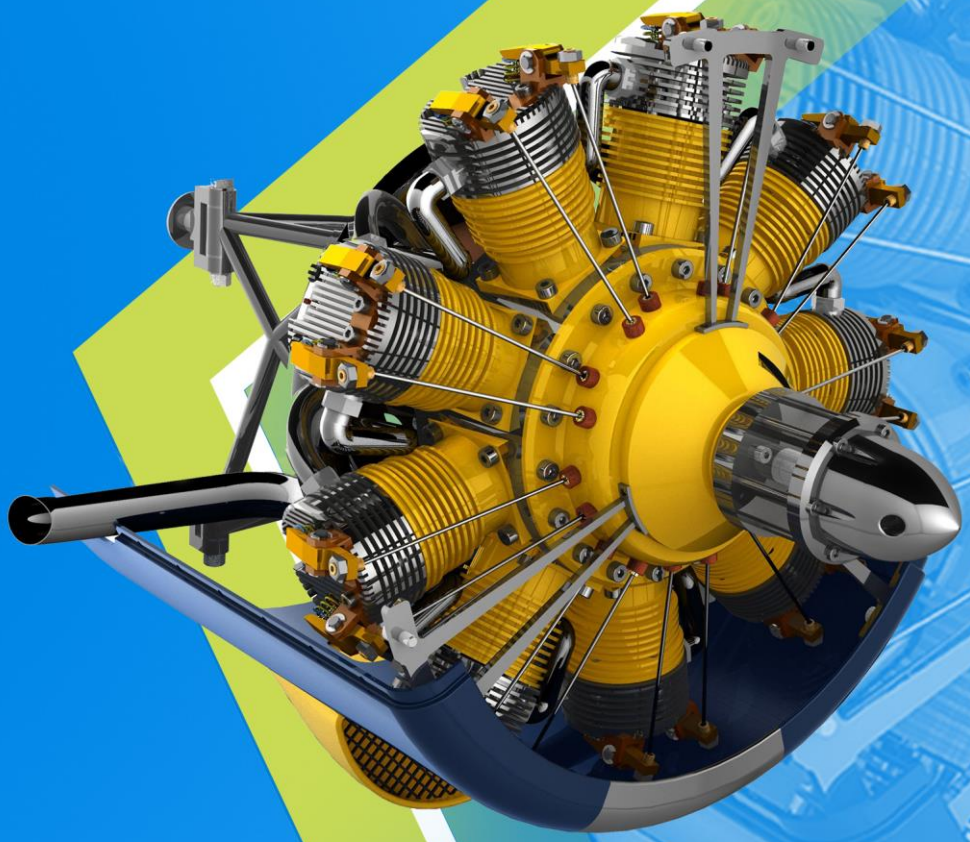
ZW3D from Entry to Master Tutorial

Assembly Design



ZW3D™ V2023 From Entry to Master CAD Assembly Design

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Foreword

In this tutorial, we provide various case studies, which are from easy to difficult and combine theory with practice. We hope to improve users' 3D CAD/CAM skills and techniques with ZW3D.

The tutorial bases on our technical engineers' years of experience in the industry and ZW3D, which is the fruit of a lot of efforts and wisdom. We sincerely hope that the tutorial will do help to you, and your precious advice on it is highly welcomed.

There are three series for this tutorial: ***Primary Tutorial***, ***From Entry to Master Tutorial***, and ***Advanced Tutorial***. From easy to difficult, they offer a step-by-step learning process that can meet different user needs.

Primary Tutorial series is for users who have little or no prior 3D CAD/CAM experience. If you are green hands of 3D CAD/CAM software, or if you are a new user of ZW3D, we recommend that you get started with this tutorial. Here you can learn the basic knowledge and concepts of ZW3D, rapidly master the simple operations and workflows of ZW3D, and practice simple cases.

From Entry to Master Tutorial series is for users with basic know-how of 3D CAD/CAM software. If you have experience in 3D CAD/CAM software and want to master common functions of ZW3D, we suggest that you start with this series. Here you can dig deeper into the functions and master more operations of ZW3D.

Advanced Tutorial series is for users with practical experience in 3D CAD/CAM software. If you hope to have a comprehensive command of ZW3D and get the complicated operations done independently, you can choose to learn this series. Here you can learn to use the software more flexibly and get rich experience to increase your efficiency.

What you are learning is ***CAD Assembly Design***, a ***From Entry to Master*** tutorial.

Thanks for being our user!

The ZW3D Team

Contents

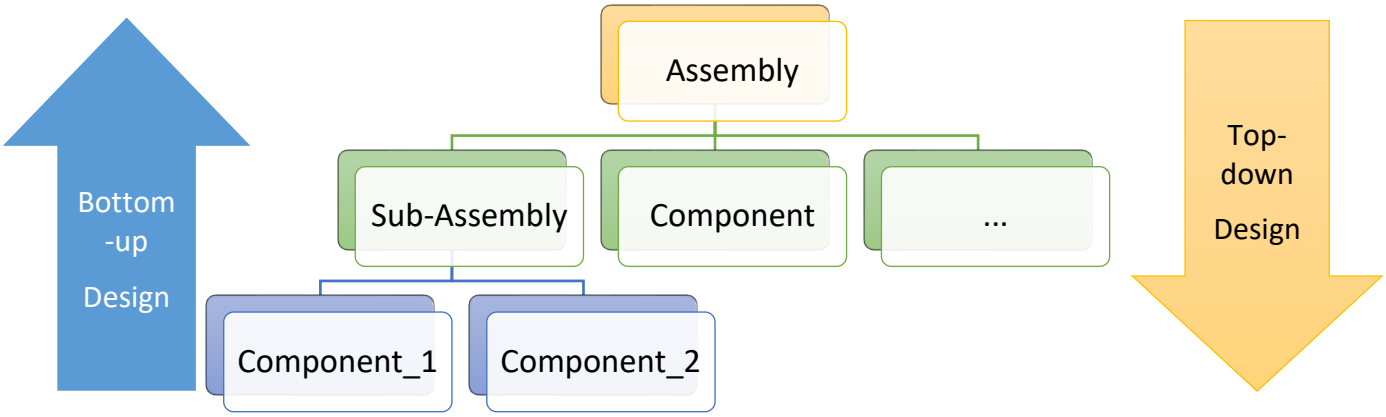
Key Points:

- ✧ Insert Components
- ✧ Define Constraints
- ✧ Manage Components
- ✧ Interference Check and Exploded View
- ✧ Animation

The General Assembly Process:

Bottom-up and Top-down Design

In ZW3D, you can adopt two common design approaches, bottom-up design and top-down design. Bottom-up design can be collaborative but error-prone, and top-down design can make up for this shortcoming, so we often use them together.



Two File Management Methods in ZW3D

- ➢ **One object per file**

Under this mode, there will be a separate file for each component. You can turn on this mode in the general configuration. If the file needs to be associated with PDM/PLM systems, please use this mode.

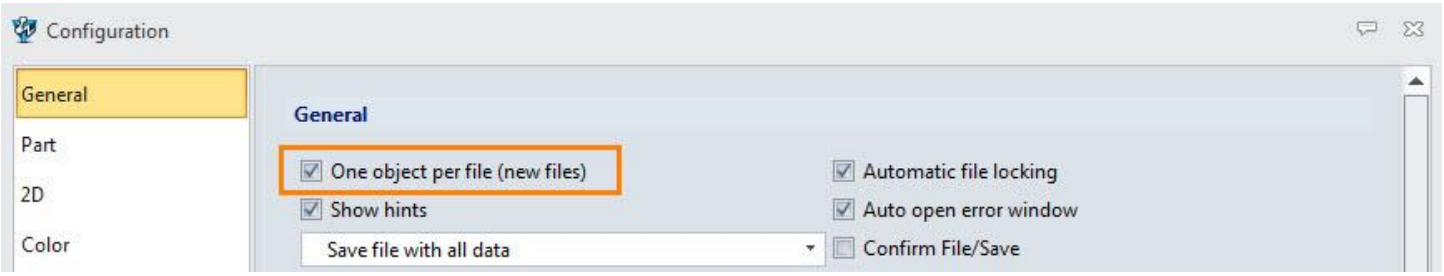


Figure 1 One object per file

- ➢ **Multiple objects per file**

Under this mode, all components including parts, assembly, 2D drawings, etc., are contained in one file. If the file doesn't need to be associated with PDM/PLM systems, this is a convenient mode.

Manager

Filter All Preview Off

Find in Name

Name	Type	Modified	Last Modified	Create Time	Description	number	Designer	Manager	Supplier	Cost	Cl...	Derived From	Material	Keywords
piston	Assembly		2020/4/14 9:50	2020/4/14 9:48									Steel AISI 4140	
crank	Assembly		2020/4/14 9:55	2020/4/14 9:51									Steel AISI 4140	
Engine crankshaft connecting rod_2D	Drawing	YES	2020/4/15 11:59	2020/4/15 11:58										
Engine crankshaft connecting rod	Assembly		2020/4/14 10:32	2020/4/13 17:04									Steel AISI 4140	
E025002A	Part		2020/4/13 17:03	2005/2/15 22:59								E025002A	Steel	
E025001A	Part		2020/4/13 17:03	2002/1/24 0:21								E025001A	Steel	
E024501A	Part		2020/4/13 17:03	2005/1/17 4:34								E024501A	Steel	
E024001A	Part		2020/4/13 17:04	2002/1/21 20:57								E024001A	Aluminum	
E023505A	Part		2020/4/13 17:04	2004/6/15 15:15									Steel	
E022004A	Part		2020/4/13 17:04	2002/1/24 0:08								E022004A	Aluminum	
E020501B	Part		2020/4/14 9:40	2004/1/16 5:36								E020501B	Steel	
DIN912-M8x1x35-12.9	Part		2020/4/13 17:04	2004/1/2 18:04								DIN912-M8x1x35-12.9	Steel AISI 4140	

Figure 2 Multiple objects per file

1 Introduction to Assembly Manager

Manager->Assembly Manager

The ***Assembly Manager*** displays all components inserted into the active assembly, the parent/child relationships of components, and the constraints for the components. You can select an item from the filter at the top of the assembly manager to show only components or alignments, or both. Also, you can right-click on these items and select a command to edit them.

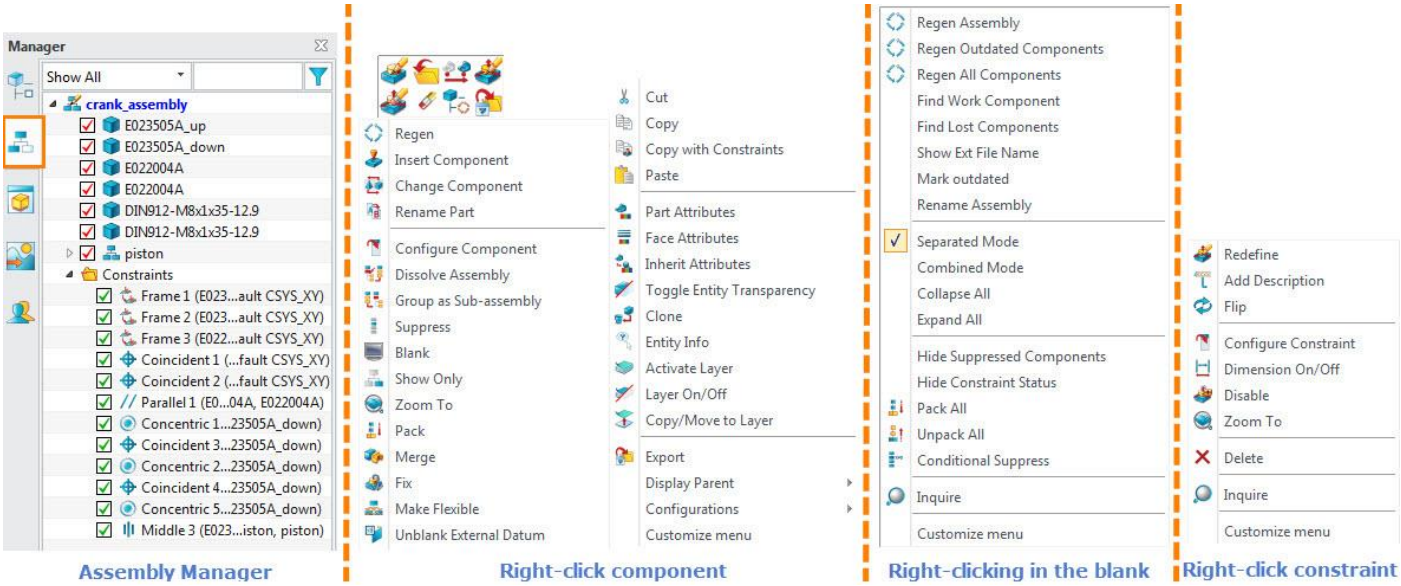


Figure 3 Assembly Manager

1.1 The Options Menu of Right-Clicking on Components

	Command	***Explanation***
	Edit Part	Activate selected components for editing in the assembly level.
	Open Part	Enter the file where the selected component is located.
	Move	Move the selected component.
	Edit Constraint	Modify the constraints of the selected component.
	Delete Constraint	Selectively delete the existing constraints of the selected component.
	Erase	Remove the selected components or sub-assembly from the assembly.
	Auto Regen①	
	Export	Export the selected component to other industry standard formats.
	Regen	Regenerate the assembly tree.
	Insert Component	Insert a component as the child of the selected component.
	Change Component	Select a new component to replace the current component.
	Rename Part	Rename the selected component.
	Configure Component②	
	Dissolve Assembly③	

	Group as Sub-assembly ④	
	Suppress/Unsuppress	Suppress/Unsuppress the selected component.
	Blank/Unblank	Blank/Unblank the selected component.
	Show Only	Show the selected components only.
	Zoom To	Enlarge the selected component to the center of the workspace.
	Pack⑤	
	Merge	Same as the Component Merge command.
	Fix	Fix the selected component.
	Make Flexible/Rigid⑥	
	Blank/UnBlank External Datum	Turn the external datum of the component on/off.
	Cut	Cut the selected component.
	Copy	Copy the selected component.
	Copy with Constraints	Copy a component and its existing constraints.
	Paste	Paste the copied or cut components as new components.
	Part Attributes	Invoke the Part Attributes dialog of the selected component.
	Face Attributes	Invoke the Face Attributes dialog of the selected component.
	Inherit Attributes	Inherit assembly/part/shape attributes into the selected assembly/part/shape.
	Toggle Entity Transparency	Automatically toggle entity transparency.
	Clone	Clone the selected component and replace it.
	Entity Info	Show the entity information.
	Activate Layer	Activate the layer where the selected component is on.
	Layer On/Off	Open/Close the layer where the selected component is on.
	Copy/Move to Layer	Copy/Move the selected component to a specific layer.
	Export	Export selected components.
	Display Parent	Show the parent ".Z3" file.
	Configurations	Switch to a different configuration for the selected component.
	Customize menu	Customize the right-click menu.

① ***Auto Regen:*** Use this command to set the auto Regen status of a component.

Here is a simple case to help you understand the different results of options.

STEP 01 Create an assembly file and add a variable "Height=100" to it.

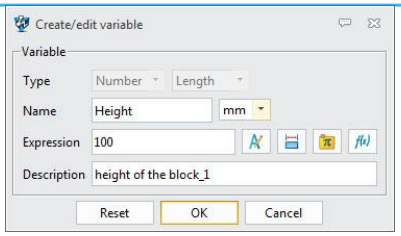


Figure 4 Adding a variable

STEP 02 Add two block components to the assembly, and associate the height of block_1 with the variable "Height".

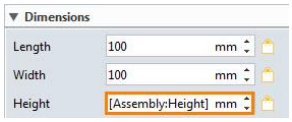


Figure 5 Adding dimensions

STEP 03 Constrain the top surfaces of block_1 and block_2 to coincide.

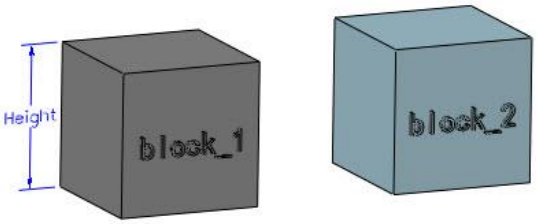


Figure 6 Constraining top surfaces

STEP 04 Adjust the variable to "Height=50" and regenerate the assembly to see the results of different auto regen options for block_1.

- None: the component is not regenerated when the assembly is regenerated.

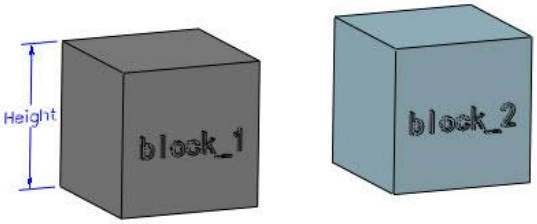


Figure 7 None

- Before assembly regen: the component will be regenerated before the assembly is regenerated.

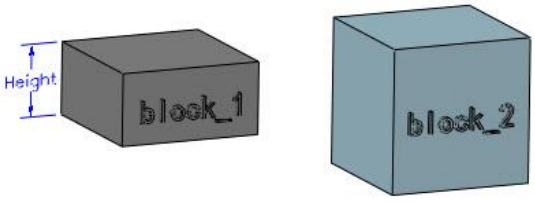


Figure 8 Before assembly regen

- After assembly regen: the component will be regenerated after the assembly is regenerated.

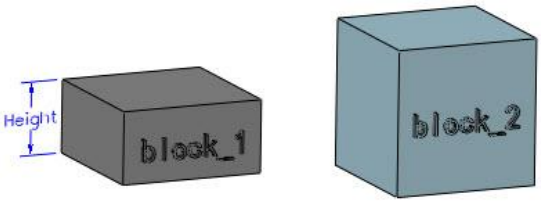


Figure 9 After assembly regen

② ***Configure Component:*** Configure components and constraints in batches, and activate different configurations to express different assembly methods.

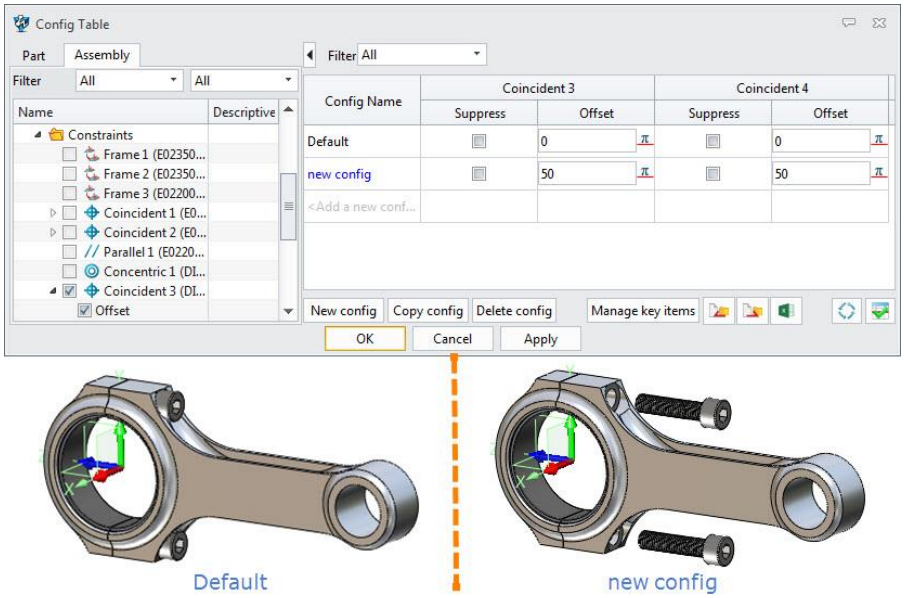


Figure 10 Configure Component

③ ***Dissolve Assembly:*** Dissolve the selected sub-assembly.

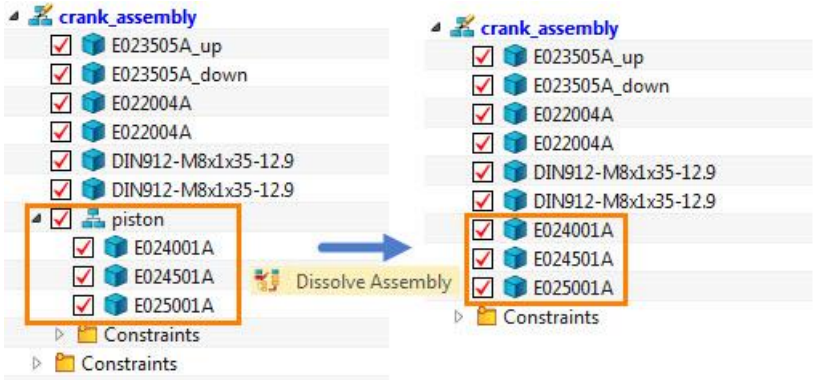


Figure 11 Dissolve Assembly

④ ***Group as Sub-Assembly:*** Combine several components into a sub-assembly.

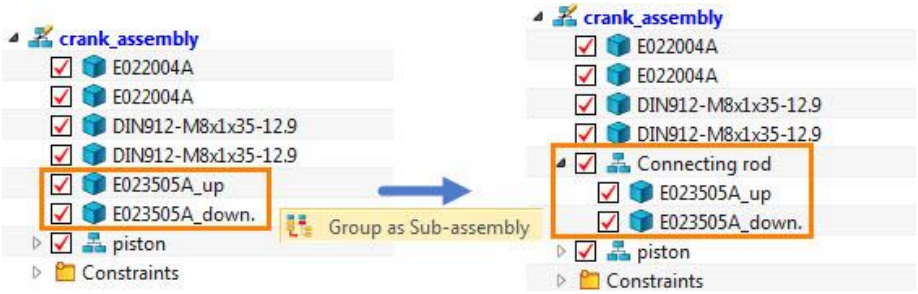


Figure 12 Group as Sub-Assembly

⑤ ***Pack:*** In the same assembly level, the same components will be packaged into a single node.

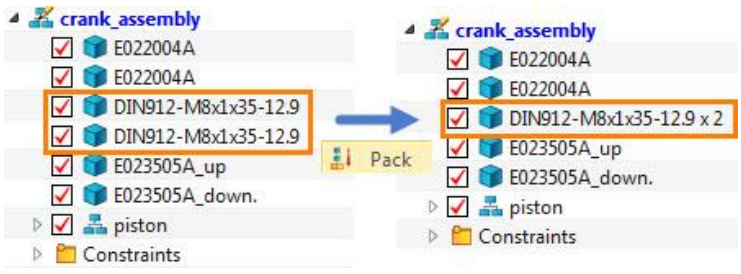


Figure 13 Pack

⑥ ***Make Flexible/Make Rigid:*** A normal sub-assembly is inserted into the assembly as one rigid component whose own parts can't be moved around under the assembly context, despite their DOFs. While the flexible sub-assembly is treated as a movable component whose own parts can be moved around under the assembly context if they have DOFs.

Tips: What is the difference between Blank and Suppress in assembly?

✧ **Blank**

Use this command to hide the selected components. You can also quickly blank the component or disable the constraint by check the box in the assembly tree.

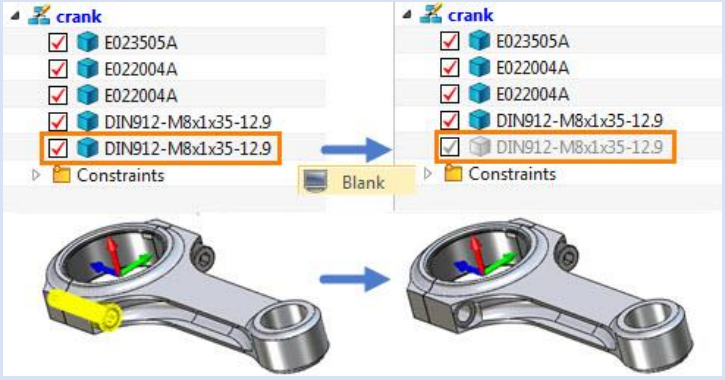


Figure 14 Blank

✧ **Suppress**

Use this command to remove the selected components from this assembly and then all constraints related to these components will go wrong. You can restore these components by unsuppressing them.

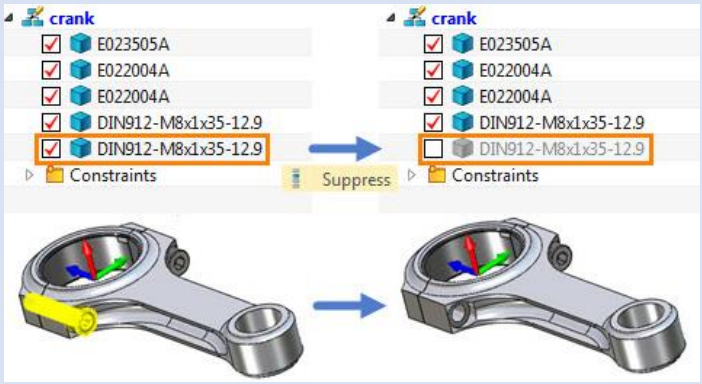


Figure 15 Suppress

1.2 The Options Menu of Right-Clicking in the Blank

	Command	***Explanation***
	Regen Assembly	Regenerate components and constraints.
	Regen Outdated Components	Only regenerate outdated components.
	Regen All Components	Regenerate all assembly components and assembly tree.
	Find Work Component	Locate to the currently activated component in the assembly tree automatically.
	Find Lost Components	Automatically find lost components in the assembly.
	Show Ext File Name	Show the file name if the component comes from an external file.

	Mark outdated	Mark the outdated component.
	Rename Assembly	Invoke the Rename Assembly dialog.
	Separated Mode ①	
	Combined Mode ②	
	Collapse All	Collapse all the sub-folder.
	Expand All	Expand all the sub-folder.
	Hide Suppressed Components	Hide the suppressed components.
	Hide Constraint Status	Hide the constraint status of the component.
	Pack All	In the same assembly level, pack all the same components into a single node.
	Unpack All	Unpack all the packed node.
	Conditional Suppress	Control the suppression of the components through expressions.

①***Separated Mode:*** At the same level, show all the components first and then show all the constraints.

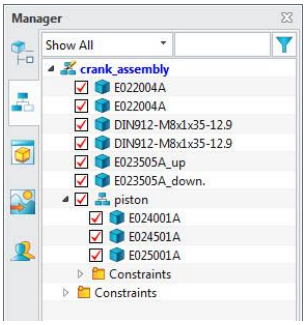


Figure 16 Separated Mode

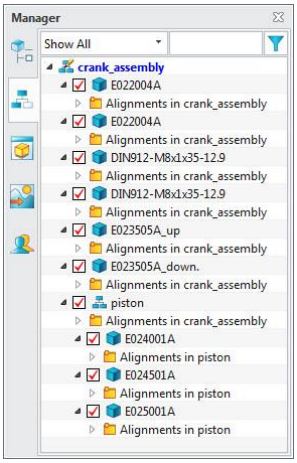


Figure 17 Combined Mode

②***Combined Mode:*** Show each component and its constraints together.

1.3 The Options Menu of Right-Clicking on Constraints

	Command	***Explanation***
	Redefine	Redefine the selected constraint.
	Add Description	Add a description to the constraint.
	Flip	Flip the alignment direction of the face/datum selected in the Align command.
	Configure Constraint	Similar to the ***Configure Component***.
	Dimension On/Off	Display the dimensions of offsets and angle value added in constraints.
	Enable/Disable	Enable/Disable the selected constraint.

2 Assembly Creation

Assembly creation is nothing more than adding components and constraints, but these two tasks account for more than 80% of the whole assembly design. So, choosing the appropriate insertion type and constraints for different scenarios can save you a lot of time.

2.1 Insert Components

In ZW3D, there are four ways to insert components.

2.1.1 Insert from an Existing File

Assembly Ribbon Tab->Component->Insert

Use this command to insert a component from an existing file.

STEP 01 Select a component object from the specified file.

