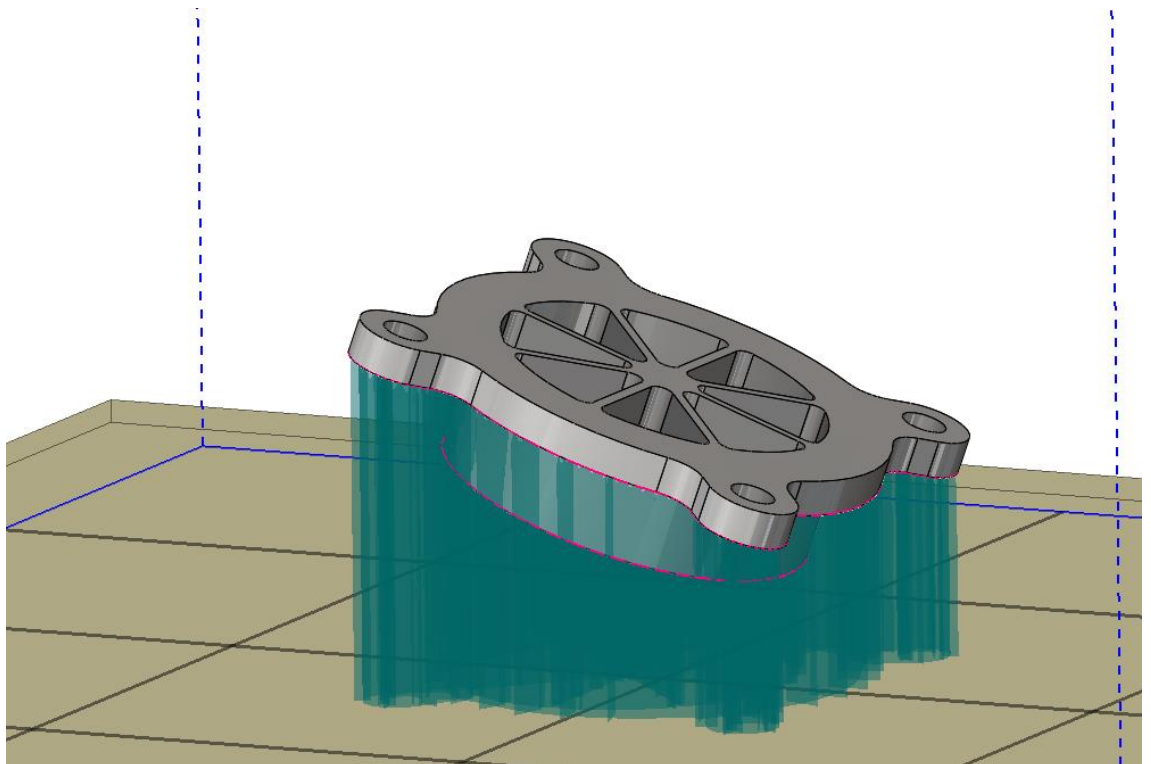


Additive Manufacturing Guide



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Product name: CAMWorks 2022 ALPHA



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1. ADDITIVE MANUFACTURING: INTRODUCTION & PRE-REQUISITES

What does the Additive Manufacturing Module do?

The *Additive Manufacturing (AM)* module introduced in *CAMWorks 2019* uses support structures to print 3D models. All metal printing technologies (including *CAMWorks Additive Manufacturing*) use support structures to keep the part models fixed to a *Build Plate* during the printing process.

The user interfaces associated with this module is automatically installed/updated when you install/upgrade your CAMWorks installation.

Use the *AM* module of *CAMWorks* to execute *Additive Manufacturing* jobs and generate *Build Tickets* required for printing 3D part models on actual 3D printers.

Pre-requisites for using Additive Manufacturing Module of CAMWorks

Pre-requisite 1: Licensing

In order to use this *AM* module, your CAMWorks license must be configured to run this module. Additionally, for executing *AM* jobs using [Demo AM machines](#), the licenses for the Build Processors associated with the Demo AM machines installed on your system need to be activated.

Contact your CAMWorks reseller to procure an updated CAMWorks license and optionally, the Evaluation license required for activating the Build Processors associated with the demo AM machines.

Pre-requisite 2: An understanding of AM terminologies and functions

A basic knowledge of how the *Additive Manufacturing* process works and associated terminologies is recommended.

Pre-requisite 3: Build Processors for executing AM Jobs using the AM Module

In order to execute an *Additive Manufacturing* job (AM job) using the **Additive Manufacturing** module of *CAMWorks*, you need to indicate the following in the [Machine Selection user interface of the Create AM Job Wizard](#):

- *Additive Manufacturing* machine that will be used for executing the AM job
- **Build Processor** associated with the selected AM Machine which will be used to generate the 3D data required for executing the AM job



To fulfill these requirements, the virtual version of *Additive Manufacturing* machines that correspond to the AM machines available at your manufacturing facility and their corresponding licensed Build Processors must be made available for selection in the [Machine Selection user interface](#) of the **Additive Manufacturing** module. Use the **Build Processor Manager** program for this purpose.

Though *CAMWorks* comes equipped with multiple [demo AM machines](#) that are representative of most AM machining environments, these machines might not always suit your machining requirements or match the actual AM Machines at your machining location. Hence, ensure that the appropriate Build Processors associated with your Additive Manufacturing machine(s) are installed on the system on which you intend to install and run the *CAMWorks* application.

Pre-requisite 4: Demo AM Machines and Demo Build Processors

The *Demo Build Processor* is a database consisting of demo *Additive Manufacturing (AM)* machines and associated *Build Processors*. These demo machines are representative of most *Additive Manufacturing* machining environments and have been provided so that users can evaluate the AM module. In the absence of actual *AM* machines, the Build tickets required for printing 3D models (using the *AM* module) can be generated via *Demo Build Processors*. However, do note that the *Build Tickets* generated using Demo Build Processors cannot be used for printing 3D part models on actual 3D printing machines. Only *Build Tickets* generated using Build Processors associated with actual 3D printing machines can be used for this printing 3D part models.

Installing Demo Build Processors

If you intend to use the *AM* module for evaluation purposes, then run the installer (*DemoBuildProcessor-x64.exe*) for this application from the *BuildProcessor* folder of the *CAMWorks Installer Package*.

Note: Refer Appendix B of the **CAMWorks Installation Guide** document for details on how to install the Demo Build Processor application.

Licensing for Demo Build Processors

Demo machines are representative of most AM machining environments. For executing **AM** jobs using Demo AM machines, the licenses for the Build Processors associated with the Demo AM machines installed on your system need to be activated. Contact your CAMWorks reseller to procure the Evaluation license required for activating the Build Processors associated with the Demo AM machines.

Once the Evaluation license is received, use the [Build Processor Manager](#) to add, install and configure these demo AM machines. Only then will these



Demo machines become available for selection in the [Machine Selection user interface](#) of the *Additive Manufacturing* module. Refer [Chapter 3](#) of this document for details on how to activate the Evaluation license for Demo AM machines.

Note: The AM Jobs illustrated in the tutorials within this document make use of Demo SM Machines.

Pre-requisite 5: Build Processor Manager

The **Build Processor Manager** application allows you to:

- Add, install and configure demo *Additive Manufacturing* machines (3D printing machines) from the [Demo Build Processor database](#)
- Add and configure the Build Processors of actual Additive Manufacturing machines

Note: The Build Processors of these machines need to be installed on your system in order to be available for addition using the **Build Processor Manager** program.

- Activate the licenses required for using the Build Processors of those *Additive Manufacturing* machines (both Demo machines and actual machines) that have already been configured using the *Build Processor Manager*

The **Build Processor Manager** application is therefore essential for functioning of the CAMWorks AM module as only *Additive Manufacturing* machines (both Demo machines and actual machines) configured using this application will then be available for use within the [Machine Selection user interface](#) of the **Additive Manufacturing** module.

Installing the Build Processor Manager application

If you intend to use the AM module of CAMWorks, then run the installer (*BuildProcessorInterface.exe*) for this application from the *BuildProcessor* folder of the *CAMWorks Installer Package*.

Note: Refer Appendix B of the CAMWorks Installation Guide document for details on how to install the Build Processor Manager application. This application does not require a license.

Using CAMWorks to Post Process Part Models printed using AM

The *Additive Manufacturing* of CAMWorks uses support structures to print 3D models. All metal printing technologies (including *CAMWorks Additive*



Manufacturing) use support structures to keep the part models fixed to a base plate during the printing process. The removal of support structures once the part model is printed tends to have an impact on surface finish, resulting in blemishes or surface roughness. This mandates the need for post processing work using CAMWorks CNC machining after the part models are 3D printed using the *CAMWorks Additive Manufacturing* module.

Note: The usage of supports does not impact the quality of the print in any way, and with proper post processing, all marks can be removed from the printed model. Post-processing of a part model printed using *CAMWorks Additive Manufacturing* is generally required for support structure removal and to improve its surface finish.

Scope of this Guide Document

The intention of this Guide is to help users gain an understanding on how to use the newly introduced *CAMWorks Additive Manufacturing* module. To this effect, the following have been provided in this document:

- Adding, installing and configuring AM Machines for making them available in the [Machine Selection user interface](#) of the *Additive Manufacturing* module (Refer [Chapter 2](#) of this document.)
- Activating License For Build Processors of AM machines that have been added and configured (Refer [Chapter 3](#) of this document.)
- Flowchart illustrating how to use the CAMWorks Additive Manufacturing Module to 3D print part models. (Refer [Chapter 4](#) of this document.)
- Two tutorials illustrating how to print part models using the CAMWorks Additive Manufacturing module and subsequently finish machine those part modules using CAMWorks CNC machining module. (Refer [Chapter 5](#) and [Chapter 6](#) of this document.)

The sample part model files used for illustrating these tutorials are automatically copied to the *CAMWorksData* folder of your computer when you install CAMWorks application.

Note: While how to use the CAMWorks Additive Manufacturing module is discussed in detail within this document, an in-depth description of how to use CAMWorks for Mill machining is beyond the scope of this document. Refer the *CAMWorks Mill Tutorial* document to gain an understanding of how to use CAMWorks for Mill machining.



2. ADDING & CONFIGURING AM MACHINES

When executing Additive Manufacturing Jobs using the *Additive Manufacturing* module of *CAMWorks*, the AM machine on which the AM job will be executed needs to be selected in the [Machine Selection dialog box of the Create AM Job Wizard](#). The list for AM machines in this user interface will be populated only if the Build Processors of the desired Additive Manufacturing machine make and models have been added, installed and configured on the system on which *CAMWorks* is installed.

Scope of this Chapter

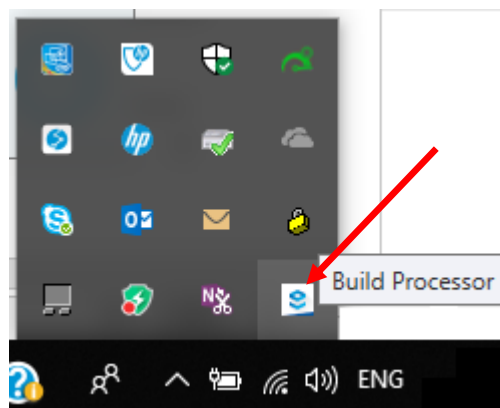
This chapter provides step-by-step detailed explanation on how to use the [Build Processor Manager](#) to add, install and configure the AM machines. Any time you need to add an AM Machine, follow the steps given in this chapter. Once configured, these AM machines will then be available for use within the [Machine Selection user interface](#) of the **Additive Manufacturing** module of *CAMWorks*.

For the purposes of illustration, in this document, one of the demo machines available within the [Demo Build Processor](#) database will be added, installed and configured using the [Build Processor Manager](#).

Steps to Add, Install and Configure Build Processors of AM Machines

Step 1: Launch the Build Processor Manager

After [installing the Build Processor Manager](#), in the Windows System tray, double-click on the icon for the *Build Processor* in order to launch this program.



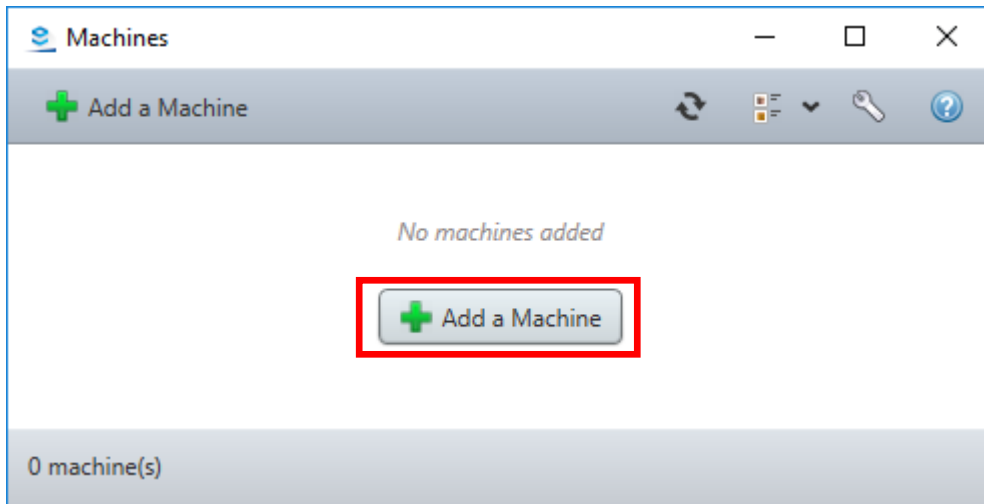
Build Processor icon in the Windows System Tray

Once the *Build Processor Manager* is launched, the first user interface to be displayed will be the *Machines* dialog box.



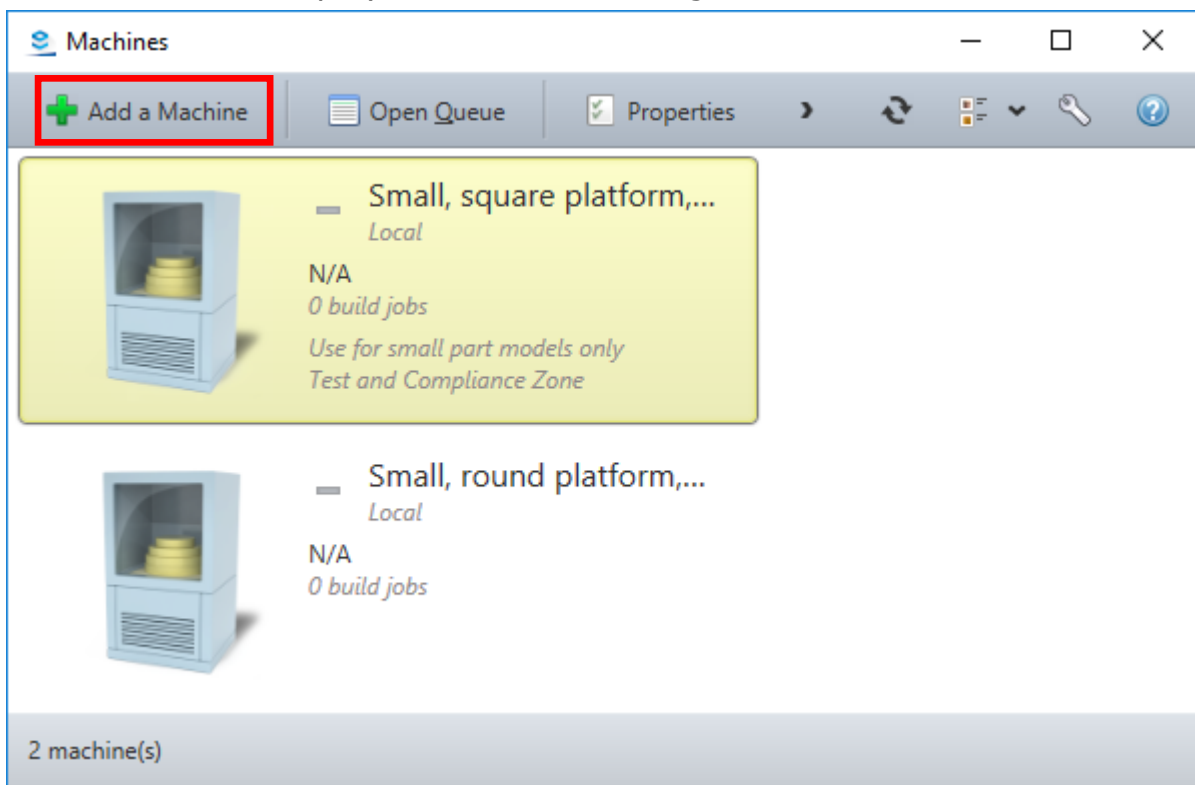
Step 2: Select the AM Machine to be Added

- i. Click on the *Add a Machine* button within this dialog box.
 - If no AM machines have been previously added and configured using this dialog box, then the *Machines* dialog box will be blank except for the *Add a Machine* button at its center.



‘Add a Machine’ button in Machines UI when no AM Machines are currently added

- If one or more AM machines have been added and configured using the *Build Processor Manager*, then all those AM Machines, which are currently active, will be displayed within this dialog box.



‘Add a Machine’ button in Machines UI when one or more AM Machines are currently added

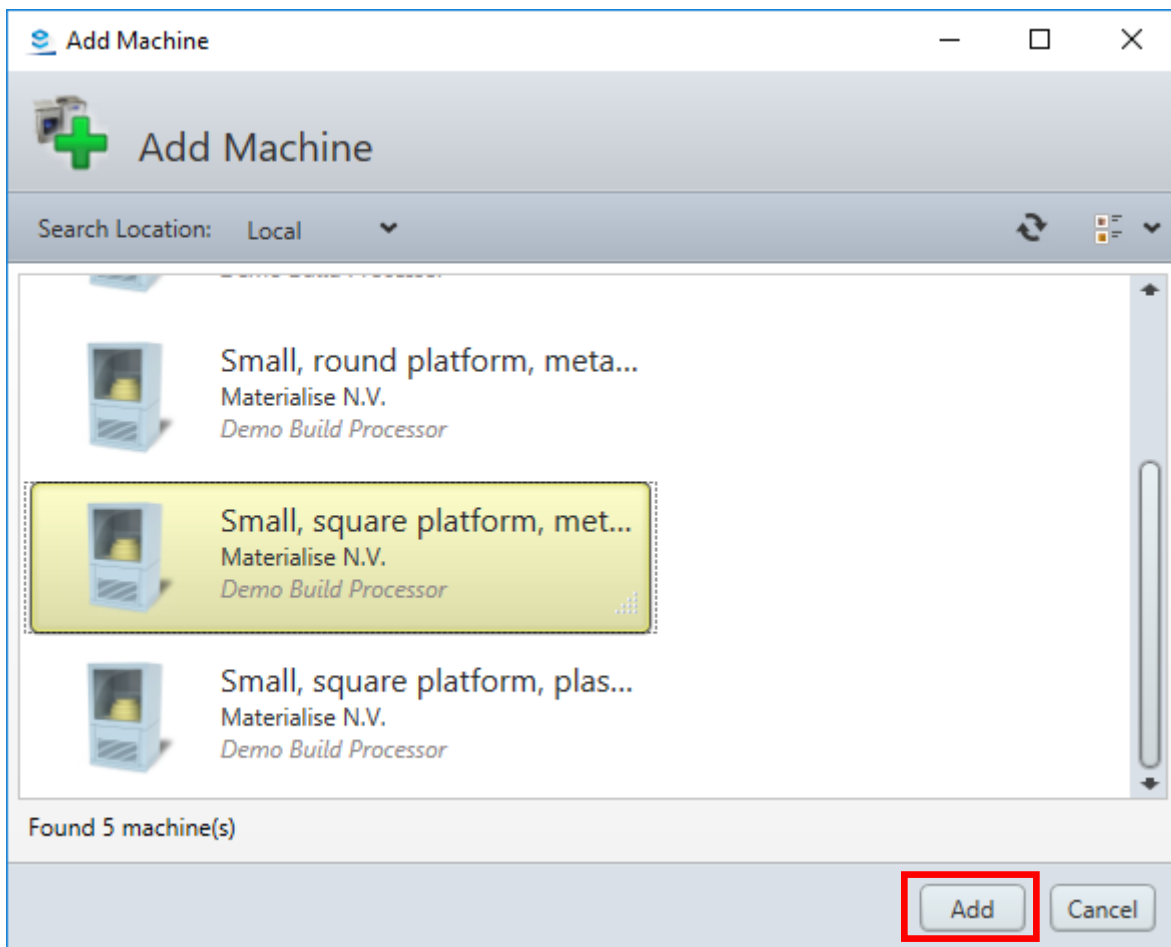


- ii. Executing this command button launches a separate *Add Machine* user interface. The *Build Processor Manager* will scan your system to detect the presence of available AM machines.
- All the Demo AM machines present in the [Demo Build Processor](#) database will be listed in the *Add Machine* user interface.
 - If the Build Processors for actual AM Machines have been installed on the system, then these machines too will be detected by the *Build Processor Manager* and listed in the *Add Machine* user interface.

Note: Even AM machines that have already been configured using the *Build Processor Manager* will be listed in this user interface.

- iii. From this list of available AM machines, select the AM machine to be added and click on the *Add* button at the bottom right corner of the *Add Machine* user interface.

(For the purposes of this tutorial document, the AM machine named *Small, square platform, metal powder bed printer* has been selected.)



Select the AM Machine to be added from the list of available AM Machines displayed in the 'Add Machine' dialog box



Step 3: Install the selected AM Machine

- i. On clicking the *Add* button, the *Installing Machine* dialog box will be displayed. Use this dialog box to:
 - Edit the **Name** for the selected AM Machine (*optional*)
 - Select the desired **Build Processor** from the dropdown list of available Build Processors for the selected machine
 - Assign a brief **Description** of the AM Machine (*optional*)
 - Indicate the **Machine Location** (*optional*)

Installing Machine

Add Machine

Manufacturer: Materialise N.V.

