Workshop – Examples of arbitrary beam cross sections with PBMSECT and PBRSECT

A PBMSECT/PBRSECT TUTORIAL

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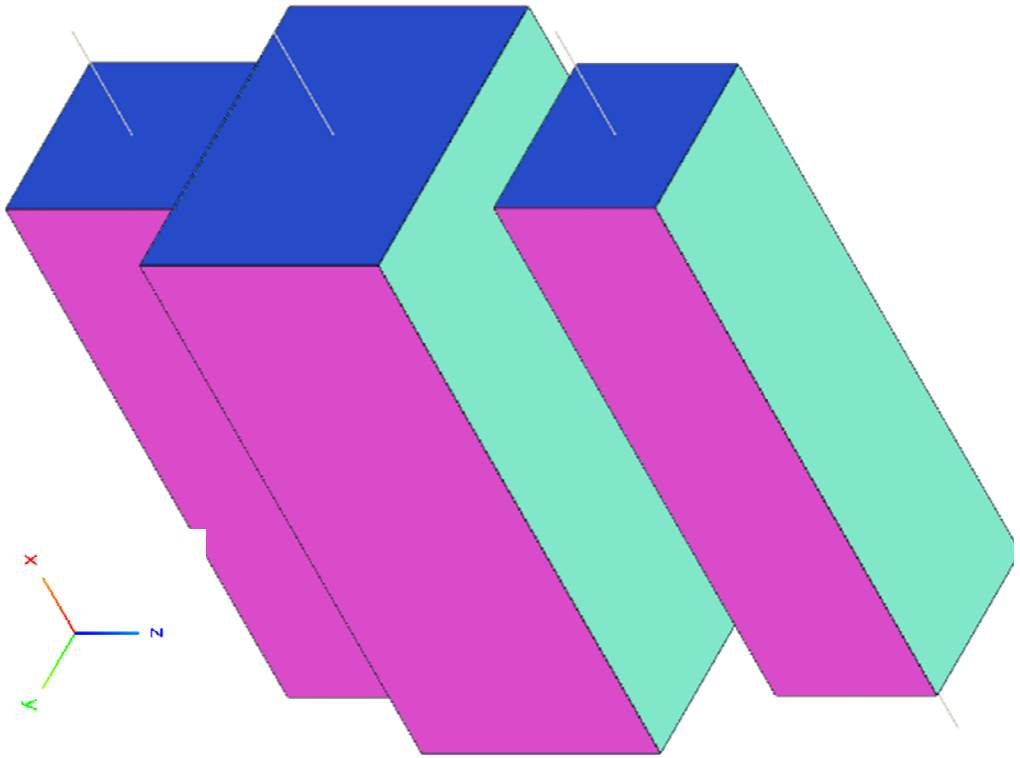
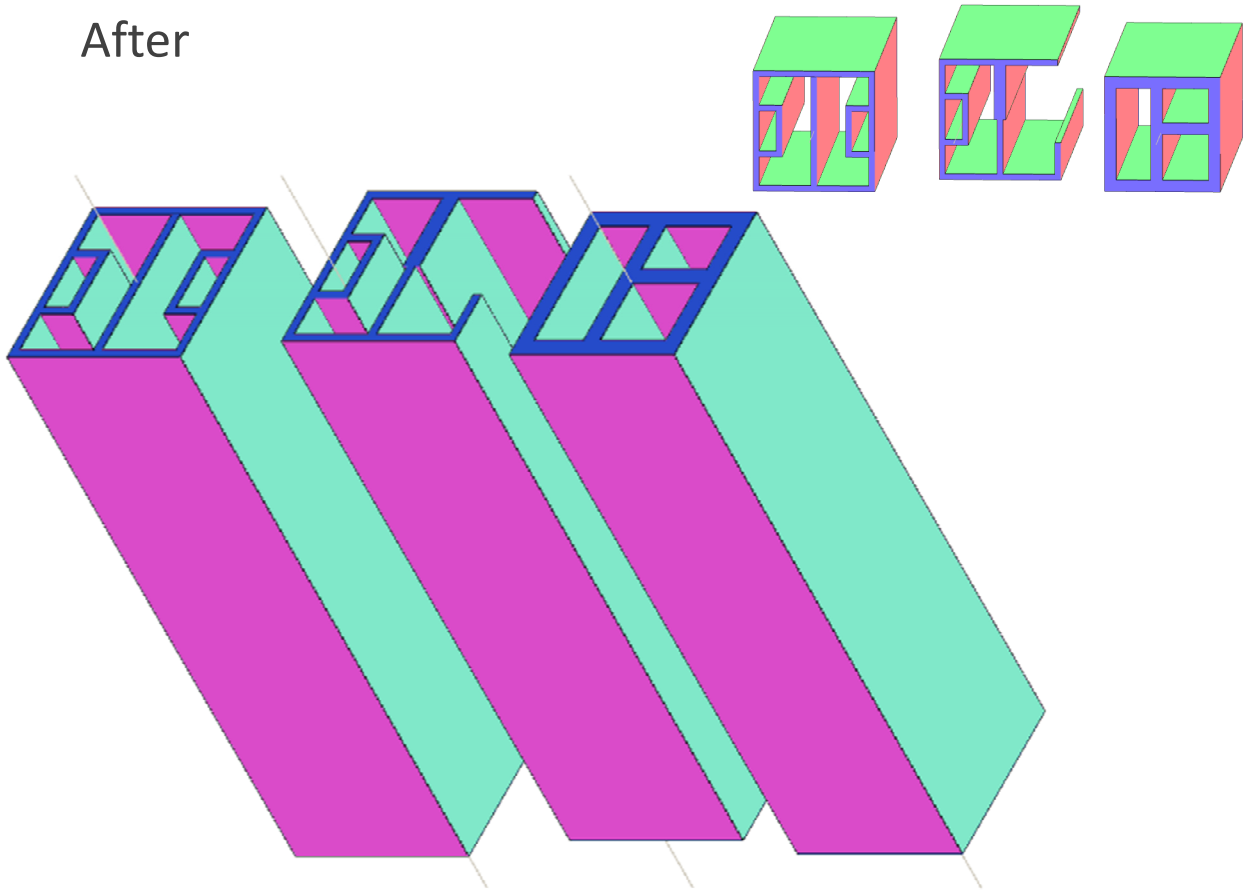
HEXAGON
Technology Partner

Goal: Create multiple arbitrary beam cross sections

Before



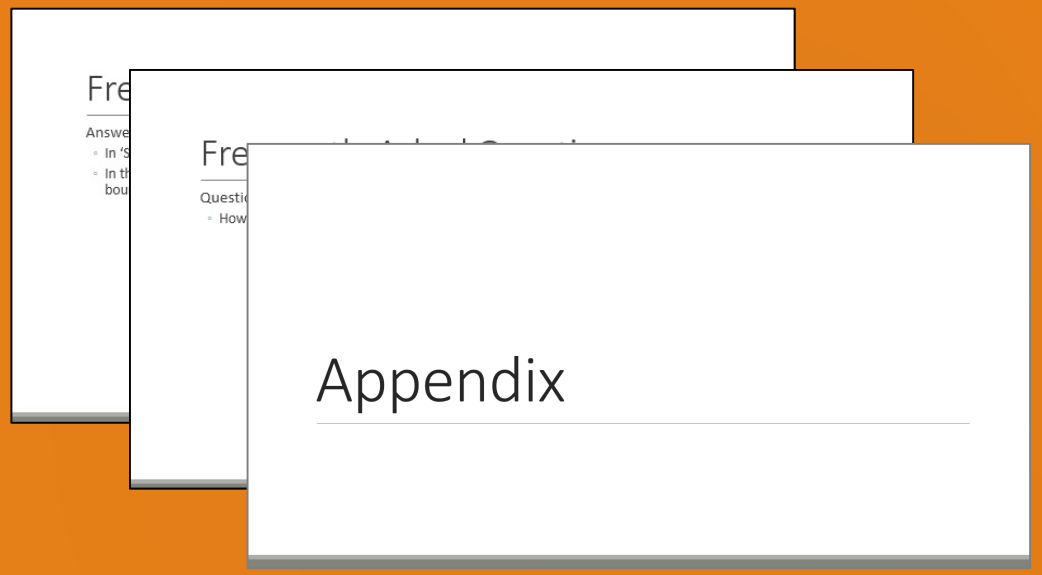
After



More Information Available in the Appendix

The Appendix includes information regarding the following:

- Avoid T Keyword and SET1 Conflicts



Contact me

- Nastran SOL 200 training
- Nastran SOL 200 questions
- Structural or mechanical optimization questions
- Access to the SOL 200 Web App

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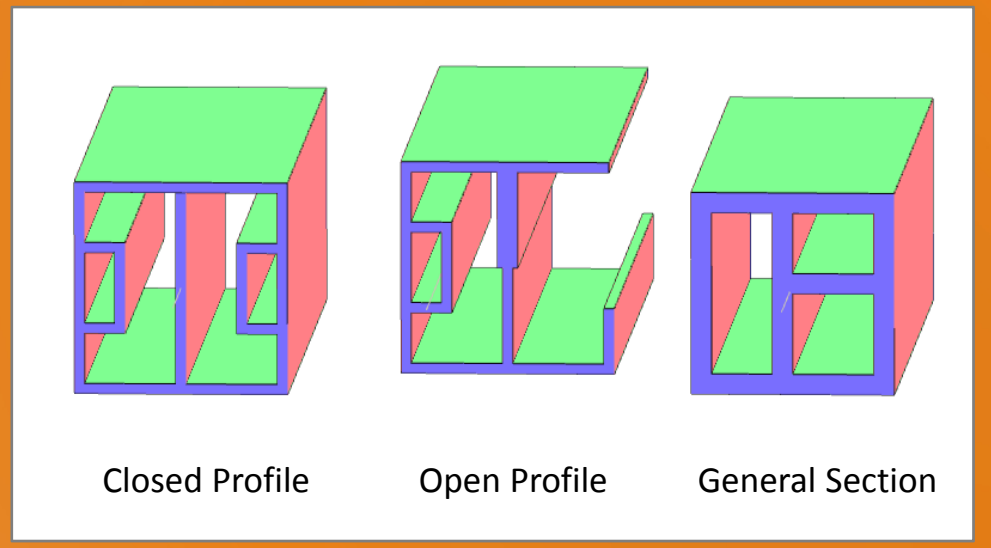
Tutorial

Tutorial Overview

1. Start with a .bdf or .dat file
2. Use the PBMSECT Web App to:
   - Create multiple arbitrary beam cross sections (ABCS)
   - Run MSC Nastran to confirm the ABCS is created properly
   - Download an updated BDF file
3. Use the Viewer to view the updated beam elements with the newest ABCSs

Special Topics Covered

Closed Profile, Open Profile and General Section - MSC Nastran's PBMSECT and PBRSECT entries have a great level of flexibility to create various types of beam cross sections. This tutorial describes the procedure to create closed and open profile sections.



SOL 200 Web App Capabilities

The Post-processor Web App and HDF5 Explorer are free to MSC Nastran users.

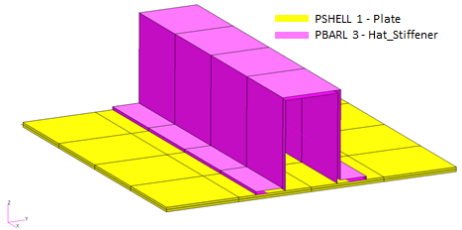
Compatibility

- Google Chrome, Mozilla Firefox or Microsoft Edge
- Windows and Red Hat Linux
- Installable on a company laptop, workstation or server. All data remains within your company.

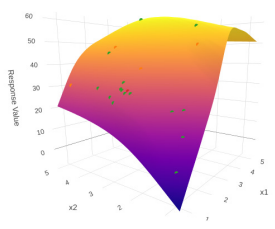
Benefits

- REAL TIME error detection. 200+ error validations.
- REALT TIME creation of bulk data entries.
- Web browser accessible
- Free Post-processor web apps
- +80 tutorials

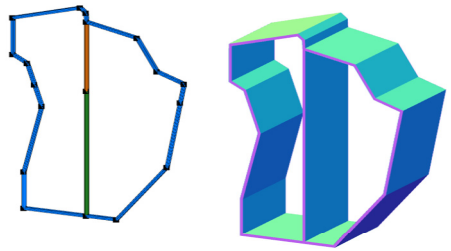
Web Apps



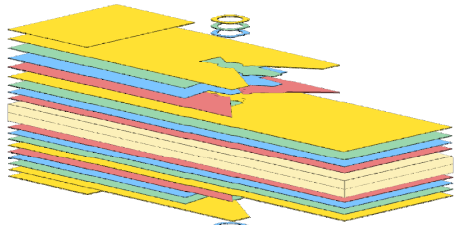
Web Apps for MSC Nastran SOL 200
Pre/post for MSC Nastran SOL 200. Support for size, topology, topometry, topography, multi-model optimization.



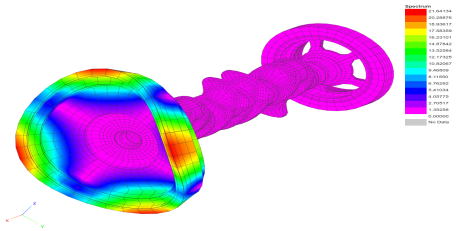
Machine Learning Web App
Bayesian Optimization for nonlinear response optimization (SOL 400)



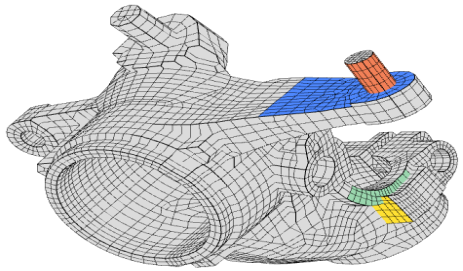
PBMSECT Web App
Generate PBMSECT and PBRSECT entries graphically



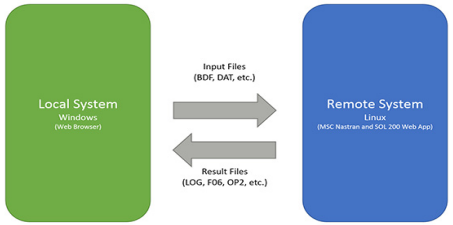
Ply Shape Optimization Web App
Optimize composite ply drop-off locations, and generate new PCOMPG entries



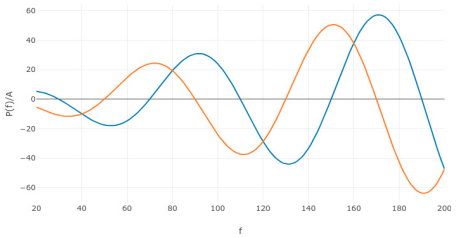
Post-processor Web App
View MSC Nastran results in a web browser on Windows and Linux



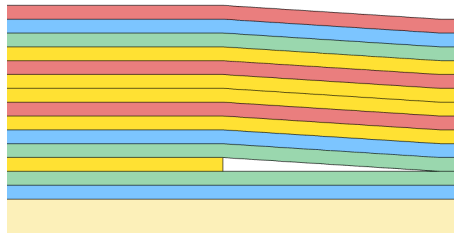
Shape Optimization Web App
Use a web application to configure and perform shape optimization.



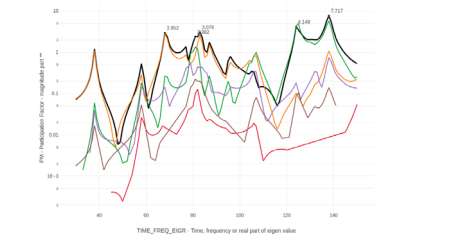
Remote Execution Web App
Run MSC Nastran jobs on remote Linux or Windows systems available on the local network



Dynamic Loads Web App
Generate RLOAD1, RLOAD2 and DLOAD entries graphically



Stacking Sequence Web App
Optimize the stacking sequence of composite laminate plies



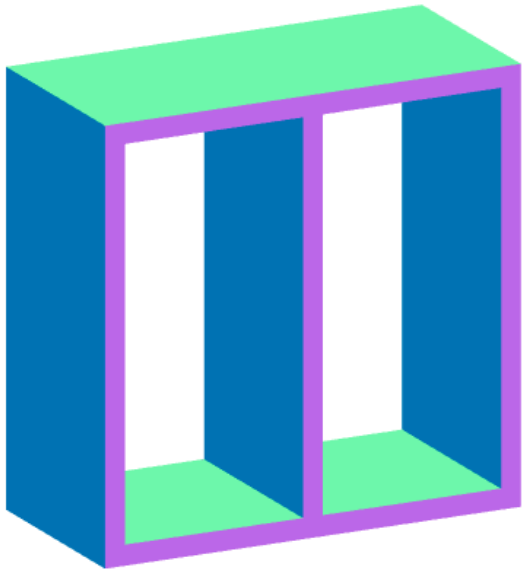
HDF5 Explorer Web App
Create graphs (XY plots) using data from the H5 file

Before Starting

- When creating an arbitrary cross section (ABCS), there are many different configurations of the entries that will yield the same ABCS.
- For the ABCS shown on the right, 4 different configurations of the PBMSECT, POINT and SET1 entries are displayed. Each configuration yields the same ABCS with these properties.
  - Area: 9.9000E+01
  - I1: 5.9182E+03
  - I2: 5.3482E+03
  - I12: 0.0
  - J: 8.2246E+03
- When you go through this tutorial, expect to get different IDs and sequences of entries. This is OK as long as your final arbitrary cross section matches what is shown in this tutorial.

```
PBMSECT 1       0888    CP
        OUTP=101,BRP(1)=102,T=1.0
POINT   1000001         0.0     -10.
POINT   1000002         0.0     10.
POINT   1000003         10.     10.
POINT   1000004         10.     -10.
POINT   1000005         -10.    10.
POINT   1000006         -10.    -10.
SET1    101     1000001 1000002 1000003 1000004
SET1    102     1000002 1000005 1000006 1000001
```

```
PBMSECT 1       0888    CP
        OUTP=101,BRP(1)=102,T=1.0
POINT   1000001         0.0     10.
POINT   1000002         -10.    10.
POINT   1000003         -10.    -10.
POINT   1000004         0.0     -10.
POINT   1000005         10.     -10.
POINT   1000006         10.     10.
SET1    101     1000001 1000002 1000003 1000004 1000005 1000006
SET1    102     1000004 1000001
```



```
PBMSECT 1       0888    CP
        OUTP=101,BRP(1)=102,T=1.0
POINT   1000001         -10.    10.
POINT   1000002         0.0     10.
POINT   1000003         0.0     -10.
POINT   1000004         -10.    -10.
POINT   1000005         10.     -10.
POINT   1000006         10.     10.
SET1    101     1000001 1000002 1000003 1000004
SET1    102     1000003 1000005 1000006 1000002
```

```
PBMSECT 1       0888    CP
        OUTP=101,BRP(1)=102,T=1.0,T(1)=[1.0,PT=(1000001,1000001)],T(2)=[
        1.0,PT=(1000001,1000004)]
POINT   1000001         0.0     10.
POINT   1000002         -10.    10.
POINT   1000003         -10.    -10.
POINT   1000004         0.0     -10.
POINT   1000005         10.     -10.
POINT   1000006         10.     10.
SET1    101     1000001 1000002 1000003 1000004 1000005 1000006
SET1    102     1000001 1000004
```

Locating the Web Apps

Throughout this tutorial the following web apps will be used

- Viewer
- PBMSECT web app

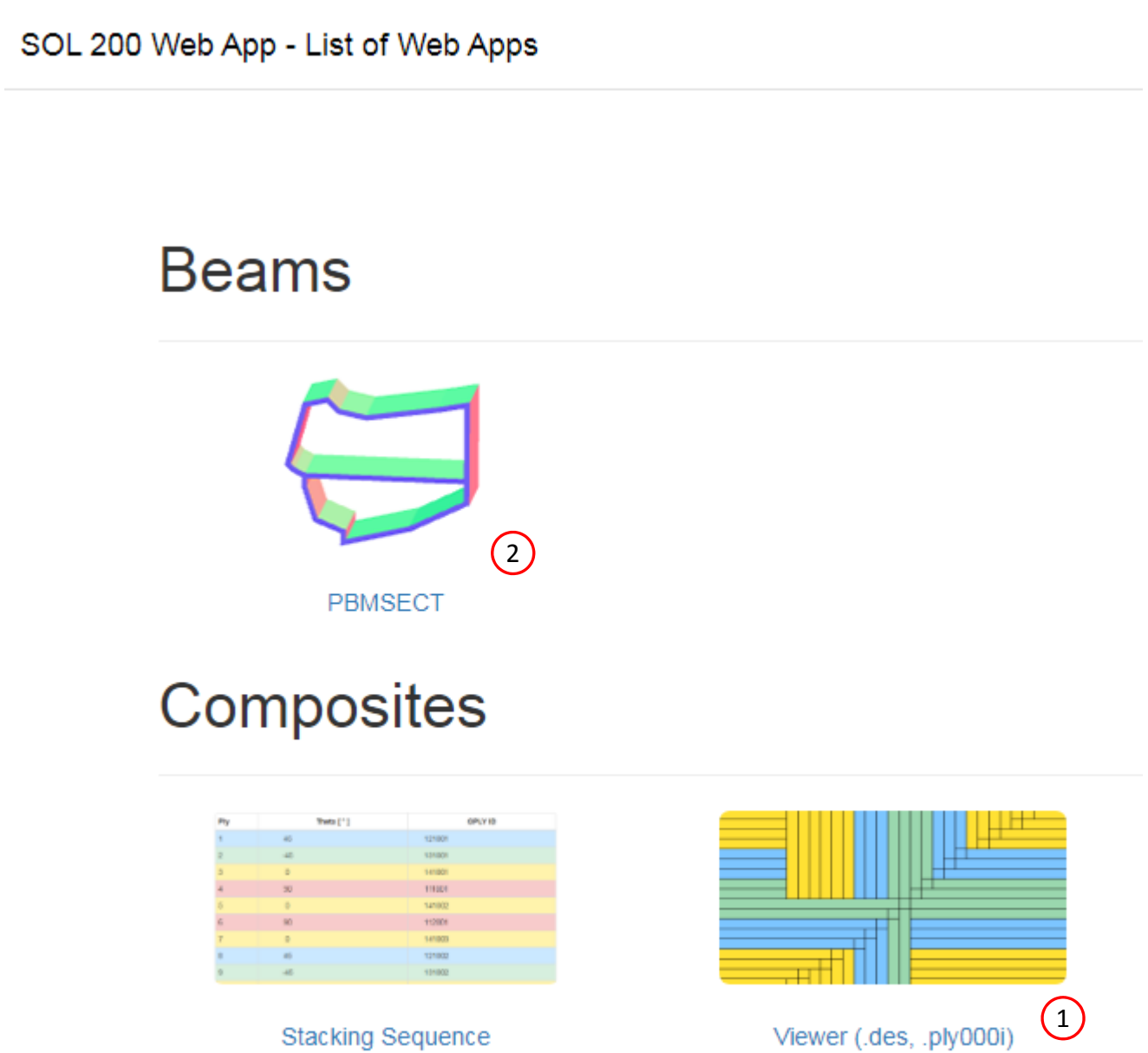
The following slides detail where to locate these web apps

