133 [mm]	88 [mm]	33.0151 [mm]	No
4	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[40, 3, 23]	No	No	134.5 [mm]	84.5 [mm]	68 [mm]	No
5	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[44, 4, 22]	No	No	134.5 [mm]	84.5 [mm]	129.5 [mm]	No
6	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[5, 16]	No	No	135.5 [mm]	69.5 [mm]	109 [mm]	No
7	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[6, 21]	No	No	135.5 [mm]	69.5 [mm]	68 [mm]	No
8	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[7, 20]	No	No	135.5 [mm]	69.5 [mm]	88.5 [mm]	No
9	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[45, 8, 17]	No	No	134.5 [mm]	84.5 [mm]	88.5 [mm]	No
10	Screw	B...	4.1 [mm]	Mid ...	0 [mm]	200000 [MPa]	0.3	Beam	Yes	[41, 9, 19]	No	No	134.5 [mm]	84.5 [mm]	109 [mm]	No

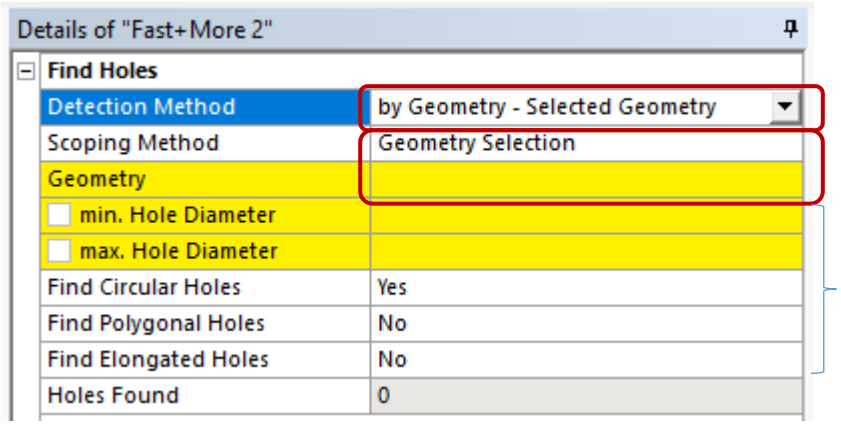
6 Workflows to generate and edit Holes

6.1 by Geometry – All Bodies



The search for Holes will be done across **all bodies**

6.2 by Geometry – Selected Geometry



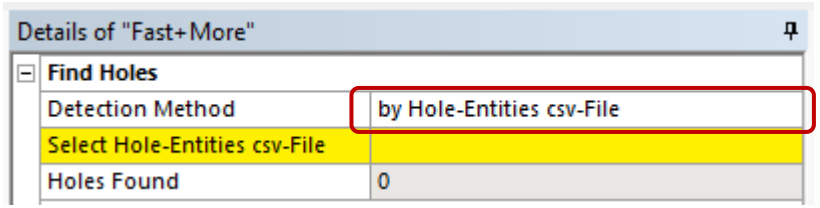
This option allows to **limit the search** for Holes to a **selected region** of the model.
Geometry Selection or Names Selections can be used.
Edges, Faces or Bodies can be selected

6.3 by Hole Entities csv-File

With the first search for Holes and Fasteners csv Files are written in the working directory. This files contain all of the Hole-Properties. The Files can be edited with an external Software (e.g. MS Excel) and reimported in Fast+More. In this case no additional search for holes on the geometry will be done.

This workflow is useful e.g. if the global FEA-model should be more simplified and the geometry-holes are deleted for a coarser mesh. Compare Section 0 on page 39.

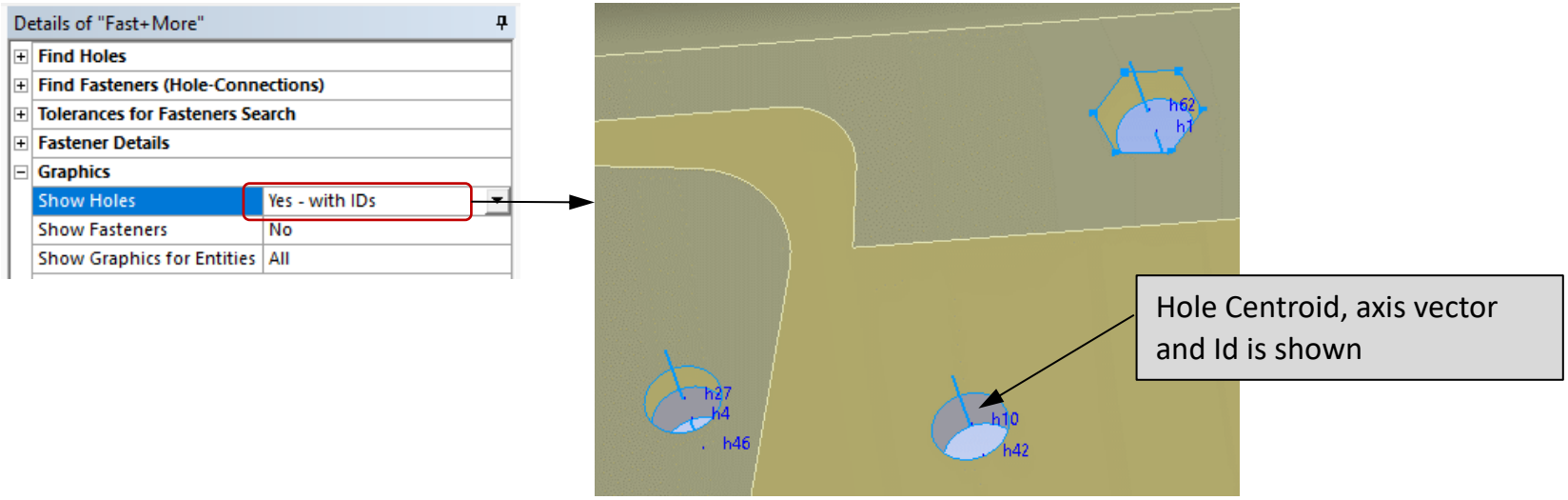
If you have Hole data coming from an external Software (e.g. CAD or manufacturing data) they can formatted like the default csv-File and be imported in Fast+More.

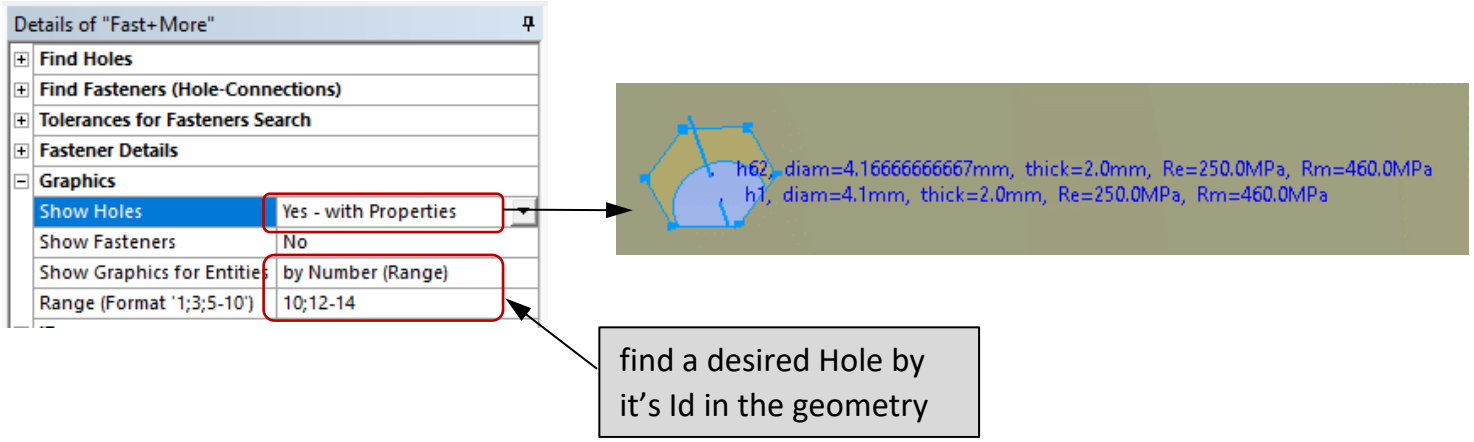


7t-FM_Pre_619_Holes.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	7t Fast+More V1.1 - Holes from load object: 619																				
2	Unit System: [mm, kg, N]																				
3																					
4	Id	Diameter	HoleType	Thickness (	Yield Strengt	Ultimate Str	Allowed Stre	ThreadedHo	ThreadedHo	Pos.X [mm]	Pos.Y [mm]	Pos.Z [mm]	Axis.X	Axis.Y	Axis.Z	Body-Ids	CylinderFace	Top-Edge-Id:	Bottom-Edge	HeadNode-C	Suppress
5	0	6.6	circular	2.0000001	250	460	250	False	0.825	-53.8686197	166.987885	-81.9999993	0.24869025	0.96858307	0	[16819]	[16750]	[16782]	[16791]	[16782]	False
6	1	6.6	circular	2.0000001	250	460	250	False	0.825	4.24636387	152.066471	-81.9999993	0.24869025	0.96858307	0	[16819]	[16751]	[16781]	[16792]	[16781]	False
7	2	6.6	circular	2.0000001	250	460	250	False	0.825	62.3613485	137.145056	-81.9999993	0.24869025	0.96858307	0	[16819]	[16761]	[16780]	[16802]	[16780]	False
8	3	6.6	circular	2.0000001	250	460	250	False	0.825	120.476332	122.223641	-81.9999993	0.24869025	0.96858307	0	[16819]	[16762]	[16779]	[16801]	[16779]	False
9	4	6.6	circular	2.0000001	250	460	250	False	0.825	152.342923	114.041678	-20.0000001	0.24869025	0.96858307	0	[16819]	[16763]	[16778]	[16800]	[16778]	False
10	5	6.6	circular	2.0000001	250	460	250	False	0.825	152.342923	114.041678	20.0000001	0.24869025	0.96858307	0	[16819]	[16764]	[16777]	[16799]	[16777]	False
11	6	6.6	circular	2.0000001	250	460	250	False	0.825	120.476332	122.223641	81.9999993	0.24869025	0.96858307	0	[16819]	[16765]	[16776]	[16798]	[16776]	False
12	7	6.6	circular	2.0000001	250	460	250	False	0.825	62.3613485	137.145056	81.9999993	0.24869025	0.96858307	0	[16819]	[16766]	[16775]	[16797]	[16775]	False

6.4 Show found Holes on geometry





7 Workflows to Generate and Edit Fasteners

Generally there are two separated data sets in Fast+More (compare Section 4 on page 14):

- **Holes**: contains all properties of a Hole (location, diameter, axis vector, …) and the Part (material properties, …)
- **Fasteners**: contains links to *Holes* and contains all properties of the Fastener (type, diameter, material properties, …)

All Search Algorithms for Fasteners are based on existing Datasets of Hole-Entities.

7.1 Auto Detect in Existing Hole-Entities

With Fastener Detection Method "*Auto Detect in Existing Hole-Entities*" the Algorithm searches in the existing data set of all previously (or automatically detected) Holes. It does not matter which method was used to create the *Hole* Datasets. For different methods to generate *Hole* see section 6 on page 32.

Find Fasteners (Hole-Connections)	
Detection Method	Auto Detect in Existing Hole-Entities
Edit Fasteners	Tabular Data
Edit Advanced Scew Properties	Tabular Data
Fasteners Found	0
Head Nodes Found	0

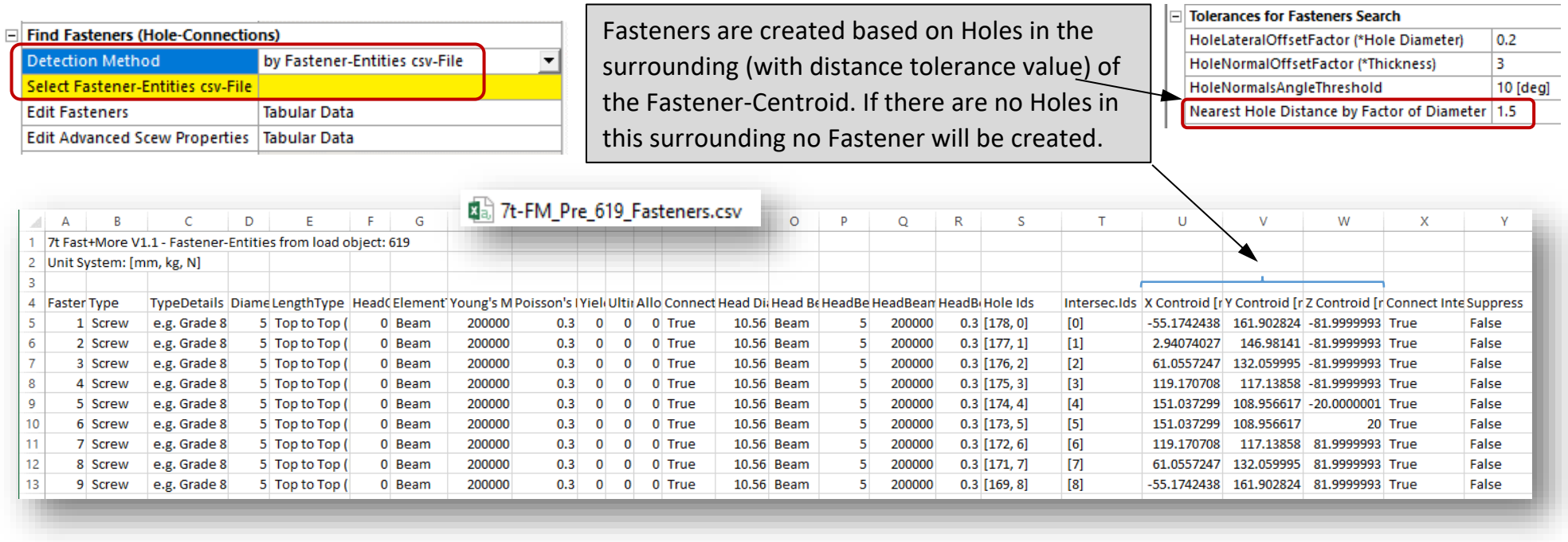
With Fastener Detection Method "*Auto Detect in Existing Hole-Entities*" the Fasteners were created with the general properties and setting defined in "Fastener Details":

Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Top to Top (Modelclass 2)
Fastener Young's Modulus	200000 [MPa]
Fastener Poisson's Ratio	0.3
Head Diameter (Nut, Washer, ...)	Factor of Bolt Diameter
Head Diameter Factor	2
Head Behavior	Beam
Head Beam Diameter	Same as Fastener-Diameter
Head Beam Young's Modulus (PR=0.3)	200000 [MPa]
Allow Slip at First Load Step (beta)	No
Bolt Pretesion (beta)	No

7.2 by Fastener-Entities csv-File

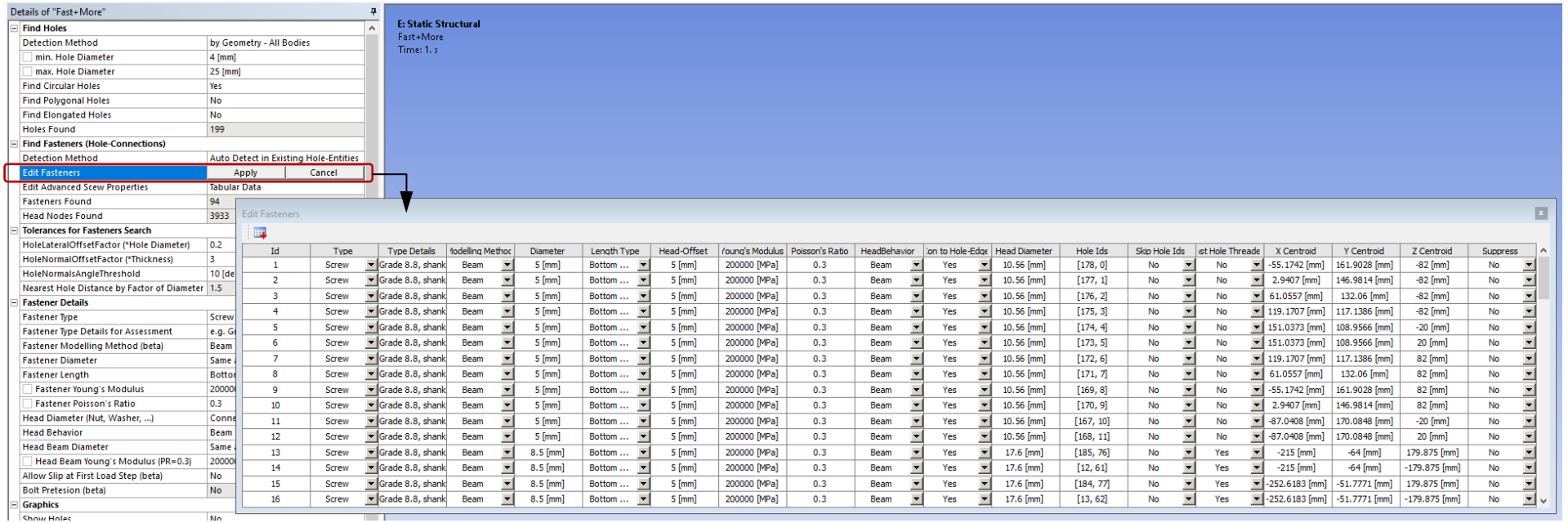
With the first search for Fasteners csv Files are written in the working directory. This files contain all of the Fastener-Properties. The Files can be edited with an external Software (e.g. MS Excel) and reimported in Fast+More. In this case no additional search for Fasteners will be done. The general properties and setting in “Fastener Details” are ignored.