Model: Small, square platform, metal powder bed printer

Network Location: Local

Name: Small, square platform, metal powder bed printer

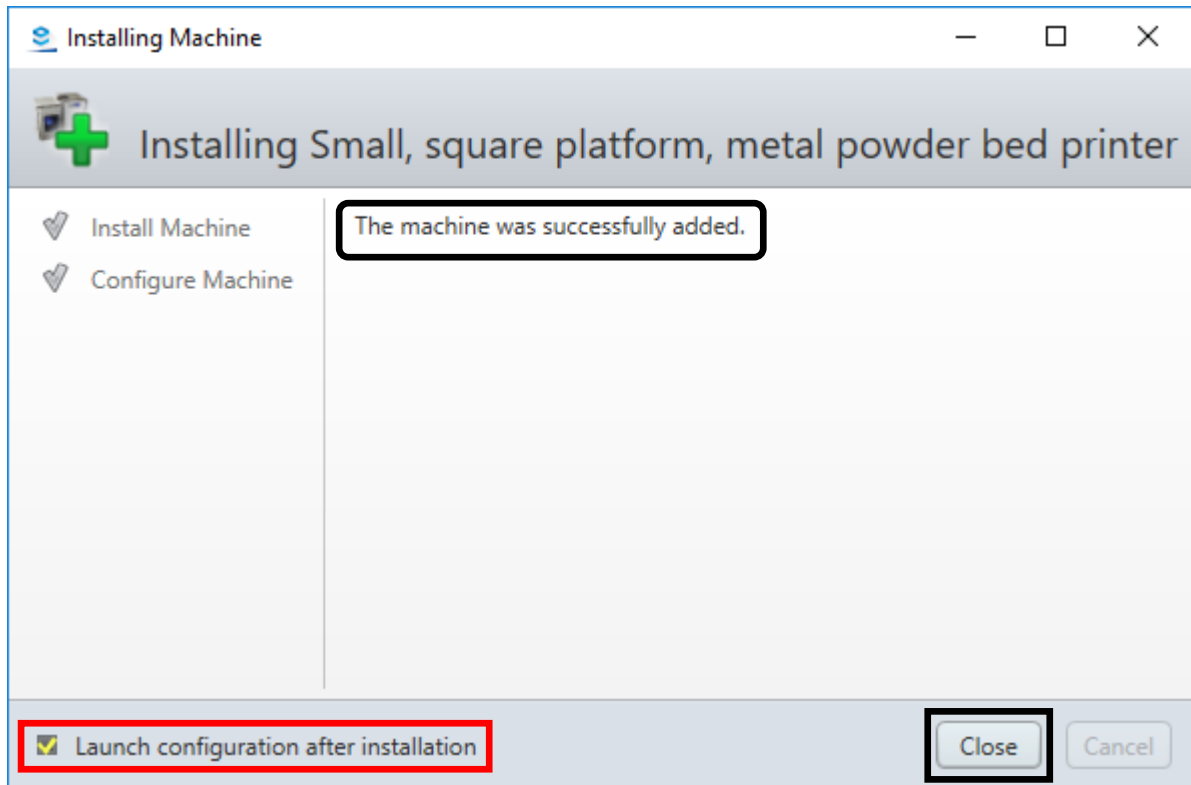
Build Processor: Demo Build Processor 2.0.01006.0

Description: Use for fidelity tests only

Machine Location: Test and Research Zone

Back Add Cancel

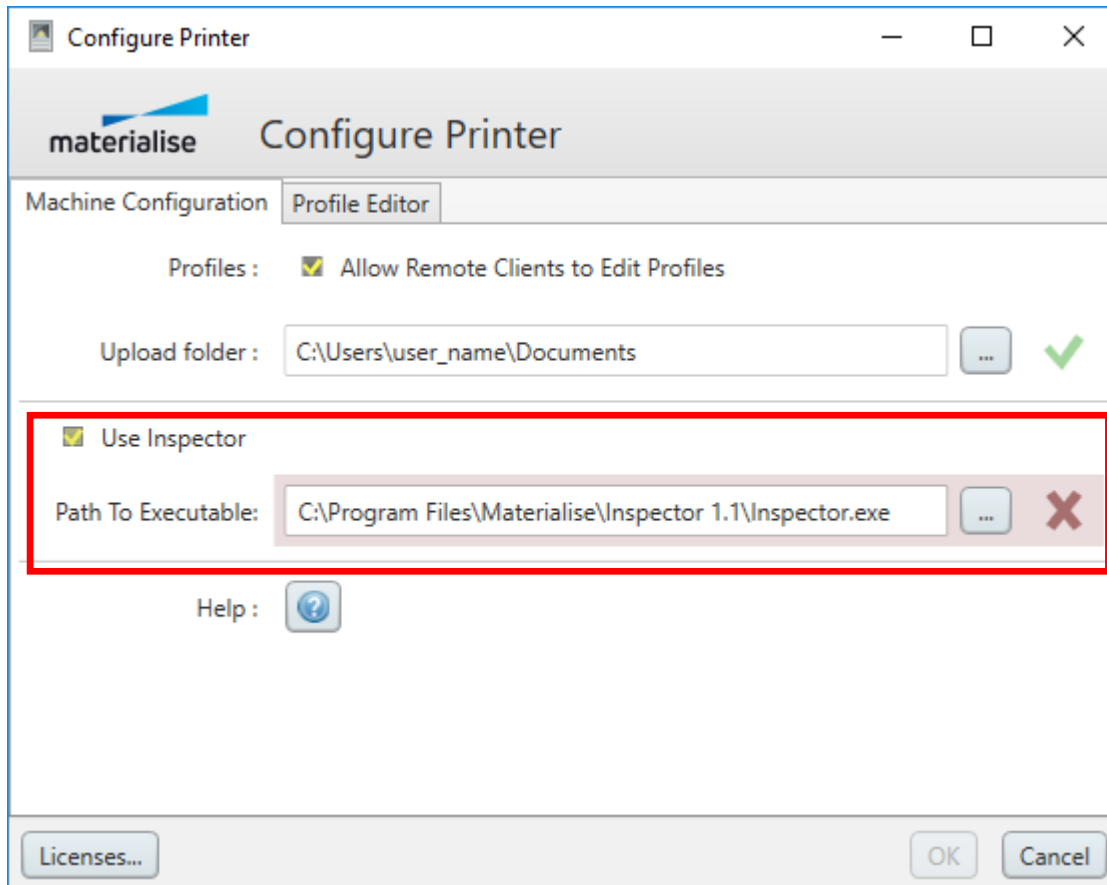
- ii. Within this user interface, once the options available for the selected AM machine have been edited to suit your requirements, click on the **Add** button.
- iii. On executing the **Add** button command, the process to install and configure the selected AM machine will begin. Once this process is completed, a message will be displayed within the **Installing Machine** dialog box stating that the machine was successfully added.



Message indicating successful addition of selected AM Machine in the 'Installing Machine' dialog box

Step 4: Viewing the Configuration Settings for the newly added AM Machine

- i. In the bottom left corner of the *Installing Machine* dialog box is the **Launch configuration after installation** checkbox option which is checked by default. Click on the *Close* button.
 - If the *Launch configuration after installation* checkbox option was unchecked before clicking on this button, the *Installing Machine* user interface will close and the user interface will revert to the *Machines* dialog box of the *Build Processor Manager*.
 - If the *Launch configuration after installation* checkbox option was left checked before clicking on this button, the *Installing Machine* user interface will close and the *Configure Printer* dialog box will be displayed.



Machine Configuration tab of Configure Printer Dialog Box

Step 5: Editing the Configuration Settings

In the *Configure Printer* dialog box, the parameters within the *Machine Configuration* and *Profile Editor* tabs are used to edit the default configuration settings of the added AM machines.

Disabling the Use Inspector option in the Machine Configuration tab

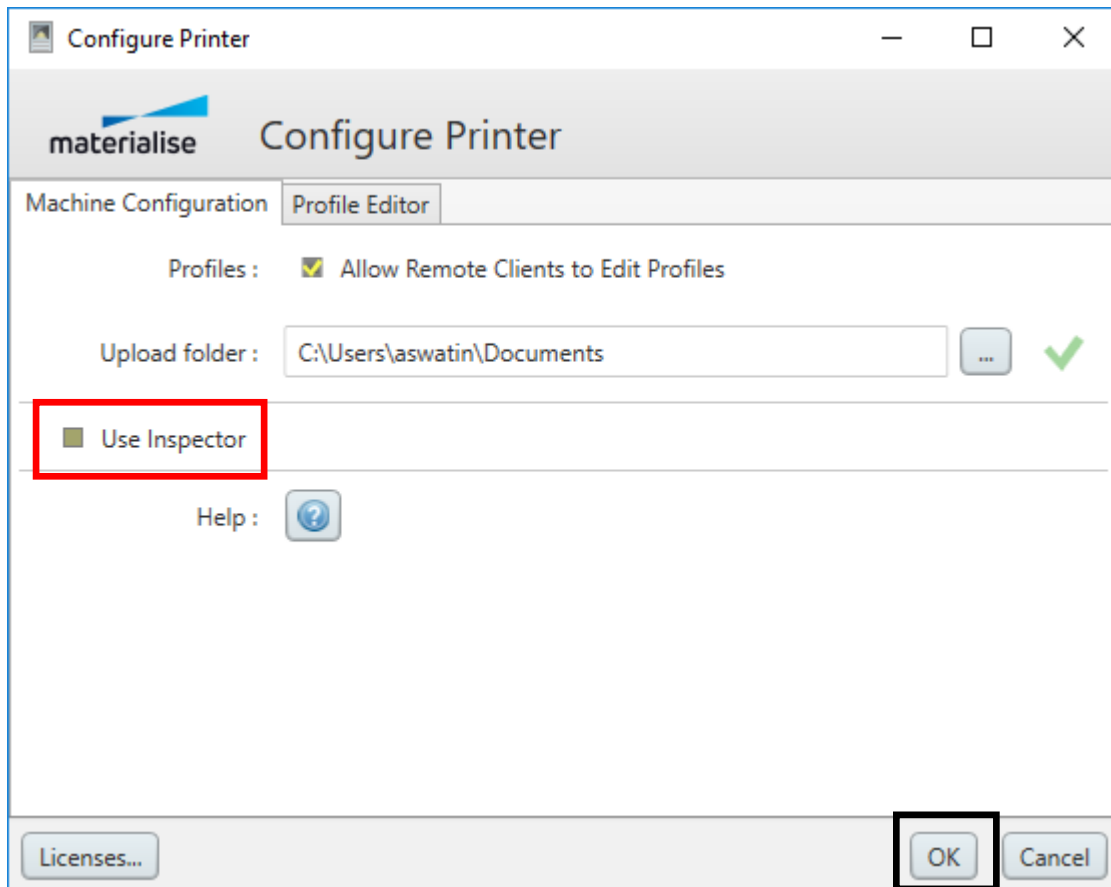
Observe that the *OK* button of the *Configure Printer* dialog box is disabled. When this button appears disabled, it indicates that one of the settings within this dialog box for the selected AM machine is invalid. In this particular case, the button is disabled because of the unavailability of the executable file required the *Use Inspector* option for the newly added Demo machine. (A red cross symbol next to the *Path To Executable* field visually confirms the parameter with invalid settings.)

The *Use Inspector* option in the *Machine Configuration* tab is checked by default. The *Additive Manufacturing* module of *CAMWorks* doesn't make use of this functionality when executing Additive Manufacturing Jobs. Hence, uncheck this option.

Note: The 'Use Inspector' checkbox option needs to be disabled for all the AM Machines added using the Build Processor Manager.



Observe that the moment this option is unchecked, the OK button gets enabled.




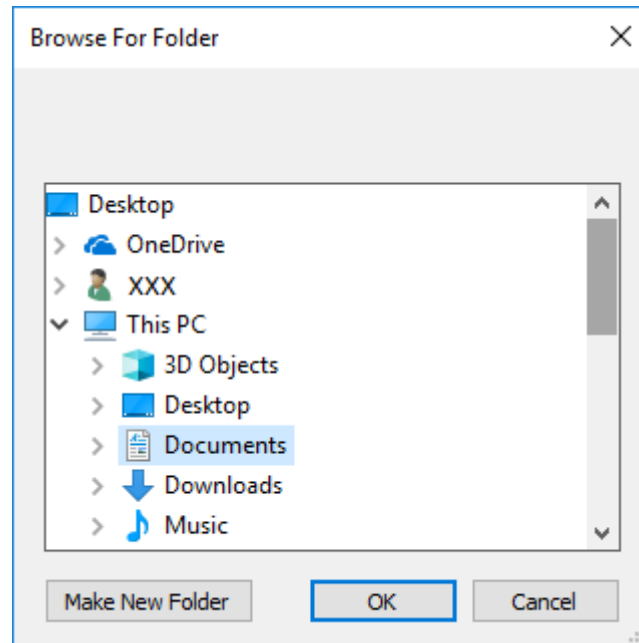
OK button enabled once the Use Inspector Option is disabled

Specifying the Upload Folder path in the *Machine Configuration* tab

Build Tickets are generated every time an AM Machine is used for executing an AM job (3D printing job). In the *Upload folder* field of this tab, specify the folder location where the Build Tickets that will be generated on using the AM machine are to be saved.

To select a folder other than the default folder location displayed in this field, following are the steps:

- i. Click on the *Browse* button  to the right of this field.
- ii. The *Browse For Folder* dialog box will be displayed. Use this dialog box to select the desired folder location and click on the *OK* button.



Browse For Folder Dialog Box

- iii. The dialog box will close and the path to the selected folder location will be displayed in the *Upload folder* field.
- iv. Click on the *OK* button to save the changes made to the configuration settings of the newly added AM machine.
- v. The **Configure Printer** dialog box will close and the user interface will revert to the *Machines* dialog box. Close this dialog box.
- vi. The AM Machine you added will be saved. It can now be selected as the AM machine (viz. 3D printing machine) of choice when executing AM Jobs using the *Additive Manufacturing* module of *CAMWorks*.



3. ACTIVATING THE LICENSE FOR DEMO BUILD PROCESSORS

AM machines added, installed and configured using the [Build Processor Manager](#) application become available for selection within the [Machine Selection user interface](#) of the **Additive Manufacturing** module of CAMWorks.

When an AM Job is created using this **Additive Manufacturing** module, the first step is to select the AM Machine on which the AM Job will be printed. The last step involved in creating an AM Job is generating 3D data required for printing/machining the part model. This 3D data is generated by Build Processor of the selected AM machine. Only a licensed version of the *Build Processor* associated with the selected AM machine can generate this 3D data and save it as a **Build Ticket**.

So essentially, only the licensed versions of Build Processors can generate and save *Build Tickets* required for the actual execution of AM Jobs created using the **Additive Manufacturing** module.

Note: Within the **Additive Manufacturing** module:

- The Build Processor for an AM machine functions in a manner similar to Post Processors used for CAMWorks CNC Mill, Turn and Mill-Turn Machining modules.
 - The Build Tickets generated on execution of an AM Job are similar to the NC Program files generated for machining Mill, Turn and Mill-Turn parts. The actual machining cannot be executed without this file.
-

Scope of this Chapter

This chapter gives details on how to activate an Evaluation license for Build Processors associated with the demo AM machines supplied with the **Additive Manufacturing** module of CAMWorks.

Steps to activate the license for Build Processors

Step 1: Add an AM Machine using the Build Processor Manager

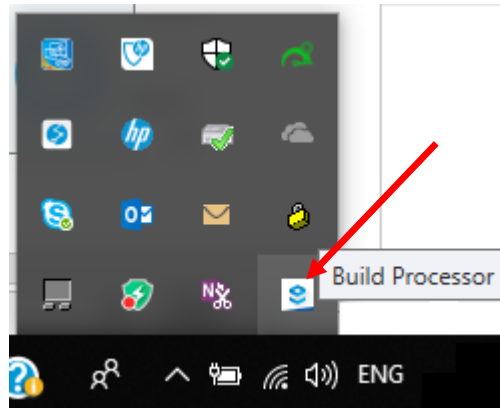
Follow the [steps given in the previous chapter](#) of this document and ensure that at least one demo AM Machine has been added and configured using the [Build Processor Manager](#) application.

Note: Licensing is AM Machine specific and needs to be procured from the corresponding manufacturer. Ensure that the AM machine is added, installed and configured using the Build Processor Manager in order to activate its license.



Step 2: Launch the Build Processor Manager

In the Windows System tray, double-click on the icon for the *Build Processor* in order to launch this program.

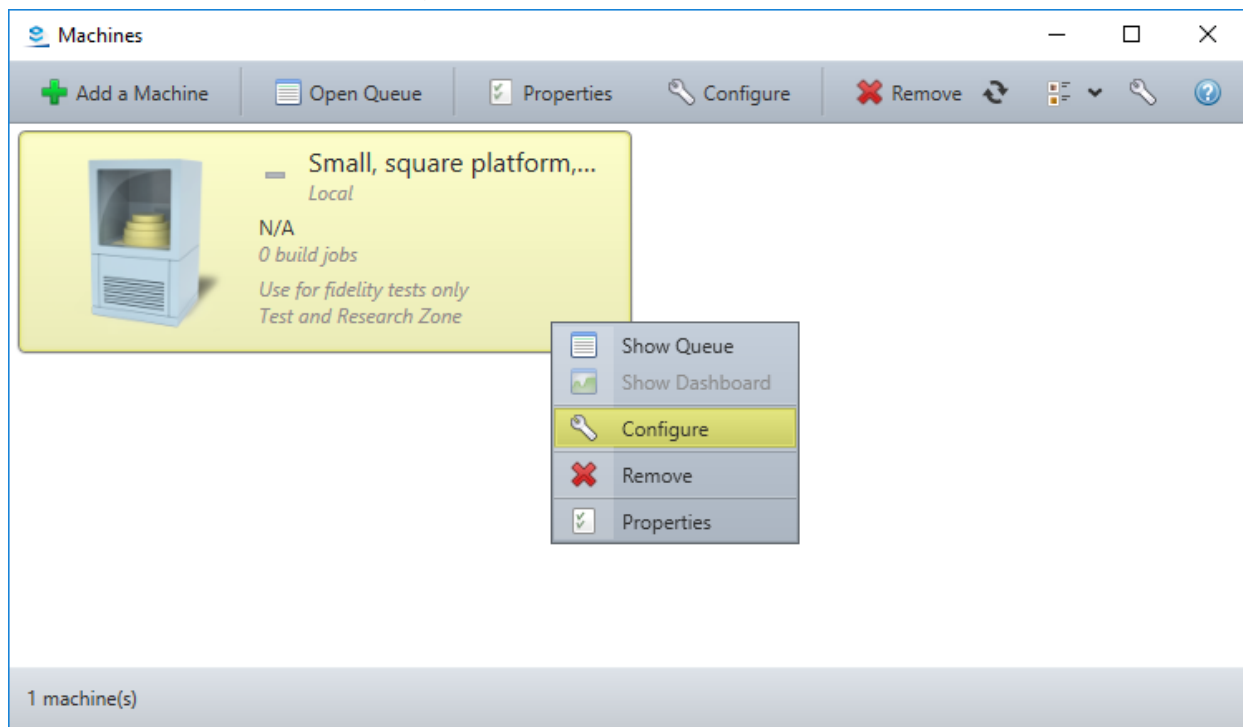


Build Processor icon in the Windows System Tray

Once the *Build Processor Manager* is launched, the first user interface to be displayed will be the *Machines* dialog box.

Step 3: Open Configuration Settings for desired AM Machine

Listed in the *Machines* dialog box are the AM Machines currently added and configured for use in the **Additive Manufacturing** module. From this list, right-click on the AM Machine for whose Build Processor the license is to be activated and select *Configure* command on the context menu.



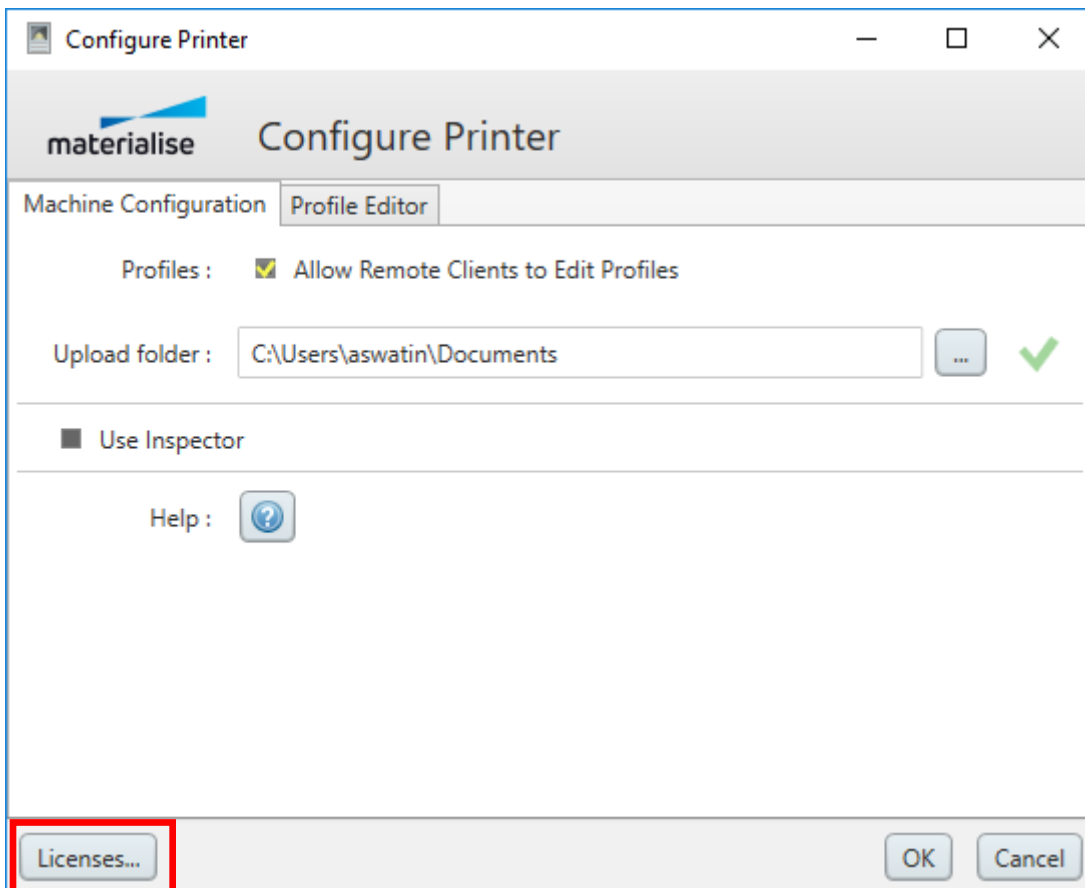
Select Configure command on the context menu of selected AM Machine



For the purpose of illustration in this tutorial document, the **Configure** command will be executed for the Demo AM Machine (*Small, square platform, metal powder bed printer*) that was used for illustrating the [steps](#) for adding, installing and configuring AM Machines in [previous chapter](#) of this document.