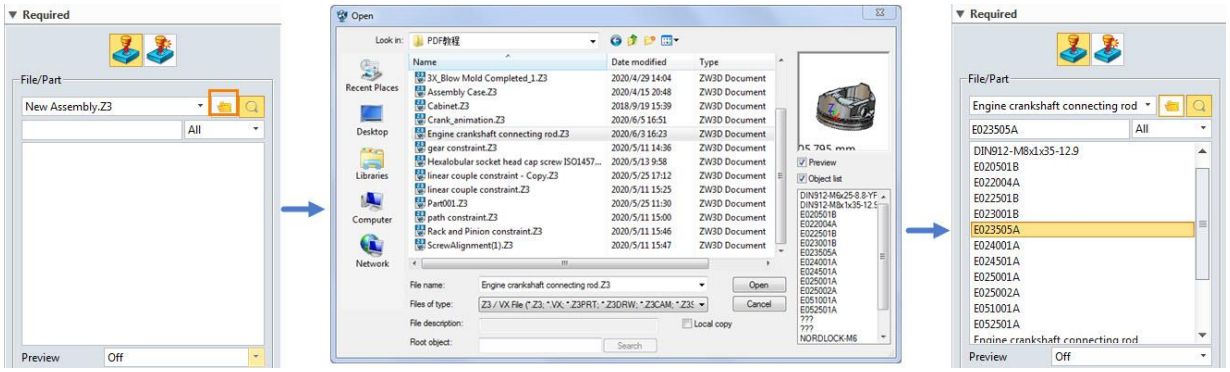


Figure 18 Selecting a component

STEP 02 Select a suitable type to locate this component.

STEP 03 Define the ***Instance*** and ***Settings*** options if needed.

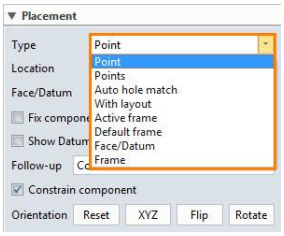


Figure 19 Selecting a locate type

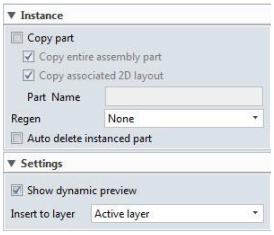


Figure 20 Defining instance and settings

STEP 04 Complete the insertion of a component.

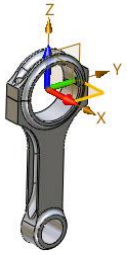


Figure 21 The inserted component

Below is the explanation of relevant options.

- **Required -> Preview**

Set the preview mode for the selected part.

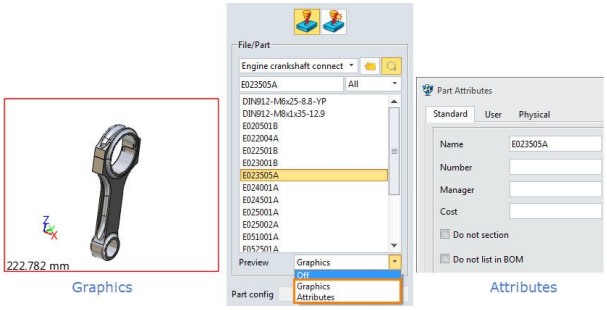


Figure 22 Preview

- **Required -> Part config**

Specify the part configuration of the part you want to insert.

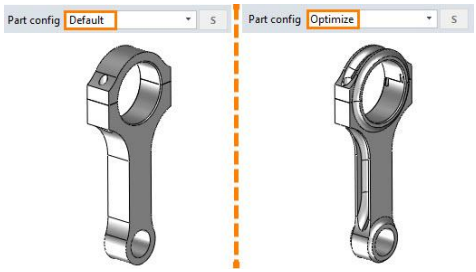


Figure 23 Part config

- **Placement -> Type**

In ZW3D, there are eight types of placement.

- Point

Locate the component according to the specified point. The component will be located at a position that the selected point and component origin point coincided.

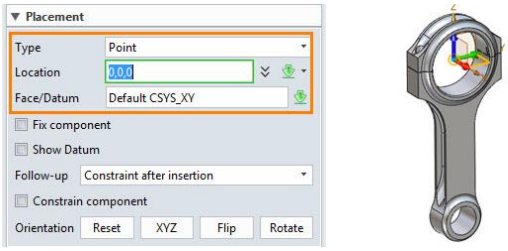


Figure 24 Locate the component according to a point

- Points

Locate the component multiple times at once.

- Auto hole match

The component will automatically match the hole on the picked face.

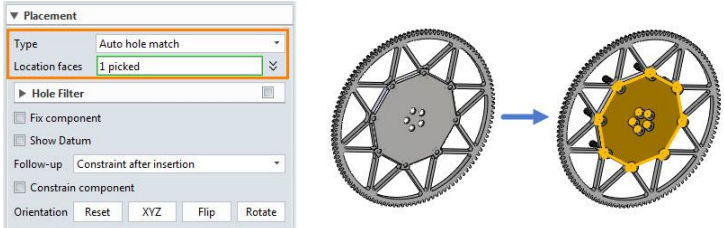


Figure 25 Locate the component using Auto Hole Match

In addition, you can add a hole filter of hole shape, hole diameter, etc.

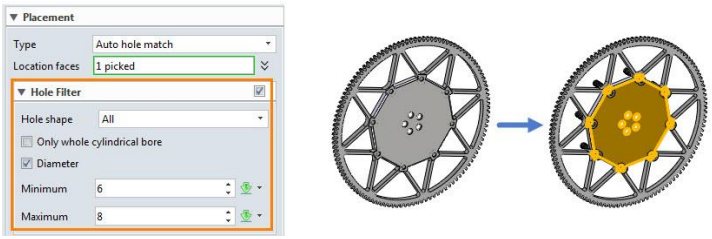


Figure 26 Hole Filter

- With layout

You need to select the type of layout, choose a face/datum, and input the key values.

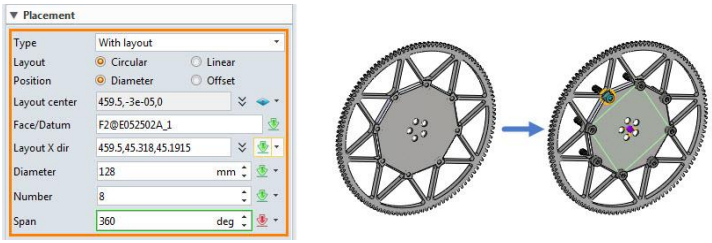


Figure 27 With layout

- Frame

Locate the component according to a selected frame. The coordinate system of the component will coincide with the selected coordinate system.

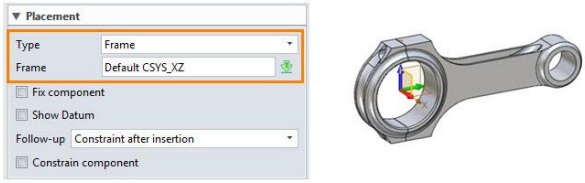


Figure 28 Frame

- Default Frame

The frame of the component will coincide with the frame of the assembly.

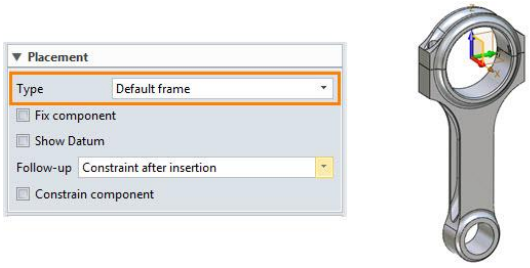


Figure 29 Default Frame

- Active frame

This option is similar to the default frame.

- Face/Datum

Locate the component according to the selected face or datum. The XY plane of the component will coincide with the selected face or datum.

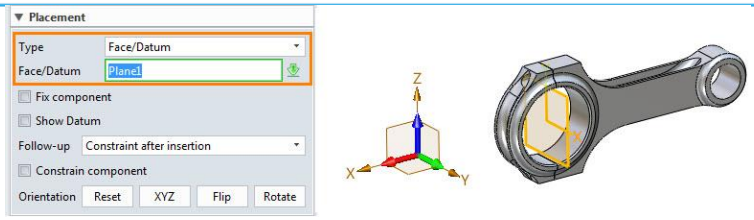


Figure 30 Face/Datum

- **Placement -> Fix Component**

Check this option and the inserted component will be fixed.

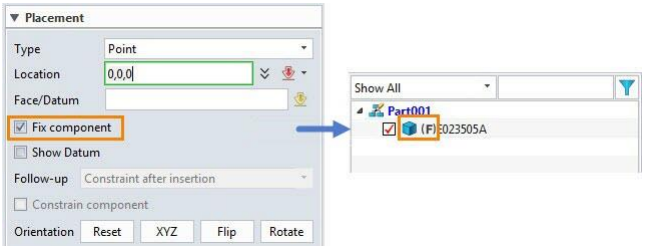


Figure 31 Fix Component

- **Placement -> Show Datum**

Check this option and the origin frame of this component will be displayed.

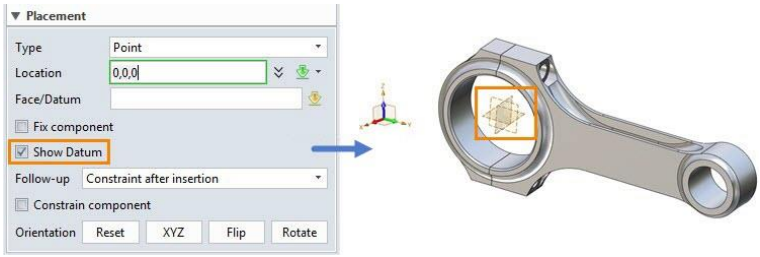


Figure 32 Show Datum

- **Placement -> Follow-up**
  - None

There will no command following the insertion of the component.

  - Constraint after insertion

The ***Common Constraint*** dialog will pop-up after inserting the component.

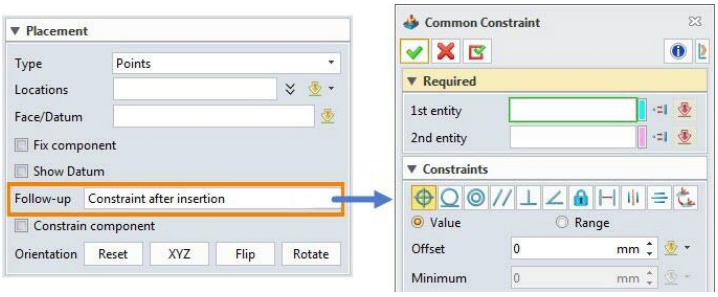


Figure 33 Constraint after insertion

  - Repeat after insertion

Repeatedly insert the component.

➢ **Placement -> Constraint component**

This option is checked by default, which means that the constraint will be automatically recorded in the assembly manager.

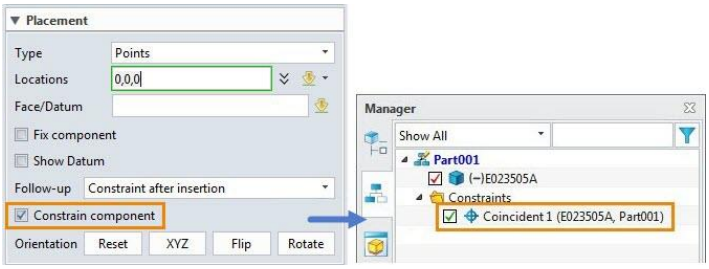


Figure 34 Constrain component

➢ **Placement -> Orientation**

Adjust the position of the component by “XYZ/Flip/Rotate”. If the position is not ideal, you can reset it.

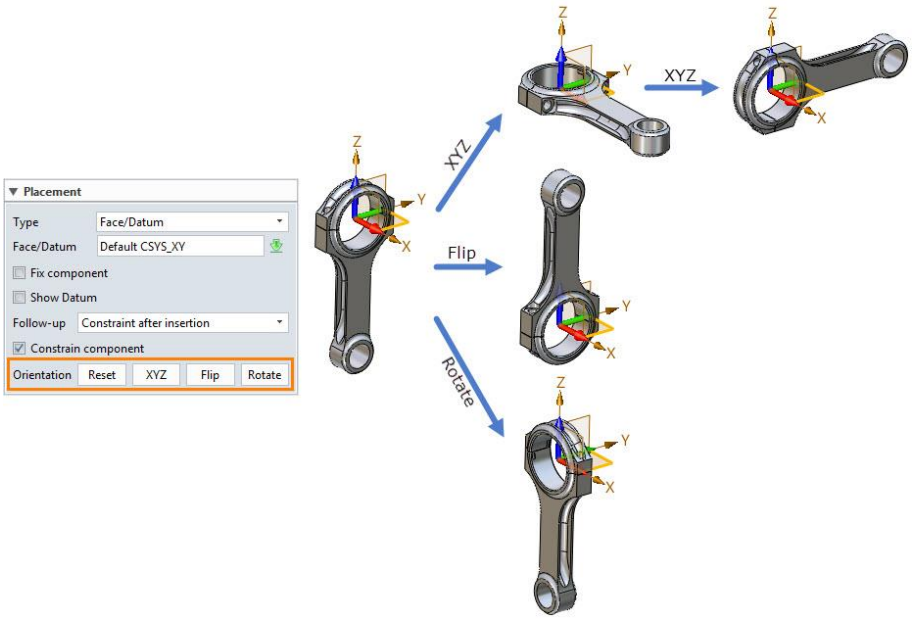


Figure 35 Orientation

➢ **Instance**

Please note that the ***Instance*** dialog can only be used in the multiple objects per file mode (*.z3 file).

➢ **Instance -> Copy Part**

If this option is checked, you can directly copy the original part and insert it into an active assembly file when inserting a component from an external file. The copy is not associated with the original component and will not change if the original one changes.

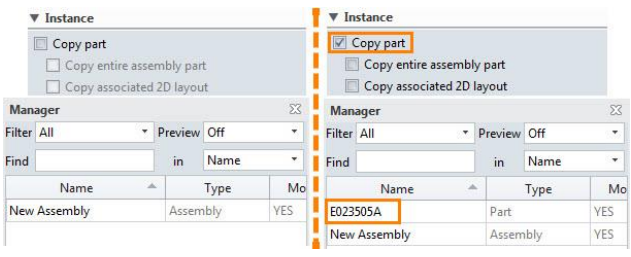


Figure 36 Copy Part

- Copy entire assembly part

If this option is checked, all the files will be copied to the new assembly, especially sub-assemblies. Otherwise, only the insert file will be copied.

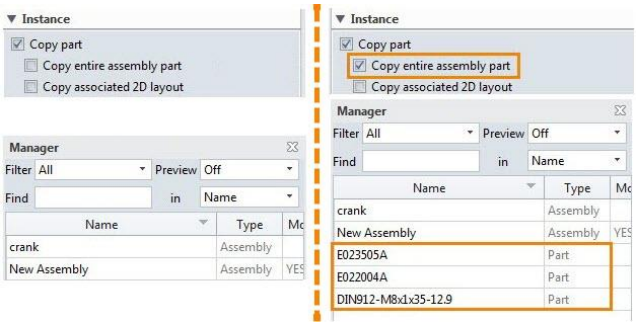


Figure 37 Copy entire assembly part

- Copy associated 2D layout

If this option is checked, the 2D sheet of the inserted file will be copied.

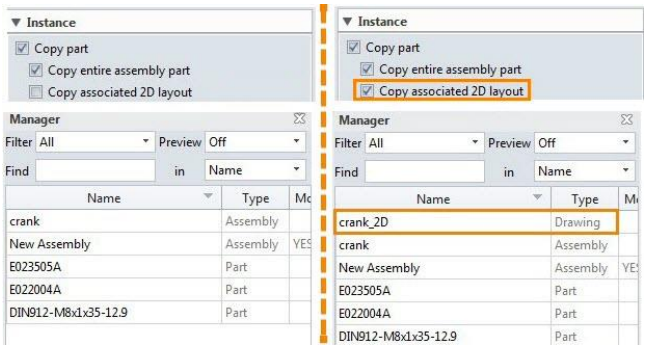


Figure 38 Copy associated 2D layout

➢ **Instance -> Part Name**

Name the newly copied part.

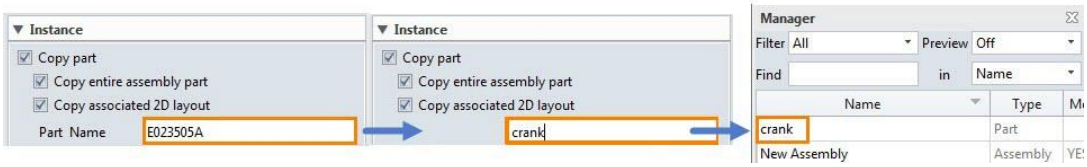


Figure 39 Part Name

➢ **Instance -> Regen**

This option is the same as the ***Auto Regen*** in the Options menu of right-clicking on components, please refer to Chapter 1.1.

➢ **Instance -> Auto delete instanced part**

If this option is checked, the inserted component will be deleted when its parent part is deleted.

➢ **Settings -> Insert to layer**

Insert this component to an existing layer.

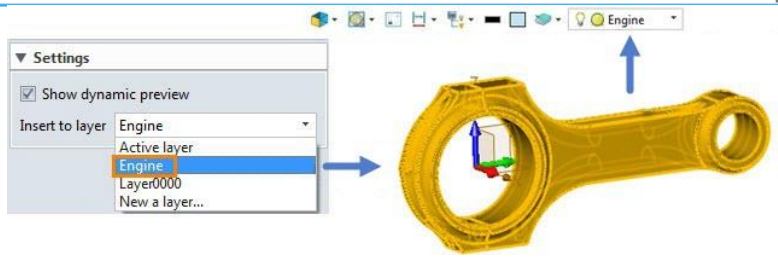


Figure 40 Insert to layer

2.1.2 Insert from a New File

Assembly Ribbon Tab->Component->Insert

Create a new file as a component.

STEP 01 Define the file and part name. If you used the one object per file mode, the part name is the file name.

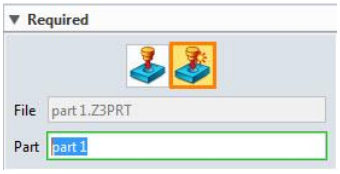


Figure 41 One object per file

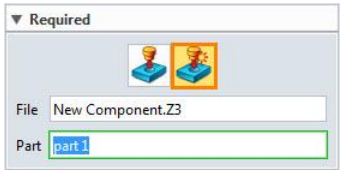


Figure 42 Multiple objects per file

STEP 02 Select the location of this new component.

STEP 03 Define the ***Instance*** and ***Settings*** options if needed.

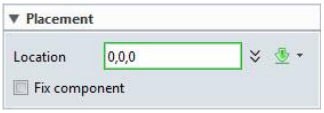


Figure 43 Location

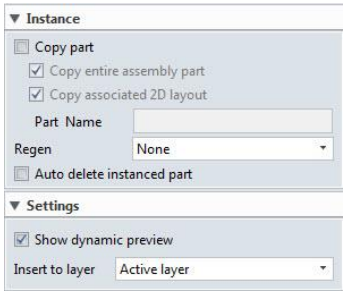


Figure 44 Define the instance and settings

STEP 04 Complete the insertion.

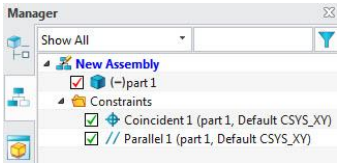


Figure 45 Complete the insertion

2.1.3 Multi-Insert

Assembly Ribbon Tab->Component->Multi-Insert

Insert one or more components repeatedly.

STEP 01 Select one or more components to insert.

STEP 02 Click or input specified coordinates to define the location.

STEP 03 Define other parameters, for example, the number of duplicates, if needed.

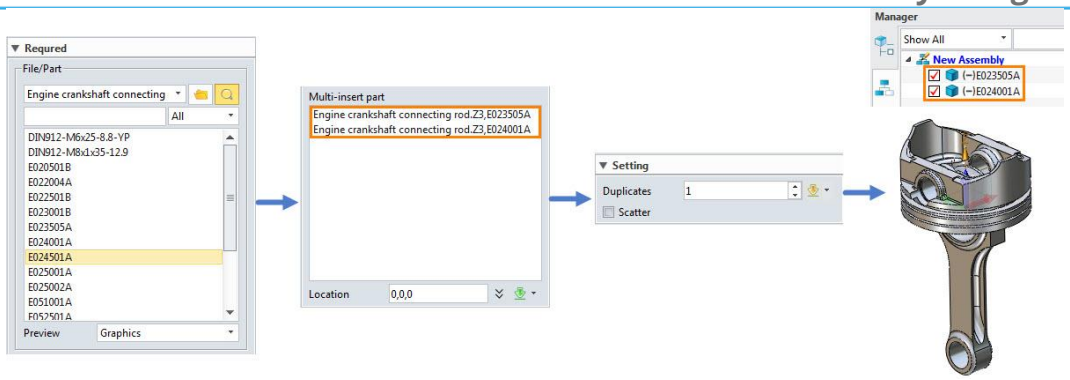


Figure 46 Multi-insert workflow

Below is the explanation of relevant options.

- **Required -> File/Part and Location**

These two options are the same as the Insert ones, please refer to Chapter 2.1.

- **Required -> Multi-insert part**

All components you need to insert will be displayed in this area.

- **Settings -> Duplicates**

Set the number of duplicates you need to insert.

- **Settings -> Scatter**

If this option is checked, the components will be arranged along the X axis. Otherwise, the components will locate at the same position.

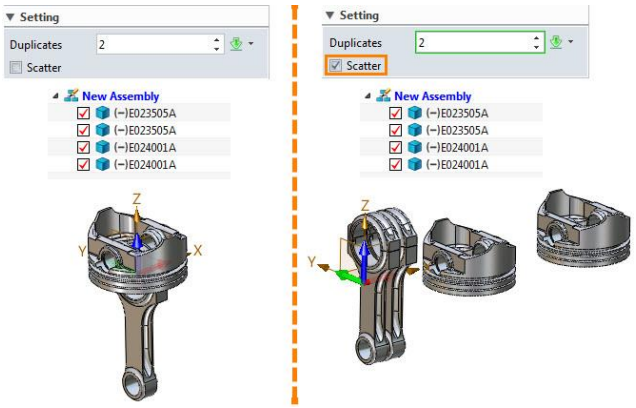


Figure 47 Scatter

2.1.4 Include Unplaced Component

Assembly Ribbon Tab->Component->Included Unplaced Component

Use this command to insert an unplaced component. Unplaced components will be displayed in the assembly tree only, and not in the workspace. Unplaced components can load in the 3D BOM and you can also load them in the assembly with the ***Insert Component*** command, which is useful in the collaborative design or when you need to generate a 3D BOM with such components without displaying them.

STEP 01 Select a component that needs to be an unplaced component.

STEP 02 Select the layer you are inserting it to or directly complete this insertion.

STEP 03 Insert the component.

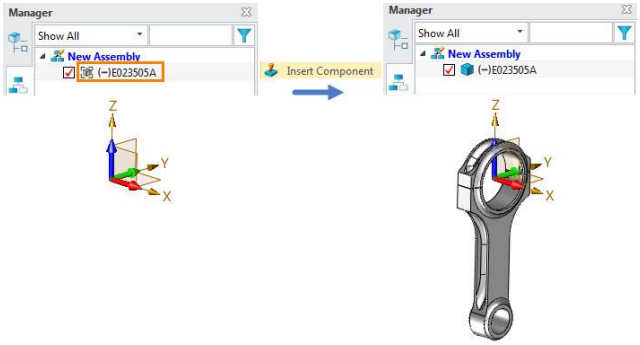


Figure 48 Insert the unplaced component

2.2 Constraint Types

To meet different user needs, common and mechanical types of constraints are available in ZW3D.

2.2.1 Fix the Component

Assembly Ribbon Tab->Constraint->Fix

Use this command to fix the current position of the selected component. If the component is already anchored, this command will remove the anchor. In the assembly tree, there will be an (F) mark in the front of all the fixed components.

STEP 01 Select the components to be fixed.

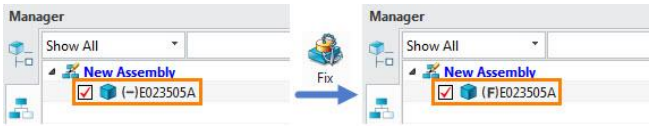


Figure 49 Fix the component

2.2.2 Common Constraints

Assembly Ribbon Tab->Constraint->Common Constraint

Use these constraints to adjust the positional relationship between components.

STEP 01 Select the type of constraint you want to add, for example, coincident.

STEP 02 Select two entities.

STEP 03 Define the constraint parameter and settings.

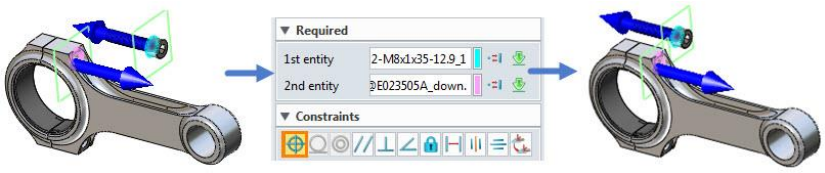


Figure 50 Adding a constraint

Below is the explanation of all common constraint types.

- **Constraint type -> Coincident**

Constrain two components to be point-point, point-line, point-surface, line-line, line-surface, or surface-surface coincident.

- **Constraint type -> Tangent**

Constrain two components to be line-surface or surface-surface tangent.

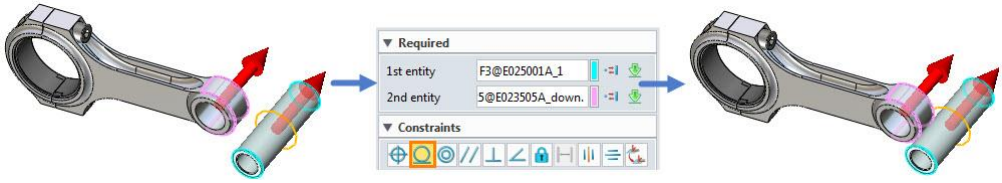


Figure 51 Tangent

- **Constraint type -> Concentric**

Constrain two components to be arc-arc, arc-cylindrical surface, or cylindrical surface-cylindrical surface concentric.

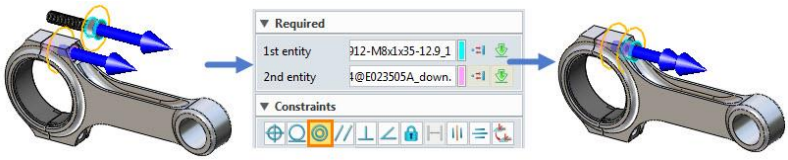


Figure 52 Concentric

- **Constraint type -> Parallel**

Constrain two components to be line-line, line-plane, or plane-plane parallel.

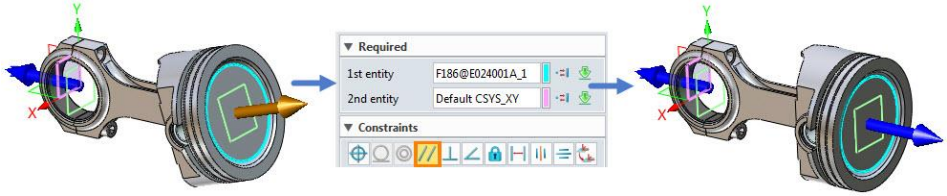


Figure 53 Parallel

- **Constraint type -> Perpendicular**

Constrain two components to be line-line, line-plane, or plane-plane perpendicular.

Figure 54 Perpendicular

- **Constraint type -> At angle**

Define the line-line, line-plane, or plane-plane angle between two components.