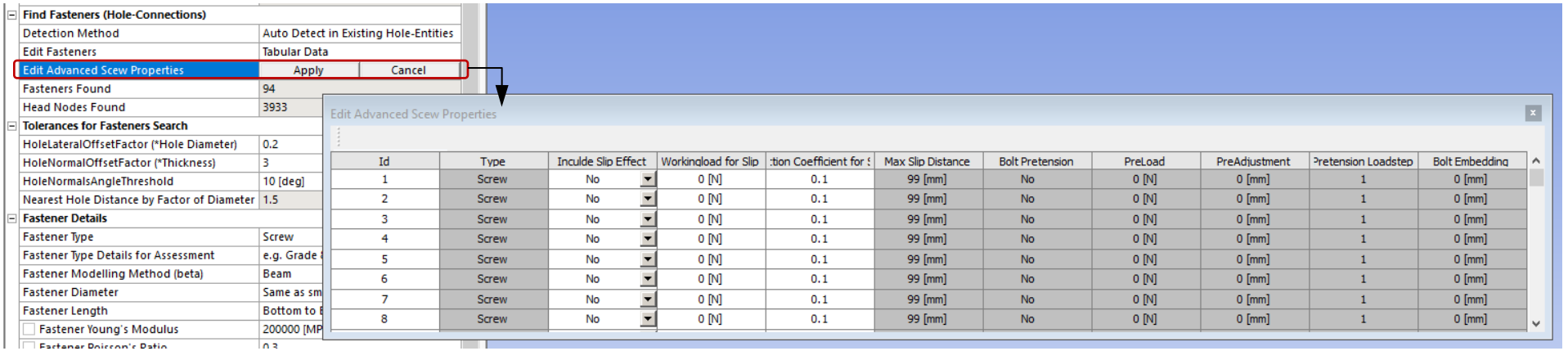
This workflow is useful e.g. if many different kinds of fasteners are used with different local setting – and if these settings should be reused for similar models.



7.3 Edit Fasteners Table

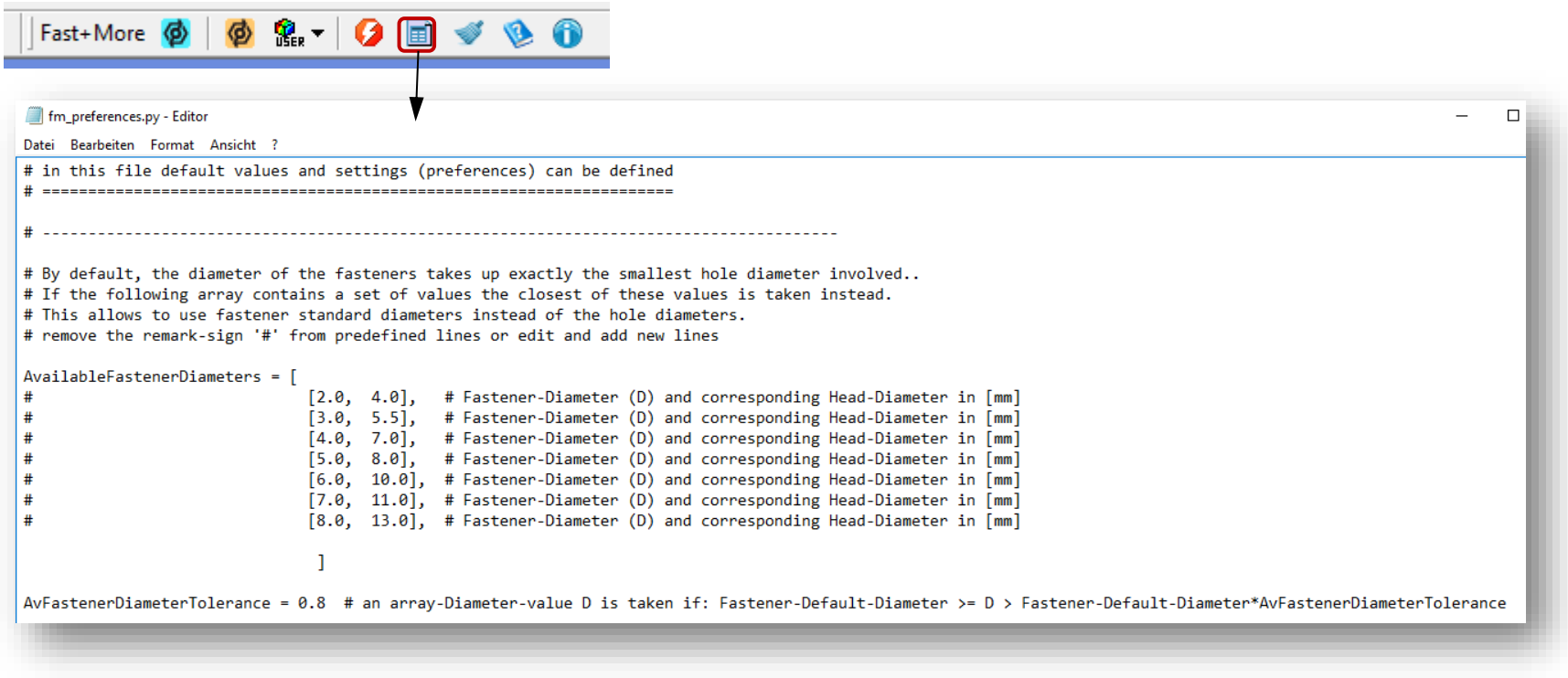
After generating Fasteners each single Fastener can be edited or deleted in the “Edit Fasteners” Table:





7.4 Fasteners with standard Diameter by using Preferences File

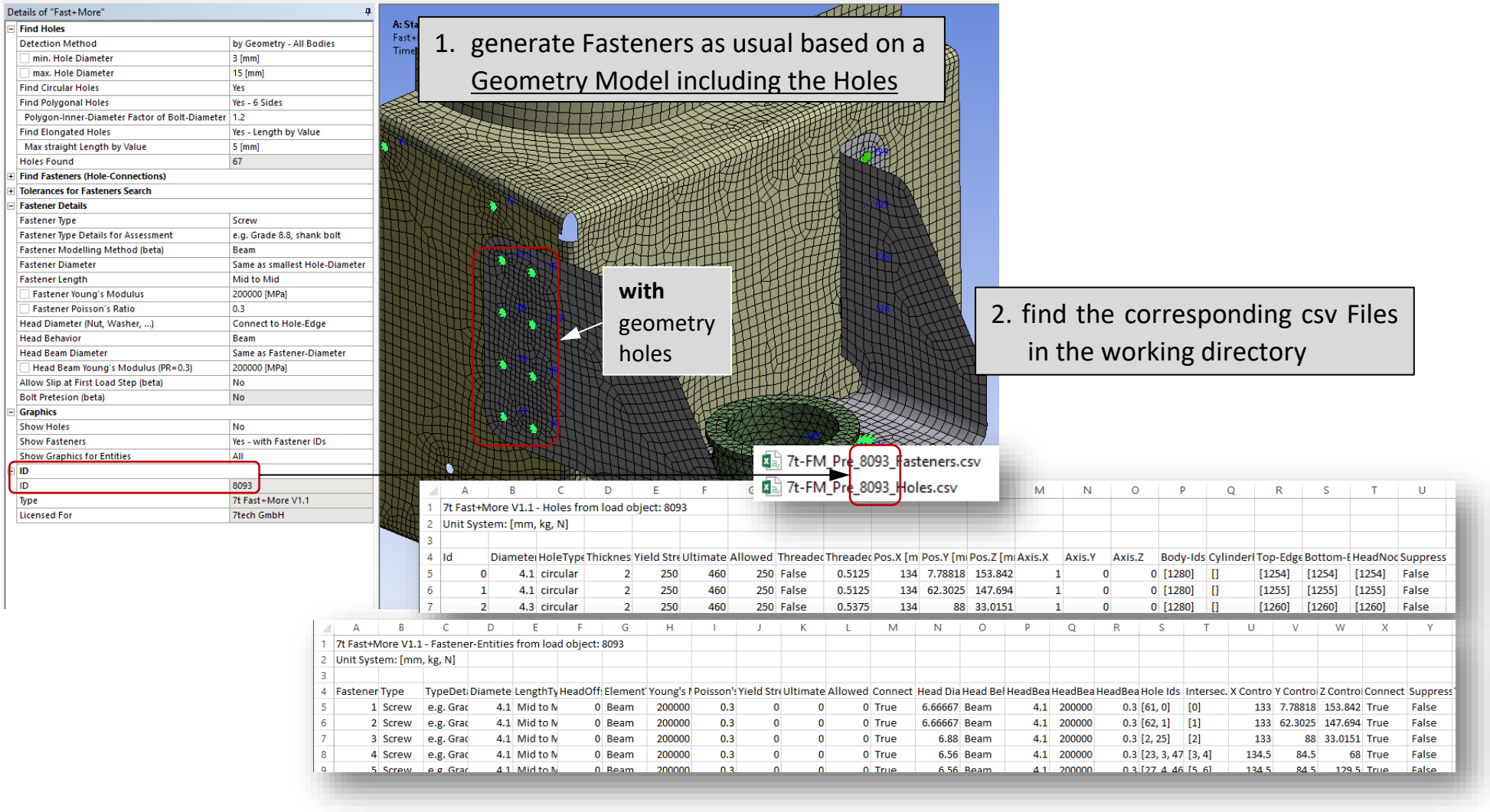
Per default the diameter of each Fastener is taken from the smallest of the corresponding Holes. For rivets this I a proper diameter – for screws this is normally not the intended Diameter. Screws should get stand diameters. This can be obtained using the preferences File. Here standard diameters can be defined:



For the handling of the preferences file see also section 11.3 on page 69.

7.5 Model with Geometry-Holes deleted

For big FEA models with a large number of small holes (e.g. riveted sheet metal boxes) it can be useful to delete the small holes to obtain a coarser mesh with less distortion. Use the following workflow to define the Fasteners in this case:

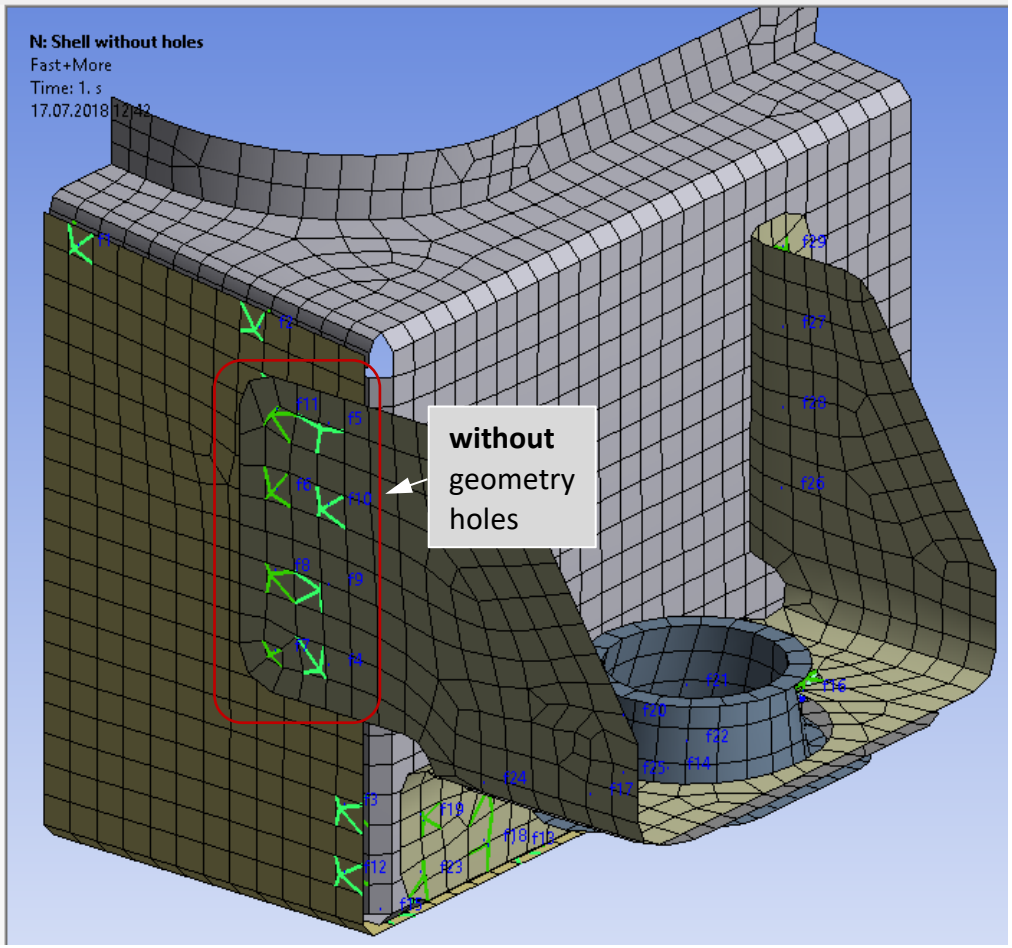


3. copy the geometry model, delete the holes and mesh (coarse)

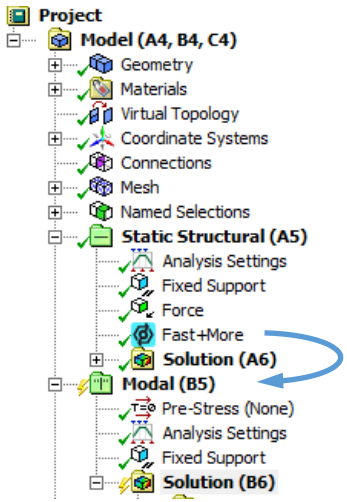
4. import the csv files in the new FEA model

Details of "Fast+More"

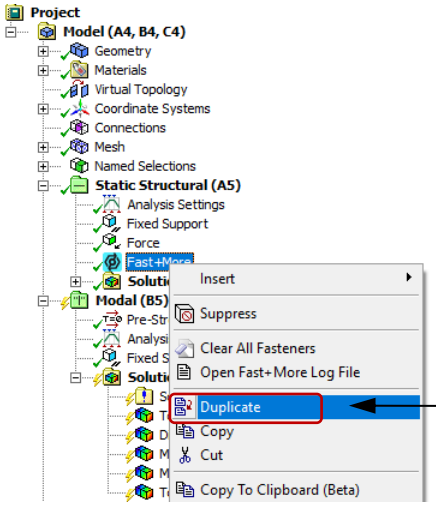
Find Holes	
Detection Method	by Hole-Entities csv-File
Select Hole-Entities csv-File	E:\tmp\7t-FM_Pre_8093_...
Holes Found	67
Find Fasteners (Hole-Connections)	
Detection Method	by Fastener-Entities csv-F...
Select Fastener-Entities csv-File	E:\tmp\7t-FM_Pre_8093_F...
Edit Fasteners	Tabular Data
Edit Advanced Scew Properties	Tabular Data
Fasteners Found	29
Head Nodes Found	273
Tolerances for Fasteners Search	
Fastener Details	
Graphics	
Show Holes	No
Show Fasteners	Yes - with Fastener IDs
Show Graphics for Entities	All
ID	
ID	279
Type	7t Fast+More V1.1
Licensed For	7tech GmbH



7.6 Drag and Drop of Fast+More Entity / Copy to another Analysis



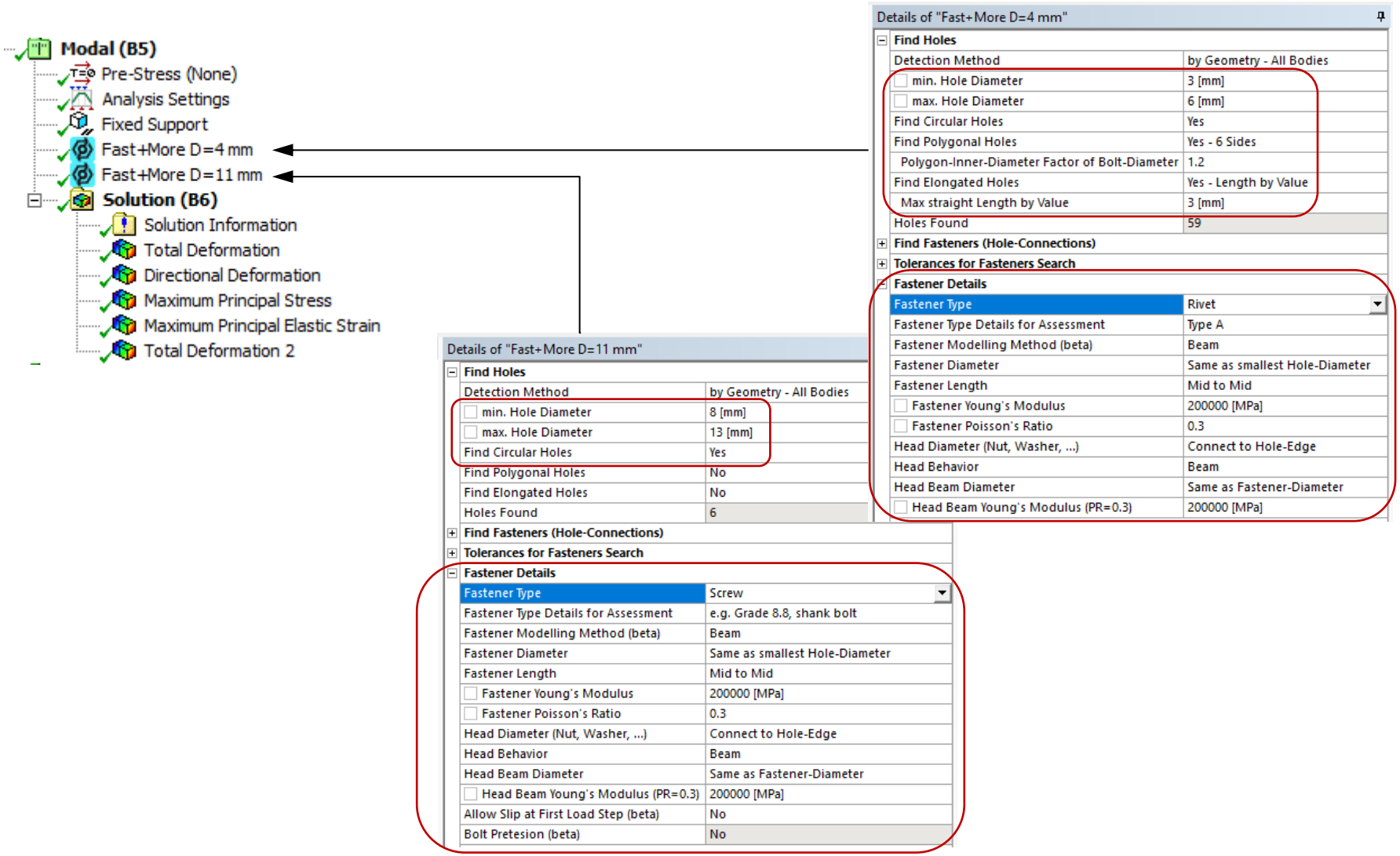
Reuse a Fast+More object with **Drag & Drop** (with pressed left mouse button