Step 4: Invoke the User Interface for Activating the License

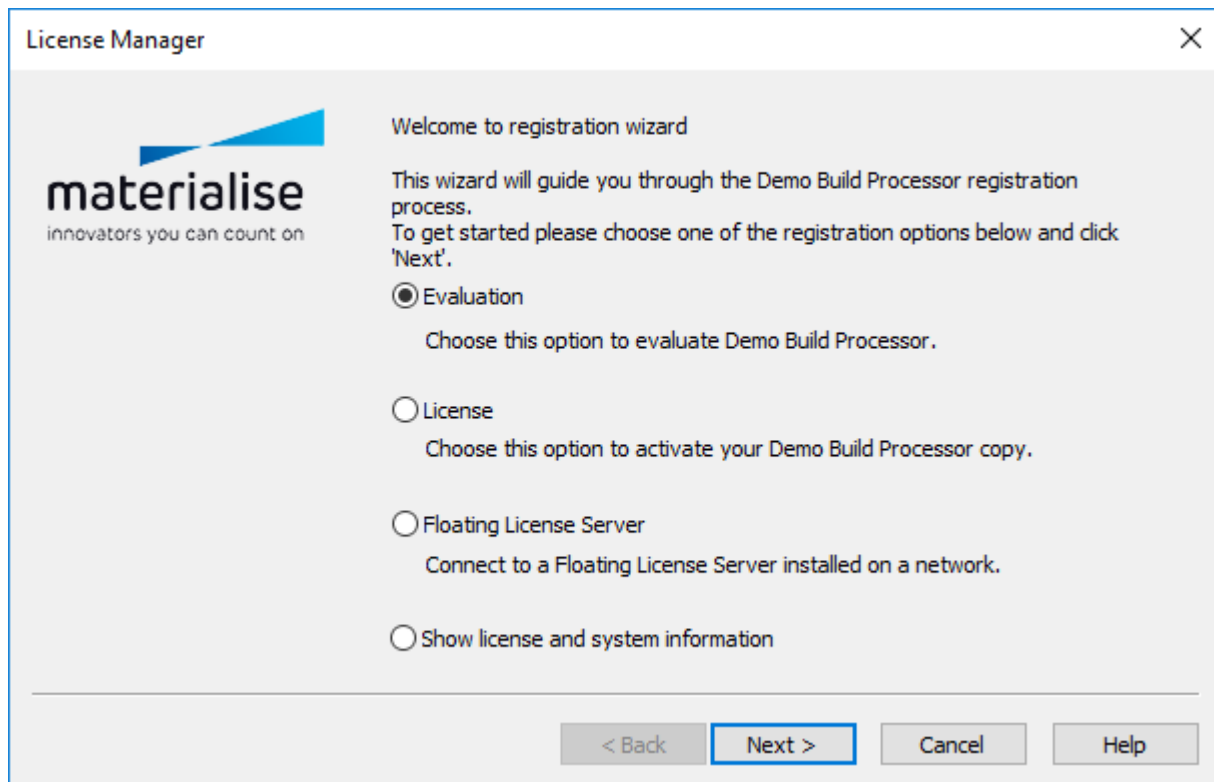
Executing the **Configure** command displays the **Configure Printer** dialog box. Click on the **Licenses** button on its bottom left corner.



Click on the 'Licenses' button in the Configure Printer Dialog Box

Step 5: Select option to activate Evaluation License

Clicking on the *Licenses* button displays the **License Manager** user interface. Options with respect to licensing are displayed in this user interface. Select the **Evaluation** option and click **Next**.

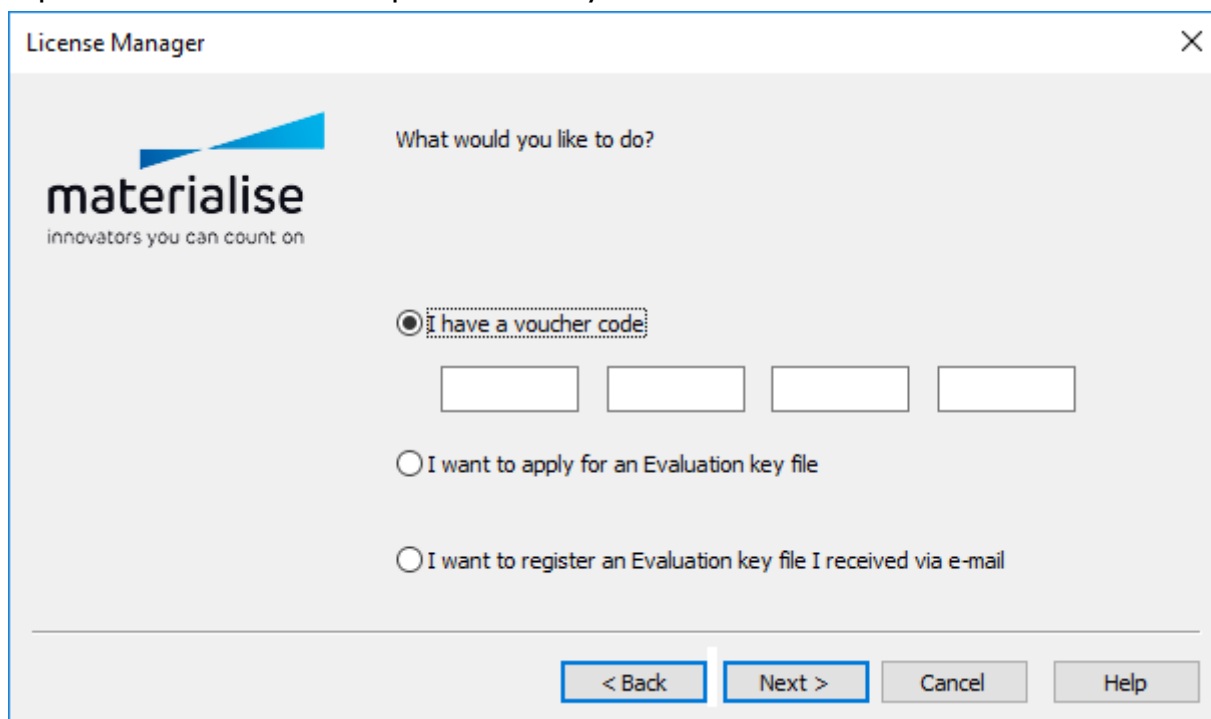


The screenshot shows the 'License Manager' window with the Materialise logo on the left. The main text reads: 'Welcome to registration wizard. This wizard will guide you through the Demo Build Processor registration process. To get started please choose one of the registration options below and click 'Next'.' There are four radio button options: 'Evaluation' (selected), 'License', 'Floating License Server', and 'Show license and system information'. Each option has a brief description. At the bottom, there are four buttons: '< Back', 'Next >' (highlighted with a blue border), 'Cancel', and 'Help'.

Select 'Evaluation' Option in License Manager Wizard

Step 6: Input Voucher Code

The *License Manager Wizard* will display multiple options with respect to activating the Evaluation License. Select the *I have a voucher code* option and input the voucher code provided to you. Click the **Next** button.



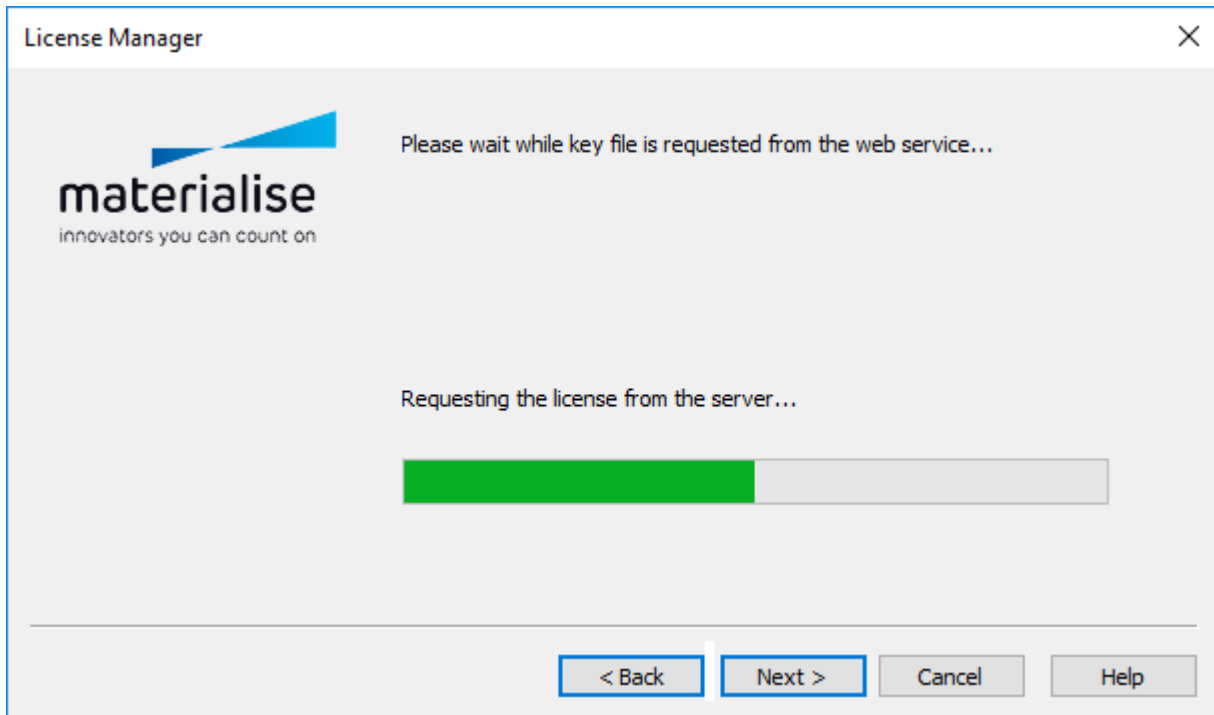
The screenshot shows the 'License Manager' window with the question 'What would you like to do?'. There are three radio button options: 'I have a voucher code' (selected and highlighted with a dashed border), 'I want to apply for an Evaluation key file', and 'I want to register an Evaluation key file I received via e-mail'. Below the first option are four empty text input boxes for the voucher code. At the bottom, there are four buttons: '< Back', 'Next >' (highlighted with a blue border), 'Cancel', and 'Help'.

Select the 'I have a voucher code' option



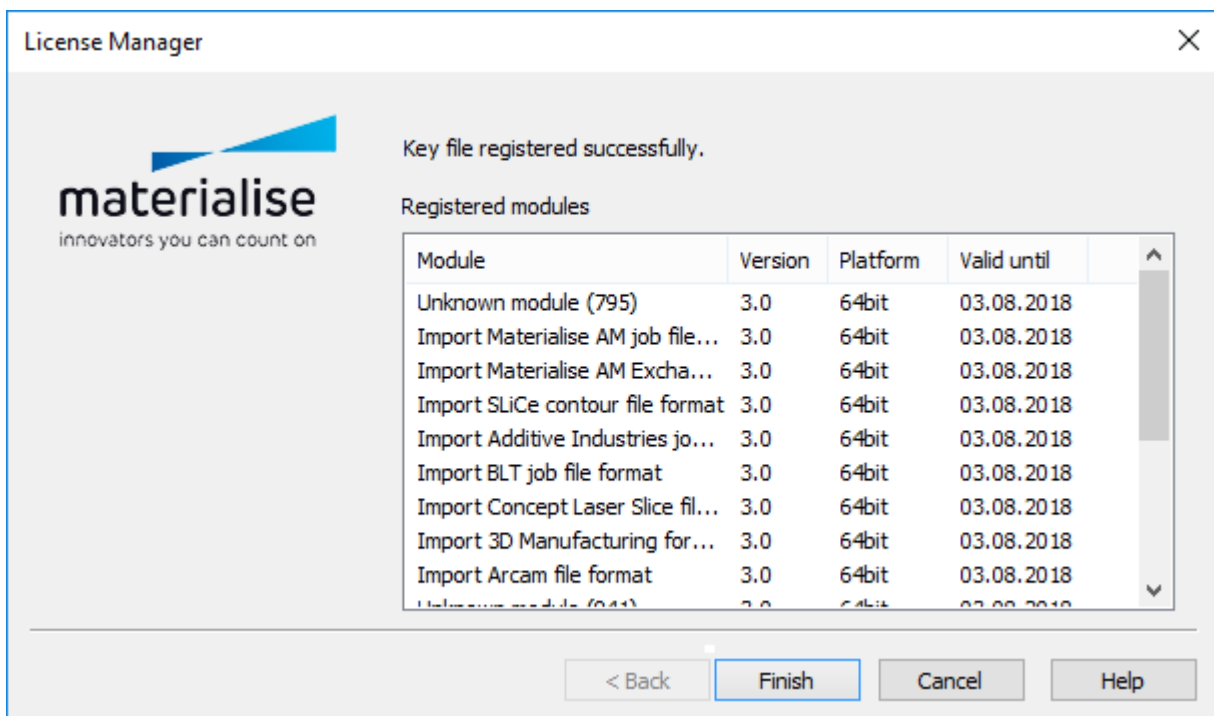
Step 7: Validation of Voucher Code for Activating License

Ensure that you have an active Internet Connection. The *License Manager Wizard* will validate the voucher code.



Validating the Voucher Code

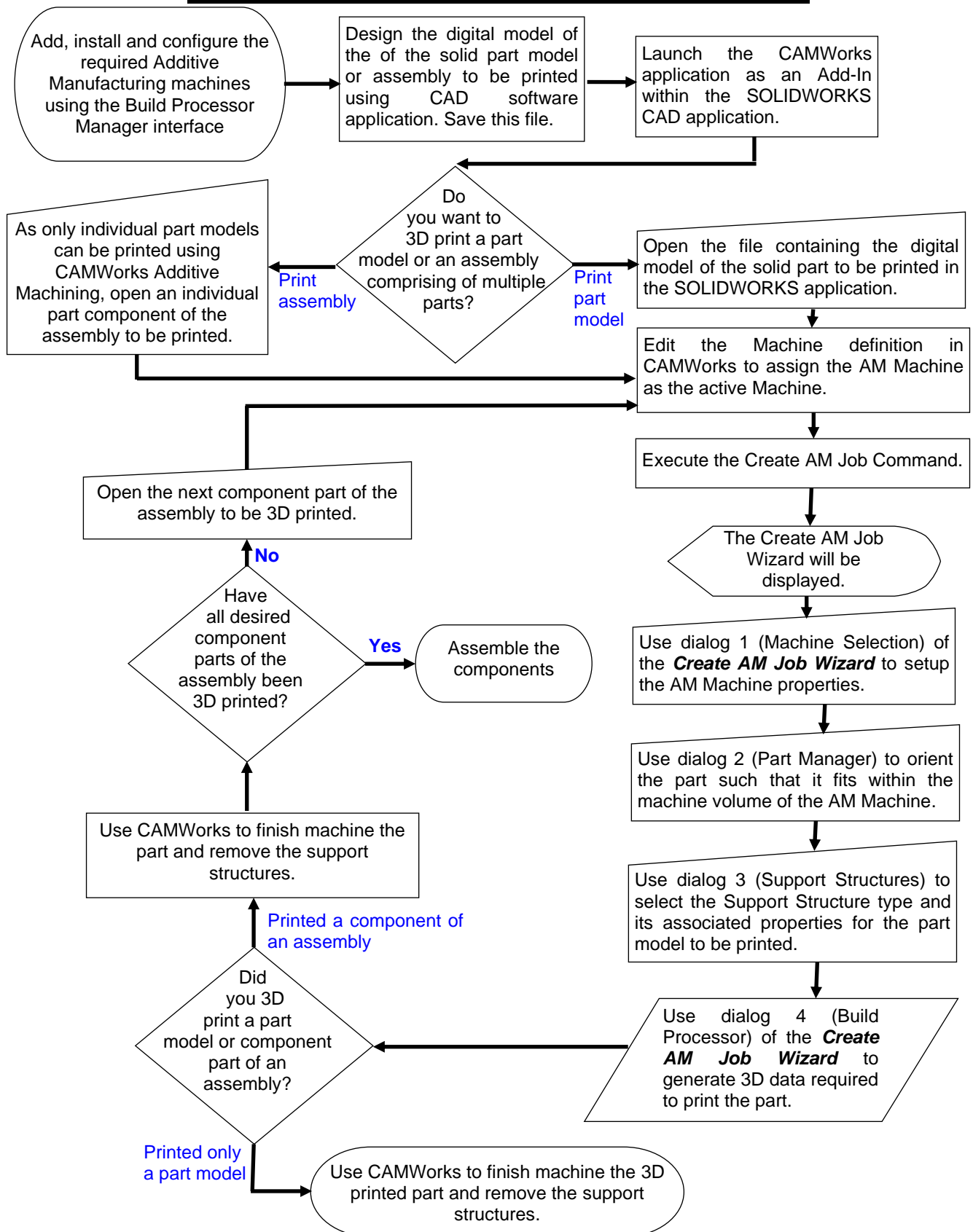
On successful validation, the license will be activated and its details will be displayed within the *License Activation Wizard*. Click on the **Finish** button to exit the Wizard.



Click the 'Finish' button to exit the License Activation Wizard



4. FLOWCHART ILLUSTRATING HOW ADDITIVE MANUFACTURING MODULE WORKS





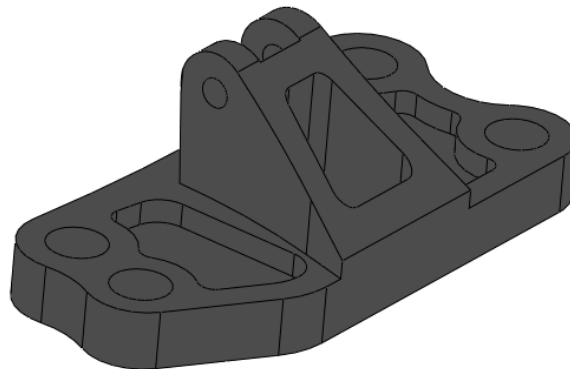
5. ADDITIVE MANUFACTURING: TUTORIAL 1

This tutorial illustrates the following:

- i. Using the **Additive Manufacturing** module of *CAMWorks* to generate 3D data required to print the sample tutorial part
- ii. Using *CAMWorks Mill Machining* module to remove support structures, machine the surfaces of the 3D printed part model that require a better surface finish and to machine features with critical tolerances

Step 1: Open the Sample tutorial part

1. Launch the *SOLIDWORKS* application.
2. Ensure that the AM Machine on which the part model is to be printed has been added, installed and configured using the [Build Processor Manager](#).
3. Ensure that *CAMWorks* is loaded as an Add-In within the *SOLIDWORKS* environment.
4. Click on the *File* menu on the *SOLIDWORKS* menu bar and select the *Open* option.
5. The *File Open* dialog box will be displayed. Use this dialog box to browse to the following folder:
C:\CAMWorksData\CAMWorks20XXx64\Examples\AdditiveManufacturing
6. Select the **Tutorial_1.sldprt** file present in this folder and click on the *Open* button in this dialog box.
7. This action will close the dialog box, load the part file and display the part model in the graphics area of *SOLIDWORKS*.



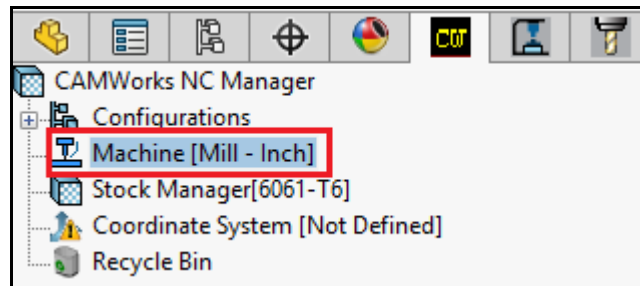
Tutorial_1.sldprt

8. Observe that the *CAMWorks* and *Additive Manufacturing* tabs are activated in the *SOLIDWORKS Command Manager* area. (These tabs will be visible only if *CAMWorks* has been loaded as an Add-In within *SOLIDWORKS*.)



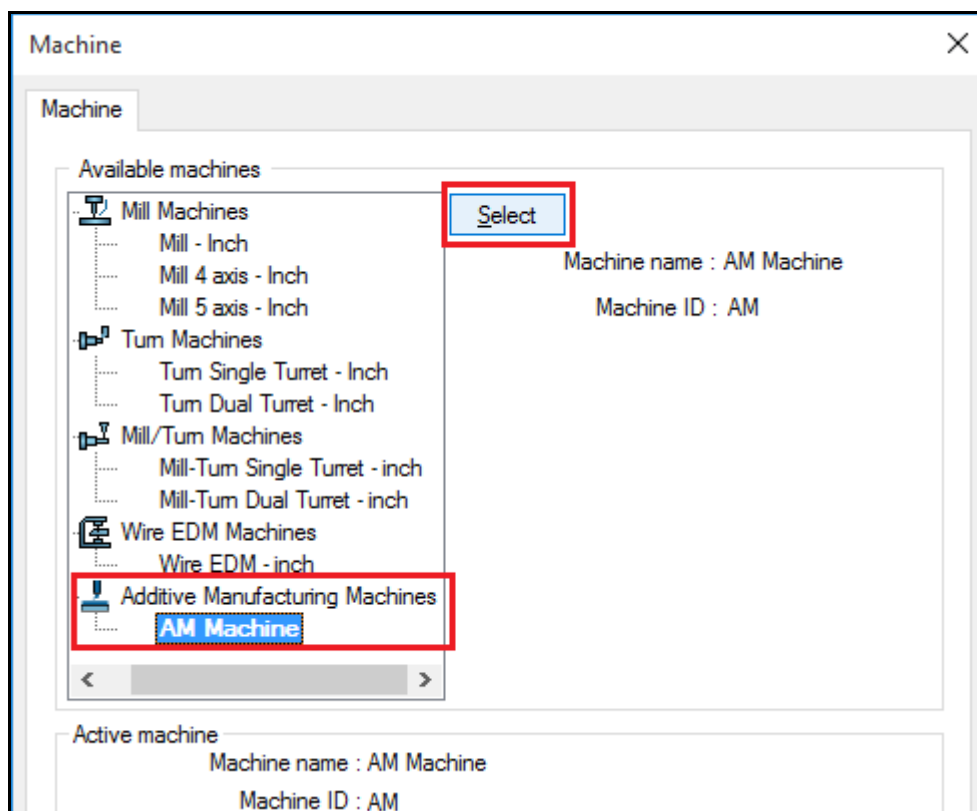
Step 2: Assign the AM Machine

1. To the left of the graphics area is the *Tree View* area. Click on the *CAMWorks Feature tree* tab in the Tree view area.
2. Observe the *Machine* item under this tree tab. By default, *CAMWorks* has assigned a CNC Mill machine to this sample part. Since this sample part is to be machined using Additive Manufacturing, a corresponding machine needs to be assigned.



