

MP21058-L Hands-on Training: Composite-Manufacturing “Hand Layup” Nesting + Laser Projection

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For cutting and composites

Class summary

This class is a follow up to “Intro to Composite Manufacturing Platform.” This hands-on course will follow the entire manufacturing process for composites, carbon fiber, and parts. It will begin with determining manufacturing strategies with the help of TruPlan software. Then we will use TruNest Composites software to nest the 2D carbon fiber plies for material efficiency. Since the carbon fiber fabric is time-sensitive, temperature-controlled material, it must be followed through the manufacturing process with high precision. The complete lifecycle of each roll of material and each carbon fiber part will be tracked accurately using TruNest Composites software. Finally, when the 2D shapes are cut using part programs generated by TruNest software, they will be laid up on the 3D part mold by hand, using laser projectors to assist with layup. The laser projectors that assist with ply layup will be programmed using TruLaser software. This session features TruNest Composites, TruLaser, and TruPlan.



Key learning objectives

At the end of this class, you will be able to:

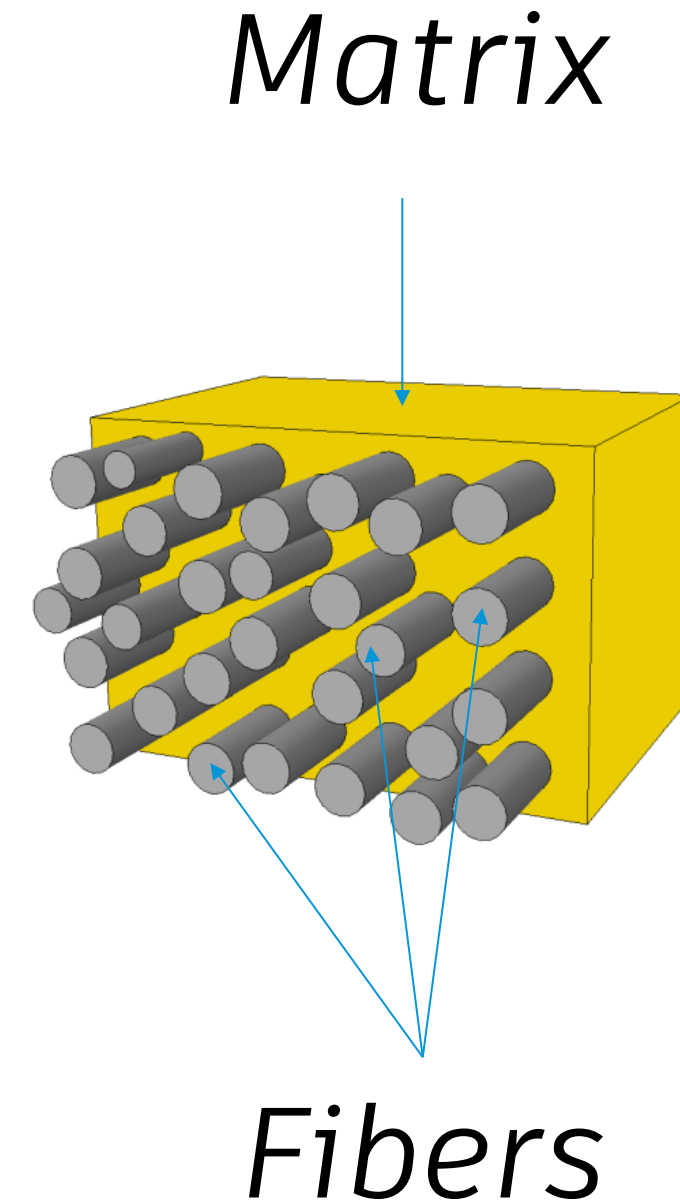
- *Use TruPlan to develop manufacturing strategy data*
- *Use TruNest Composites to nest 2D ply shapes*
- *Use TruLaser to simulate and prepare laser projection data*
- *Learn about material tracking with TruNest Composites*

About composite materials

What Are Composites?

Composite: Material with two or more constituents with *significantly different properties*.

In the scope of this discussion, our “constituents” are **Fibers** and a polymer **Matrix**



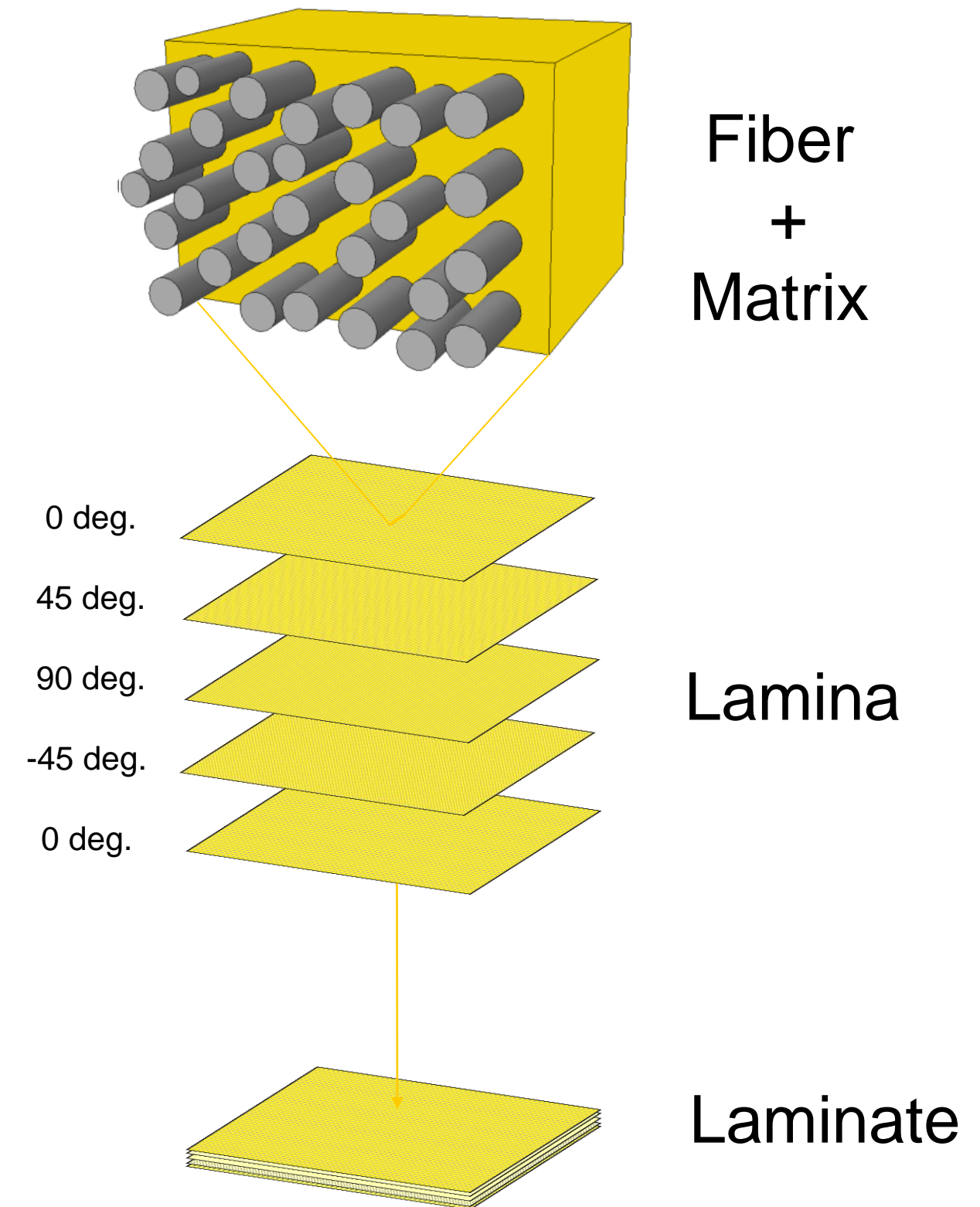
What Are Composites?

Composite: Material with two or more constituents with *significantly different properties*.

Homogenized material is called a **laminate**

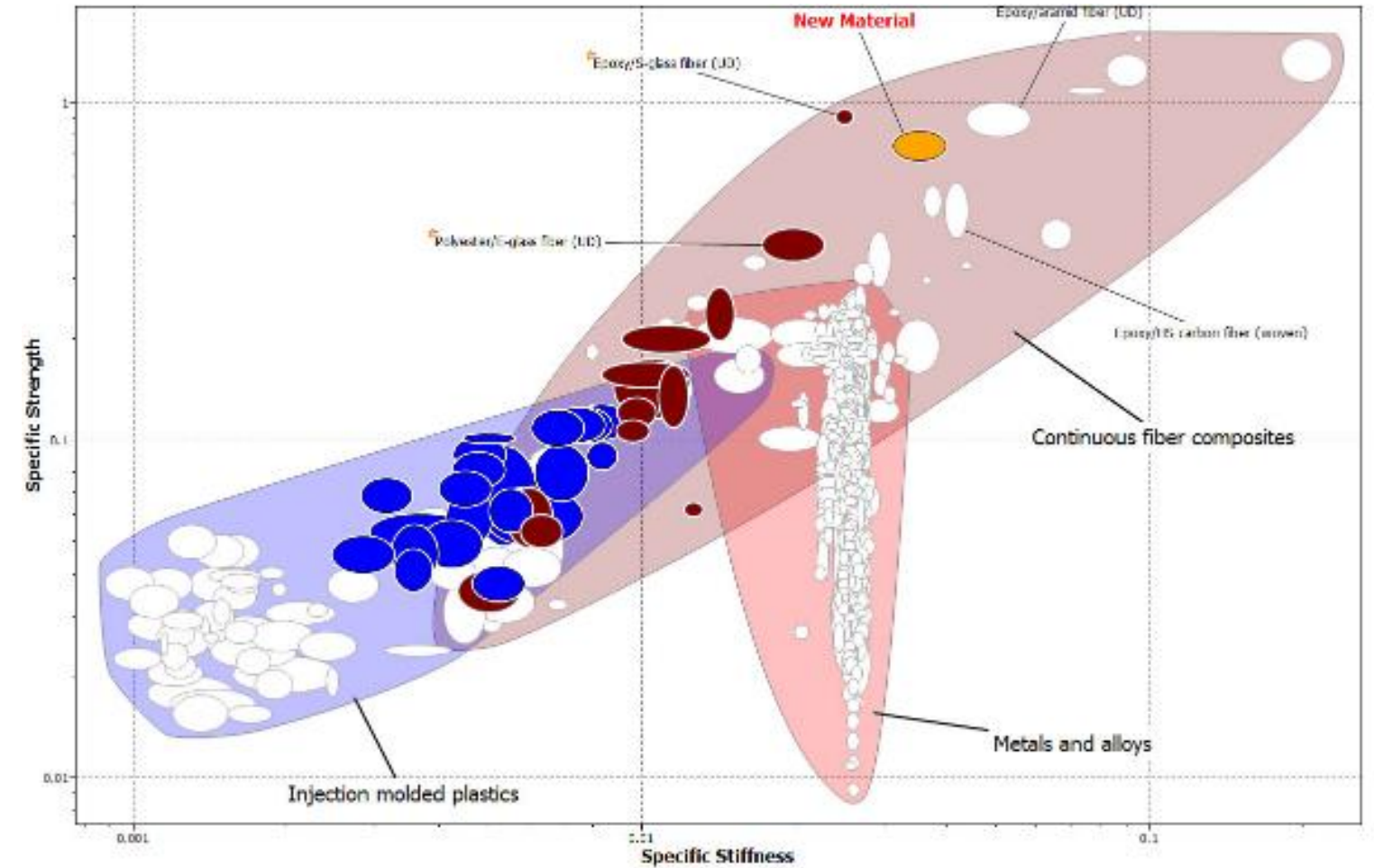
Composed of layers called **lamina**

Since we design lamina, we can **narrowly design** our material

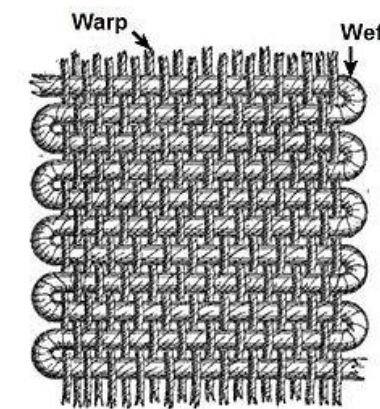
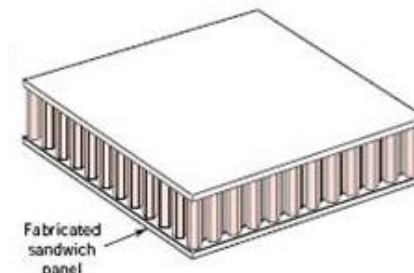
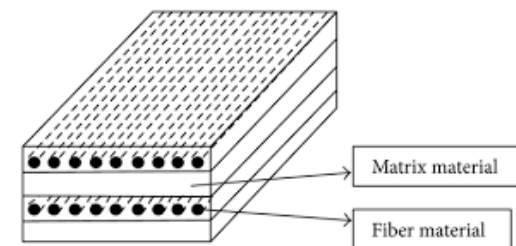


Why Composites?

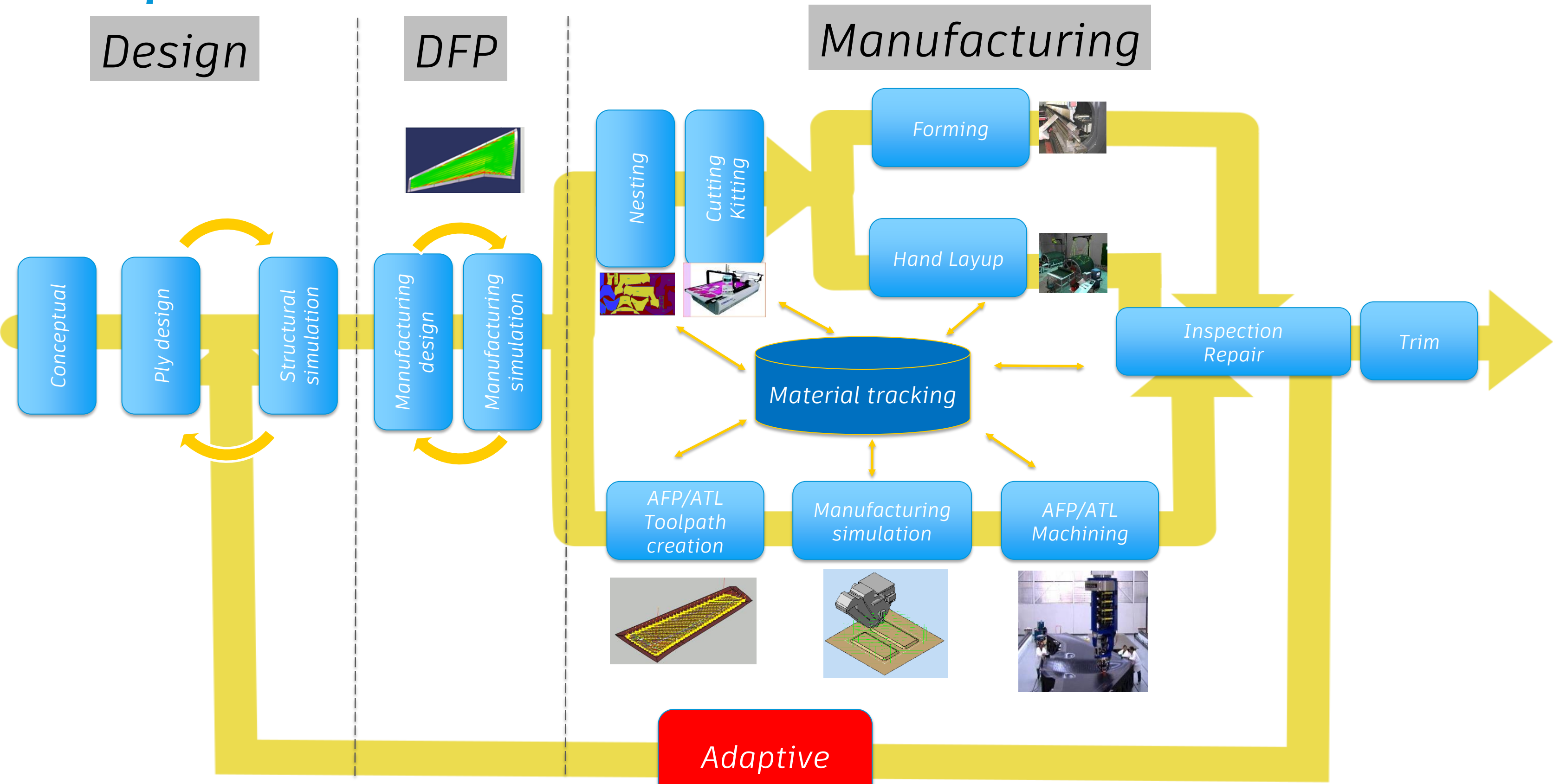
- Favorable strength/weight ratio
- Tailor material properties to intended use
 - Customize compression, extension, torque characteristics
 - Warp/weft density
 - Direction of plies (0,-45,+45,90)
 - Mix materials