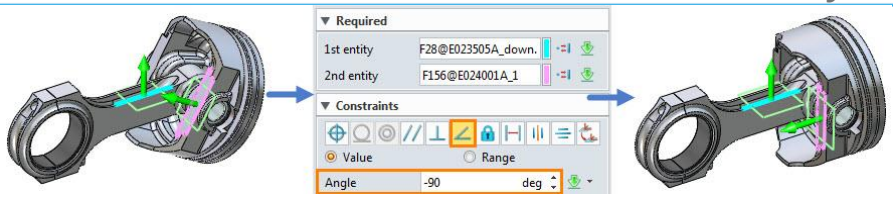


Figure 55 At angle

- **Constraint type -> Lock**

Lock the relative positions of two components.

- **Constraint type -> Distance**

Define the point-point, point-line, point-plane, line-line, line-plane, or plane-plane distance between two components.

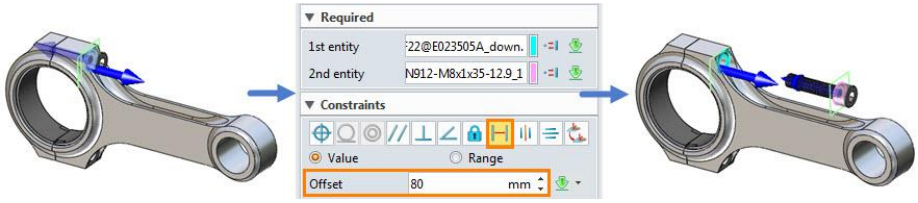


Figure 56 Distance

- **Constraint type -> Middle**

Create a middle constraint by selecting two base entities on a component and one or two center entities on another component.

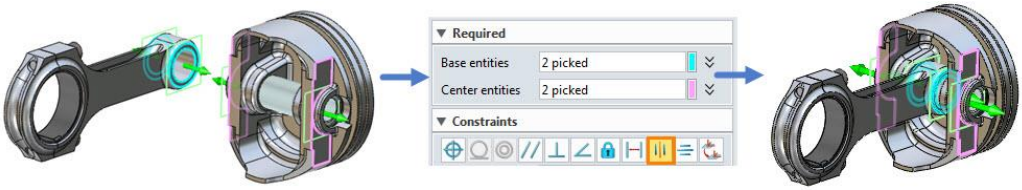


Figure 57 Middle

- **Constraint type -> Symmetry**

Constrain two components to be symmetrical.

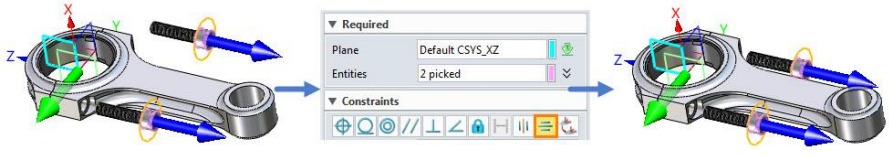


Figure 58 Symmetry

- **Constraint type -> Frame**

Make the coordinate systems of two components coincident.

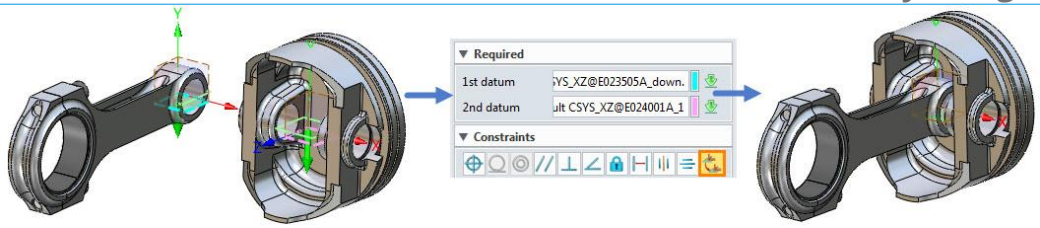


Figure 59 Frame

Tips: When adding the constraints, we usually use the datum from the component. So how to control the switch of external datum of the component in an assembly?

In ZW3D, there are three ways to control the display of the external datum.

✧ Unblank External Datum

Select one or more components, then right-click and select ***Unblank External Datum.***

Figure 60 Unblank External Datum

✧ Visibility Manager

Use the ***Visibility Manager***, you can control the showing and hiding of all component datums at once.

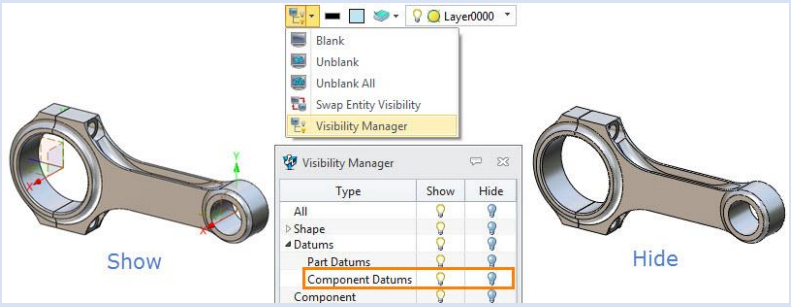


Figure 61 Visibility Manager

✧ External Datum On/Off

Use this option to control the showing and hiding of the unblanked external datums.

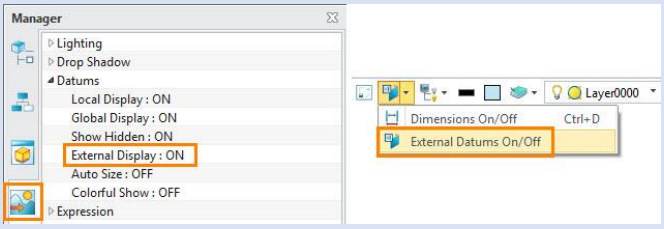


Figure 62 External Datum On/Off

Below is the explanation of constraint parameters.

- **Constraint Parameters -> Value**

Define the offset value of two selected entities to be coincident, tangent, parallel, at angle, or distance.

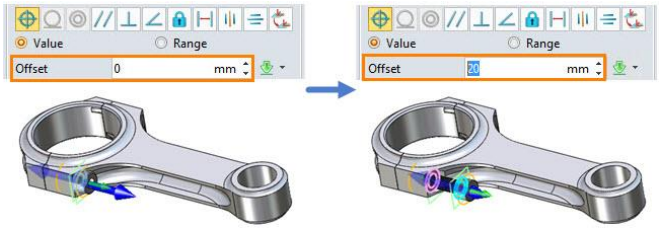


Figure 63 Value

- **Constraint Parameters -> Range**

Set a range so that components can be moved within this range.

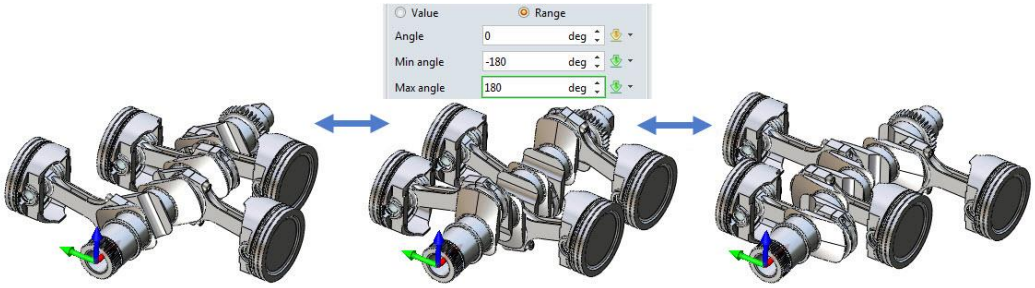


Figure 64 Range

- **Constraint Parameters -> Flip direction**

Flip the direction of the current constraint.

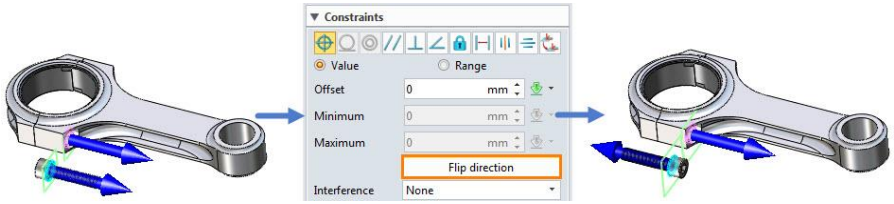


Figure 65 Flip direction

Below is the explanation of constraint options.

- **Constraint options -> Interference**

Determine how interferences between components are handled.

- None

Do not check for interferences.

- Highlight

When interferences occur between components, highlight the interfered surface.

- Stop at

When a component interferes, it will stop at the point of intersection.

- Add constraint

Automatically add constraints to components.

➢ **Constraint options -> Lock rotation**

Components with concentric constraints cannot rotate.

➢ **Constraint options -> Display existing constraints**

The existing constraints of the selected component will show.

➢ **Constraint options -> Use for position only**

The constraint will only change the position of the component, without adding constraints.

➢ **Constraint options -> Popup mini bar**

After you select an entity, a movable ***Constrain Component*** mini bar with some commonly used options will pop up.

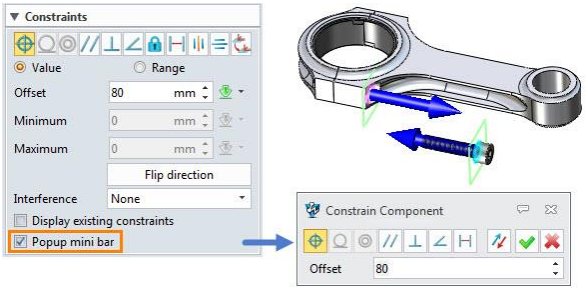


Figure 66 Popup mini bar

2.2.3 Mechanical Constraints

Assembly Ribbon Tab->Constraint->Mechanical Constraint

To meet the needs for designing mechanical transmission mechanisms, some mechanical constraints like gear, screw, etc. are available in ZW3D.

Below is the explanation of all mechanical constraint types and options.

➢ **Mechanical Constraint -> Gear**

Create a gear constraint to make two components rotate relative to each other around the axes. This constraint can be used not only for the transmission between gears, but also for the rotation relationship between any two components.

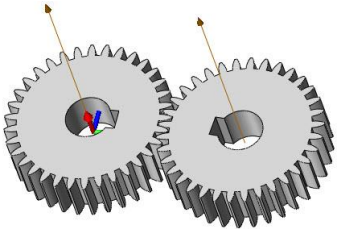


Figure 67 Gears

STEP 01 Adjust the meshing position of the two rotating components.

STEP 02 Click ***Mechanical Constraint*** and select ***Gear Constraint***.

STEP 03 Select the two components.

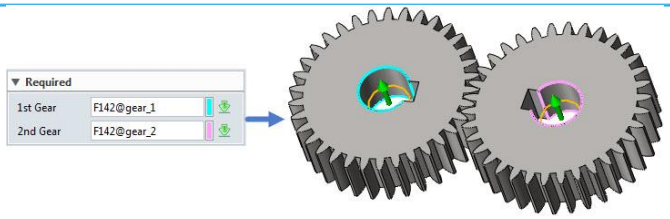


Figure 68 Adding gear constraints to two components

STEP 04 Set an appropriate transmission ratio.

STEP 05 Change the angle to adjust the relative position of the components and check whether the current gear ratio is appropriate.

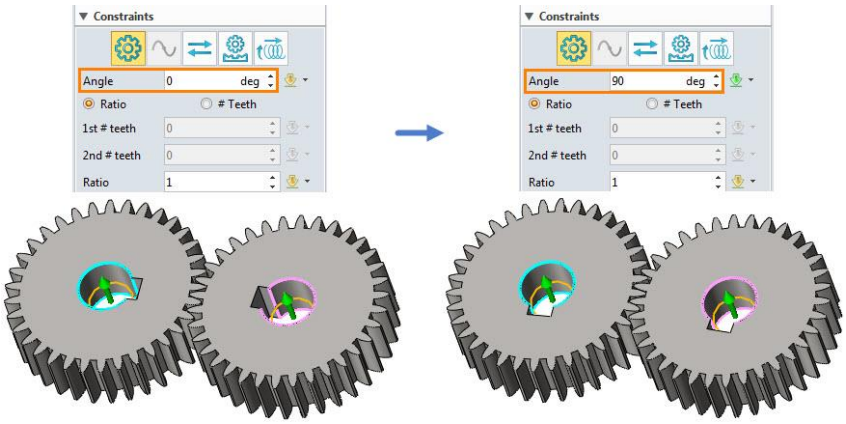


Figure 69 Adjusting the angle

➢ **Constraint Parameters -> Ratio & Teeth**

- Ratio

For example, if the ratio is set to 1, it means that the 1st gear and 2nd gear both rotate around a circle; if the ratio is set to 2, it means that the 1st gear rotates around a circle and 2nd gear rotates around two circles, and so on.

- Teeth

If the component is two gears, we can express the transmission ratio by entering the number of teeth of the gears.

➢ **Mechanical Constraint -> Path**

Create a path constraint to make the component move along the selected path. The point element must be inside the component, and the path can be the edge, sketch, or wireframe in the component or the assembly file.

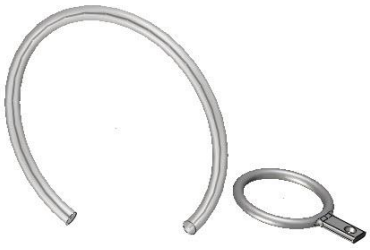


Figure 70 Ring and Shrink-ring

STEP 01 Click ***Mechanical Constraint*** and select ***Path Constraint***.

STEP 02 Select a point on the component and the path.

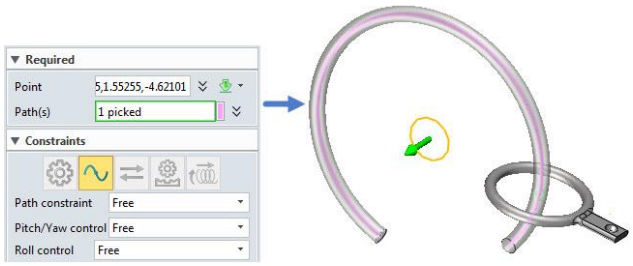


Figure 71 Path constraint

STEP 03 Set the appropriate transmission ratio.

➢ **Constraint Parameters -> Path constraint**

Constrain the position of the component on the path.

- Free

The component can move freely along the path.

- Distance along path

Constrain the distance from the component vertex to the path endpoint.

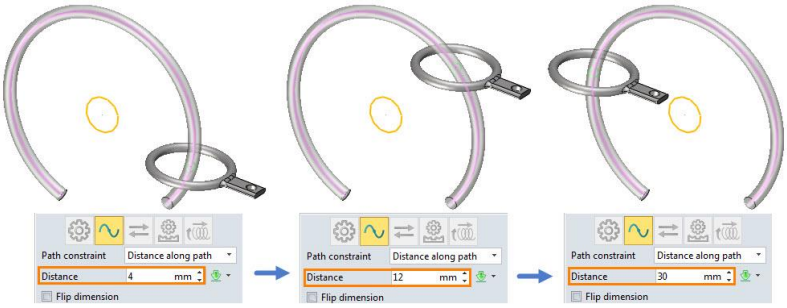


Figure 72 Distance along path

- Percent along path

Constrain the distance from the component vertex to a specified percentage of the path.

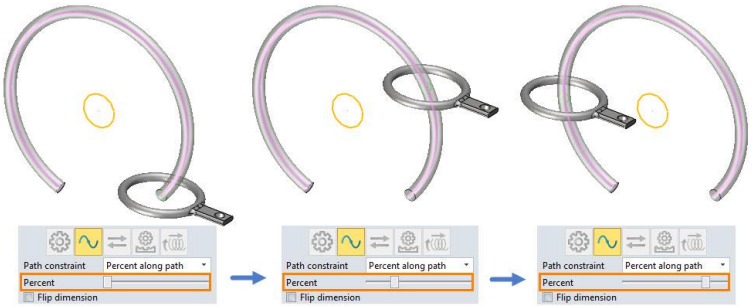


Figure 73 Percent along path

➢ **Constraint Parameters -> Pitch/Yaw control**

Specify the pitch and yaw of the constraint.

- Free

The pitch and yaw of the component are not constrained.

- Follow Path

Constrain one axis of the component to be tangent to the path. Select X, Y or Z.

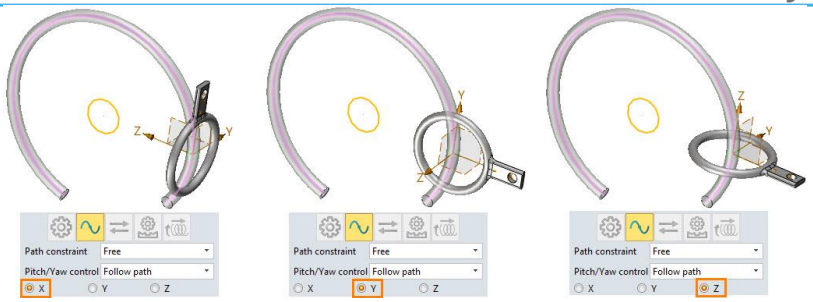


Figure 74 Follow Path

➢ **Constraint Parameters -> Roll control**

Specify the roll control of the constraint.

- Free

The roll of the component is not constrained.

- Up Vector

Constrain one axis of the component to align with the selected vector. You can select a linear edge or planar face as ***Up Vector***.

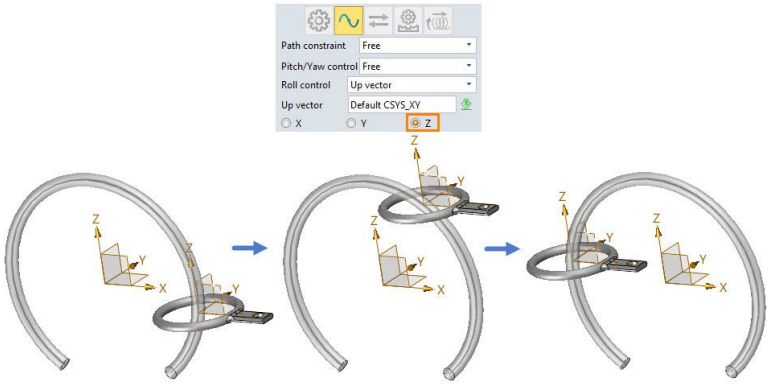


Figure 75 Up Vector

➢ **Mechanical Constraint -> Linear couple**

Create a linear couple constraint to add a relative linear movement relationship between two components.

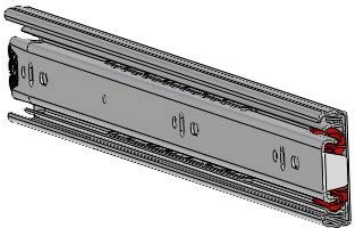


Figure 76 Bearing rail

STEP 01 After constraining the movement direction of the components, add the linear couple constraint.

STEP 02 Click ***Mechanical Constraint*** and select ***Linear couple***.

STEP 03 Select two components and specify their directions of movement.

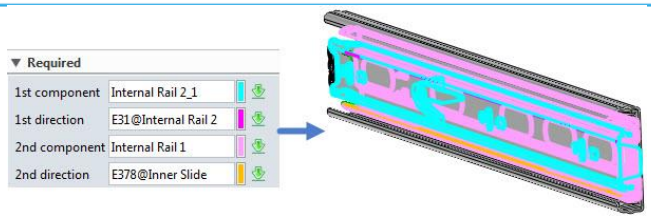


Figure 77 Linear couple constraint

STEP 04 Set the appropriate relative motion ratio, then click OK.

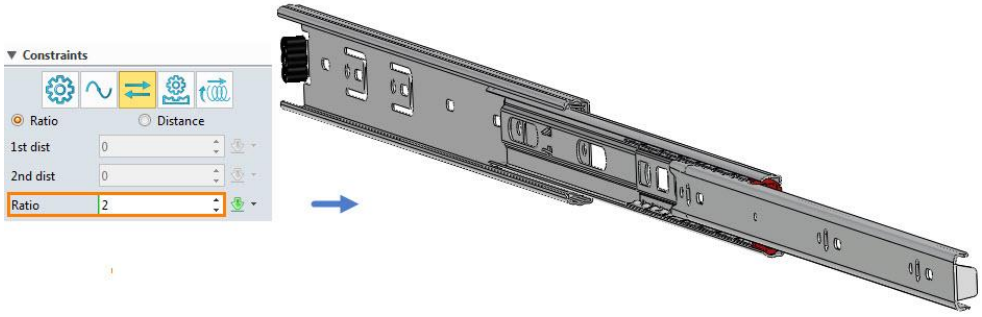


Figure 78 Linear couple

- **Constraint Parameters -> Ratio and Distance**
  - Ratio

For example, if the ratio is set to 1, it means that the 1st and 2nd components both move 1 mm; if the ratio is set to 2, it means that the 1st component moves 1 mm and 2nd component moves 0.5 mm, and so on.

  - Distance

Directly specify the relationship between the movement distance of these two components. In addition:

$$ratio = \frac{1^{st}\ dist}{2^{nd}\ dist}$$

- **Mechanical Constraint -> Rack and pinion**

Add a rack and pinion constraint so that the linear transmission of one component (rack) will cause the rotation of another component (pinion), and vice versa. You can constrain any two components (with or without gear teeth) to have this type of movement relative to each other.

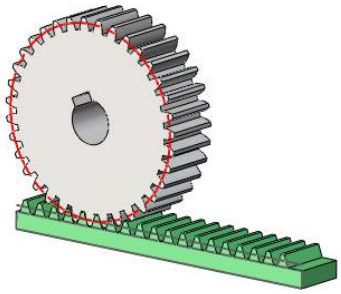


Figure 79 Rack and pinion

STEP 01 Adjust the meshing position of the rack and pinion.

STEP 02 Click ***Mechanical Constraint*** and select ***Rack and pinion***.

STEP 03 Select the linear edge in the rack and the cylinder in the pinion, then set the appropriate transmission ratio.

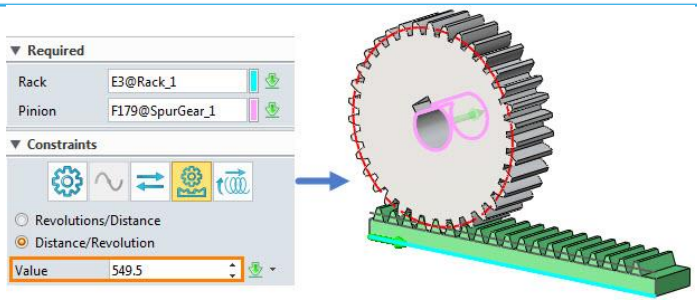


Figure 80 Rack and pinion

STEP 04 Drag the rack to check whether the transmission ratio is correct.

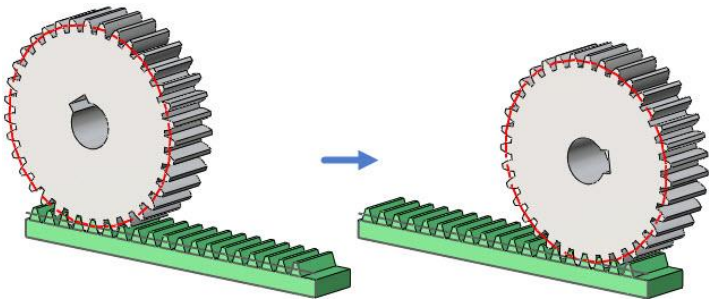


Figure 81 Rack and pinion

- **Constraint Parameters -> Value**
  - Distance/Revolution & Revolution/Distance

The “Distance/Revolution” option determines the distance that the rack moves for the pinion to make one revolution. So if it is a rack and pinion mechanism, the distance is the circumference of the pinion pitch circle. The “Revolution/Distance” option is the opposite of it.

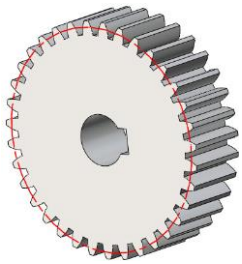


Figure 82 Pitch circle

$Distance = \pi d$ (“d” is the diameter of the pitch circle)

- **Mechanical Constraint -> Screw**

The screw constraint will constrain the two selected components to be concentric, and add a set of relations that cause rotation and transmission. It can be used to not only constrain the bolt and nut, but also define the rotation and transmission relationship between two components.

For this spanner, we use the screw constraint to realize the worm-driven spanner lip.

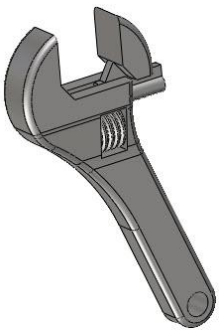


Figure 83 Spanner

STEP 01 Adjust the position of the spanner lip to align with the worm.

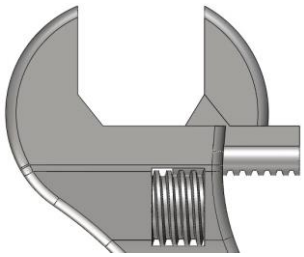


Figure 84 Screw

STEP 02 Create an auxiliary line that is concentric with the worm in the spanner lip.

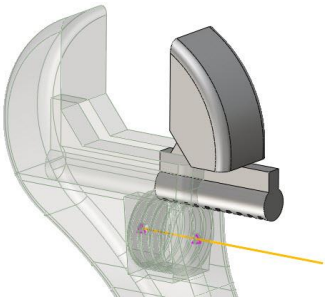


Figure 85 Adding an auxiliary line

STEP 03 Click ***Mechanical Constraint*** and select ***Screw***.

STEP 04 Select a cylinder surface in the worm as the screw entity, then the auxiliary line in the spanner lip as the linear entity, and set a suitable value.

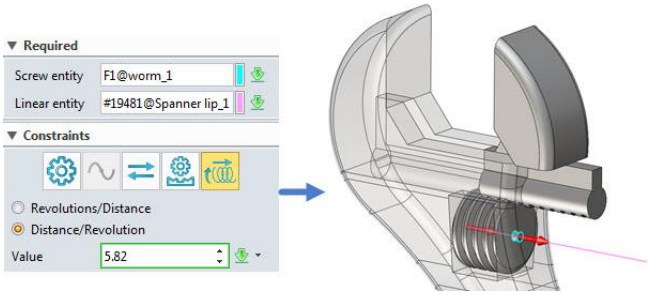


Figure 86 Adding the screw constraint

STEP 05 Rotate the worm to confirm whether the spanner lip is moving correctly.

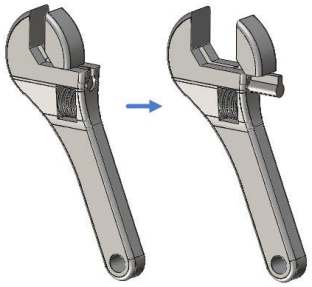


Figure 87 Screw

- **Constraint Parameters -> Value**
  - Distance/Revolution & Revolution/Distance

These options are similar to those of the rack and pinion. For example, the value of ***Distance/Revolution*** is 5.82 mm, it represents the distance that the spanner lip moves when the worm rotates around a circle.

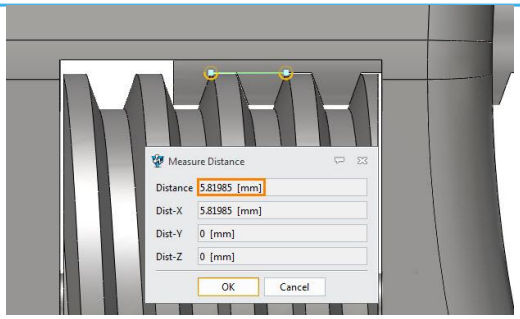


Figure 88 Value

- **Constraint Parameters -> Flip**

Adjust the relative movement direction of two components.

- **Constraint Parameters -> Same facing & Opposite**

Adjust the alignment of two components.

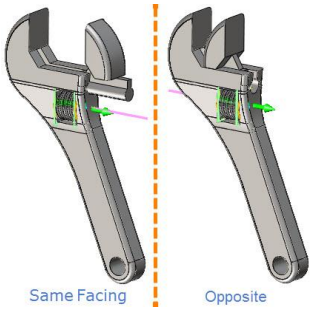


Figure 89 Same facing & Opposite

Tips: When there is a conflict between constraints, some constraints will be colored in the assembly manager.

Here's an example to help you better understand it.