Viewer and PBMSECT Web App

1. Navigate to the homepage
2. Click on the indicated link

Viewer and PBMSECT Web App

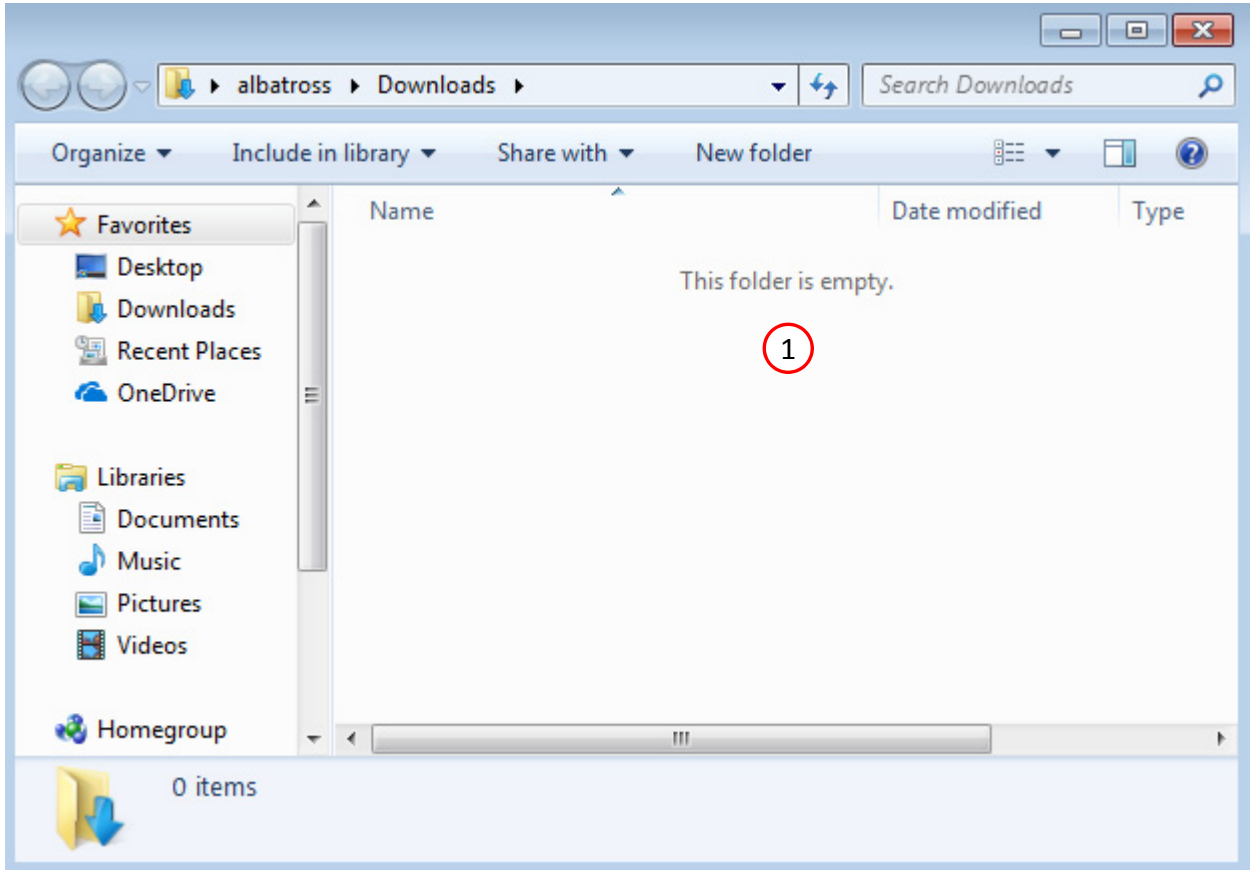
1. Click the icon titled Viewer to open the Viewer
2. Click the icon titled PBMSECT to open the PBMSECT web app



Before Starting

1. Ensure the Downloads directory is empty in order to prevent confusion with other files

- Throughout this workshop, you will be working with multiple file types and directories such as:
  - .bdf/.dat
  - nastran_working_directory
  - .f06, .log, .pch, .h5, etc.
- To minimize confusion with files and folders, it is encouraged to start with a clean directory.



Go to the User's Guide

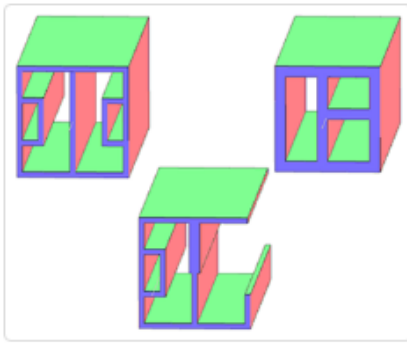
1. Click on the indicated link

- The necessary BDF files for this tutorial are available in the Tutorials section of the User's Guide.

Obtain Starting Files

1. Find the indicated example
2. Click Link
3. The starting file has been downloaded

- When starting the procedure, all the necessary BDF files must be collected together.

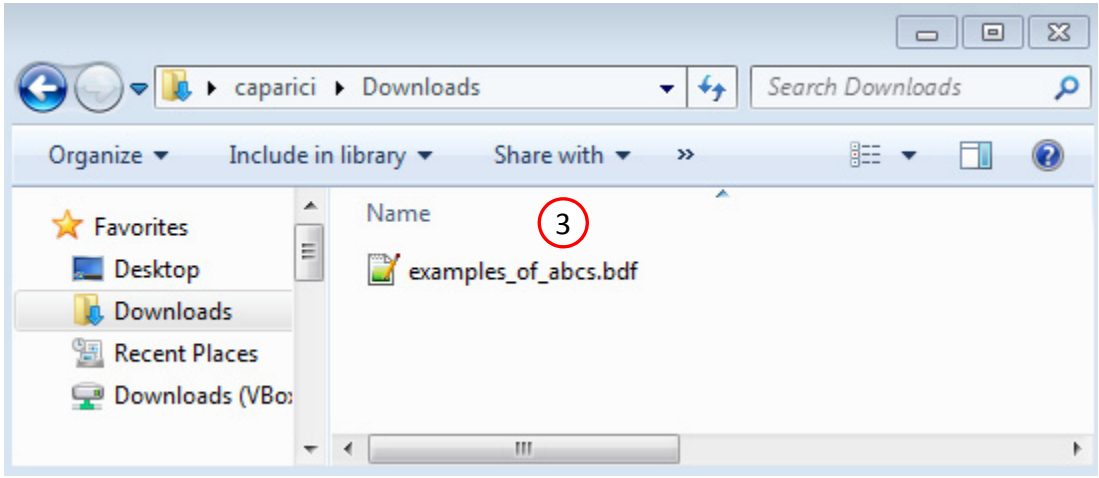


1

Examples of arbitrary beam cross sections with PBMSECT and PBRSECT

This tutorial describes the procedure to generate different types of arbitrary beam cross sections, including open or closed profiles.

Starting BDF Files: Link 2
Solution BDF Files: Link

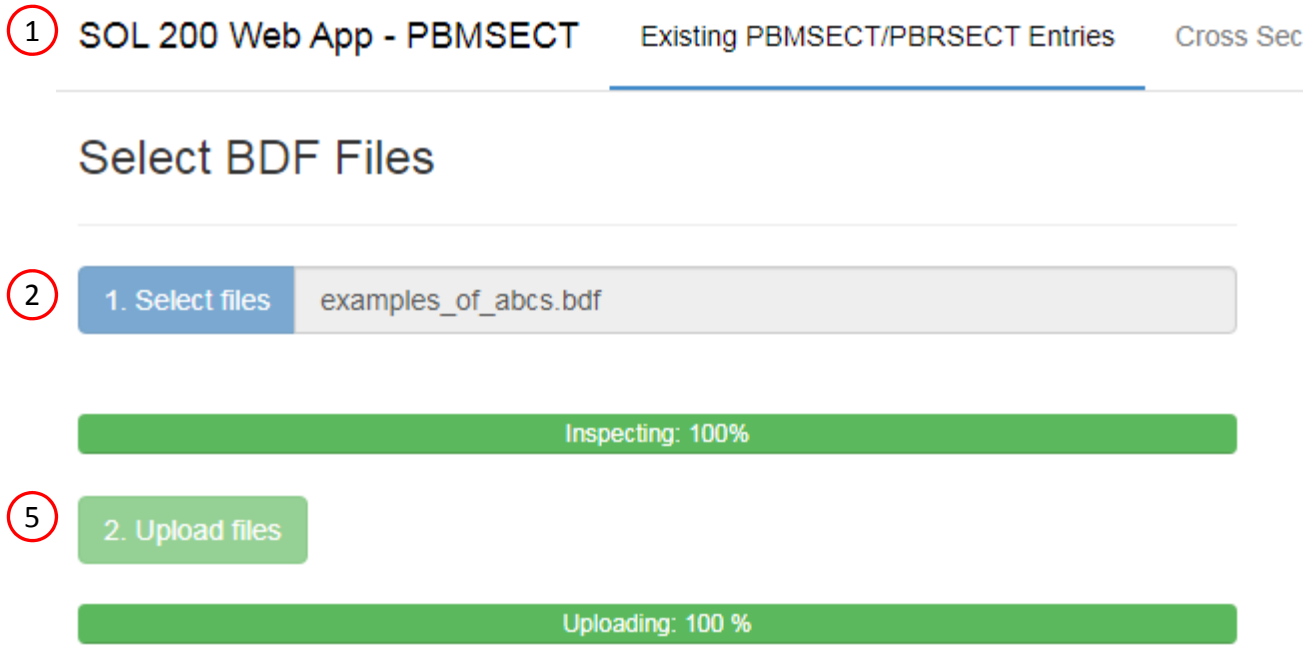


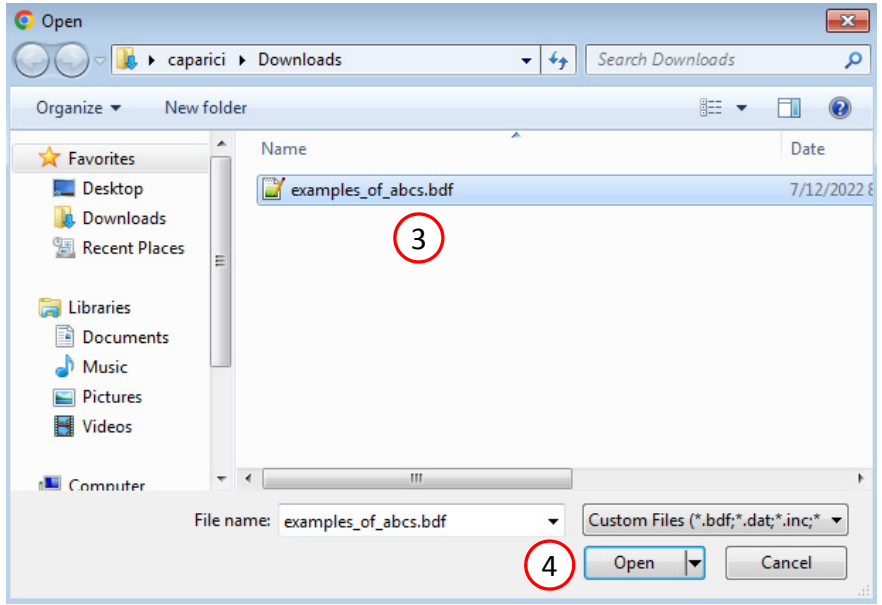
PBMSECT Web App

The PBMSECT web app will be used to define an arbitrary beam cross section by defining a PBMSECT, POINT and SET1 entries

1. Open the PBMSECT web app
2. Click Select files
3. Select examples_of_abcs.bdf
4. Click Open
5. Click Upload files

- The selected BDF file was created by a separate pre processor. The PBMSECT Web App only generates the following entries: PBMSECT, PBRSECT, POINT and SET1.

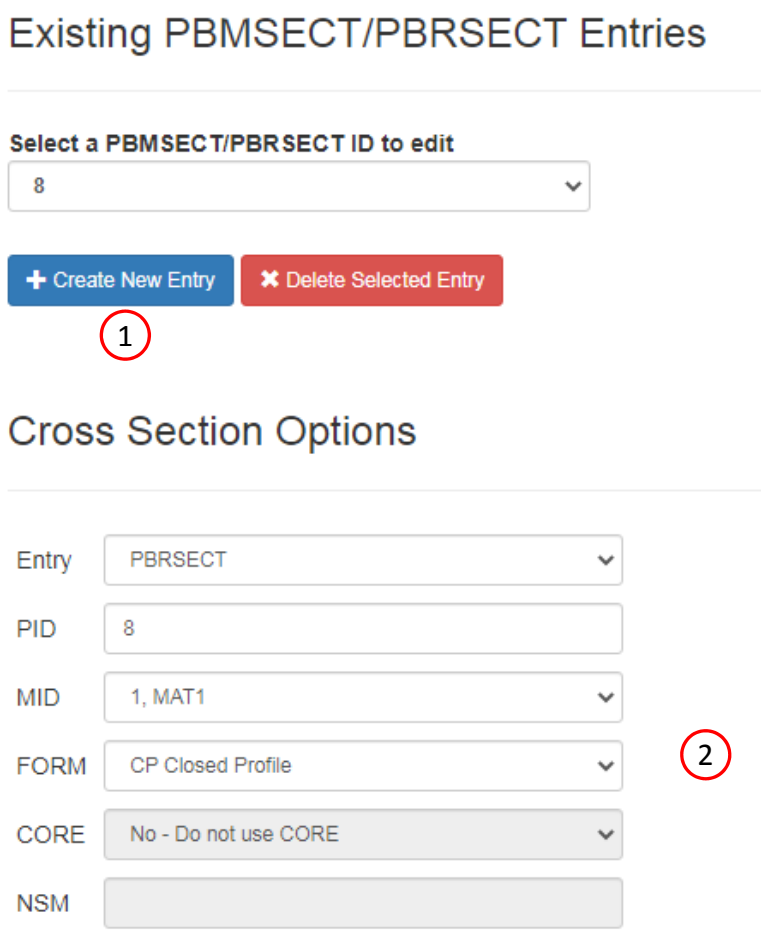




Cross Section 1

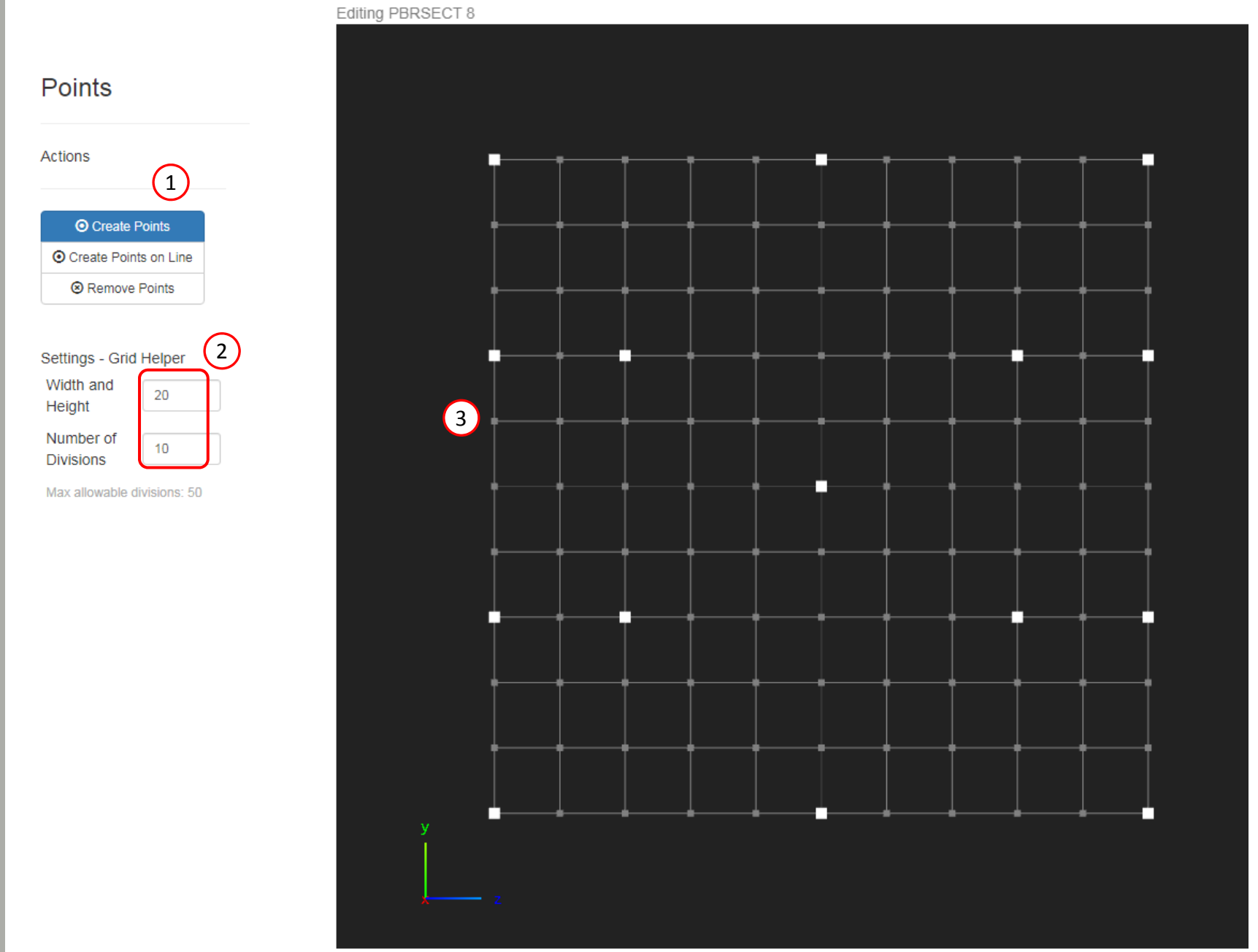
Create a New PBMSECT Entry

1. Click Create New Entry
2. Configure the Cross Section Options follows:
   - Entry: PBRSECT
   - PID: 8
   - MID: 1, MAT1
   - FORM: CP Closed Profile



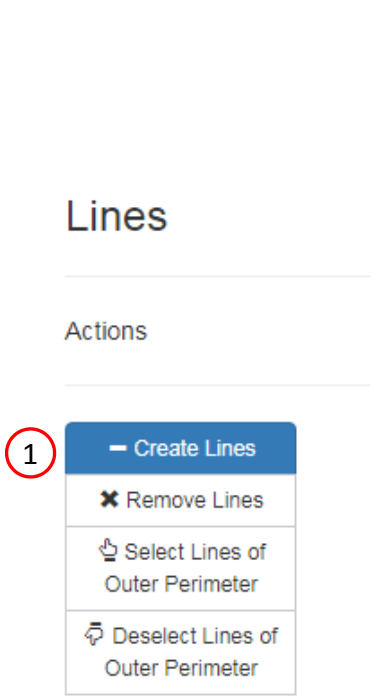
Points

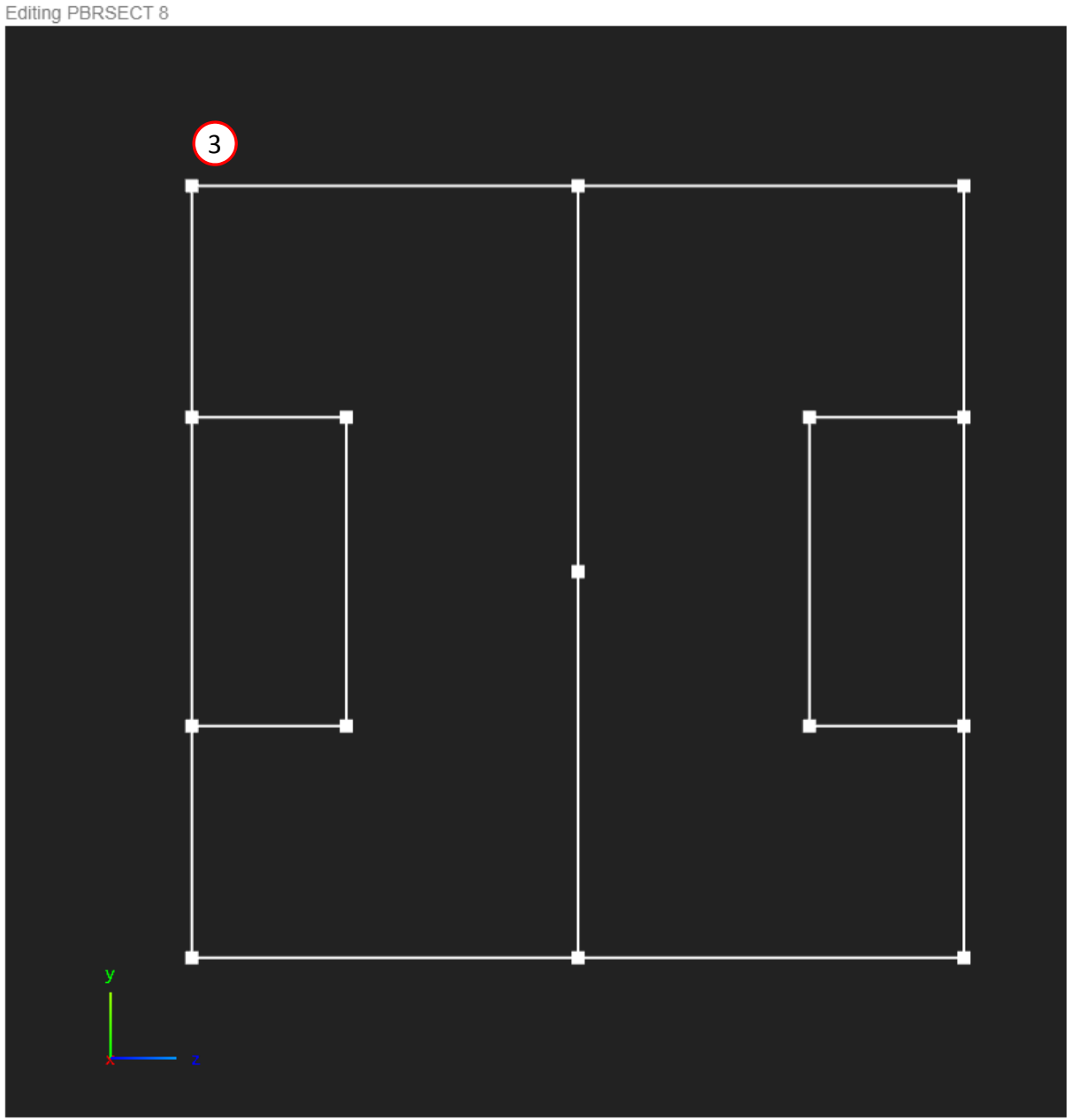
1. Click Create Points (The button should be blue)
2. Adjust the Grid Helper as follows
   1. Width and Height: 20
   2. Number of Divisions: 10
3. Click on the points on the Grid Helper to create 15 white points approximately in the same locations as shown in the image.