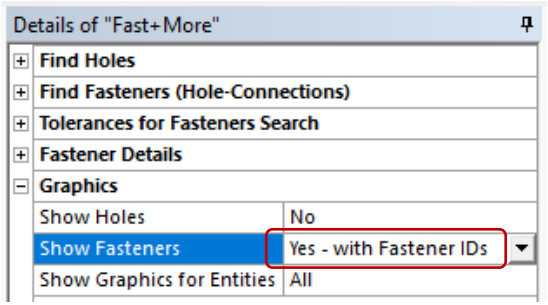
Reuse a Fast+More object with RMB **Duplicate**

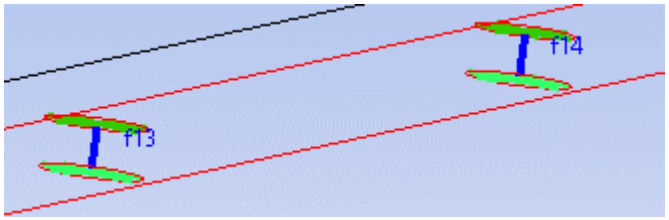
7.7 Multiple Fast+More Objects in one Analysis

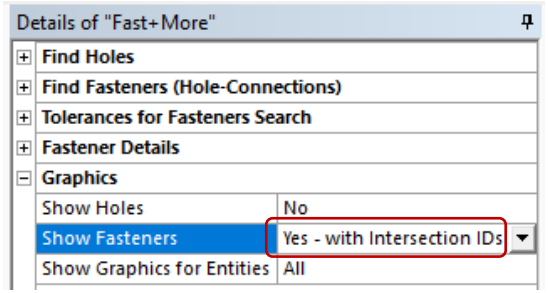
For different Types of Fasteners in one FEA model you can work with multiple Fast+More objects in tree. This allows to edit the global properties separately for these groups of Fasteners:

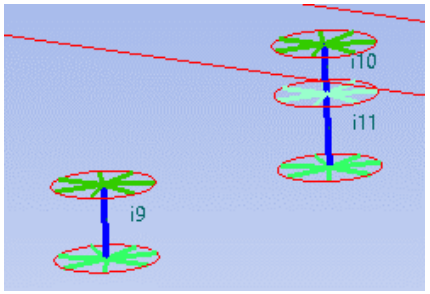


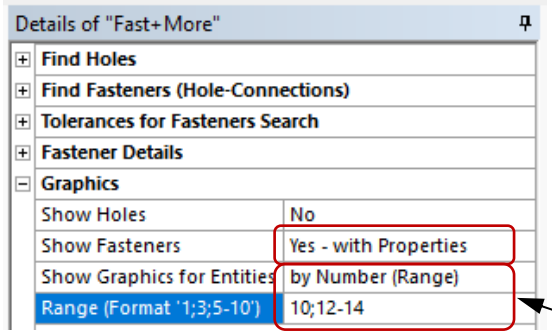
7.8 Show found Fasteners on geometry

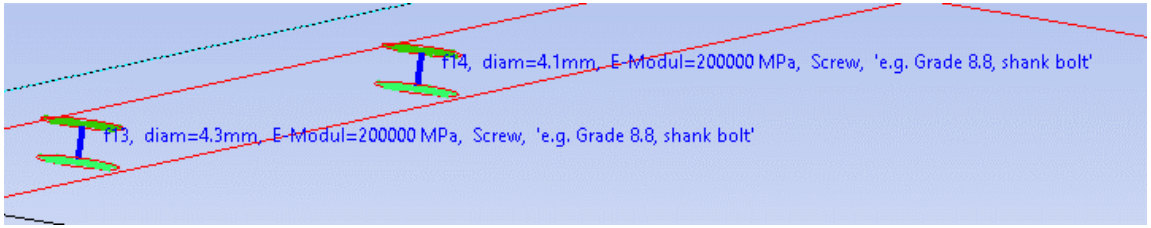








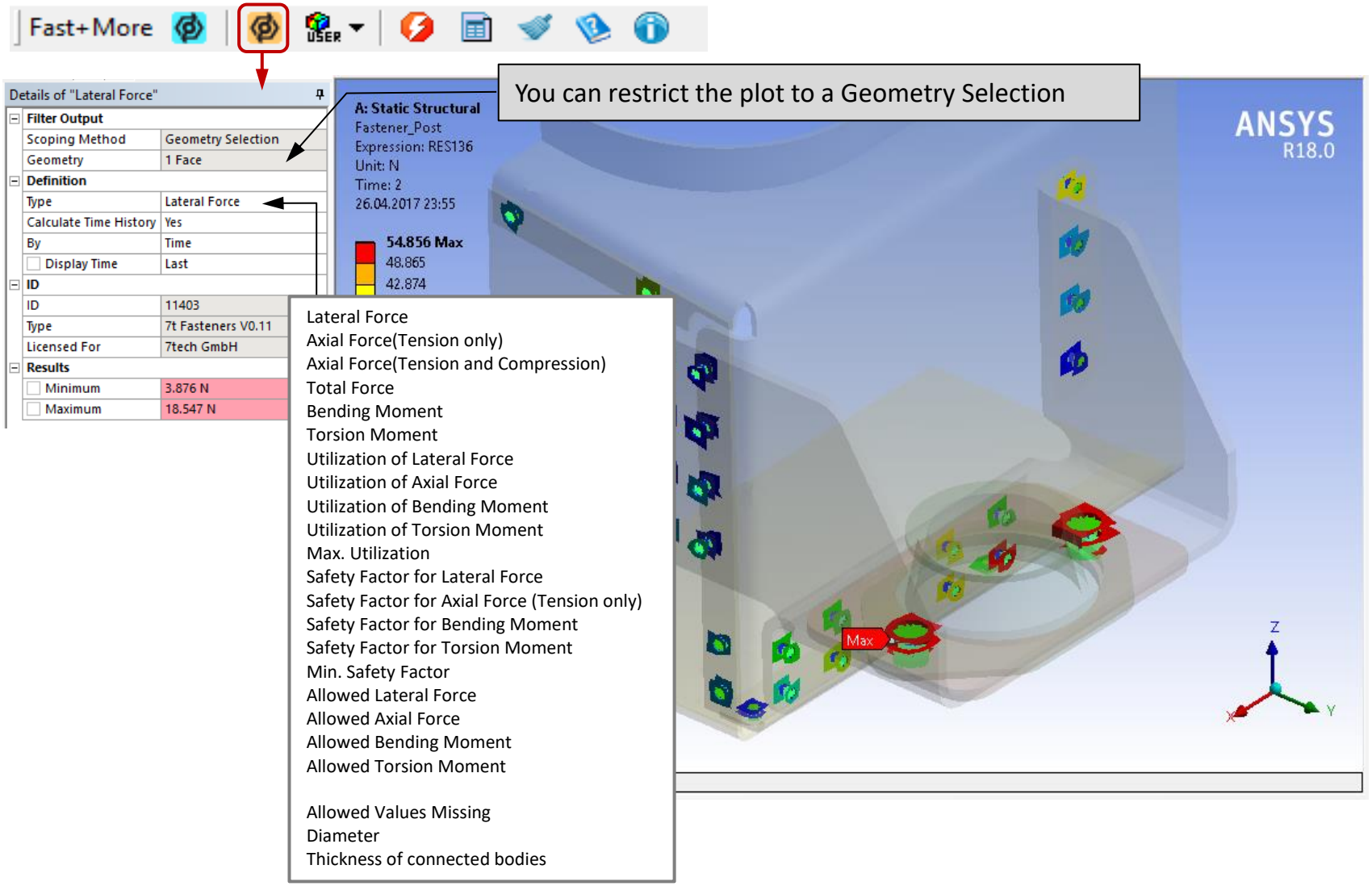




find a desired Fastener by it's Id in the geometry

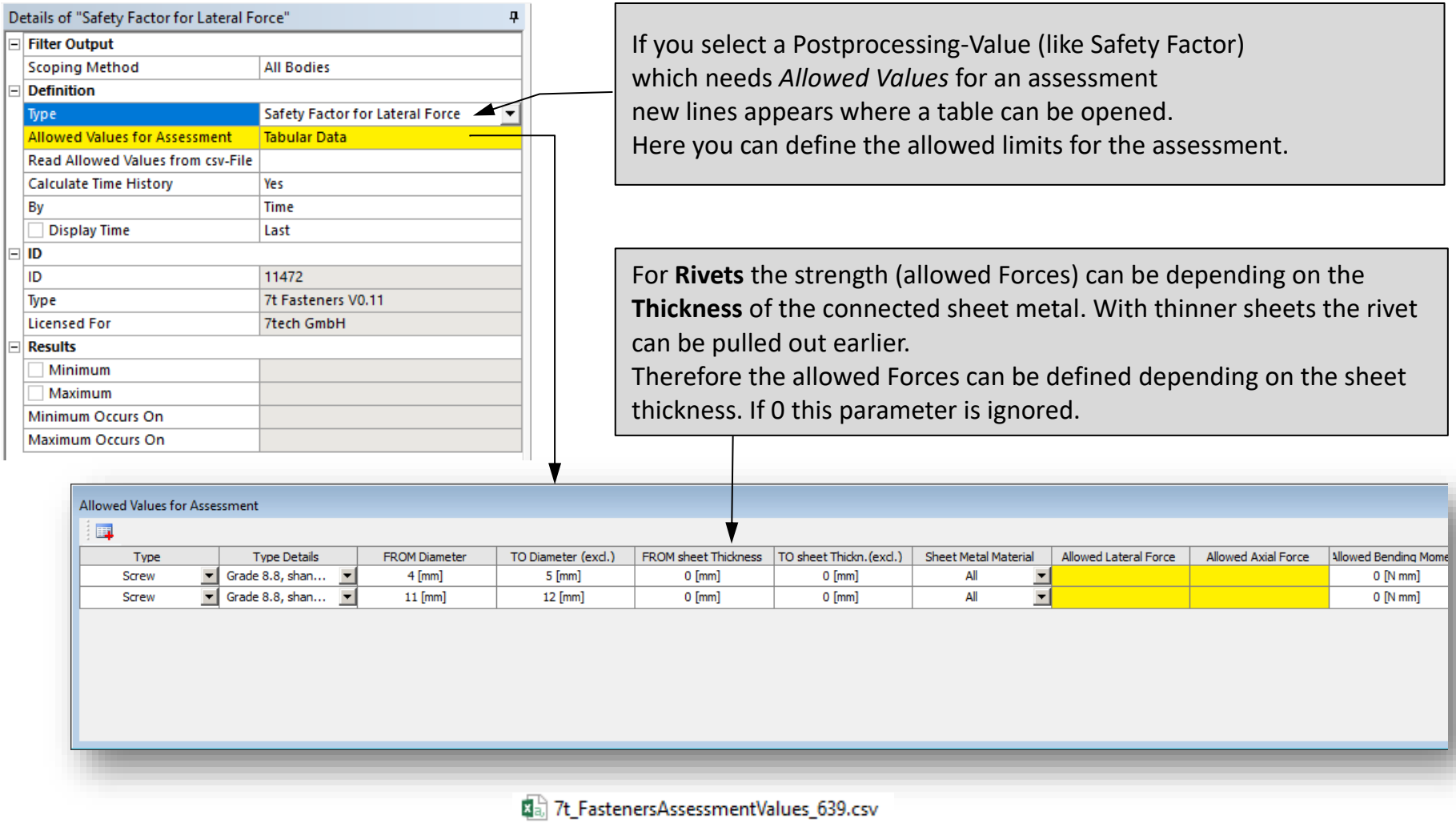
8 Postprocessing

8.1 Plot Results on Holes



8.2 Allowed Forces and Moments for Assessment

If a *Utilization* or a *Safety Factor* is selected allowed forces and moments have to be defined:



Allowed Values for Assessment

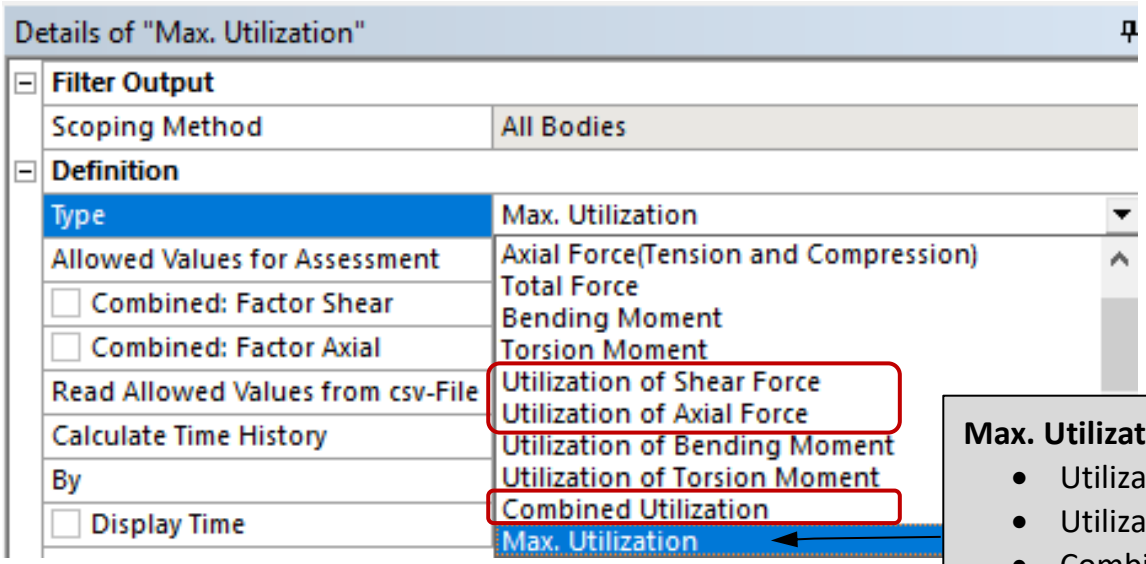
Type	Type Details	FROM Diameter	TO Diameter (excl.)	FROM sheet Thickness	TO sheet Thickn.(excl.)	Sheet Metal Material	Allowed Lateral Force	Allowed Axial Force	Allowed Bending Mome
Screw	Grade 8.8, shan...	4 [mm]	5 [mm]	0 [mm]	0 [mm]	All			0 [N mm]
Screw	Grade 8.8, shan...	11 [mm]	12 [mm]	0 [mm]	0 [mm]	All			0 [N mm]

7t_FastenersAssessmentValues_639.csv

Details of "Safety Factor for Lateral Force"

Filter Output	
Scoping Method	All Bodies
Definition	
Type	Safety Factor for Lateral Force
Allowed Values for Assessment	Tabular Data
Read Allowed Values from csv-File	E:\tmp\7t_FastenersAssessmentValues_639.csv
Calculate Time History	Yes
By	Time
Display Time	Last
ID	
ID	11472
Type	7t Fasteners V0.11
Licensed For	7tech GmbH
Results	
Minimum	
Maximum	
Minimum Occurs On	
Maximum Occurs On	

For a large number of limit values you can prepare a csv-File and read in this data instead of typing all the values in the table.
Use the automatically generated csv-File as a template.



Max. Utilization is the maximum value of:

- Utilization of Shear Force
- Utilization of Axial Force (Tension only)
- Combined Utilization

The same applies analogously to **Min. Safety Factor**

8.3 Combined Utilization

For assessment of screws and rivets according to EUROCODE 9 (DIN EN 1999-1-1) Table 8.5 use:

$$\frac{F_{v,Ed}}{F_{v,Rd}} + \frac{F_{t,Ed}}{1{,}4 \cdot F_{t,Rd}} \leq 1$$

Details of "Combined Utilization"

Filter Output	
Scoping Method	All Bodies
Definition	
Type	Combined Utilization
Allowed Values for Assessment	Tabular Data
Combined Factor Lateral	1
Combined Factor Axial	1.4
Read Allowed Values from csv-File	
Calculate Time History	Yes
By	Time
Display Time	Last

Details of "Max. Utilization"

Filter Output	
Scoping Method	All Bodies
Definition	
Type	Max. Utilization
Allowed Values for Assessment	Tabular Data
Combined: Factor Lateral	1
Combined: Factor Axial	1.4

$$\textbf{Combined Utilization} = \frac{F_{lateral}}{F_{lateral,\ allowed} * Factor_{lateral}} + \frac{F_{axial}}{F_{axial,\ allowed} * Factor_{axial}} \leq 1$$