STEP 01 Insert a block and set the distance from the block to the XZ plane to 50 mm.

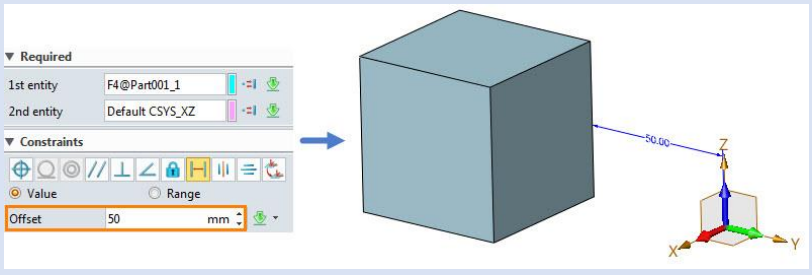


Figure 90 Setting the distance from the block to the XZ plane

STEP 02 Constrain one face of the block and the XZ plane to coincide.

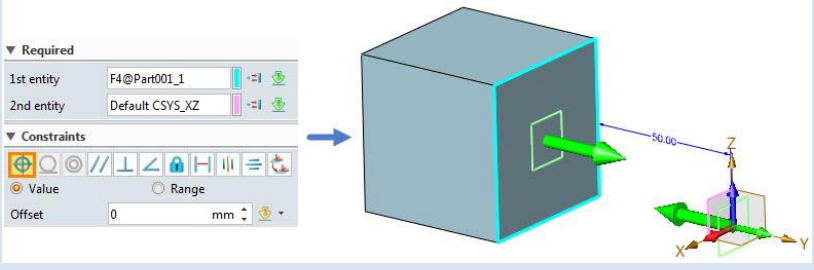


Figure 91 Constraining two faces to coincide

STEP 03 Check the colored status of the two conflicted constraints.

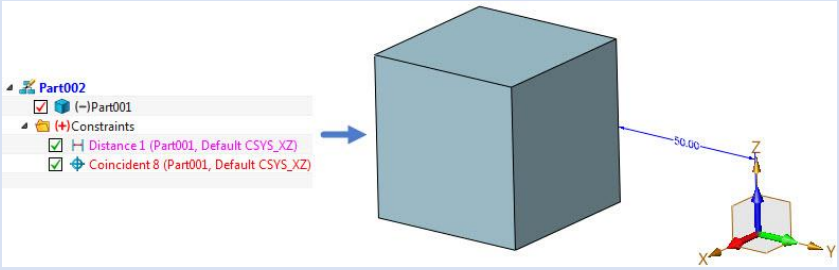


Figure 92 Conflict

✧ **Constraints turn red**

If the constraint turns red, it means there is conflict between the constraint and existing constraints. And the position of this component does not represent the correct position.

✧ **Constraints turn pink**

If the constraint turns pink, it means there is conflict between it and the newly created constraint.

3 Component Management

Component management is very important in assembly design because it can help you quickly adjust and edit components, thereby saving design time.

3.1 Merge

Assembly Ribbon Tab->Component->Merge

Create a base shape (using the Base option) or feature (using the Add, Remove or Intersect options) from a component.

STEP 01 Select the ***Merge*** type.

STEP 02 Select the component that needs to be merged.

STEP 03 Select the part shape for the boolean operation.

Below is the explanation of all Merge types and options.

➢ **Merge type -> Base**

Convert components to separate shapes. If the Base option is activated, the “Boolean Shapes” option will be automatically forbidden.

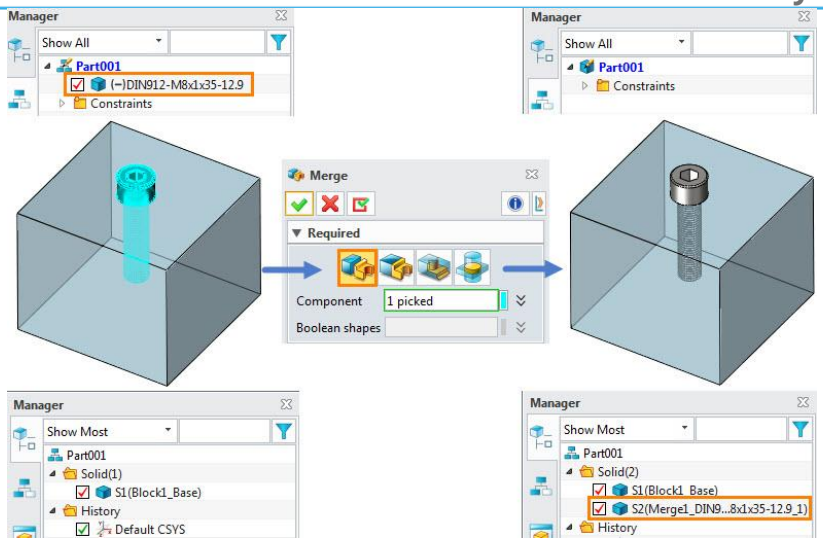


Figure 93 Base

- **Merge type -> Add**

Combine the components and shapes together.

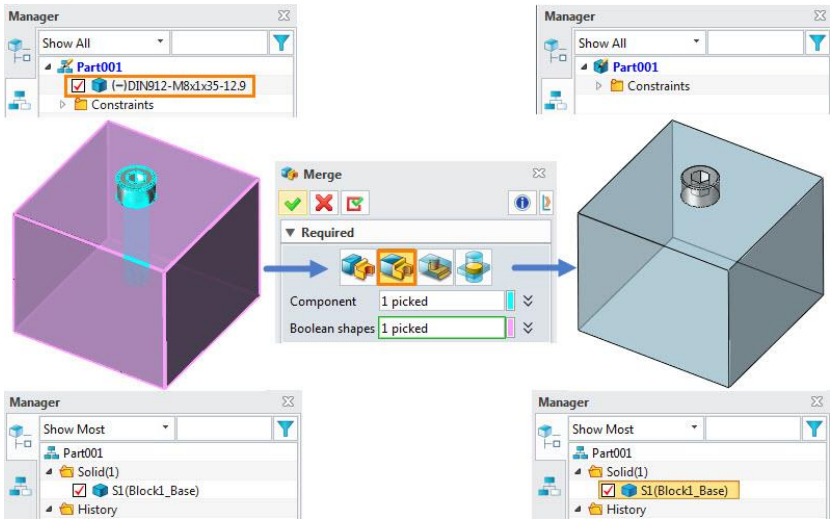


Figure 94 Add

- **Merge type -> Remove**

Remove the component shape from the selected Boolean shapes.

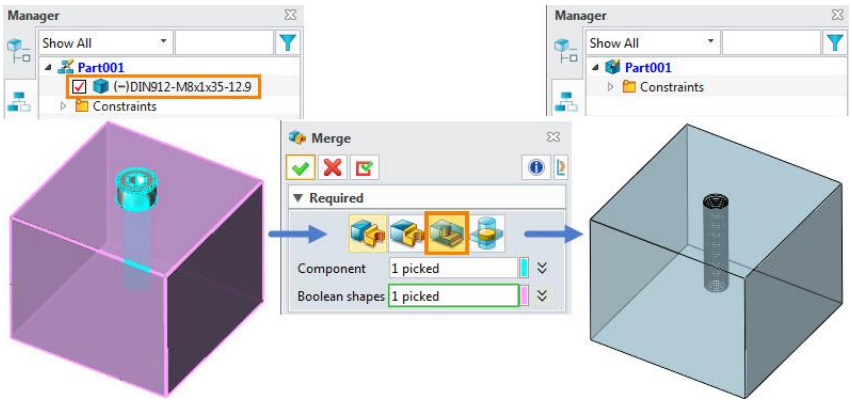


Figure 95 Remove

➢ **Merge type -> Intersect**

Get the intersection between component shapes and selected Boolean shapes.

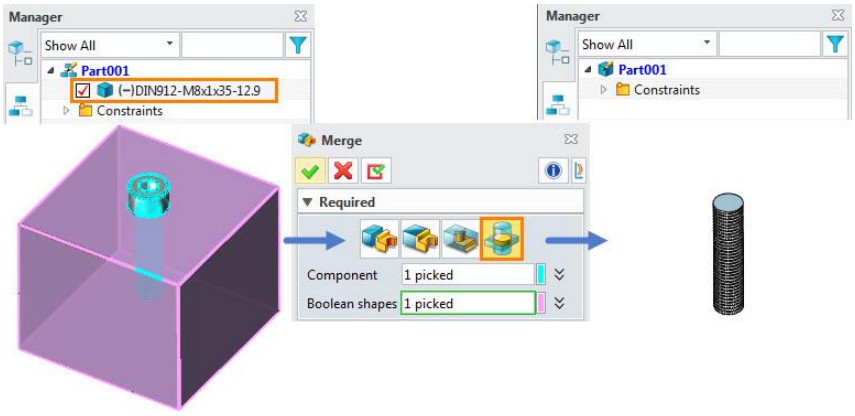


Figure 96 Intersect

➢ **Settings -> Merge wireframe**

Merge any wireframe geometry that exists in the component into the active parent.

➢ **Settings -> Merge dimensions**

Merge any dimensions that exist in the component into the active parent.

➢ **Settings -> Inherit component name**

The part shape inherits the name of the component after merging.

➢ **Settings -> Boundary**

Select any bounding faces if the component is an open shape to close the open shape.

3.2 Extract Shape

Assembly Ribbon Tab->Component->Extract Shape

Use this command to extract a "stand-alone" shape out of the active part and convert it into a component. This command can be an alternative assembly design method: you can build all the shapes for an assembly in one part, then extract them to be separate components for CAM and 2D drawing.

STEP 01 Select the extract shapes.

STEP 02 Define the frame and name of the new object file.

STEP 03 Define the settings of the extract shape.

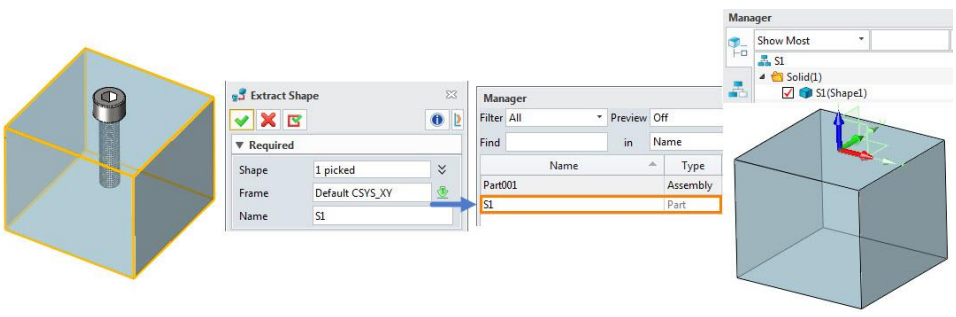


Figure 97 Extract Shape

Below is the explanation of all Extract Shape options.

- **Settings -> Extract mode**

If ***Encapsulation*** is selected, the newly created shape will be independent and not affected by the original shape. If ***Associative extract*** is selected, the newly created shape will be an imported geometry that will be affected by the original one.

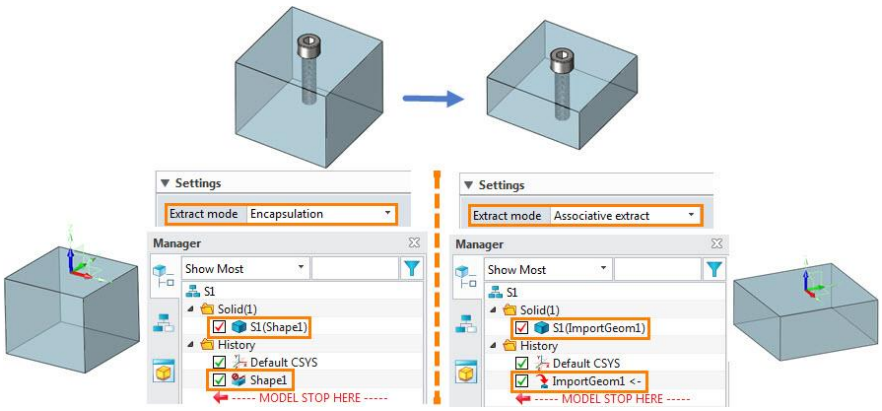


Figure 98 Extract modes

- **Settings -> Warn before overwriting existing part**

A warning will pop up when a part name already exists. By default, "Yes" is chosen and the existing part will be replaced by the extracted part.

Note: *If "No" is chosen, the extracted part will be automatically renamed.*

Figure 99 Warn before overwriting existing part

- **Settings -> Extract as component**

The shape will be extracted as a component in the assembly.

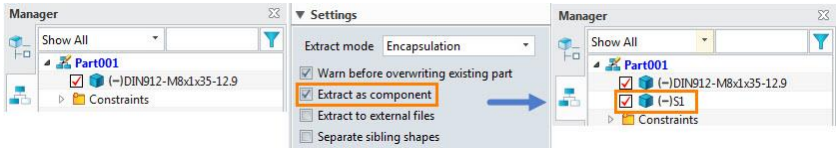


Figure 100 Extract as component

- **Settings -> Extract to external files**

Create a new ZW3D file for each shape. You can also set the file prefix and choose a file mode.

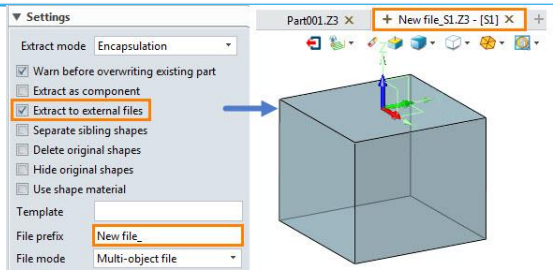


Figure 101 Extract to external files

- **Settings -> Separate sibling shapes**

Shapes that were merged from the same component (sub-assembly) are extracted as separate components.

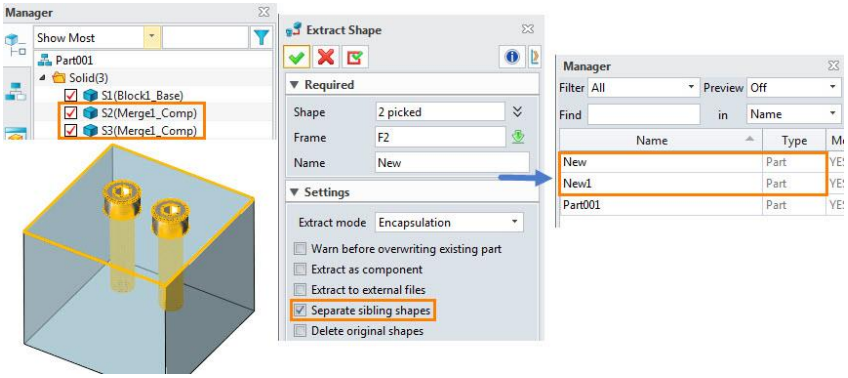


Figure 102 Separate sibling shapes

- **Settings -> Delete original shapes**

The original shapes will be deleted after extraction.

- **Settings -> Hide original shapes**

The original shapes will be hidden after extraction.

Note: *This option is not available if the* ***Delete original shapes*** *option is checked.*

- **Settings -> Use shape material**

The material of the new object file will be the same as that of the original shape.

- **Settings -> Template**

The external files can be created based on a defined ZW3D template. If you have a predefined part template, you can enter its name here.

3.3 Geom to Part

Assembly Ribbon Tab->Component->Geom to Part

Copy geometries from the active part to a destination part (new or existing).

STEP 01 Select the geometry to be copied.

STEP 02 Specify the destination file, or define a new file name to make the geometry a new part.

STEP 03 Define the extract shape settings.

Below is the explanation of all Geom to Part options.

- **Settings -> Extract mode**

Encapsulation and ***Associative extract*** are the same as in ***Extract Shape*** command. If you select ***Extract History***, the newly created shape will inherit the whole modeling process.

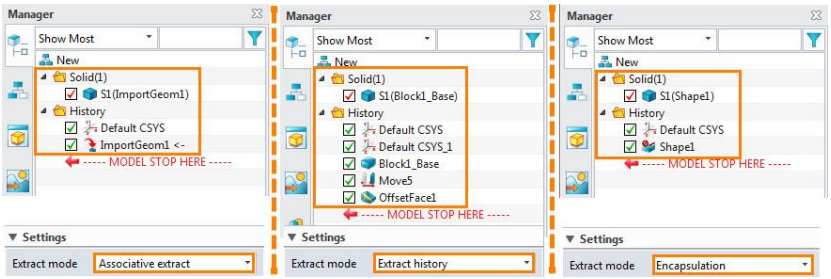


Figure 103 Extract mode

- **Settings -> Extract as component**

This option is the same as in ***Extract Shape***.

- **Settings -> Warn before modifying existing part**

A warning will pop up when copying the selected geometry to an existing part. By default, “Yes” is chosen.

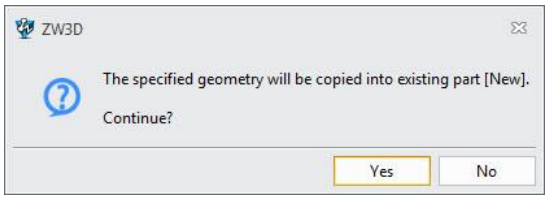


Figure 104 Warn before modifying existing part

- **Settings -> Create sub-part in destination part**

Create a sub-part in the destination part.

Note: This option is only available when the extract mode is ***Associative extract***.

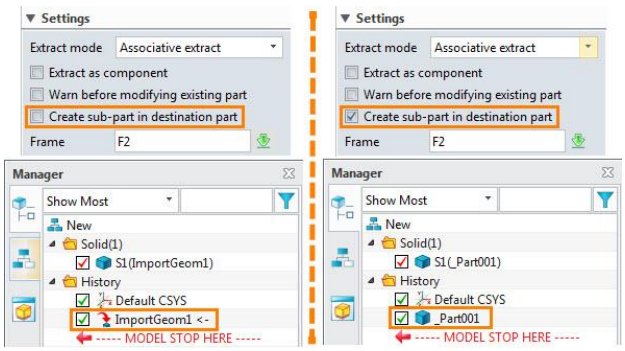


Figure 105 Create sub-part in destination part

- **Settings -> Delete original entities**

The original entities will be deleted after extraction.

Note: *This option is available if the extract mode is* ***Extract history*** or ***Encapsulation****.*

- **Settings -> Unlink dependents**

Remove weakly related objects (including default CSYS, datum, axis, etc.) on the selected geometry.

Note: *This option is not available if the extract mode is* ***Extract history****.*

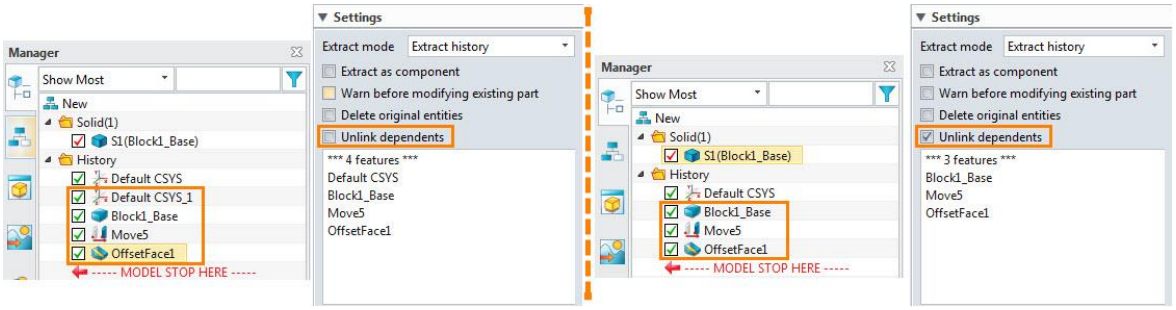


Figure 106 Unlink dependents

- **Settings -> Frame**

Select a plane as the frame of these entities.

Note: *This option is available if the extract mode is* ***Associated extract*** or ***Encapsulation****.*

3.4 External Part

Assembly Ribbon Tab->Component->External Part

Copy an external part and then insert it into the active part as a shape which is associated with the original part. If the source part is modified, the shape will change accordingly after the active part is regenerated.

STEP 01 Select the shapes from the destination part.

STEP 02 Define the location.

STEP 03 Define the shape settings.

Below is the explanation of all External Part options.

- **Settings -> Frame & Flip Direction**

Select a face, the align direction will be calculated with the location and the face. These two options will be activated when ***History*** has been set to ***Associative Copy in this Part*** or ***Sub-Part with History***.

- **Settings -> Copy Wireframes & Copy Dimensions**

Check these two options to copy all wireframes and dimensions included in the external part.

- **Settings -> Sub-Part with Associative Copy**

Create a sub-part with a copy of the geometry of the external part. When the parent part is modified, the sub-part will not be updated, unless you right-click on it and select the ***Enable/Disable sub-part***

regeneration. When ***Regen*** is enabled for the sub-part, it will be updated after regenerating the history. By default, the ***Regen*** is disabled for a new sub-part.

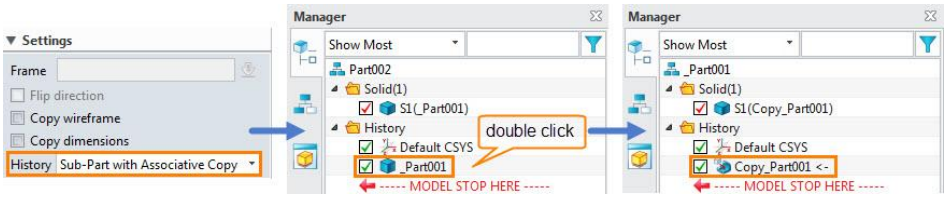


Figure 107 Sub-Part with Associative Copy

- **Settings -> Sub-Part with History**

Create a sub-part with a copy of the full history of the external part. You can edit the local copy, but it is unlinked from the parent part's history.

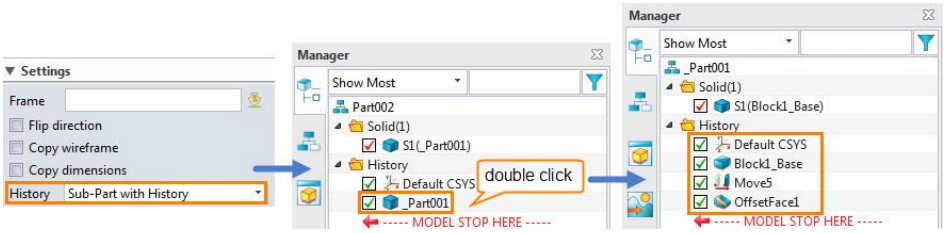


Figure 108 Sub-Part with History

- **Settings -> History copied into this Part**

Copy the history of the external part into the active part and append the external part's history to the end of the active part's history. Imported history operations are renamed so that they do not conflict with the pre-existing operations in the active part. Use this option instead of ***Sub-Part with History*** if you do not want the imported part as a separate sub-part.

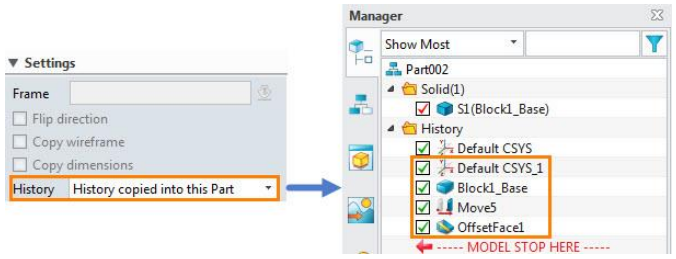


Figure 109 History copied into this part

- **Settings -> Associative Copy in this Part**

Add an ***Associative Copy*** operation to the history of the active part that imports the geometry of the external part. When the parent shape changes, it will be updated automatically after regenerating the history. If the external part cannot be found, the ***Associative Copy*** operation will fail.

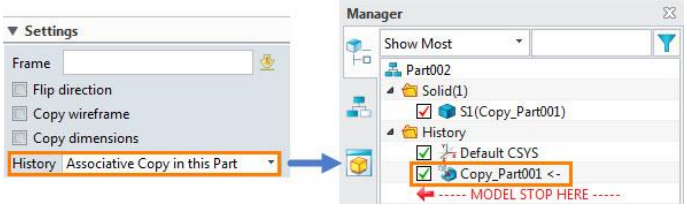


Figure 110 Associative Copy in this part

3.5 Pattern Component

Assembly Ribbon Tab->Basic Editing->Pattern

This command is similar to ***Pattern*** under the shape ribbon, but this command can only be used to pattern components. Six different methods of patterning are available. For more details, please refer to ***Pattern*** in the ***Solid Modelling*** section.

STEP 01 Select the component you want to pattern.

STEP 02 Define the direction, number, etc.

STEP 03 Define other settings like toggle type, orientation.

Below is the explanation of all Pattern options.

- **Other -> Instanced as component**

Check this option, the patterned entity will be inserted as an independent component in the assembly tree. Otherwise, this operation will be recorded as a pattern node in the assembly tree. After that, this pattern operation can be edited.

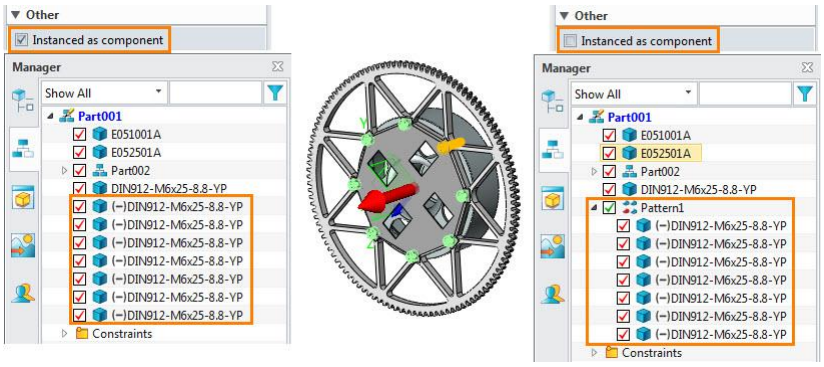


Figure 111 Instanced as component

- **Other -> Inherit constraints**

The components of the pattern will inherit the constraints of the parent components.

Note: *When* ***Instanced as component*** *is checked,* ***Inherit constraints*** *will not take effect.*

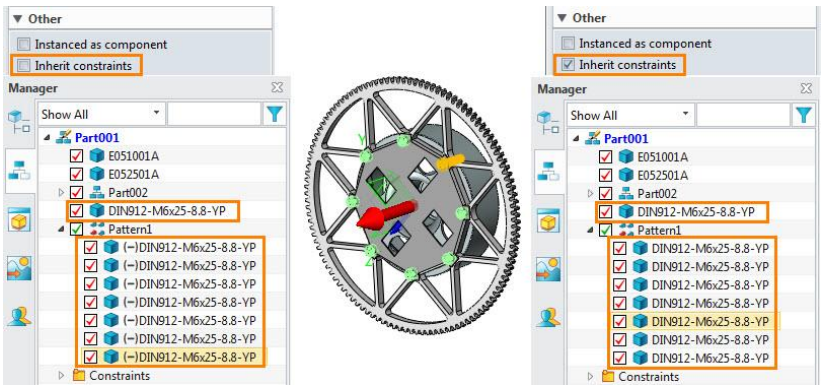


Figure 112 Inherit constraints

- **Instances' attributes as parent**

Synchronize all instances as their parent during redefining. Synchronized attributes include color, visibility, position, and so on.

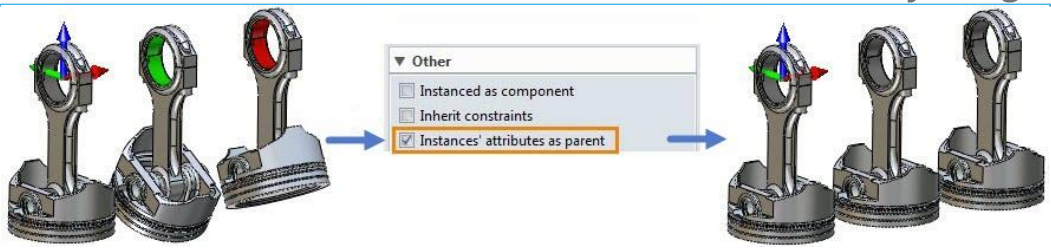


Figure 113 Instances' attributes as parent

3.6 Mirror Component

Mirror the components along a datum plane, planar face, or sketch. Mirroring an assembly component creates a new part which will be inserted as a component in the active assembly.