Lines

1. Click Create Lines
2. Click on 2 points to create one line
3. Repeat the process to create a total of 18 lines





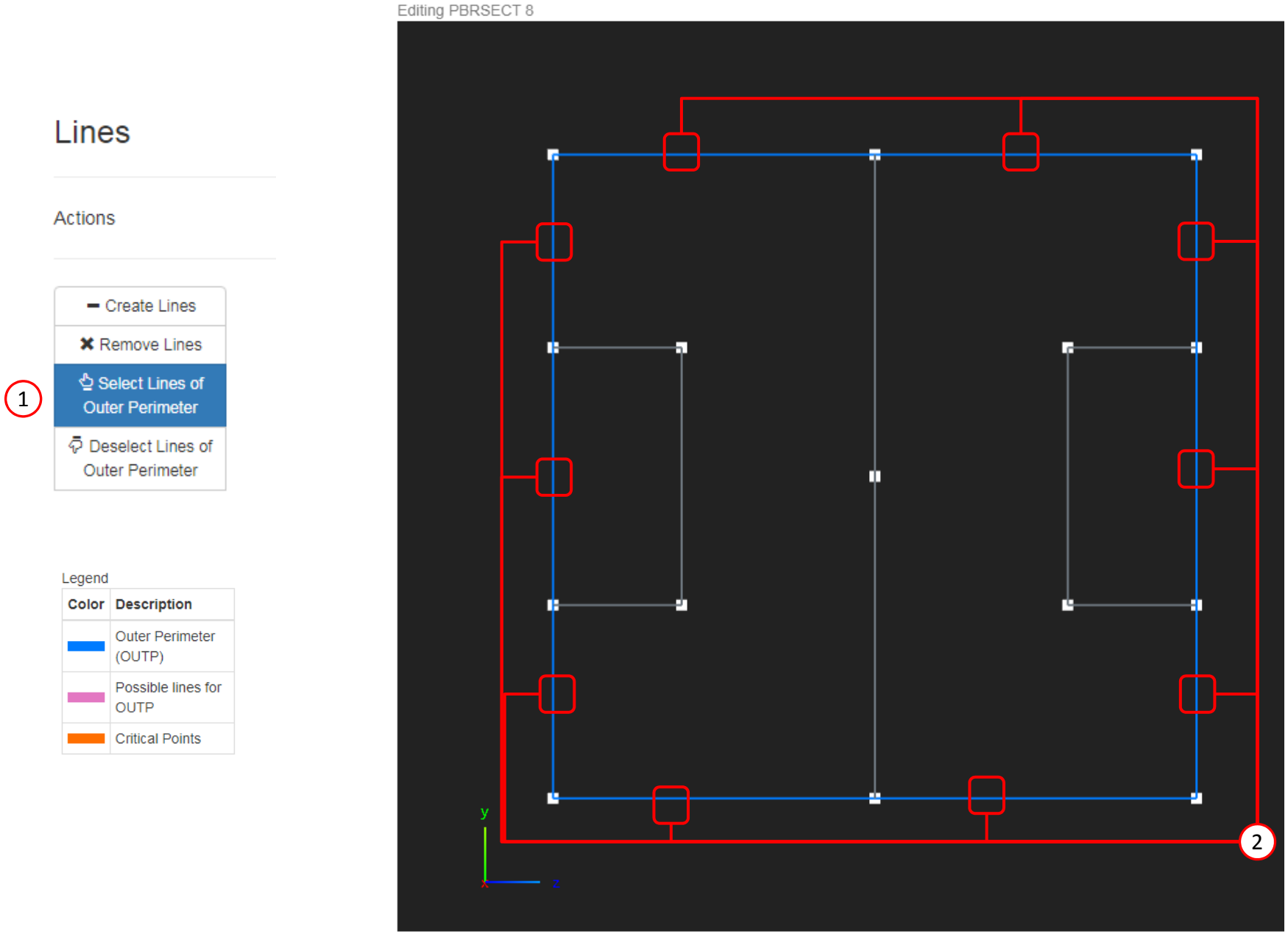
Outer Perimeter

On this slide, the outer perimeter is defined, which corresponds to the OUTP keyword on the PBRSECT entry

1. Click Select Lines of Outer Perimeter
2. Click on the indicated lines to select the lines as part of the Outer Perimeter. Successful selection is indicated by a blue color.

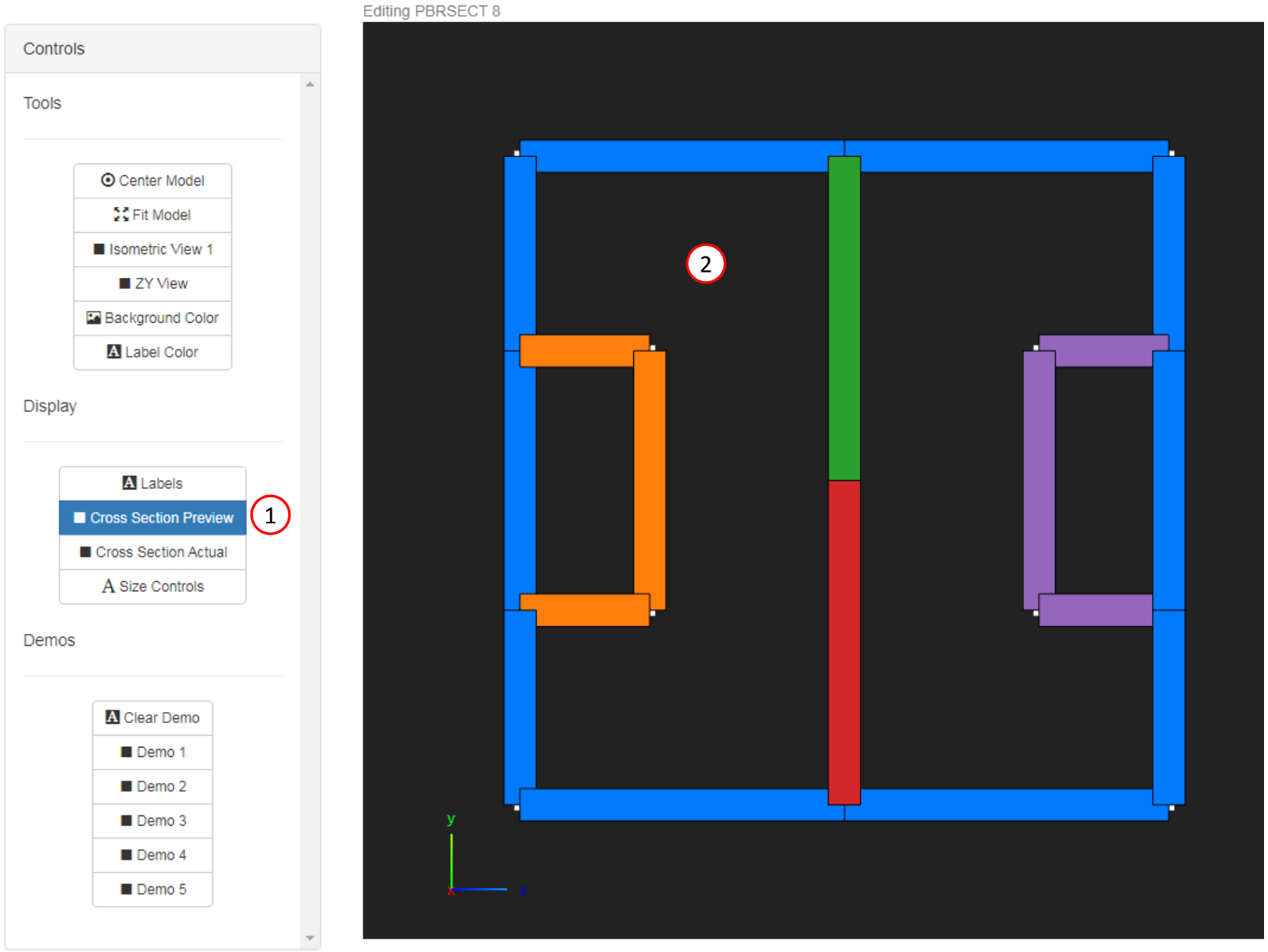
IMPORTANT!

Defining the outer perimeter is the most critical step in defining the PBMSECT/PBRSECT entry. Constantly inspect the outer perimeter. Only one continuous outer perimeters is valid.



Cross Section Preview

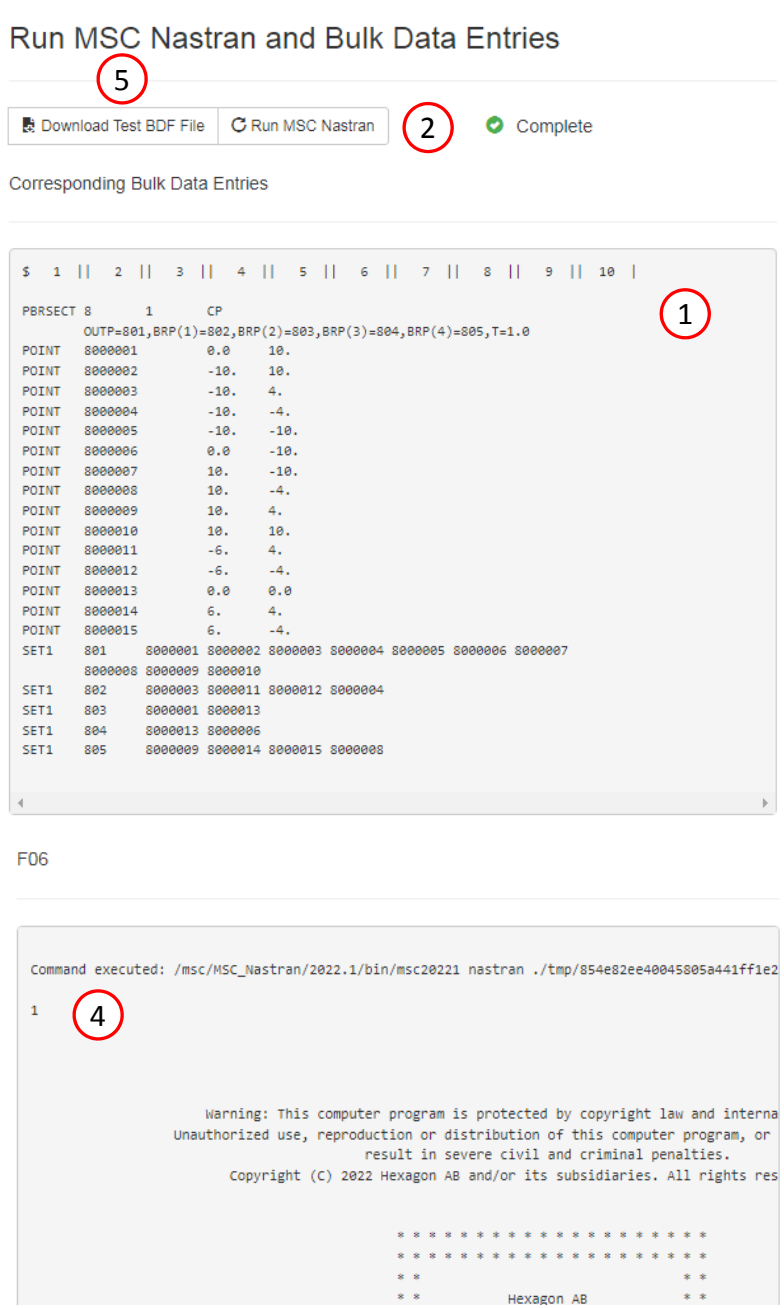
1. Click Cross Section Preview
2. A preview of the arbitrary beam cross section is displayed

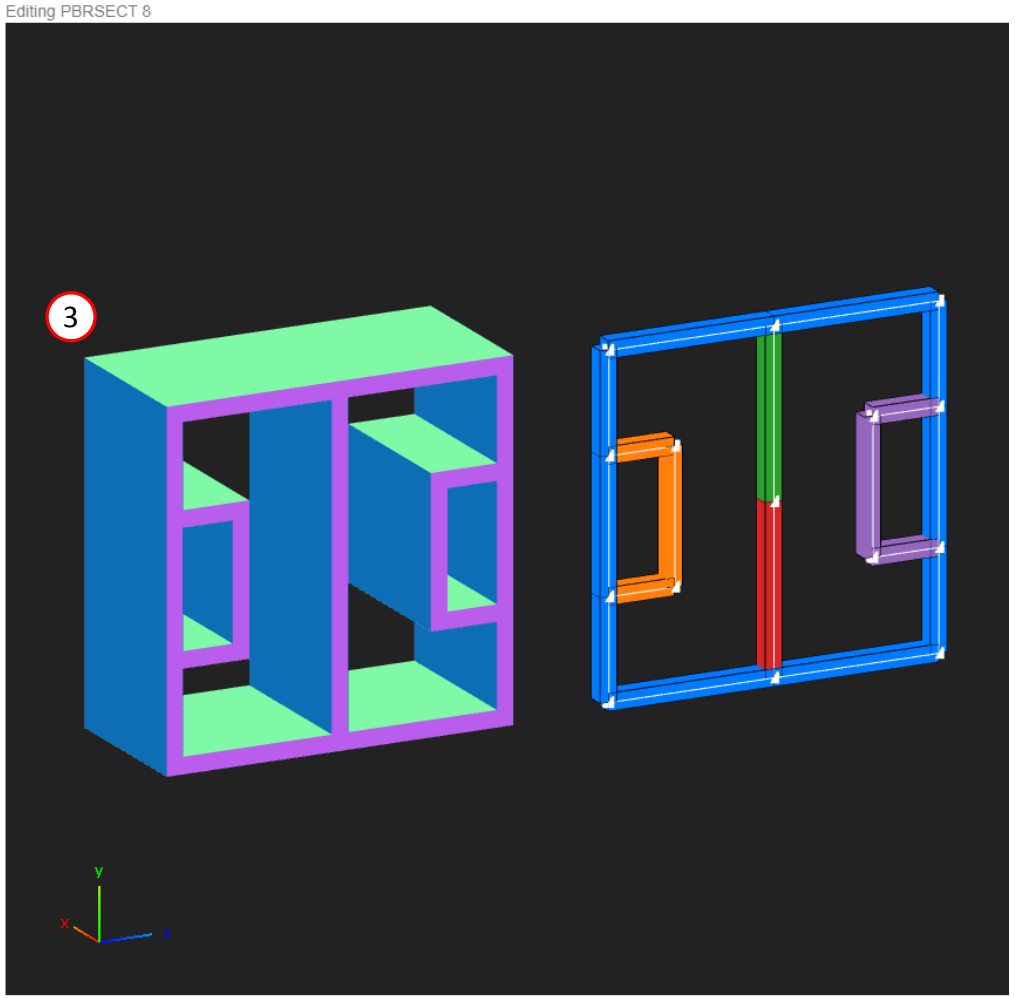


Run MSC Nastran to Generate the Cross Section

The following requires MSC Nastran to be installed on the same machine as the SOL 200 Web App.

1. The respective entries that define the arbitrary beam cross section are displayed
2. Click Run MSC Nastran
   - The web app will run MSC Nastran in the background and determine the cross section generated by MSC Nastran. This MSC Nastran run should take no more than 10 seconds. MSC Nastran must be installed on the machine as the SOL 200 Web App.
3. If the run is successful, the MSC Nastran generated cross section is displayed
4. Inspect the F06 file to inspect the result of the run
5. The test BDF file used for this test run may be downloaded by clicking Download Test BDF File





Run MSC Nastran to Generate the Cross Section

1. If the MSC Nastran run was a success, an equivalent PBAR entry is generated and listed in the F06 file. This PBAR entry displays cross section information such as the cross sectional area and moments of inertia.
    - If a PBRSECT entry is created, a PBAR entry is generated.
    - If a PBMSECT is created with the CORE keyword, which is used for a composite section, a PBEAM3 entry is generated.
    - If a regular PBMSECT entry is created, a PBEAM entry is generated.

```
^^^
*** USER INFORMATION MESSAGE 4379 (IFP9A)
    THE USER SUPPLIED PBARL/PBRSECT BULK DATA ENTRIES ARE REPLACED BY THE FOLLOWING PBAR ENTR
    CONVERSION METHOD FOR PBARL/PBEAML - FINITE ELEMENT METHOD.
PBAR            8           1  1.2900E+02  6.2328E+03  6.7748E+03  8.3118E+03  0.0000E+00
        1.0500E+01  1.0500E+01  4.0000E+00 -1.0500E+01 -1.0500E+01 -1.0500E+01 -1.0500E+01
        5.1710E-01  2.0901E-01  0.0000E+00
```

1

PBAR Simple Beam Property

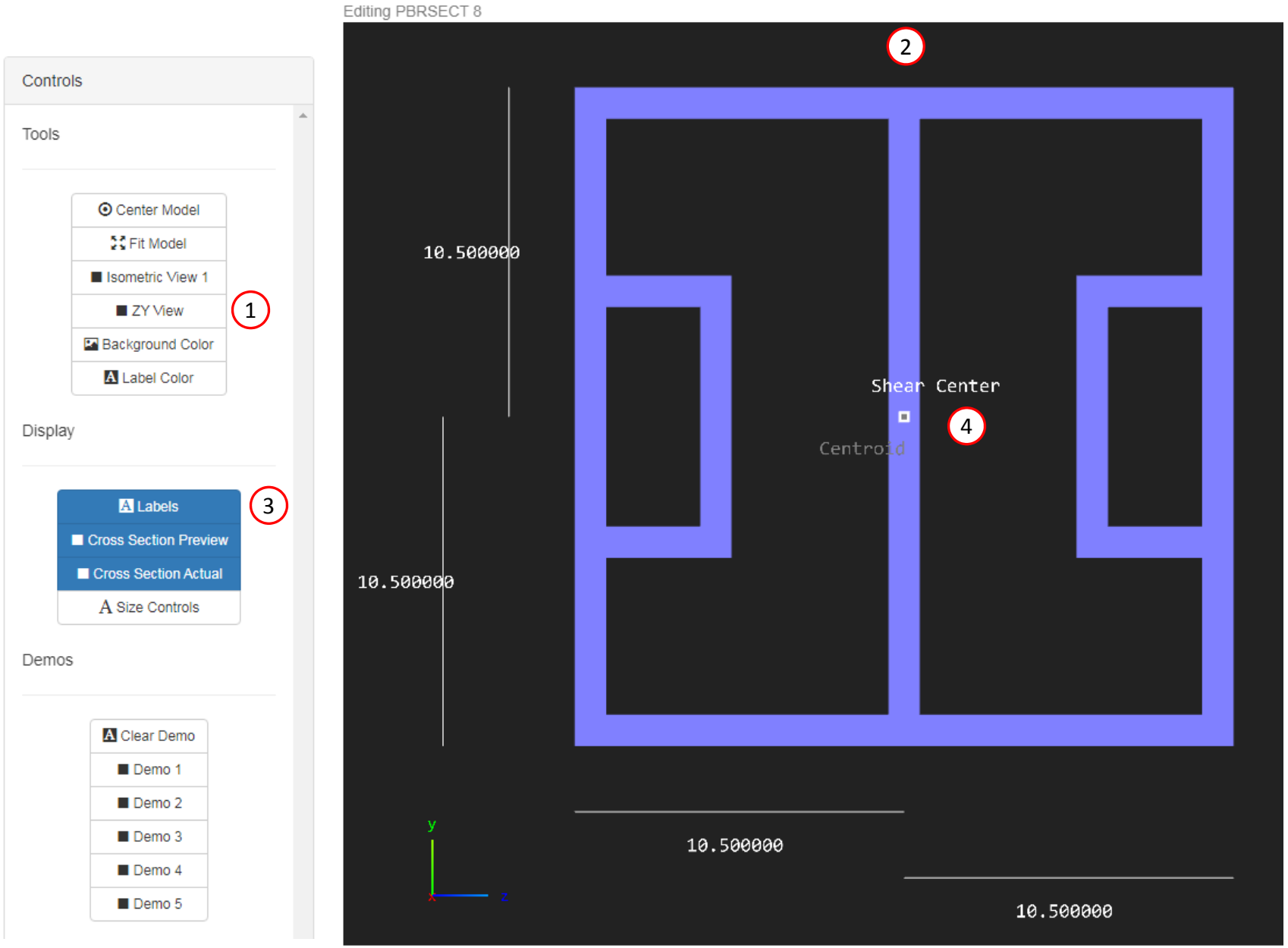
Defines the properties of a simple beam element (CBAR entry).

Format:

1	2	3	4	5	6	7	8	9	10
PBAR	PID	MID	A	I1	I2	J	NSM		
	C1	C2	D1	D2	E1	E2	F1	F2	
	K1	K2	I12						

Cross Section Preview

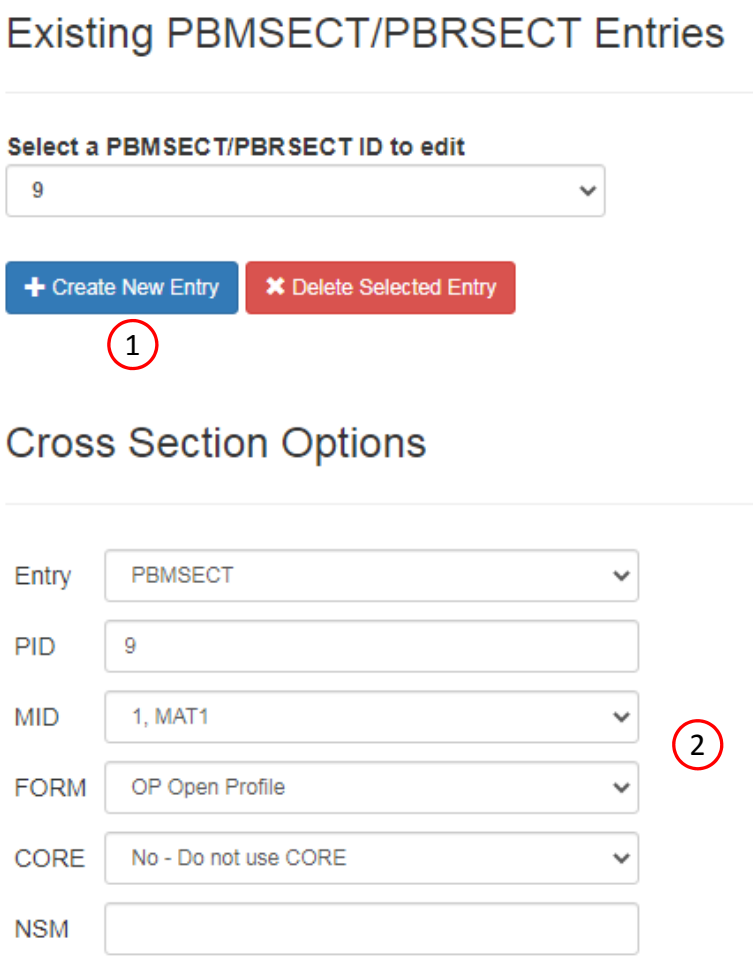
1. Click ZY View
2. Zoom in and center the cross section generated by MSC Nastran
3. Click Labels
4. Note the following:
   - Since the cross section is symmetric, the shear center and centroid coincide
   - CBAR elements are limited to cross sections that have coinciding shear center and centroid, so it is recommended that the arbitrary beam cross section, through the use of the PBRSECT entry, should be symmetric.