- Structural elements
 - Fibers
 - Bonding matrix
 - Core
- Cost vs. performance



Composite workflow



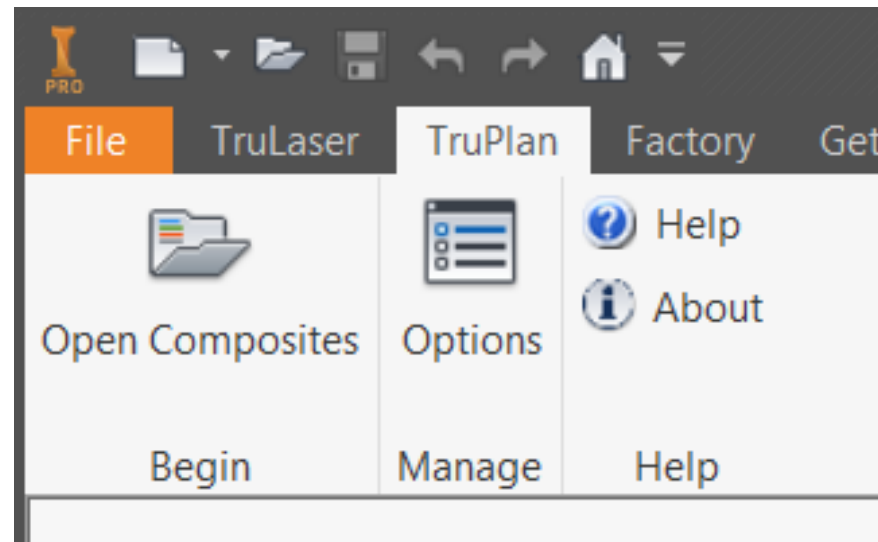
Setup Composite design in TruPlan

Setup Composite design in TruPlan

1. Open Inventor

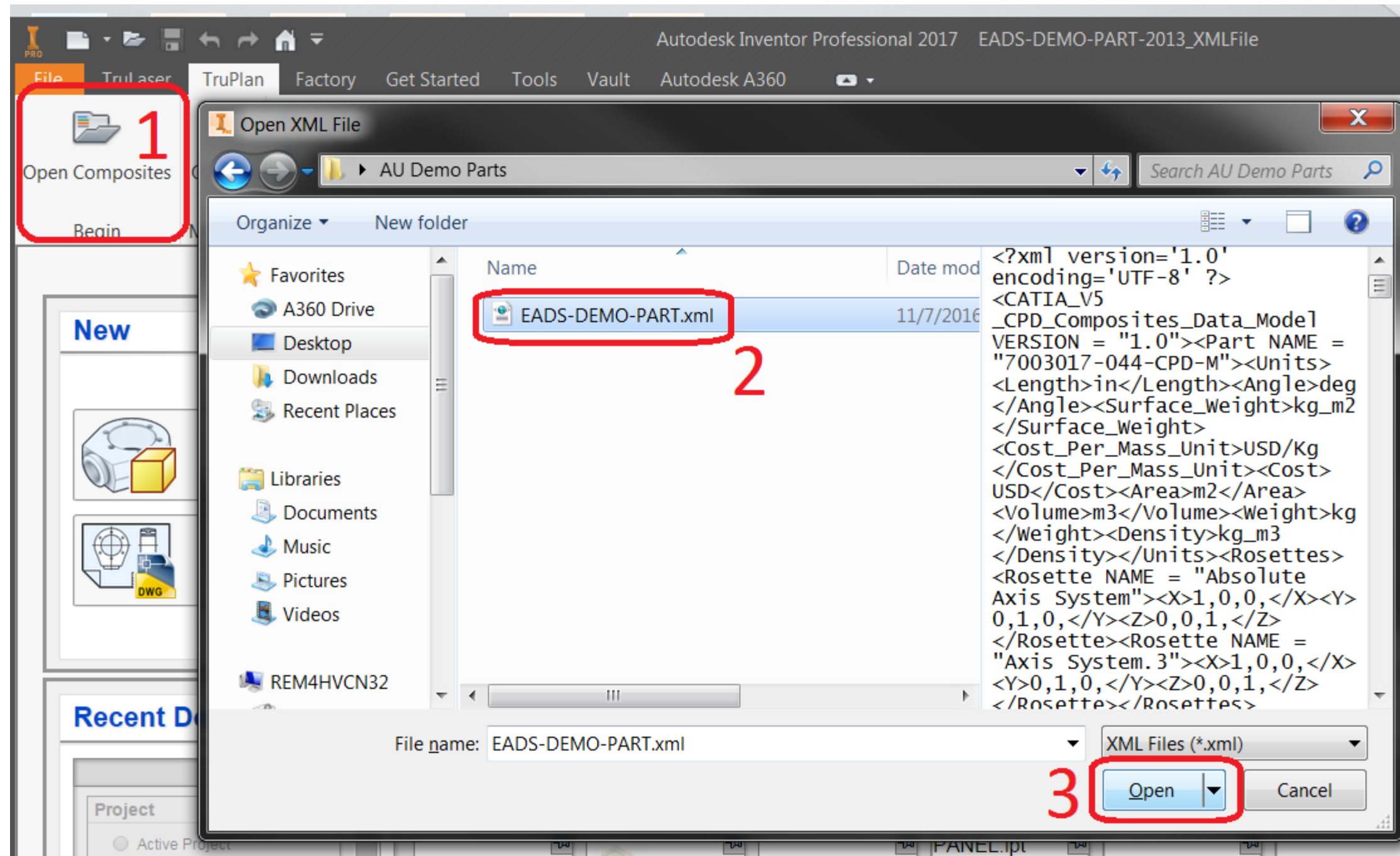


2. Click the TruPlan tab



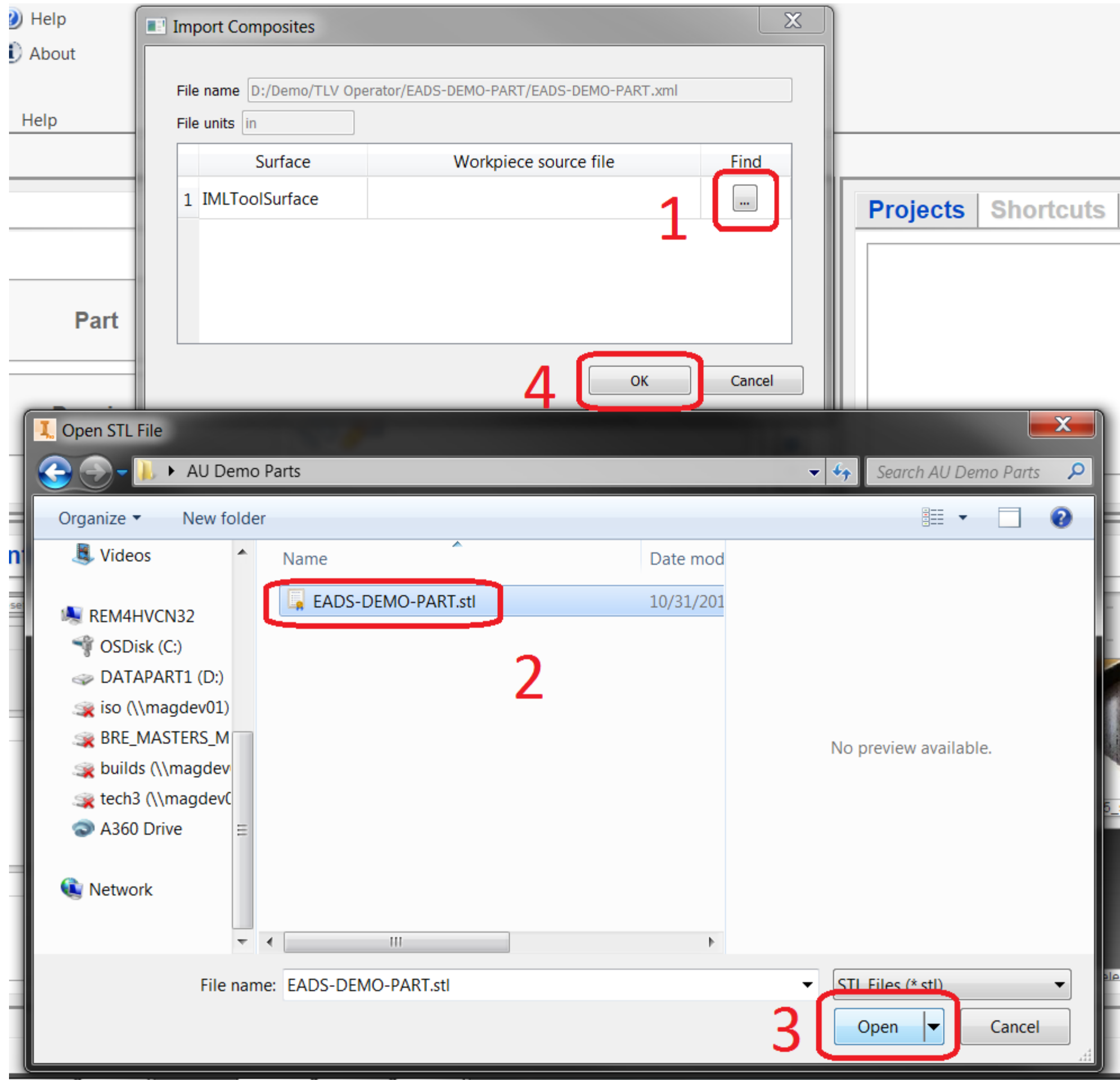
Setup Composite design in TruPlan

1. Click Open composites
2. Select **EADS-DEMO-PART.xml**
3. Click Open

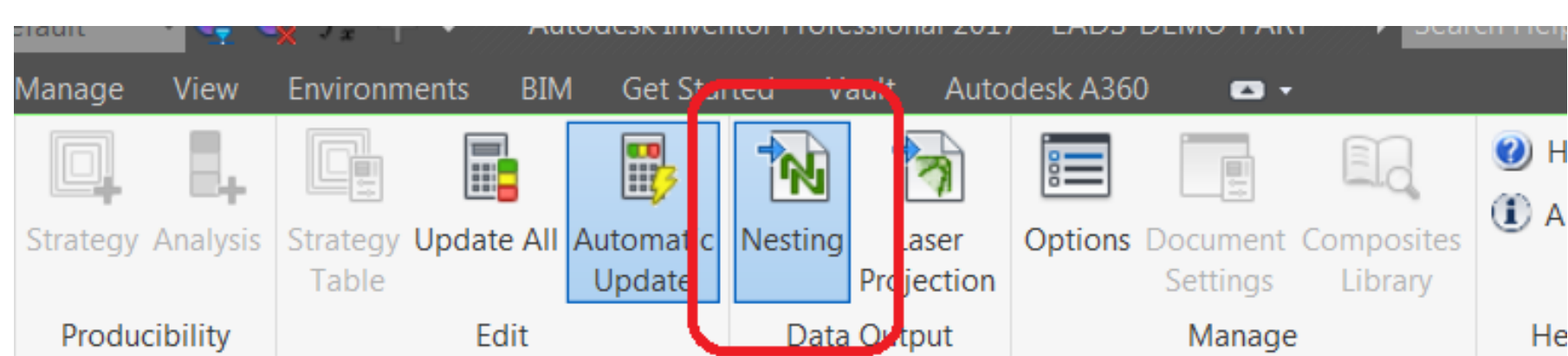


Setup Composite design in TruPlan

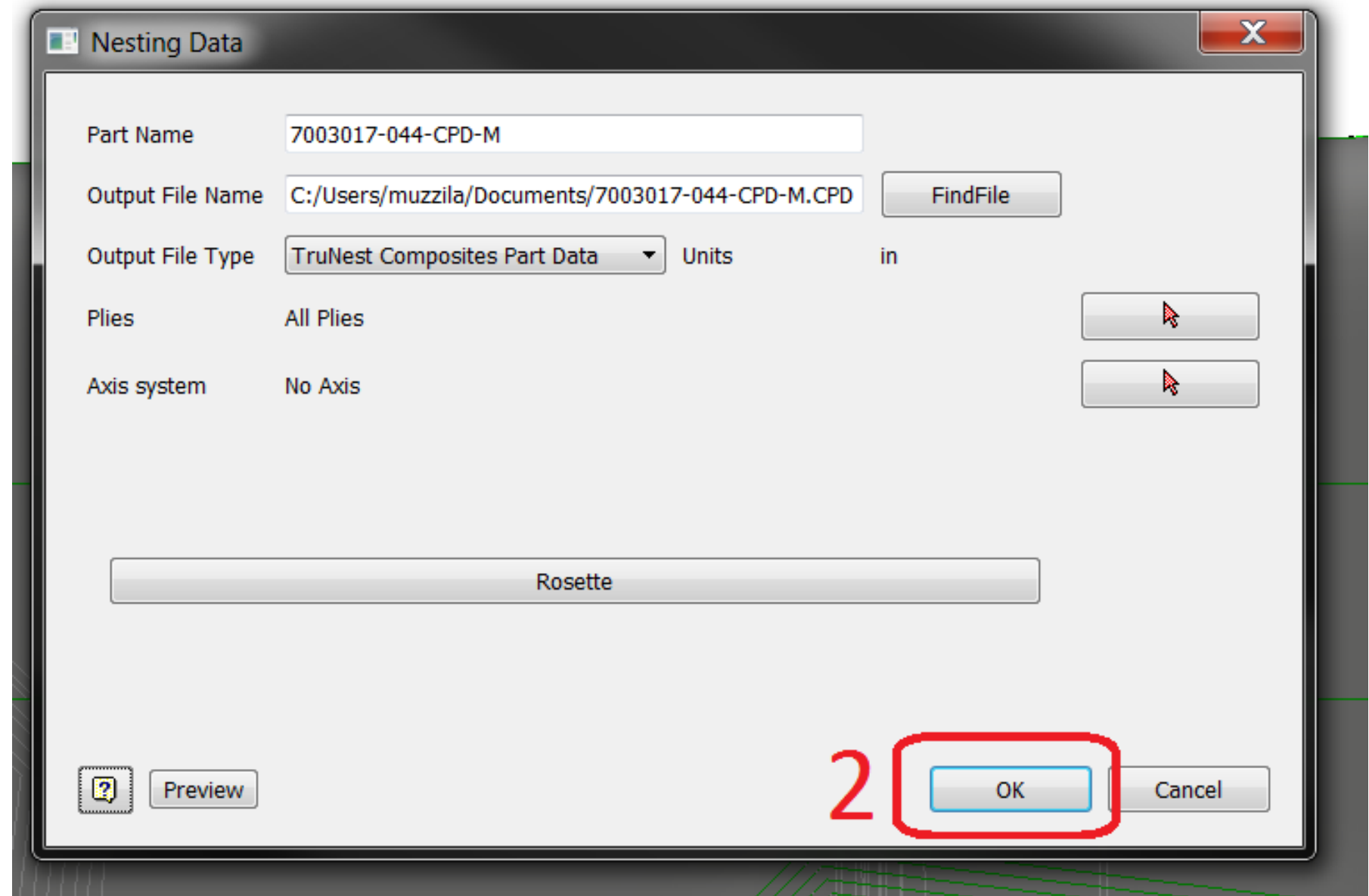
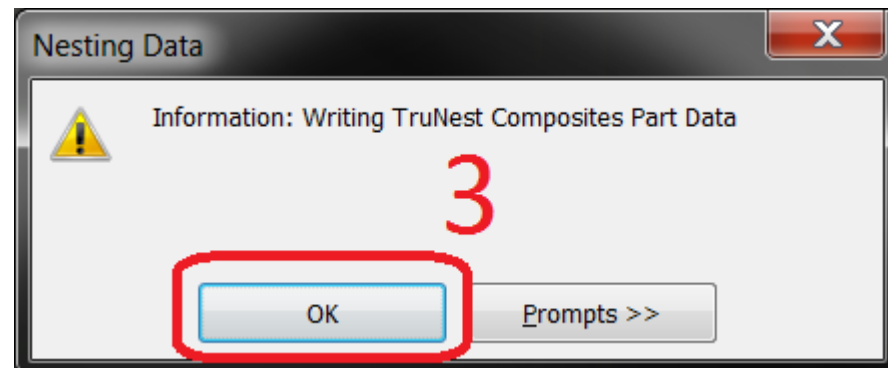
1. Click Find (...)
2. Select **EADS-DEMO-PART.stl**
3. Click Open
4. Click OK