Machine item indicating CNC Mill Machine selection in CAMWorks Feature Tree

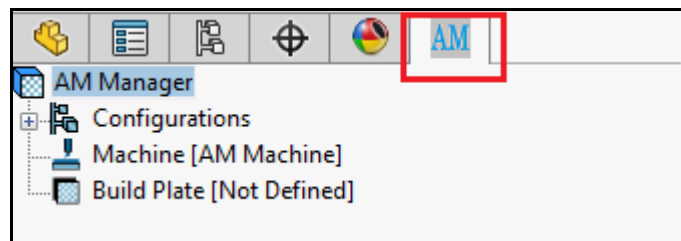
3. Double-click on the *Machine* item under this *Feature tree* to open the *Machine* dialog box. Alternatively, you can click on the *Define Machine* command on the *CAMWorks Command Manager* tab to open this dialog box.



Machine Tab of Machine Dialog Box



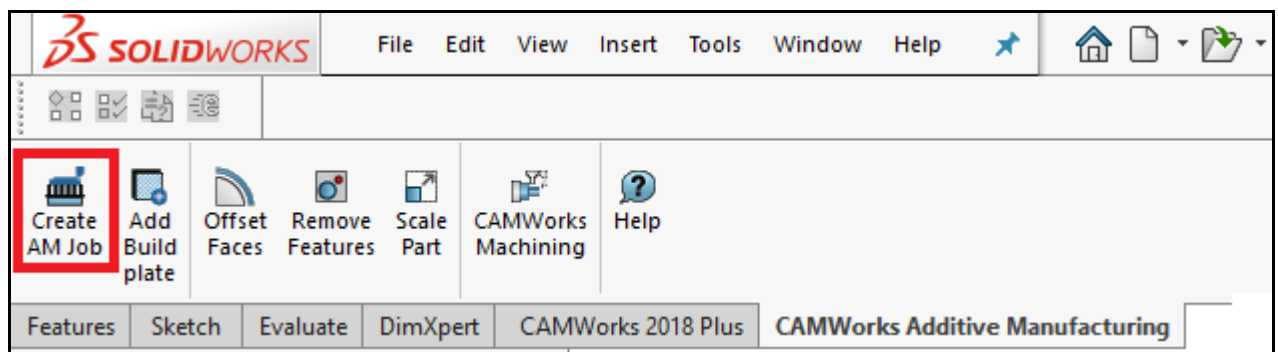
4. The *Machine* tab of the *Machine* dialog box lists all the machines defined in the Technology Database. In the list of *Available machines* under this tab, observe that *Additive Manufacturing Machines* too have been defined. Highlight the *AM Machine* item in this list and click the *Select* button.
5. Click the *OK* button to apply the changes and close this dialog box.
6. Observe the *Tree View* area. The *AM* tab is now active while the *CAMWorks Feature tree*, *Operation tree* and *Tool Tree* tabs are no longer displayed. The active machine listed under the *AM Tree* tab is now an *AM* machine.



AM Tree tab in Tree View Area

Step 3: Execute the 'Create AM Job' command

1. On the *CAMWorks Additive Manufacturing* Command Manager tab, click on the *Create AM Job* command.




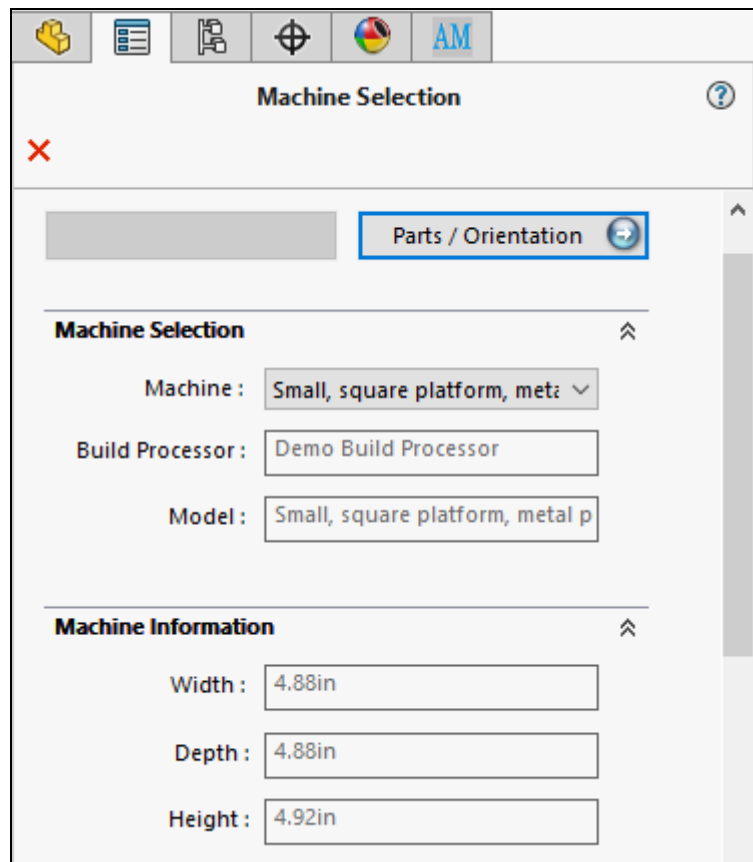
'Create AM Job' Command on Additive Manufacturing Command Manager

2. Executing this command displays the **Create AM Job** wizard. This wizard is a series of dialog boxes that allow you to assign properties and parametric values associated with executing an additive manufacturing job.



Step 3-a: Create AM Job Wizard: Machine Selection dialog box

1. On clicking the *Create AM Job* command, the first dialog box displayed in the **Create AM Job** wizard will be the *Machine Selection* dialog box.
2. Use the *Machine* dropdown list parameter under the *Machine Selection* group box to select the properties associated with the AM machine that you will be using for 'printing' this part. For the purposes of this tutorial, we will select the *Small, square platform, metal powder bed printer* option from this dropdown list.
3. Click the *Next* button .



The image shows the 'Machine Selection' dialog box from the 'Create AM Job' wizard. The dialog has a title bar with a question mark icon and a red 'X' icon. Below the title bar is a toolbar with icons for a 3D model, a list, a file, a target, a color wheel, and an 'AM' button. The main area contains a 'Parts / Orientation' button with a right arrow icon. Below this is a section titled 'Machine Selection' with a collapse/expand icon. It contains three fields: 'Machine' (a dropdown menu showing 'Small, square platform, metz'), 'Build Processor' (a text box with 'Demo Build Processor'), and 'Model' (a text box with 'Small, square platform, metal p'). Below this is a section titled 'Machine Information' with a collapse/expand icon. It contains three text boxes: 'Width' (4.88in), 'Depth' (4.88in), and 'Height' (4.92in).

Machine Selection Dialog Box of Create AM Job Wizard

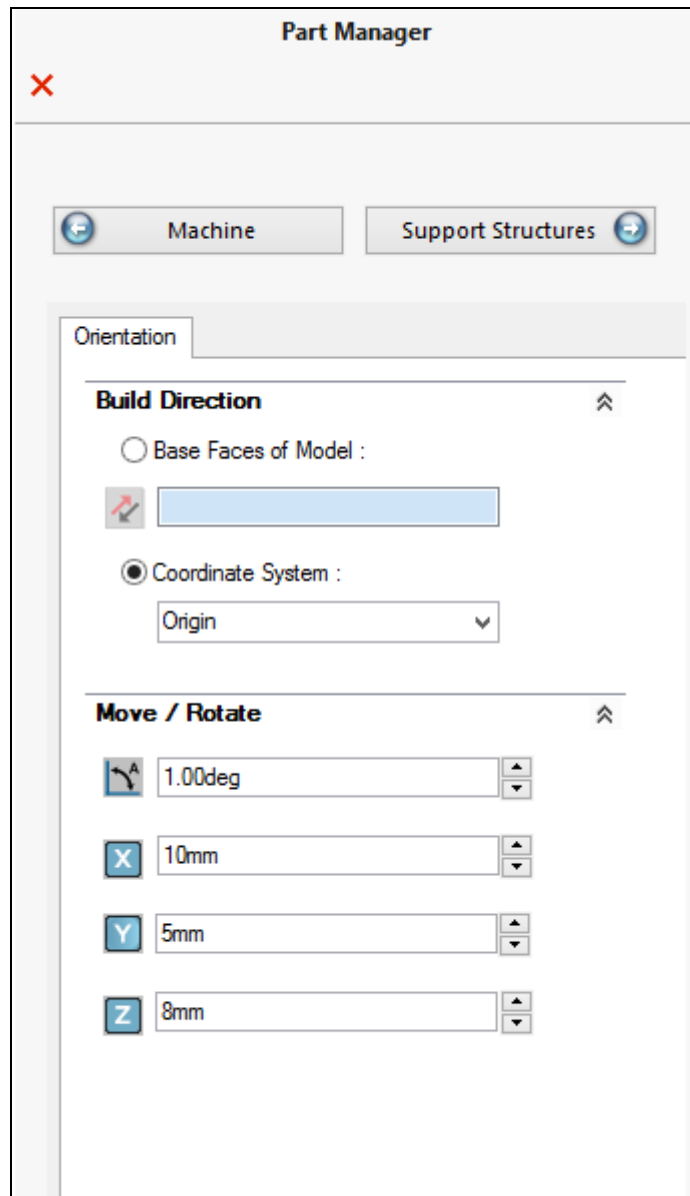


Step 3-b: Create AM Job Wizard: Part Manager dialog box

On clicking the *Next* button, the *Part Manager* dialog box will be displayed. Use the parameters in this dialog box to orient the part model on the plate. *CAMWorks Additive Manufacturing* provides two methods to orient the part viz. either by selecting the face of the part model or by selecting a desired Coordinate system. In this tutorial, the part model will be oriented by selecting a pre-defined Coordinate System for the part.

Following are the steps:

1. In the *Orientation* tab of this dialog box, under the *Build direction* group box, select the option *Coordinate System*. (This option is to be selected when orienting the part model based on one of its pre-defined Coordinate Systems.)
2. In the *Coordinate System* dropdown list, select *Origin*. (This selected coordinate system was previously defined for the part model.)
3. In the graphics area, the cuboidal volume represented by the blue bounding box indicates the machine volume. (The machine volume indicates the space within which additive manufacturing will take place for the selected machine.) We need to ensure that the part model to be printed fits within this machine volume. Use the parameters provided in the ***Move/ Rotate*** group box to move the part model on the plate as needed and to ensure that the part model fits within the machine volume.



Part Manager Dialog box of 'Create AM Job' dialog box

- The values assigned to the X, Y and Z parameters in this group box will move/offset the part model in those corresponding directions.



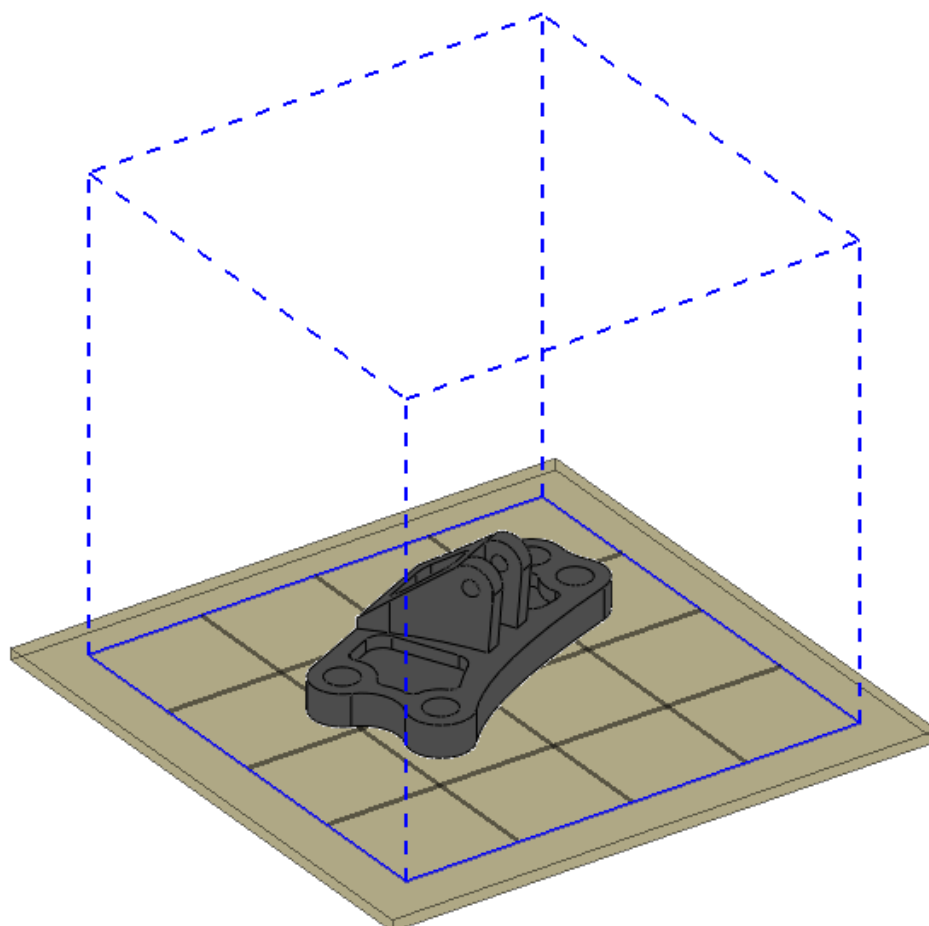
For this tutorial part, we will assign the following parametric values:

- X: 10 mm; Y: 5 mm; Z: 8 mm
- The value (in degrees) assigned in the **Rotate** field will rotate the part model by that many degrees.

For this tutorial part, we will assign *1 degree* as the value for rotation in the **Rotate** field.

- The **Move/ Rotate to Fit** option to automatically orient the part model within the machine volume. In this tutorial, we will not use this option as we are orienting the part model by manually assigning values to the *Move/ Rotate* parameters in the **Move/ Rotate** group box.

Note: Orientation also plays an important role in where support will be located. By optimally reorienting a part, the amount of support (and therefore the cost of the print) can be drastically reduced.



Part Model oriented within the Machine Volume

4. Click the *Next* button .

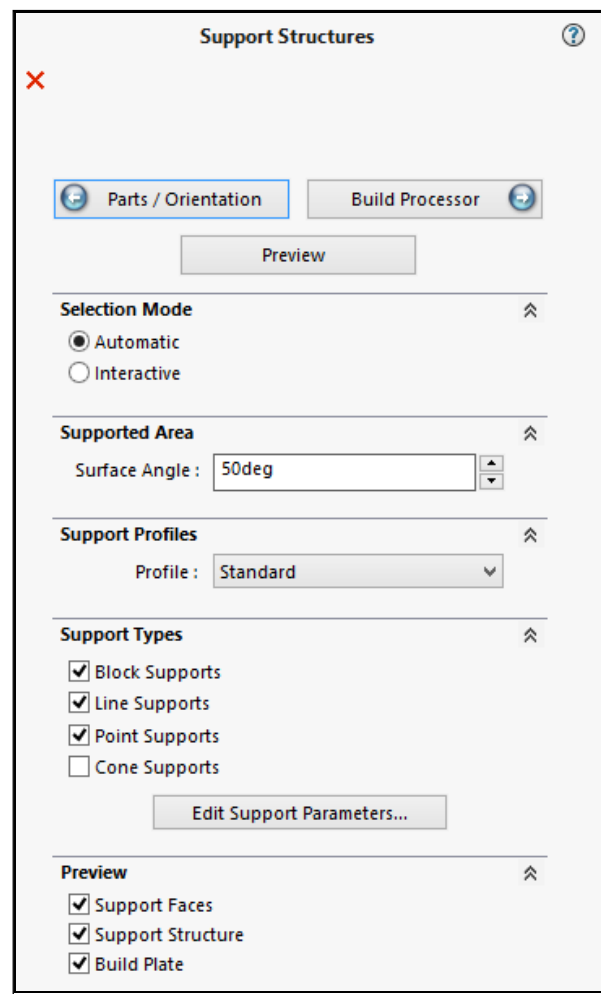
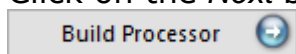


Step 3-c: Create AM Job Wizard: Support Structures dialog box

On clicking the *Next* button, the third dialog box in the *Create AM Job Wizard* viz. the *Support Structures* dialog box will be displayed. Use the parameters in this dialog box to assign properties and values associated with support structures for the part model to be printed using additive manufacturing.

Following are the steps:

1. The options in the **Selection Mode** group box allow you to select the mode (*Automatic* or *Interactive*) for defining the Support Structures. In this tutorial, we will define the support structures automatically. Hence, select the *Automatic* option in this group box.
2. The **Support Type** group box list the different types of support structures. Only one type can be selected. For this tutorial, we will select the type *Block Supports*. Place a check in the checkbox adjacent to **Block Supports** in this group box.
3. In the **Preview** group box, ensure that both the *Support Faces* and *Support Structure* options are checked.
4. *Structure* options are checked.
5. Click on the **Preview** button (located at top center of this dialog box).
6. Executing the *Preview* button command enables you to preview how the support structures will be built. This previewing process might take a few seconds. (Part models with complex geometry might end up taking a few more seconds to process.)
7. Once previewing is completed, the support structures will be visible in the graphics area.
8. Click on the *Next* button

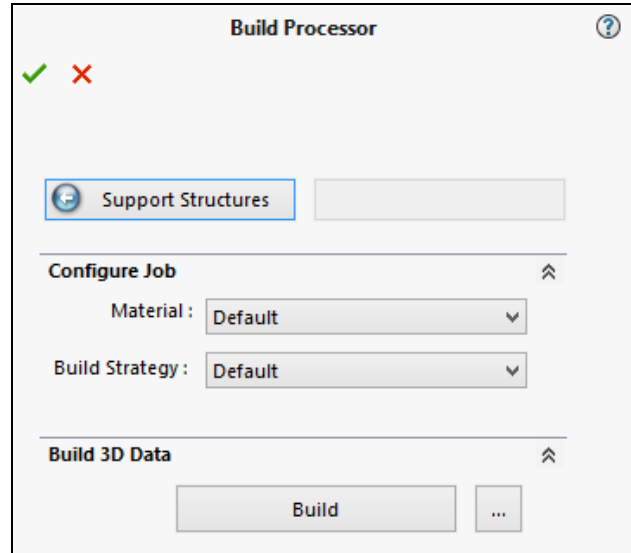


Support Structures Dialog box of 'Create AM Job' dialog box



Step 3-d: Create AM Job Wizard: Build Processor dialog box

On clicking the *Next* button, the final dialog box in the *Create AM Job Wizard* viz. the *Build Processor* dialog box will be displayed.




Build Processor Dialog box of Create AM Job Wizard

Use the parameters in this dialog box to build the 3D data required for 3D printing this part model.

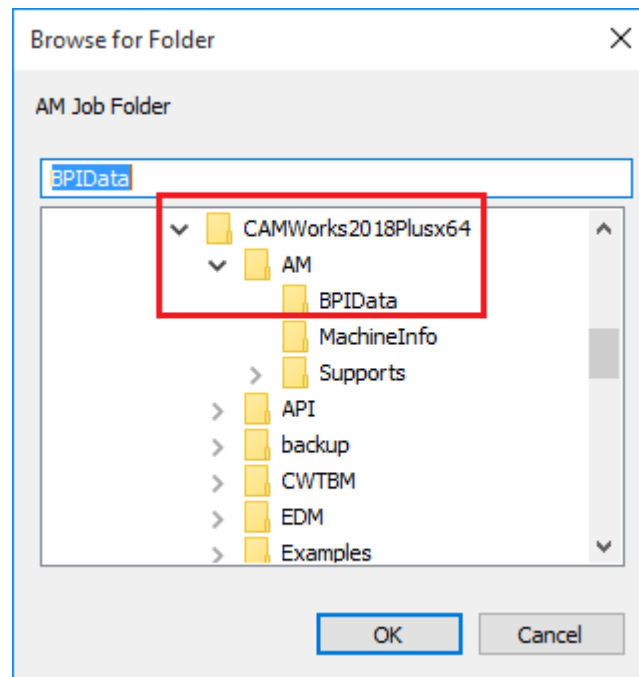
Following are the steps:

1. By default, the 3D data required for successful printing to this part will be saved to the *CAMWorksData* folder at the following location:

C:\CAMWorksData\CAMWorks20XXx64\AM\BPIData

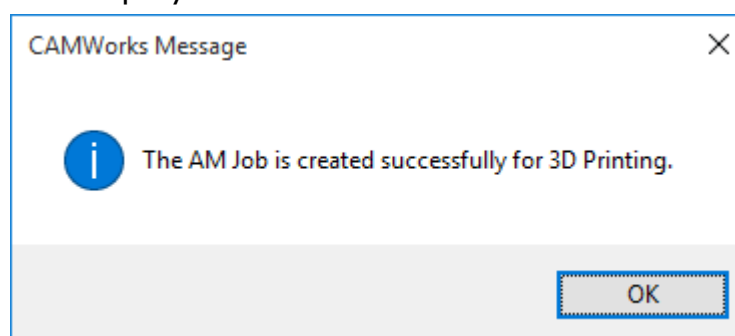
To save the 3D data that will be generated to another folder location of your choice, click on the *Browse* button . Use the ***Browse for Folder*** dialog box that will be displayed to browse and select the folder location of your choice and click on the *OK* button.

For the purposes of this tutorial, the default folder location within the *CAMWorksData* folder will be retained.




'Browse for Folder' dialog box displayed on clicking the Browse button

2. Under the **Build 3D Data** group box, click on the **Build** button.
3. The 3D data thereby generated will be saved to the specified folder location. Once the 3D data is successfully generated and saved, a message box indicating that the 3D data has been successfully generated will be displayed.



Message displayed on successful completion of 3D Data Generation

4. Click on the **OK** button to close this message box.
5. Click the **OK** button  at the top left hand corner of *Build Processor* dialog box to close the *Create AM Job Wizard*.