Cross Section 2

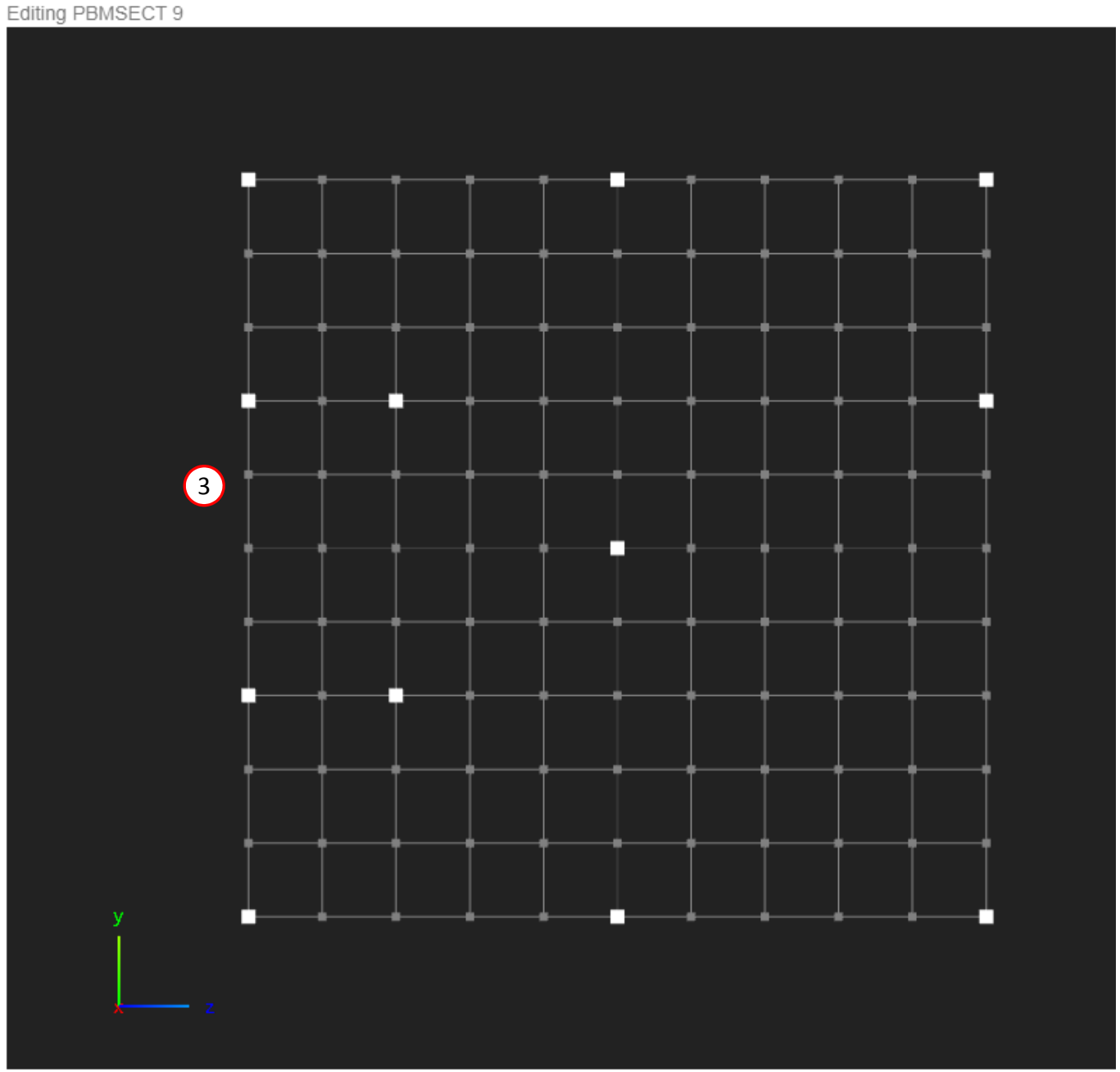
Create a New PBMSECT Entry

1. Click Create New Entry
2. Configure the Cross Section Options follows:
   - Entry: PBMSECT
   - PID: 9
   - MID: 1, MAT1
   - FORM: OP Open Profile
   - CORE: No – Do not use CORE
   - NSM: Blank



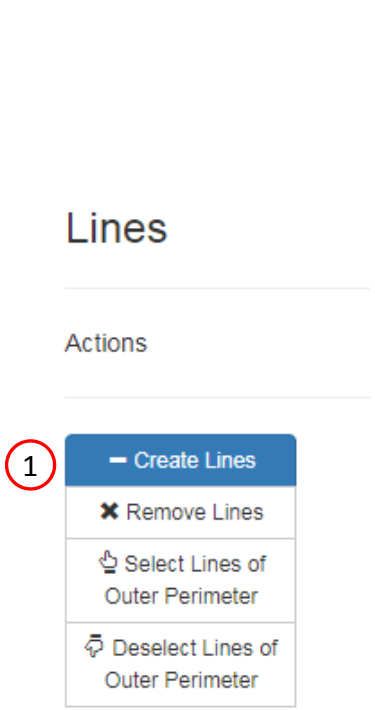
Points

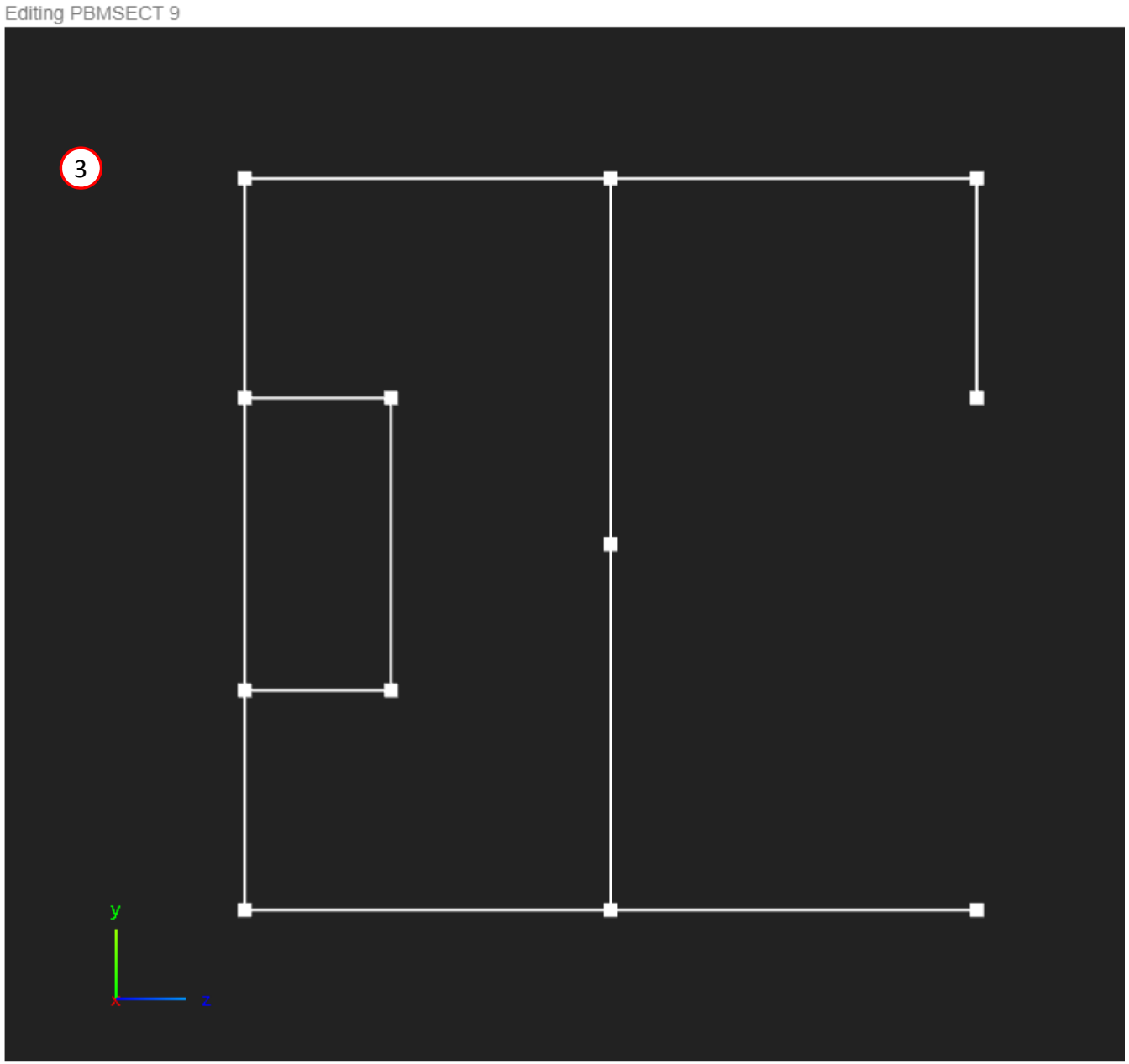
1. Click Create Points (The button should be blue)
2. Adjust the Grid Helper as follows
    1. Width and Height: 20
    2. Number of Divisions: 10
3. Click on the points on the Grid Helper to create 12 white points approximately in the same locations as shown in the image.



Lines

1. Click Create Lines
2. Click on 2 points to create one line
3. Repeat the process to create a total of 13 lines





Outer Perimeter

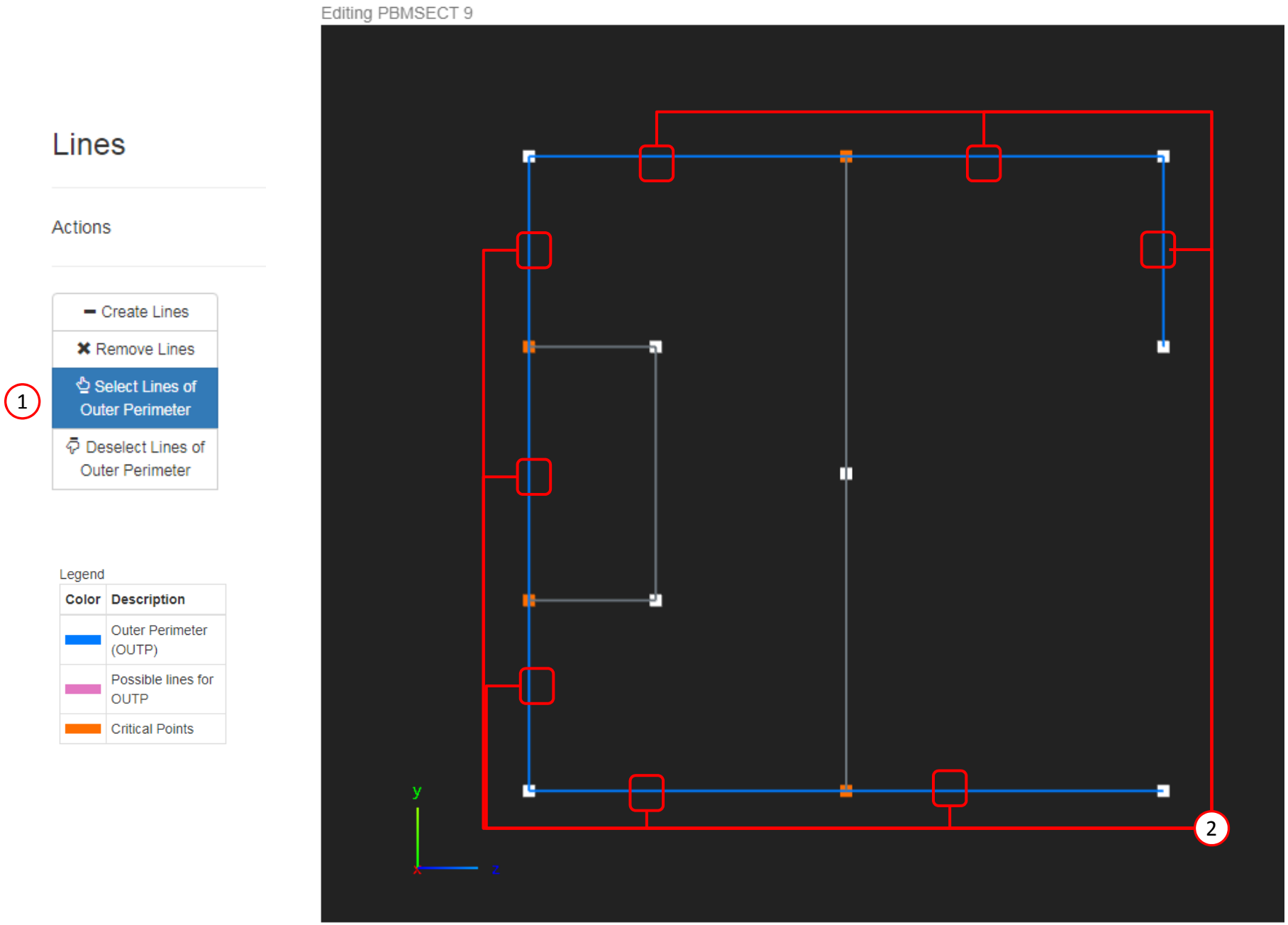
On this slide, the outer perimeter is defined, which corresponds to the OUTP keyword on the PBMSECT entry

1. Click Select Lines of Outer Perimeter
2. Click on the indicated lines to select the lines as part of the Outer Perimeter. Successful selection is indicated by a blue color.

When constructing open profile cross sections, one guideline is to ensure the outer perimeter goes through the critical points.

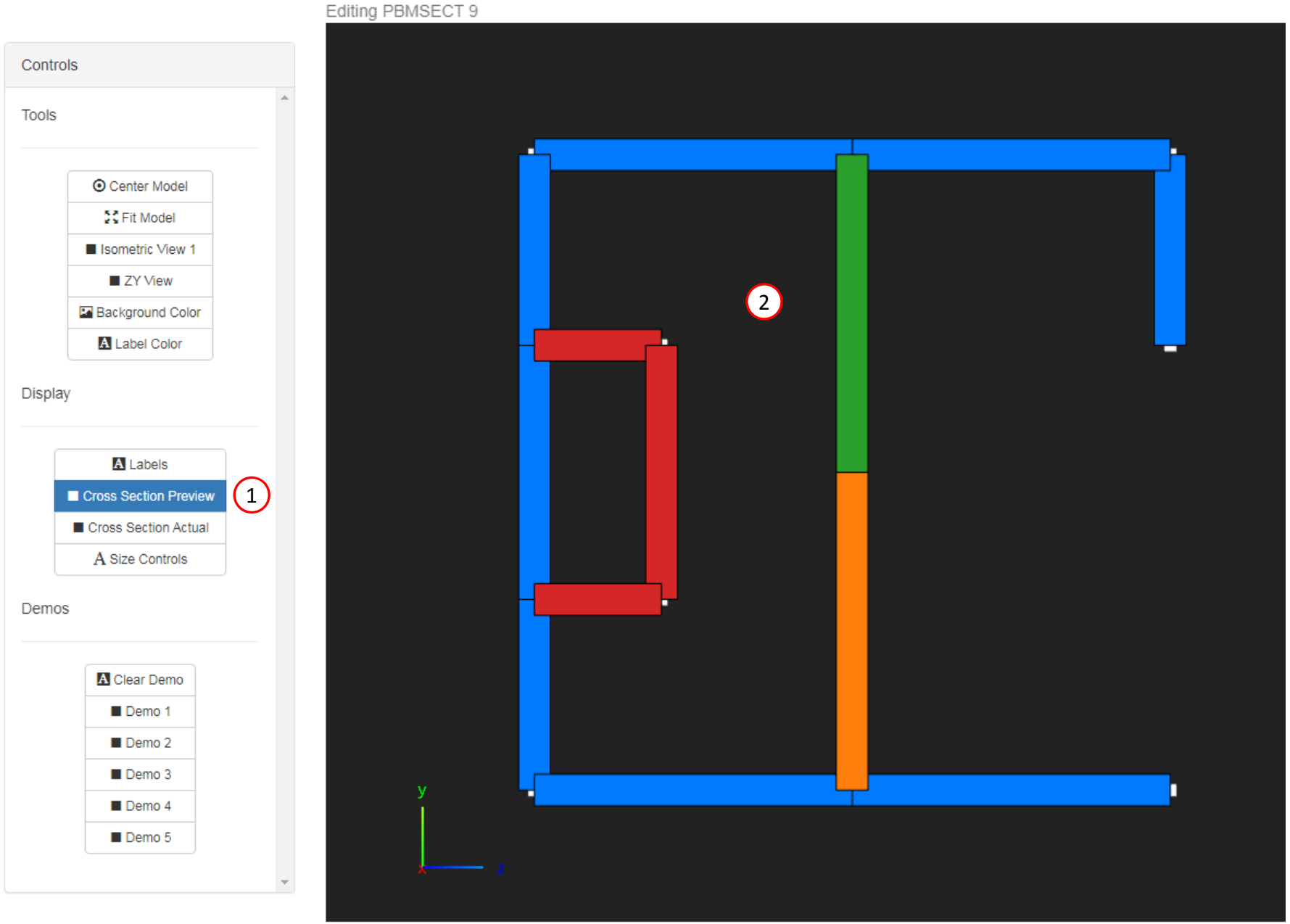
IMPORTANT!

Defining the outer perimeter is the most critical step in defining the PBMSECT/PBRSECT entry. Constantly inspect the outer perimeter. Only one continuous outer perimeters is valid.



Cross Section Preview

1. Click Cross Section Preview
2. A preview of the arbitrary beam cross section is displayed



Cross Section Preview

1. Set the default thickness for all the line segments to 1.0
2. Set the thickness to one of the BRP line segments to 2.0
3. The preview is updated with the latest thickness values

Lines

Actions

- Create Lines
- Remove Lines
- Select Lines of Outer Perimeter
- Deselect Lines of Outer Perimeter

Status:

Legend

Color	Description
	Outer Perimeter (OUTP)
	Possible lines for OUTP
	Critical Points

Adjustments

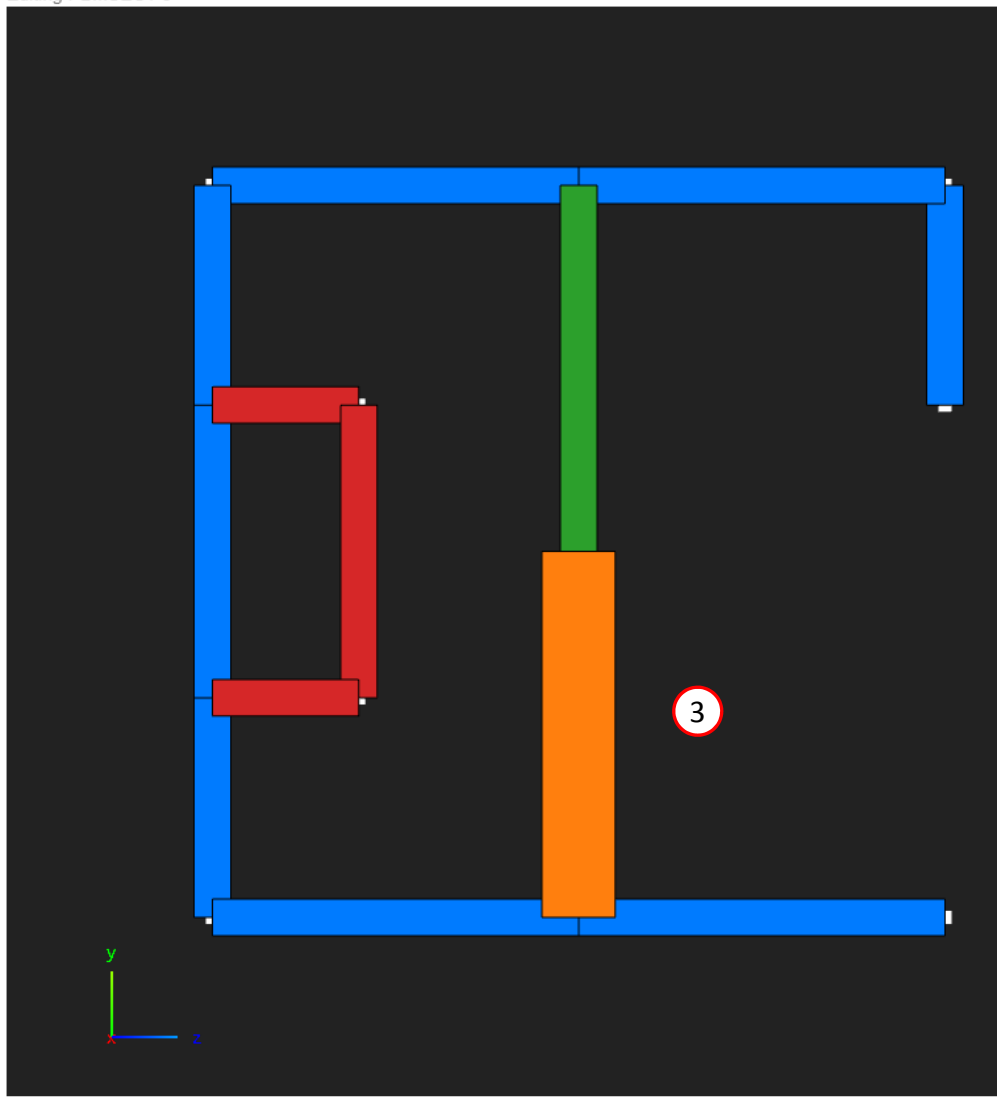
Default Thickness

1.0 (1)

Line Segments

Line ID	Type	Thickness
1	OUTP	
2	OUTP	
3	OUTP	
4	OUTP	
5	OUTP	
6	OUTP	
7	OUTP	
8	OUTP	
9	BRP 1	2. (2)
10	BRP 2	
11	BRP 3	
12	BRP 3	
13	BRP 3	

Editing PBMSECT 9



Run MSC Nastran to Generate the Cross Section

The following requires MSC Nastran to be installed on the same machine as the SOL 200 Web App.