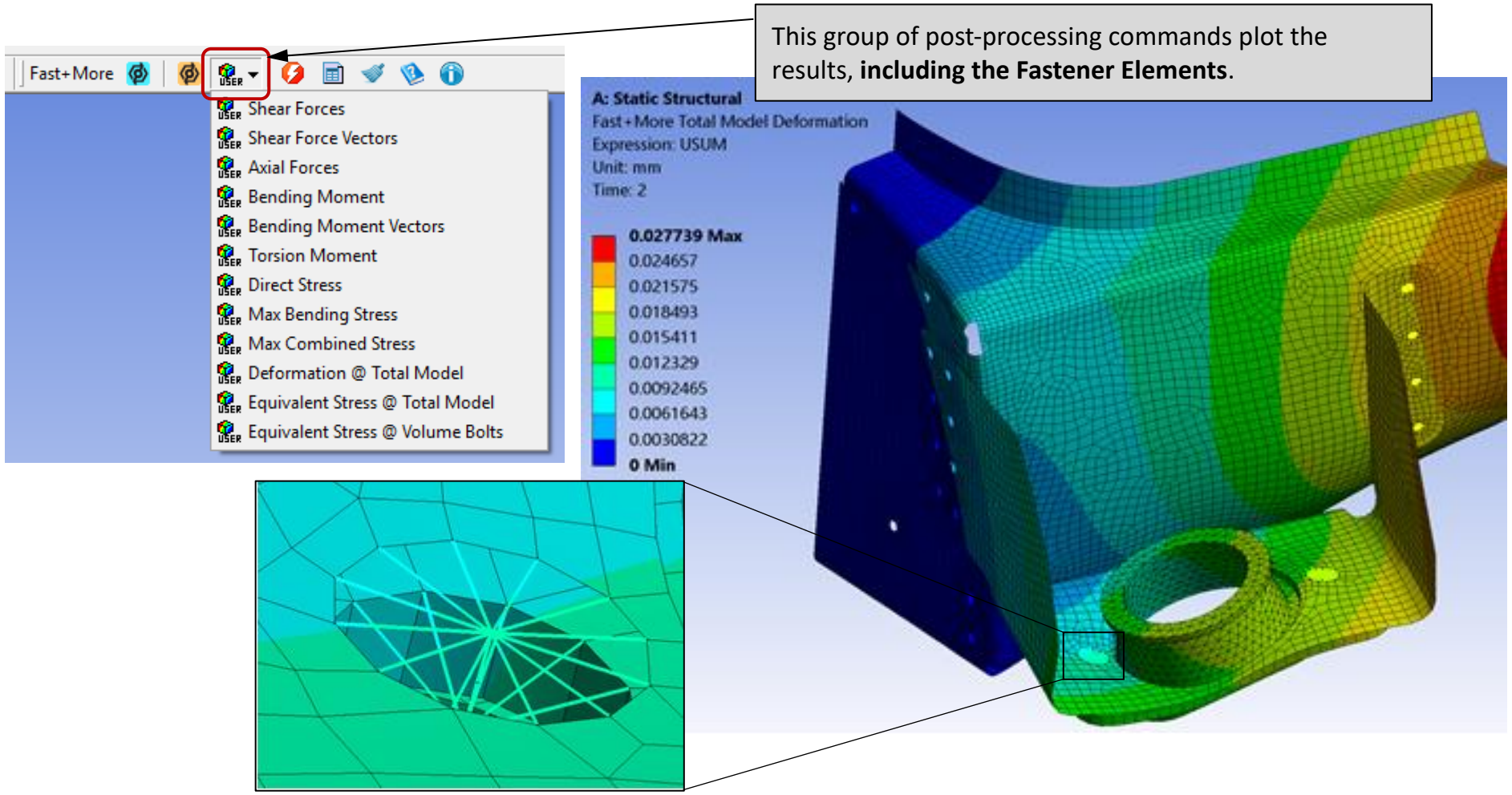
additional needed:

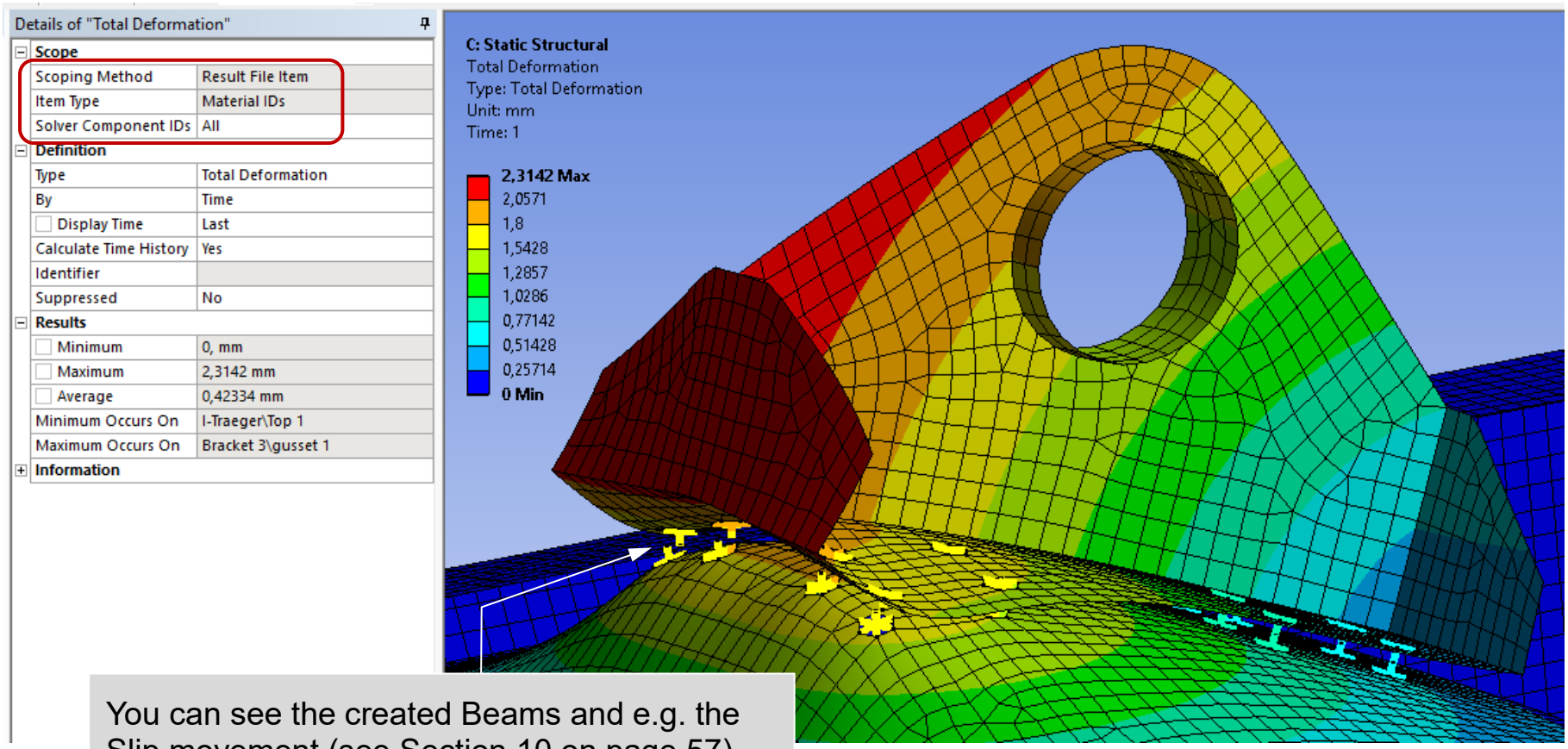
$$\textbf{Utilization of Lateral Forces} = \frac{F_{lateral}}{F_{lateral,\ allowed}} \leq 1$$

$$\textbf{Utilization of Axial Forces} = \frac{F_{axial}}{F_{axial,\ allowed}} \leq 1$$

Shows Maximum of all of the Degrees of Utilization

8.4 Plot Results on Fasteners

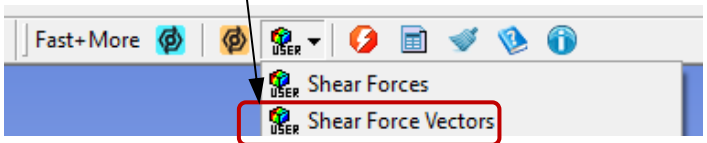




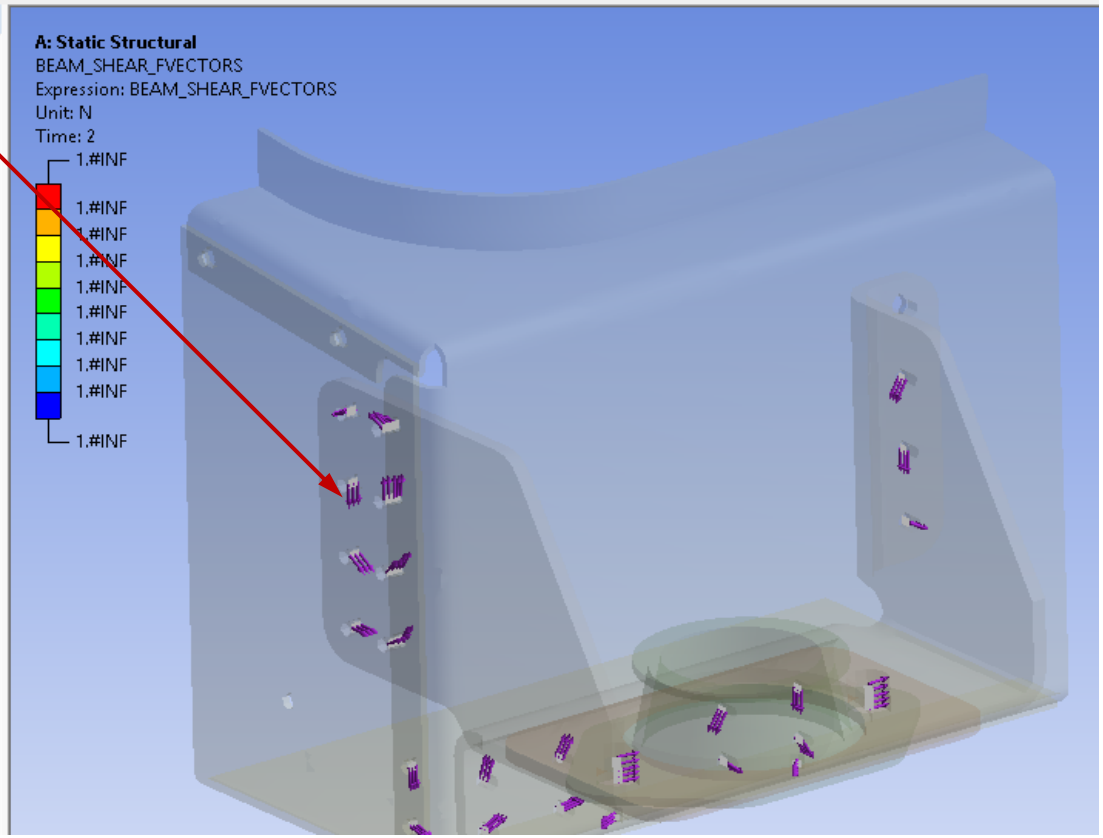
You can see the created Beams and e.g. the Slip movement (see Section 10 on page 57)

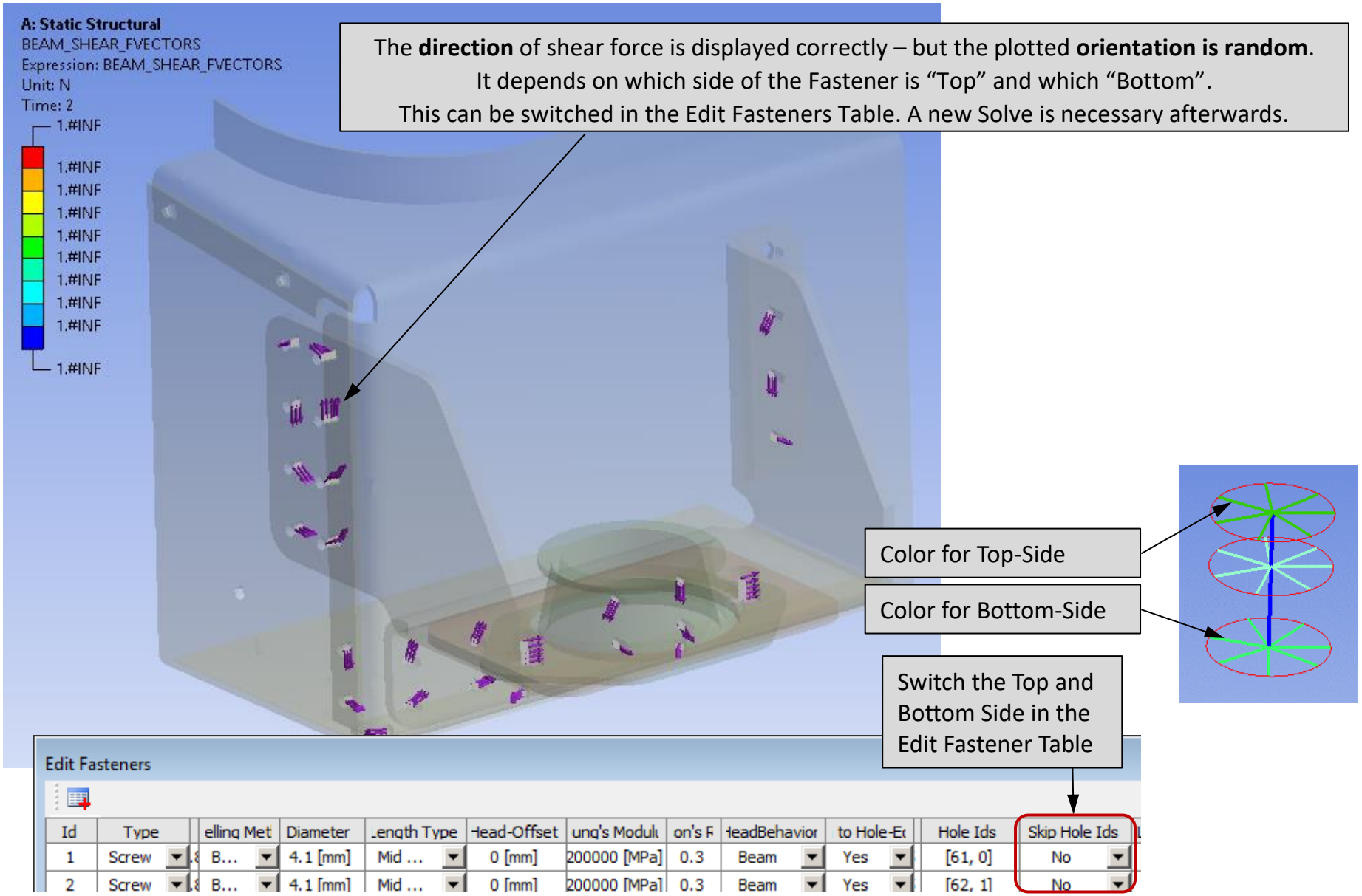
This feature displays vectors to visualize the **direction** of shear forces.

to obtain a proper Graphic use these settings



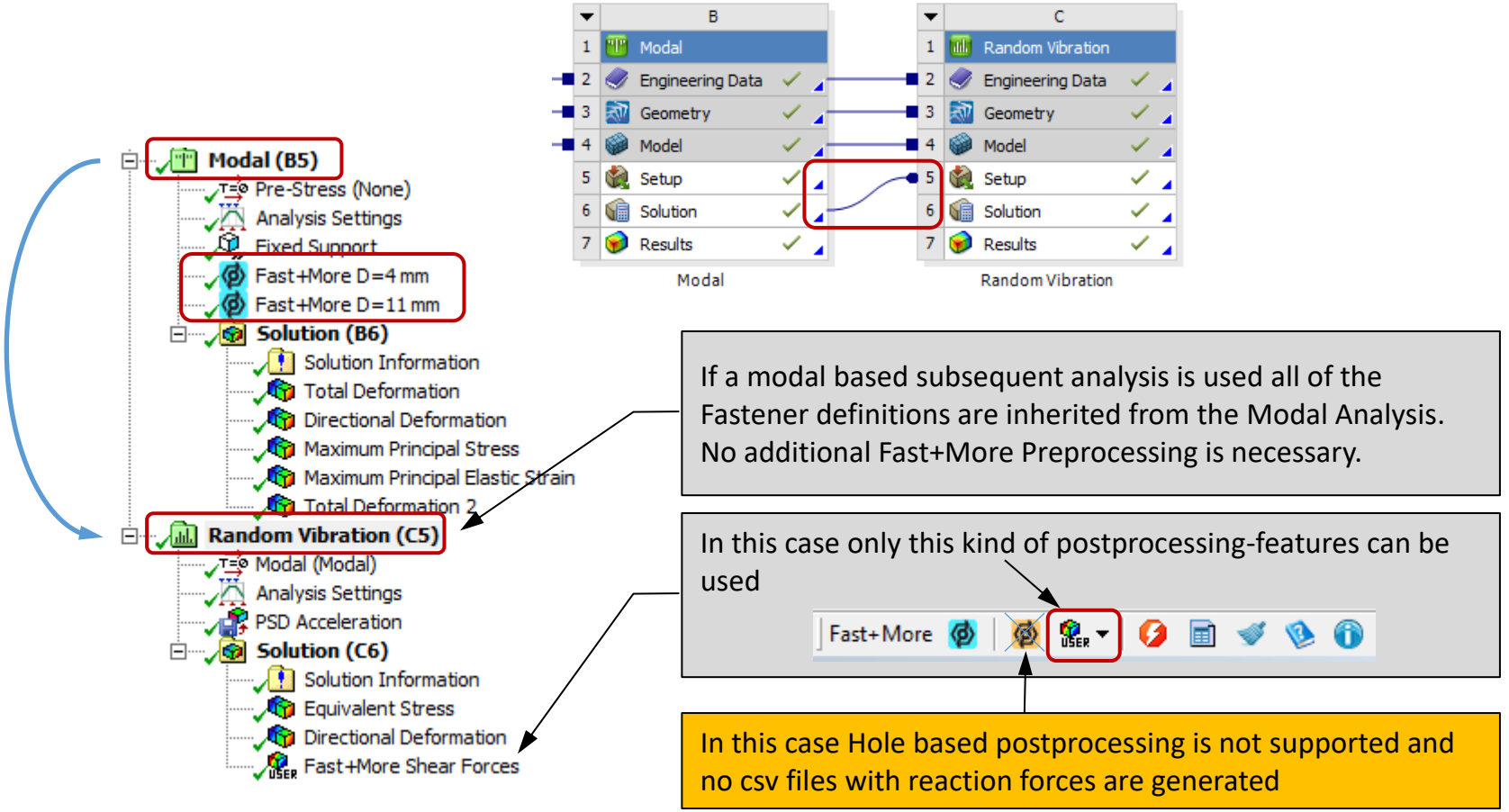
Details of "BEAM_SHEAR_FVECTORS"	
Scope	
Scoping Method	Result File Item
Item Type	Element Type IDs
Solver Component IDs	9
Definition	
Type	User Defined Result
Expression	= BEAM_SHEAR_FVECTORS
Input Unit System	Metric (mm, kg, N, s, mV, mA)
Output Unit	Force
By	Time
Display Time	Last
Coordinate System	Global Coordinate System
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	2.1123 N
Maximum	1.#INF N
Minimum Occurs On	
Maximum Occurs On	
Minimum Value Over Time	
Minimum	-60.152 N
Maximum	-11.839 N
Maximum Value Over Time	
Minimum	8.9885e+307 N
Maximum	8.9885e+307 N
Information	