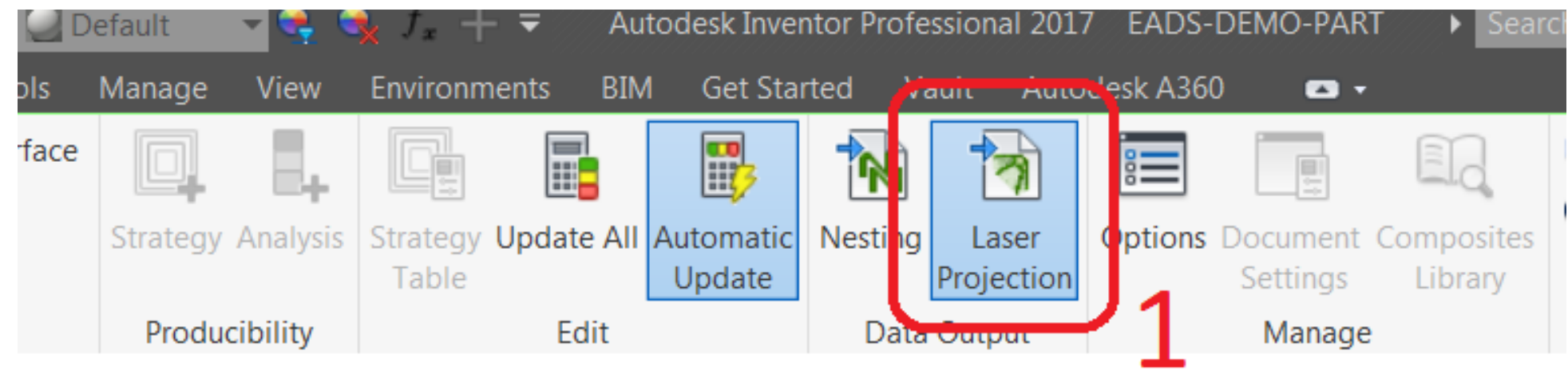
Setup Composite design in TruPlan



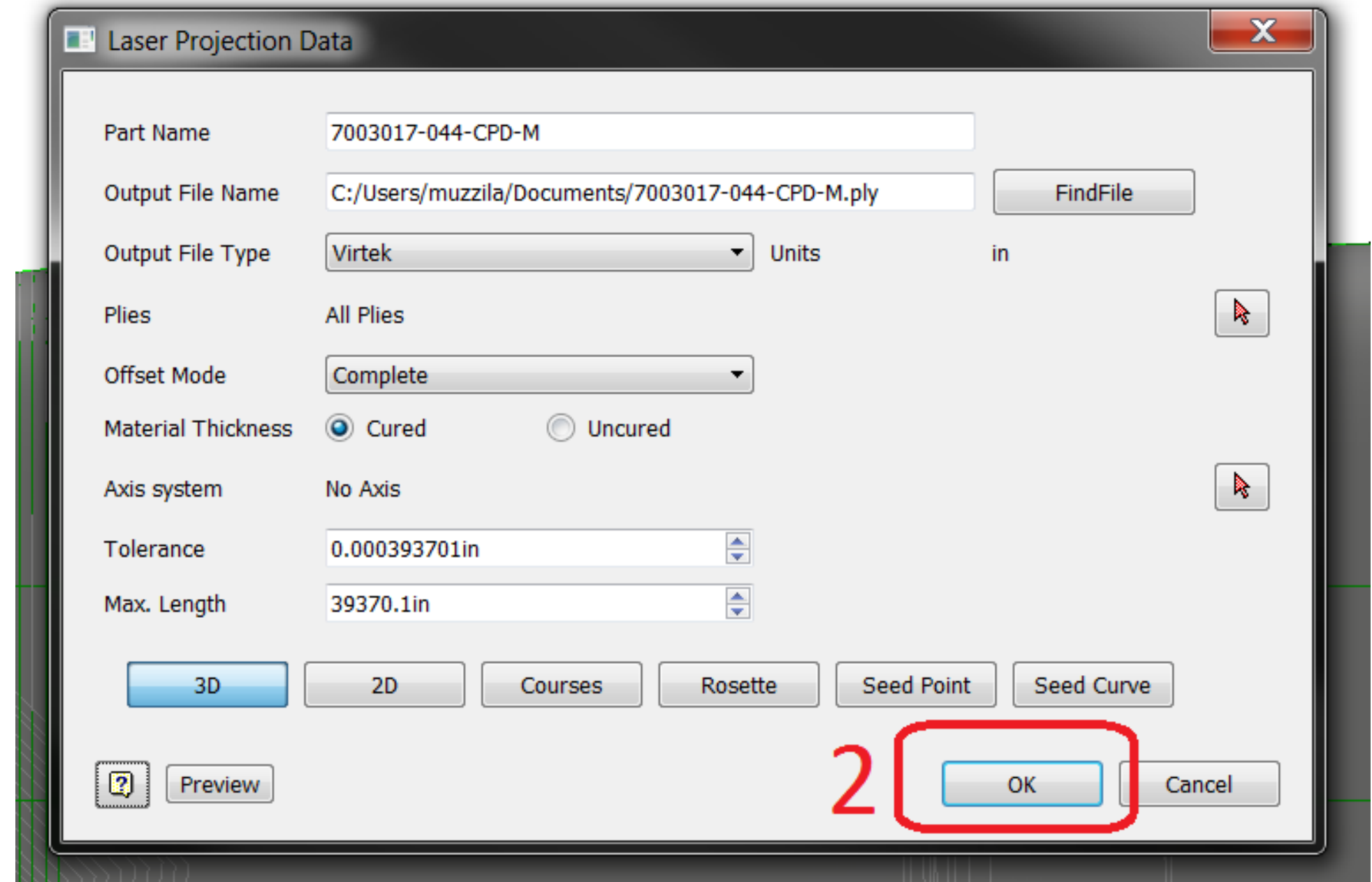
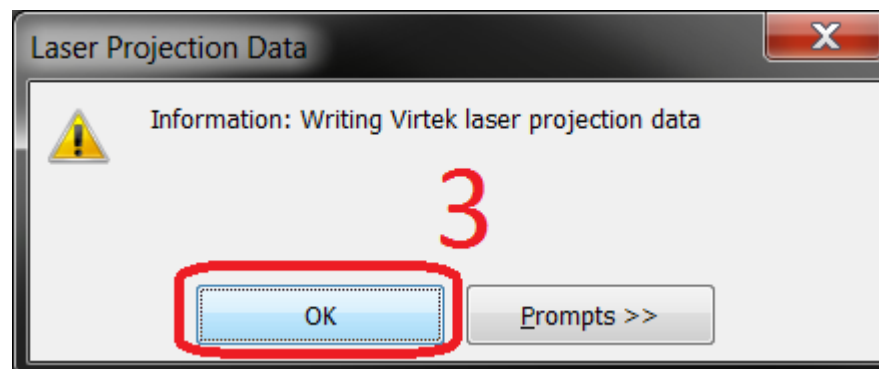
1. Click Nesting
2. Click OK
3. Click OK again



Setup Composite design in TruPlan



1. Click Laser Projection
2. Click OK
3. Click OK again



Nest 2D ply shapes in TruNest Composites



Nest 2D ply shapes in TruNest Composites

1. Open TruNest Composites



2. Login

1. User: admin
2. Pass: admin

Username:

Password:

Login

3. Click Login

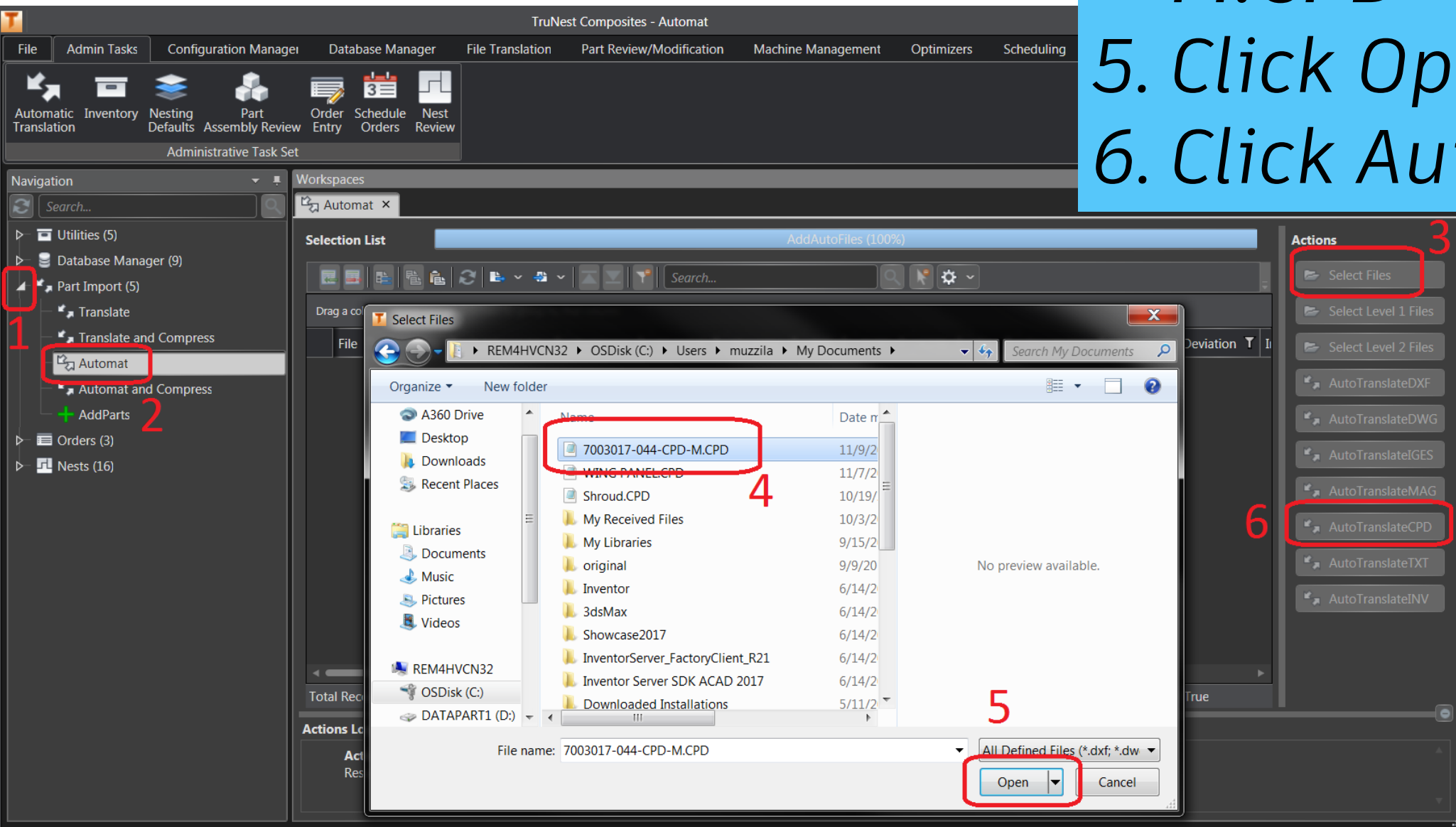
Admin

Login

User belongs to multiple groups, please select one.

Nest 2D ply shapes in TruNest Composites

1. Expand Part Import in the tree
2. Click Automat
3. Click Select Files
4. Select C:\Users\public\My Documents\7003017-044-CPD-M.CPD
5. Click Open
6. Click AutoTranslateCPD



Nest 2D ply shapes in TruNest Composites

The screenshot shows the TruNest Composites - Order Entry application. The interface includes a top menu bar with options like File, Admin Tasks, Configuration Manager, Database Manager, File Translation, Part Review/Modification, Machine Management, Optimizers, Scheduling, Nest Generation, and Review Nests. Below this is a toolbar with icons for Automatic Translation, Inventory, Nesting Defaults, Part Assembly Review, Order Entry, Schedule Orders, and Nest Review. The left sidebar contains a 'Navigation' pane with a tree view showing categories like Utilities (5), Database Manager (9), Part Import (6), Parametrics (2), Translate, Translate and Compress, Automat, Automat and Compress, AddParts, Orders (3), Order Entry, Schedule Orders, Active Orders, and Nests (16). The 'Orders (3)' category is expanded, and 'Order Entry' is selected. The main workspace has a 'Part Filtering' section with a search box containing '7'. Below this is a table with columns 'Assembly' and 'SubAssembly'. The 'Active Orders' section at the bottom shows a table with columns: Assembly, SubAssembly, Partname, Quantity, Date, JobOrder, Priority, Comment, MaterialGroup, and Facility. The status bar at the bottom indicates 'Total Records: 0', 'Selected Records: 0', 'Current Record: 0', 'Table: actorder', 'Filter: <NONE>', 'Can Edit: True', 'Can Insert: True', and 'Can Delete: True'. Red annotations are present: a red box around the 'Orders (3)' folder in the tree (1), a red box around the 'Order Entry' item (2), a red box around the search box containing '7' (3), and a red box around the 'Add Order(s)' button (4).

TruNest Composites - Order Entry

File Admin Tasks Configuration Manager Database Manager File Translation Part Review/Modification Machine Management Optimizers Scheduling Nest Generation Review Nests

Automatic Translation Inventory Nesting Defaults Part Assembly Review Order Entry Schedule Orders Nest Review

Administrative Task Set

Navigation

Search...

Utilities (5)

Database Manager (9)

Part Import (6)

Parametrics (2)

Translate

Translate and Compress

Automat

Automat and Compress

AddParts

Orders (3)

Order Entry

Schedule Orders

Active Orders

Nests (16)

Workspaces

Automat x Order Entry x

Part Filtering

Assembly SubAssembly

7003017-044-CPD-M	1
7003017-044-CPD-M	10
7003017-044-CPD-M	11
7003017-044-CPD-M	12
7003017-044-CPD-M	12
7003017-044-CPD-M	13
7003017-044-CPD-M	14
7003017-044-CPD-M	15
7003017-044-CPD-M	16

7003017-044-CPD-M/P12

7003017-044-CPD-M/P13

7003017-044-CPD-M/P14

7003017-044-CPD-M/P15

7003017-044-CPD-M/P16

7003017-044-CPD-M/P17

Mat Group: MG

Facility: ADMIN

Comment:

Add Order(s)

Active Orders

Drag a column header and drop it here to group by that column

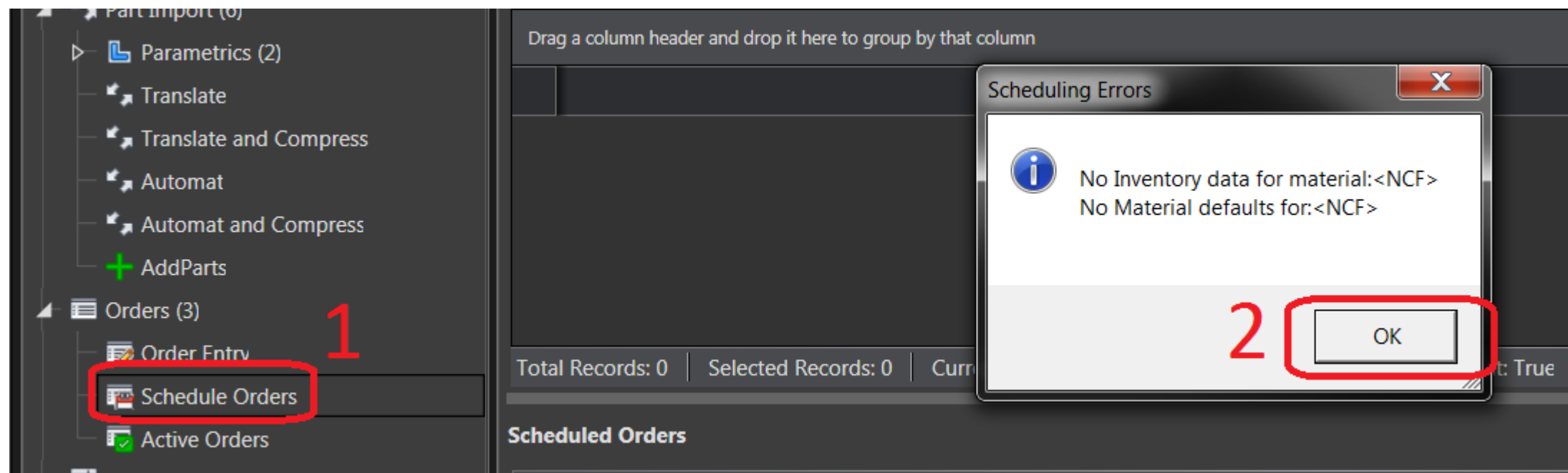
Assembly	SubAssembly	Partname	Quantity	Date	JobOrder	Priority	Comment	MaterialGroup	Facility
----------	-------------	----------	----------	------	----------	----------	---------	---------------	----------

Total Records: 0 | Selected Records: 0 | Current Record: 0 | Table: actorder | Filter: <NONE> | Can Edit: True | Can Insert: True | Can Delete: True

1. Expand Orders in the tree
2. Click Order Entry
3. Type 7 in the Assembly filter box
4. Click Add Order(s)

Nest 2D ply shapes in TruNest Composites

1. Click Schedule Orders in the tree
2. Click OK



Nest 2D ply shapes in TruNest Composites

1. Click Schedule

TruNest Composites - Schedule Orders

File Admin Tasks Configuration Manager Database Manager File Translation Part Review/Modification Machine Management Optimizers Scheduling Nest Generation Review Nests

Automatic Translation Inventory Nesting Defaults Part Assembly Review Order Entry Schedule Orders Nest Review

Administrative Task Set

Navigation

Search...

Utilities (5)

Database Manager (9)

Part Import (6)

Parameters (2)

Automat and Compress

Orders (3)

Order Entry

Schedule Orders

Active Orders

Nests (16)

Workspaces

Automat x Schedule Orders x

Unscheduled Orders

Drag a column header and drop it here to group by that column

	Facility	MaterialGroup	Material	Machine	Jobs	Parts	Pieces	Start	Cut	Filler	Status	Hours	Plates
▶	ADMIN	MG	S1454_G950	GERBER	1	66	66.0000	2016-11-09	2016-11-09	2016-11-09	ACTV	2.6061	0.423

Total Records: 1 | Selected Records: 1 | Current Record: 1 | Table: ordactv_tempforedit | Filter: <NONE> | Can Edit: True | Can Insert: False | Can Del

Scheduled Orders

Drag a column header and drop it here to group by that column

	Group	Nest	Facility	MaterialGroup	Material	Jobs	Parts	Pieces	Start	Cut	Filler	Status	Hours	Plates
	Stellia	N016	ADMIN	MG	S1454_G803	2	101	202	2016-11-02	2016-11-02	2016-11-02	RJCT	3.0101	2
	group_014	N018	ADMIN	MG	S1454_G950	1	66	66	2016-11-07	2016-11-07	2016-11-07	STAG	1.0577	1
	group_013	N017	ADMIN	MG	S1454_G950	1	9	9	2016-11-07	2016-11-07	2016-11-07	STAG	0.1453	1
	group_012	N015	ADMIN	MG	S1454_G803	1	101	101	2016-11-02	2016-11-02	2016-11-02	RJCT	1.5051	1

Total Records: 23 | Selected Records: 1 | Current Record: 22 | Table: ordschd | Filter: <NONE> | Can Edit: False | Can Insert: False | Can Delete: False

Actions

Group Name: group_015

Nest Prefix: N

Schedule

Delete

Forward

Backward

Copy

Delete



Nest 2D ply shapes in TruNest Composites

The screenshot shows the TruNest Composites - Part List application. A blue box in the center contains the following instructions:

1. Expand Nests in the tree
2. Expand group_015
3. Expand N019
4. Click Part List
5. Scroll right and change Filter to ----->

Red numbered callouts (1-5) are placed on the interface to indicate the steps:

- 1: Points to the 'Nests' folder in the left navigation tree.
- 2: Points to the 'group_015' folder in the left navigation tree.
- 3: Points to the 'N019' folder in the left navigation tree.
- 4: Points to the 'Part List' sub-item under 'N019'.
- 5: Points to the 'Filter' dropdown menu in the table header.