1. The respective entries that define the arbitrary beam cross section are displayed
2. Click Run MSC Nastran
   - The web app will run MSC Nastran in the background and determine the cross section generated by MSC Nastran. This MSC Nastran run should take no more than 10 seconds. MSC Nastran must be installed on the machine as the SOL 200 Web App.
3. If the run is successful, the MSC Nastran generated cross section is displayed
4. Inspect the F06 file to inspect the result of the run
5. The test BDF file used for this test run may be downloaded by clicking Download Test BDF File

Run MSC Nastran and Bulk Data Entries

5

Download Test BDF File | Run MSC Nastran (2) | Complete

Corresponding Bulk Data Entries

```
$   1 ||   2 ||   3 ||   4 ||   5 ||   6 ||   7 ||   8 ||   9 ||  10 |

PBMSECT 9       1       OP
        OUTP=901,BRP(1)=902,BRP(2)=903,BRP(3)=904,T=1.0,T(1)=[2.,PT=(900
        0008,9000010)]
POINT   9000001         10.     4.
POINT   9000002         10.     10.
POINT   9000003         0.0     10.
POINT   9000004         -10.    10.
POINT   9000005         -10.    4.
POINT   9000006         -10.    -4.
POINT   9000007         -10.    -10.
POINT   9000008         0.0     -10.
POINT   9000009         10.     -10.
POINT   9000010         0.0     0.0
POINT   9000011         -6.     4.
POINT   9000012         -6.     -4.
SET1    901     9000001 9000002 9000003 9000004 9000005 9000006 9000007
        9000008 9000009
SET1    902     9000008 9000010
SET1    903     9000010 9000003
SET1    904     9000005 9000011 9000012 9000006
```

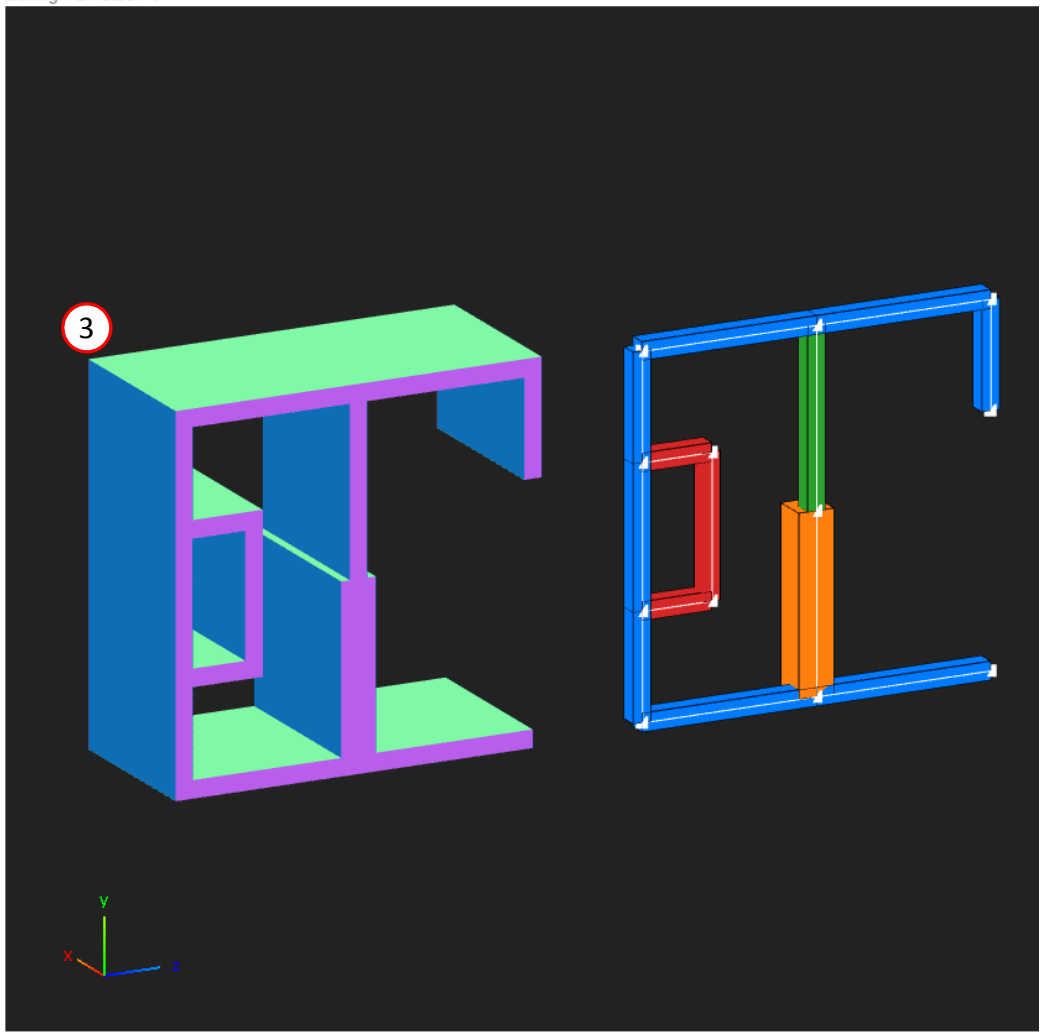
(1)

F06

```
Command executed: /msc/MSC_Nastran/2022.1/bin/msc20221 nastran ./tmp/854e82ee40045805a441ff1e2

1

                    Warning: This computer program is protected by copyright law and interna
                Unauthorized use, reproduction or distribution of this computer program, or
                                    result in severe civil and criminal penalties.
                        Copyright (C) 2022 Hexagon AB and/or its subsidiaries. All rights res

                                                * * * * * * * * * * * * * * * * * * * *
                                                * * * * * * * * * * * * * * * * * * * *
                                                * *                               * *
                                                * *          Hexagon AB           * *
```

(4)

Editing PBMSECT 9



Run MSC Nastran to Generate the Cross Section

1. If the MSC Nastran run was a success, an equivalent PBEAM entry is generated and listed in the F06 file. This PBEAM entry displays cross section information such as the cross sectional area and moments of inertia.
   - If a PBRSECT entry is created, a PBAR entry is generated.
   - If a PBMSECT is created with the CORE keyword, which is used for a composite section, a PBEAM3 entry is generated.
   - If a regular PBMSECT entry is created, a PBEAM entry is generated.

```
^^^
*** USER INFORMATION MESSAGE 4379 (IFP9A)
    THE USER SUPPLIED PBEAML/PBMSECT BULK DATA ENTRIES ARE REPLACED BY THE FOLLOWING PBEAM ENTRIE
    CONVERSION METHOD FOR PBARL/PBEAML - FINITE ELEMENT METHOD.
 PBEAM             9           1  1.0950E+02  6.0040E+03  4.1280E+03  4.1587E+02  3.0625E+03  0.
           7.2773E+00  1.6693E+01  1.7773E+00  1.7693E+01 -1.2723E+01  1.7193E+01 -1.1723E+01  1.
           3.7010E-01  2.4948E-01  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  1.6612E+05  1.
           0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00 -2.2501E+00  4.9818E+00 -2.2501E+00  4.
```

1

PBEAM Beam Property

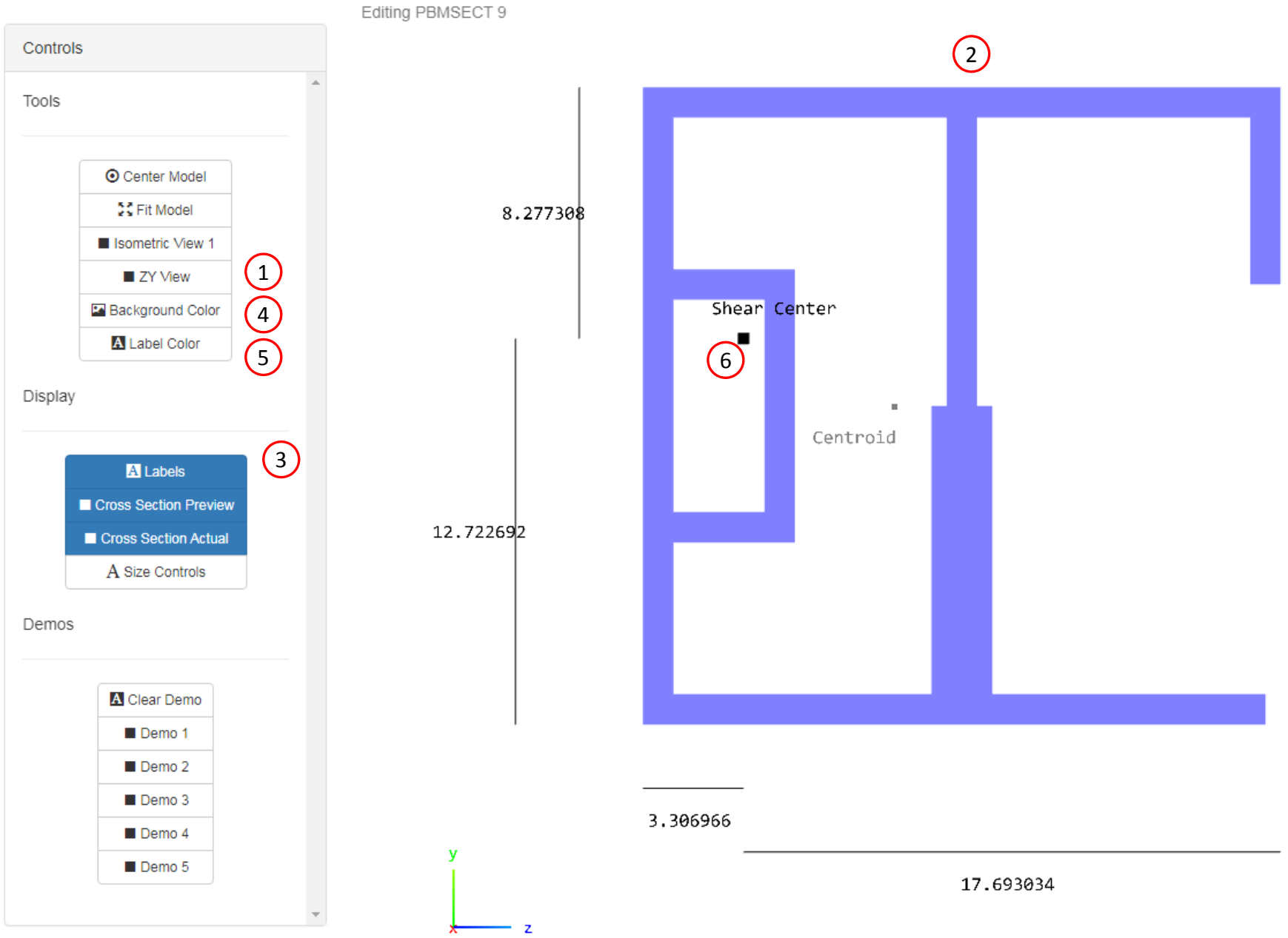
Defines the properties of a beam element (CBEAM entry). This element may be used to model tapered beams.

Format:

1	2	3	4	5	6	7	8	9	10
PBEAM	PID	MID	A(A)	I1(A)	I2(A)	I12(A)	J(A)	NSM(A)	
	C1 (A)	C2 (A)	D1 (A)	D2 (A)	E1 (A)	E2 (A)	F1 (A)	F2 (A)	

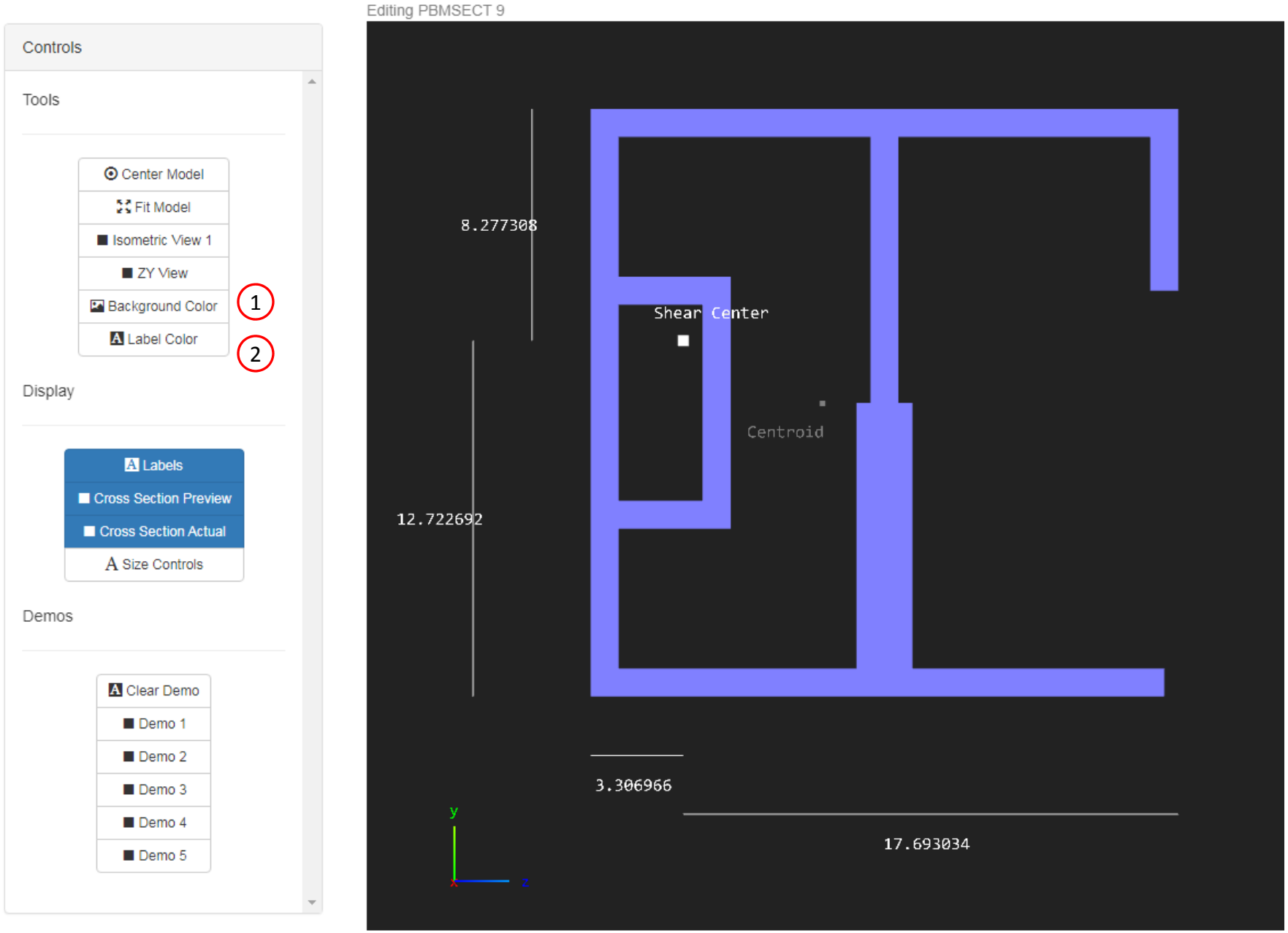
Cross Section Preview

1. Click ZY View
2. Zoom in and center the cross section generated by MSC Nastran
3. Click Labels
4. Click Background Color to change the background to a white color
5. Click Label Color multiple times to change the font color to your liking
6. Note the following:
   - Since the cross section is unsymmetric, the shear center and centroid do not coincide
   - CBEAM elements support cross sections that do not have coinciding shear center and centroid



Cross Section Preview

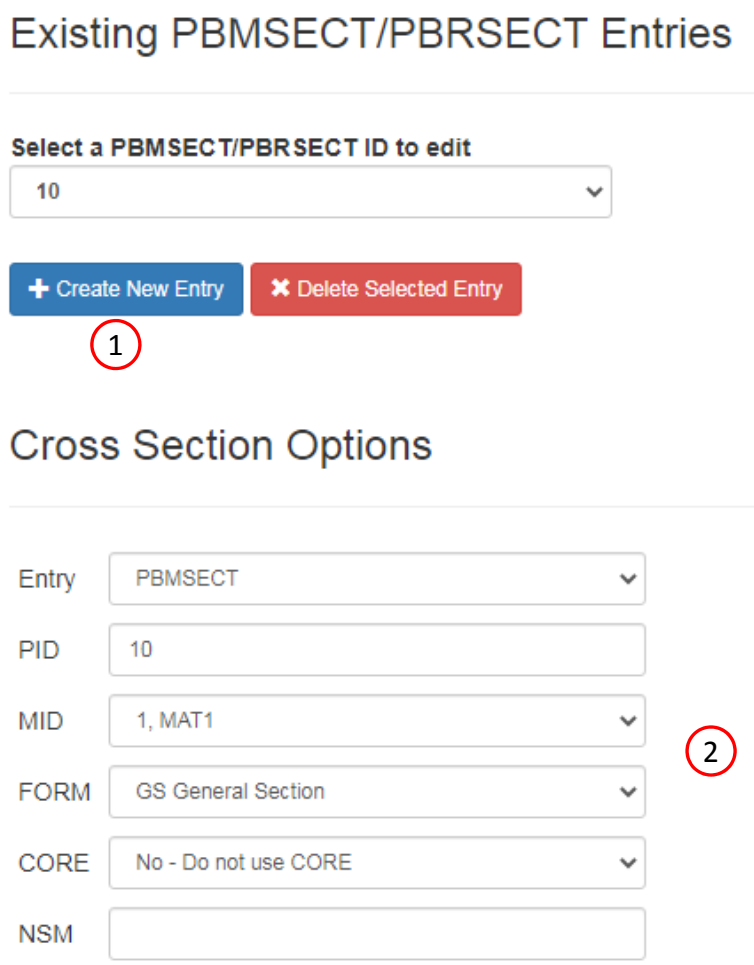
1. Click Background Color to change the background to a black color
2. Click Label Color multiple times to change the font color to your liking



Cross Section 3

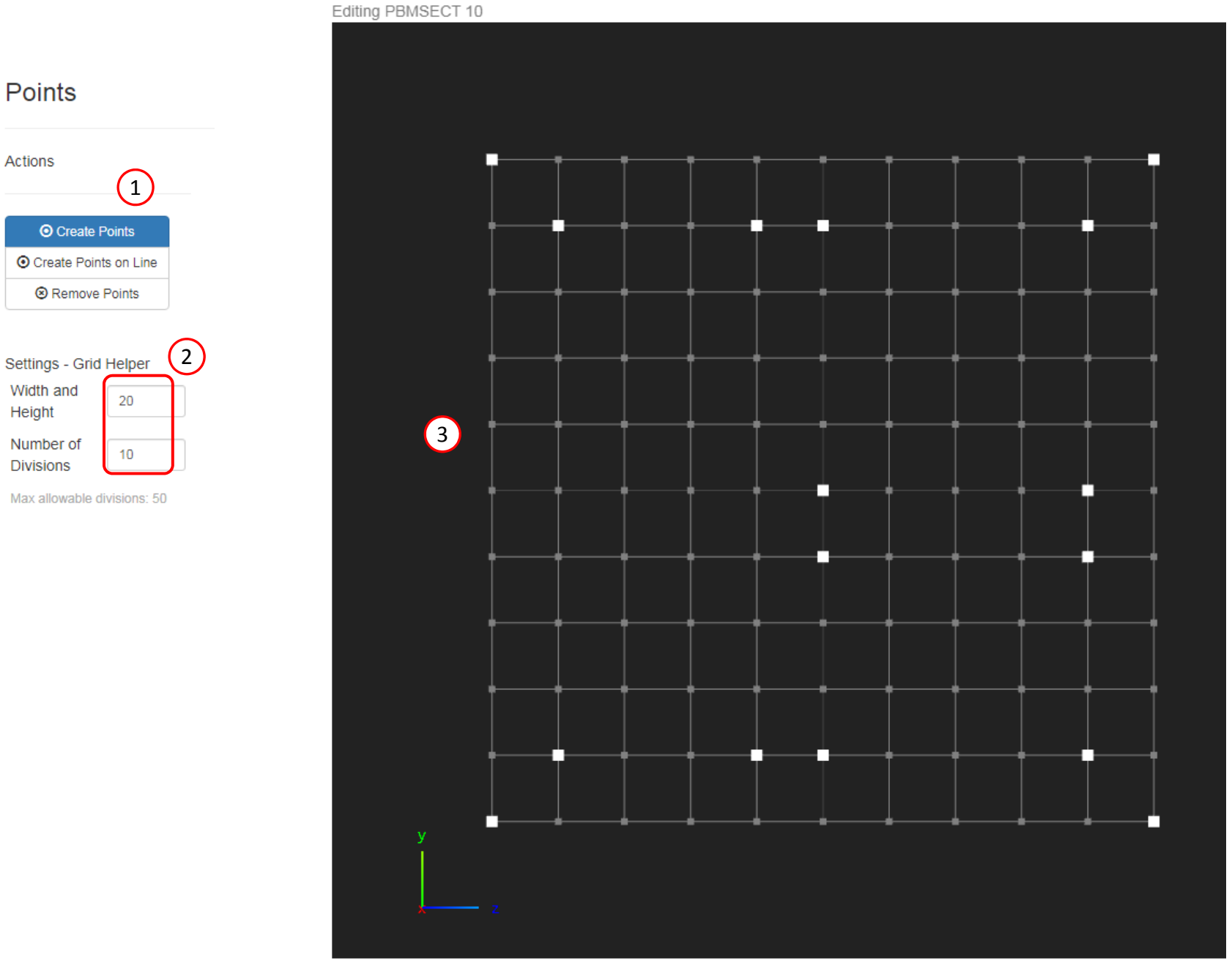
Create a New PBMSECT Entry

1. Click Create New Entry
2. Configure the Cross Section Options follows:
   - Entry: PBMSECT
   - PID: 10
   - MID: 1, MAT1
   - FORM: GS General Section
   - CORE: No – Do not use CORE
   - NSM: Blank