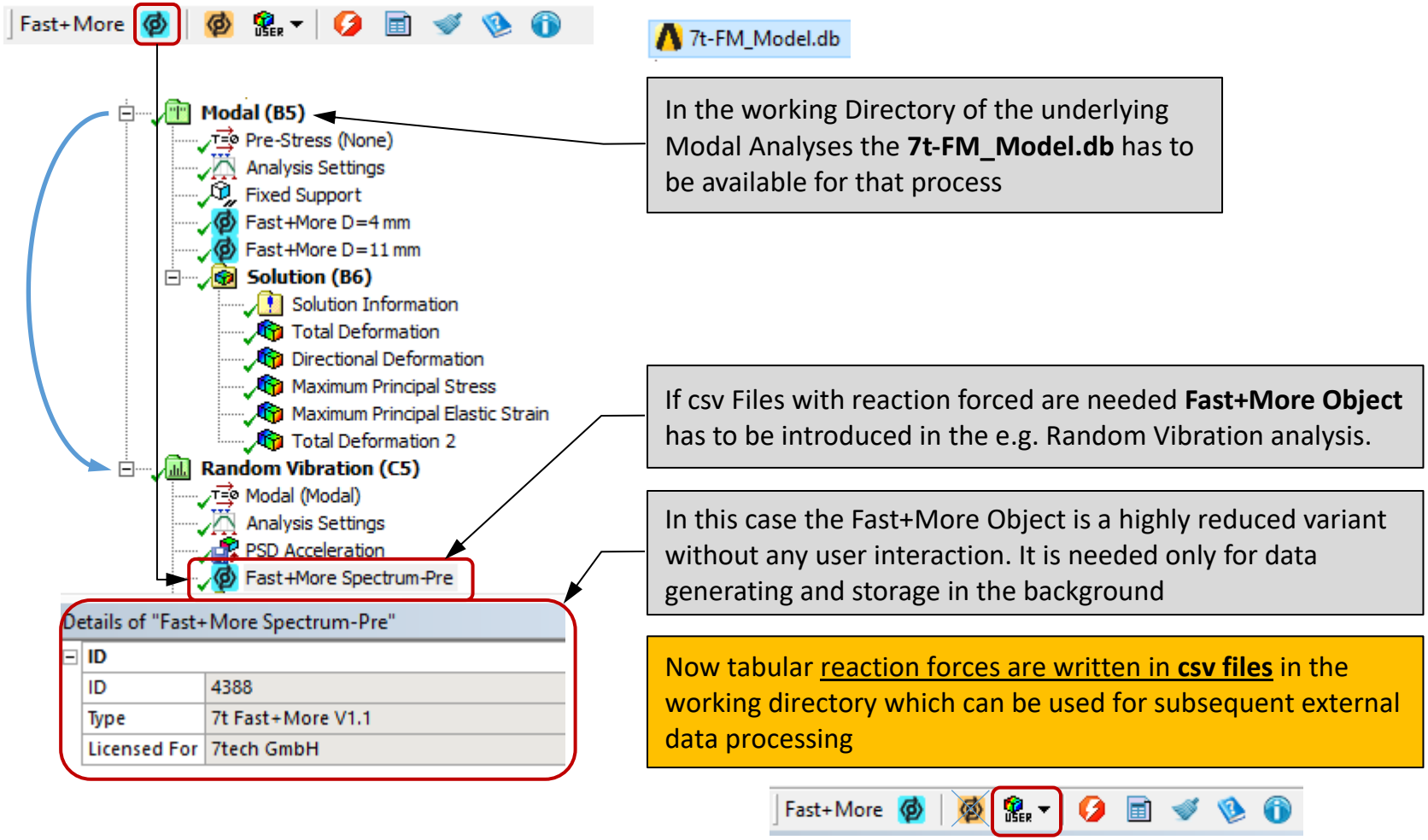

A: Static Structural
BEAM_SHEAR_FVECTORS
Expression: BEAM_SHEAR_FVECTORS
Unit: N
Time: 2
1.#INF
1.#INF
1.#INF
1.#INF
1.#INF
1.#INF
1.#INF
1.#INF
1.#INF
The **direction** of shear force is displayed correctly – but the plotted **orientation is random**.
It depends on which side of the Fastener is "Top" and which "Bottom".
This can be switched in the Edit Fasteners Table. A new Solve is necessary afterwards.
Color for Top-Side
Color for Bottom-Side
Switch the Top and Bottom Side in the Edit Fastener Table
Edit Fasteners
Id
Type
elling Met
Diameter
_ength Type
Head-Offset
ung's Modul
on's R
HeadBehavior
to Hole-Ec
Hole Ids
Skip Hole Ids
1
Screw
B...
4.1 [mm]
Mid ...
0 [mm]
200000 [MPa]
0.3
Beam
Yes
[61, 0]
No
2
Screw
B...
4.1 [mm]
Mid ...
0 [mm]
200000 [MPa]
0.3
Beam
Yes
[62, 1]
No

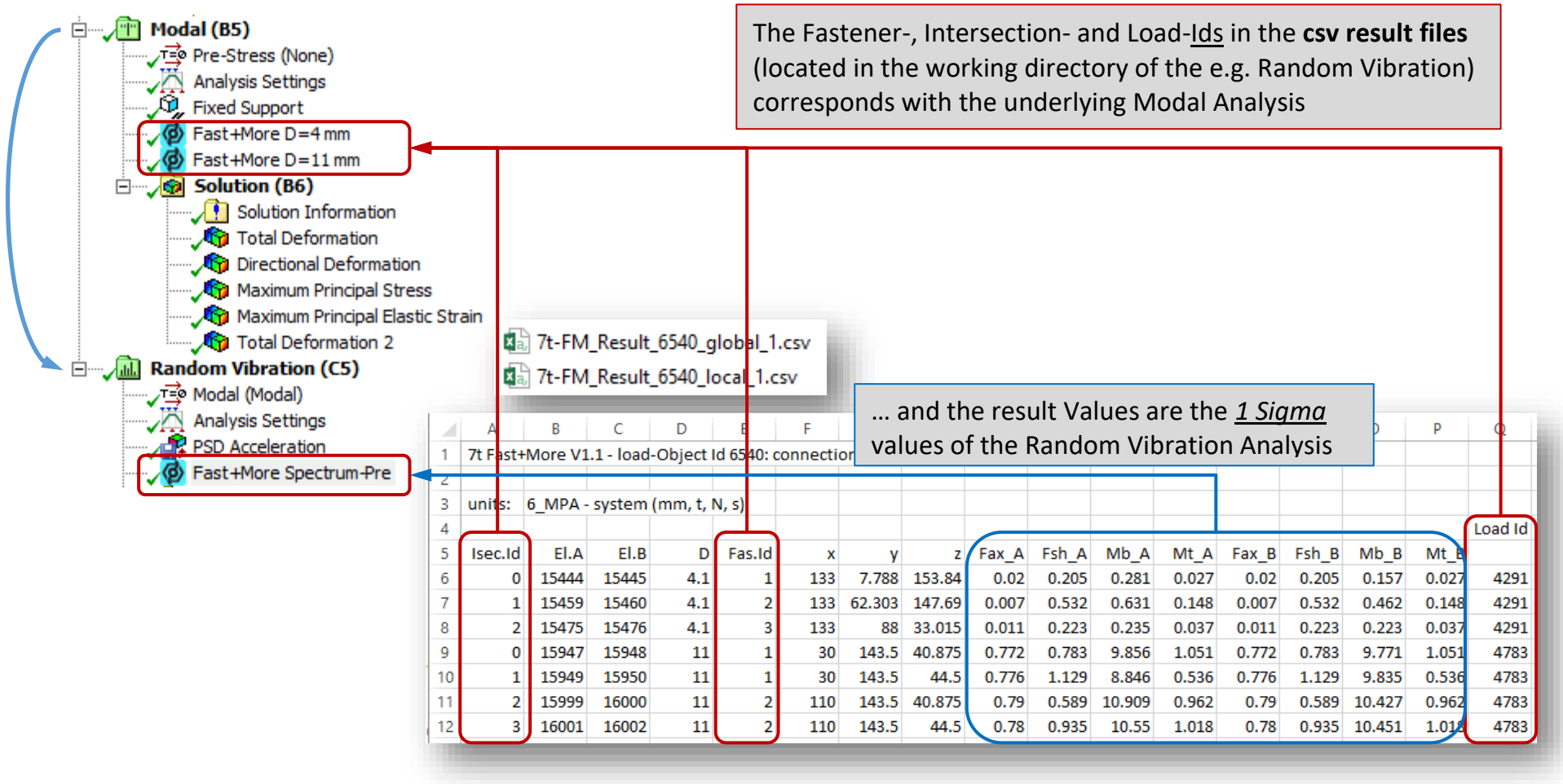
9 Modal Based Analysis like Random Vibration, Response Spectrum or Harmonic

9.1 Modal Based Analysis WITHOUT reaction force csv files



9.2 Modal Based Analysis WITH reaction force csv files



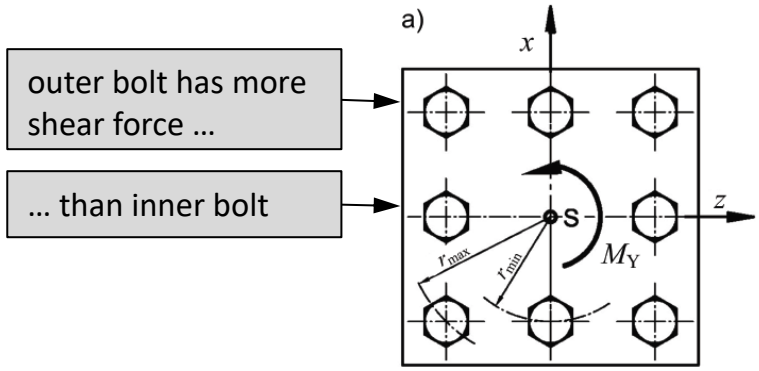

Modal (B5)
Pre-Stress (None)
Analysis Settings
Fixed Support
Fast+More D=4 mm
Fast+More D=11 mm
Solution (B6)
Solution Information
Total Deformation
Directional Deformation
Maximum Principal Stress
Maximum Principal Elastic Strain
Total Deformation 2
Random Vibration (C5)
Modal (Modal)
Analysis Settings
PSD Acceleration
Fast+More Spectrum-Pre
The Fastener-, Intersection- and Load-Ids in the csv result files (located in the working directory of the e.g. Random Vibration) corresponds with the underlying Modal Analysis
7t-FM_Result_6540_global_1.csv
7t-FM_Result_6540_local_1.csv
… and the result Values are the 1 Sigma values of the Random Vibration Analysis
7t Fast+More V1.1 - load-Object Id 6540: connection
units: 6_MPA - system (mm, t, N, s)
Isec.Id El.A El.B D Fas.Id x y z Fax_A Fsh_A Mb_A Mt_A Fax_B Fsh_B Mb_B Mt_B Load Id
0 15444 15445 4.1 1 133 7.788 153.84 0.02 0.205 0.281 0.027 0.02 0.205 0.157 0.027 4291
1 15459 15460 4.1 2 133 62.303 147.69 0.007 0.532 0.631 0.148 0.007 0.532 0.462 0.148 4291
2 15475 15476 4.1 3 133 88 33.015 0.011 0.223 0.235 0.037 0.011 0.223 0.223 0.037 4291
0 15947 15948 11 1 30 143.5 40.875 0.772 0.783 9.856 1.051 0.772 0.783 9.771 1.051 4783
1 15949 15950 11 1 30 143.5 44.5 0.776 1.129 8.846 0.536 0.776 1.129 9.835 0.536 4783
2 15999 16000 11 2 110 143.5 40.875 0.79 0.589 10.909 0.962 0.79 0.589 10.427 0.962 4783
3 16001 16002 11 2 110 143.5 44.5 0.78 0.935 10.55 1.018 0.78 0.935 10.451 1.018 4783

10 Slip Effect (beta)

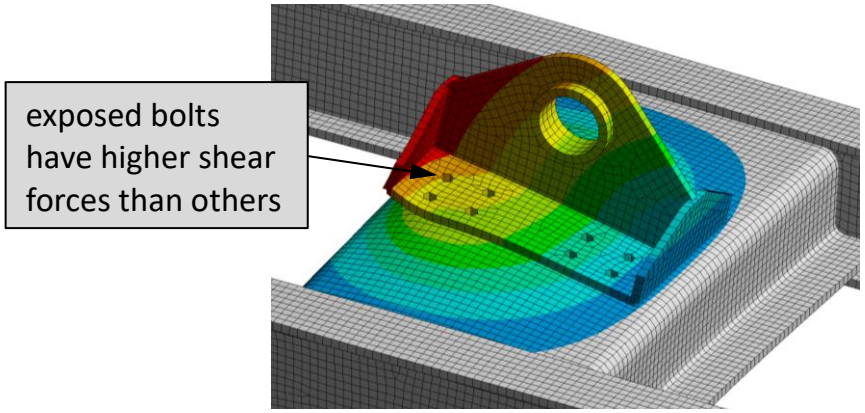
10.1 Basic Idea, Intention

Normally bolted joints are designed in such a manner that all shear forces are transferred with sticking between the connected parts. For a single bolt sliding is normally not wanted. That means that the shear forces should be smaller than Bolt Pretension (working axial load) times coefficient of friction.

If parts are connected with a larger number of bolts the shear forces a spread between these bolts. The outer screws often do not meet this criterion. In this case the outer connection show a small relative displacement (slip) and the overall shear forces are distributed newly. Shear force is transferred from the outer bolts to the inner ones.



Source: VDI 2230 Part 2, Dec. 2014: Figure 8a

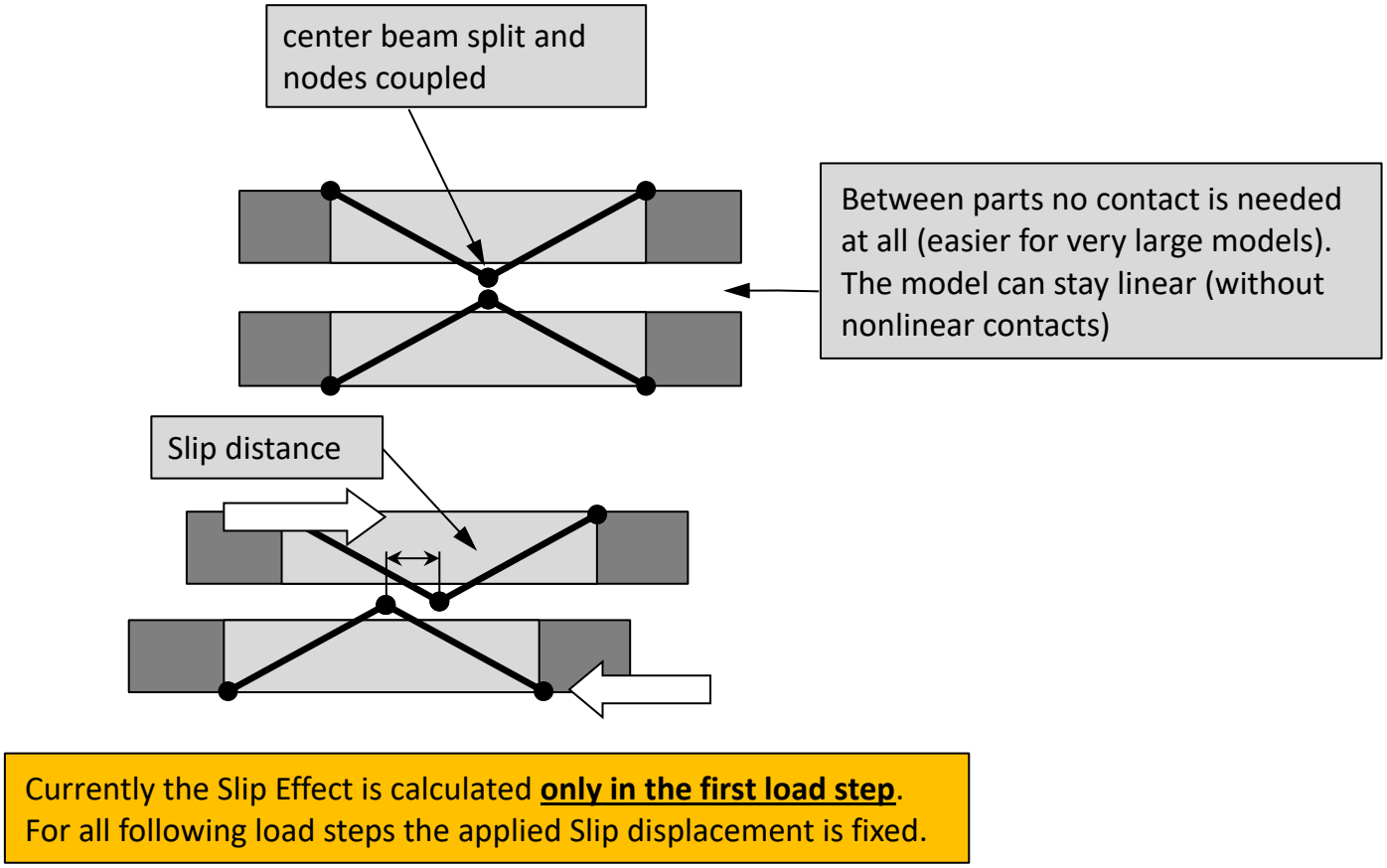


Without taking this effect into account such connections cannot be assessed properly. To take this into account in an FEA model requires a nonlinear analysis with pretension and nonlinear friction contact. This can lead to a long Solve time – for big Models with a large number of bolts even unacceptable solve time.