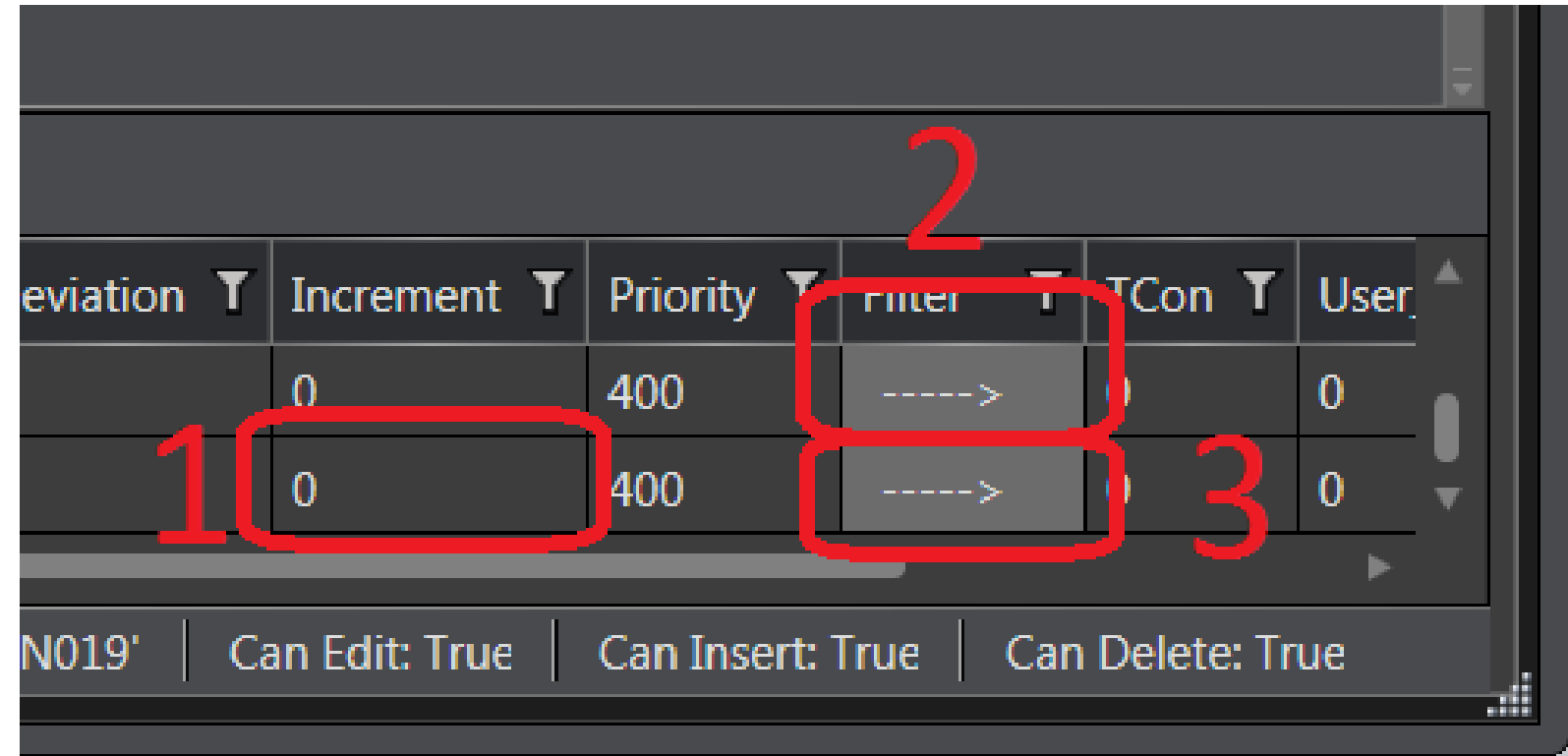
The interface also shows a 3D workspace with a purple plane and a coordinate system (X, Y, Z). A red box highlights the 'Part List' sub-item in the left navigation tree. The table at the bottom displays a list of parts with columns for Name, Grain, Orientation, Mirror, Quantity, JobOrder, R90, R180, R270, Flip, Deviation, Increment, Priority, Filter, Con, and User. The 'Filter' column is highlighted with a red box and a red number 5.

Name	Grain	Orientation	Mirror	Quantity	JobOrder	R90	R180	R270	Flip	Deviation	Increment	Priority	Filter	Con	User
17-044-CPD-M/P1	<input checked="" type="checkbox"/>	0	<input type="checkbox"/>	1	JOB	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	0	400	----->	0	0
17-044-CPD-M/P10	<input checked="" type="checkbox"/>	0	<input type="checkbox"/>	1	JOB	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0	0	400	>	0	0

Total Records: 66 | Selected Records: 1 | Current Record: 1 | Table: part | Filter: [group] = 'group_015' AND nest = 'N019' | Can Edit: True | Can Insert: True | Can Delete: True

Nest 2D ply shapes in TruNest Composites

1. Click outside the current record
2. Select Filter on top record and type **Ctrl + c**
3. Click and drag down on Filter from 2nd record to the end of list
4. Type **Ctrl + v**



Nest 2D ply shapes in TruNest Composites

The screenshot shows the TruNest Composites - Create Nests application. The interface includes a menu bar, a toolbar, a navigation pane on the left, a workspace area in the center, and an actions pane on the right. Red numbers 1 through 4 are placed over the interface to indicate the steps for creating nests.

Navigation Pane (Left):

- 1. Expand the **Nests (17)** folder.
- 2. Expand the **group_015 (3)** folder.
- 3. Click the **Create Nests** button.

Workspace Area (Center):

Selection List:

Group	Nest	Material	MaterialGroup	Facility	Machine	EstPlt	Hours	Status	MinDate	MaxDate
group_015	N019	S1454_G950	MG	ADMIN	GERBER	22	0.0000	SCHD/SCHD	2016-11-09	2016-11-09

Actions Pane (Right):

- 4. Click the **Yes** button.

Text Overlay:

1. Expand Nests in the tree
2. Expand group_015
3. Click Create Nests
4. Click Yes

Status Bar:

Total Records: 1 | Selected Records: 1 | Current Record: 1 | Table: schdlist | Filter: <NONE> | Can Edit: False | Can Insert: False | Can Delete: False

Actions Log:

Nest 2D ply shapes in TruNest Composites

The screenshot shows the TruNest Composites - Orders application interface. The top menu bar includes File, Admin Tasks, Configuration Manager, Database Manager, File Translation, Part Review/Modification, Machine Management, Optimizers, Scheduling, Nest Generation, and Review Nests. Below the menu is a toolbar with icons for Automatic Translation, Inventory, Nesting Defaults, Part Assembly Review, Order Entry, Schedule Orders, and Nest Review. The left sidebar contains a Navigation pane with a search bar and a tree view. The tree view shows a hierarchy of folders: Utilities (5), Database Manager (9), Part Import (6), Orders (3), and Nests (17). The Nests folder is expanded, showing sub-folders: group_015 (3), Create Nests, Manage Nests, N019 (5), Part List, Plate List, Nesting Parameters, Report, and N019_001 (3). The N019_001 folder is selected, and its sub-items are listed: Orders, Nc Code, and Report. The main workspace area displays a 2D layout of a nest, showing a grid of numbered parts (1-54) and a yellow box highlighting a specific part. The bottom pane shows a data table with columns: User, Group, Nest, Assembly, SubAssembly, Partname, Quantity, Date, JobOrder, Priority, Status, Plate, PartSeq, and Con. The table contains two records. The first record is selected, and the second record is highlighted. The status bar at the bottom indicates: Total Records: 66, Selected Records: 1, Current Record: 2, Table: rsvorder, Filter: <NONE>, Can Edit: False, Can Insert: False, Can Delete: False.

1. Expand N019_001 in the tree

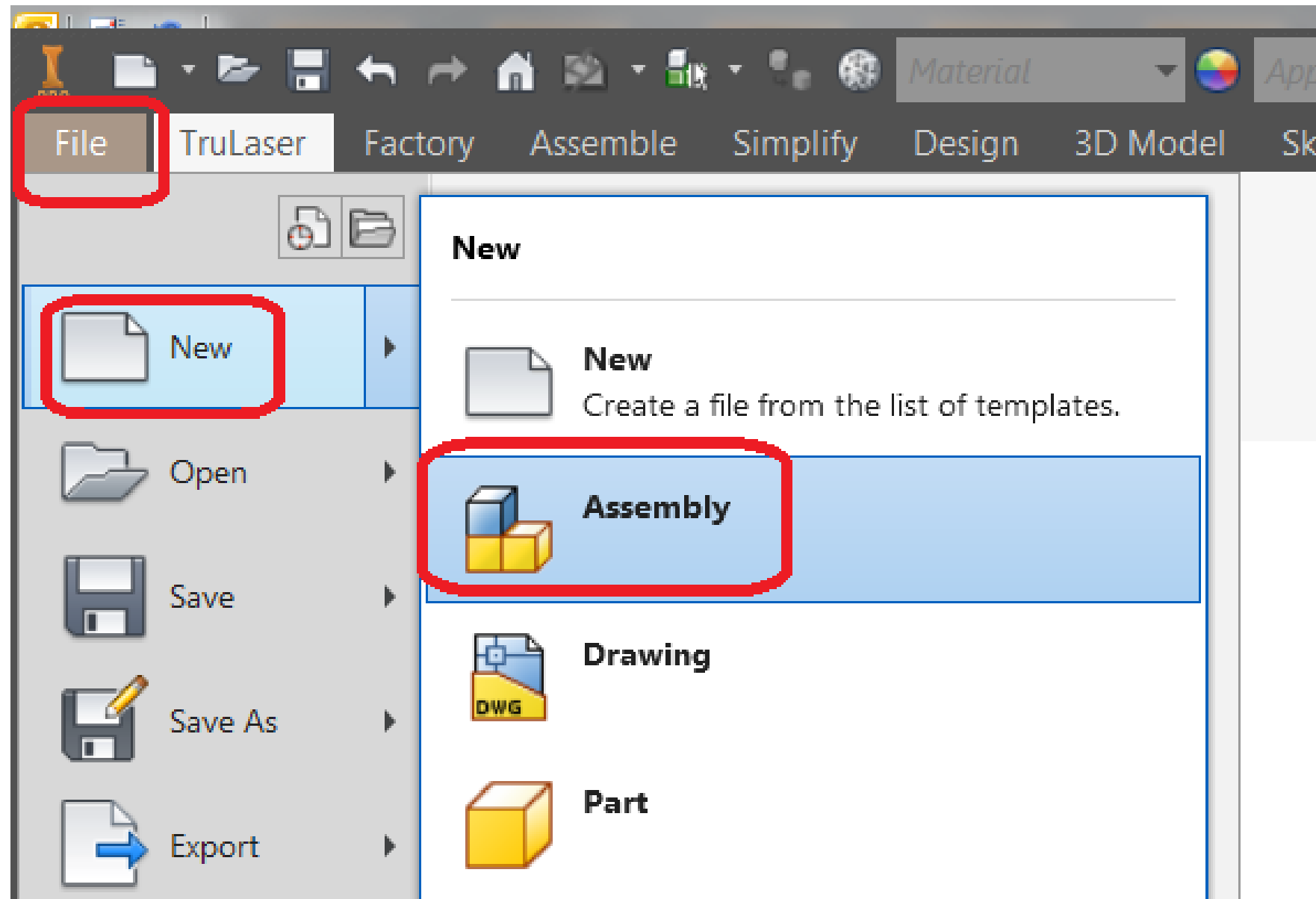
2. Click Orders

3. Click 2nd record in list

User	Group	Nest	Assembly	SubAssembly	Partname	Quantity	Date	JobOrder	Priority	Status	Plate	PartSeq	Con
admin	group_015	N019	7003017-044-CPD-M	1	7003017-044-CPD-M/P1	1	09-Nov-2016	JOB	400	STAG	001	13	
admin	group_015	N019	7003017-044-CPD-M	10	7003017-044-CPD-M/P10	1	09-Nov-2016	JOB	400	STAG	001	6	

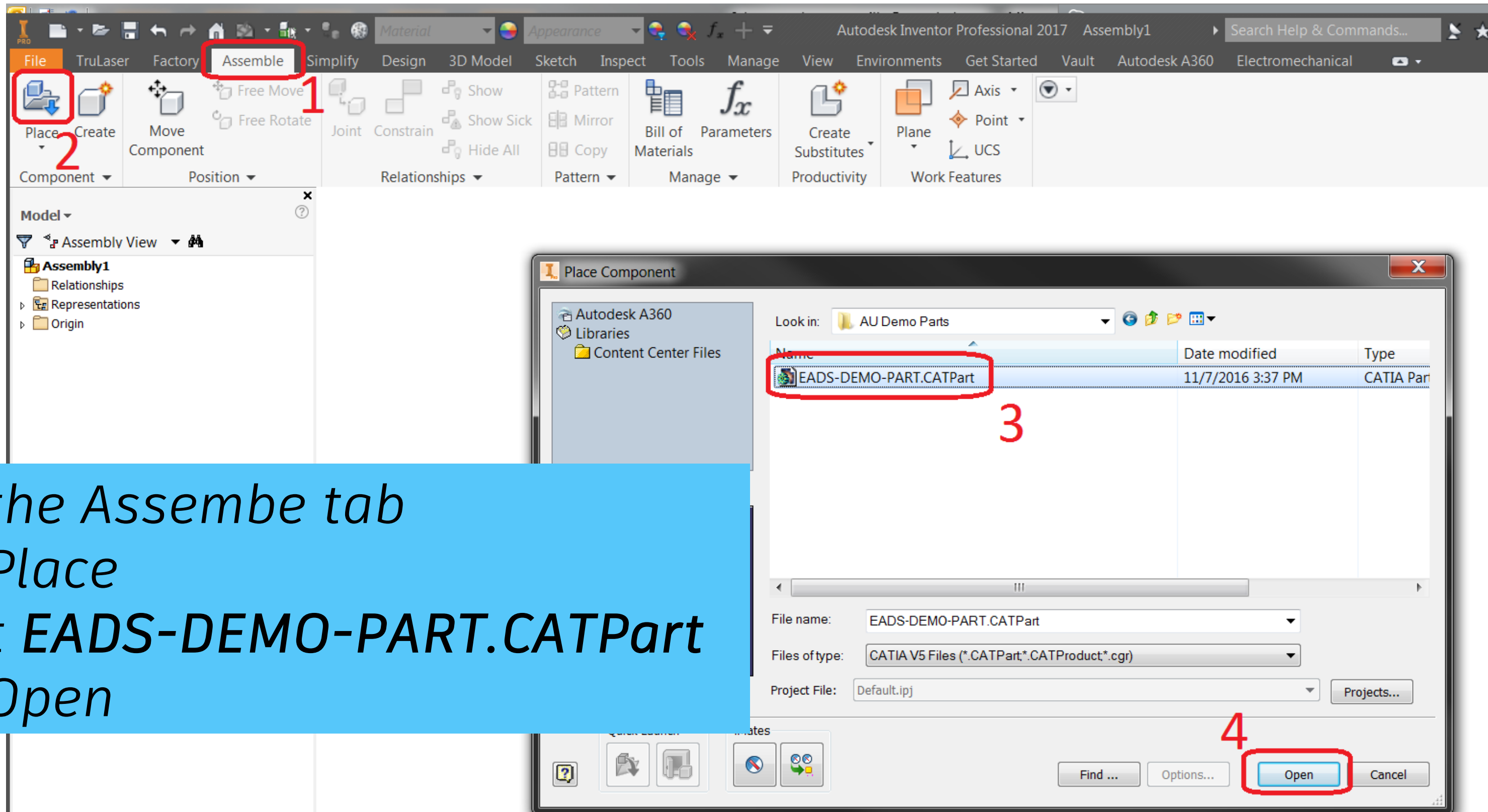
Optimize laser projection data with TruLaser