STEP 01 Select the component or sub-assembly you want to mirror.

STEP 02 Define the mirror plane.

STEP 03 Define the settings.

Below is the explanation of all Mirror options.

- **Settings -> Duplicate mirrored geometry**

Create a new part when mirroring a component.

- **Settings -> Instanced as component**

This option is the same as in ***Pattern***.

- **Settings -> As a whole to mirror**

When checked, the mirror center will be calculated as a whole. When unchecked, the mirror center will be calculated and transformed one by one.

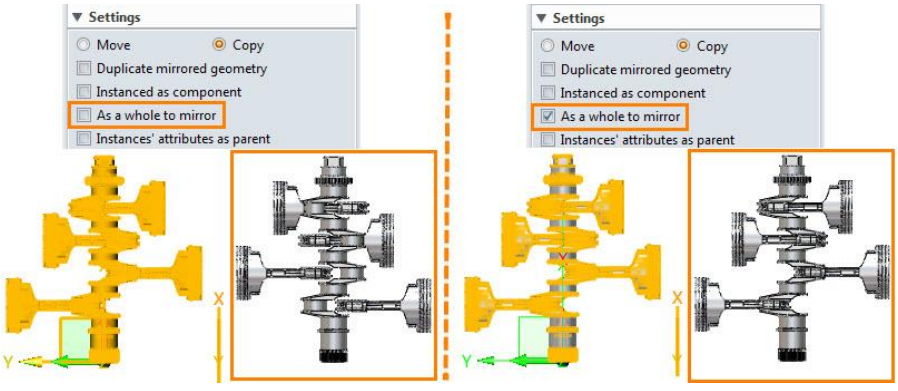


Figure 114 As a whole to mirror

- **Settings -> Instances' attributes as parent**

This option is the same as in ***Pattern***.

- **Center of**

Set the center of rotation for the mirror component. The ***Bounding box*** and ***Mass*** options are supported.

➢ **Self-symmetric**

Specify the component's self-symmetric plane to create a mirror component which is customizable.

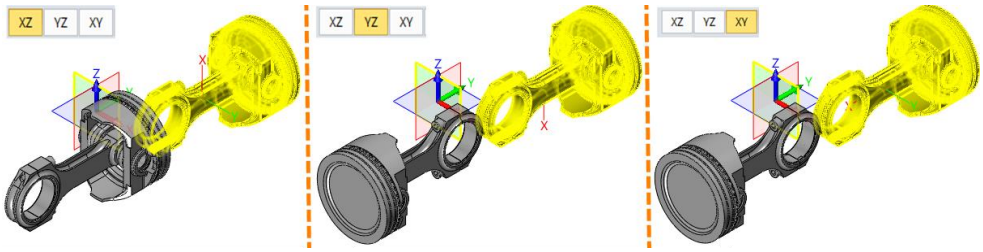


Figure 115 Self-symmetric

3.7 Move Component

Assembly Ribbon Tab->Basic Editing->Move

Move the components within an assembly according to directions, points, or frames. This command is similar to ***Move*** under the shape ribbon, but it can only be used to move components. For more details, please refer to that in the ***Solid Modelling*** section.

3.8 Change Component

Assembly Ribbon Tab->Component->Change

Change the component in the active assembly. Alignment constraints placed on the original part may no longer be valid on the new part, unless the new part is a copy of the original part. In this case, you need to delete the invalid constraints and replace them with valid constraints.

STEP 01 Select the component that needs to be changed.

STEP 02 Select the new component to replace the old component.

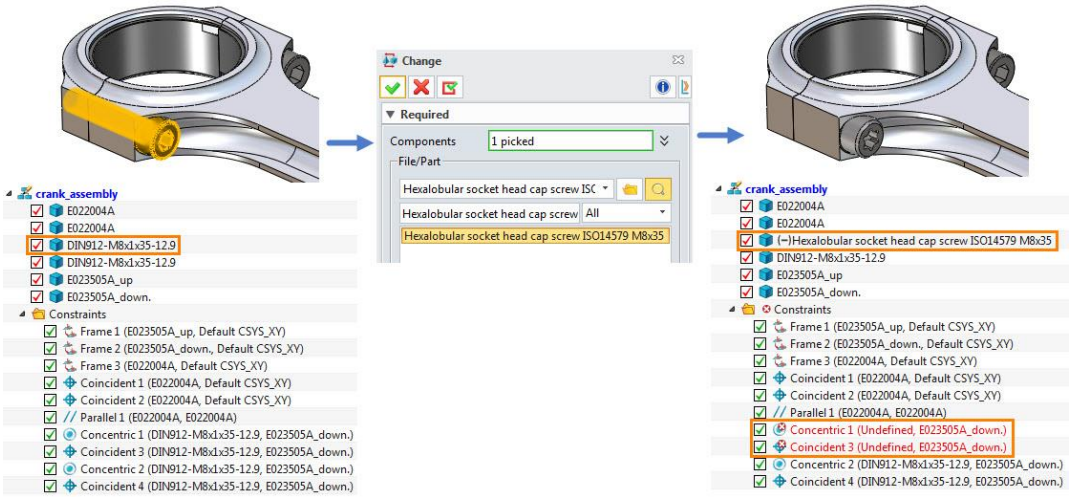


Figure 116 Change Component

3.9 Edit Component

Assembly Ribbon Tab->Component->Edit

Activate a component for editing in the assembly environment.

Tips: To edit the component, you can also directly double-click on the component in the assembly tree or workspace, or use ***Edit Part*** in the right-click menu.

STEP 01 Select the component that needs to be edited.

STEP 02 Edit the component.

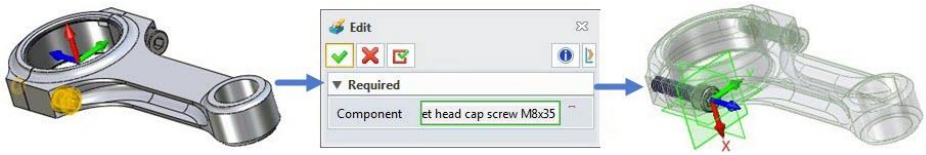


Figure 117 Edit Component

4 Constraint Management

Constraints are essential to an assembly, and will be affected by assembly changes. Keep reading to learn how to quickly modify constraints and check whether they are proper.

4.1 Edit Constraint

Assembly Ribbon Tab->Constraint->Edit Constraint

Edit all constraints of the selected one or two components.

STEP 01 Select one or two components to see all related constraints on this component or between the two components in the dialog.

STEP 02 Delete, add or modify constraints.

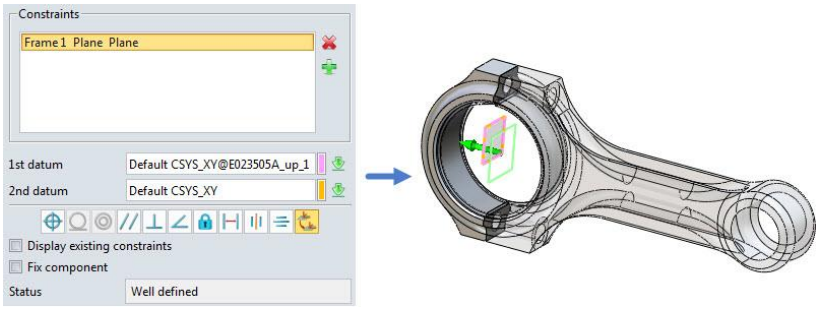


Figure 118 Edit Constraint

- **Non-associated components**

In ZW3D, there are four different display modes to control the display of non-associated components.

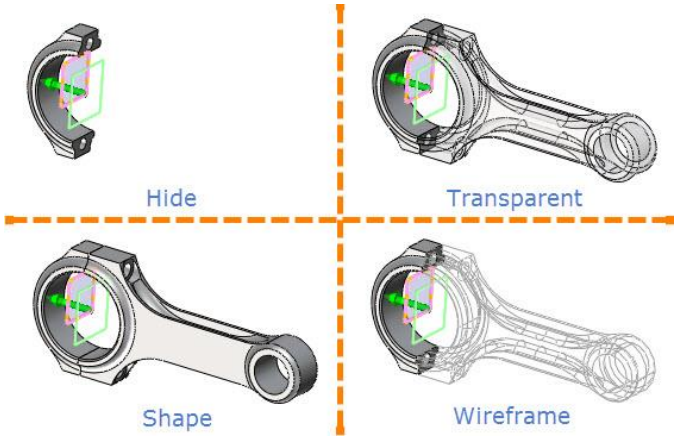


Figure 119 None-associated components

4.2 Delete Constraint

Assembly Ribbon Tab->Constraint->Delete Constraint

Delete constraints of the selected component.

STEP 01 Select the component to see all related constraints in the dialog.

STEP 02 Select one or multiple constraints to be deleted from the dialog.

4.3 Disable and Enable Constraint

STEP 01 Select the constraints you need to disable or enable.

STEP 02 Uncheck or check the constraints, or right-click on them to select the ***Disable*** command or ***Enable*** command.

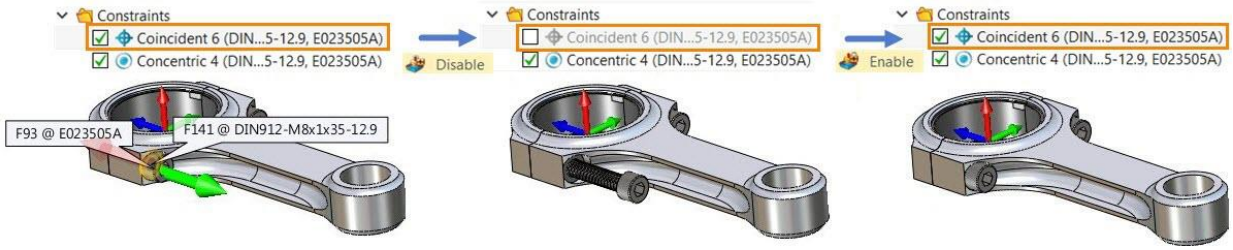


Figure 120 Disable and enable constraint

4.4 Inquire Constraint Status

Assembly Ribbon Tab->Inquire->Constraint Status

Inquire the constraint status of a component or the components of the whole assembly. Each constraint status will be displayed in a different color.

For example, green means well-defined, blue means under-defined. In addition, this command can also detect the degree of freedom of the component.

Here's an example to help you better understand it.

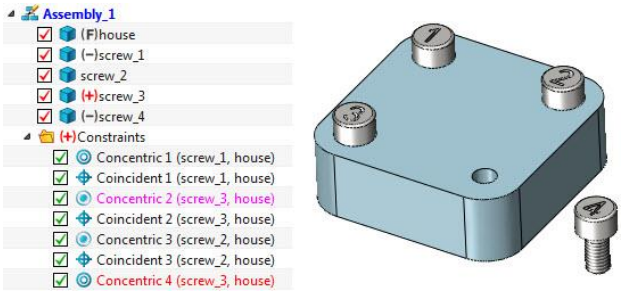


Figure 121 Constraint status

STEP 01 Click ***Constraint Status***, and you can judge the constraint status by the color of the components or the information in the dialog.

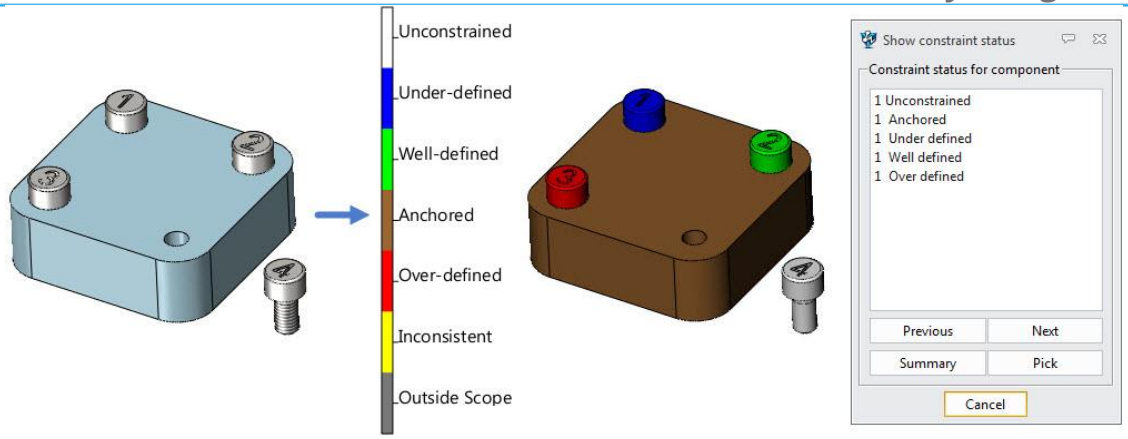


Figure 122 Constraint status in different colors

STEP 02 After clicking the ***Pick*** button, you can select a component and view its degree of freedom.

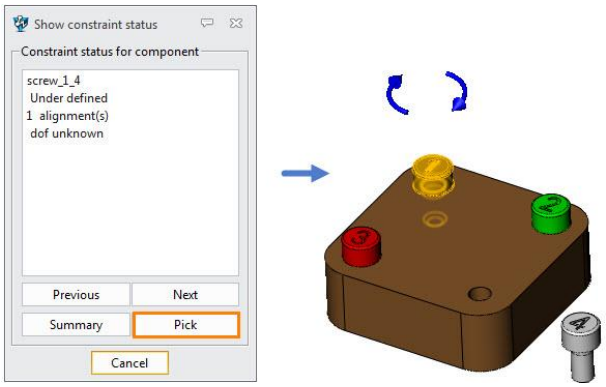


Figure 123 Show constraint status

Below is the explanation of all constraint status.

- **Constraint status -> Unconstrained**

No constraints are added to the component.

- **Constraint status -> Under-defined**

The degree of the freedom of the component is not completely restricted, which means that the component can be moved or rotated.

- **Constraint status -> Well-defined**

The component is completely and correctly constrained.

- **Constraint status -> Anchored**

The component is anchored and will not move.

- **Constraint status -> Over-defined**

The component has conflicting or redundant constraints.

- **Constraint status -> Inconsistent**

The component has constraints that could be valid with certain dimension values, but the current dimension values are inconsistent.

➢ **Constraint status -> Outside Scope**

When editing a sub-assembly in the context of an assembly, sibling sub-assemblies will be ***Outside Scope***. These components are not considered in the current constraint system.

Tips: Quickly confirm the constraint status of the component in the assembly manager.

When the component is in different constraint status, its mark in the assembly manager is also different.

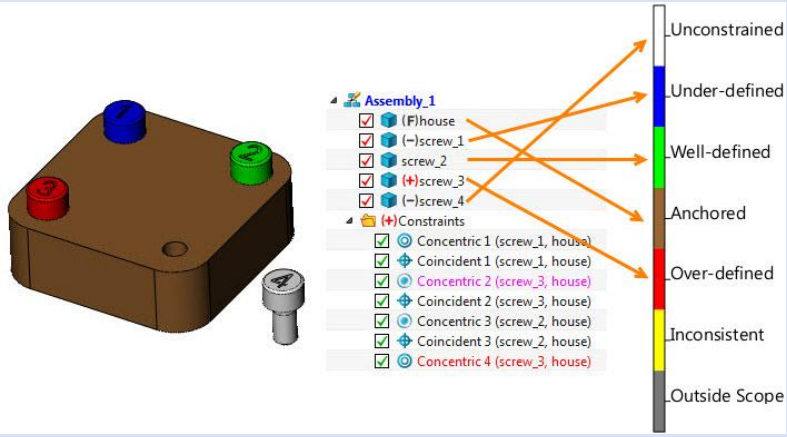


Figure 124 Quickly determine constraint status

The mark corresponding to the constraint status:

✧ **(F) component**

When the constraint status of the component is ***Fix***, the mark of the component is (F).

✧ **(-) component**

When the constraint status of the component is ***Unconstrained*** or ***Under-defined***, the mark of the component is (-).

✧ **(+) component**

When the constraint status of the component is ***Over-defined***, the mark of the component is (+).

✧ **No mark**

When the constraint status of the component is ***Well-defined***, the component has no mark.

4.5 Check Movement

After adding constraints to the whole assembly, you will need to check the assembly movement to verify the rationality of assembly. The best way is to drag the component directly in the assembly. Nevertheless, in ZW3D, there are also two commands to help you quickly verify and measure.

4.5.1 Drag

Assembly Ribbon Tab->Basic Editing->Drag

Drag a component through its DOF (degrees of freedom).

Note: *Fully constrained components will not move. You can also use this command to test the total freedom of a constraint system.*

STEP 01 Select a point on the component as the start.

STEP 02 Select another point as the arrival.

Below is the explanation of all Drag options.

- **Settings -> Interference**

This option is the same as in ***Common Constraint***.

- **Settings -> Relaxed solution**

When this option is checked, ZW3D will attempt to solve the assembly constraints with an alternative algorithm that may find a solution when the default algorithm can not. As a result, the ***Relaxed*** algorithm will be slower and possibly less accurate, though will still solve within tolerance.

- **Dynamic Clearance**

See the dynamic clearance between selected two entities.

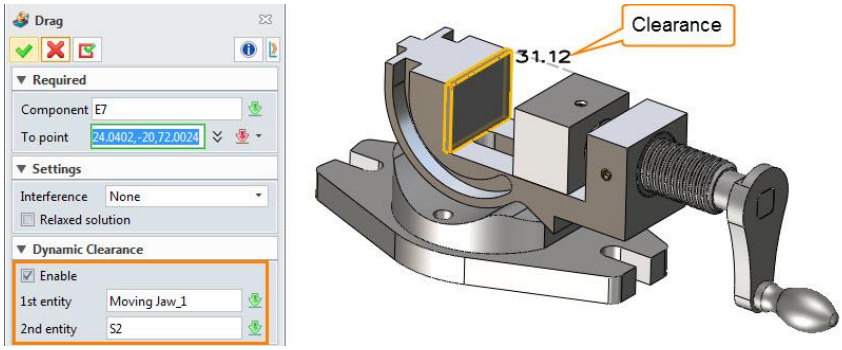


Figure 125 Dynamic Clearance

- **Copy Option -> Copy**

Copy the selected component to the destination.

4.5.2 Rotate

Assembly Ribbon Tab->Basic Editing->Rotate

Dynamically rotate the selected component around the center of its bounding box.

Note: *Fully constrained components will not rotate.*

STEP 01 Select the component to rotate.

STEP 02 Select the origin.

STEP 03 Rotate the component to the desired position.

Below is the explanation of all Rotate options.

- **Dynamic Clearance**

This option is the same as in ***Drag***.

5 Assembly Editing

There are several component editing commands to help you quickly edit assembly components directly in the assembly environment.

Note: *Modifications caused by these commands are only visible in the assembly, and can be inherited to components via settings.*

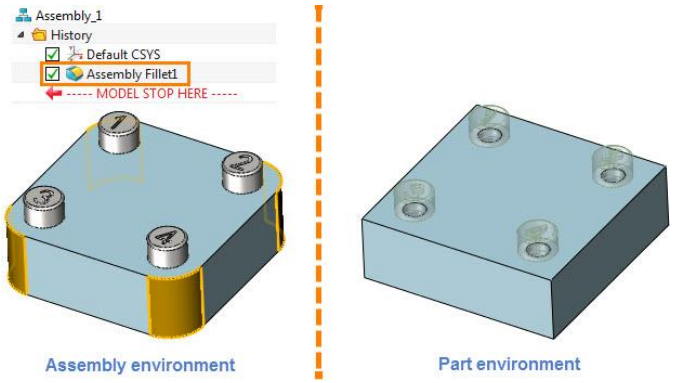


Figure 126 Assembly editing

5.1 Assembly Cut

Assembly Ribbon Tab->Basic Editing->Cut

Select the cutter (components or shapes or both) to cut off the part that overlaps with the components. This command is usually used to cut off the obstruction of the component or the interference between components.

STEP 01 Select components or shapes as the cutter.

STEP 02 Select the component that needs to be cut.

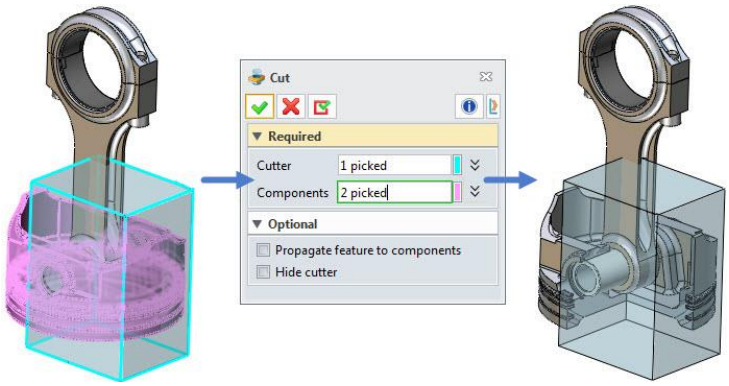


Figure 127 Cut

Below is the explanation of all Cut options.

- **Propagate feature to component**

Use this option to propagate this feature to the component. To prevent this modification from affecting the component, the modeling history of the component will be frozen.

By default, the feature propagation is related so that after modifying, the feature in the assembly will propagate to the component. When the modification is confirmed, you can manually unlink it.

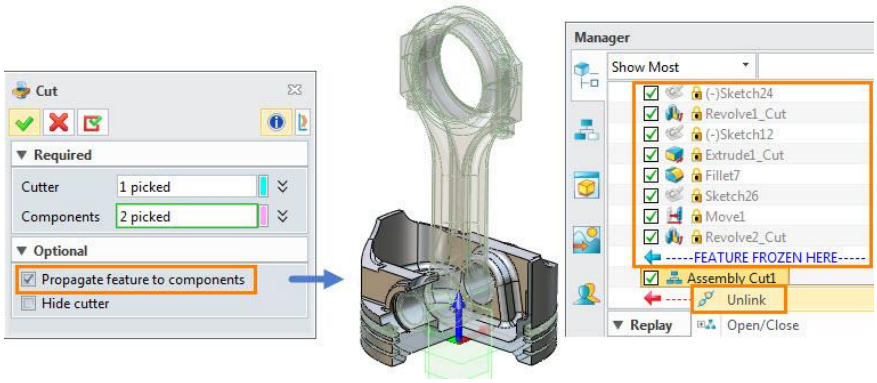


Figure 128 Propagate feature to component

- **Hide cutter**

Hide the cutter.

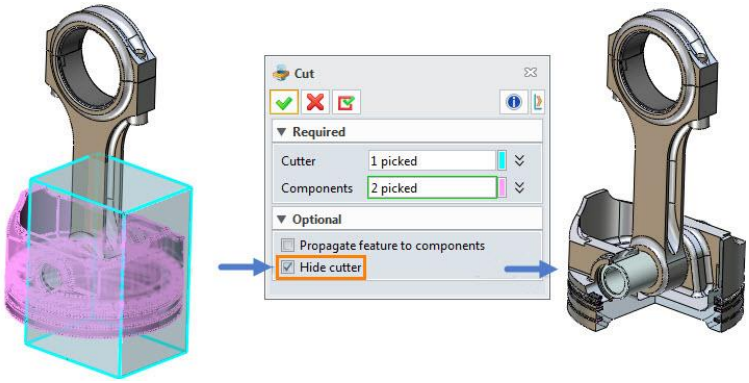


Figure 129 Hide cutter

5.2 Assembly Hole

Assembly Ribbon Tab->Basic Editing->Hole

Add a ***Hole*** feature to the component in the assembly level. The ***Hole*** feature will not be propagated to the component part, it only takes effect in the assembly level.

5.3 Assembly Fillet and Chamfer

Assembly Ribbon Tab->Basic Editing->Fillet/Chamfer

Add a ***Fillet*** or ***Chamfer*** feature to the component in the assembly level. The ***Fillet*** or ***Chamfer*** feature will not be propagated to the component part, it only takes effect in the assembly level.

6 Assembly Check

Necessary detection and inquire commands will help greatly improve product reliability.

6.1 Interference check

Assembly Ribbon Tab->Inquire->Interference Check

Check the interference between components or the assembly. Suppressed components in an assembly will be ignored during these calculations.

STEP 01 Select the component that needs to be checked.

STEP 02 Define the check scope and other options.

STEP 03 Click the ***Check*** button to calculate, and the result will be listed in the dialog.

STEP 04 Check the interference in ***Result*** and make adjustments.

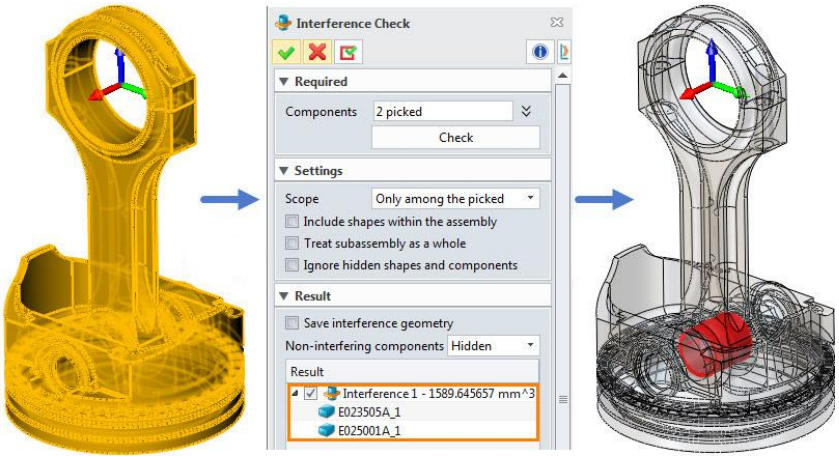


Figure 130 Interference Check

Below is the explanation of all Interference Check options.

- **Including shapes within the assembly**

Check the interference between the picked components and the shapes.

- **Check among shapes**

Check the interference among all the shapes.

- **Treat sub-assembly as a whole**

Do not check the interference within the sub-assembly.

Note: *This option is only available when the selected component contains a sub-assembly.*

- **Ignore hidden shapes and components**

The hidden parts and components are not involved in the interference check.

- **Save interference geometry**

Save the interference shapes in the history list.

- **Non-interfering components**

This option is the same as ***Non-associated components***.

6.2 Clearance Check

Assembly Ribbon Tab->Inquire->Clearance Check

Check the clearance between components or in the assembly.

Note: *The clearance value must be a positive number. When the clearance between components is less than the set value but greater than 0, the minimum clearance between components will be displayed in the workspace and the result dialog.*

STEP 01 Select the component that needs to be checked.

STEP 02 Define the settings and display mode.

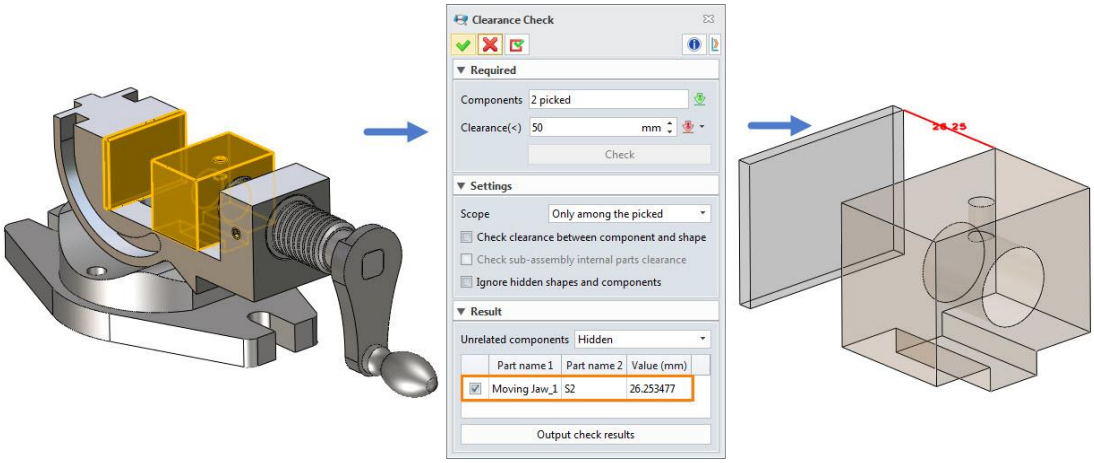


Figure 131 Clearance Check

Below is the explanation of all Clearance Check options.