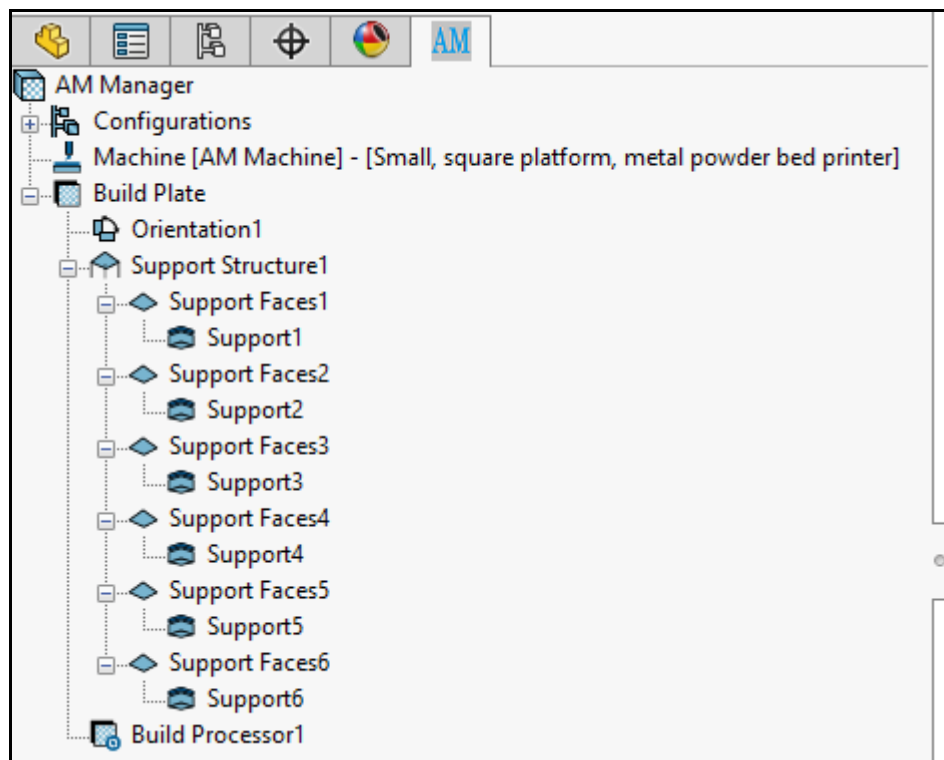


Step 4: Viewing the Support Structures in the AM Tree

Once the *Create AM Job Wizard* closes, the user interface on the left hand side of the graphics area will revert to the *Tree View* with the *AM tree* tab being the active tab.

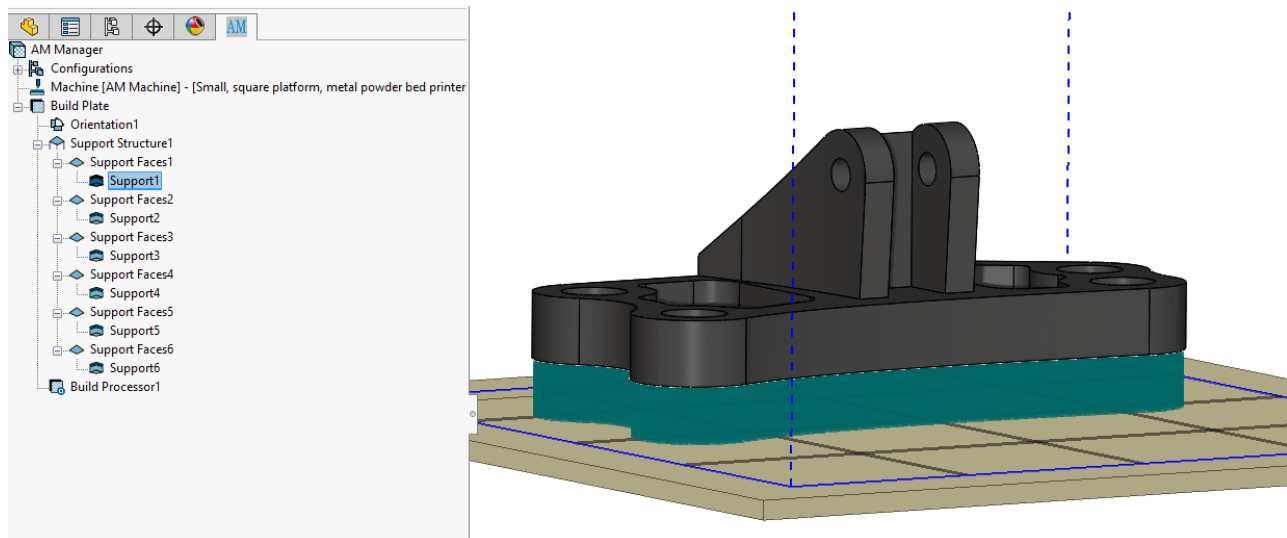
Observe that in this *AM tree* tab:

- Under the expanded *Support Structure1* item, the faces of the part in contact with the support structures (viz. the Support Faces) are listed separately.
- Under each expanded *Support Face* item, the corresponding *Support* structure is listed.



Support Structures and Faces listed in the AM Tree after execution of the AM Job

- If you highlight a support face or structure in this AM Tree, the corresponding face/support structure will be highlighted on the part model displayed in the graphics area.



Highlighted Supports in the graphics area on highlighting the corresponding Support items in the AM Tree

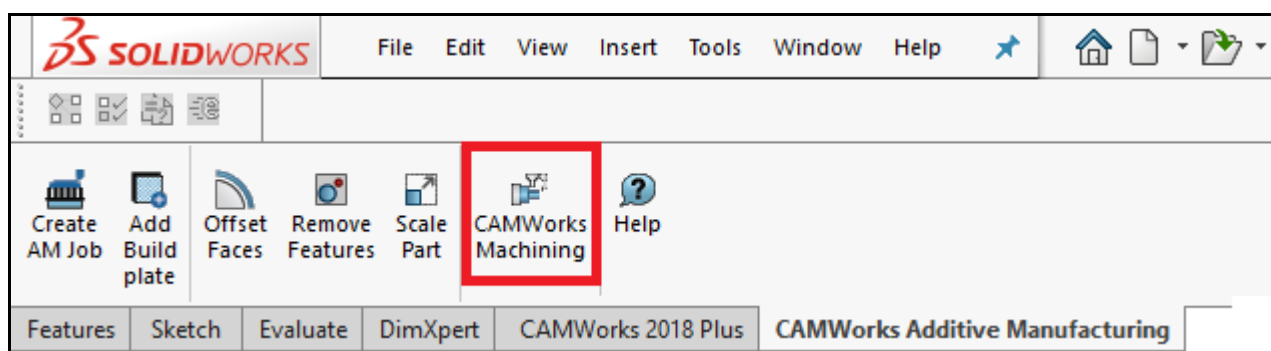
Step 5: Finish Machining using CAMWorks

With the support structures now defined using the CAMWorks Additive Manufacturing module, we will now use CAMWorks to program the CNC Mill machine that will machine:

- i. Features with critical tolerances
- ii. Surfaces of the part model that require a better surface finish
- iii. Eliminate support structures

To do so, following are the steps:

1. On the *Additive Manufacturing* Command Manager, click on the *CAMWorks Machining* command.




CAMWorks Machining Command on the Additive Manufacturing Command

The *CAMWorks Machining* dialog box will be displayed to the left of the graphics area.

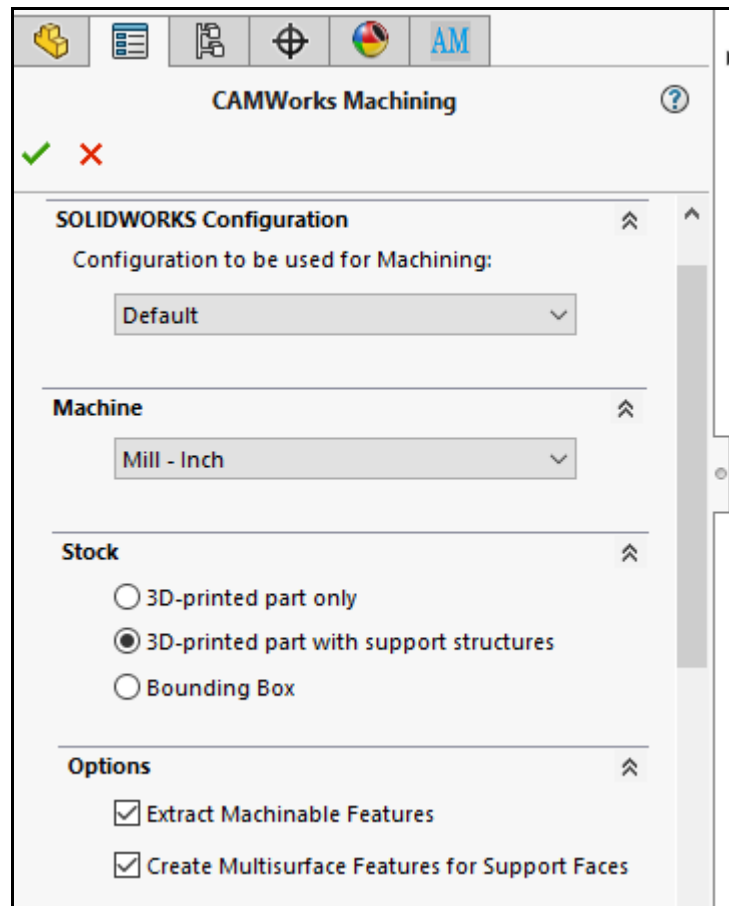


2. The settings under the **SOLIDWORKS Configuration** group box will be applicable only in the part file to be machined consists of multiple configurations. In such a scenario, use the dropdown list within this group box to select the configuration to be machined.

For the tutorial part being machined, only a single configuration exists. Hence, no changes are to be done to the settings of this group box. (The dropdown list within this group box will display *Default* as the configuration to be machined.)

3. Under the *Machine* group box of this dialog box, select the desired CNC Machine from the dropdown list. (These are machines defined in the Technology Database associated with your current CAMWorks installation.)
4. The next step is to define the stock. Under the *Stock* group box, you need to select the Stock type. Since the output of CAMWorks Additive Manufacturing in the previous step viz. the 3D printed solid part with support structures serves as the input for CNC machining, select **3D printed part with support structures** as the stock type in this group box.
5. Under *Options* group box:
 - a. Ensure that the *Extract Machinable Features* checkbox option is checked. Enabling this option ensures that all 2.5 Axis Mill features on the part model will be automatically recognized by CAMWorks on executing the *CAMWorks Machining* command.
 - b. Ensure that the *Create Multisurface Features for Support Faces* checkbox option is checked. Enabling this option ensures that all support structures for the part model will be automatically recognized as multisurface features on executing the *CAMWorks Machining* command.
6. Click on the **OK** button  at the top left hand corner of the *CAMWorks Machining* dialog box to close this dialog box and execute the *CAMWorks Machining* command.

On executing this command, CAMWorks will use the support faces found in additive manufacturing to automatically find those surfaces and features that require additional machining to tolerance. Proportional to the complexity of the part model, this process will take a few seconds.



CAMWorks Machining Dialog Box

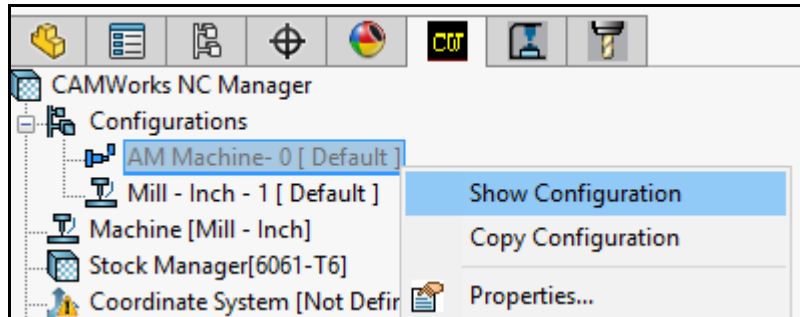
7. The recognized 2.5 Axis mill Features and multisurface features (in any) will be listed under Mill Part Setup(s) in the *CAMWorks Feature Tree* tab. Appropriate machining operations corresponding to these features will be added to the *CAMWorks Operation tree* tab.
8. Edit the operations parameters of the operations as required to suit your machining requirements.

Note: The intention of this manual is to help users gain an understanding on how to use the newly introduced CAMWorks Additive Manufacturing module. Hence, in-depth description of how to use CAMWorks for Mill machining is beyond the scope of this document. Refer the CAMWorks Mill tutorial document to gain an understanding of how to use CAMWorks for Mill machining.

9. You can verify the toolpaths generated for these operations using the *Simulate Toolpath* command on the *CAMWorks Command Manager*.
10. Post process the toolpaths by executing the *Post Process* command on the *CAMWorks Command Manager*.



11. The additive manufacturing data is still available under the *CAMWorks Configuration Manager* under the *CAMWorks Operation Tree*. You can activate this AM machine (by right-clicking and selecting *Show configuration* from the context menu) to review the support structure data.



Show Configuration command on the Context menu of Configurations item under CAMWorks NC Manager

12. On saving the part file, all additive manufacturing data and CNC programming data will be saved inside the SOLIDWORKS part file.



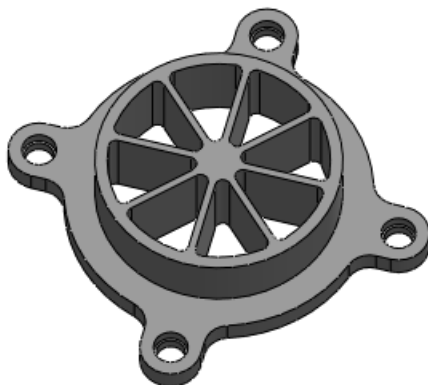
6. ADDITIVE MANUFACTURING: TUTORIAL 2

This tutorial illustrates the following:

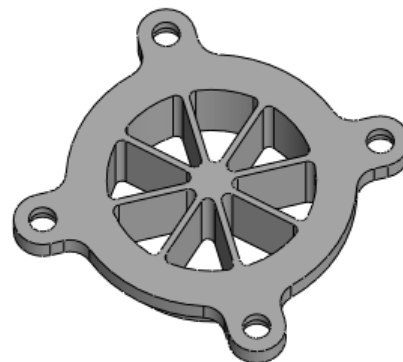
- i. Using the **Additive Manufacturing** module of *CAMWorks* to generate 3D data required to print the sample tutorial part
- ii. Using *CAMWorks Mill Machining* module to remove support structures, machine the surfaces of the 3D printed part model that require a better surface finish and to machine features with critical tolerances

Step 1: Open the Sample tutorial part

1. Launch the *SOLIDWORKS* application.
2. Ensure that the AM Machine on which the part model is to be printed has been added, installed and configured using the [Build Processor Manager](#).
3. Ensure that *CAMWorks* is loaded as an Add-In within the *SOLIDWORKS* environment.
4. Click on the *File* menu on the *SOLIDWORKS* menu bar and select the *Open* option.
5. The *File Open* dialog box will be displayed. Use this dialog box to browse to the following folder:
C:\CAMWorksData\CAMWorks20XXx64\Examples\AdditiveManufacturing
6. Select the **Tutorial_2.sldprt** file present in this folder and click on the *Open* button in this dialog box.
7. This action will close the dialog box, load the part file and display the part model in the graphics area of *SOLIDWORKS*.



Top view of Tutorial_2.sldprt



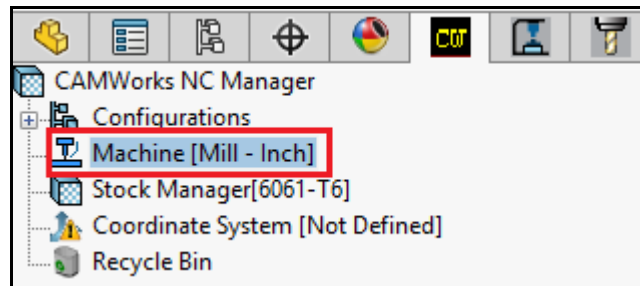
Bottom View of Tutorial_2.sldprt

8. Observe that the *CAMWorks 20XX* and *Additive Manufacturing* tabs are activated in the *SOLIDWORKS Command Manager* area. (These tabs will be visible only if *CAMWorks* has been loaded as an Add-In within *SOLIDWORKS*.)



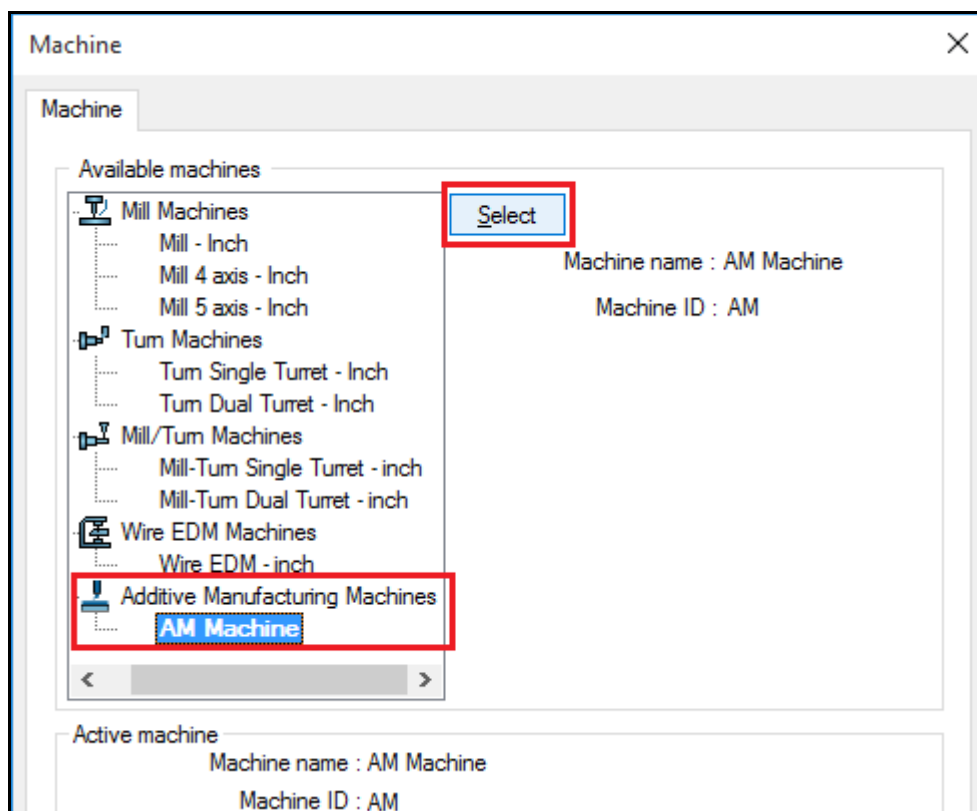
Step 2: Assign the AM Machine

1. To the left of the graphics area is the *Tree View* area. Click on the *CAMWorks Feature tree* tab in the Tree view area.
2. Observe the *Machine* item under this tree tab. By default, *CAMWorks* has assigned a CNC Mill machine to this sample part. Since this sample part is to be machined using Additive Manufacturing, a corresponding machine needs to be assigned.



Machine item indicating CNC Mill Machine selection in CAMWorks Feature Tree

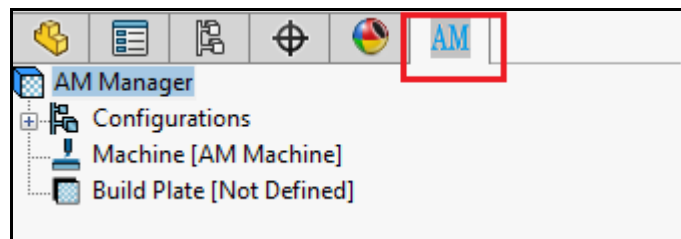
3. Double-click on the *Machine* item under this *Feature tree* to open the *Machine* dialog box. Alternatively, you can click on the *Define Machine* command on the *CAMWorks Command Manager* tab to open this dialog box.



Machine Tab of Machine Dialog Box




4. The *Machine* tab of the *Machine* dialog box lists all the machines defined in the Technology Database. In the list of *Available machines* under this tab, observe that *Additive Manufacturing Machines* too have been defined. Highlight the *AM Machine* item in this list and click the *Select* button.
5. Click the *OK* button to apply the changes and close this dialog box.
6. Observe the *Tree View* area. The *AM* tab is now active while the CAMWorks Feature tree, Operation tree and Tool Tree tabs are no longer displayed. The active machine listed under the AM Tree tab is now an AM machine.



AM Tree tab in Tree View Area

Step 3: Execute the 'Create AM Job' command

1. On the *Additive Manufacturing* Command Manager tab, click on the *Create AM Job* command button .
2. Executing this command displays the **Create AM Job** wizard. This wizard is a series of dialog boxes that allow you to assign properties and parametric values associated with executing an additive manufacturing job.

Step 3-a: Create AM Job Wizard: Machine Selection dialog box

1. On clicking the *Create AM Job* command, the first dialog box displayed in the **Create AM Job** wizard will be the *Machine Selection* dialog box.
2. Use the *Machine* dropdown list parameter under the *Machine Selection* group box to select the properties associated with the AM machine that you will be using machine type that you will be using for '*printing*' this part. For the purposes of this tutorial, we will select the *Small, square platform, metal powder bed printer* option from this dropdown list.

Read-only parameters associated with the option you select will be displayed in this dialog box.

3. Click the *Next* button .



The image shows a software dialog box titled "Machine Selection". At the top, there is a toolbar with icons for a 3D model, a list, a selection tool, a coordinate system, a globe, and an "AM" button. Below the toolbar, the dialog has a close button (X) and a "Parts / Orientation" button with a right-pointing arrow. The main content area is divided into two sections. The first section, "Machine Selection", contains three fields: "Machine:" with a dropdown menu showing "Small, square platform, metz", "Build Processor:" with a text box containing "Demo Build Processor", and "Model:" with a text box containing "Small, square platform, metal p". The second section, "Machine Information", contains three fields: "Width:" with a text box containing "4.88in", "Depth:" with a text box containing "4.88in", and "Height:" with a text box containing "4.92in".

Machine Selection Dialog Box of Create AM Job Wizard

Step 3-b: Create AM Job Wizard: Part Manager dialog box

On clicking the *Next* button, the *Part Manager* dialog box will be displayed. Use the parameters in this dialog box to orient the part model on the *Build Plate*. *CAMWorks Additive Manufacturing* provides two methods to orient the part viz. either by selecting the face of the part model as the base face to be in contact with the build plate or by selecting a desired Coordinate system. In this tutorial, the part model will be oriented by selecting a face of the part as the base face.