Optimize laser projection data with TruLaser



1. Click File
2. Hover over New
3. Click Assembly

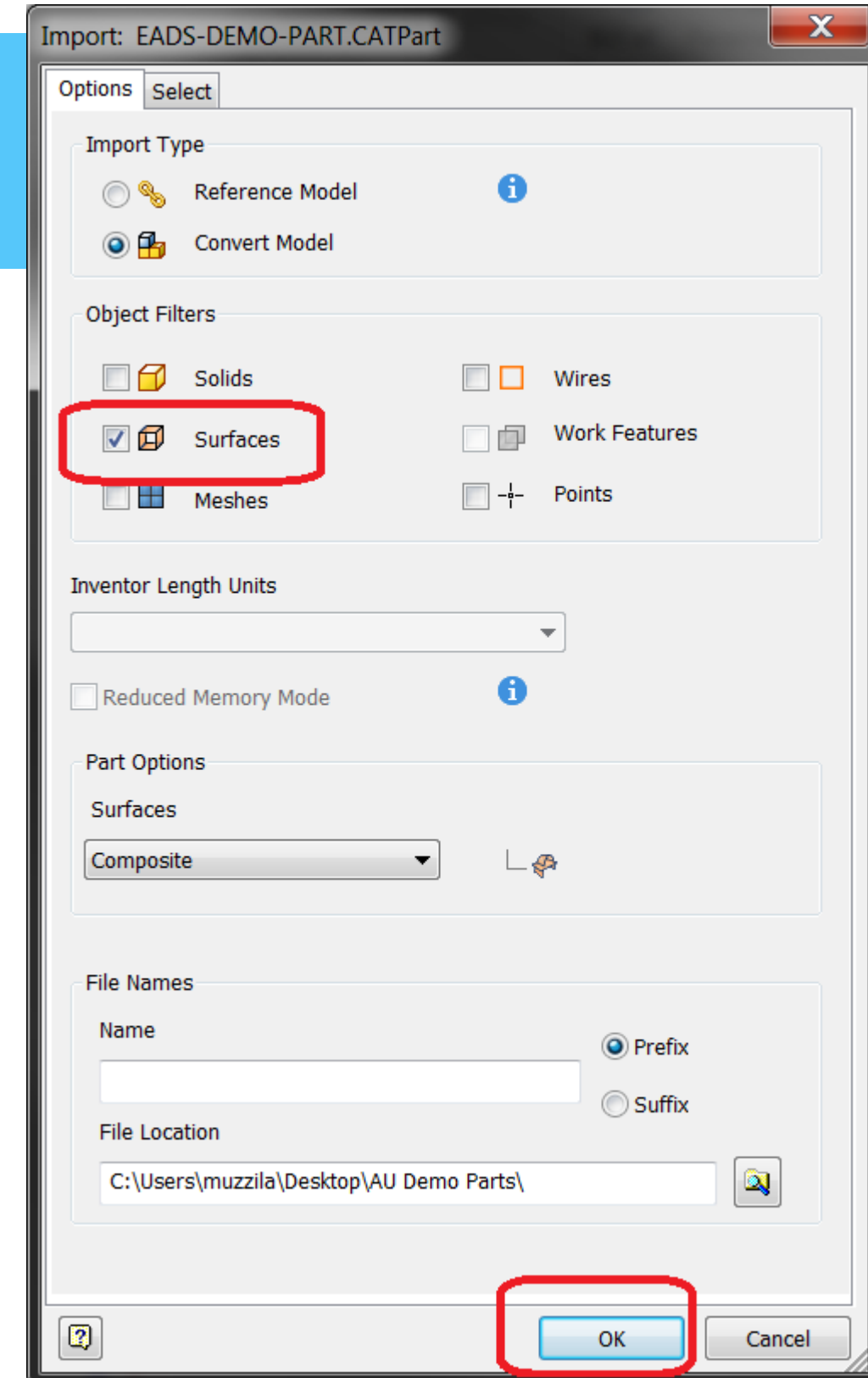
Optimize laser projection data with TruLaser



1. Click the Assemble tab
2. Click Place
3. Select **EADS-DEMO-PART.CATPart**
4. Click Open

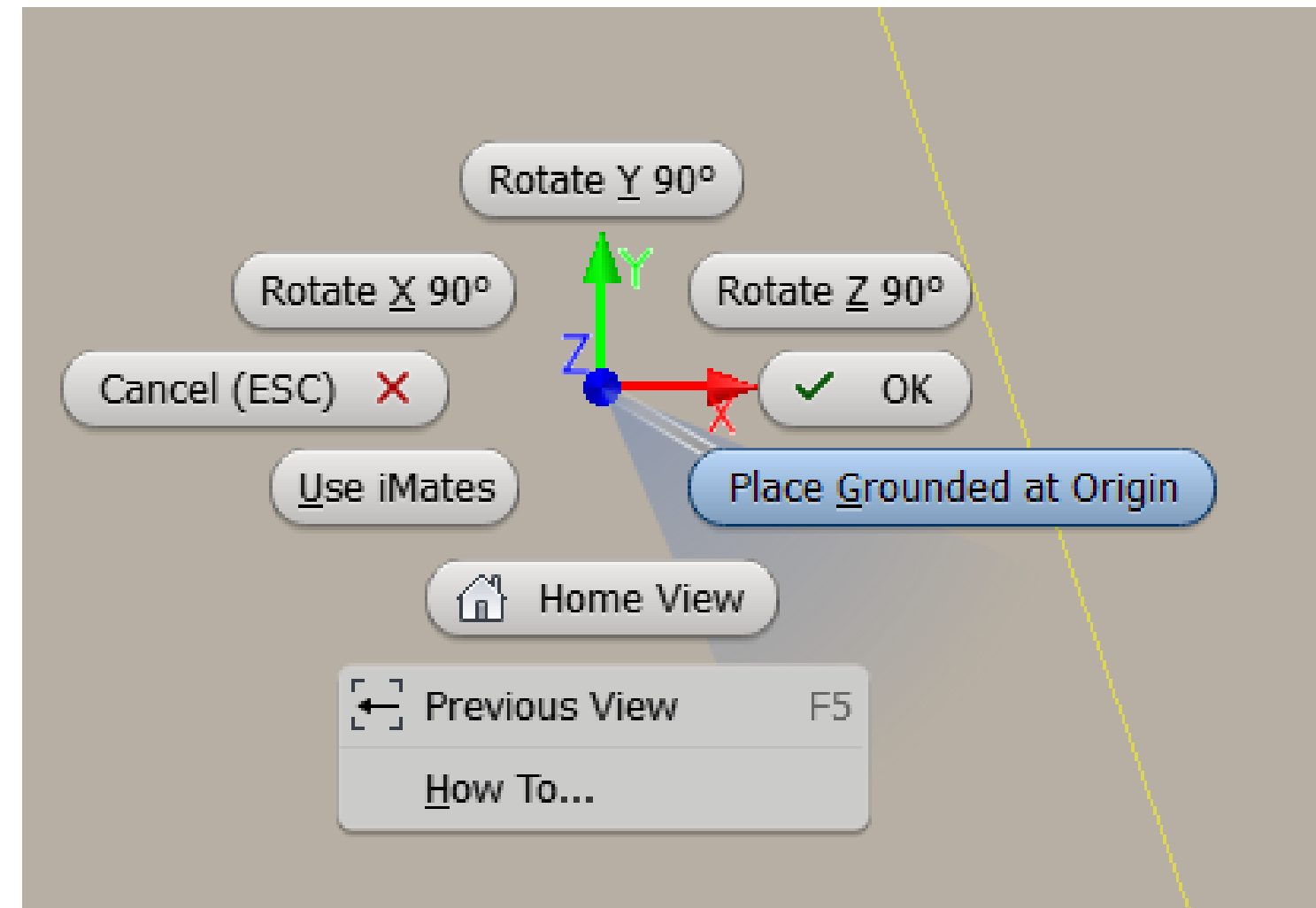
Optimize laser projection data with TruLaser

1. *DESELECT* ALL checkboxes except Surfaces
2. Click OK



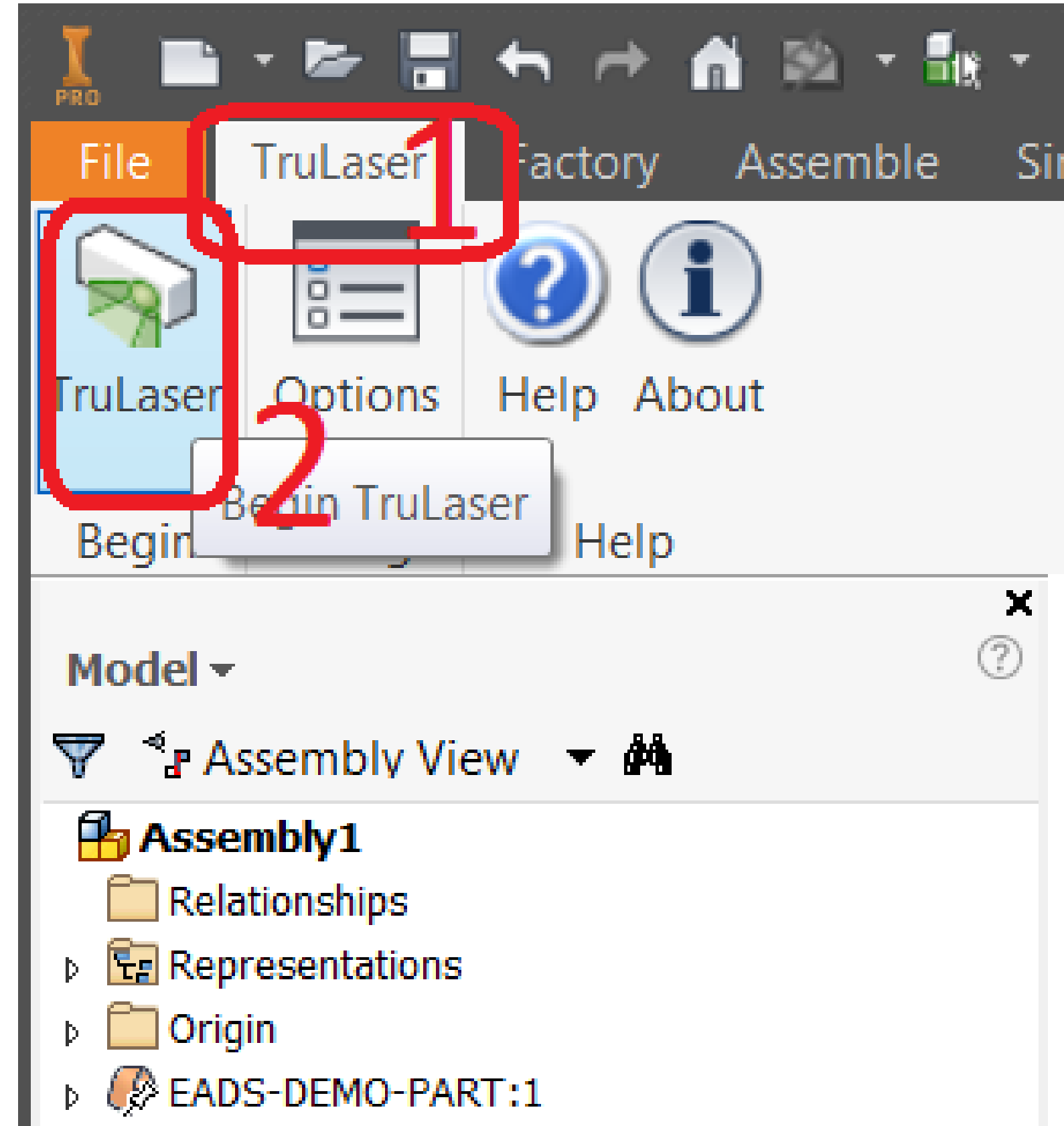
Optimize laser projection data with TruLaser

1. *RIGHT-Click* anywhere in the graphic window
2. Select *Place Grounded at Origin*
3. Type *Escape*



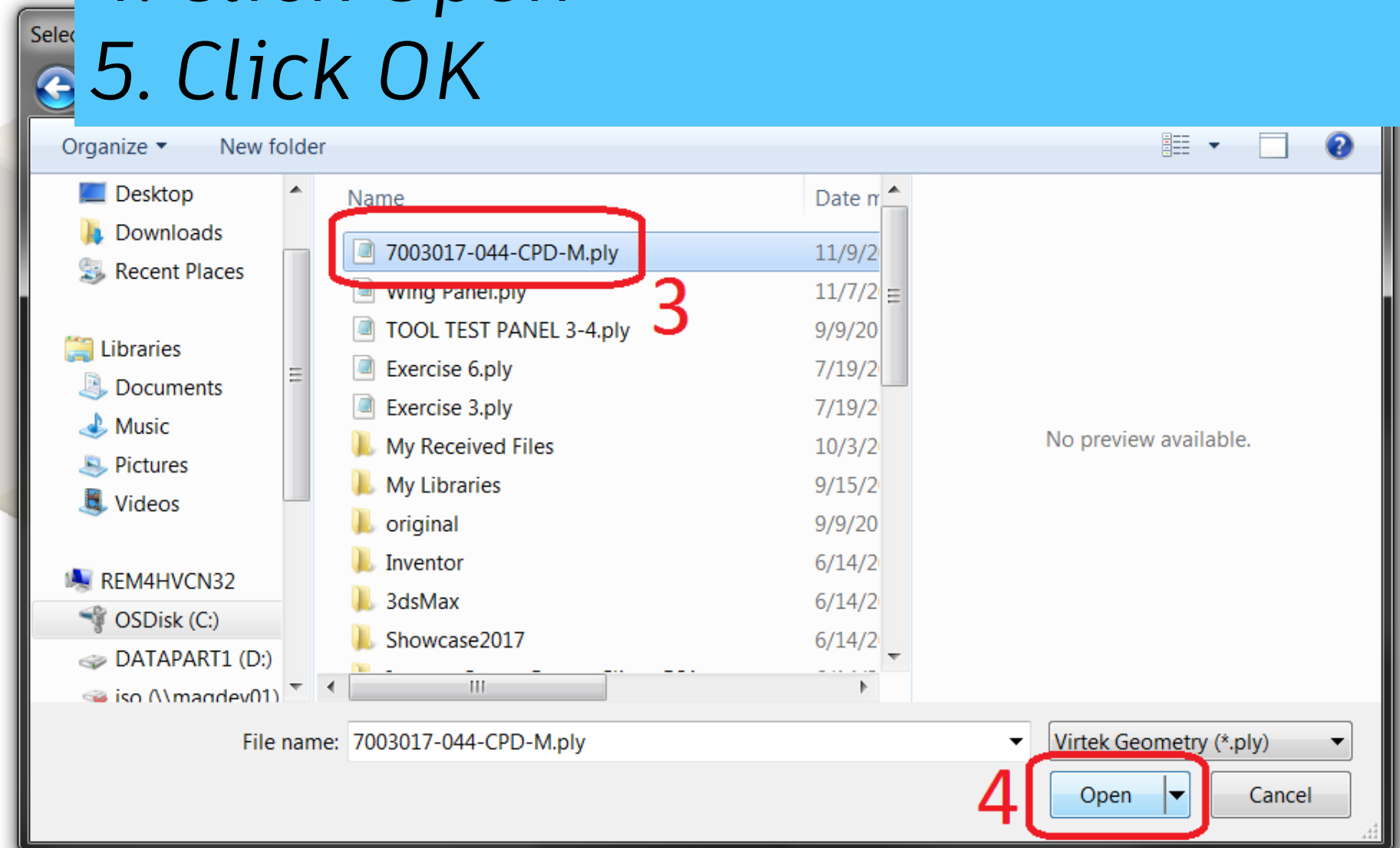
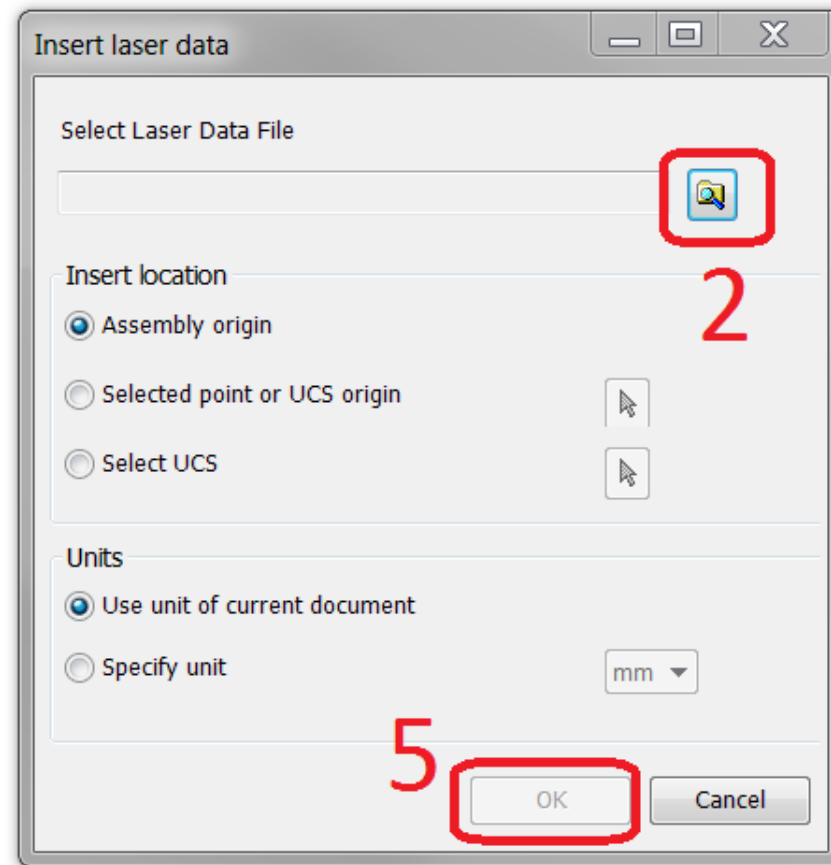
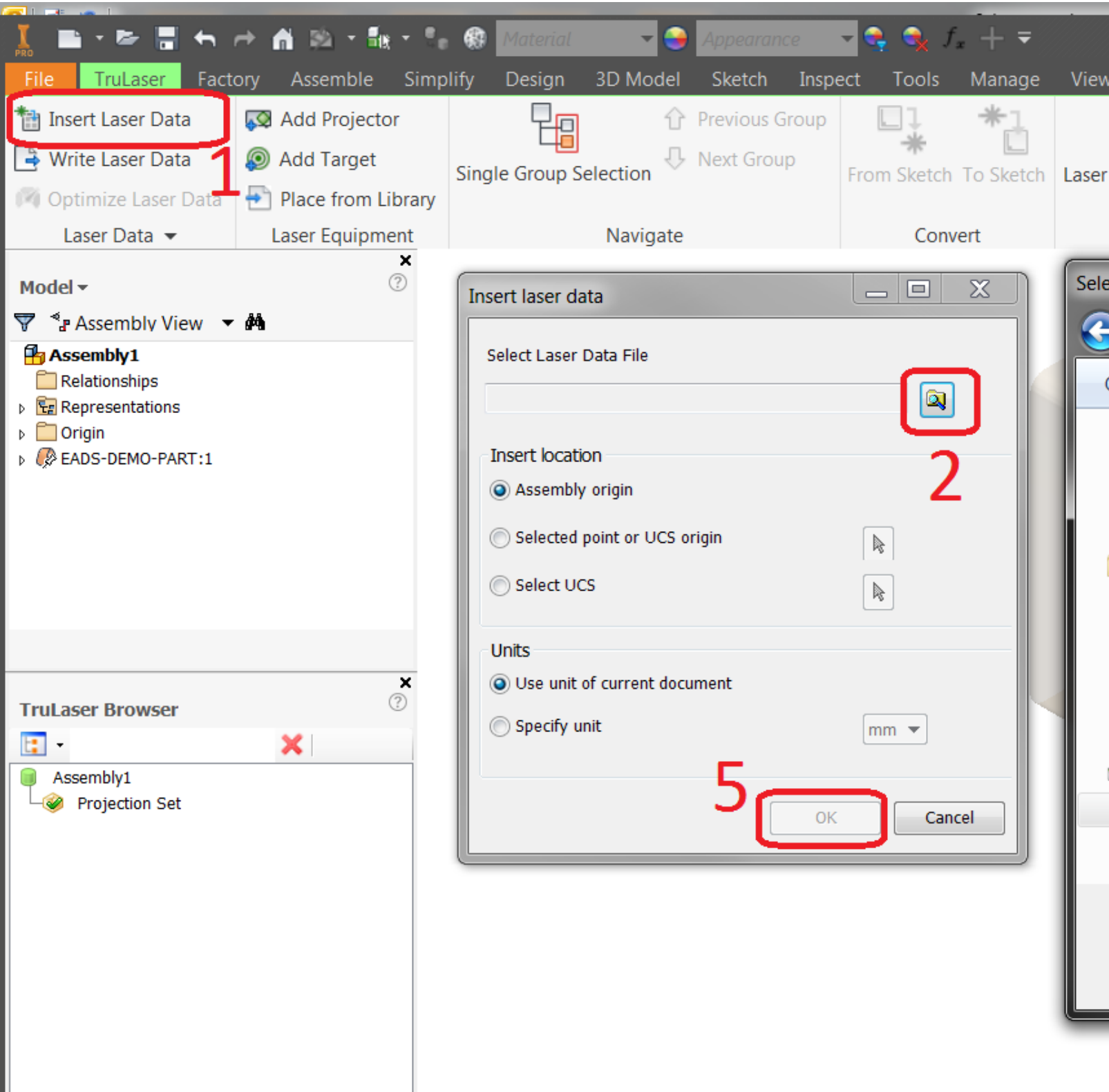
Optimize laser projection data with TruLaser