- **Check clearance between component and shape**

Check the clearance between the picked components and the shapes.

- **Check sub-assembly internal parts clearance**

The parts in the sub-assembly will also be checked for clearance.

- **Ignore hidden shapes and components**

The hidden parts and components are not involved in the clearance check.

- **Unrelated components**

This option is the same as in ***Interference Check***.

6.3 Compare Parts

Assembly Ribbon Tab->Inquire->Compare Parts

Compare two parts and show the different faces between them. This function is often used to compare the differences between different revisions of the same part.

STEP 01 Select the base and compared parts, then click ***Calculate*** to get the comparison result.

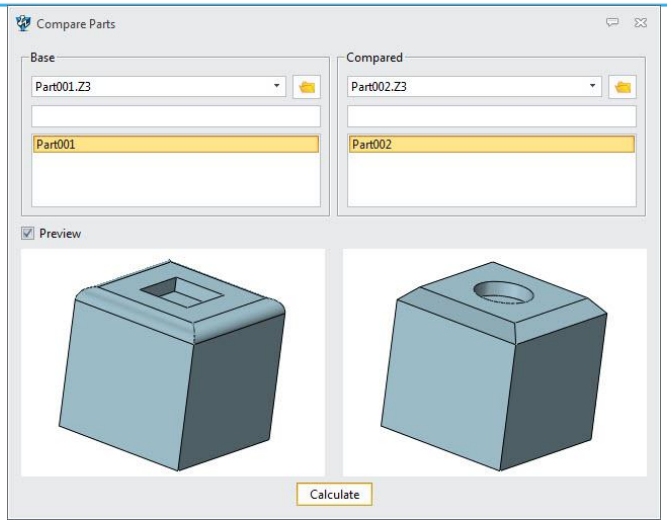


Figure 132 Compare parts

STEP 02 The unchanged, changed, and unique faces between two parts will be identified and colored respectively.

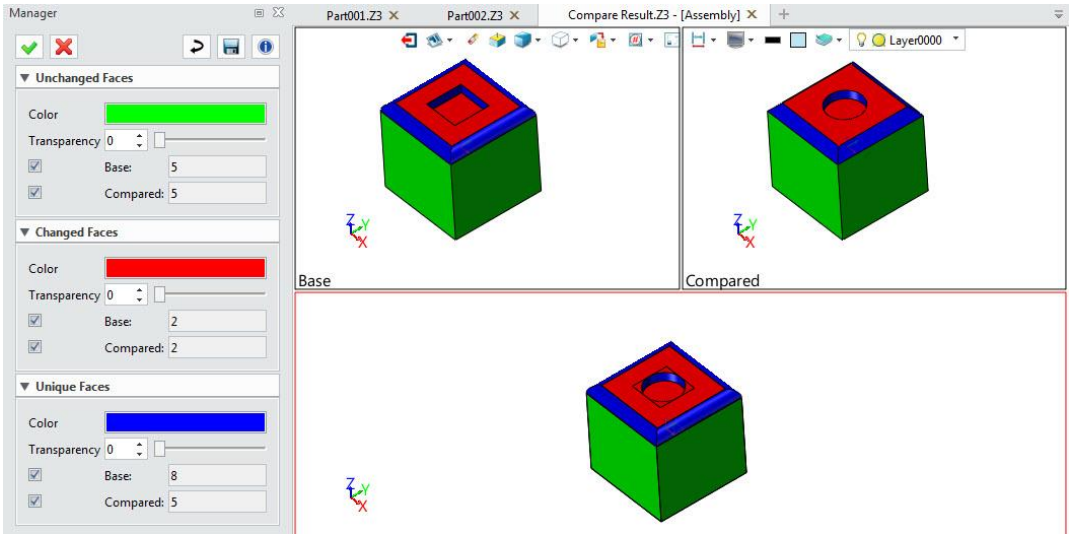


Figure 133 Comparison Result

6.4 3D BOM

Assembly Ribbon Tab->Inquire->3D BOM

After the assembly design is completed, use this command to automatically generate the BOM table that compiles various BOM tables.

STEP 01 Click the ***3D BOM*** icon to automatically generate a BOM table.

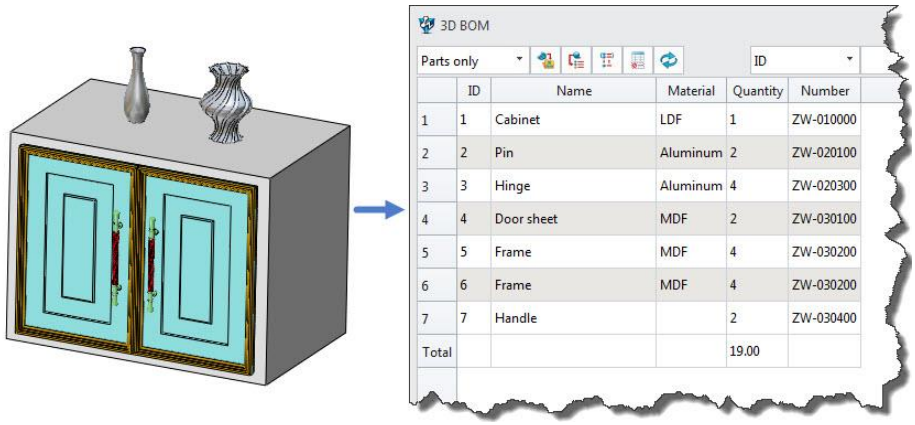


Figure 134 3D BOM

STEP 02 Select a type of display level.

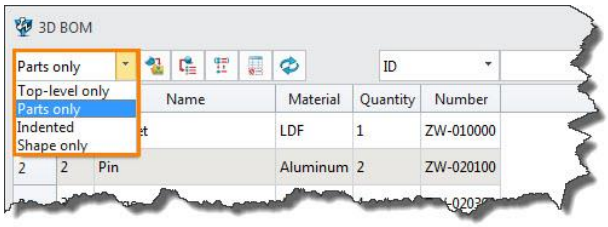


Figure 135 Select the display level

STEP 03 Select the attributes and define all attributes.

STEP 04 Export the completed BOM to Excel.

Below is the explanation of all 3D BOM options.

- **Level Display Settings**

Top-level only: Display only the top-level components.

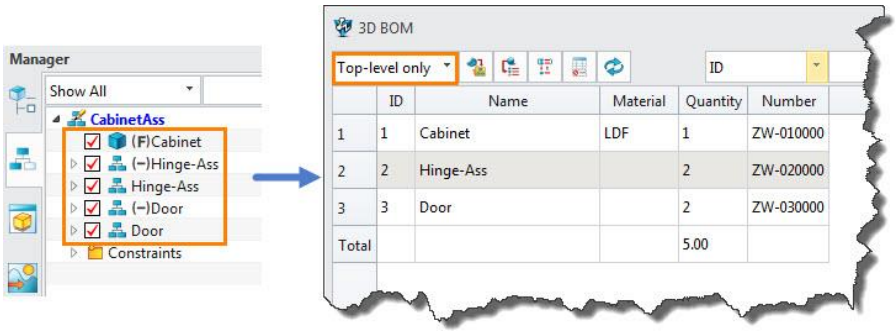


Figure 136 Top-level only

Parts only: Display only parts.

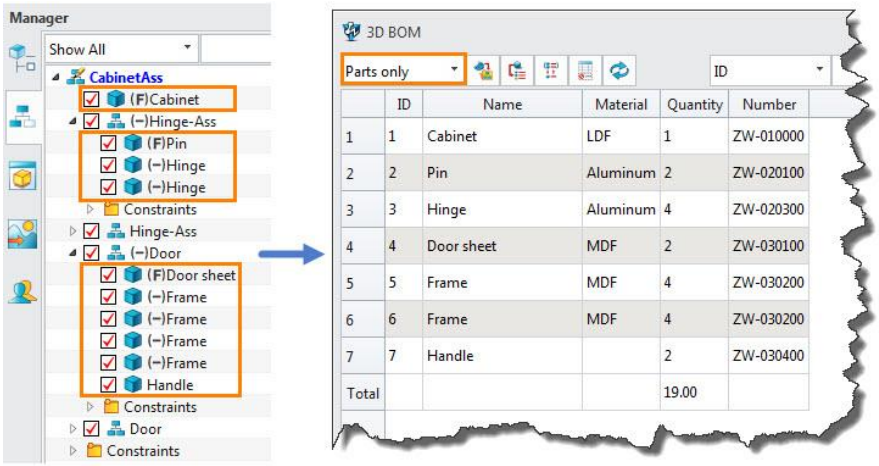


Figure 137 Parts only

Indented: Indent the 3D BOM according to the assembly level.

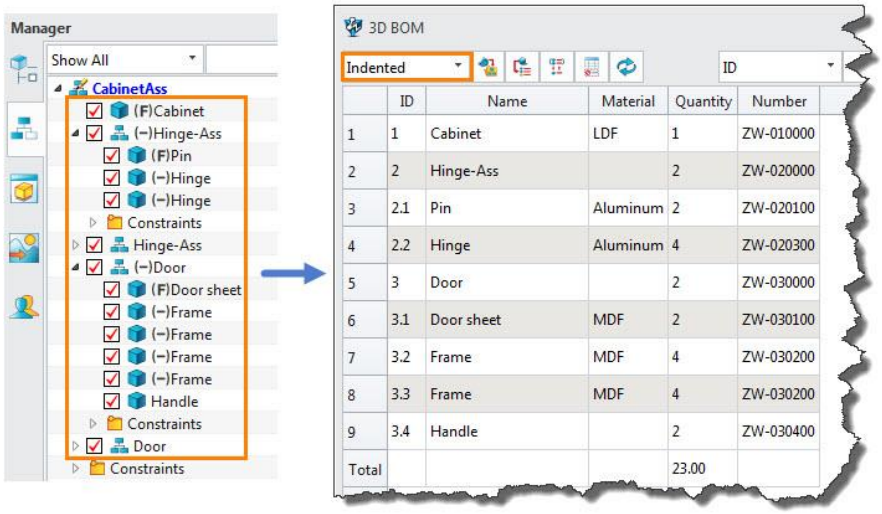


Figure 138 Indented

Shape only: Display only the shapes.

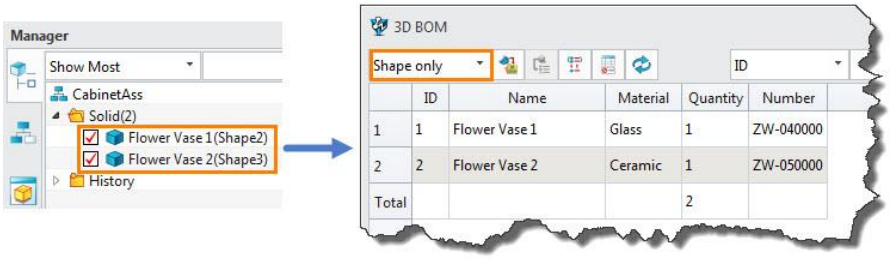


Figure 139 Shape only

- **Buttons**

Include unplaced components: Display the unplaced components.

Include shape: Display the shape information.

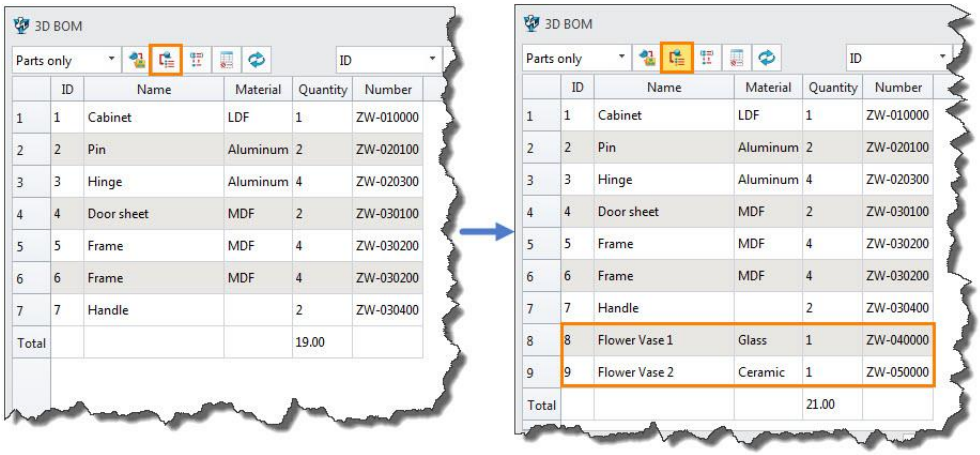


Figure 140 Include shape

Display configurations of the same part as one item: Different configurations of the same part will be merged and displayed as one item in the 3D BOM table.

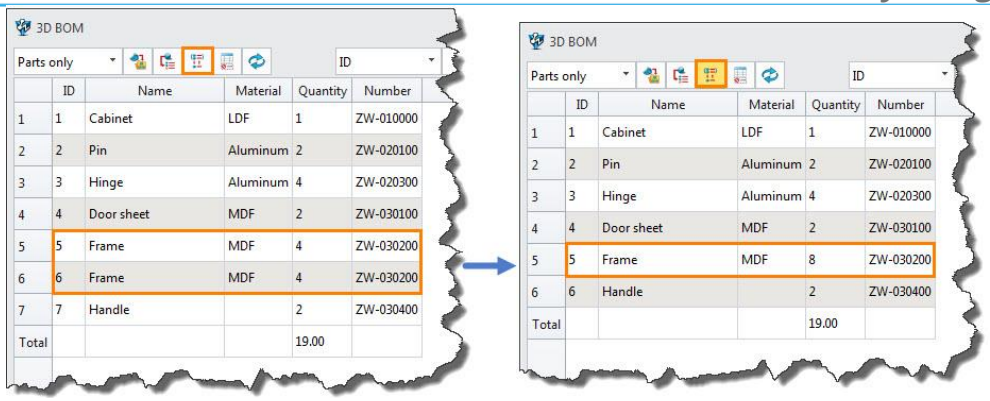


Figure 141 Display configurations of the same part as one item

Show "do not list in BOM" items: Show "do not list in BOM" items.

Update calculated attributes: Update all the calculated attributes in the 3D BOM table.

➢ Search Function

Select an attribute and enter the required value to search the corresponding content in the 3D BOM table.

Exact search: If started, only the component information that is identical to the search content will show as the search results. If not started, the component information that contains the search content will show as the search results.

Filter search result: Display the search results separately.

➢ Export Data

Export format: Output the current form of 3D BOM as a template which is saved in the .Z3DBOMTT format.

Export data: Export the current 3D BOM content to Excel.

➢ Column

All the optional attributes of the 3D BOM are displayed in the ***Column*** tab, including system attributes and user attributes. You can check the default attributes or add a new attribute.

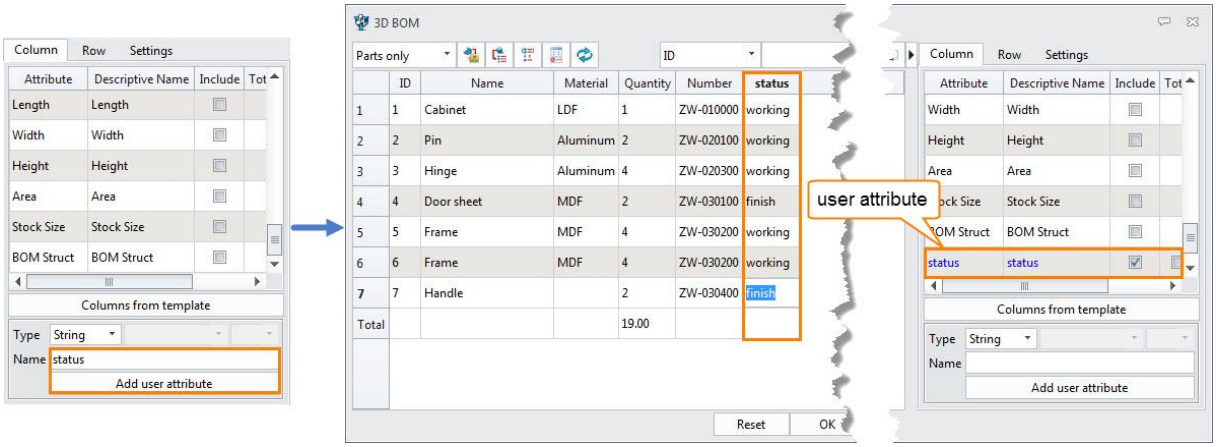


Figure 142 Add user attributes

➢ Row

All excluded components are displayed in the ***Row*** tab. The excluded items can be added back to the 3D BOM by selecting ***Include component*** from the right-click menu.

BOM Filter: Similar to 2D BOM filters, 3D BOM filters also provide conditional filtering for BOM based on different attribute values. Filtration conditions can be saved in the BOM format files for reuse.

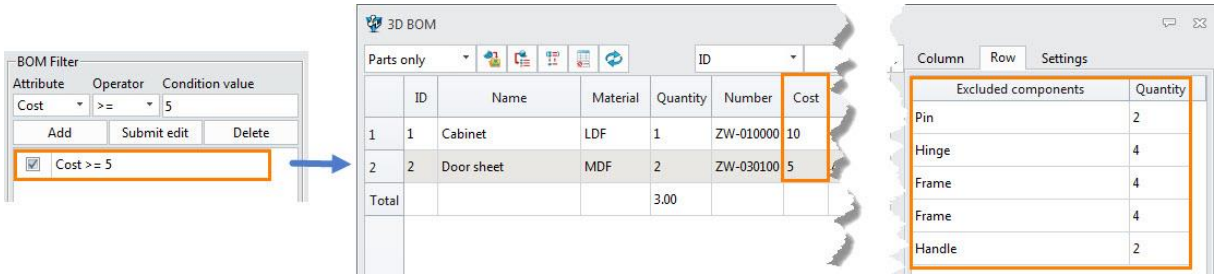


Figure 143 3D BOM Filter

➢ Settings

Default template setting: Checking this option allows you to select a template as the default.

Preset attribute list: Checking this option allows you to customize the preset attribute list.

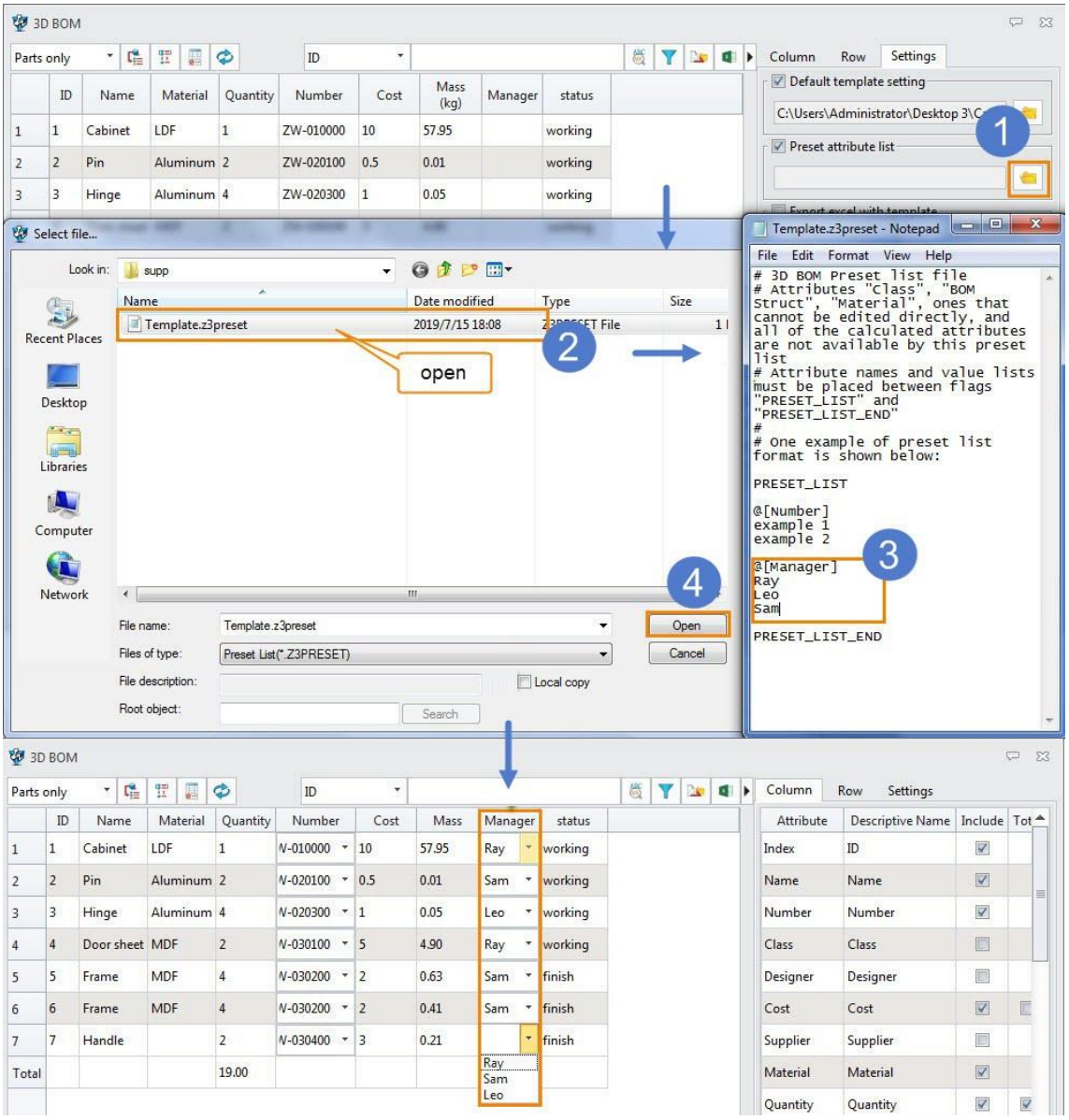


Figure 144 Preset attribute list

Export excel with template: Check the check box and select a template as the template when you export the BOM to Excel.

7 Reference (3D)

In top-down assembly design, you often need to refer to some geometries of other components when modeling a part.

7.1 Reference

Assembly Ribbon Tab->Reference->Reference

Extract points, lines, planes, faces, and shapes to the activate part's parent object, its child object, or another component.

STEP 01 Create a new component or enter an assembly component editing environment.

STEP 02 Switch to the display status of all components.

STEP 03 Click the ***Reference*** command and select the reference object type to curve.

STEP 04 Select a curve in the external component.

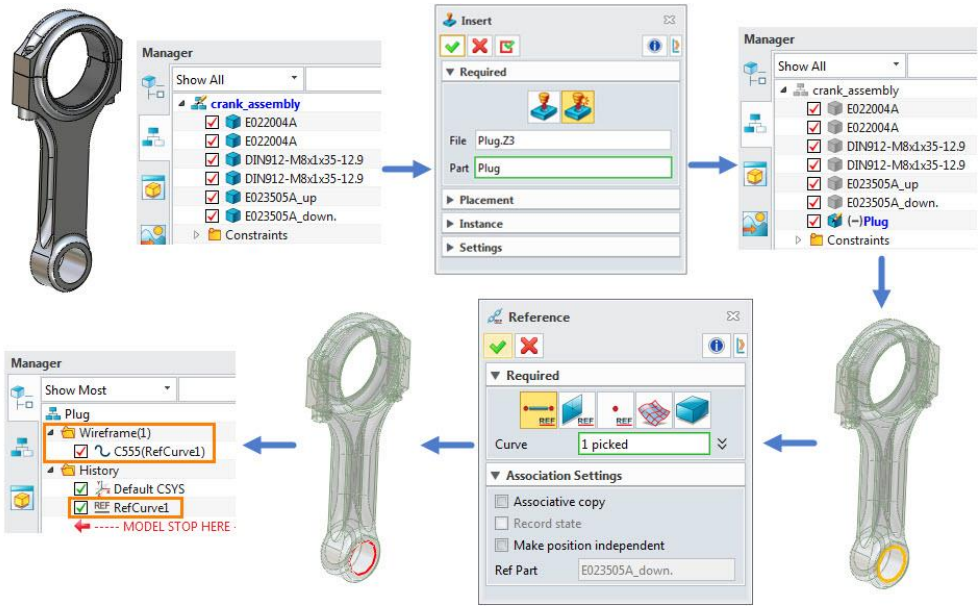


Figure 145 Extract a curve as a reference

Below is the explanation of all the Reference object types and options.

- **Reference object type -> Plane/Point/Face/Shape**

These types are same as the curve.

- **Association Settings -> Associative copy**

Create the reference geometry that associates with the referenced external geometry. If this option is checked, the reference geometry re-evaluates each time when referenced geometry is regenerated. If not checked, this option creates the reference geometry that is a one-time static copy of the selected geometry.

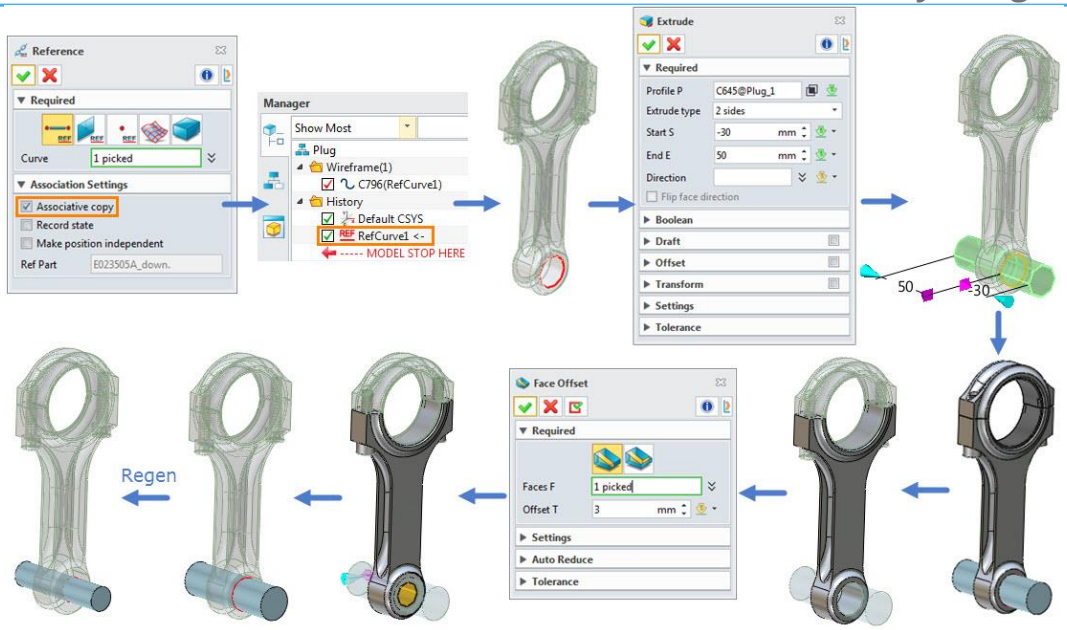


Figure 146 Associative copy

- **Association Settings -> Record state**

Record the state of the history of the part from which the reference geometry is extracted. When a timestamped reference geometry is regenerated, the part it references is rolled back to the recorded history state before the reference geometry is re-evaluated.

- **Association Settings -> Make position independent**

If this option is checked, the position of the reference geometry is the same as the referenced assembly. If not checked, the position of the reference geometry is the same as the original part associated with the referenced assembly.