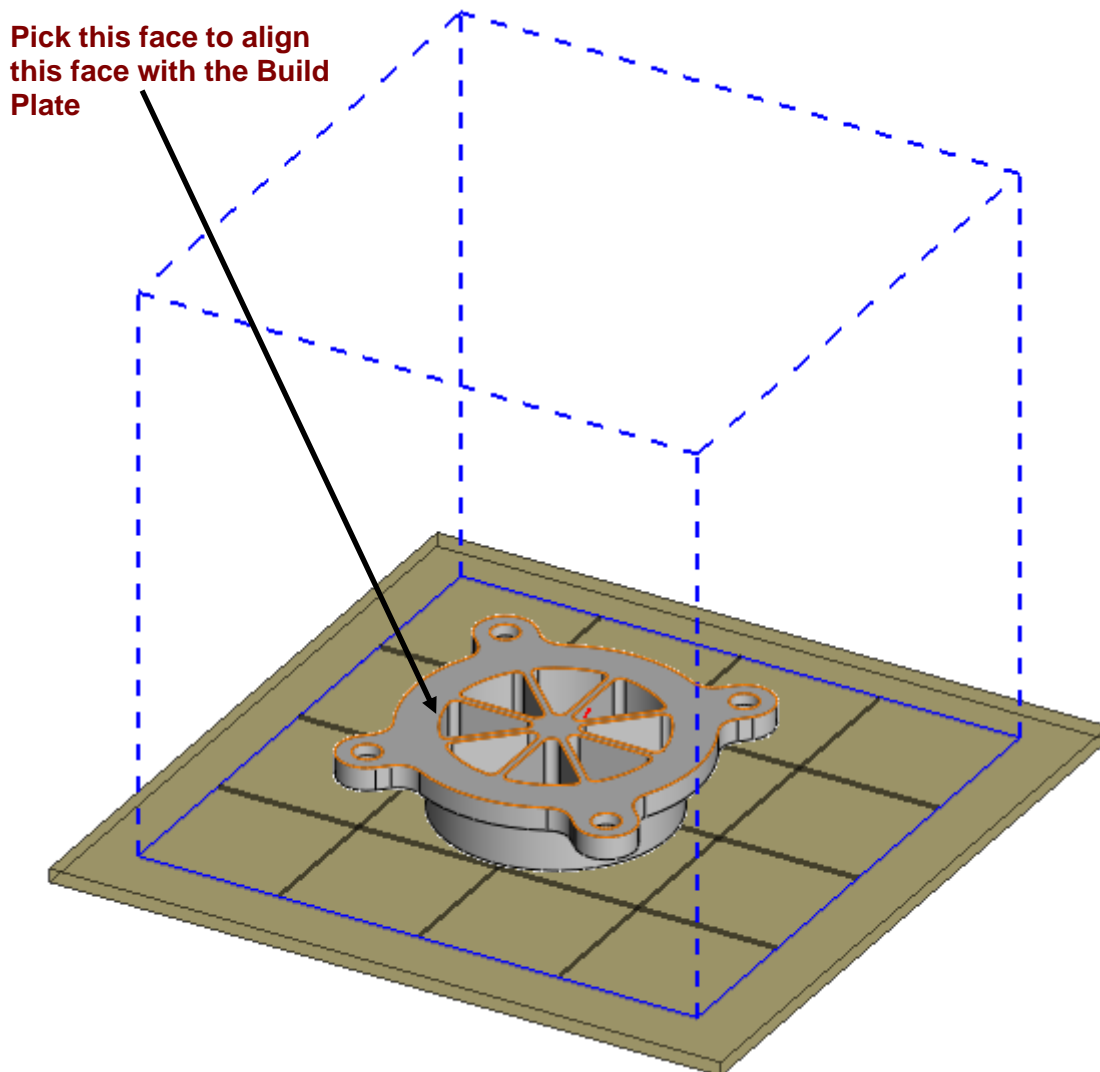
Following are the steps:

1. In the *Orientation* tab of this dialog box, under the *Build direction* group box, select the option *Base Faces of Model*. (This option is to be selected when orienting the part model with respect to the Build Plate based on one of its faces.)
2. Ideally, when orienting the part with respect to the *Build Plate*, the face with the largest surface area must be parallel to the *Build Plate*. Depending on the geometry of the part, such an orientation will reduce the number of support structures required. However, in the case of this tutorial part, observe in the graphics area that the part model has its top face with lower surface oriented with the *Build Plate*. This situation can be rectified by selecting the bottom face of the part as the base face to be aligned with the *Build Plate*.



To do so, following are the steps:

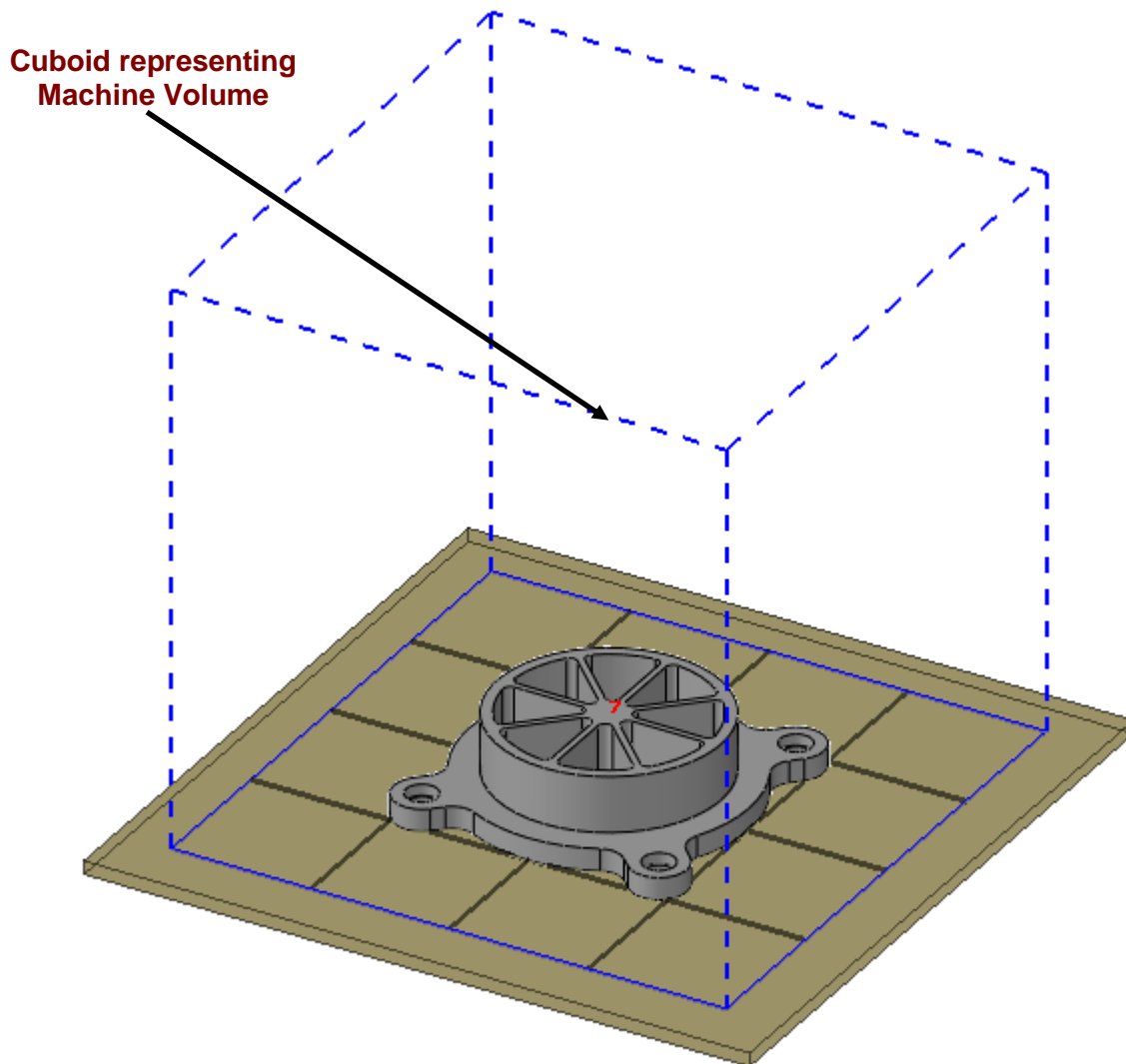
- i. Left-mouse click in the cyan colored field below the *Base Faces of Model* option. This action makes the face selection functionality active.
- ii. In the graphics area, pick the bottom face of the part (the face to be selected is highlighted in orange in the image below).



Tutorial part with top face (with surface area lower than bottom face) aligned with the Build Plate

- iii. In the graphics area, pick the bottom face of the part (the face to be selected is highlighted in orange in the image below).
- iv. This action will cause the tutorial part in the graphics area to be immediately reoriented with the selected face now aligned with the *Build Plate*.

- v. The name of the selected face will be displayed in the field below the *Base Faces of Model* option.

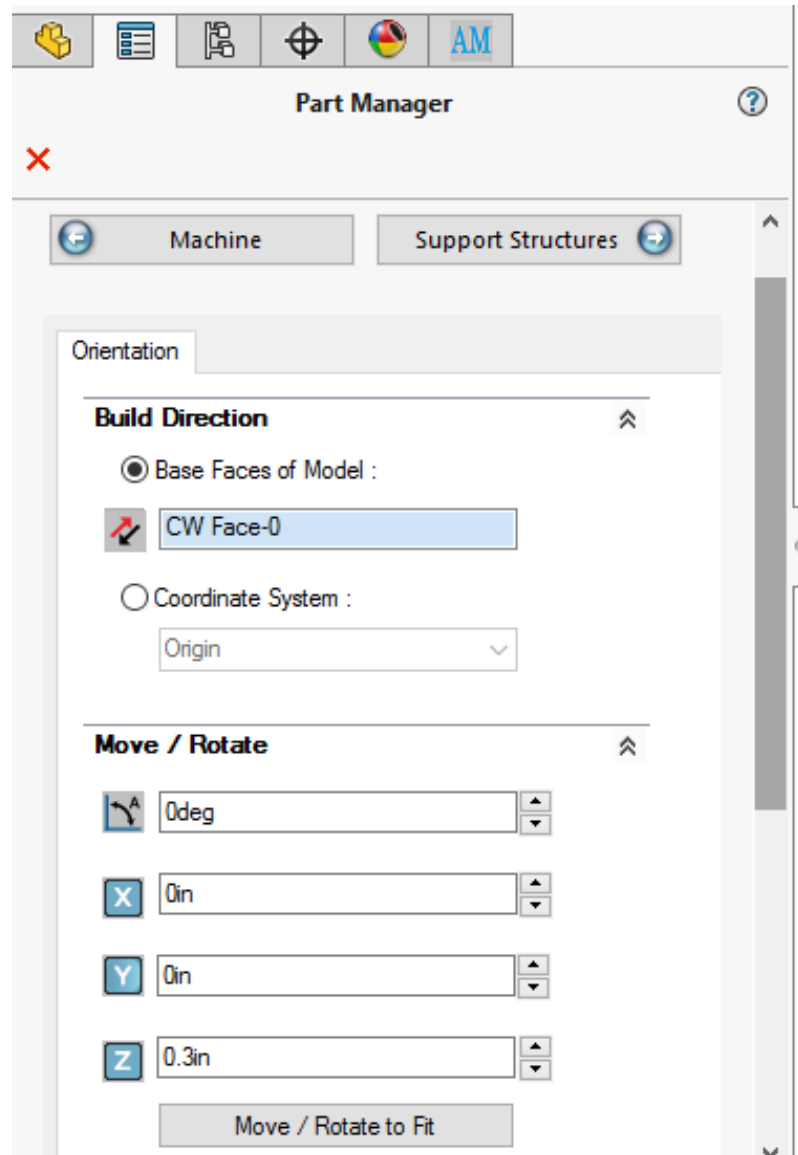


Tutorial Part correctly aligned with the Build Plate

3. In the graphics area, the cuboidal volume represented by the blue bounding box indicates the machine volume. (The machine volume indicates the space within which additive manufacturing will take place for the selected machine.) We need to ensure that the part model to be printed fits within this machine volume. Use the parameters provided in the **Move/Rotate** group box to move the part model on the plate as needed and to ensure that the part model fits within the machine volume.
- The values assigned to the X, Y and Z parameters in this group box will move/offset the part model in those corresponding directions.
 - The value (in degrees) assigned in the **Rotate** field will rotate the part model by that many degrees.



For this tutorial part, we will assign a value of 0.3 inches to the Z parameter in order insert a gap between the printed part and the Build Plate. The other parameters within the **Move/ Rotate** group box will be left untouched.



Part Manager Dialog box of 'Create AM Job' dialog box

4. Click the *Next* button .

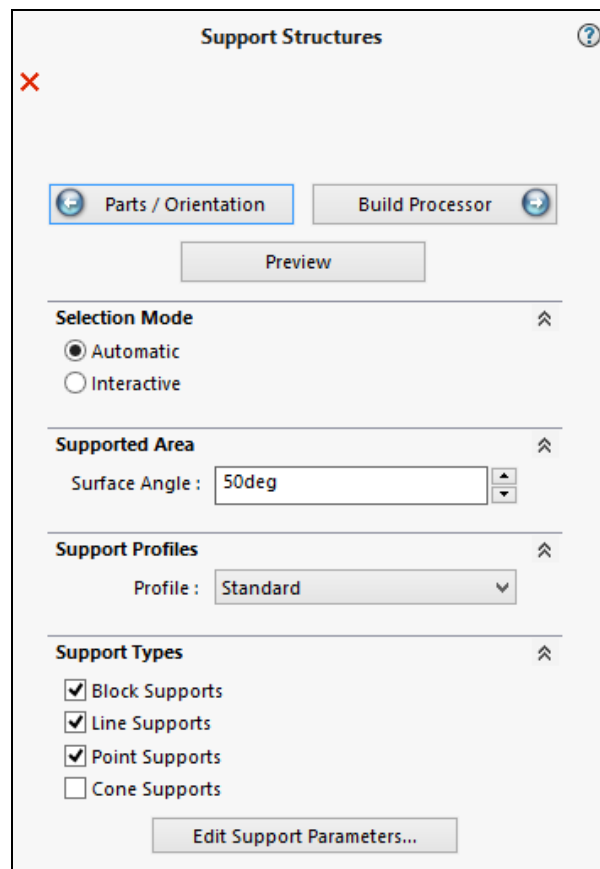
Step 3-c: Create AM Job Wizard: Support Structures dialog box

On clicking the *Next* button, the third dialog box in the *Create AM Job Wizard* viz. the *Support Structures* dialog box will be displayed. Use the parameters in this dialog box to assign properties and values associated with support structures for the part model to be printed using additive manufacturing.



Following are the steps:

1. The options in the **Selection Mode** group box allow you to select the mode (*Automatic* or *Interactive*) for defining the Support Structures. In this tutorial, we will define the support structures automatically. Hence, select the *Automatic* option in this group box.
2. The **Support Type** group box list the different types of support structures. Only one type can be selected. For this tutorial, we will select the type *Block Supports*. Place a check in the checkbox adjacent to **Block Supports** in this group box.
3. In the **Preview** group box, ensure that both the *Support Faces* and *Support Structure* options are checked.
4. Click on the **Preview** button (located at top center of this dialog box).
5. Executing the *Preview* button command enables you to preview how the support structures will be built. This previewing process might take a few seconds. (Part models with complex geometry might end up taking a few more seconds to process.)
6. Once previewing is completed, the support structures will be visible in the graphics area.



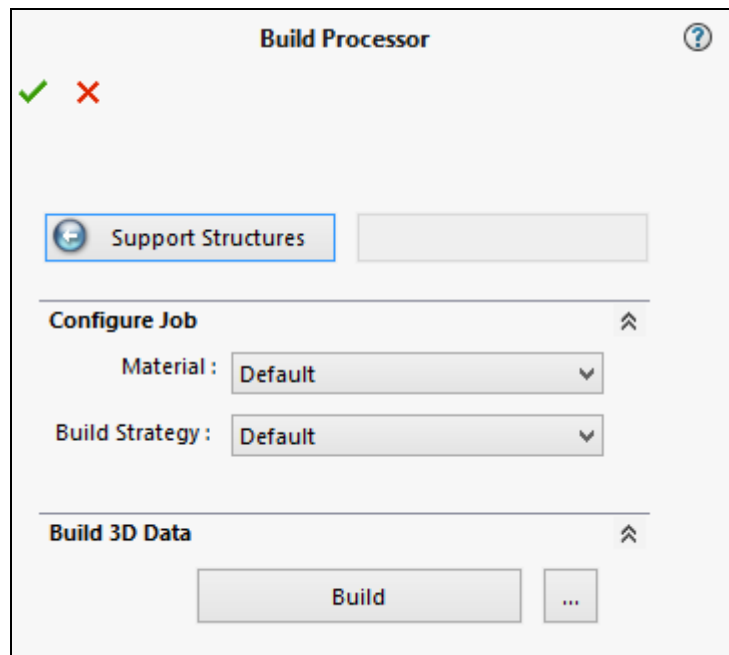
Support Structures Dialog box of 'Create AM Job' dialog box



7. Click on the *Next* button .

Step 3-d: Create AM Job Wizard: Build Processor dialog box

On clicking the *Next* button, the final dialog box in the *Create AM Job Wizard* viz. the *Build Processor* dialog box will be displayed.




Build Processor Dialog box of Create AM Job Wizard

Use the parameters in this dialog box to build the 3D data required for 3D printing this part model.

Following are the steps:

1. By default, the 3D data required for successful printing to this part will be saved to the *CAMWorksData* folder at the following location:

C:\CAMWorksData\CAMWorks20XXx64\AM\BPIData


To save the 3D data that will be generated to another folder location of your choice, click on the *Browse* button . Use the **Browse for Folder** dialog box that will be displayed to browse and select the folder location of your choice and click on the *OK* button.

For the purposes of this tutorial, the default folder location within the *CAMWorksData* folder will be retained.

2. Under the **Build 3D Data** group box, click on the **Build** button.
3. The 3D data thereby generated will be saved to the specified folder location. Depending on the complexity of the part, the Build process will take a few seconds to a few minutes to complete. Once the 3D data has been successfully generated and saved, a message box indicating that



the 3D data has been successfully generated will be displayed. Click on the *OK* button to close this message box.

4. Click the **OK** button  at the top left hand corner of *Build Processor* dialog box to close the *Create AM Job Wizard*.

Step 4: Viewing the Support Structures in the AM Tree

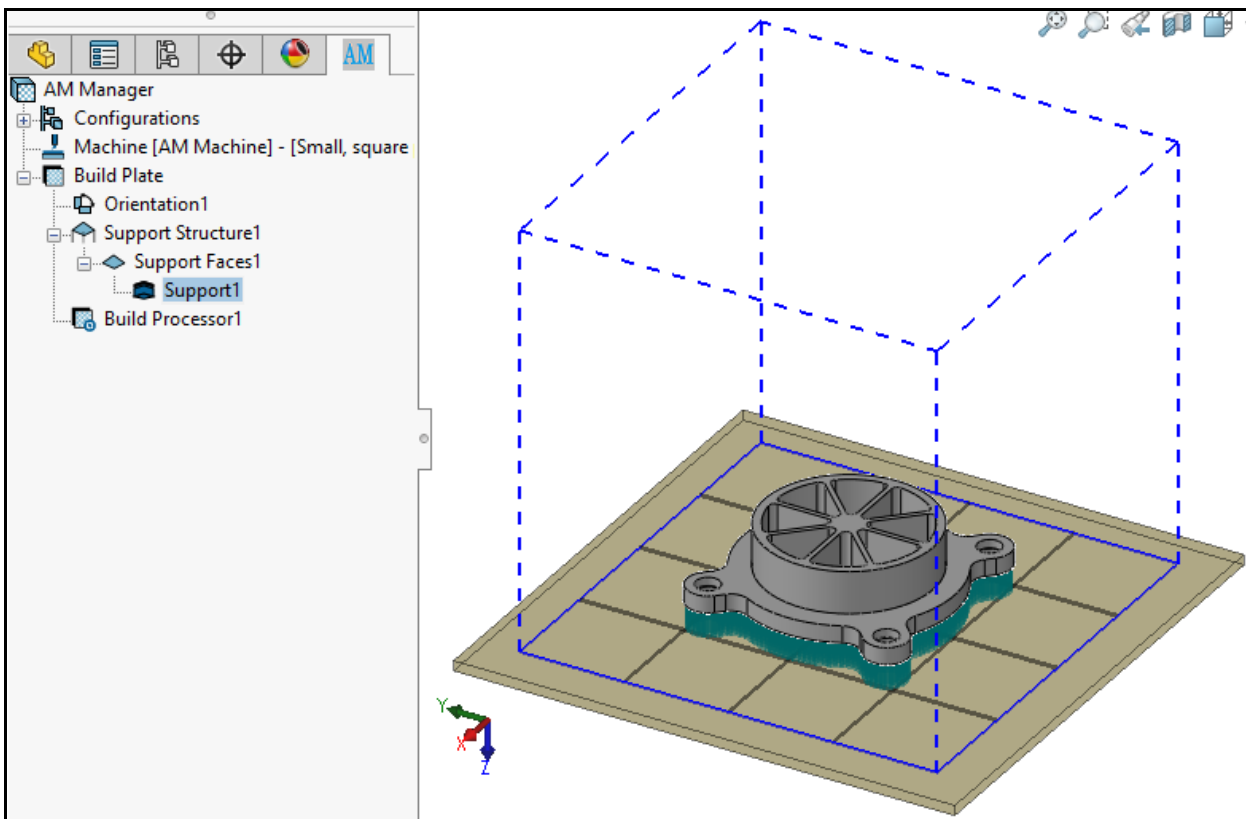
Once the *Create AM Job Wizard* closes, the user interface on the left hand side of the graphics area will revert to the *Tree View* with the *AM tree* tab being the active tab.

Observe that in this *AM tree* tab:

- Under the expanded *Support Structure1* item, the faces of the part in contact with the support structures (viz. the Support Faces) are listed separately.

Since the tutorial part was optimally oriented, only one support structure was required.

- If you highlight this support structure in the AM Tree, the corresponding support structure will be highlighted on the part model displayed in the graphics area.



Highlighted Supports in the graphics area on highlighting the corresponding Support item in the AM Tree




Step 5: Finish Machining using CAMWorks

With the support structures now defined using the CAMWorks Additive Manufacturing module, we will now use CAMWorks to program the CNC Mill machine that will machine:

- i. Features with critical tolerances
- ii. Surfaces of the part model that require a better surface finish
- iii. Eliminate support structures

To do so, following are the steps:

1. On the *Additive Manufacturing* Command Manager, click on the *CAMWorks Machining* command .


The *CAMWorks Machining* dialog box will be displayed to the left of the graphics area.