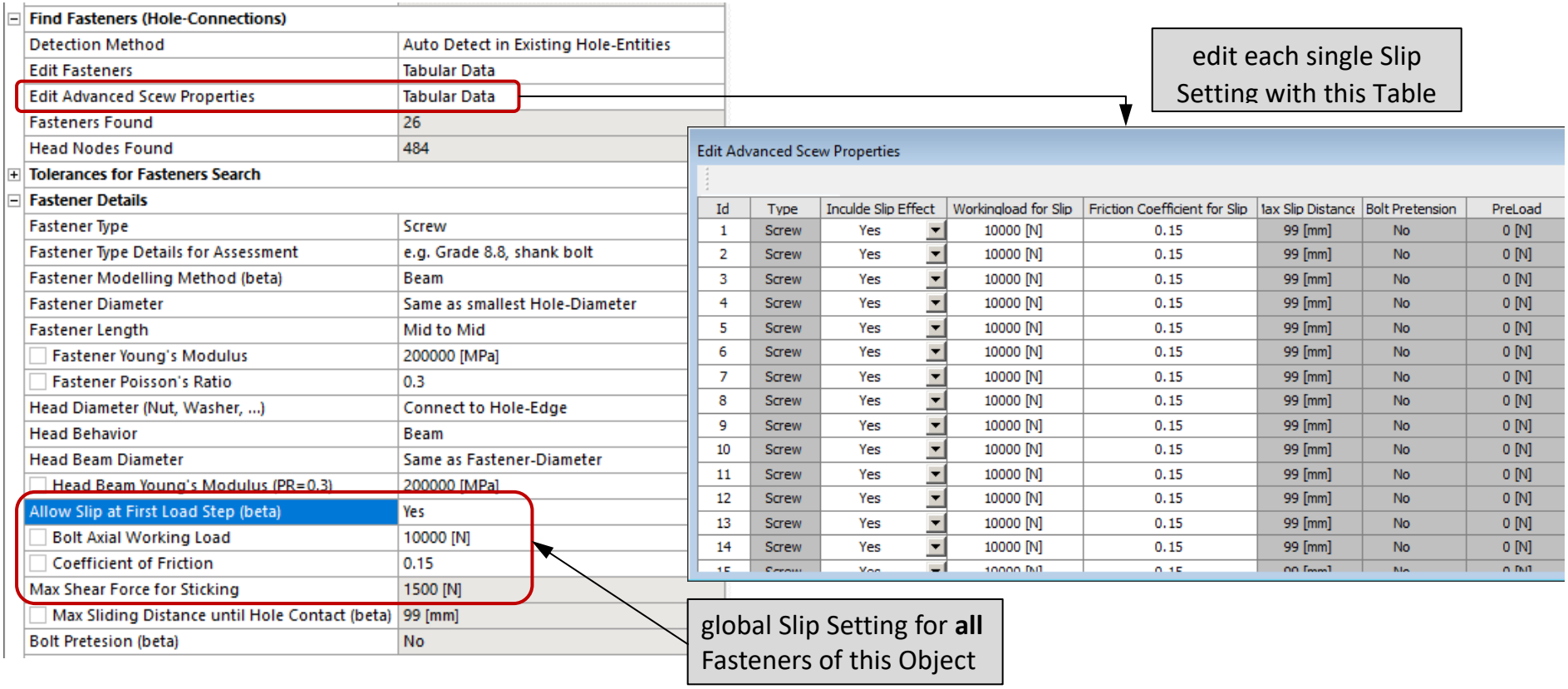
Fast+More has implemented a special algorithm that allows the slip effect to be taken into account very efficiently even with linear models and a large number of fasteners.

10.2 Implementation in Fast+More

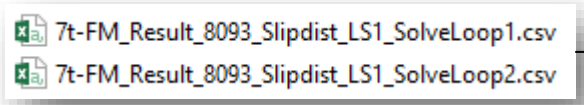
In Fast+More the center beam of each intersection is split in the middle and the end nodes are coupled. For slip these coupled nodes are moved relatively to each other by an appropriate algorithm. This Method can be used even for large linear FEA models – nonlinear contact with friction is not needed.



To define the setting for including the Slip Effect use the following menu:



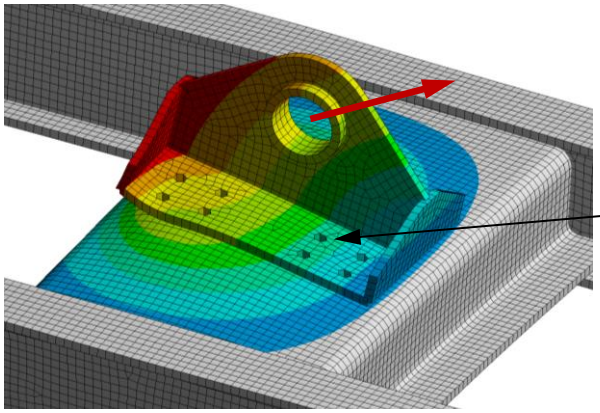
The Slip Algorithm needs a few iterations to spread the shear forces between slipping bolts and their neighbor bolts. After Solve in the working directory for each iteration (SolveLoop) a csv file is written. They contain information what happened and shows the slip-status and slip-distance of each Fastener (Intersection):



	A	B	C	D	E	F	G	H	I	J	K
1	7t Fast+More V1.0 - load Id 8093: Results with MicroSlip at loadstep 1										
2	forces and displacements are given in LOCAL element coordinate system										
3	values in solver unit system										
4	status: 1=sticking 2=sliding 3=HoleContact										
5											
6	Fastener	Intersect	status	Fx	Fy	Fz	Fshear	Fsh max	slip uy	slip uz	slip usum
7	1	0	1	0.105	-3.573	-6.662	7.56	10	0	0	0
8	2	1	1	0.605	-9.015	26.693	28.175	0	0	0	0
9	3	2	1	1.529	-6.244	2.994	6.925	0	0	0	0
10	4	3	1	0.781	0.707	0.573	0.911	0	0	0	0
11	4	4	1	2.371	-3.738	-17.335	17.734	0	0	0	0
12	5	5	1	-1.591	4.165	-0.064	4.166	0	0	0	0
13	5	6	1	-1.284	0.405	0.515	0.655	0	0	0	0
14	6	7	1	-0.245	3.777	0.127	3.779	0	0	0	0
15	7	8	1	-1.623	9.353	7.218	11.814	0	0	0	0

The slip movement can be shown in postprocessing e.g. with the method shown in section 8.4 on page 50 ff.

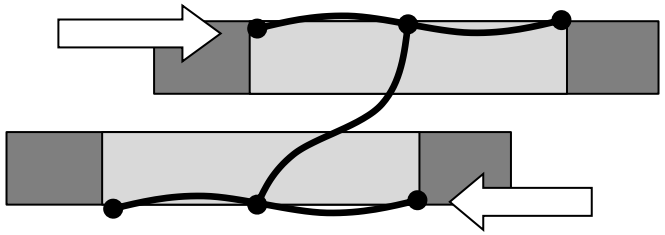
It is strongly recommended to **switch off** the Slip Effect **for at least one bolt** of connected parts. The Slip algorithm opens the coupling of the center nodes for slipping bolts. If all bolts between connected parts slip, rigid body motion occurs and the solve-process fails.



Edit Advanced Scew Properties

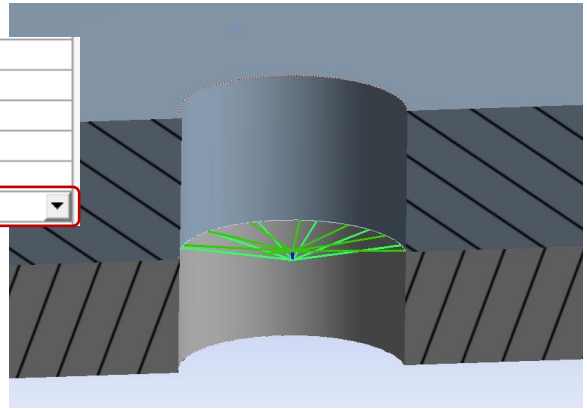
Id	Type	Inculde Slip Effect	Workingload for Slip	Friction Coefficient
1	Screw	Yes	10000 [N]	0.15
2	Screw	Yes	10000 [N]	0.15
3	Screw	Yes	10000 [N]	0.15
4	Screw	No	10000 [N]	0.15
5	Screw	Yes	10000 [N]	0.15
6	Screw	Yes	10000 [N]	0.15
7	Screw	Yes	10000 [N]	0.15
8	Screw	Yes	10000 [N]	0.15
9	Screw	Yes	10000 [N]	0.15
10	Screw	Yes	10000 [N]	0.15

With modeling the bolt <u>without pretention and friction contact</u> shear forces lead to an **<u>elastic</u>** displacement of the bolt elements. To separate this elasticity from the stick/slip displacement it would be good to have a bolt model with high lateral stiffness (e.g. higher Young's Modulus).



For an accurate slip analysis it is a good practice to use in Fast+More the Modelling Method
"*Bottom to Bottom (Modelclass 1)*"

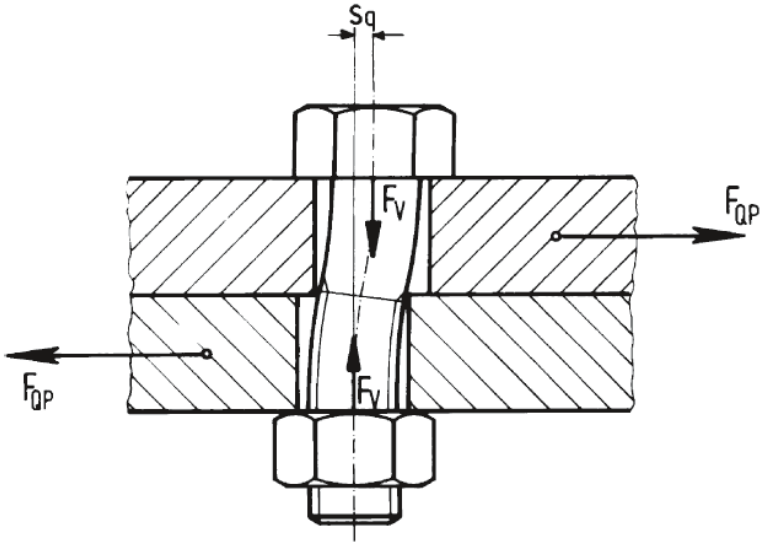
Fastener Details	
Fastener Type	Screw
Fastener Type Details for Assessment	e.g. Grade 8.8, shank bolt
Fastener Modelling Method (beta)	Beam
Fastener Diameter	Same as smallest Hole-Diameter
Fastener Length	Bottom to Bottom (Modelclass 1)



10.3 Limiting values / allowed slip distances

10.3.1 Loosening of the nut

Too big slip distance can lead to a loosening of the nut. The literature contains the following rough estimation formula for a limiting value of slip distance according to slip of the nut (loosening):



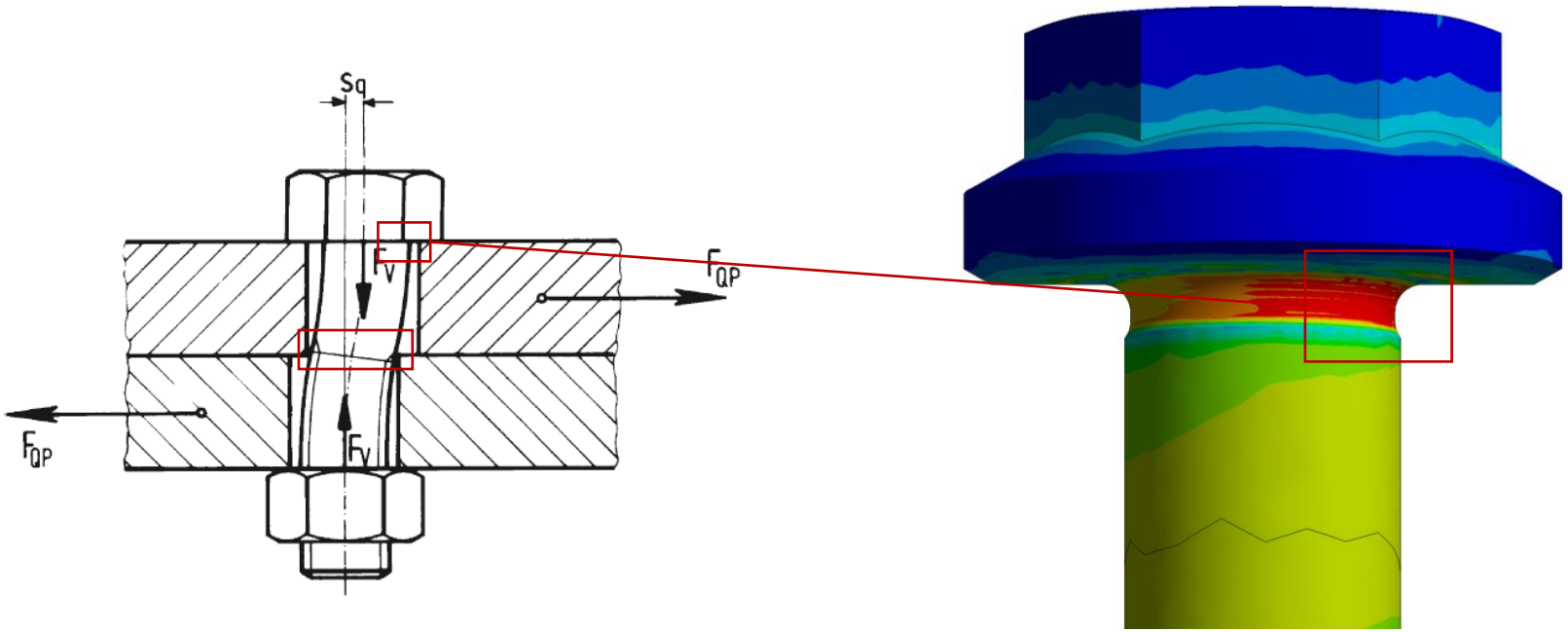
$$s_{Gth} = \frac{F_V \cdot \mu_K \cdot l_K^3}{12 \cdot E \cdot I}$$

F_V … axial working load of the bolt
μ_K … coefficient of friction
l_K … clamping length of the Fastener

source: „**Schraubenverbindungen** Grundlagen, Berechnung, Eigenschaften, Handhabung“, 5. edition
authors: Prof. Dr.-Ing. Karl-Heinz **Kloos**, Dr.-Ing. Wolfgang **Thomala**
section 9.3, page 385

10.3.2 Strength of the bolt

The second limiting effect is of course the strength of the bolt. This has to be investigated separately in e.g. with a detailed Model.



10.4 Planned further developments regarding the slip calculation

The working load (residual clamping load F_{cp}) of each connection defines combined with the coefficient of friction the limit of sticking and the beginning of slip. F_{cp} depends on several forces and stiffness's (see picture right)

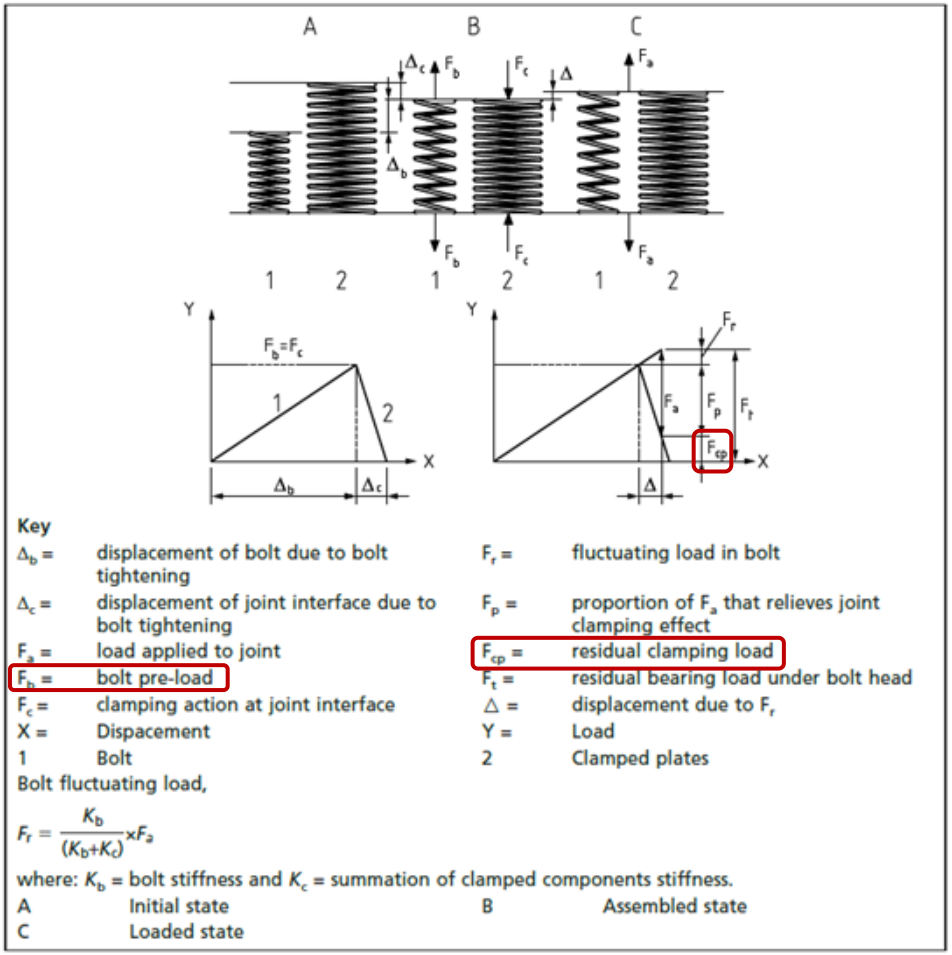
currently the working load has to be set for each single blot by the user. In Future this should be automatically calculated

Edit Advanced Scew Properties

Id	Type	Inculde Slip Effect	Workingload for Slip	Friction Coefficient for Slip
1	Screw	Yes	10000 [N]	0.15
2	Screw	Yes	10000 [N]	0.15
3	Screw	Yes	10000 [N]	0.15
4	Screw	Yes	10000 [N]	0.15
5	Screw	Yes	10000 [N]	0.15
6	Screw	Yes	10000 [N]	0.15
7	Screw	Yes	10000 [N]	0.15
8	Screw	Yes	10000 [N]	0.15
9	Screw	Yes	10000 [N]	0.15
10	Screw	Yes	10000 [N]	0.15
11	Screw	Yes	10000 [N]	0.15
12	Screw	Yes	10000 [N]	0.15
13	Screw	Yes	10000 [N]	0.15
14	Screw	Yes	10000 [N]	0.15

BS 7608:2014+A1:2015 BRITISH STANDARD

Figure 8 Relative stiffness effects on the fluctuating load in a bolt in a concentrically clamped and concentrically loaded bolted joint



Key

Δ_b =	displacement of bolt due to bolt tightening	F_r =	fluctuating load in bolt
Δ_c =	displacement of joint interface due to bolt tightening	F_p =	proportion of F_a that relieves joint clamping effect
F_a =	load applied to joint	F_{cp} =	residual clamping load
F_b =	bolt pre-load	F_t =	residual bearing load under bolt head
F_c =	clamping action at joint interface	Δ =	displacement due to F_r
X =	Dispacement	Y =	Load
1	Bolt	2	Clamped plates

Bolt fluctuating load,

$$F_r = \frac{K_b}{(K_b+K_c)} \times F_a$$

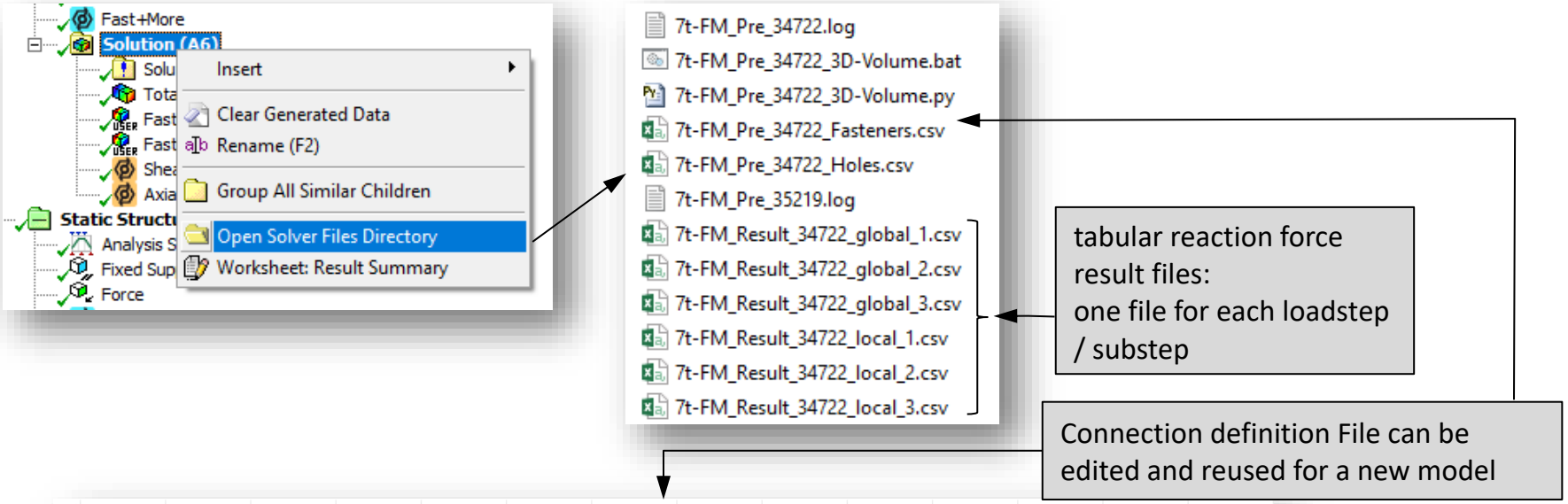
where: K_b = bolt stiffness and K_c = summation of clamped components stiffness.