- **Association Settings -> Ref Part**

Display the name of the file where the selected geometry locates.

7.2 Regen Ext Ref

Assembly Ribbon Tab->Reference ->Regen Ext Ref

Regenerate the external reference.

7.3 Link Manager

Assembly Ribbon Tab->Reference->Link Manager

Associate other ZW3D objects and external files with the active part.

Below is the explanation of all Link Manager options.

- **Link Inquire**

Identify all external reference information in all open files. You can also open or unlink an external reference in the manager.

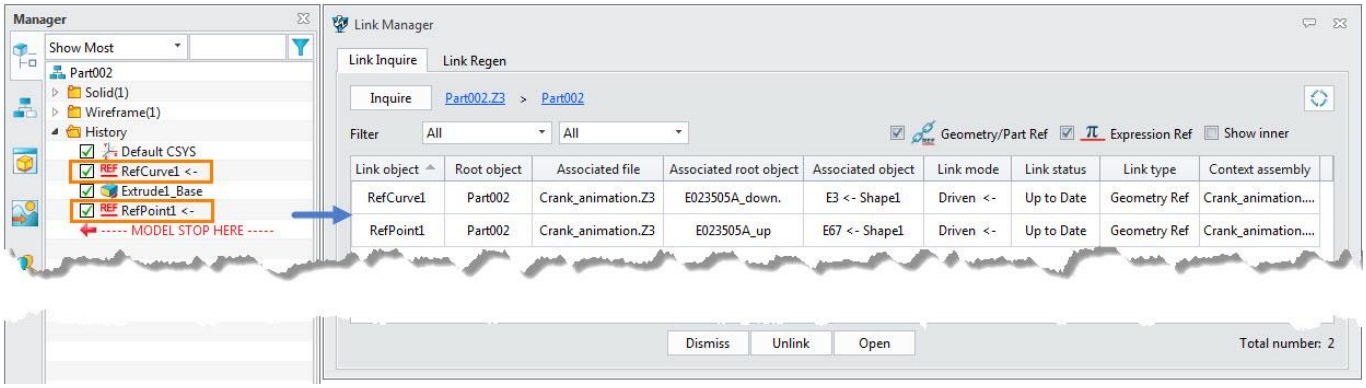


Figure 147 Link Inquire

- **Link Regen**

Set three different types of links.

8 Exploded View

Showing the internal structure and composition of the product, the exploded view is indispensable to product display.

8.1 Exploded View

Assembly Ribbon Tab->Exploded View->Exploded View

Create exploded views for each assembly configuration. Also, you can re-order the existing steps by drag-dropping the picked step in a list that records every explosion step.

STEP 01 Select a config to explode. If an existed exploded view is selected, the system will explode automatically. If not, the system will create a new exploded view.

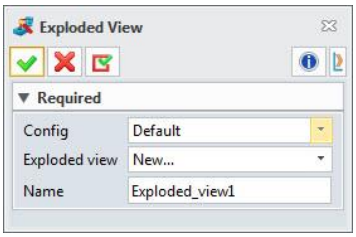


Figure 148 Exploded view

STEP 02 Add explosion steps manually or use the auto explode.

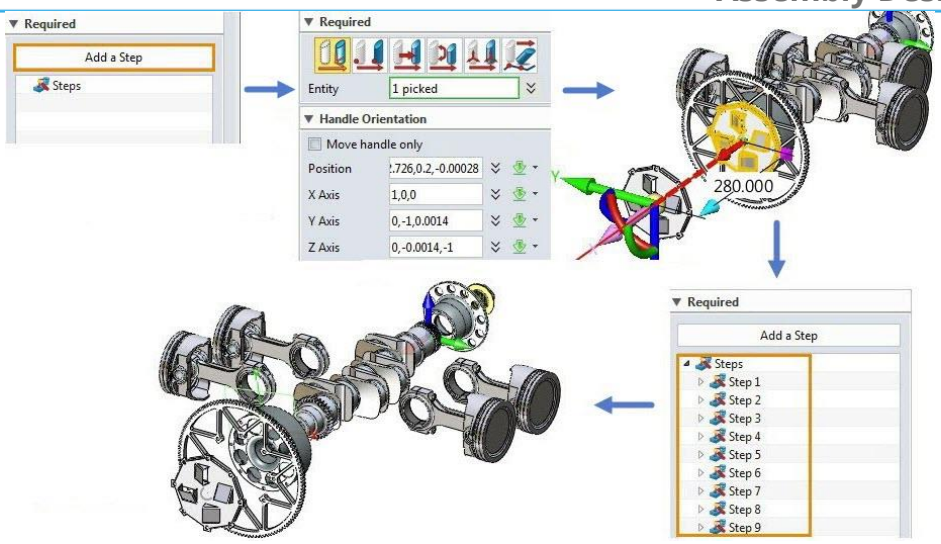


Figure 149 Add a step

Below is another way to generated an Exploded view.

- **Add by Auto Explode**

Click this button to generate self-explosion steps, then adjust these steps manually. This button is only available when there is no explosion step existing in the list.

8.2 Exploded View Video

Assembly Ribbon Tab->Exploded View->Exploded View Video

Convert the picked exploded view from the list into an AVI video.

STEP 01 Select an exploded view that has been created and click OK.

Below is the explanation of all Exploded View Video options.

- **Save explosion process**

Save the explosion process as a video.

- **Save collapse process**

Save the collapse process as a video.

9 Animation

The animation module of ZW3D is used to simulate the real movement of the product for product motion simulation animation and product assembly animation. Its principle is to record the positions of components at different times based on keyframes, and then concatenate these keyframes into an animation in order.

Note: *The animation object is a target object that is only in the assembly. There is no access to the animation outside of the assembly. You can only open the assembly file, and then use the* ***Edit animation*** *command to view and edit the animation.*

9.1 Key Animation Parameters and Commands

Every animation is inseparable from the key parameters. Master their usage and you create animations easily.

Below is the explanation of all key Animation parameters and commands.

- **Timeline**

The timeline is where you manage all the animation keyframes. In it, you can activate the keyframe at the different times to check the position of the product at the keyframe.

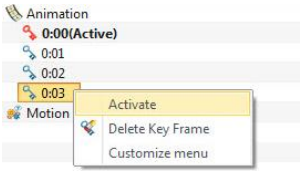


Figure 150 Timeline

Figure 151

- **Keyframe**

A keyframe is the smallest unit of the animation that records the position of the product in the current time. The smallest unit of the keyframe time is second, and it will be automatically converted into a minute every 60 seconds. In addition, all keyframes will be automatically arranged in order.

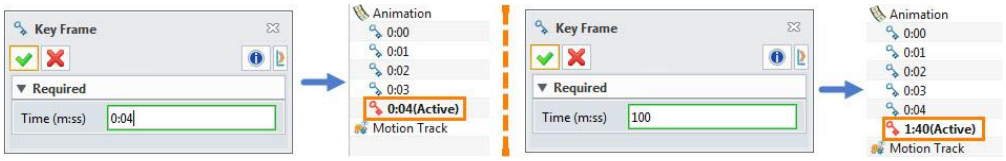


Figure 152 Keyframe

- **Parameter**

Animation parameters are the main variables that drive product position changes. They adjust the position of the corresponding component in each keyframe by referring to the driving variable in the assembly constraint. So, constraints with distance or angle offset variables can be used as parameters in the assembly animation.

- **Camera Position**

This command allows you to add a camera position to each keyframe, which helps create "fly-through" animations and hence, show the product from multiple angles by changing the camera location at each keyframe. In addition, we can directly adjust the model position in the model space and define it as the current camera position or define the camera position by precise coordinates.

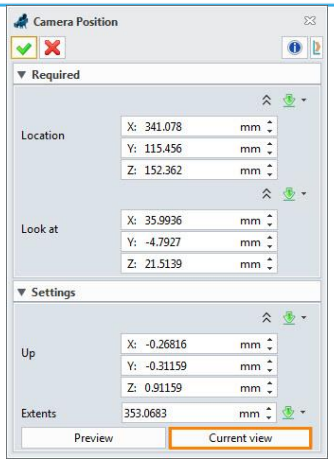


Figure 153 Camera Position

9.2 Motion Simulation Animation

Simulating the real movement of transmission products can help not only avoid design mistakes, but also others better understand our product. Below is the workflow of making a motion simulation animation.

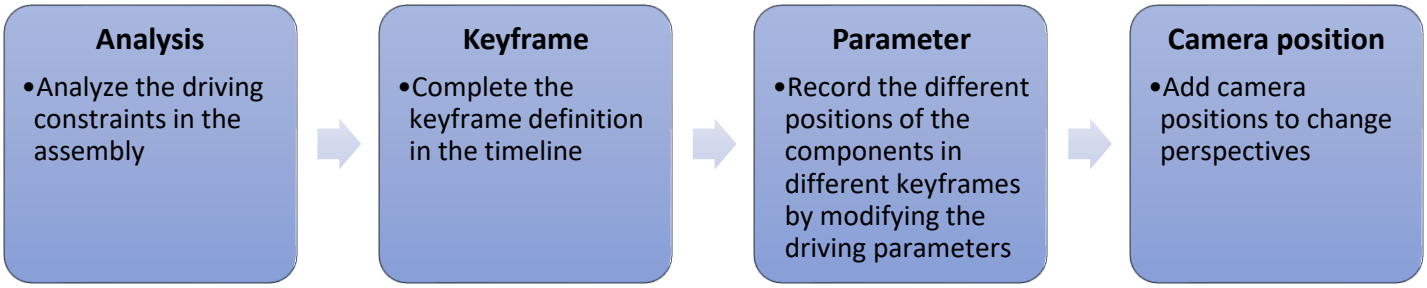


Figure 154 Motion simulation animation workflow

Below is a complete case to show how to make a motion simulation animation.

- **Motion Simulation Case -- Crankshaft connecting rod system**

Case analysis: The crankshaft connecting rod was originally a four-piston connecting rod driving the crankshaft to rotate, but we can define the rotation of the crankshaft to simulate the movement of the crankshaft connecting rod. On this premise, we lock the driving constraint to the Angle constraint on the crankshaft.

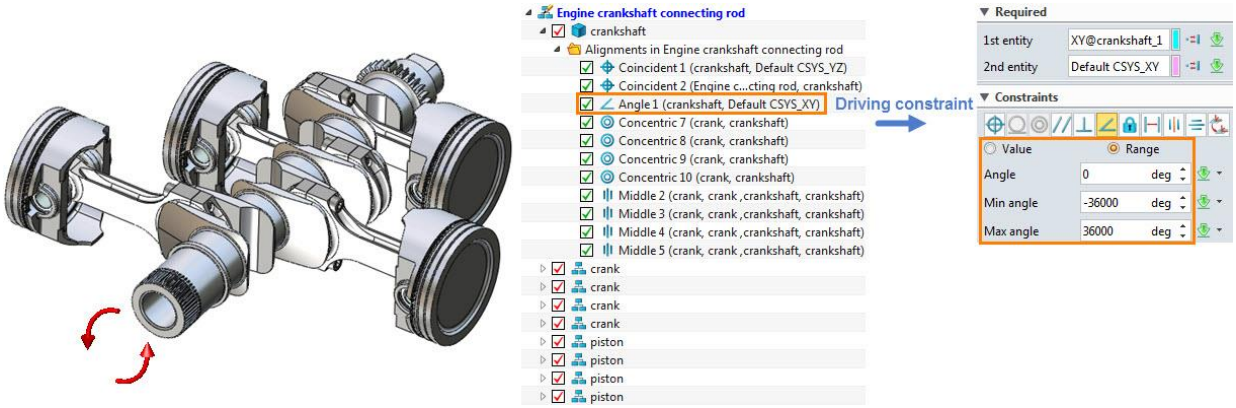


Figure 155 Case analysis

STEP 01 Create a new animation, set its duration and name. After that, the keyframe of the start and end time will be automatically generated.

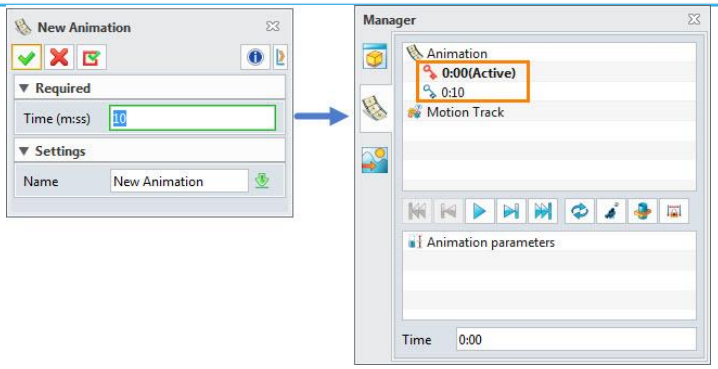


Figure 156 Create a new animation

STEP 02 Add driving parameters by clicking the ***Parameter*** command and selecting parameters.

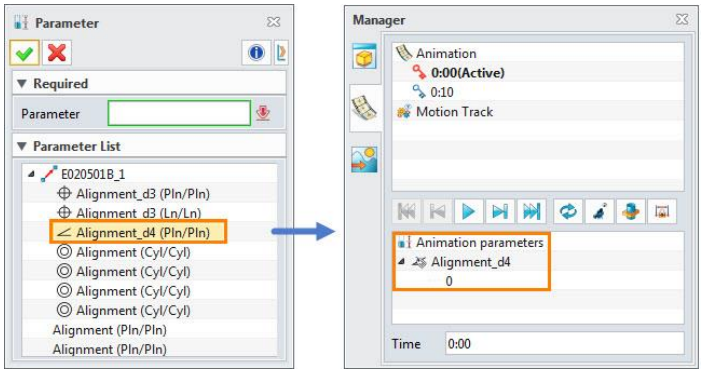


Figure 157 Add driving parameters

Note: *There must be a constraint in the assembly that controls the rotation of the crankshaft.*

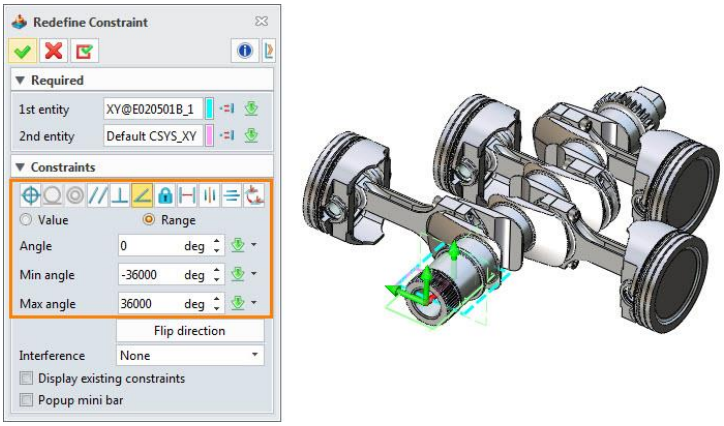


Figure 158 Rotation of the crankshaft

STEP 03 Set the parameter value of the 0:00 keyframe to 0 because it is the initial position.

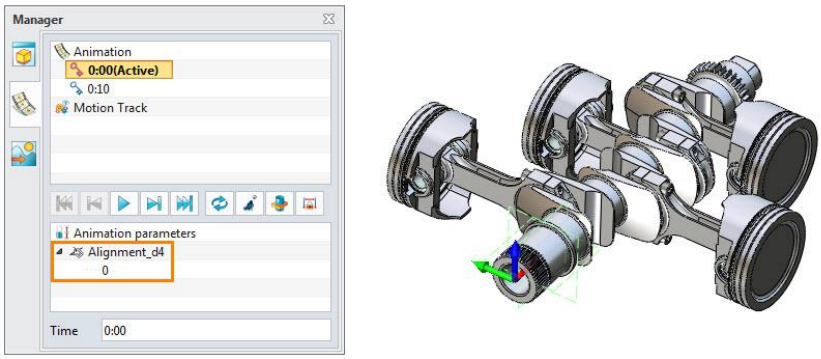


Figure 159 0:00 keyframe

STEP 04 Click ***Key Frame*** to create the 0:01 keyframe and set the parameter value to 90.

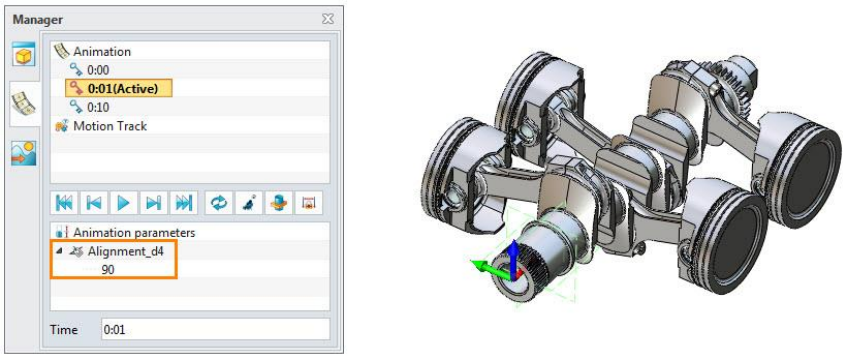


Figure 160 0:01 keyframe

STEP 05 Click ***Key Frame*** to create the 0:02 keyframe and set the parameter value to 180.

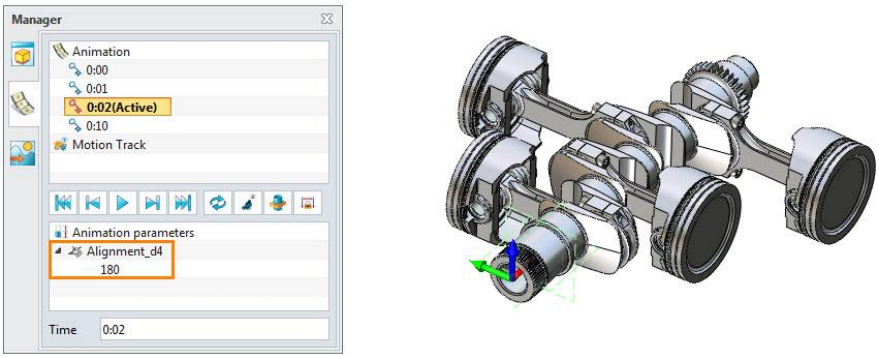


Figure 161 0:02 keyframe

STEP 06 Click ***Key Frame*** to create the 0:03 keyframe and set the parameter value to 270.

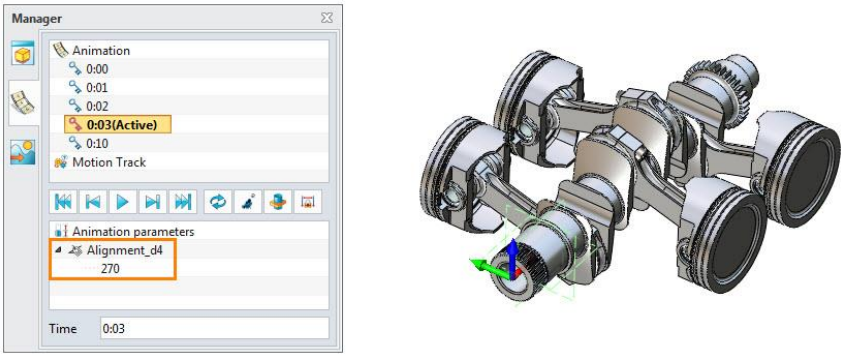


Figure 162 0:03 keyframe

STEP 07 Click ***Key Frame*** to create the 0:04 keyframe and set the parameter value to 360.

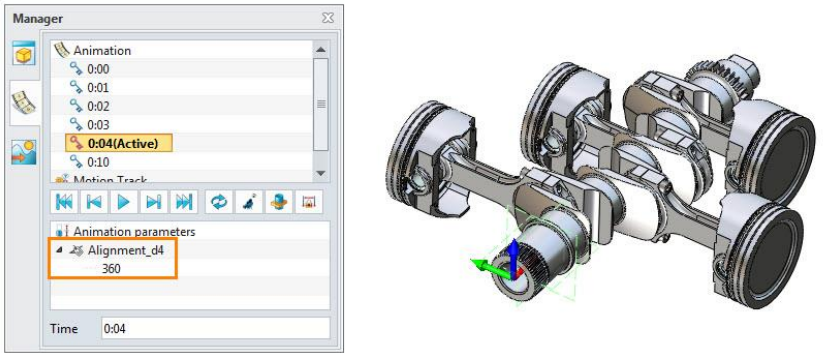


Figure 163 0:04 keyframe

STEP 08 Play the keyframes we have completed.

STEP 09 Add camera positions to switch different views for each keyframe.

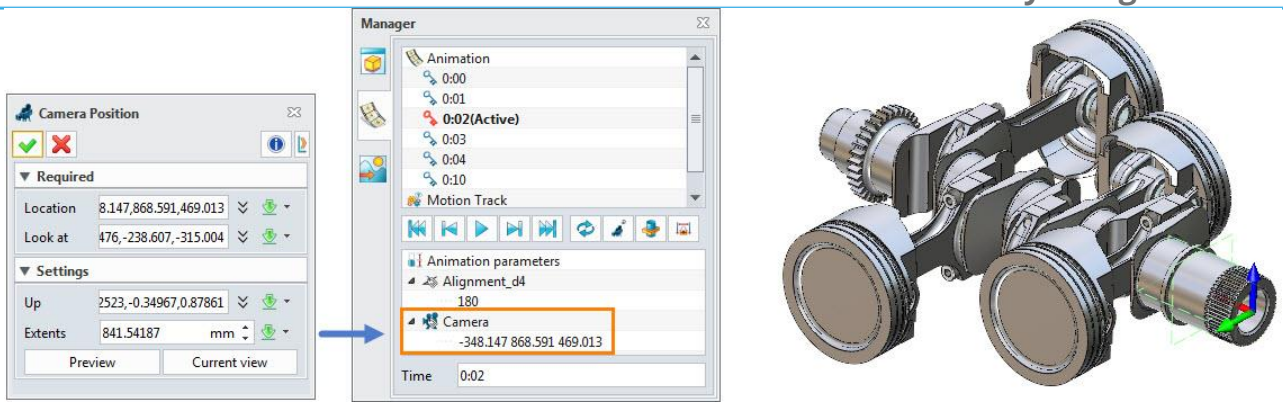


Figure 164 Camera Position

STEP 10 Control the speed of the motion by modifying the time interval or parameter value.

9.3 Assembly and Disassembly Simulation Animation

Below is the workflow of making an assembly or disassembly simulation animation.

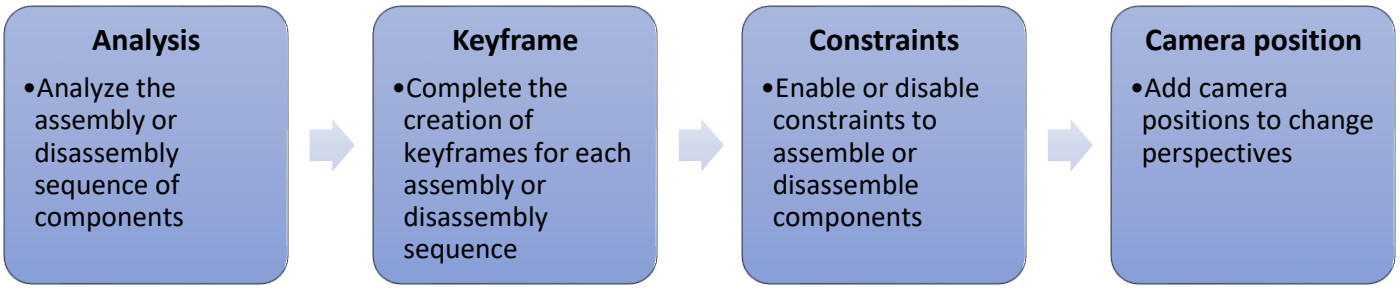


Figure 165 Assembly and disassembly simulation animation workflow

Below is a complete case to show how to make a disassembly simulation animation.

- **Disassembly Simulation Case -- Connecting rod**

Case analysis: We first disassemble the fasteners, and then disassemble the other components.

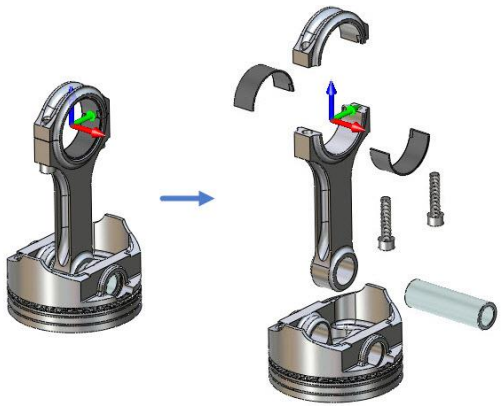


Figure 166 Disassembly Animation

STEP 01 Create a new animation, set its duration and name.

STEP 02 Set the 0:00 keyframe as the initial state of the disassembly.

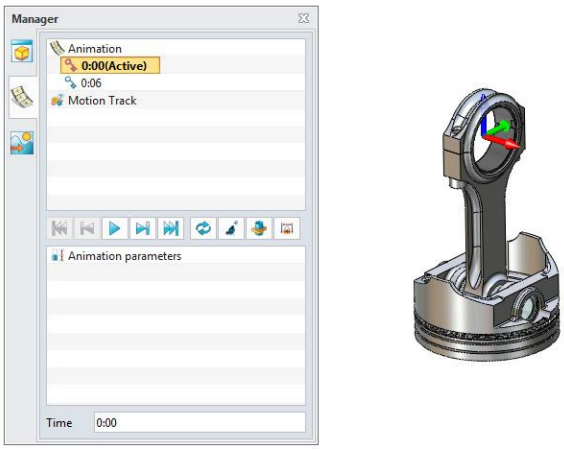


Figure 167 0:00 keyframe

STEP 03 Click ***Key Frame*** to create the 0:01 keyframe. Before we disassemble the first component, we need to disable its constraints, otherwise, we cannot disassemble it.

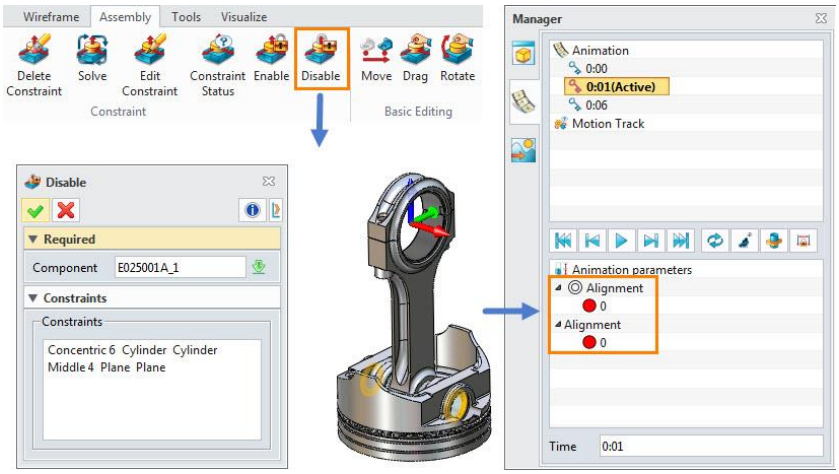


Figure 168 Disable the constraints of the component

STEP 04 After disabling its constraints, use the ***Move*** command to disassemble the component.

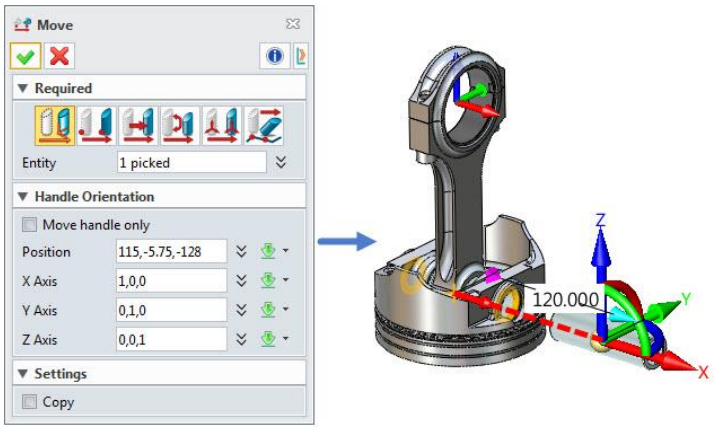


Figure 169 0:01 keyframe

STEP 05 Click ***Key Frame*** to create the 0:02 keyframe. Disable the constraints and move the component.