1. Click the TruLaser tab
2. Click TruLaser begin



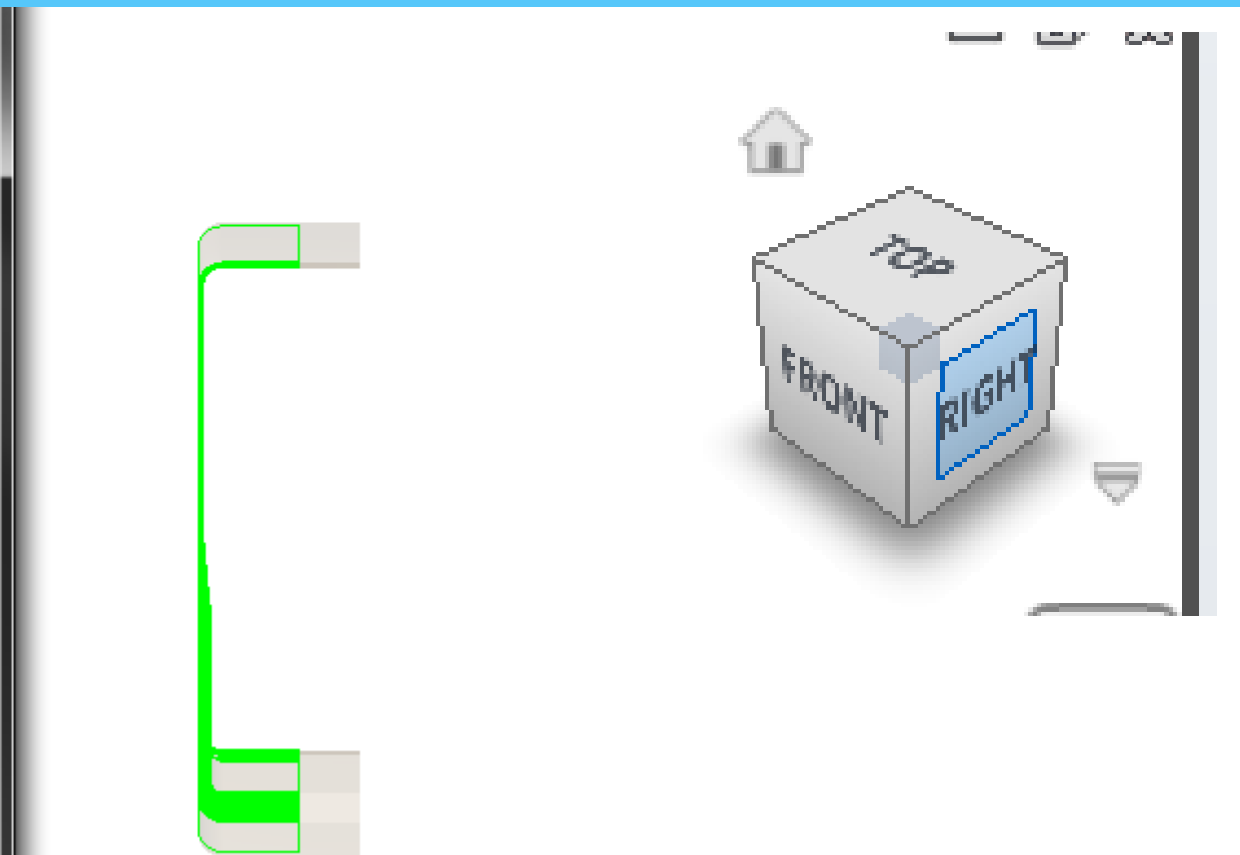
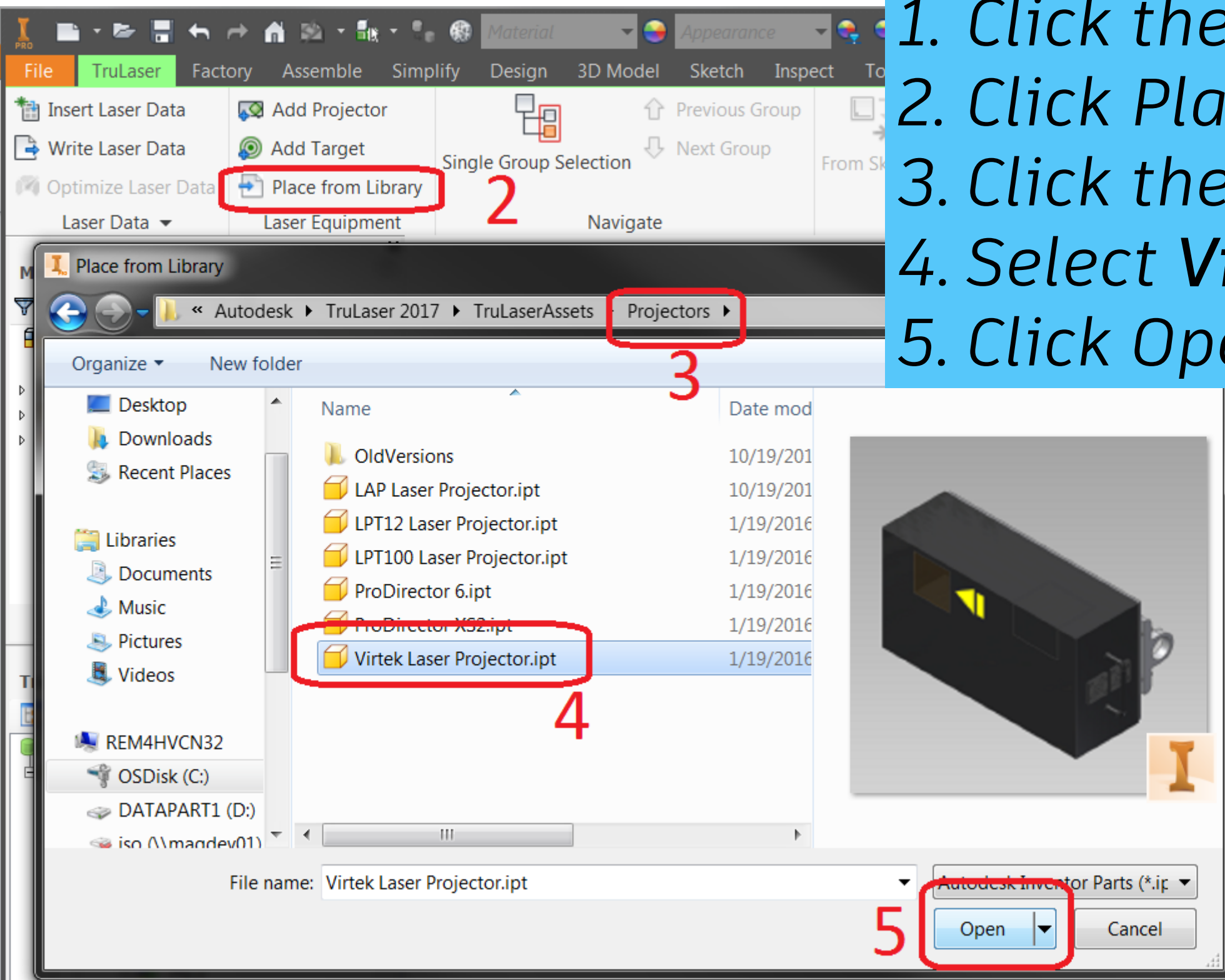
Optimize laser projection data with TruLaser

1. Click Insert laser data
2. Click the folder
3. Select 7003017-044-CPD-M.ply
4. Click Open
5. Click OK



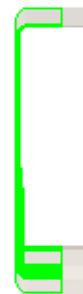
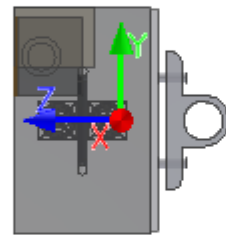
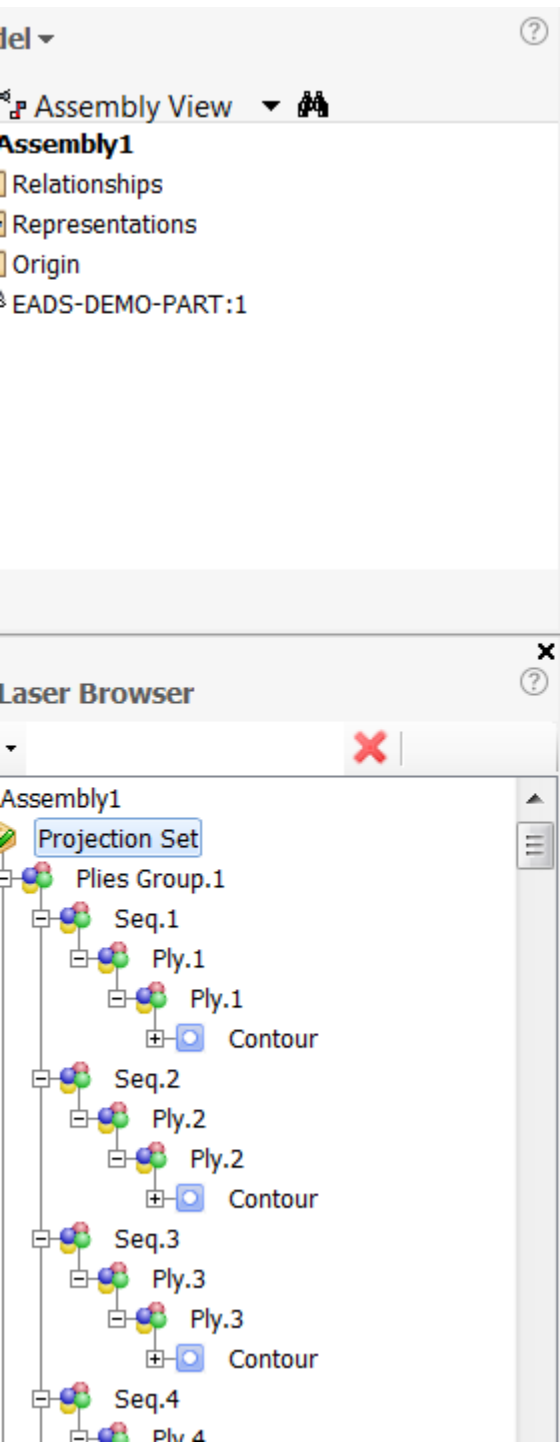
Optimize laser projection data with TruLaser

1. Click the right face on the view cube
2. Click Place from Library
3. Click the projectors folder
4. Select Virtek Laser Projector.ipt
5. Click Open



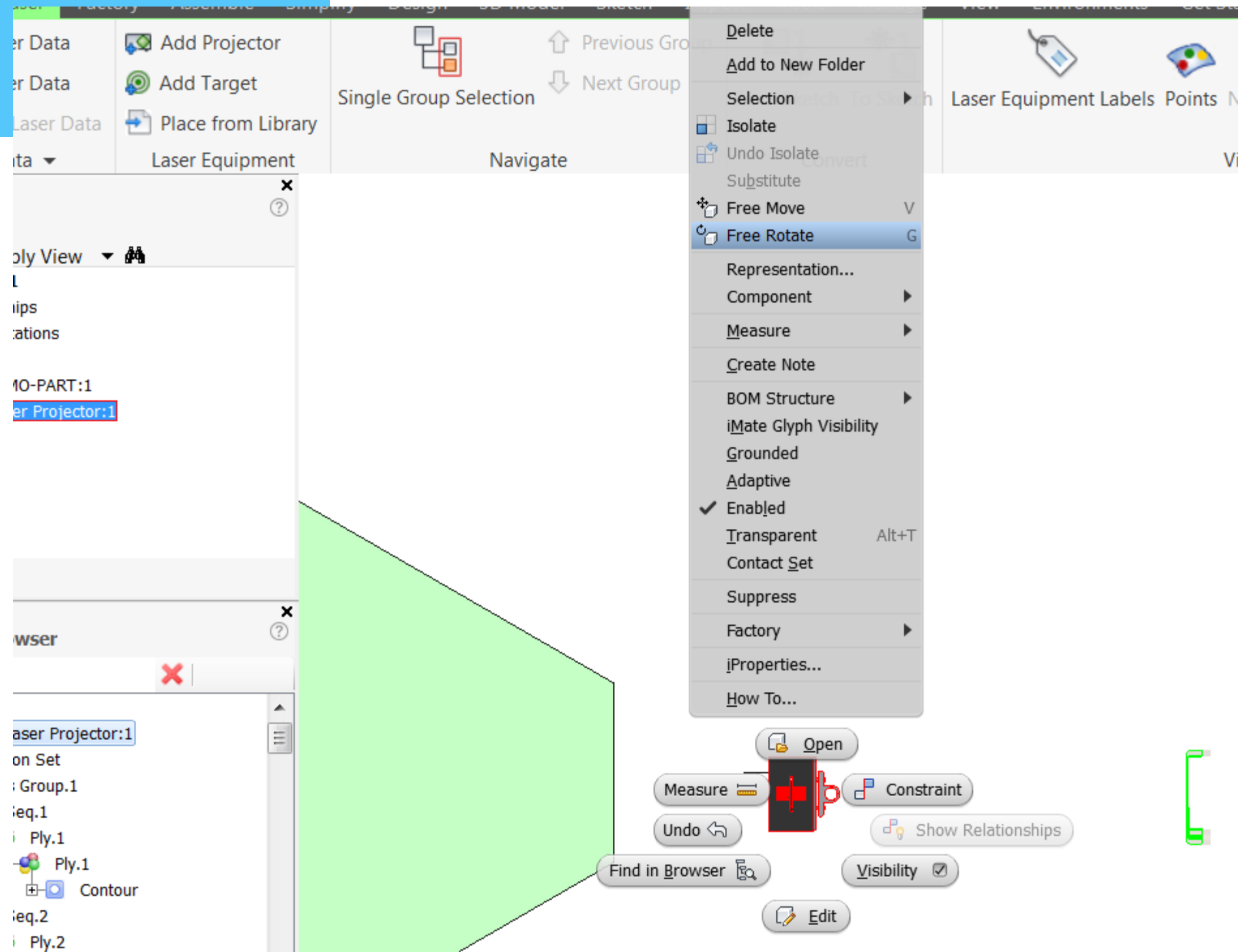
Optimize laser projection data with TruLaser

1. Scroll middle mouse wheel to zoom in and out
2. Move projector to the left of the tool
3. Click to place projector
4. Type **Escape**