A	Initial state	B	Assembled state
C	Loaded state		

11 General Topics

11.1 Additional Files in Working Directory

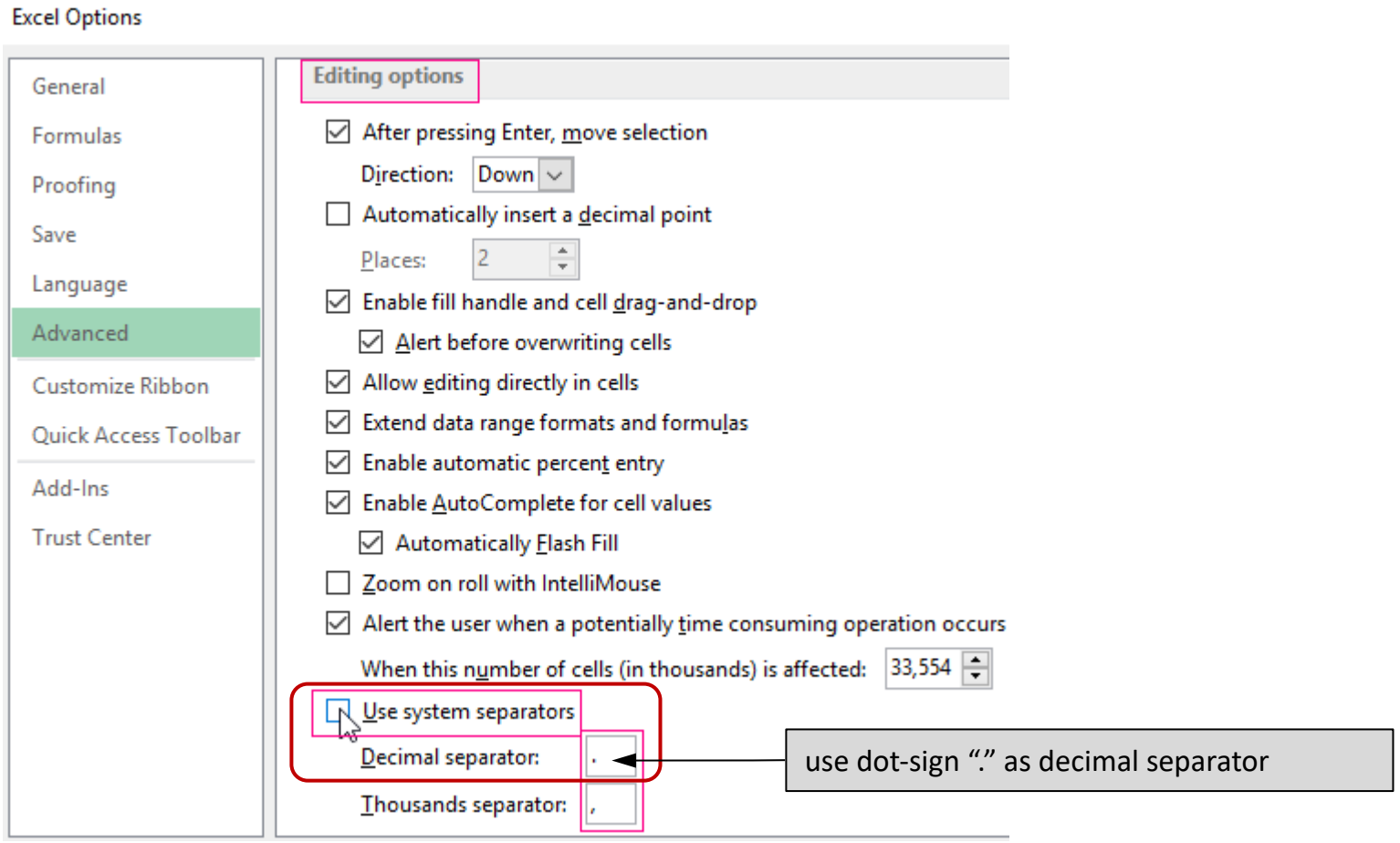
There were several additional files written in background. Have a look at the working directory of the Model:

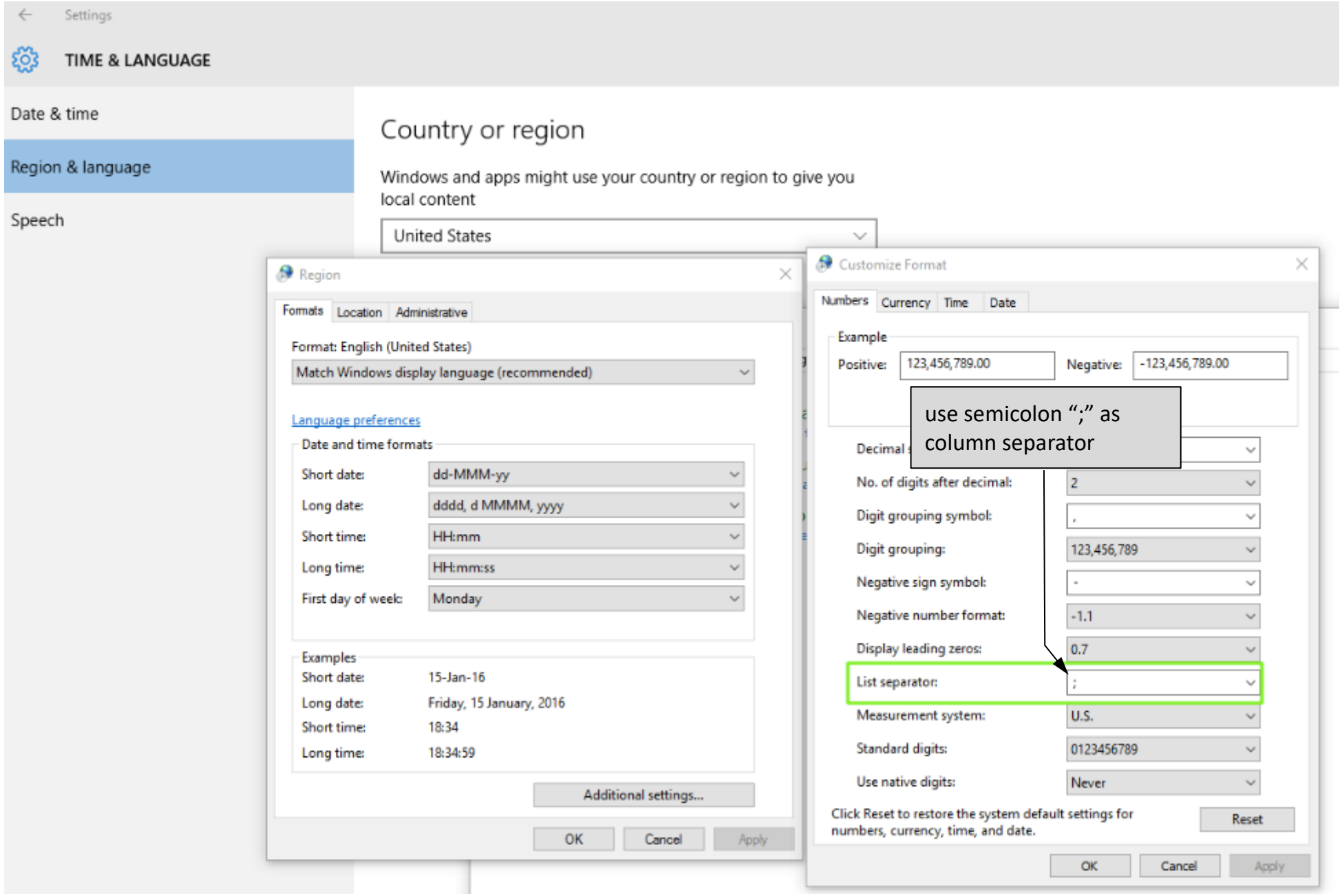


	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Connections (Con) from load object: 95 Fasteners													
2	Unit System: [mm, kg, N]													
3														
4	Con-Id (Con)	Con Type	Con Part (e.g. 8.8 Screw, 10.8 Screw, ...)	Young's Modulus (Con-Beam)	Poisson's Ratio (Con-Beam)	Diameter (Con-Beam)	HoleA-Id (HA)	HoleB-Id (HB)	HA X Controid	HA Y Controid	HA Z Controid	HB X Controid	HB Y Controid	HB Z Controid
5	0	Screw		200000	0.3	4.1	0	59	134.000003	7.78817737	153.842092	131.999999	7.78817737	153.842092
6	1	Screw		200000	0.3	4.1	1	60	134.000003	62.3025443	147.693653	131.999999	62.3025443	147.693653
7	2	Screw		200000	0.3	4.1	43	2	131.999999	87.9999998	33.0152542	134.000003	87.9999995	33.0150003
8	3	Screw		200000	0.3	4.1	23	3	136.999995	84.4999999	68	134.000003	84.4999999	68
9	4	Screw		200000	0.3	4.1	3	41	134.000003	84.4999999	68	131.999999	84.4999999	68
10	5	Screw		200000	0.3	4.1	22	4	136.999995	84.4999999	129.499999	134.000003	84.4999999	129.499999

11.2 MS Excel Setting for reading the csv files correctly

The csv-Files are written with dot "." as comma character (decimal separator) and a semicolon ";" as column separator. To be able to correctly open these cvs-File correctly with MS-Excel use the following settings:




Settings
TIME & LANGUAGE
Date & time
Region & language
Speech
Country or region
Windows and apps might use your country or region to give you local content
United States
Region
Formats
Location
Administrative
Format: English (United States)
Match Windows display language (recommended)
Language preferences
Date and time formats
Short date: dd-MMM-yy
Long date: dddd, d MMMM, yyyy
Short time: HH:mm
Long time: HH:mm:ss
First day of week: Monday
Examples
Short date: 15-Jan-16
Long date: Friday, 15 January, 2016
Short time: 18:34
Long time: 18:34:59
Additional settings...
OK
Cancel
Apply
Customize Format
Numbers
Currency
Time
Date
Example
Positive: 123,456,789.00
Negative: -123,456,789.00
use semicolon ";" as column separator
Decimal
No. of digits after decimal: 2
Digit grouping symbol: ,
Digit grouping: 123,456,789
Negative sign symbol: -
Negative number format: -1.1
Display leading zeros: 0.7
List separator: ;
Measurement system: U.S.
Standard digits: 0123456789
Use native digits: Never
Click Reset to restore the system default settings for numbers, currency, time, and date.
Reset
OK
Cancel
Apply

11.3 using Preferences File

Several parameters and global settings can be edited in the following preferences file:

fm_preferences.py - Editor

Datei Bearbeiten Format Ansicht ?

```
# in this file default values and settings (preferences) can be defined
# ====================================================================

# ------------------------------------------------------------------------------------

# By default, the diameter of the fasteners takes up exactly the smallest hole diameter involved..
# If the following array contains a set of values the closest of these values is taken instead.
# This allows to use fastener standard diameters instead of the hole diameters.
# remove the remark-sign '#' from predefined lines or edit and add new lines

AvailableFastenerDiameters = [
#                             [2.0,  4.0],   # Fastener-Diameter (D) and correspo
#                             [3.0,  5.5],   # Fastener-Diameter (D) and corresponding Head-Diameter in [mm]
#                             [4.0,  7.0],   # Fastener-Diameter (D) and corresponding Head-Diameter in [mm]
#                             [5.0,  8.0],   # Fastener-Diameter (D) and corresponding Head-Diameter in [mm]
#                             [6.0,  10.0],  # Fastener-Diameter (D) and corresponding Head-Diameter in [mm]
#                             [7.0,  11.0],  # Fastener-Diameter (D) and corresponding Head-Diameter in [mm]
#                             [8.0,  13.0],  # Fastener-Diameter (D) and corresponding Head-Diameter in [mm]

                              ]

AvFastenerDiameterTolerance = 0.8  # an array-Diameter-value D is taken if: Fastener-Default-Diameter >= D > Fastener-Default-Diameter*AvFastenerDiameterTolerance

# ------------------------------------------------------------------------------------

SaveModelDB = False         # decide whether to save a *.db file with all the additions made by Fast+More. This can be useful for model checking in MAPDL.
                            # Modal analyses keep their *db files anyway, as they may be required for later response spectrum, harmonic or similar analyses.

# ------------------------------------------------------------------------

# define the meshsize of Fasteners modeled with Volume-Elements:

VolumeFastenerMeshSize = 5  # integer value from 1 (fine mesh) to 10 (coarse mesh)

# ------------------------------------------------------------------------
```

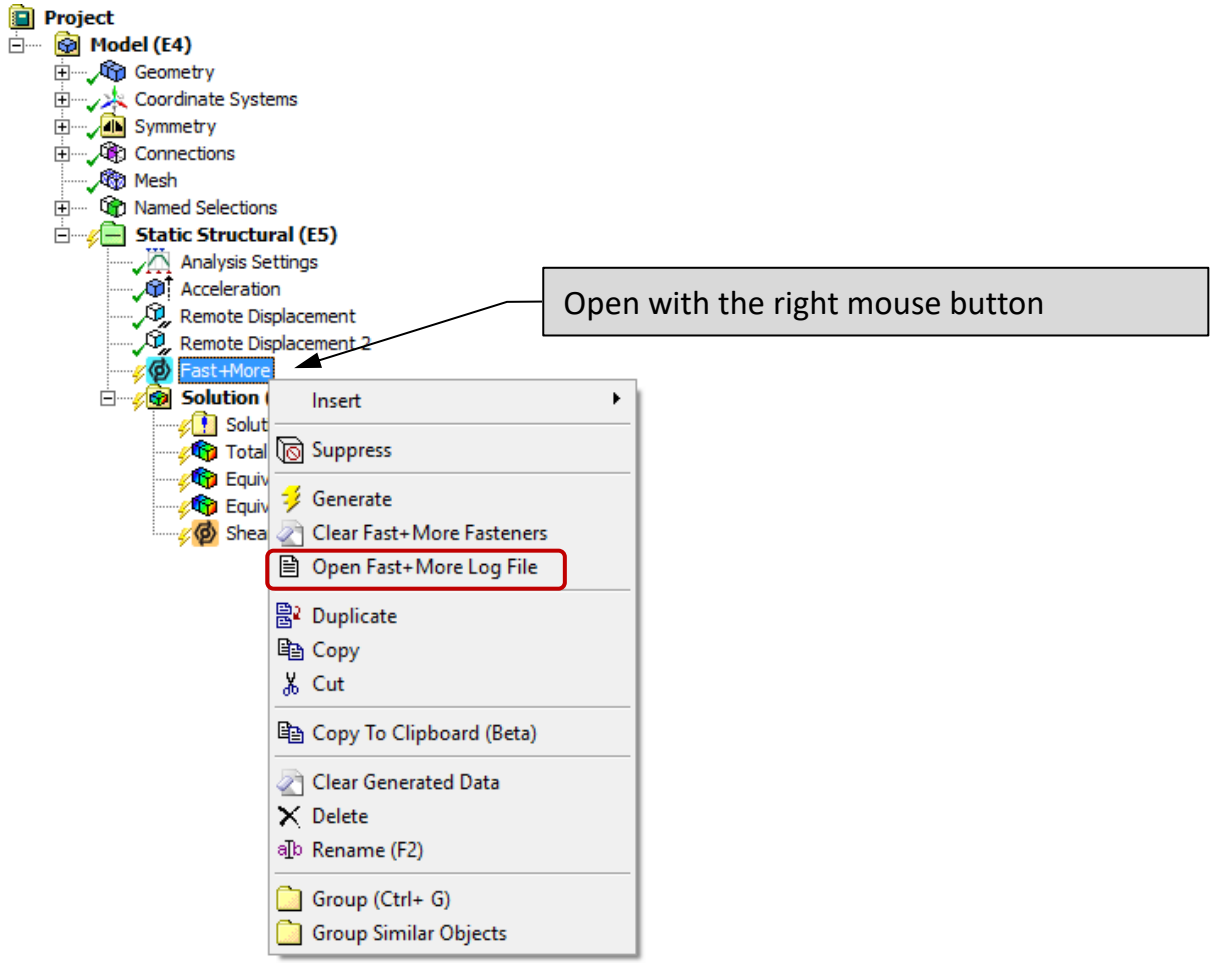
is the comment sign
Every command after a # is ignored

Take care that a default **Text-Editor** is defined in MS-Windows.
Otherwise the botton-click will not be able to open the text File.