2. The settings under the **SOLIDWORKS Configuration** group box will be applicable only in the part file to be machined consists of multiple configurations. In such a scenario, use the dropdown list within this group box to select the configuration to be machined.

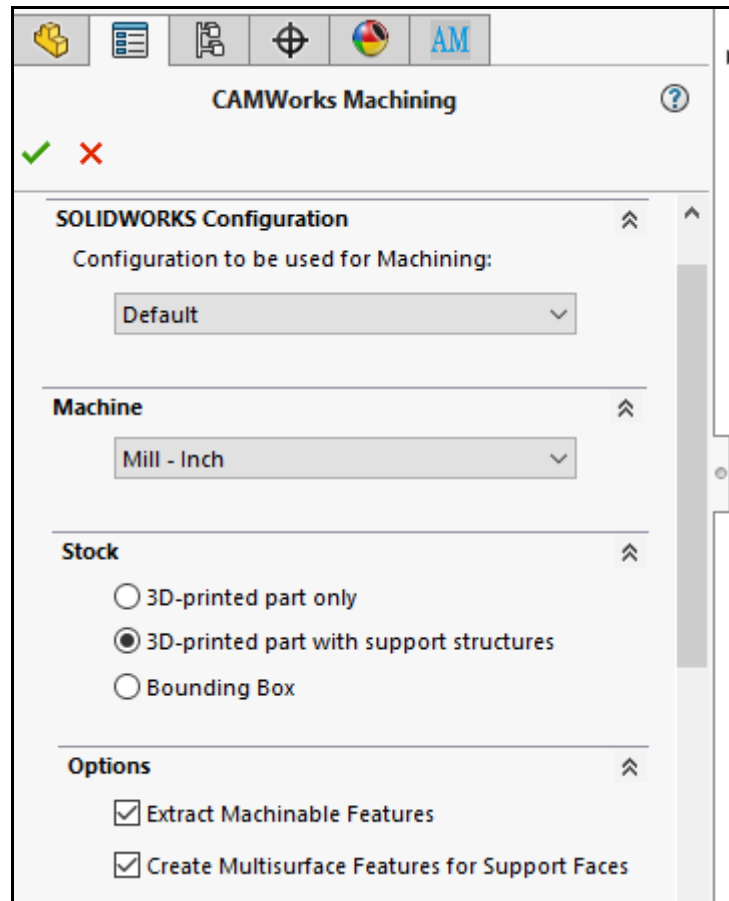
For the tutorial part being machined, only a single configuration exists. Hence, no changes are to be done to the settings of this group box. (The dropdown list within this group box will display *Default* as the configuration to be machined.)

3. Under the *Machine* group box of this dialog box, select the desired CNC Machine from the dropdown list. (These are machines defined in the Technology Database associated with your current CAMWorks installation.)
4. The next step is to define the stock. Under the *Stock* group box, you need to select the Stock type. Since the output of CAMWorks Additive Manufacturing in the previous step viz. the 3D printed solid part with support structures serves as the input for CNC machining, select **3D printed part with support structures** as the stock type in this group box.
5. Under *Options* group box:
 - a. Ensure that the *Extract Machinable Features* checkbox option is checked. Enabling this option ensures that all 2.5 Axis Mill features on the part model will be automatically recognized by CAMWorks on executing the *CAMWorks Machining* command.
 - b. Ensure that the *Create Multisurface Features for Support Faces* checkbox option is checked. Enabling this option ensures that all support structures for the part model will be automatically recognized as multisurface features on executing the *CAMWorks Machining* command.



- Click on the **OK** button  at the top left hand corner of the *CAMWorks Machining* dialog box to close this dialog box and execute the *CAMWorks Machining* command.

On executing this command, CAMWorks will use the support faces found in additive manufacturing to automatically find those surfaces and features that require additional machining to tolerance. Proportional to the complexity of the part model, this process will take a few seconds.



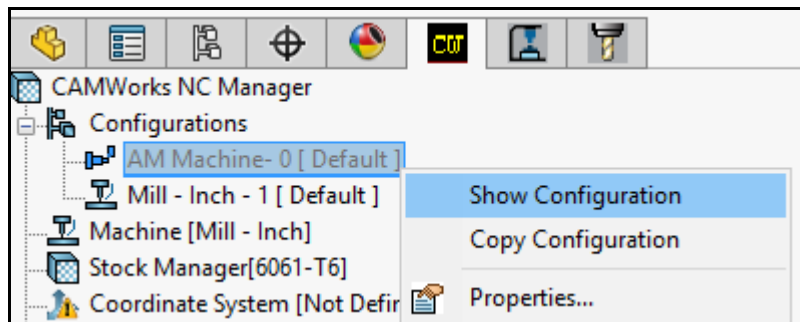
CAMWorks Machining Dialog Box

- The recognized 2.5 Axis mill Features and multisurface features (in any) will be listed under Mill Part Setup(s) in the *CAMWorks Feature Tree* tab. Appropriate machining operations corresponding to these features will be added to the *CAMWorks Operation tree* tab.
- Edit the operations parameters of the operations as required to suit your machining requirements.

Note: The intention of this manual is to help users gain an understanding on how to use the newly introduced CAMWorks Additive Manufacturing module. Hence, in-depth description of how to use CAMWorks for Mill machining is beyond the scope of this document. Refer the CAMWorks Mill tutorial document to gain an understanding of how to use CAMWorks for Mill machining.



9. You can verify the toolpaths generated for these operations using the *Simulate Toolpath* command on the *CAMWorks Command Manager*.
10. Post process the toolpaths by executing the *Post Process* command on the *CAMWorks Command Manager*.
11. The additive manufacturing data is still available under the *CAMWorks Configuration Manager* under the *CAMWorks Operation Tree*. You can activate this AM machine (by right-clicking and selecting *Show configuration* from the context menu) to review the support structure data.



Show Configuration command on the Context menu of Configurations item under CAMWorks NC Manager

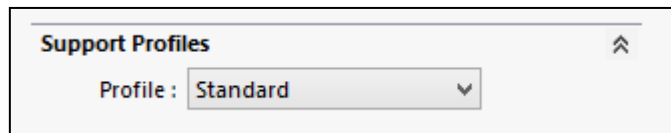
12. On saving the part file, all additive manufacturing data and CNC programming data will be saved inside the SOLIDWORKS part file.



7. SUPPORT PARAMETERS

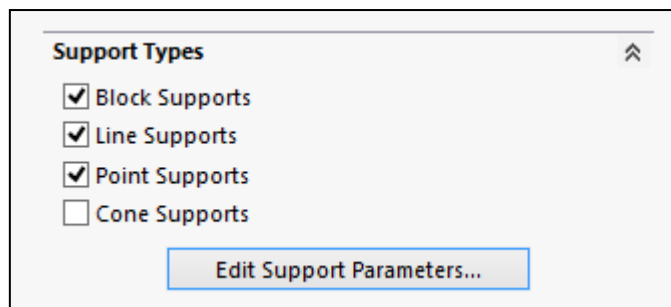
Support Profiles

Provides user interface to manage different support parameters profiles for the same machine. This profile can be material specific or contains different supports parameters.eg: For Demo machine, Standard profile has been added.



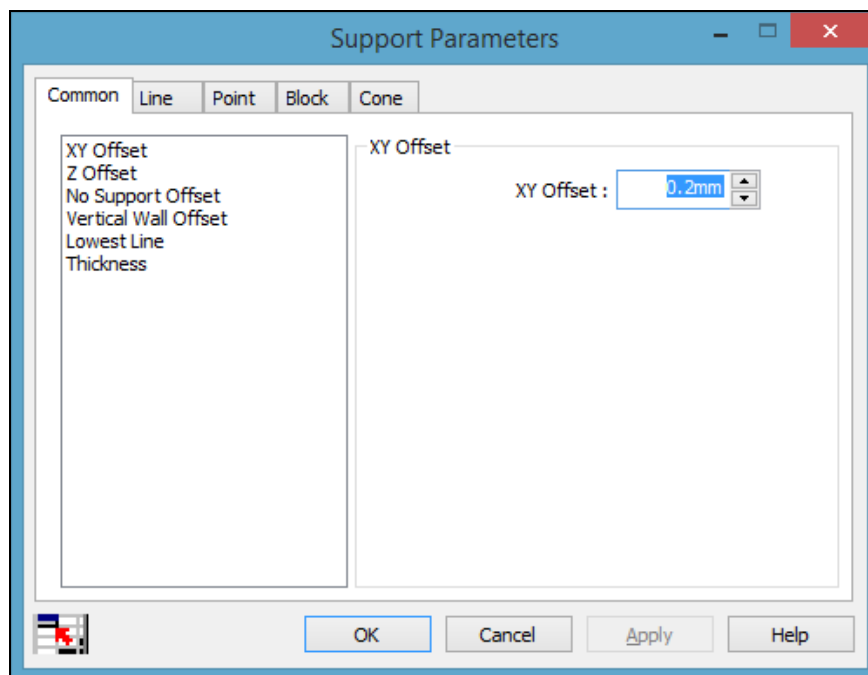
Select Support Profiles interface

However, user can always override the parameters of *Support Profiles* using the *Edit Support Parameters* command.



Edit Support Parameters Button

Clicking on the *Edit Support Parameters* button launches *Support Parameters* dialog box with a set of different parameters such as *Common*, *Block*, *Line*, *Point* and *Cone*.



Support Parameter Dialog Box



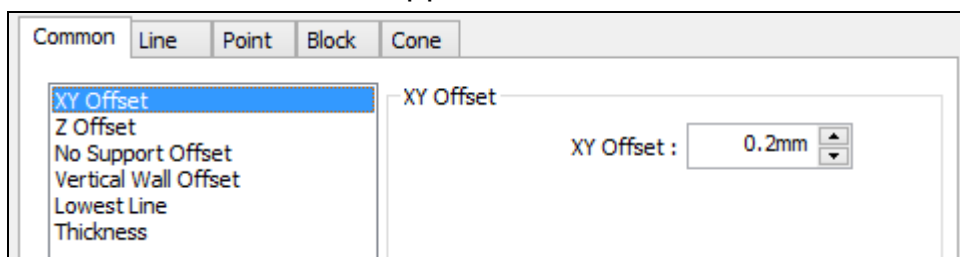
Note: User needs to select *Preview Button* to regenerate the support after editing the parameters. If user select *Build Processor* button it will regenerate the support with the edited parameters.

Common Parameters

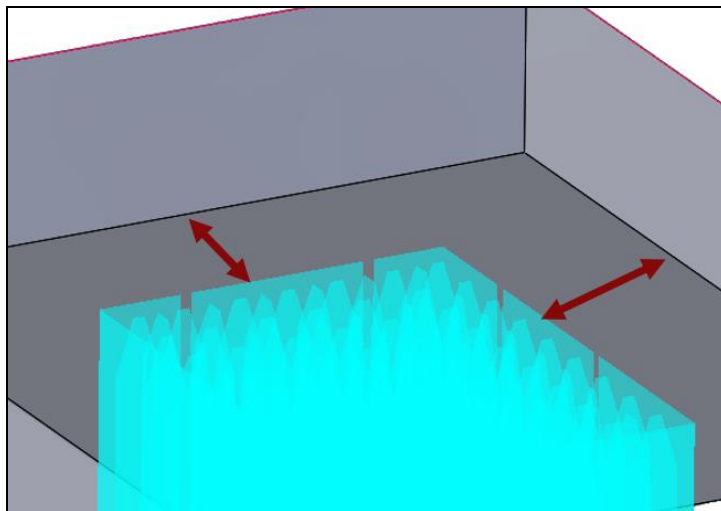
These parameters are common for all type of supports.

XY Offset

This offset defines how far the support must be from the border of the part



XY Offset Parameter



Arrows indicating XY Offset

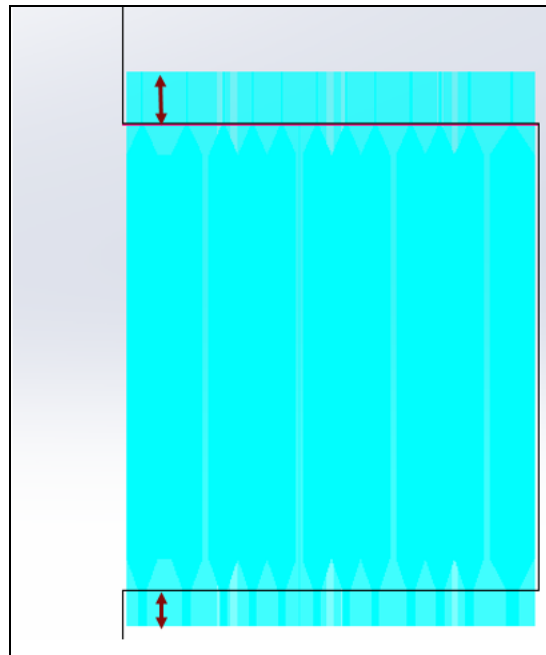
Z Offset

Supports can have a certain offset into the part for better contact between part and support. Lower offset will be present only when there is any part geometry. i.e. it will not be present when supports are in contact with build plate.



Common	Line	Point	Block	Cone
<div>XY Offset</div> <div>Z Offset</div> <div>No Support Offset</div> <div>Vertical Wall Offset</div> <div>Lowest Line</div> <div>Thickness</div>				
<div>Z Offset</div> <div>Upper Z offset : 0.5mm</div> <div>Lower Z Offset : 0.5mm</div>				

Z Offset parameters



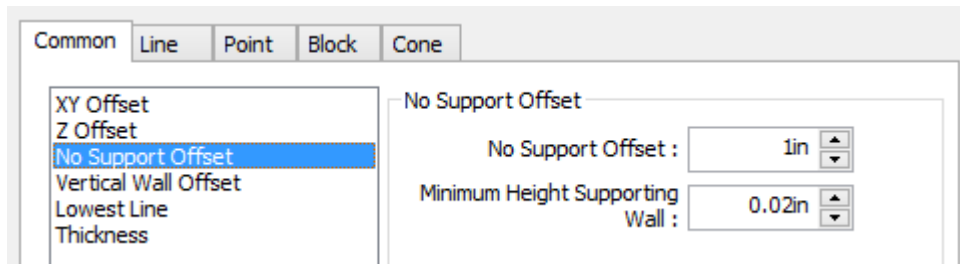
Arrow indicating Upper and Lower Z offsets

No Support Offset

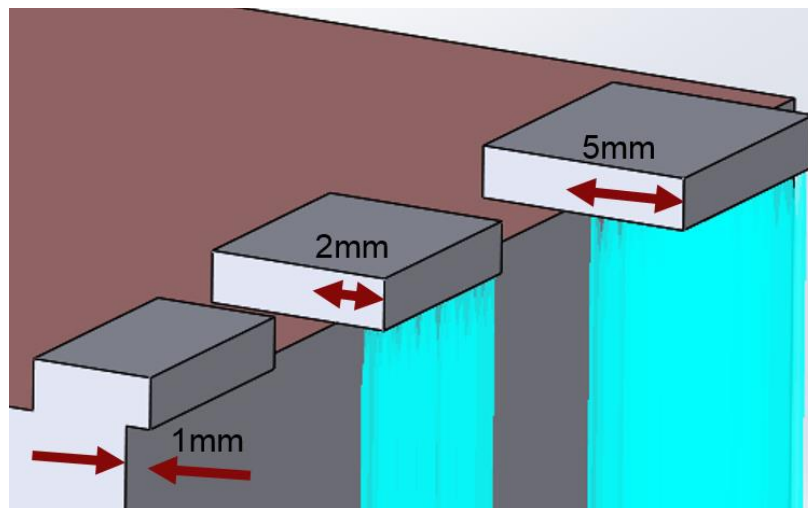
Vertical wall gives support to another surface. For this reason, there is no support needed if there is only a very small overhang.

No Support Offset - Overhangs less than this values will not be supported. Also, a support is generated only when the wall height is greater than the Minimum height supporting Wall Value.

Minimum Height Supporting Wall - *No Support Offset* parameter will only be applied when the wall height is greater than the minimum height supporting wall



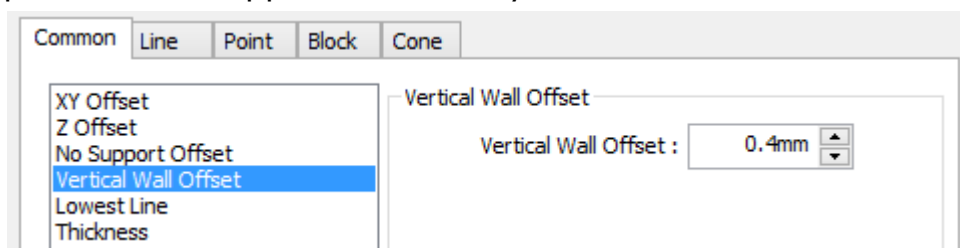
No Support Offset parameters



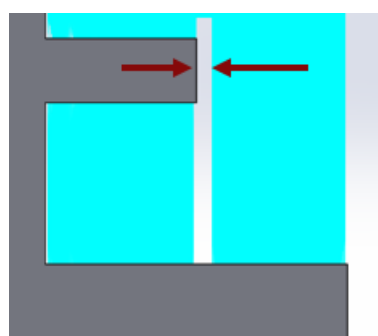
Arrow heads indicating 'No Support Offset' of 1 mm

Vertical Wall Offset

This parameter ensure that supports don't get placed on a vertical wall. A small gap allows the support to be easily removed.



Vertical Wall Offset parameter

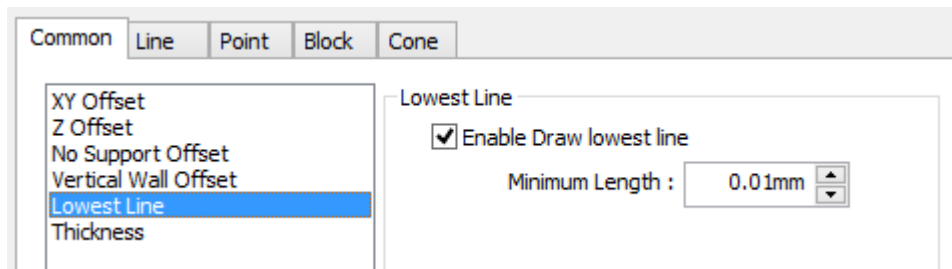


Arrows indicating the Vertical Wall Support

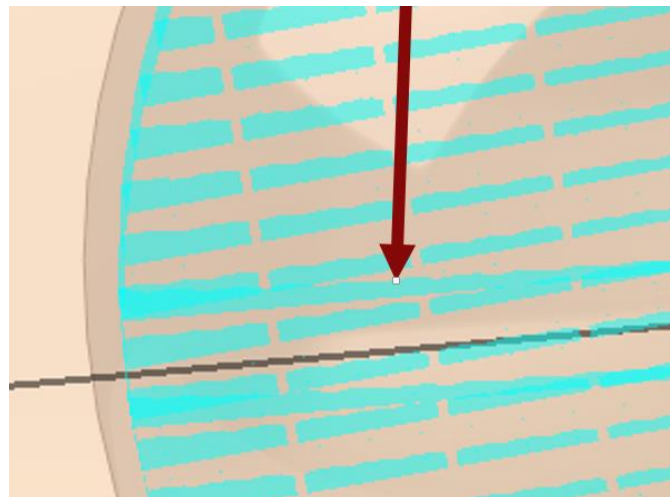


Lowest Line

Support under a curved surface, it can happen that the lowest line is not supported correctly. This can cause problems when building the part with some RP-techniques. When lowest line is checked, an extra line of support will be placed so that this lowest line is correctly supported. Lowest Lines smaller than this length will be filtered out.



Lowest Line parameters



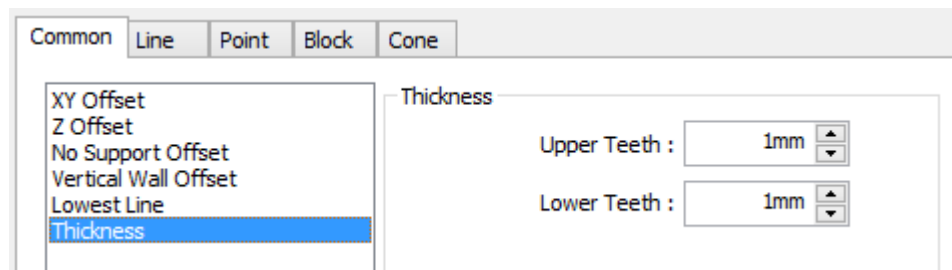
Arrow indicating the Lowest Line created for Circular Surface

Thickness

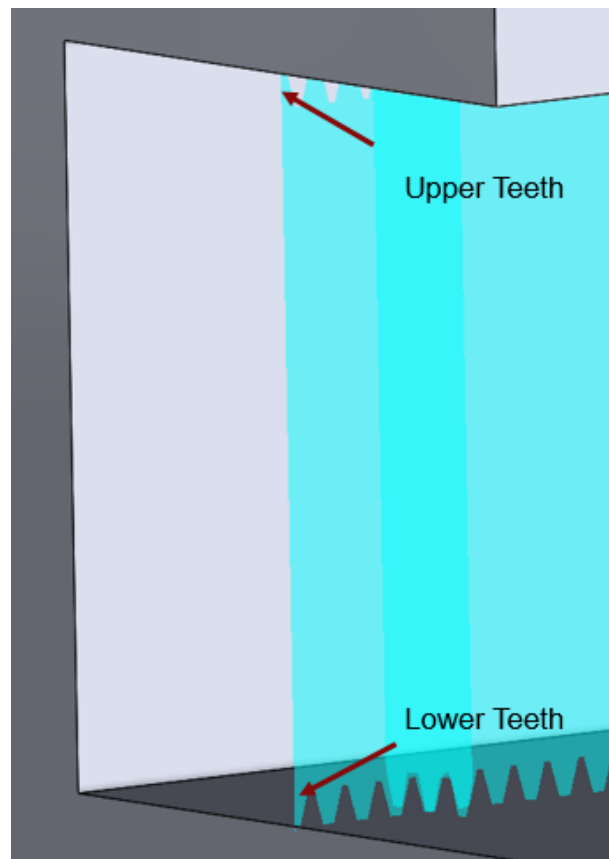
Set the thickness for supports.