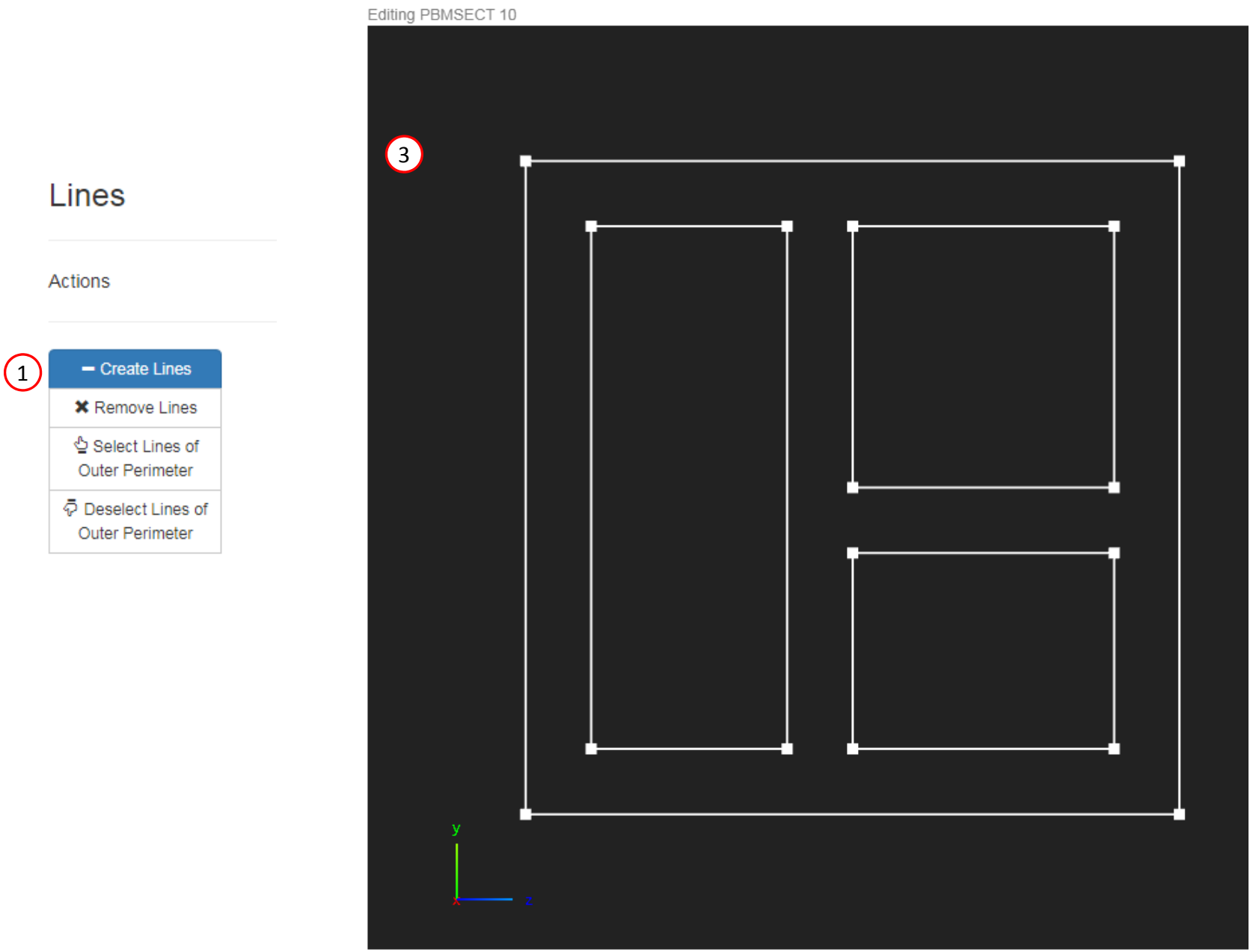
Points

1. Click Create Points (The button should be blue)
2. Adjust the Grid Helper as follows
   1. Width and Height: 20
   2. Number of Divisions: 10
3. Click on the points on the Grid Helper to create 16 white points approximately in the same locations as shown in the image.



Lines

1. Click Create Lines
2. Click on 2 points to create one line
3. Repeat the process to create a total of 16 lines



Outer Perimeter

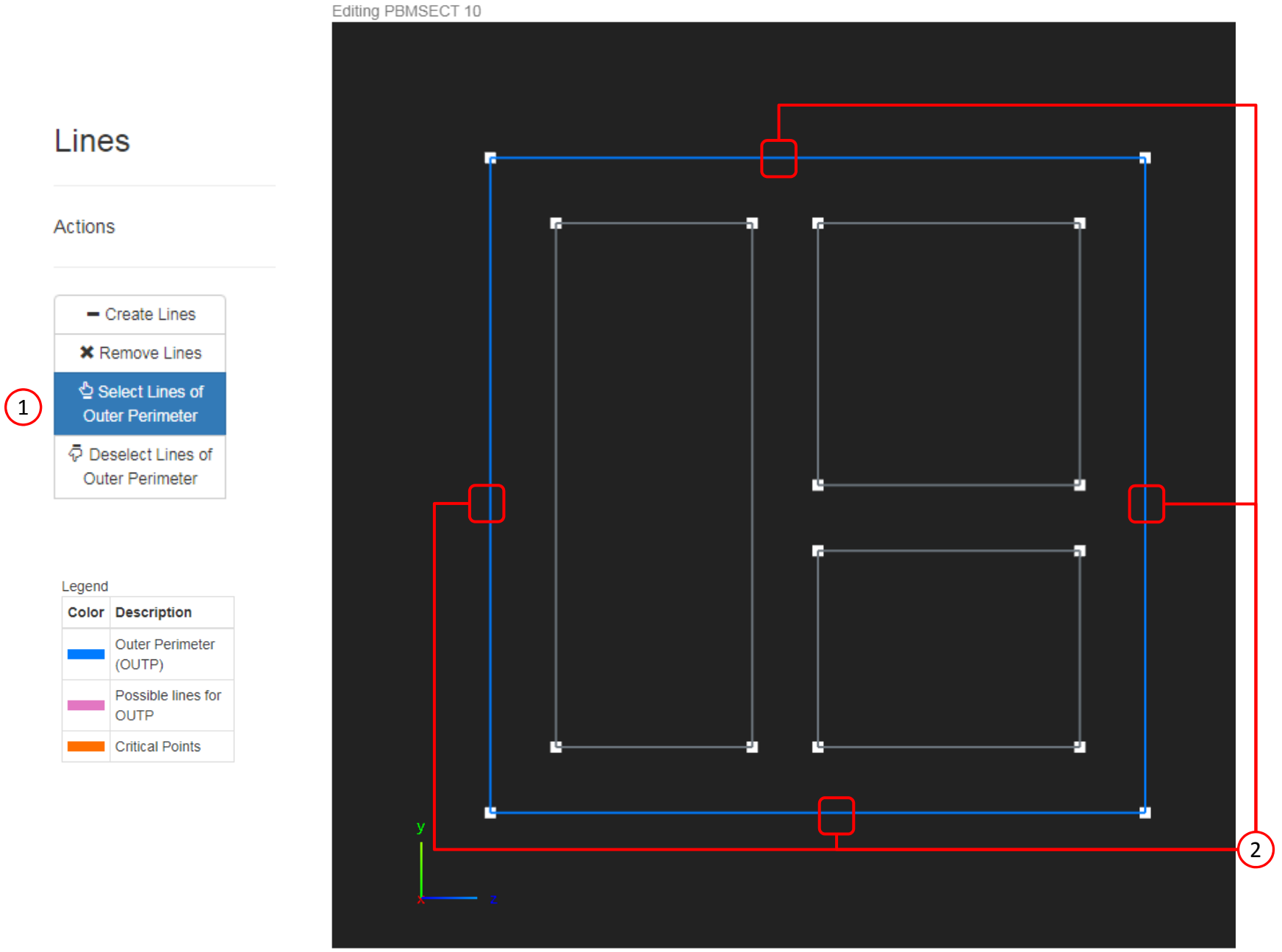
On this slide, the outer perimeter is defined, which corresponds to the OUTP keyword on the PBMSECT entry

1. Click Select Lines of Outer Perimeter
2. Click on the indicated lines to select the lines as part of the Outer Perimeter. Successful selection is indicated by a blue color.

When constructing open profile cross sections, one guideline is to ensure the outer perimeter goes through the critical points.

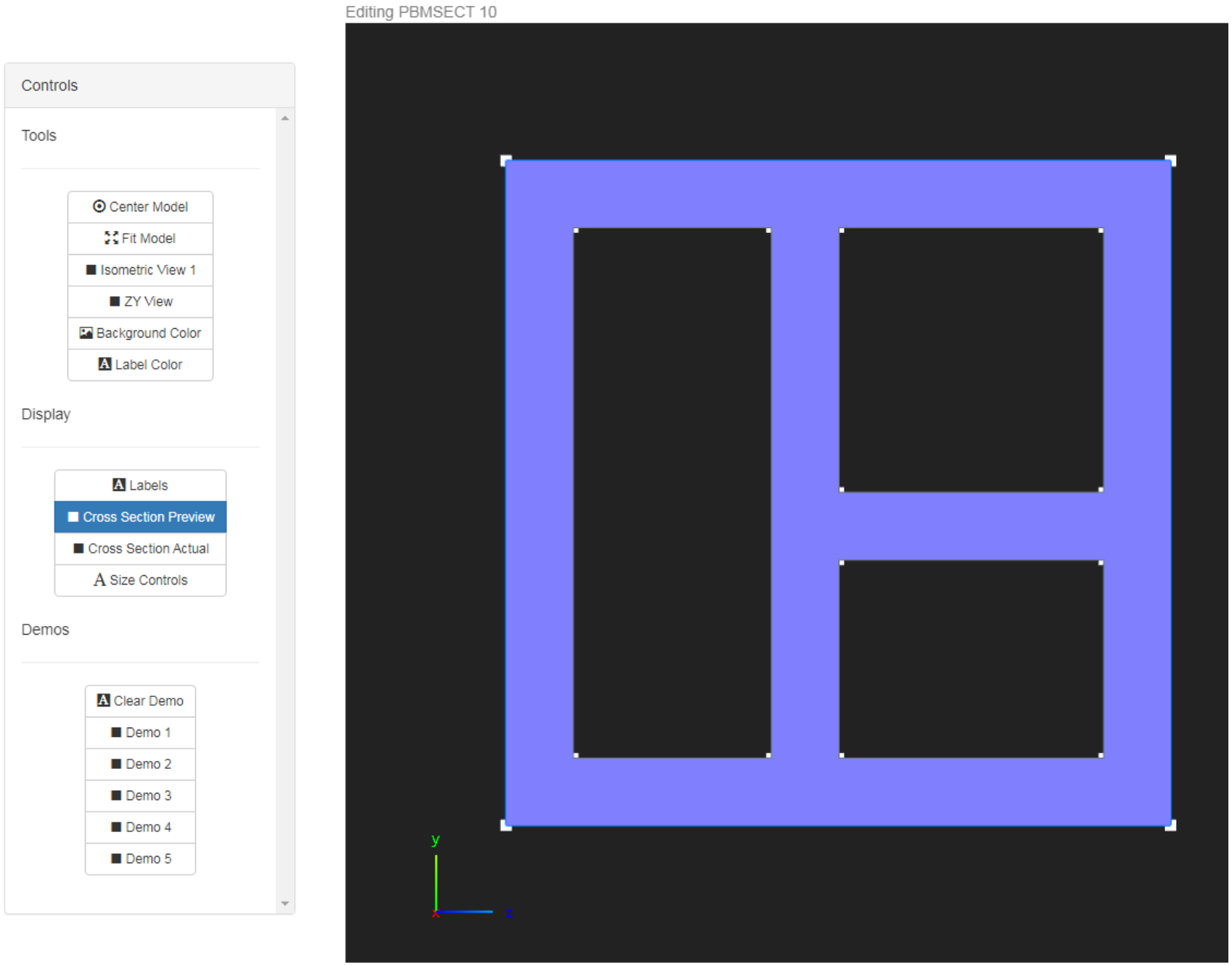
IMPORTANT!

Defining the outer perimeter is the most critical step in defining the PBMSECT/PBRSECT entry. Constantly inspect the outer perimeter. Only one continuous outer perimeters is valid.



Cross Section Preview

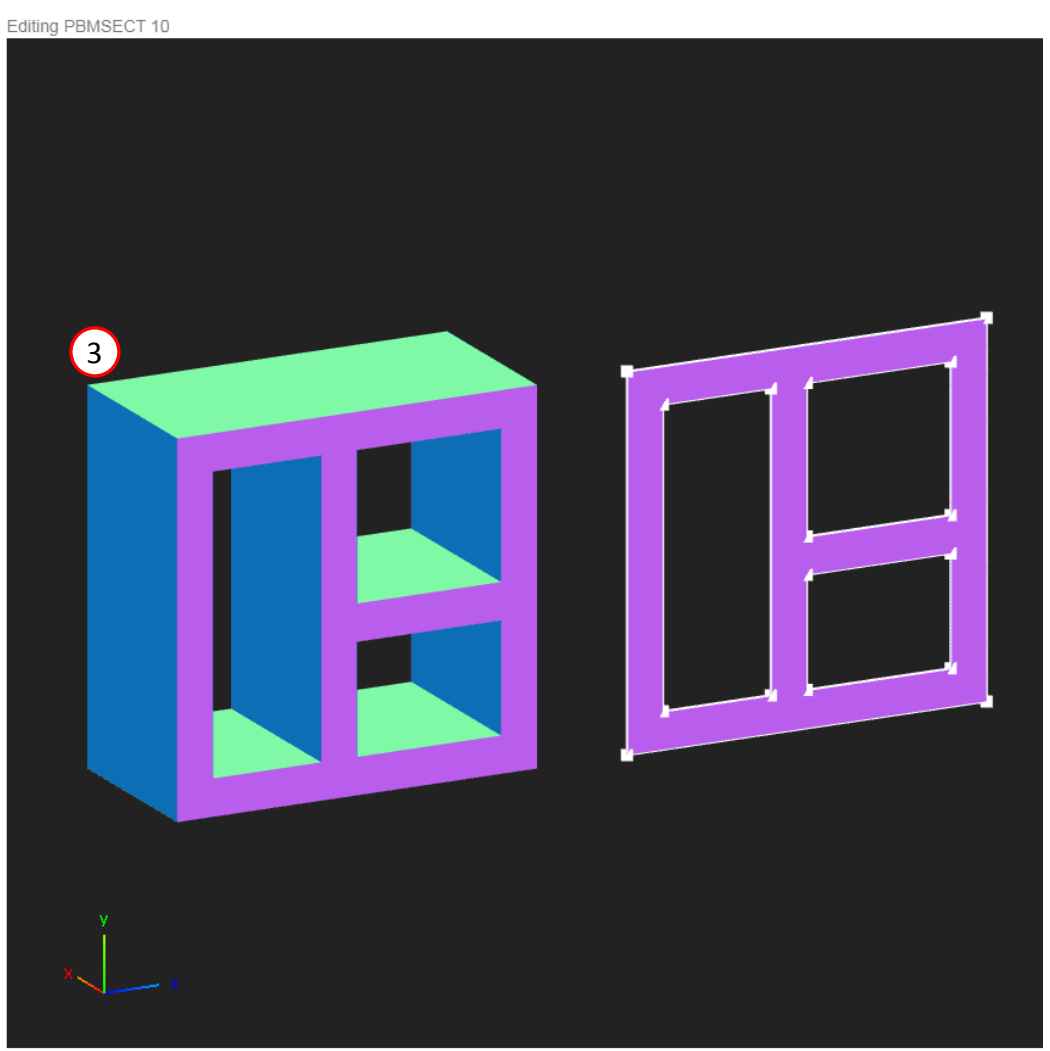
1. Click Cross Section Preview
2. A preview of the arbitrary beam cross section is displayed



Run MSC Nastran to Generate the Cross Section

The following requires MSC Nastran to be installed on the same machine as the SOL 200 Web App.

1. The respective entries that define the arbitrary beam cross section are displayed
2. Click Run MSC Nastran
   - The web app will run MSC Nastran in the background and determine the cross section generated by MSC Nastran. This MSC Nastran run should take no more than 10 seconds. MSC Nastran must be installed on the machine as the SOL 200 Web App.
3. If the run is successful, the MSC Nastran generated cross section is displayed
4. Inspect the F06 file to inspect the result of the run
5. The test BDF file used for this test run may be downloaded by clicking Download Test BDF File



Run MSC Nastran to Generate the Cross Section

1. If the MSC Nastran run was a success, an equivalent PBEAM entry is generated and listed in the F06 file. This PBEAM entry displays cross section information such as the cross sectional area and moments of inertia.
   - If a PBRSECT entry is created, a PBAR entry is generated.
   - If a PBMSECT is created with the CORE keyword, which is used for a composite section, a PBEAM3 entry is generated.
   - If a regular PBMSECT entry is created, a PBEAM entry is generated.

```
^^^
*** USER INFORMATION MESSAGE 4379 (IFP9A)
    THE USER SUPPLIED PBEAML/PBMSECT BULK DATA ENTRIES ARE REPLACED BY THE FOLLOWING PBEAM ENTRIE
    CONVERSION METHOD FOR PBARL/PBEAML - FINITE ELEMENT METHOD.
 PBEAM             10           1  1.9200E+02  8.5747E+03  8.2507E+03 -6.1333E+01  1.2504E+04  0.
           1.0174E+01  1.0284E+01  1.0174E+01 -9.7164E+00 -9.8264E+00 -9.7164E+00 -9.8264E+00  1.
           5.5297E-01  4.1815E-01  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  1.9821E+03  1.
           0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  9.0228E-02  4.5026E-01  9.0228E-02  4.
```

1

PBEAM Beam Property

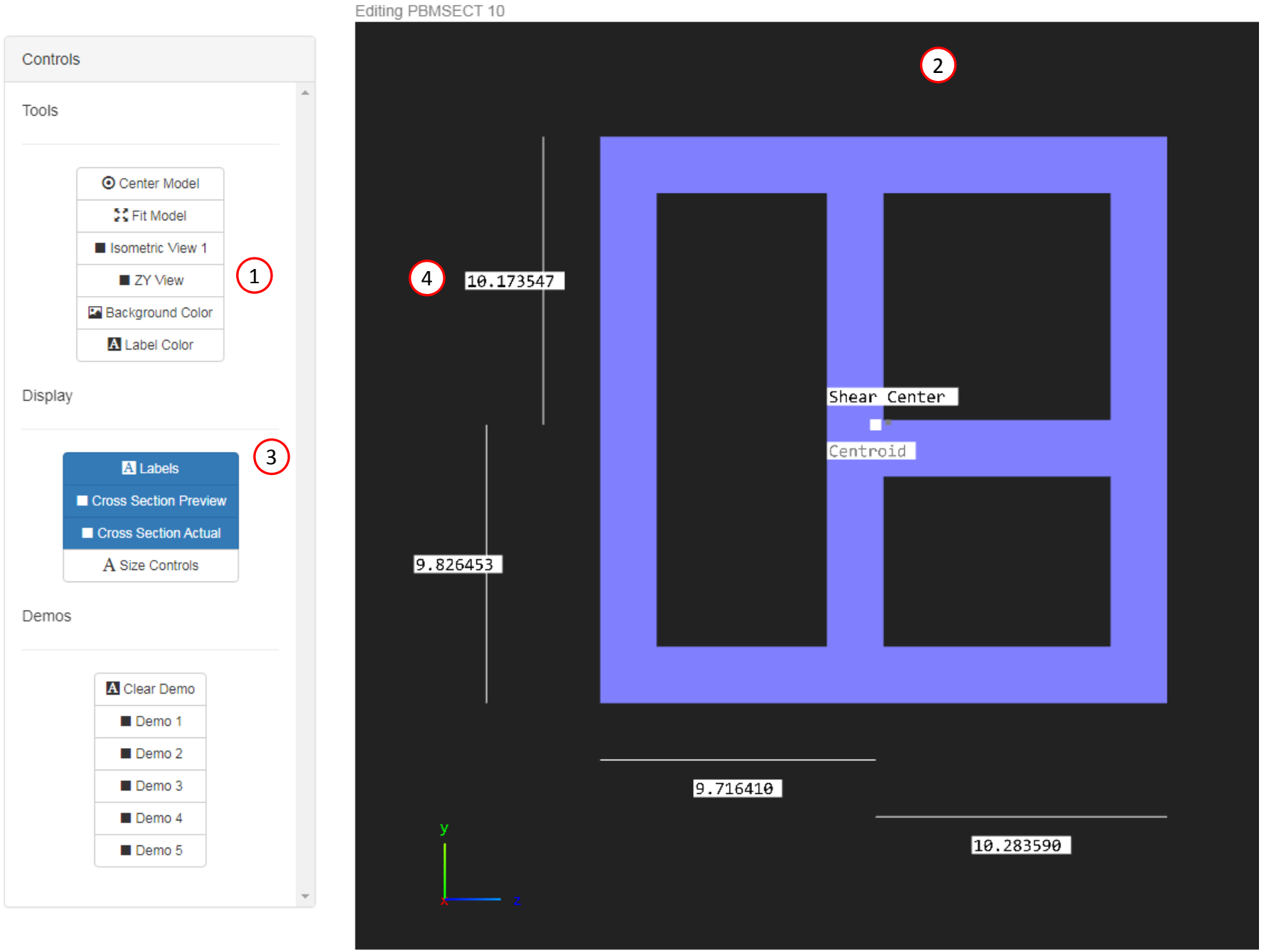
Defines the properties of a beam element (CBEAM entry). This element may be used to model tapered beams.

Format:

1	2	3	4	5	6	7	8	9	10
PBEAM	PID	MID	A(A)	I1(A)	I2(A)	I12(A)	J(A)	NSM(A)	
	C1 (A)	C2 (A)	D1 (A)	D2 (A)	E1 (A)	E2 (A)	F1 (A)	F2 (A)	

Cross Section Preview

1. Click ZY View
2. Zoom in and center the cross section generated by MSC Nastran
3. Click Labels
4. Note the following:
   - Distance markers are visible from the shear center to the outer fibers



Download an Updated BDF File

Download BDF Files

1. Navigate to the Download section
2. The Download Information section provides details regarding how the original BDF files will be edited and downloaded
3. Click Download BDF Files

1

Download Information

The following PBMSECT/PBRSECT entries, and respective POINT and SET1 entries, have been edited in this web app and will be updated in the downloaded BDF files.