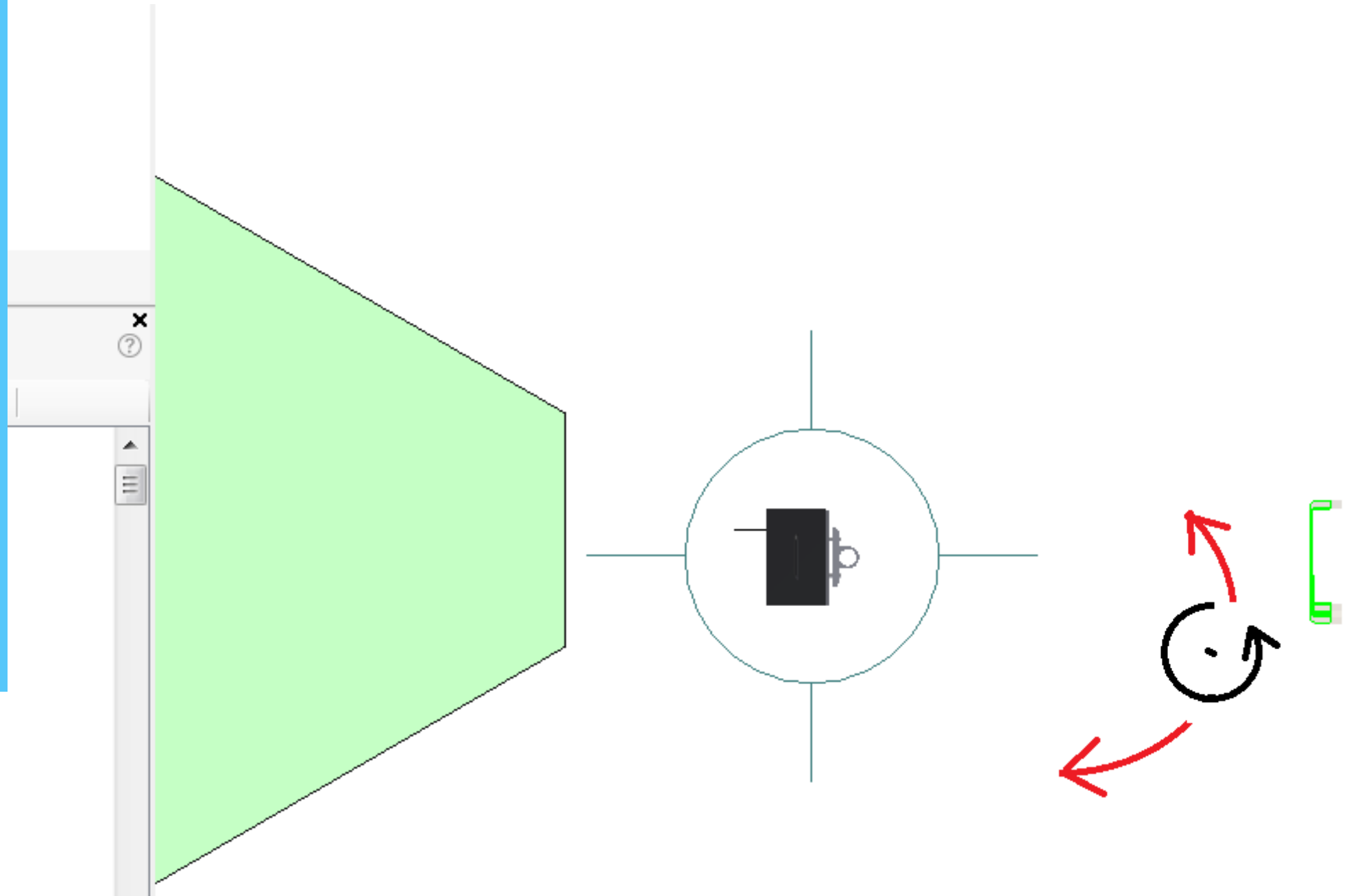
Optimize laser projection data with TruLaser

1. Click the projector to select
2. Right click the projector
3. Select Free Rotate



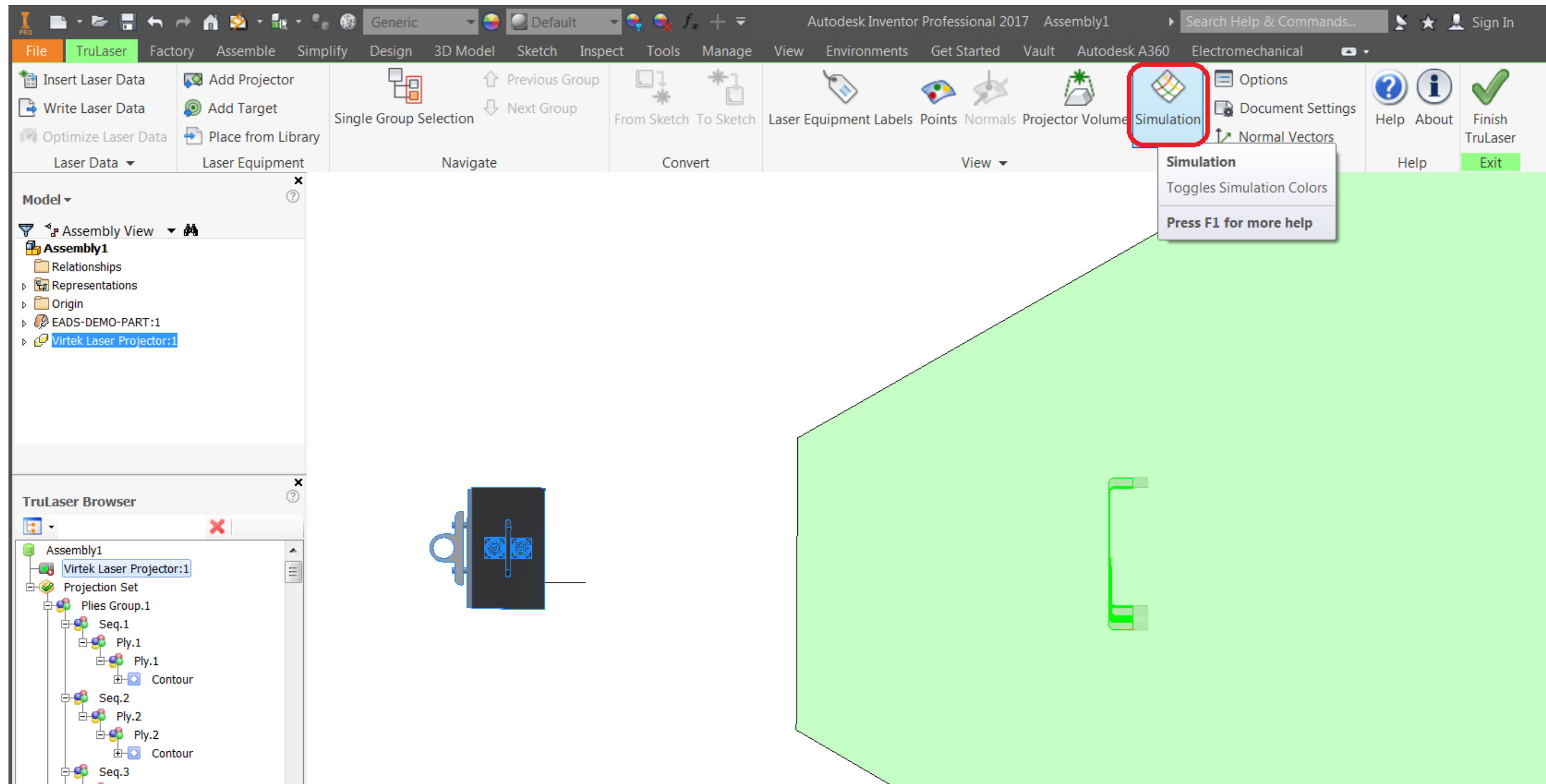
Optimize laser projection data with TruLaser

1. Move the pointer outside the rotation circle
2. Click and drag until the projector is pointed towards the tool
3. Single click over open space to accept changes



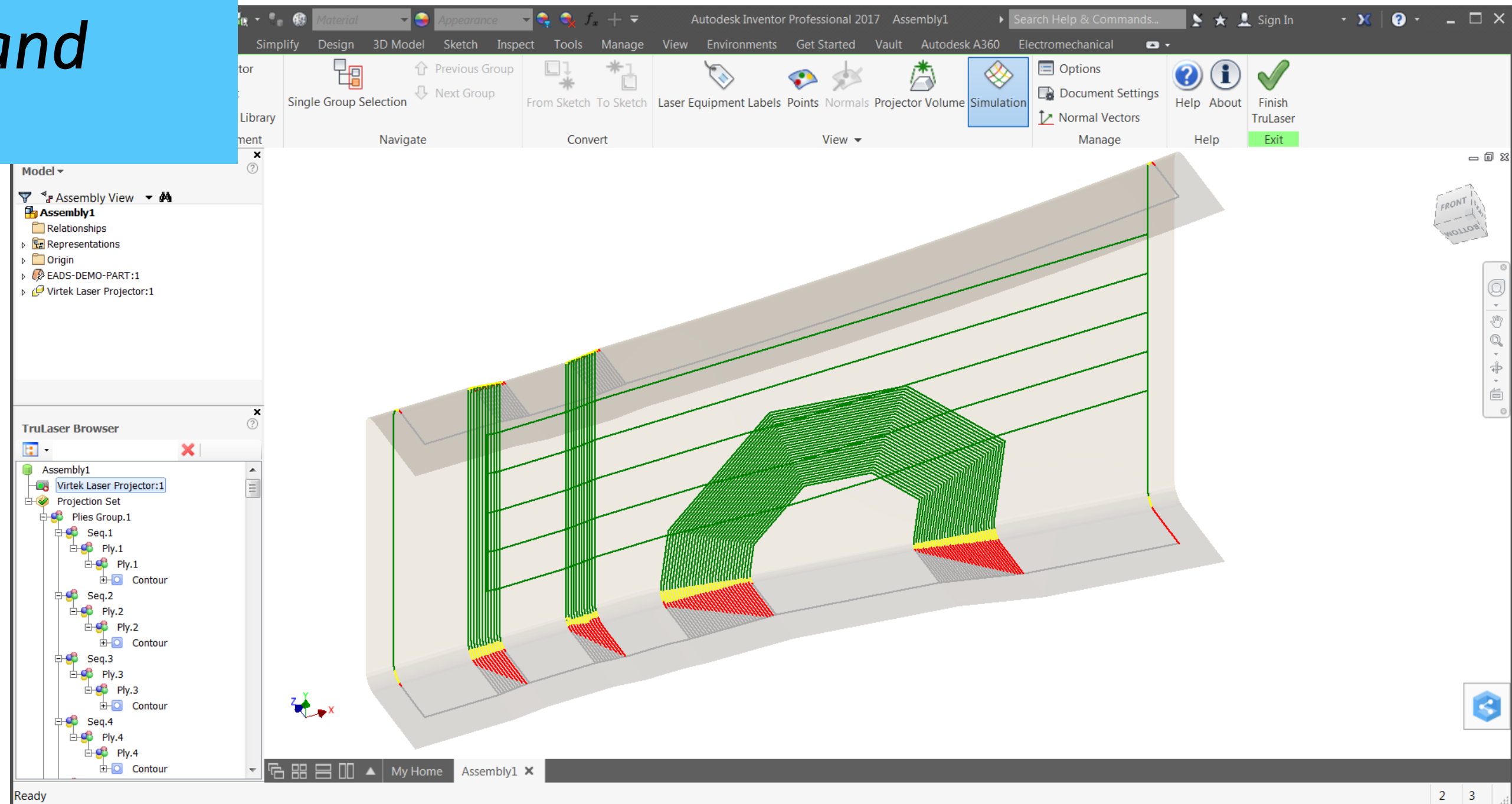
Optimize laser projection data with TruLaser

1. Click Simulation



Optimize laser projection data with TruLaser

1. Rotate model with
**Shift + middle
mouse click and
drag**



TruNest composites for Material tracking

Material Tracking



Freezer

Autoclave



Cutting



Layup



- Expiration dates for all plies
- In/Out time for all plies
- Remaining shelf life for plies
- Which Roll Each Ply Came From

RFID
Bar Code

Bar Code



RFID
Bar Code

Bar Code



TruNest composites for Material tracking

TruNest connects to *multiple* systems

1. Automated freezer tracking system / *RFID*
material tracking point on cutting table



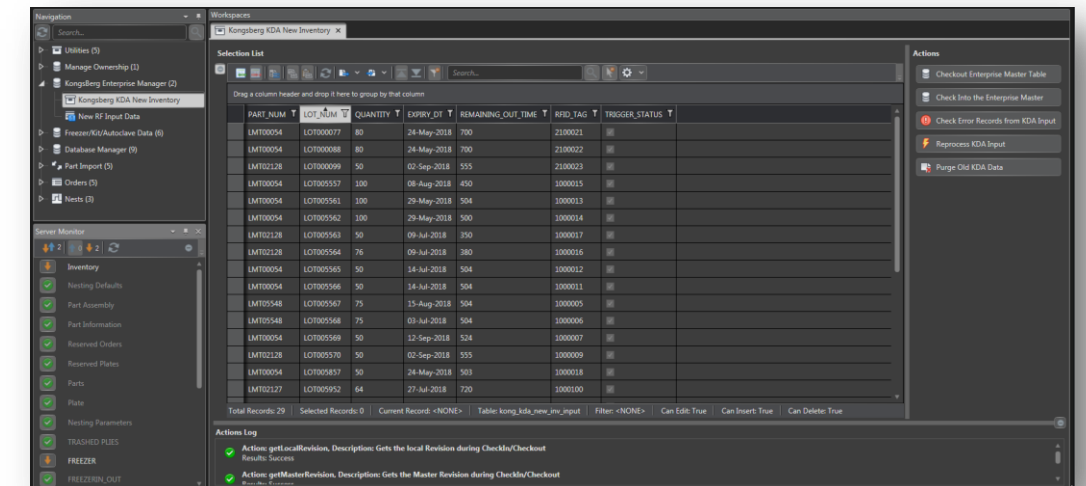
2. *ERP* connection for order input and
inventory feedback



3. *Bar code* readers



1. Unload from cutting table
2. Layup station
3. Autoclave



TruNest composites for Material tracking

TruNest connects to *multiple* systems

4. *NC code generated for cutting table / labeler*



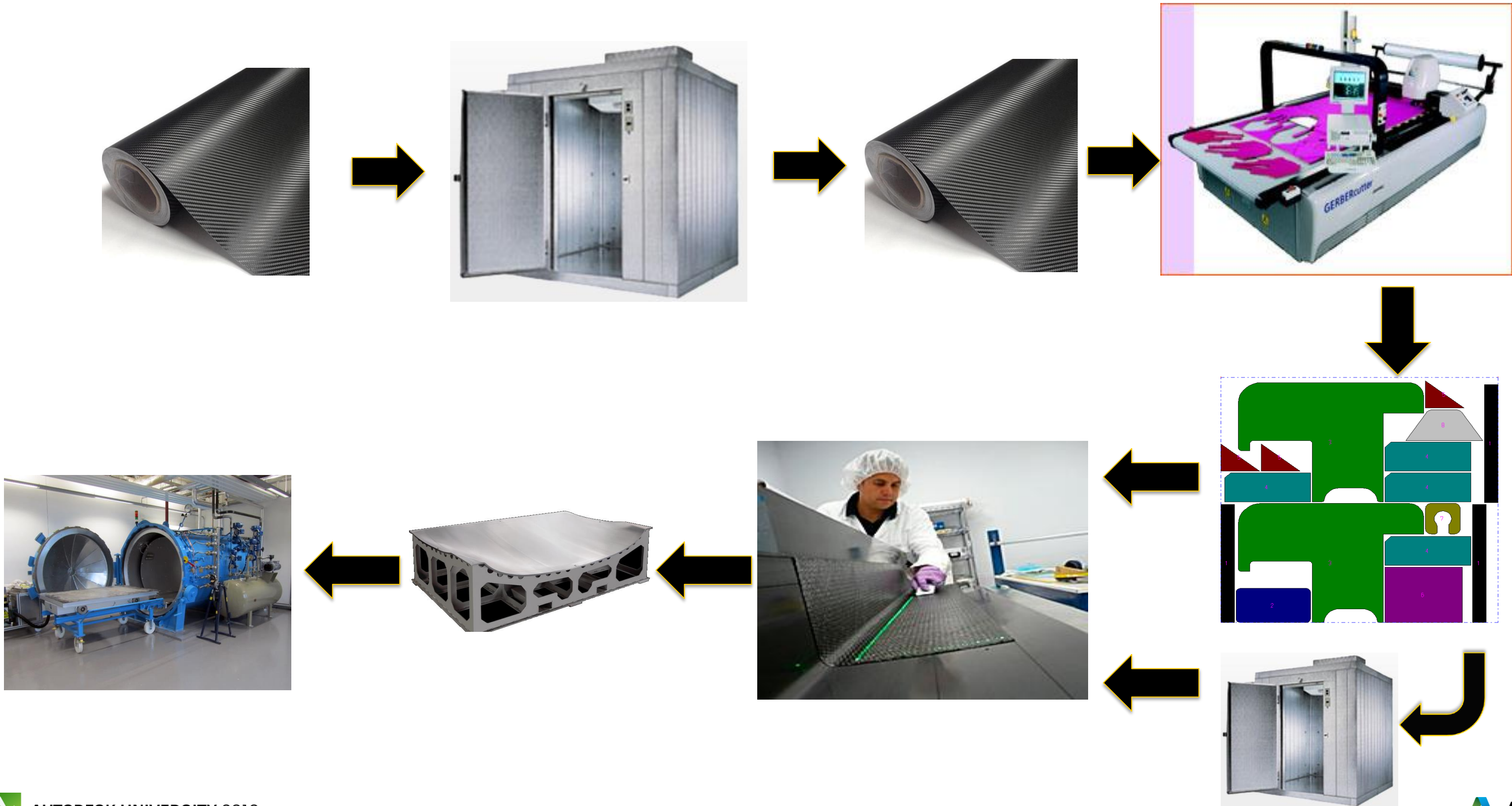
5. *Laser projection files generated for layup assist*