Close and reopen Mechanical after editing and saving the Preferences File. Otherwise the changes will not be loaded in Fast+More.

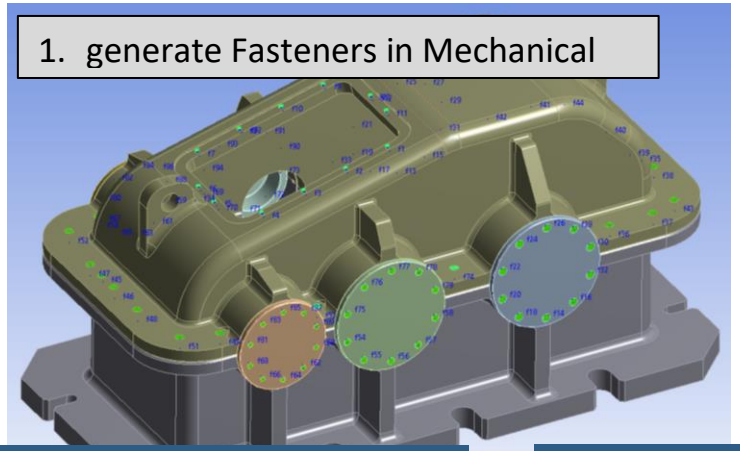
11.4 log File with additional information

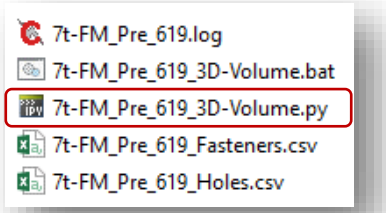
A log file stores all the activities of Fast+More and gives feedback if something goes wrong:

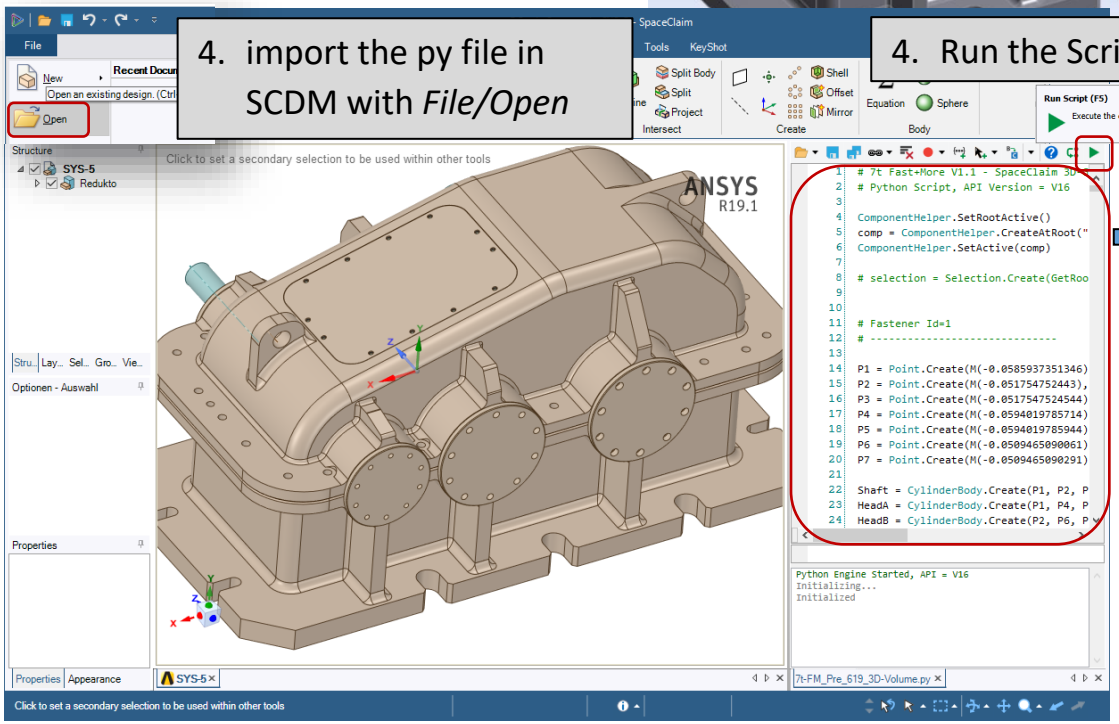


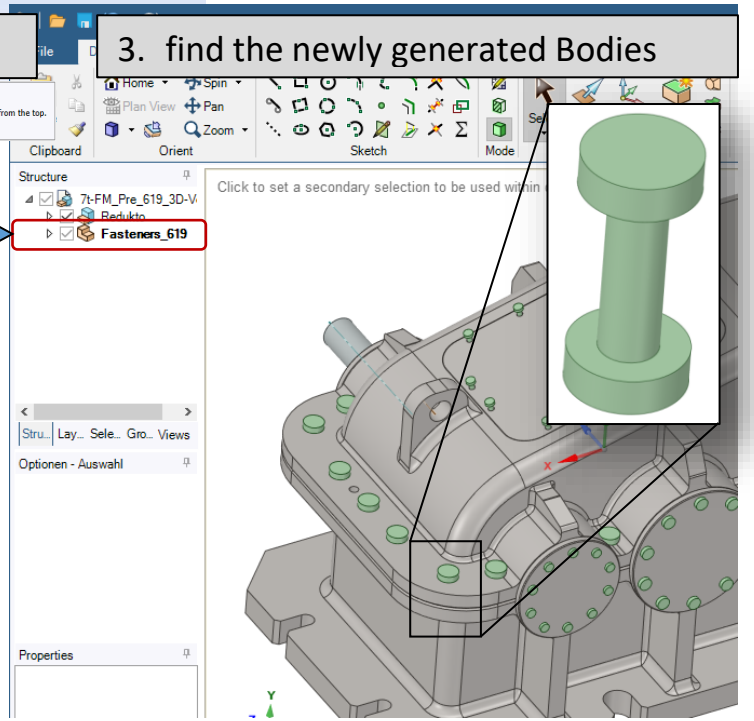
11.5 Generating Fastener Volume Bodies in SpaceClaimDirectModeler

Fast+More automatically generates a Python File which can be used to generate **Fastener Volume Bodies** in SpaceClaimDirectModeler. These Bodies can be used for detailed Analysis with the ANSYS native Features.



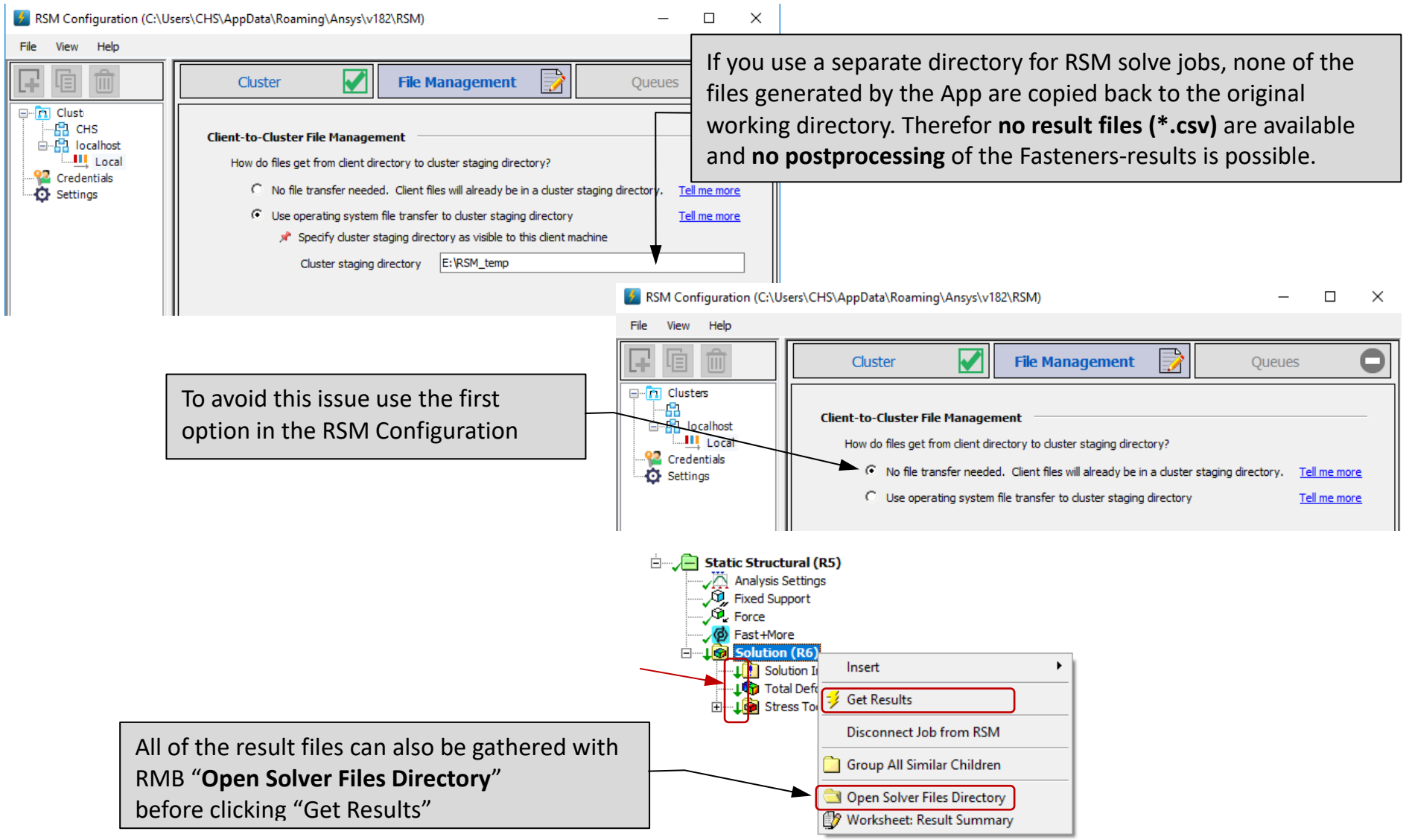






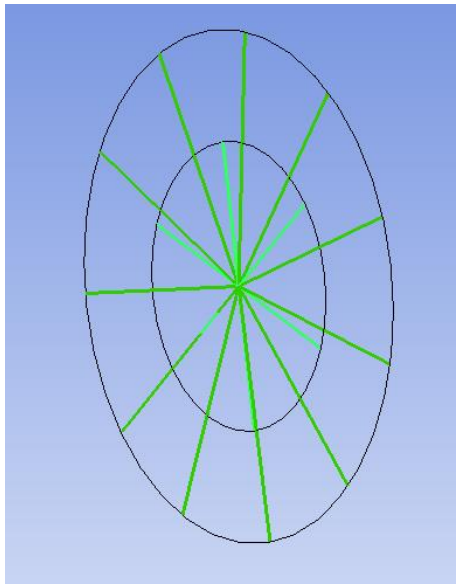
12 Known Issues

12.1 RSM



12.2 Holes with coincident Midpoints

In some cases two Holes with **coincident Midpoints** are detected. In this case the center beam has a **zero length** and that causes an error during the solve. This issue is not deleted automatically by the program because the result is not always what the user wants to have.
To resolve this problem please have a look in the log file. A WARNING Message appears and the affected Connection-Ids are listed. Search for that Connections in the Model and try to change the geometry or delete the connection in the *Connections*.csv File and read in the csv-File.



7t_FastenersPre_264.log - Editor

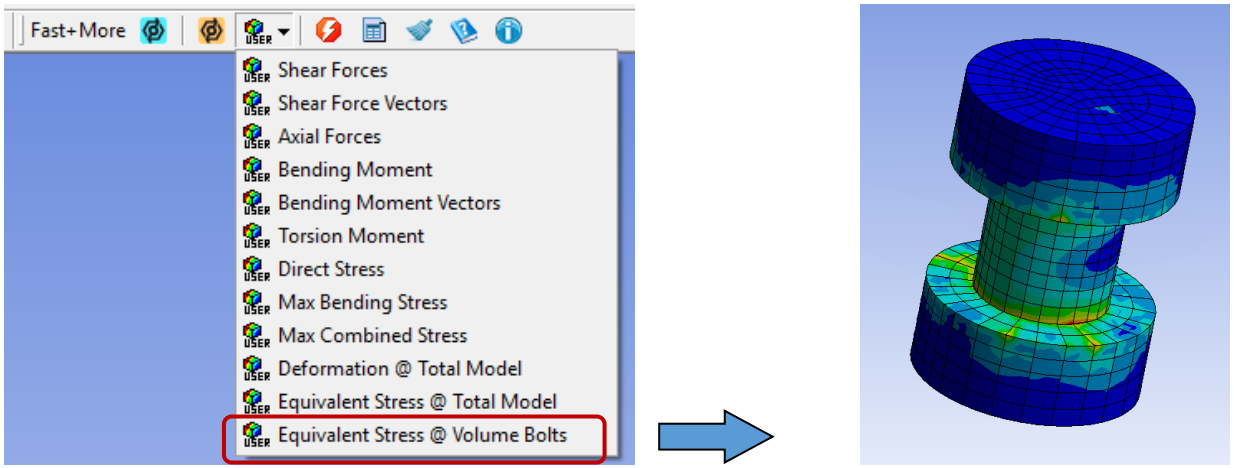
Datei Bearbeiten Format Ansicht ?

```
 *** Connections search started                                time = 12.08.1
 ************************************

Connections search: Hole Group Nb = 1  of 4 Groups

Connections search: Holes left = 28
Connections search: Holes left = 27
Connections search: Holes left = 25
Connections search: Holes left = 22
Connections search: Holes left = 19
Connections search: Holes left = 16
Connections search: Holes left = 14
Connections search: Holes left = 12
Connections search: Holes left = 9
Connections search: Holes left = 6
Connections search: Holes left = 3
Connections search: Holes left = 1
WARNING: short Hole Distance = 5.55111512313e-17  at Connection Id = 5 !
WARNING: short Hole Distance = 5.55111512313e-17  at Connection Id = 13 !
```

Graphics	
Show Holes	No
Show Fasteners	Yes - with Fastener IDs
Show Graphics for Entities	by Number (Range)
Range (Format '1;3;5-10')	5;13

12.3 Volume Bolts Postprocessing

Currently for Fasteners modeled with Volume Elements there are no reaction forces and moments written. This will follow in one of the upcoming releases. Currently the best way to postprocess Volume-Fasteners is to plot the Equivalent Stresses:



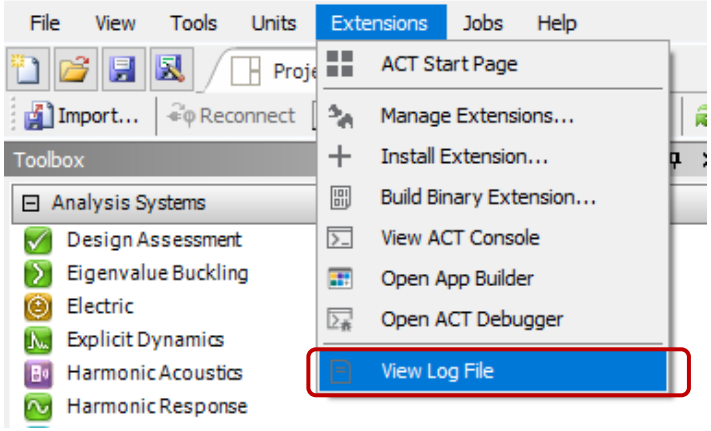
Slip Effect is currently not available for Volume Fasteners.

12.4 Bolt Pretension

This feature will follow in one of the upcoming releases. The GUI is already prepared fore that.

12.5 Error Messages

If errors occur while running the software, the error messages can be reviewed in the following window:

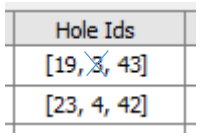


These error messages may be required when contacting the support and for debugging.

13 Release Notes

Fast+More V1.1

- ANSYS V19.1 is now supported
- With Holes-Search by "*Geometry – Selected Geometry*" now not only Bodies but also Faces and Edges can be selected. This allows much more precisely to define at which positions Holes should be searched.
- Volume-Fasteners are now meshed exclusively with hexahedral elements – and mesh size of the volume mesh can now be adjusted via the *preferences*-file.
- some bugs-fixes according to import Fastener definition csv-File (*Detection Method – by Fastener csv-File*)
- some bugs-fixes according to Random Vibration Analyses
- some bugs-fixes according to postprocessing of *Combined Utilization*
- graphic issues while "Show Fasteners" / "Show Holes" in combination with RMB "Generate" are fixed
- in the "Edit Fasteners" Table now intermediate Holes can be deleted



- this Help document was extended

Fast+More V1.2

- Fast+More V1.1 ran properly under ANSYS V19.1, but generated errors under ANSYS V19.0. This was fixed.

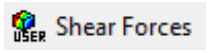
Fast+More V1.3

- some corrections regarding postprocessing in Demo-Mode
- error while copying a Fast+More object in the same analysis corrected
- Status of Fast+More load-Object was not updated with RMB "Clear All Fasteners". This is fixed.

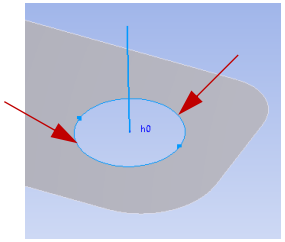
Fast+More V1.4

- In the previous version there was a defect where all Fasteners were deleted after closing and reopening the model. This bug has been fixed.

Fast+More V1.5

- first version for floating licensing
- some corrections regarding postprocessing while having multiple Fast+More preprocessing-objects in tree
- user results 

now based on element components for better graphical appearance
- For shell-bodies a circular hole can consist of *two edges*.



Fast+More V1.6

- updated to be compatible with ANSYS Release 2019 R1
- bugfix regarding shell-body-holes with edges with *one* vertex
- bugfix regarding demo mode

14 Contact Information

for more Information see: www.fast-and-more.com

or contact: info@fast-and-more.com

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