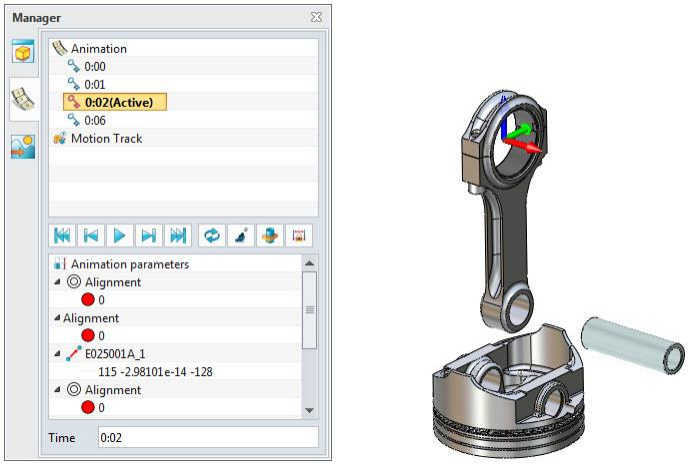


Figure 170 0:02 keyframe

STEP 06 Click ***Key Frame*** to create the 0:03 keyframe.

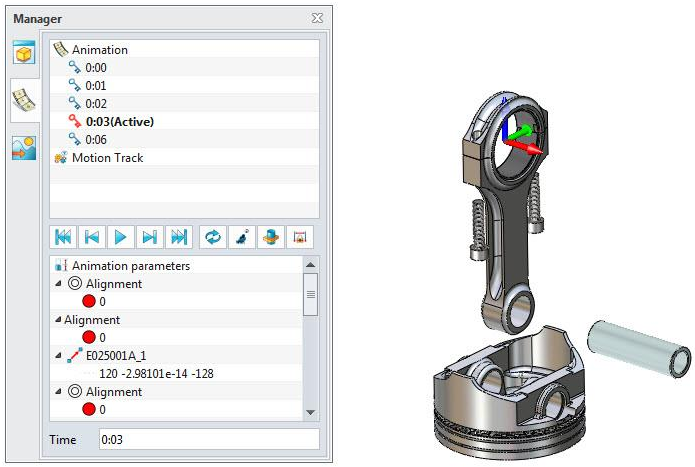


Figure 171 0:03 keyframe

STEP 07 Click ***Key Frame*** to create the 0:03.5 keyframe.

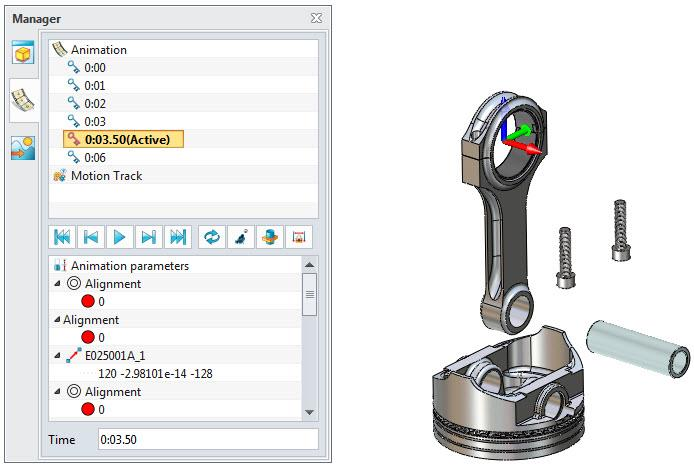
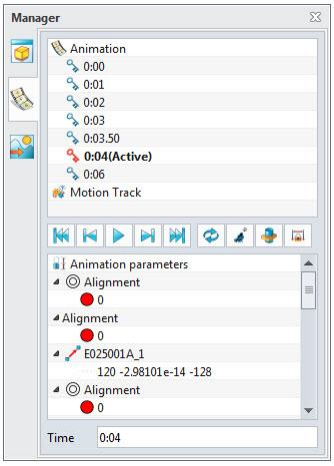


Figure 172 0:03.5 keyframe

STEP 08 Click ***Key Frame*** to create the 0:04 keyframe.



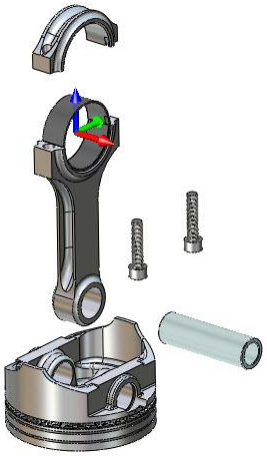
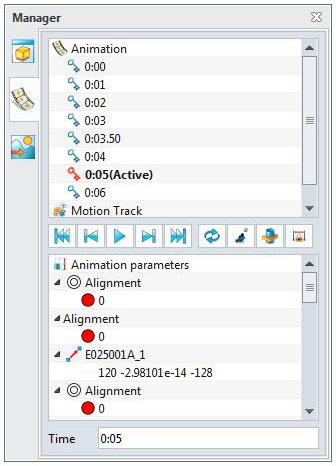


Figure 173 0:04 keyframe

STEP 09 Click ***Key Frame*** to create the 0:05 keyframe.



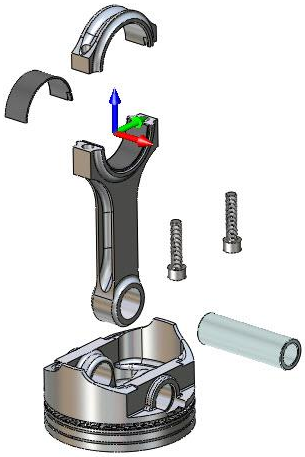
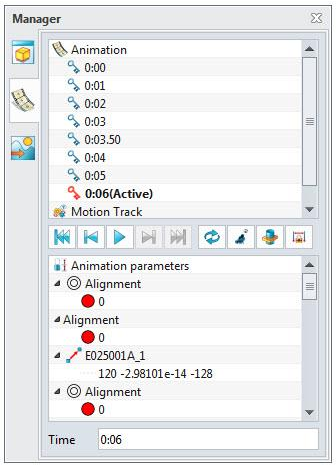


Figure 174 0:05 keyframe

STEP 10 Activate the 0:06 keyframe.



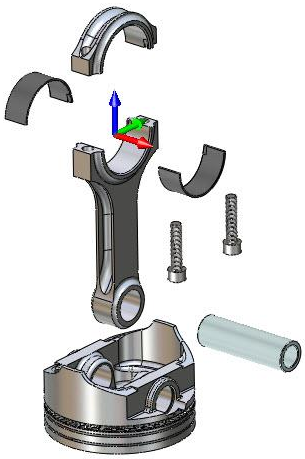


Figure 175 0:06 keyframe

STEP 11 Play the keyframes we have completed.

STEP 12 To continue to make the assembly animation, increase the keyframes and use the ***Enable*** command to assemble the components.

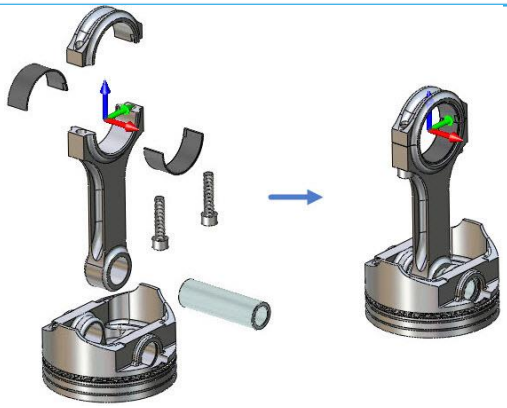


Figure 176 Assembling components

9.4 Other Parameters and Commands

Below is the explanation of other Animation parameters and commands.

- **Animation Management**

New animation: Create a new animation.

Edit animation: View and edit an existing animation.

Inquire animation: Inquire the information and parameters about an existing ZW3D animation.

Delete animation: Delete an existing animation.

- **Motion Track**

Get a motion track of a point. You can also export this motion track to a CSV file.

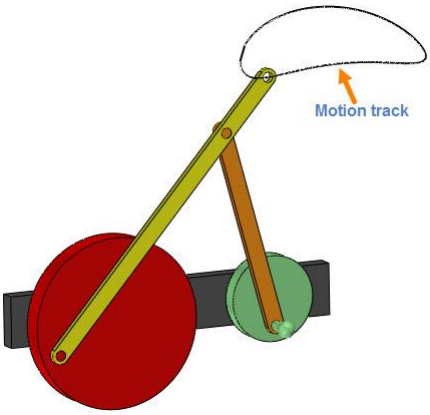


Figure 177 Motion Track

- **Options in the Animation Manager**

Figure 178 Animation Manager

Repeat: Play the animation again and again.

View through camera: Create "fly-through" animations by changing the camera location at each keyframe.

Check for interference: Automatically check the assembly for interferences during the animation.

Lock at previous keyframe: Lock the animation at the previous keyframe's parameters.

- **Animation output tool**

Capture: Capture the active display to a file. It automatically turns off the view extents readout, the world axis triad, and the default datum display. You can save it in BMP, GIF, JPG, and TIF graphics file formats. It also allows up to the maximum pixel resolution supported by your graphics card.

Record animation: Save the active animation to an external AVI movie file.

- **Animation Settings**

Right-click in the Animation Manager and adjust the animation settings.

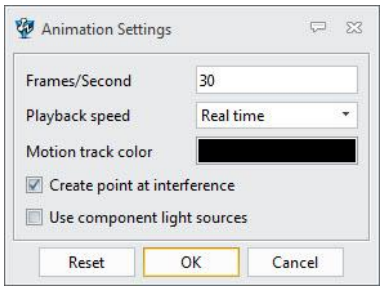


Figure 179 Preference

Frames/Second: Set the number of frames per second during the playback.

Playback Speed: Choose the desired playback speed from “Play every frame”, “1/4 speed”, “1/2 speed”, “Real Time”, “2x speed”, and “4x speed”.

Motion track color: Set the color of the motion track line.

Create point at interference: With the ***Check for Interference*** icon (see Figure 178) turned off, check this box to create an intersection contact point.

Use component light sources: Check this box to use any component light sources defined in the current active assembly.

10 Assembly Case

The below example is to show you how to complete the assembly of a product in ZW3D.

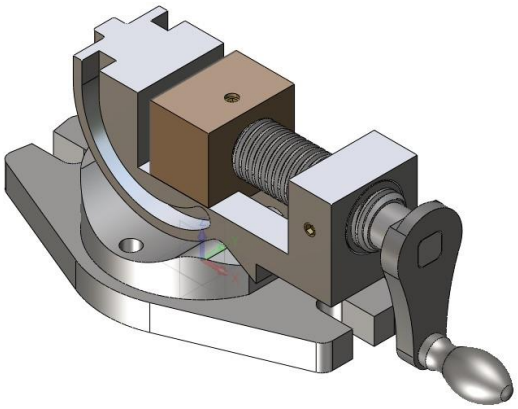


Figure 180 Jaw

Below are the detailed steps of this case.

- **Create New Assembly File**

STEP 01 Open the file “Assembly Case.Z3”, and create a new object with the name ***New Example***.

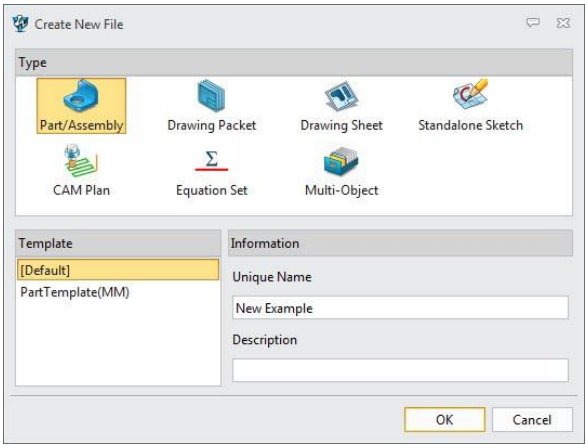


Figure 181 Create a new assembly object

- **Insert First Component**

STEP 01 Click the ***Insert*** command.

STEP 02 In the dialog, select the ***Lower Base*** component.

STEP 03 Pick the coordinate origin (0,0,0) as the location point and click ***OK*** to insert this component.

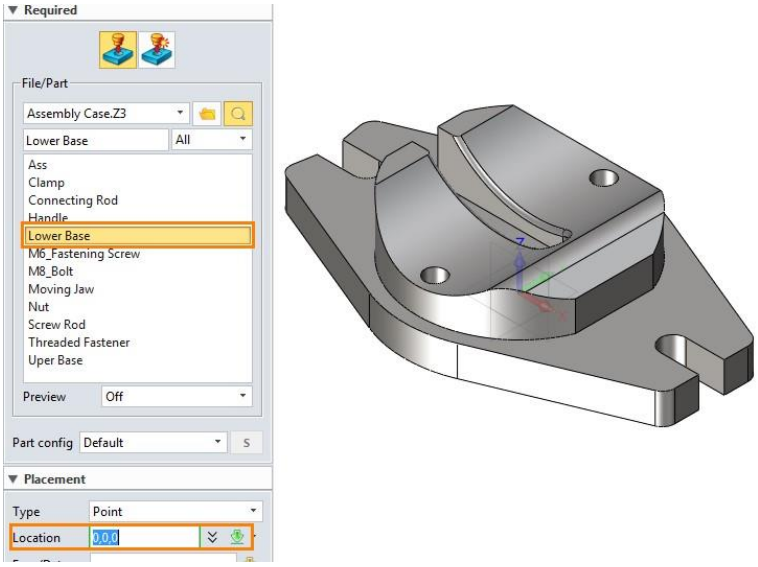


Figure 182 Insert the first component

- **Fix Component**

STEP 01 Click the ***Fix*** command, and select the ***Lower Base*** component.

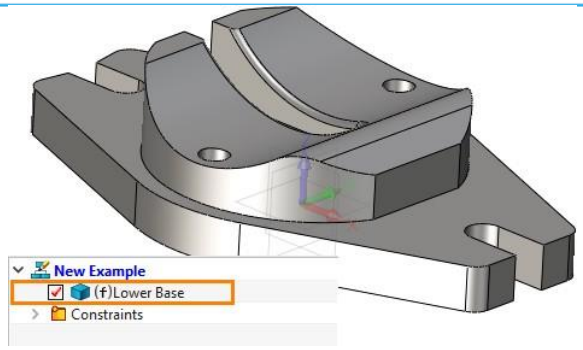


Figure 183 Fix Component

Note: *After the component is fixed, it cannot be moved or rotated.*

- **Insert Second Component**

STEP 01 Click the ***Insert*** command.

STEP 02 In the dialog, select the ***Uper Base*** component.

STEP 03 Pick any point as the location point and click ***OK*** to insert it.

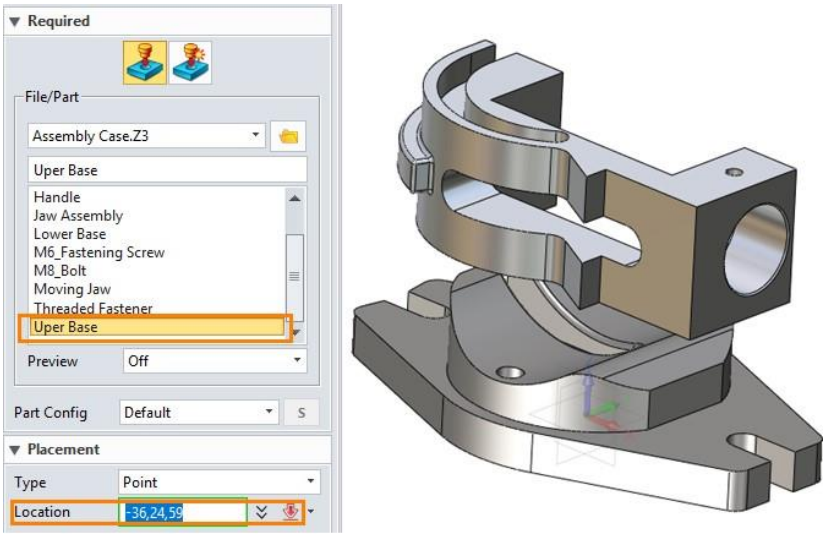


Figure 184 Insert the second component

- **Define the constraint**

STEP 01 Click the ***Common Constraint*** command.

STEP 02 In the dialog, select ***F3@Uper Base (Light Green color)*** and ***F35@Lower Base (Pink Color)*** as the constraint faces.

STEP 03 Select the ***Concentric*** type, then click OK.

Note: *If the auto constraint direction is not ideal, you can change the direction with* ***Same facing or Opposite****.*

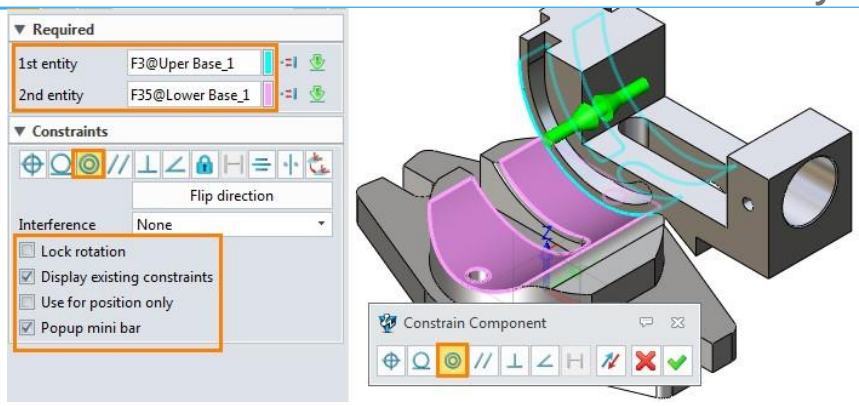


Figure 185 Define the concentric constraint

STEP 04 Select the ***Middle*** type.

STEP 05 Select two groups of the surface to finish the middle constraint.

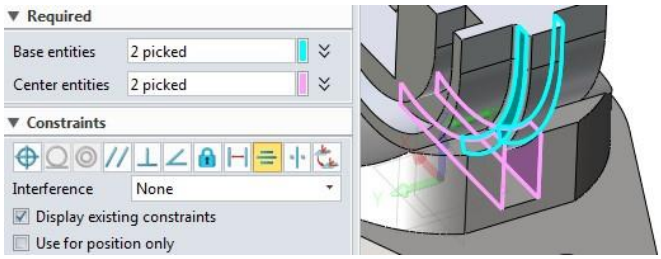


Figure 186 Define the middle constraint

STEP 06 Select the ***Parallel*** type.

STEP 05 Select face ***F12@Uper Base*** and the ***YZ*** plane to finish the parallel constraint.

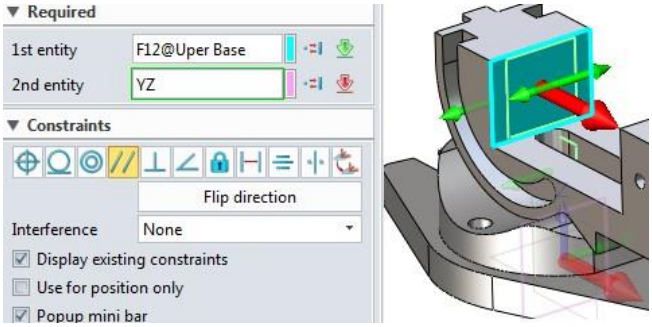


Figure 187 Define the parallel constraint

- **Insert Moving Jaw Component**

STEP 01 Insert the component ***Moving Jaw***.

STEP 02 Define the ***Coincident*** constraint between ***F7@Moving Jaw*** and ***F33@Uper Base***.

STEP 03 Define the ***Parallel*** constraint between ***F6@Moving Jaw*** and ***F37@Uper Base***.

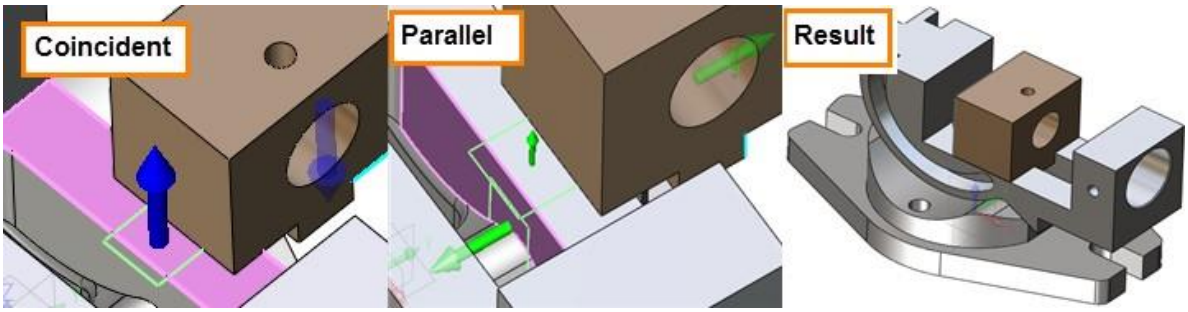


Figure 188 Insert the moving jaw component

➢ **Insert Threaded Fastener Component**

STEP 01 Insert the component ***Threaded Fastener***.

STEP 02 Define the ***Concentric, Parallel,*** and ***Coincident*** constraints.

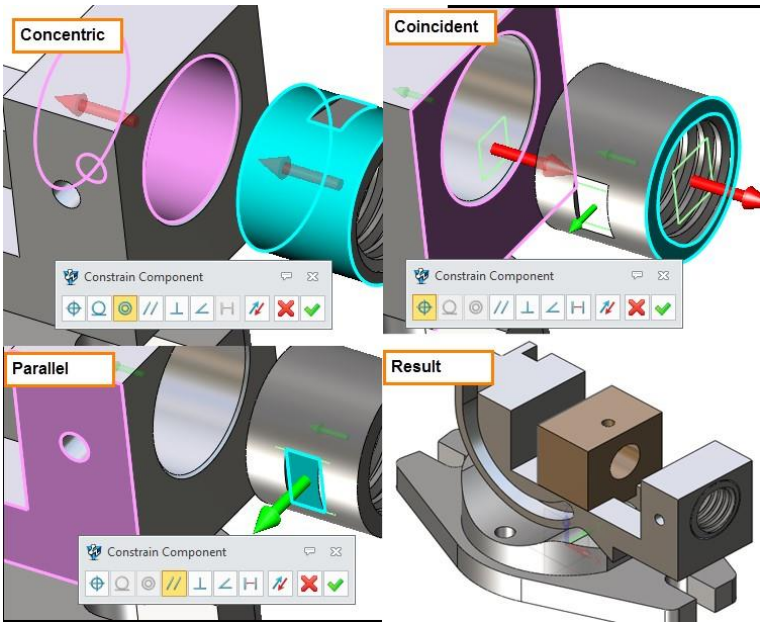


Figure 189 Insert the threaded fastener component

➢ **Insert Screw Rod Component**

STEP 01 Insert the component ***Screw Rod***.

STEP 02 Define the ***Concentric*** and ***Coincident*** constraints.

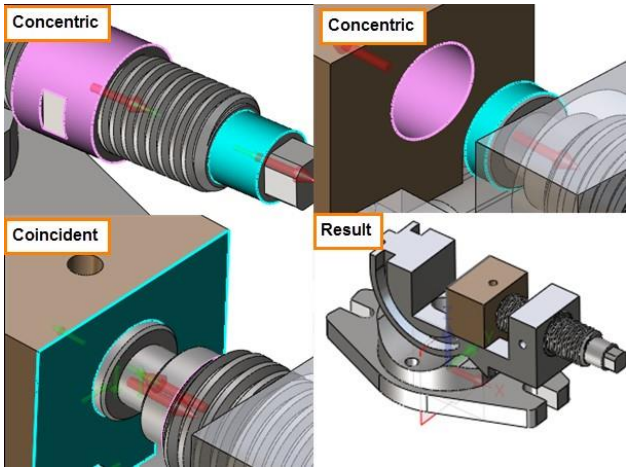


Figure 190 Insert the screw rod component

➢ **Insert Connecting Rod Component**

STEP 01 Insert the component ***Connecting Rod***.

STEP 02 Define the ***Coincident*** constraint.

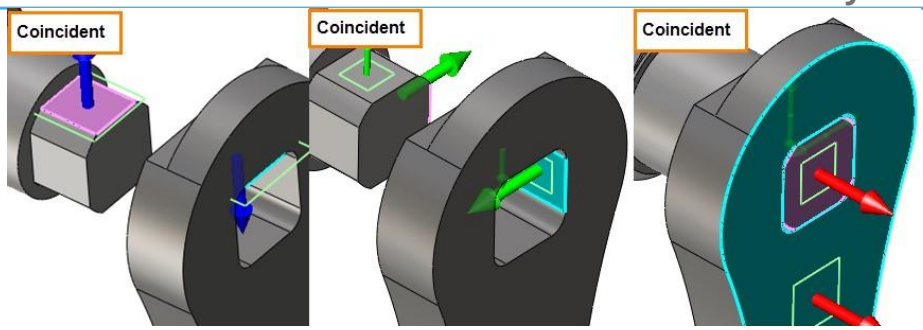


Figure 191 Insert the connecting rod component

- **Insert Handle Component**

STEP 01 Insert the component ***Handle***.

STEP 02 Define the ***Concentric*** and ***Coincident*** constraints.

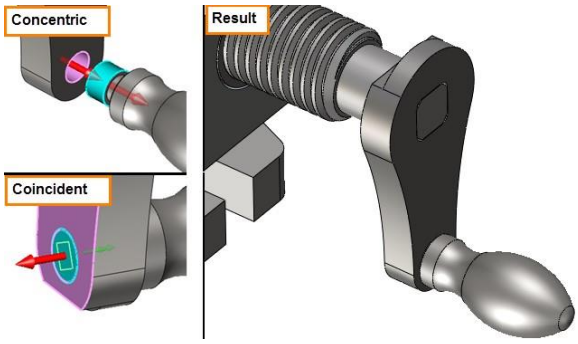


Figure 192 Insert the handle component

STEP 03 Turn on the external datum and define the ***Coincident*** constraint between external components.

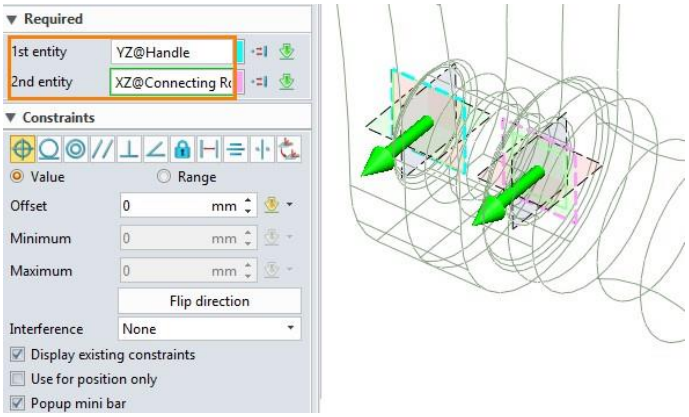


Figure 193 Define the coincident constraint with the external datum

Now we have finished the assembly. With the steps above, you can quickly design your own assembly part.

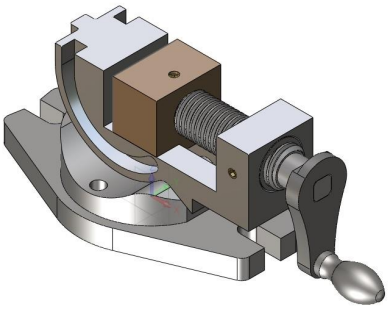


Figure 194 Assembly Product