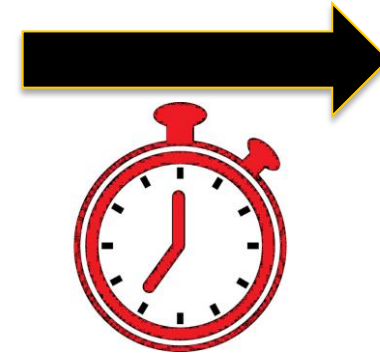
6. *XML print template for ply bag labels*



Workflow for Material tracking

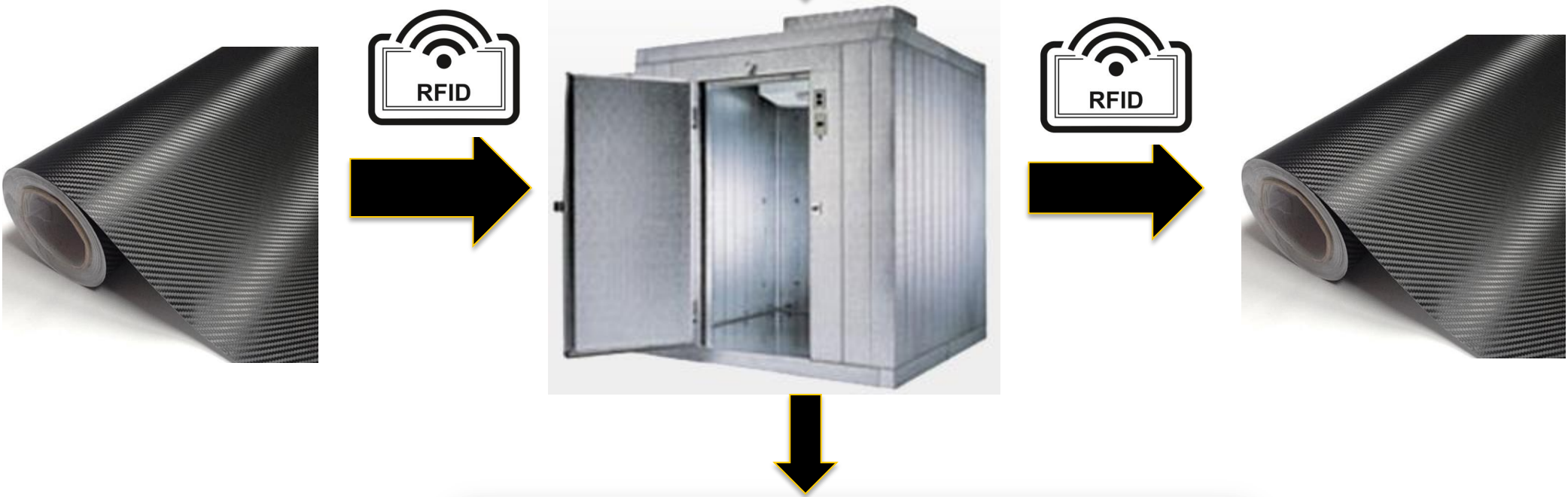


Timer for Material tracking



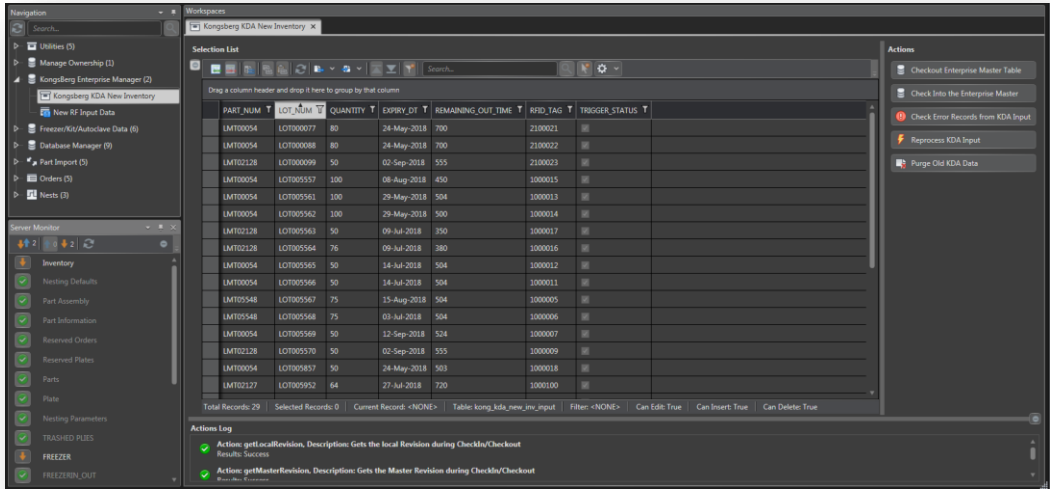
Workflow for Material tracking

	A	B	C	D	E	F
1	Roll name	Material	Quantity	Width	Time remaining	Expiration date
2	ATP000001	2ZZZ8v96de	100	1270	222	12/31/2016
3	ATP000002	2ZZZ8v96de	60	1270	162	12/31/2016
4	ATP000003	2ZZZ8v96de	90	1080	992	12/31/2016
5	ATP000004	2ZZZ8v96d48	80	1270	264	4/30/2017
6	ATP000005	2ZZZ8v96d48	22	1270	926	4/30/2017
7	ATP000006	2ZZZ8v96d48	109	1080	453	4/30/2017



Freezer station

1. Automated freezer
2. Software driven
3. Feeds data to TruNest

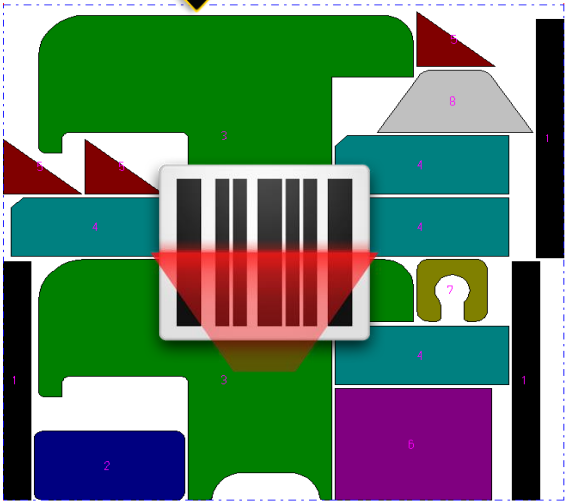
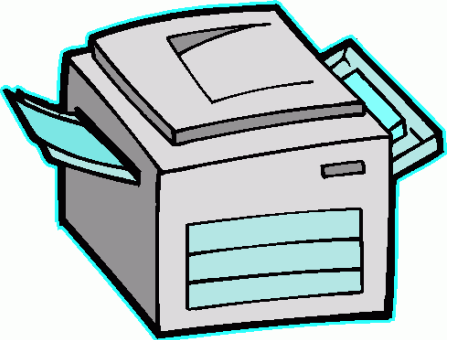
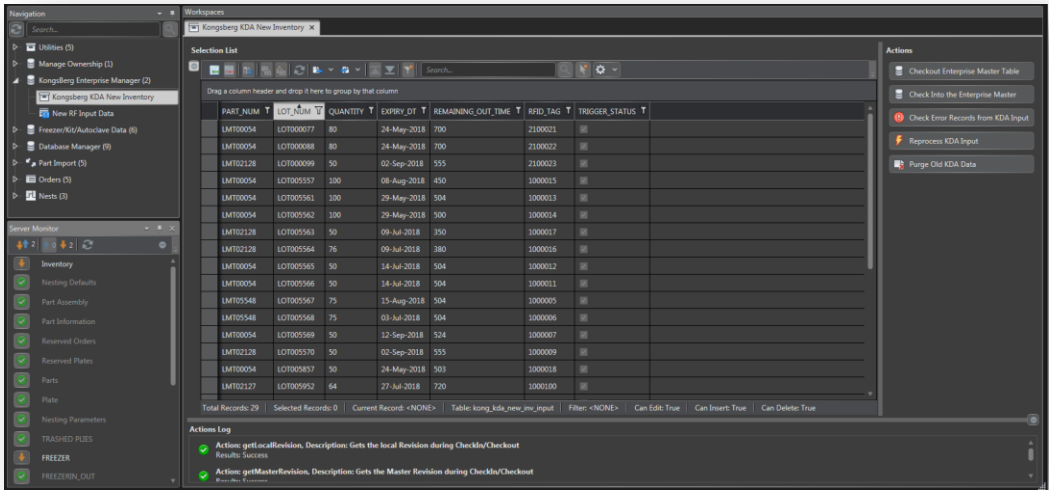
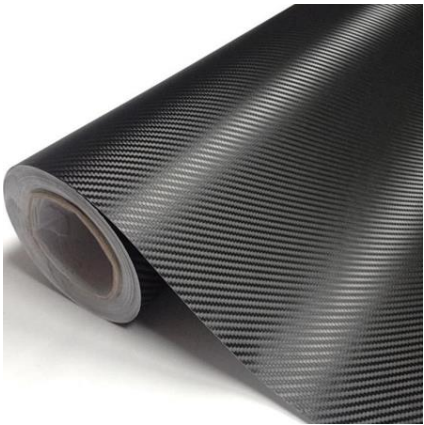


Workflow for Material tracking

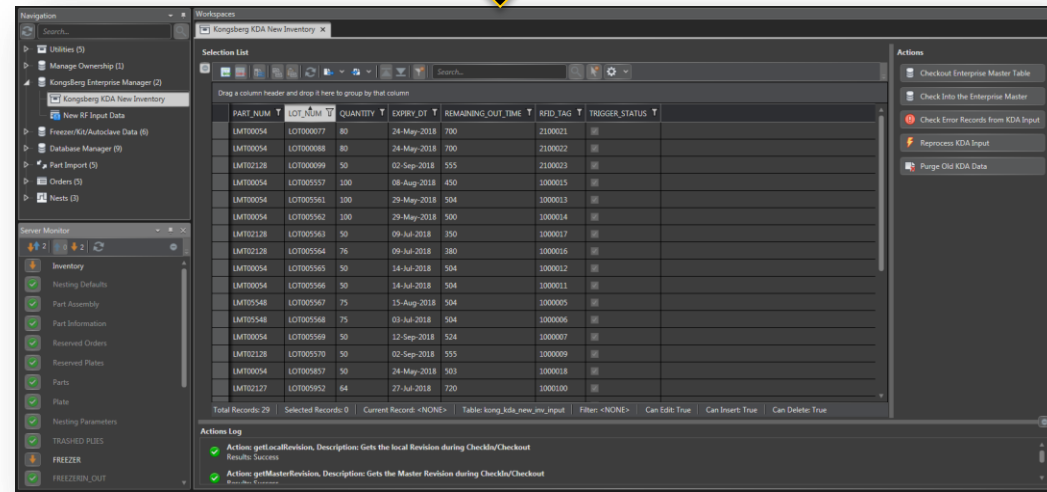
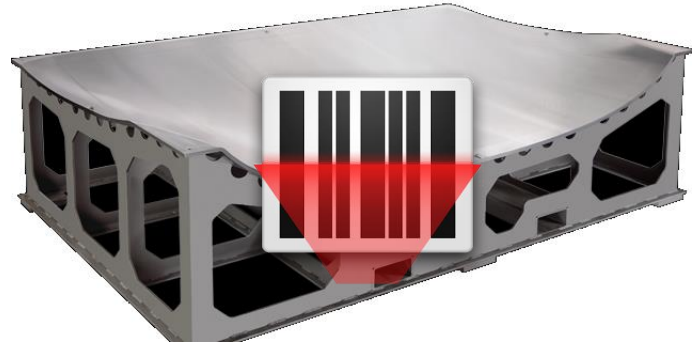
	A	B	C	D	E	F
1	Roll name	Material	Quantity	Width	Time remaining	Expiration date
2	ATP000001	2ZZZ8v96de	100	1270	222	12/31/2016
3	ATP000002	2ZZZ8v96de	60	1270	162	12/31/2016
4	ATP000003	2ZZZ8v96de	90	1080	992	12/31/2016
5	ATP000004	2ZZZ8v96d48	80	1270	264	4/30/2017
6	ATP000005	2ZZZ8v96d48	22	1270	926	4/30/2017
7	ATP000006	2ZZZ8v96d48	109	1080	453	4/30/2017



- Cutter station
1. Orders from ERP
 2. RFID shows roll
 3. Post for cutter
 4. Bar code label
 5. Bag label to printer

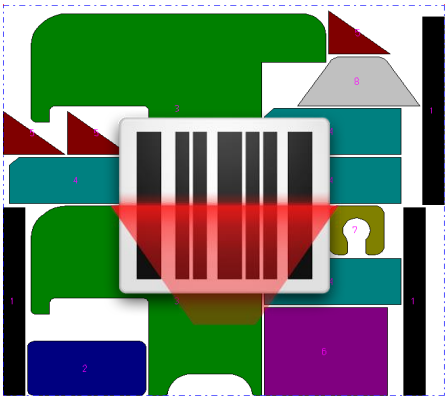


Workflow for Material tracking



Layup station

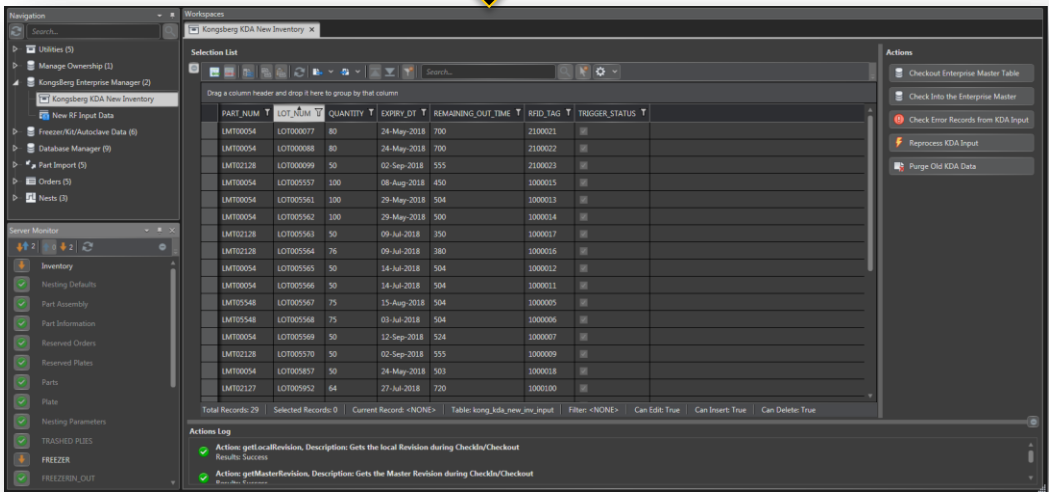
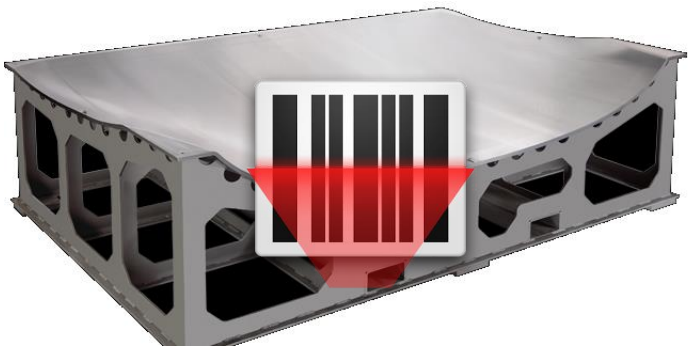
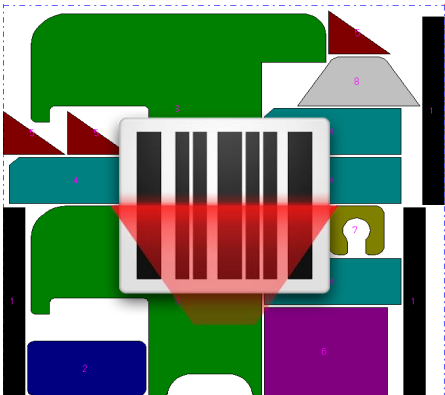
1. Come from cutter or freezer
2. Bar code kit bag
3. Bar code tool
4. Trash / Transfer plies



Workflow for Material tracking

Autoclave station

- 1. Bar code from tool
- 2. 4 autoclave
- 3. Prep station
- 4. IN status
- 5. Stops timer after 3 hours



	A	B	C	D	E	F
1	Roll name	Material	Quantity	Width	Time remaining	Expiration date
2	ATP000001	2ZZZ8v96de	100	1270	222	12/31/2016
3	ATP000002	2ZZZ8v96de	60	1270	162	12/31/2016
4	ATP000003	2ZZZ8v96de	90	1080	992	12/31/2016
5	ATP000004	2ZZZ8v96d48	80	1270	264	4/30/2017
6	ATP000005	2ZZZ8v96d48	22	1270	926	4/30/2017
7	ATP000006	2ZZZ8v96d48	109	1080	453	4/30/2017



1



2



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