2

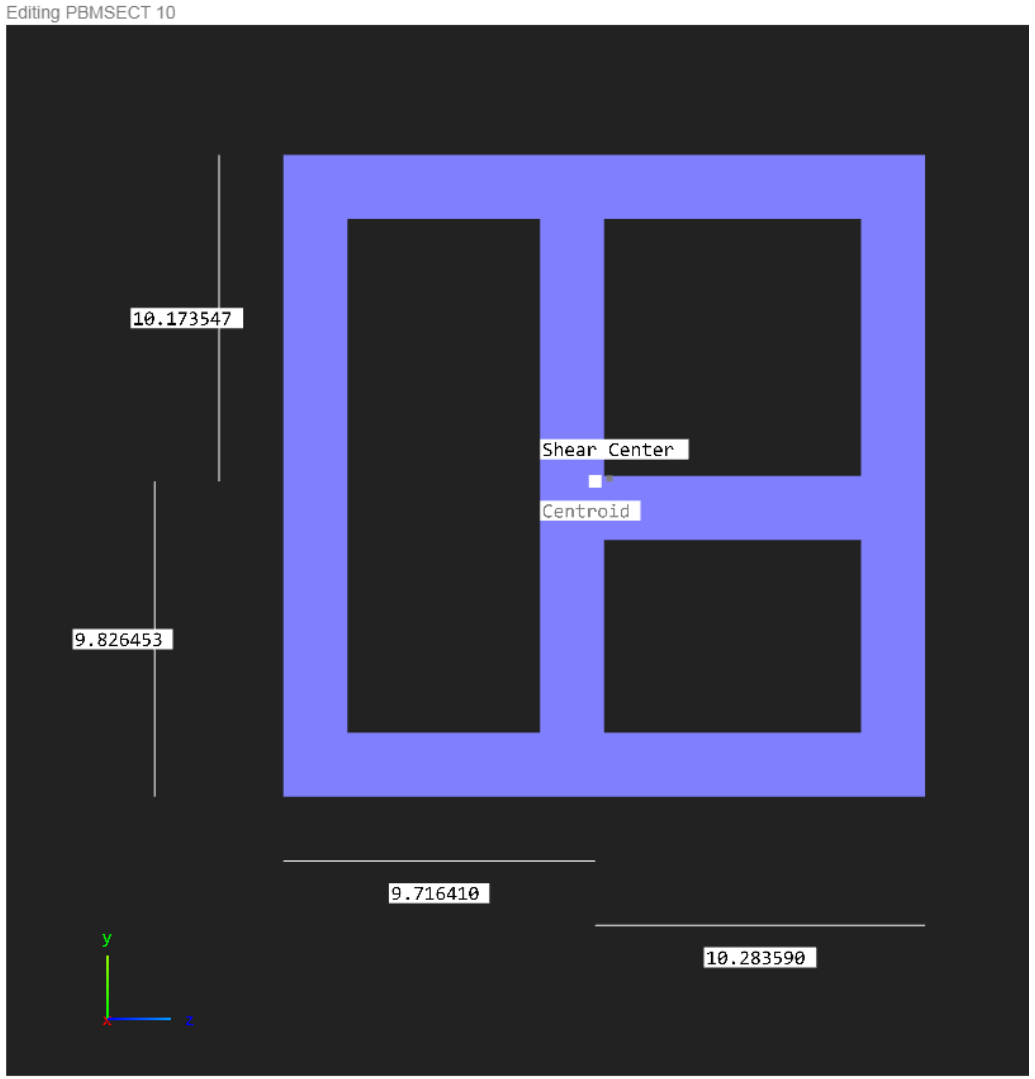
Changes will be made at BEGINBU LK or near lines [12] in file examples_of_abcs.bdf.

Entry	PID
PBRSECT	8
PBMSECT	9
PBMSECT	10

Download

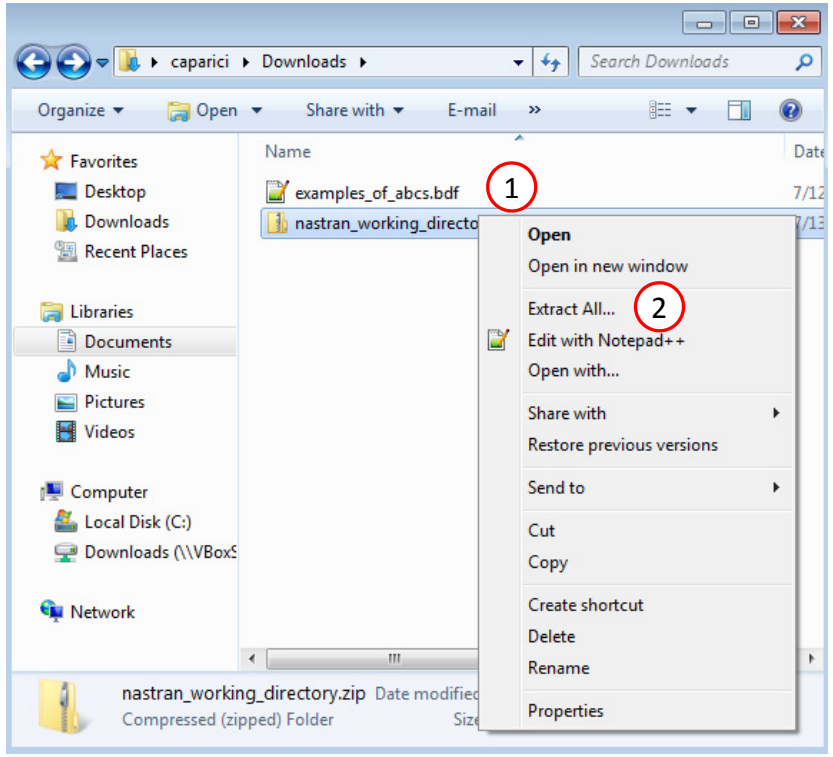
Download BDF Files

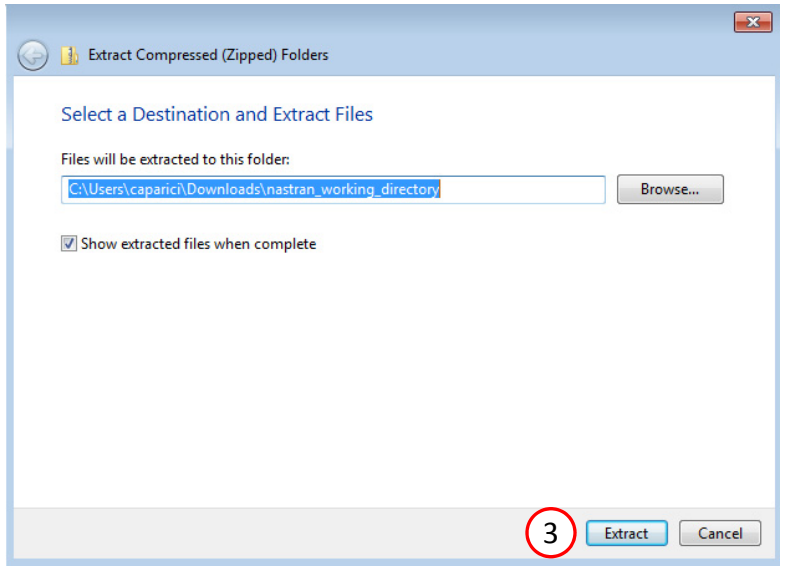
3

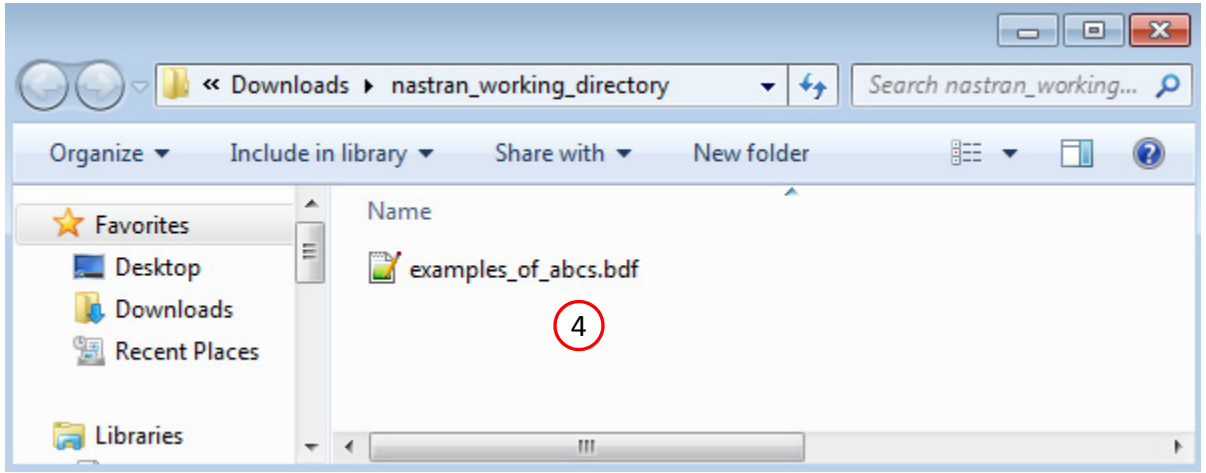


Extract the ZIP File

1. A new file nastran_working_directory.zip has been downloaded
2. Right click on the ZIP file and click Extract All
3. Click Extract
4. A new folder nastran_working_directory is created and inside is the updated examples_of_abcs.bdf file







Compare the Original and New BDF Files

The file examples_of_abcs.bdf currently has multiple line elements configured to use PBAR 5, PBEAM 6 and PBEAM 7. The entries will no longer be used and these entries are renumbered.

1. Open the new file examples_of_abcs.bdf in a text editor (Not shown)
2. Change the ID of the PBAR 5 to 1
3. Change the ID of the PBAR 6 to 2
4. Change the ID of the PBAR 7 to 3
5. Save the edits (not shown)

Before

```
PBAR    5       1       9.90E1  5.91E3  5.34E3  8.22E3  0.0
        1.05E1  1.05E1  1.05E1  2.07-16-1.05E1 -1.05E1 -1.05E1  1.05E1
        5.E-1   3.E-1   0.0
PBEAM   6       1       8.85E1  5.55E3  4.17E3  5.60E2  2.77E3  0.0
        6.1354  1.86E1 -1.48E1  1.81E1 -1.38E1  1.81E1 -3.9212  1.86E1
        3.E-1   3.E-1   0.0     0.0     0.0     0.0     2.73E5  2.73E5
        0.0     0.0     0.0     0.0    -3.7997  7.0130 -3.7997  7.0130
PBEAM   7       1       1.76E2  8.55E3  7.90E3 -8.26-13 1.24E4  0.0
        1.00E1  1.03E1  1.00E1 -9.6507 -9.9995 -9.6507 -9.9995  1.03E1
        5.E-1   3.E-1   0.0     0.0     0.0     0.0     1.75E3  1.75E3
        0.0     0.0     0.0     0.0     5.E-4   1.E-1   5.E-4   1.E-1
ENDDATA
```

1

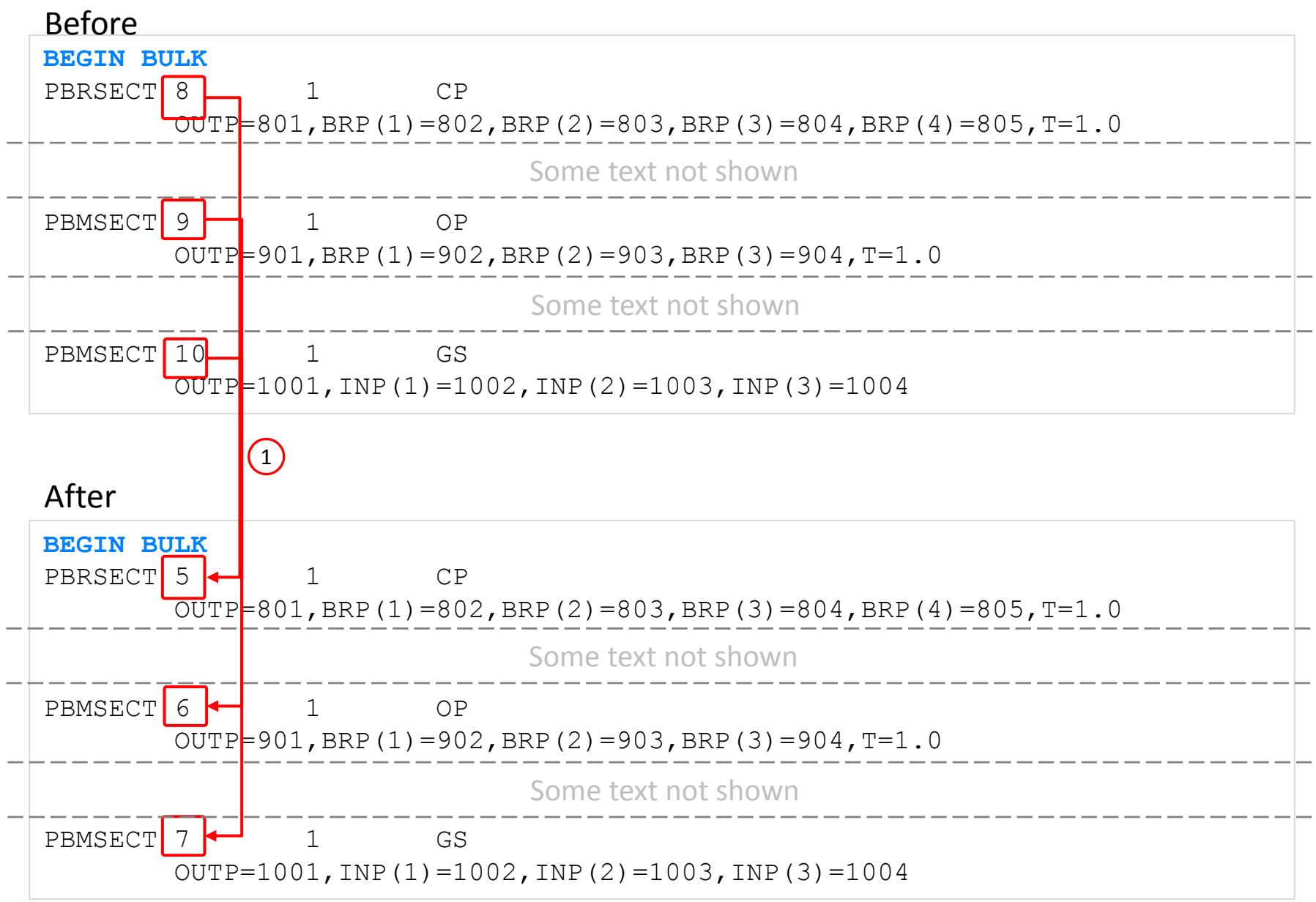
After

```
PBAR    1       1       9.90E1  5.91E3  5.34E3  8.22E3  0.0
        1.05E1  1.05E1  1.05E1  2.07-16-1.05E1 -1.05E1 -1.05E1  1.05E1
        5.E-1   3.E-1   0.0
PBEAM   2       1       8.85E1  5.55E3  4.17E3  5.60E2  2.77E3  0.0
        6.1354  1.86E1 -1.48E1  1.81E1 -1.38E1  1.81E1 -3.9212  1.86E1
        3.E-1   3.E-1   0.0     0.0     0.0     0.0     2.73E5  2.73E5
        0.0     0.0     0.0     0.0    -3.7997  7.0130 -3.7997  7.0130
PBEAM   3       1       1.76E2  8.55E3  7.90E3 -8.26-13 1.24E4  0.0
        1.00E1  1.03E1  1.00E1 -9.6507 -9.9995 -9.6507 -9.9995  1.03E1
        5.E-1   3.E-1   0.0     0.0     0.0     0.0     1.75E3  1.75E3
        0.0     0.0     0.0     0.0     5.E-4   1.E-1   5.E-4   1.E-1
ENDDATA
```

Compare the Original and New BDF Files

The newest PBRSECT and PBMSECT entries are renumbered. Once this is done, the existing line elements will use the newest PBRSECT and PBMSECT entries.

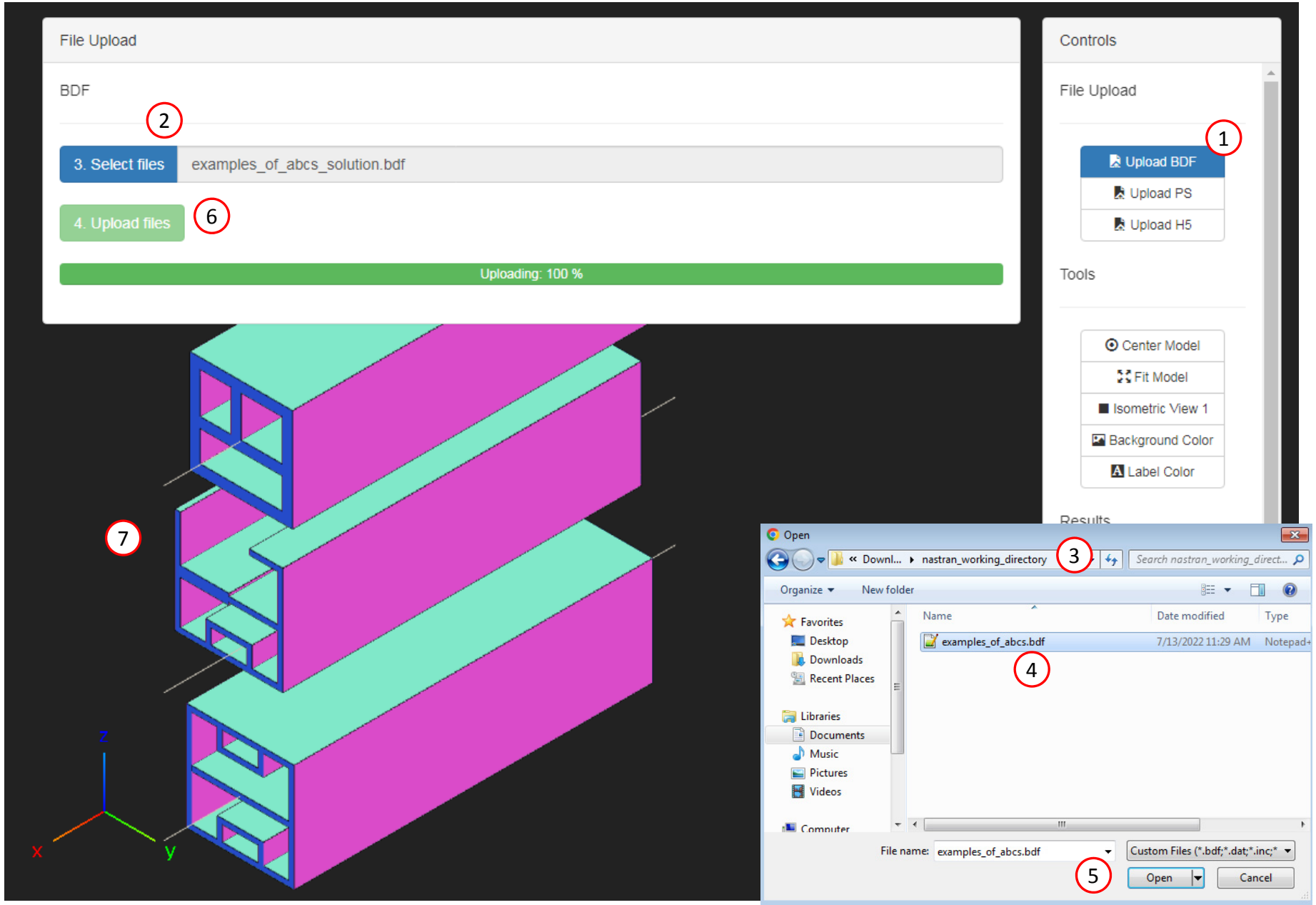
1. Open the new file examples_of_abcs.bdf in a text editor (Not shown)
2. Change the ID of the PBRSECT 8 to 5
3. Change the ID of the PBMSECT 9 to 6
4. Change the ID of the PBMSECT 10 to 7
5. Save the edits (not shown)



View the Model in the Viewer

Open the Viewer in a new web browser tab or window (Not shown)

1. Click Upload BDF
2. Click Select files
3. Navigate to the directory nastran_working_directory
4. Select examples_of_abcs.bdf
5. Click Open
6. Click Upload files
7. The MSC Nastran model has been uploaded to the Viewer
   - Notice the cross section is now the ABCS that was defined in the PBMSECT web app



End of Tutorial

Appendix

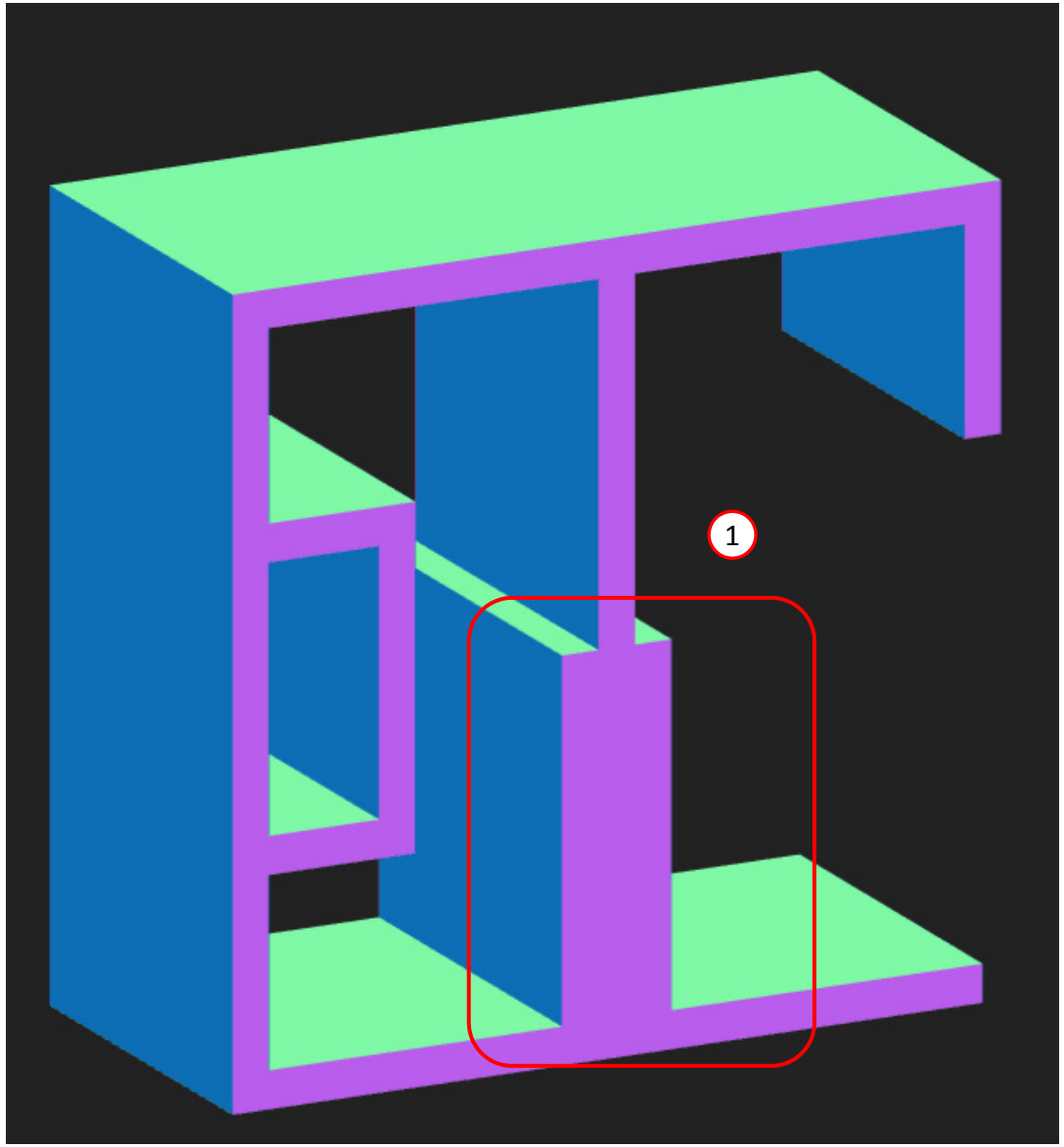
Appendix Contents

- Avoid T Keyword and SET1 Conflicts

Avoid T Keyword and SET1 Conflicts

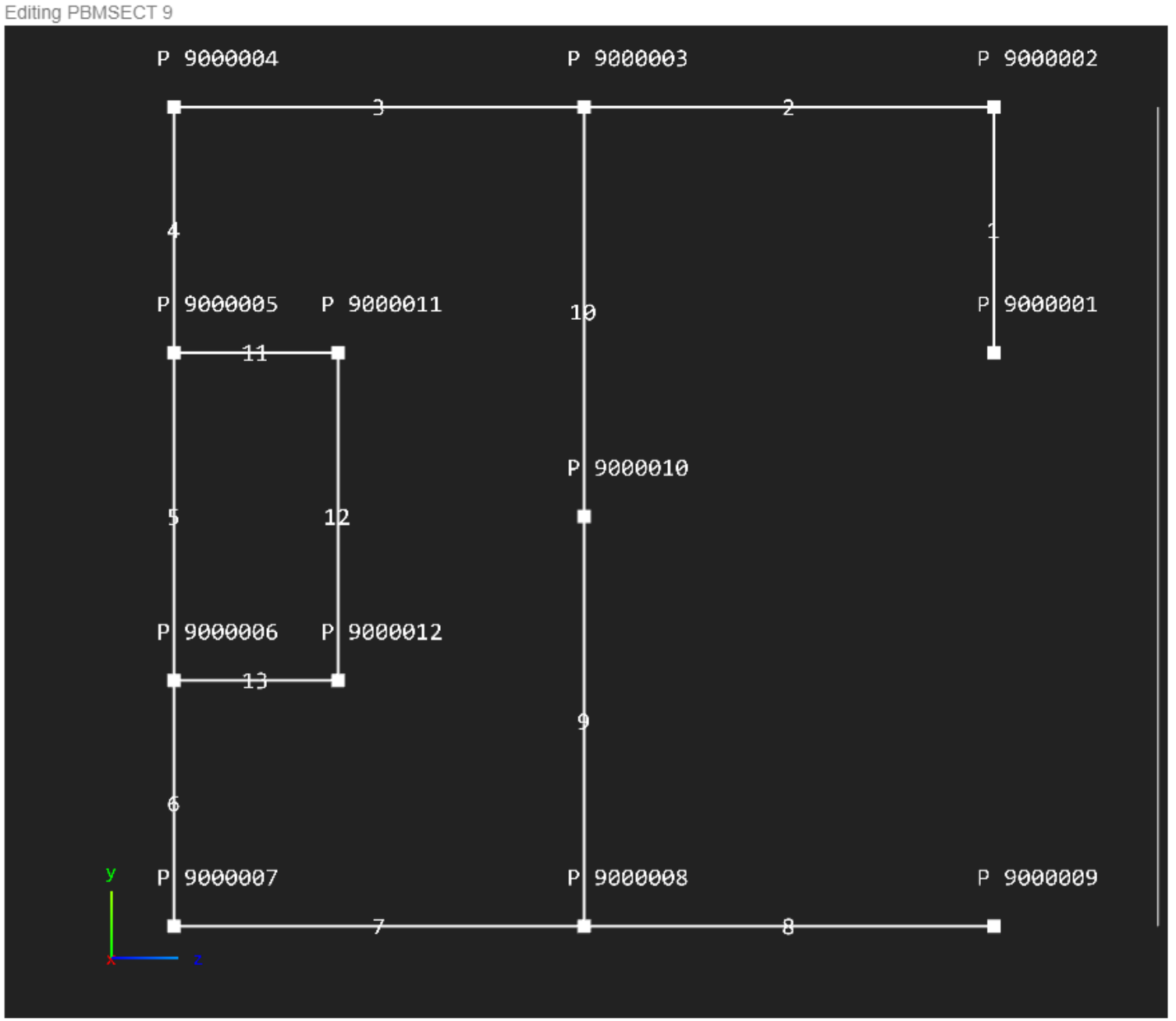
Avoid T Keyword and SET1 Conflicts

1. Recall that one of the cross sections assigned a thickness value of 2.0 to one of the lines.



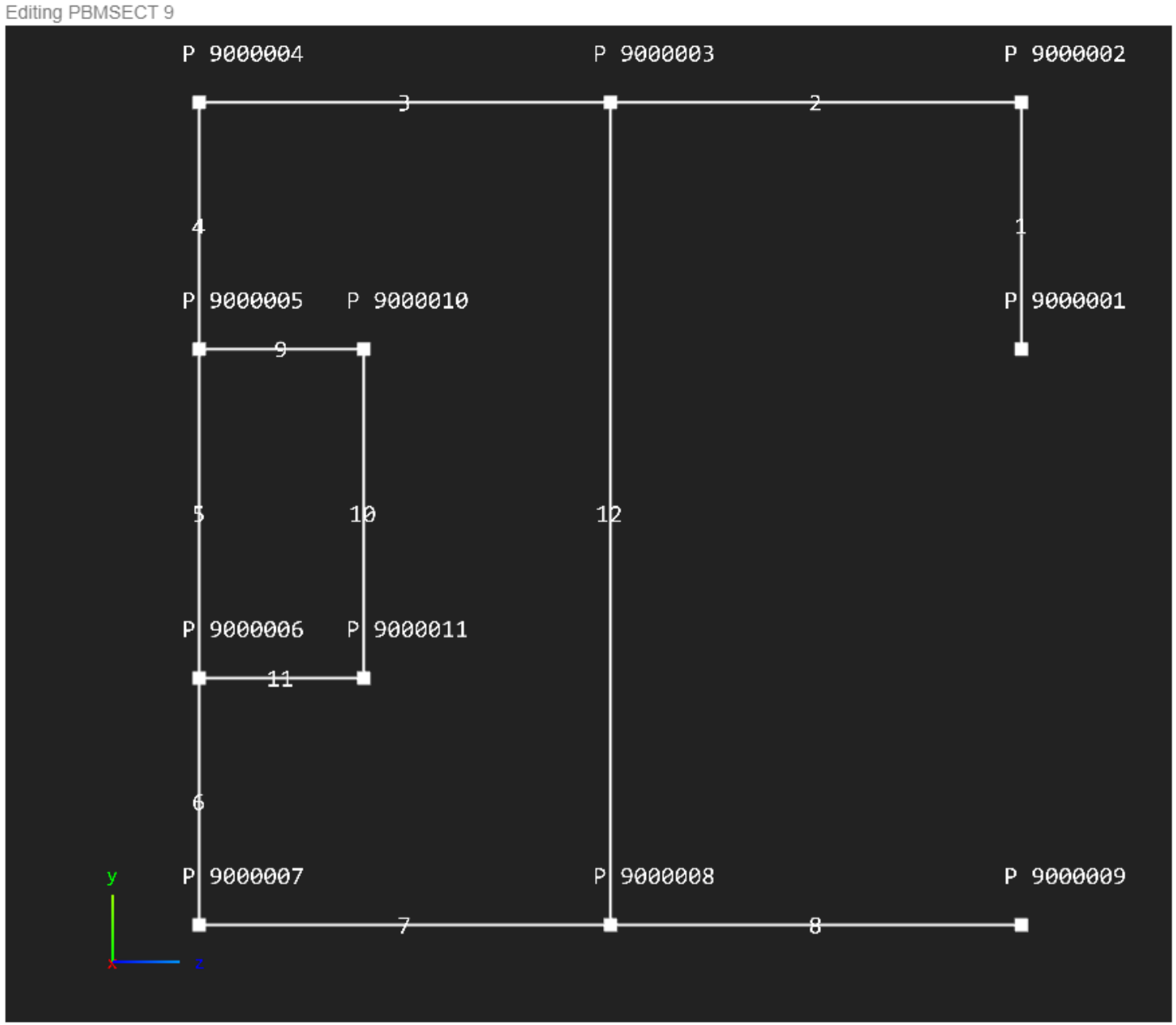
Avoid T Keyword and SET1 Conflicts

1. Consider lines 10 and 9. You might ask why do I need 2 lines when 1 line should be sufficient?



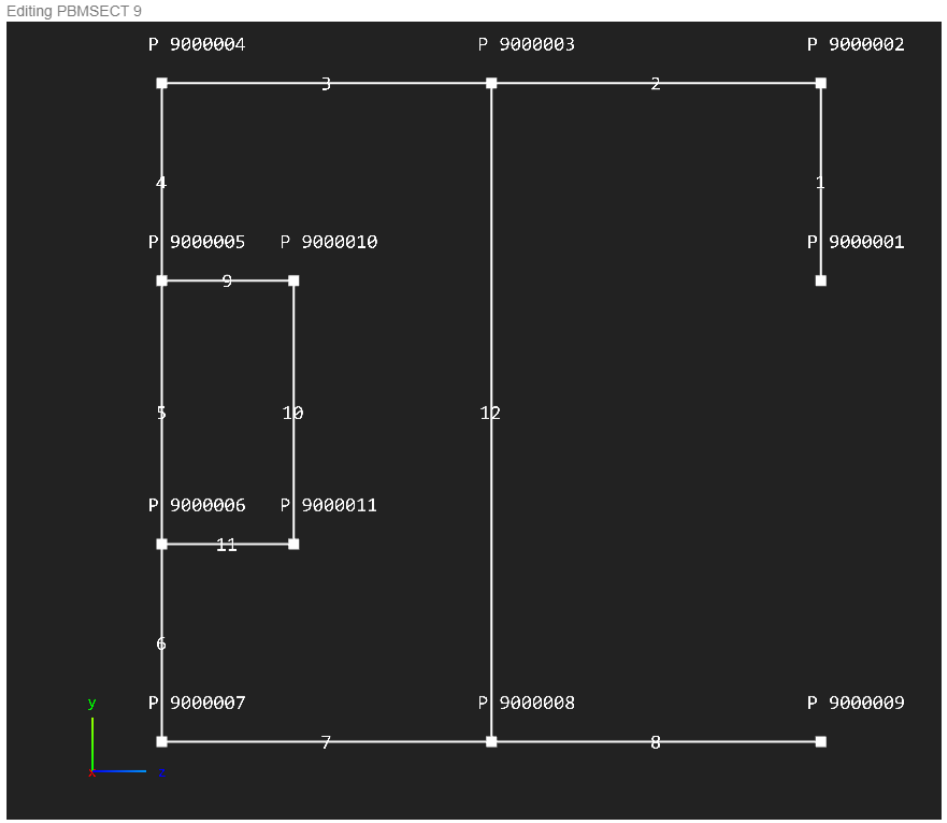
Avoid T Keyword and SET1 Conflicts

1. Suppose this example was repeated with lines 9 and 10 removed and POINT 9000010 removed, and in their place line 12 is added

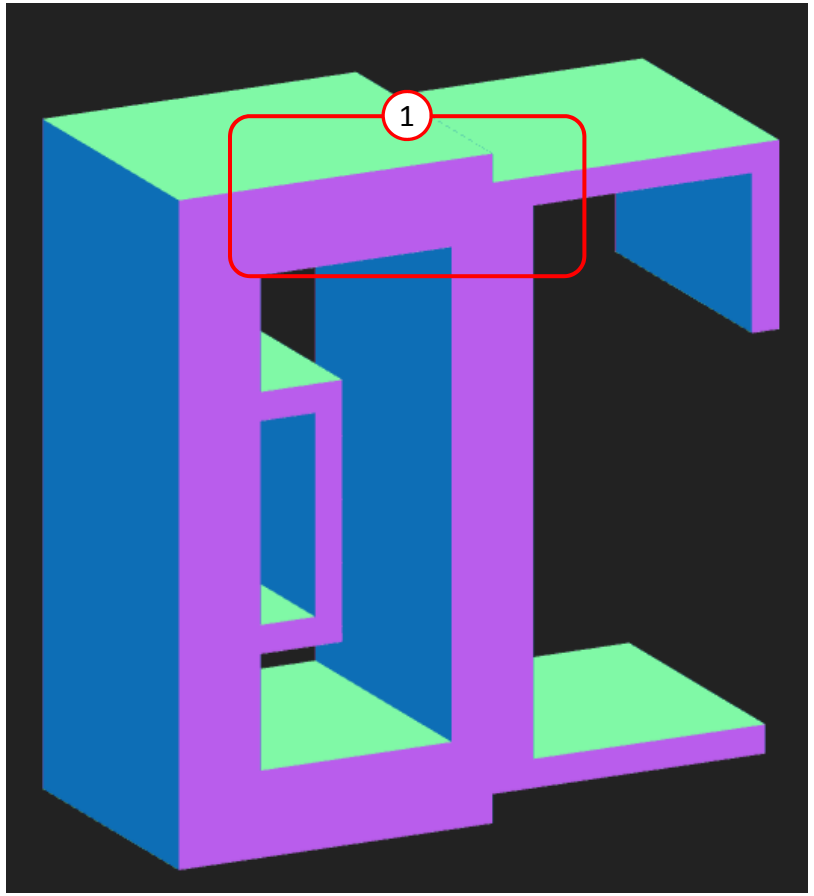


Avoid T Keyword and SET1 Conflicts

1. If only one line is used, the thickness value is applied to the incorrect lines



NOT OK



Avoid T Keyword and SET1 Conflicts

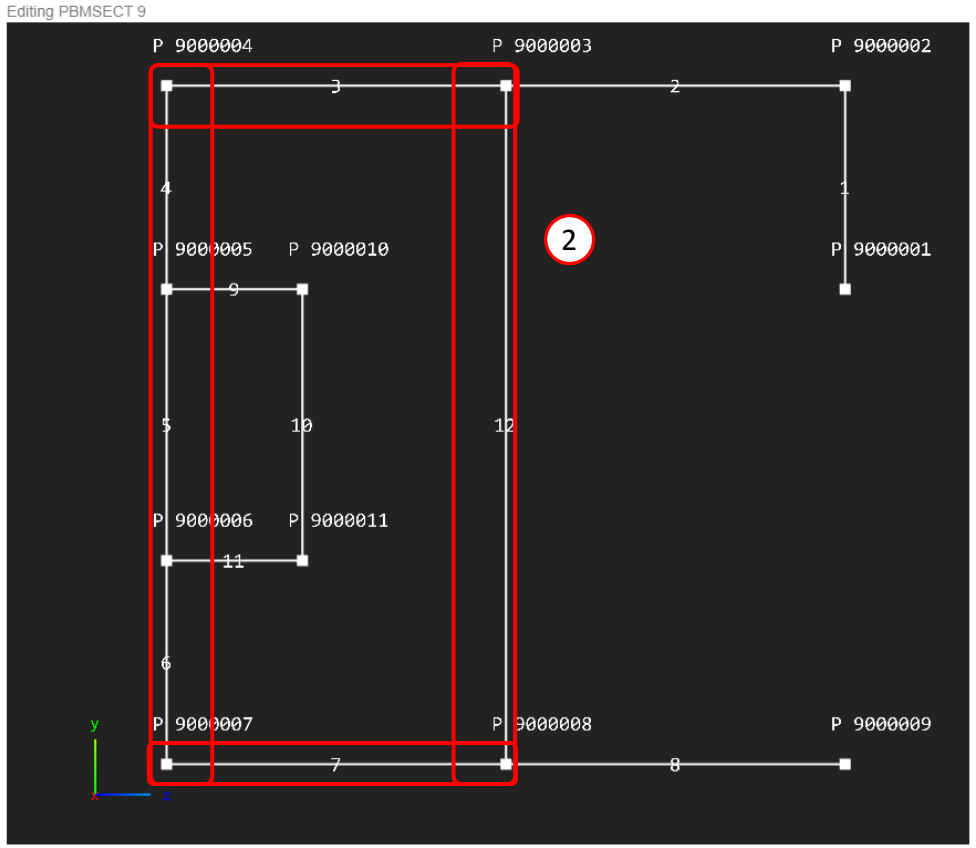
This happens for the following reason.

1. T(1), which has a thickness value of 2.0, is to be placed between POINTs 9000003 and 9000008. MSC Nastran's internal algorithm looks through each SET1 for these 2 points. For each SET1 it finds with these 2 points, T(1) is placed along those points.

2. In this example, SET1 901 and 903 have POINTs 9000003 and 9000008, so the algorithm places T(1) along POINTs 9000003, 9000004, 9000005, 9000006, 9000007, 9000008 and 9000003, 9000008.

The intent is to assign T(1) along the vertical line.

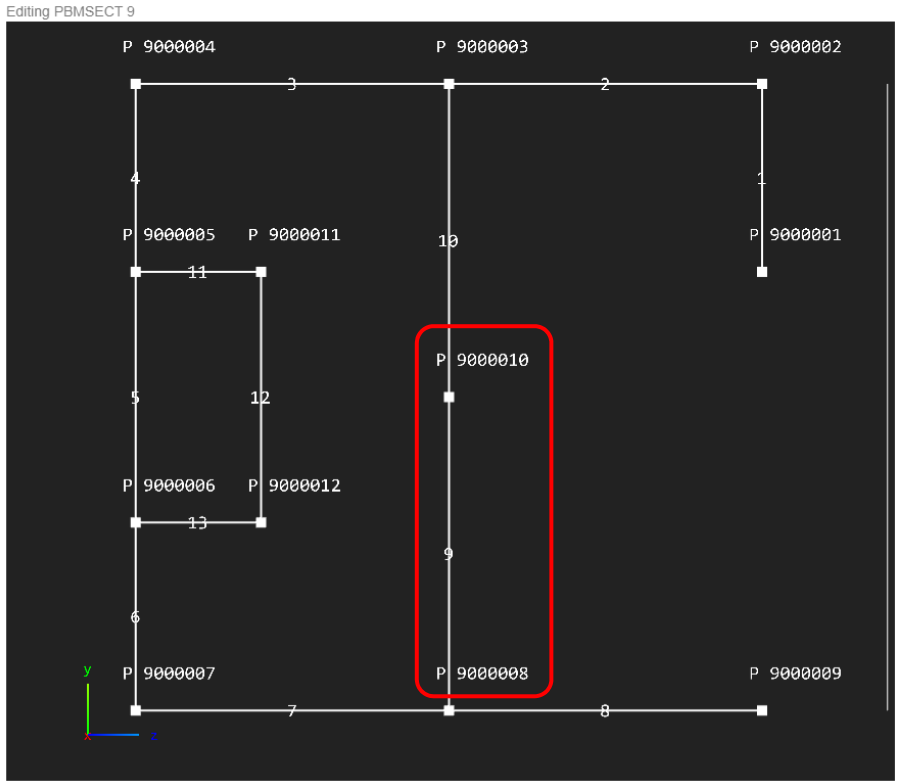
```
PBMSECT 9       1       OP
        OUTP=901,BRP(1)=902,BRP(2)=903,T=1.0,
        T(1)=[2.0,PT=(9000003,9000008)]
SET1    901     9000001 9000002
        9000003 9000004 9000005 9000006 9000007 9000008 9000009
SET1    902     9000005 9000010 9000011 9000006
SET1    903     9000003 9000008
```



Avoid T Keyword and SET1 Conflicts

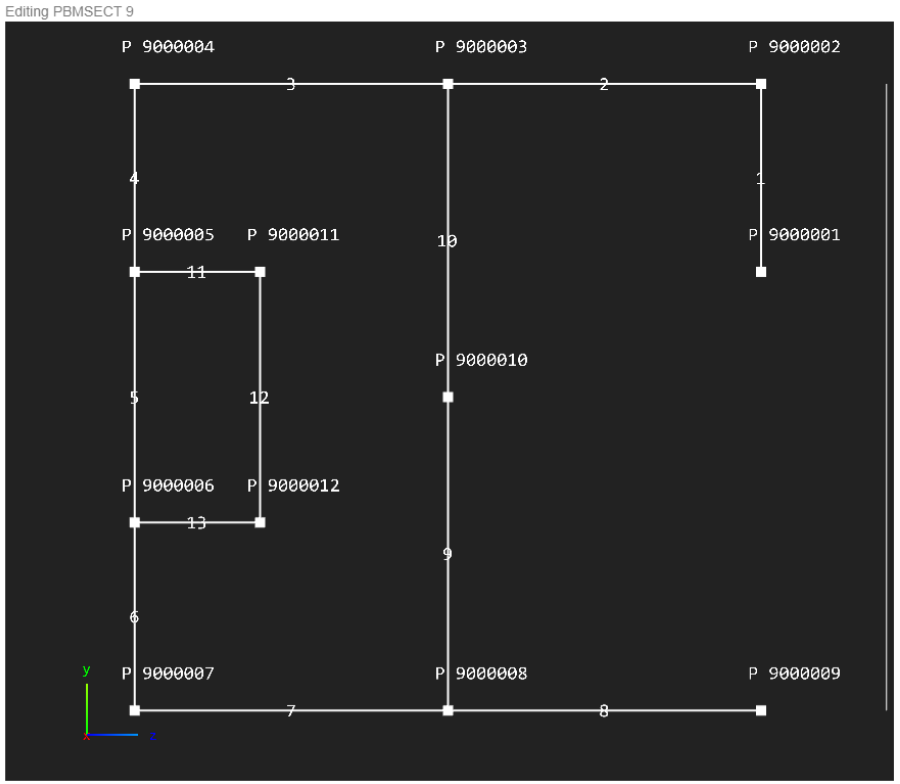
In this tutorial a point is added, e.g. POINT 9000010, so 2 lines are used to create the vertical section.

```
PBMSECT 6       1       OP
        OUTP=901,BRP(1)=902,BRP(2)=903,BRP(3)=904,T=1.0,
        T(1)=2.0,PT=(9000008,9000010)]
SET1    901     9000001 9000002 9000003 9000004 9000005 9000006 9000007
        9000008 9000009
SET1    902     9000008 9000010
SET1    903     9000010 9000003
SET1    904     9000005 9000011 9000012 9000006
```



Avoid T Keyword and SET1 Conflicts

1. The thickness of one line is now 2.0



OK