Upper teeth - The thickness of the upper teeth

Lower teeth - The thickness of the lower teeth



Thickness parameters



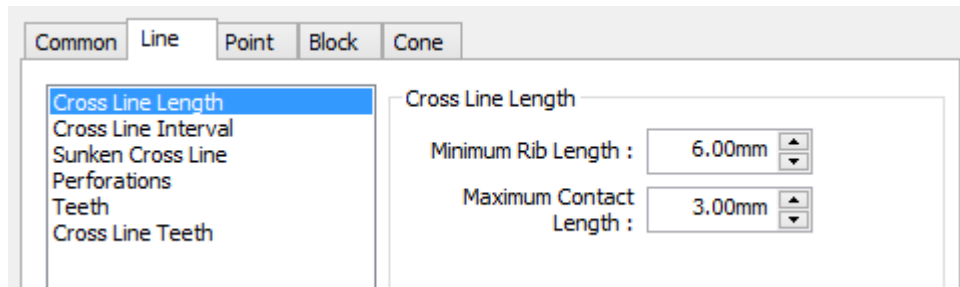
Arrows indicating Upper and Lower Teeth Thicknesses



Line Parameters

Cross line length

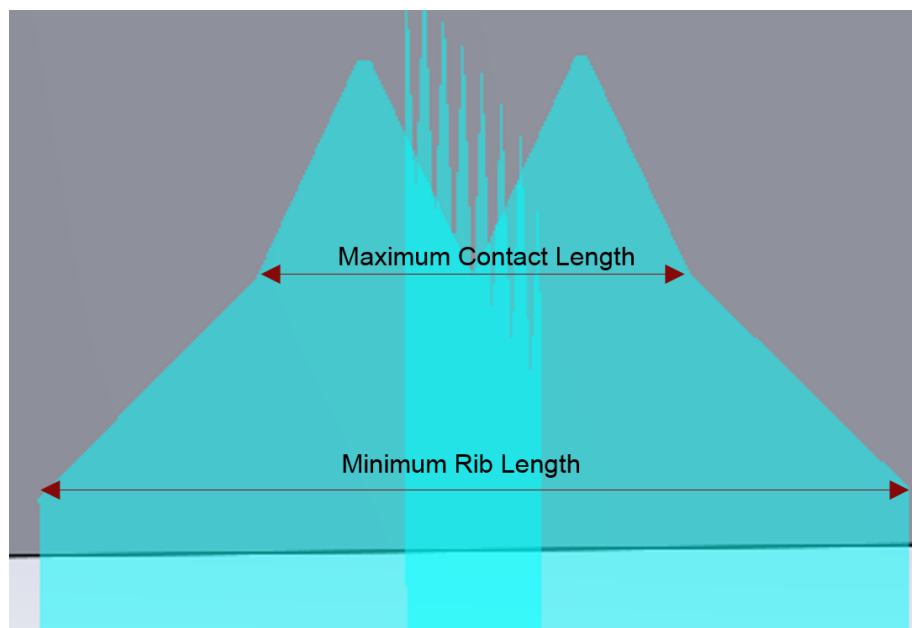
It defines length of the crossing lines



Cross Line Length parameters

Minimum Rib Length-The length of the crossing lines

Maximum Contact Length-The contact length of the crossing lines with the support

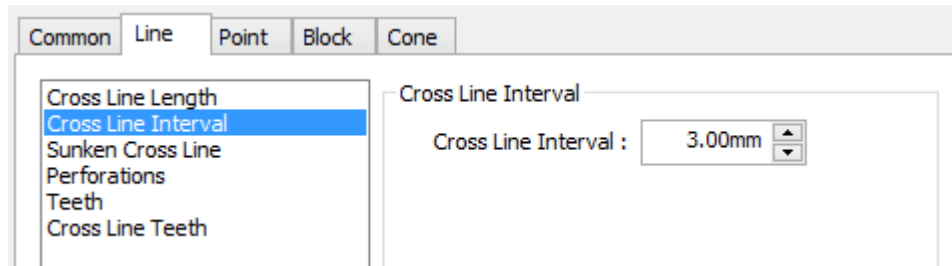


Cross Line Length applied

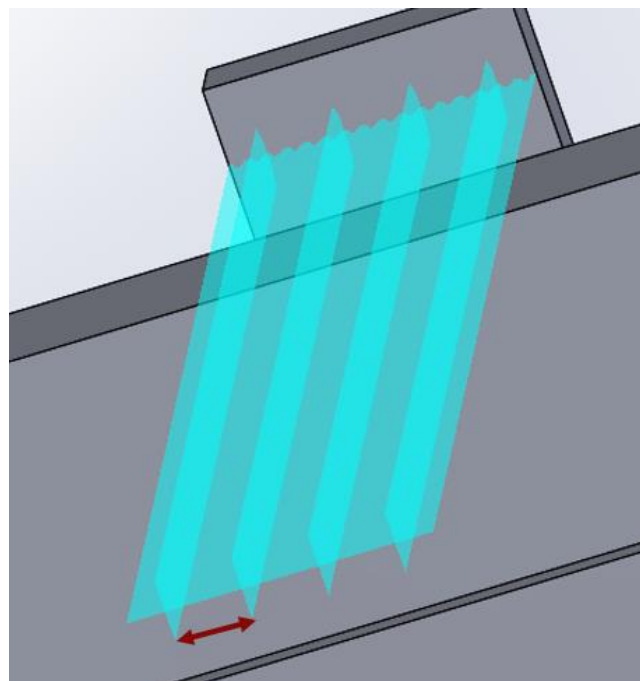


Cross Line Interval

Defines distance between two consecutive cross lines of a line support.



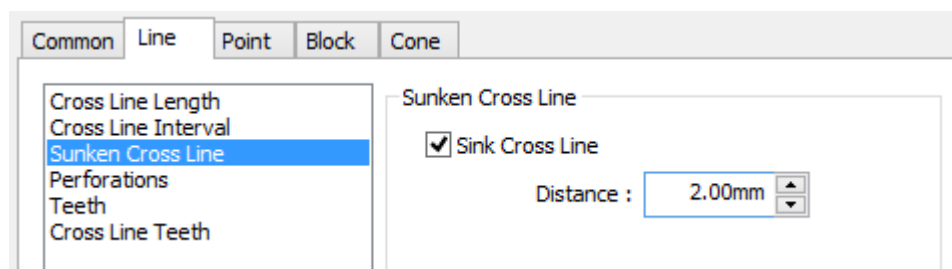
Cross Line Interval parameters



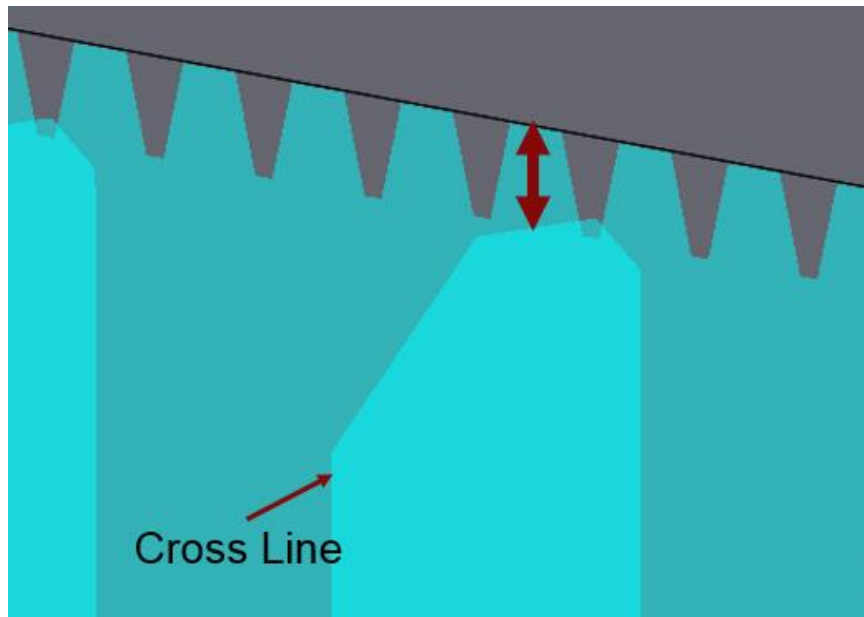
Arrow indicating Cross Line Interval

Sunken Cross Line

Cross lines can be sunken, to minimize the contact area of the support with the parts. They will stop at a certain distance before the part



Sunken Cross Line parameters



Arrow indicating the Sink Cross Line Distance

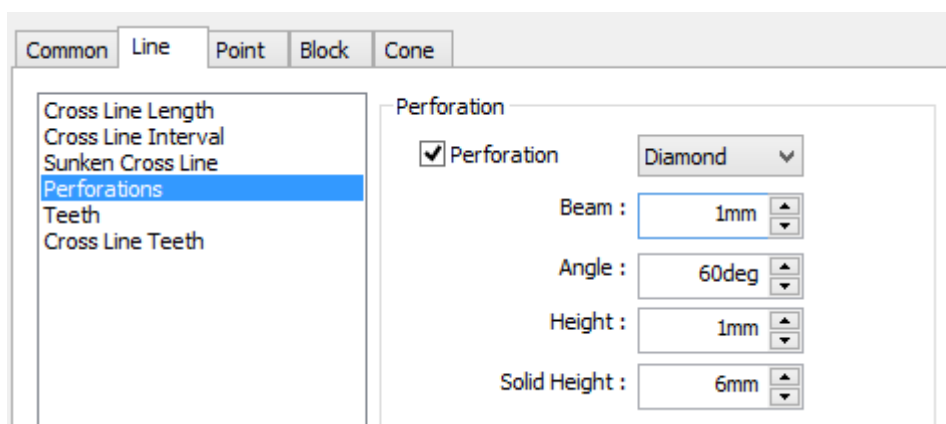
Perforations

There are two kind of perforations possible:

Diamond

When this perforation option is selected, the shape and the size of the perforations are user defined by setting following four parameters to create diamond shaped perforations.

- Beam - Defines the thickness of the beams.
- Angle - Determines the angle of the perforations.
- Height - The height of the vertical part is set with this parameter.
- Solid Height - The separate parameter Solid Height guarantees a good connection to the platform and the teeth.

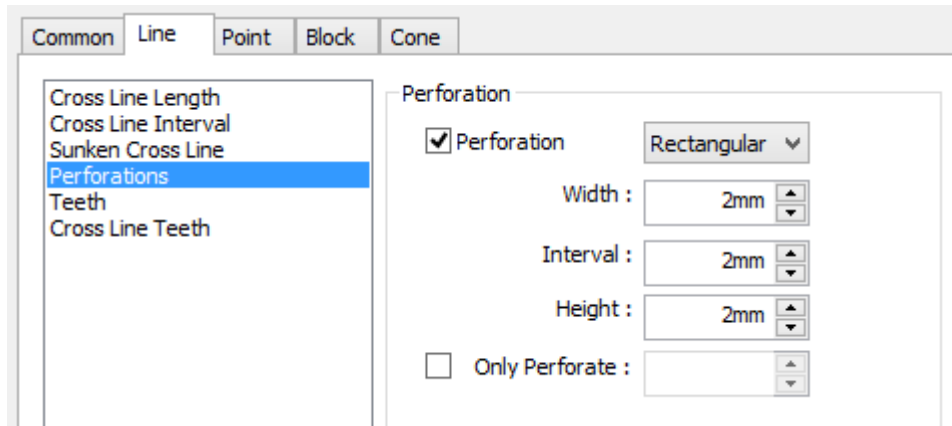


Diamond shape perforation parameters



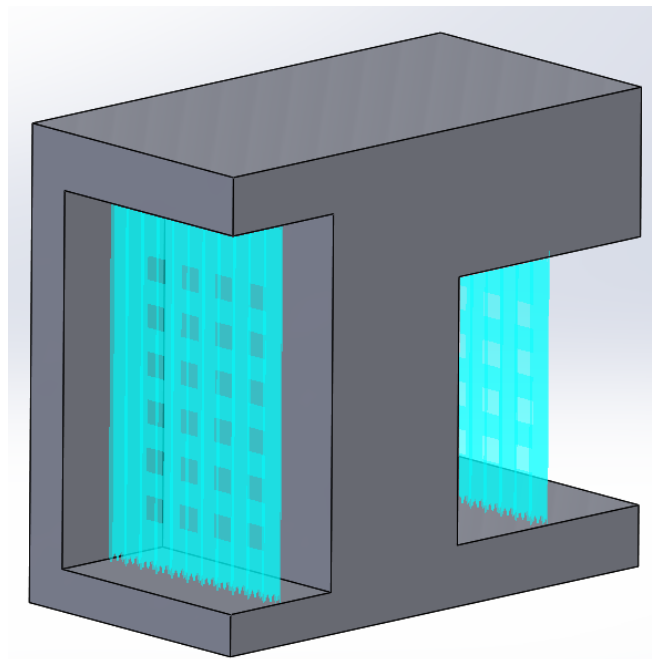
Rectangular

When this perforation option is selected, the shape and the size of the perforations are user defined by setting the following four parameters to create rectangular shaped perforations.



Rectangular perforations parameters

- Width - The width parameter defines the width of the rectangular holes.
- Height - The Height parameter defines the height of the rectangular holes
- Solid Height - The Solid Height parameter guarantees a good connection to the platform and the part.
- Interval - The interval parameter defines the interval between the holes.
- Only perforate rows- The support will only be perforated for the given rows, starting from the bottom. This enables the drainage of resin and ensures stable supports

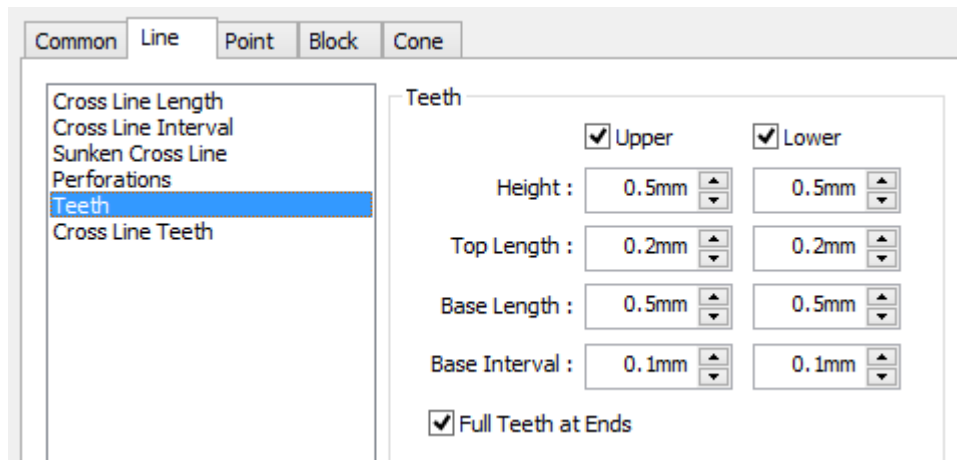


Rectangular perforations

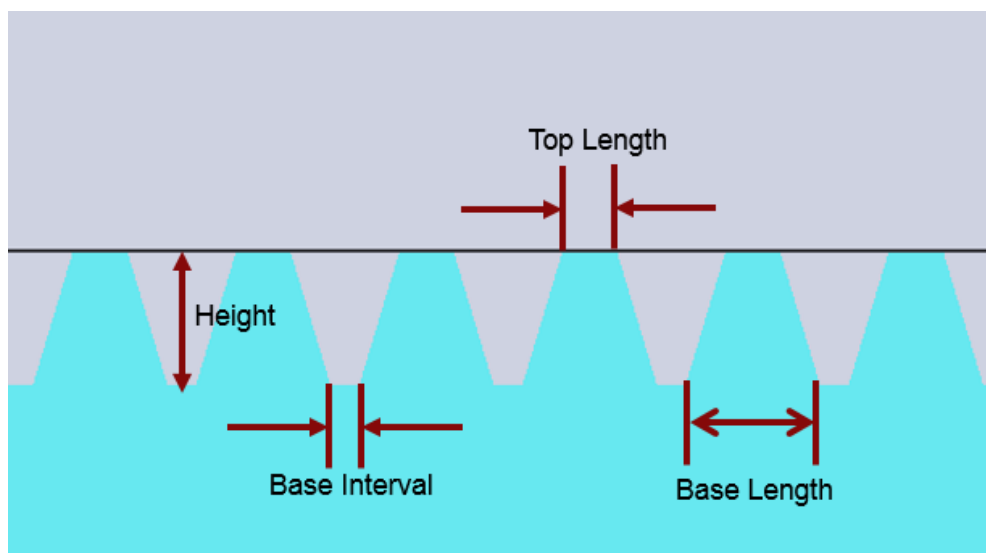


Teeth

Line supports contains teeth profiles on the top and on the bottom.



Teeth parameters

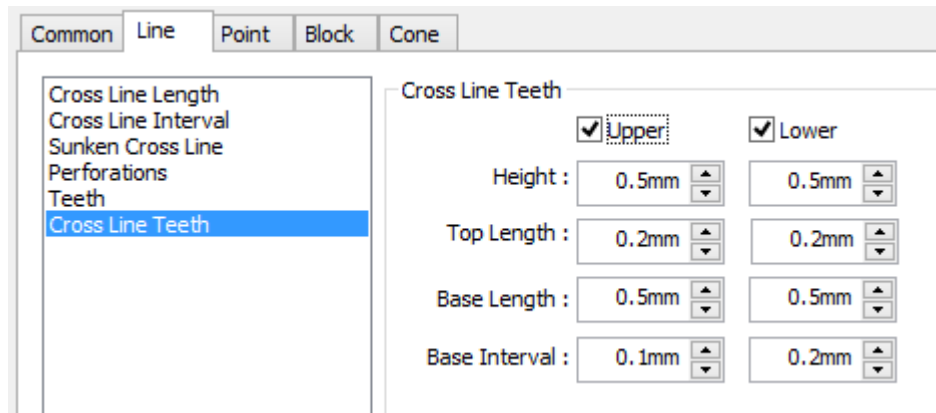


Illustrative Image indicating How to interpret Teeth parameters on Actual Teeth

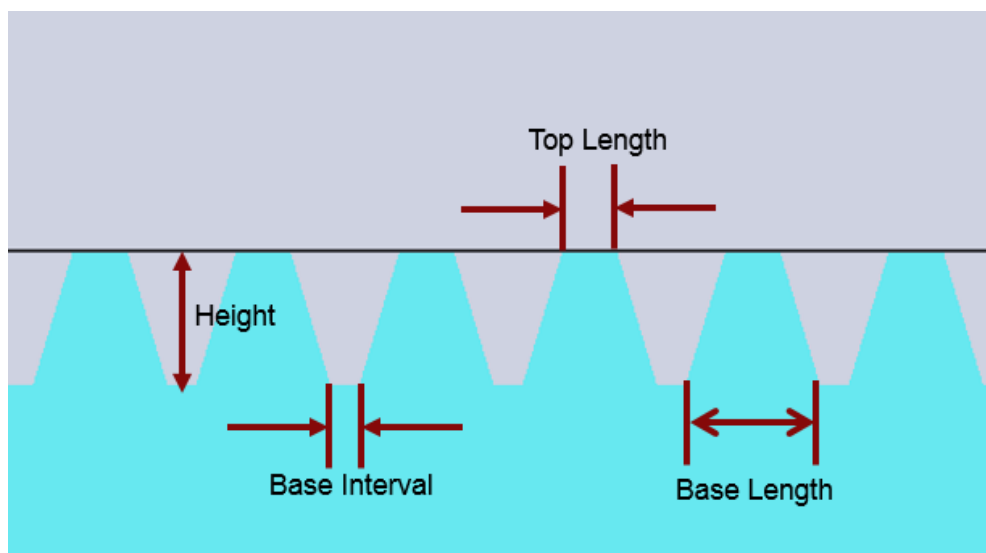


Cross Line Teeth

These teeth parameters will be applied only for the cross lines used in line supports.



Cross Line Teeth parameters



Illustrative Image indicating How to interpret Cross Line Teeth Parameters on Actual Teeth



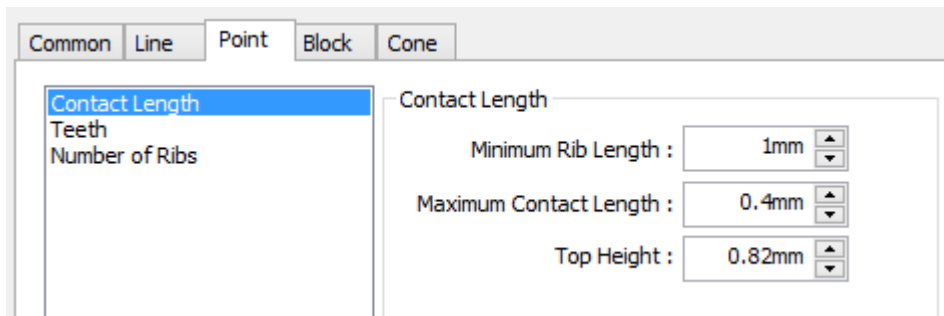
Point Parameters

Contact Length

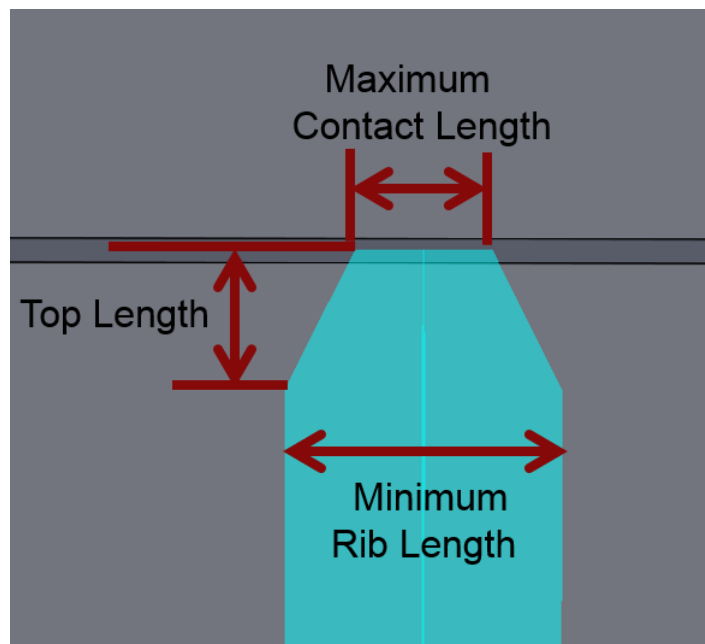
Minimum Rib Length - Define the length of the ribs.

Maximum Contact Length - Define the contact length of support with surface.

Top Height - Define distance from the support to the part



Contact Length parameters

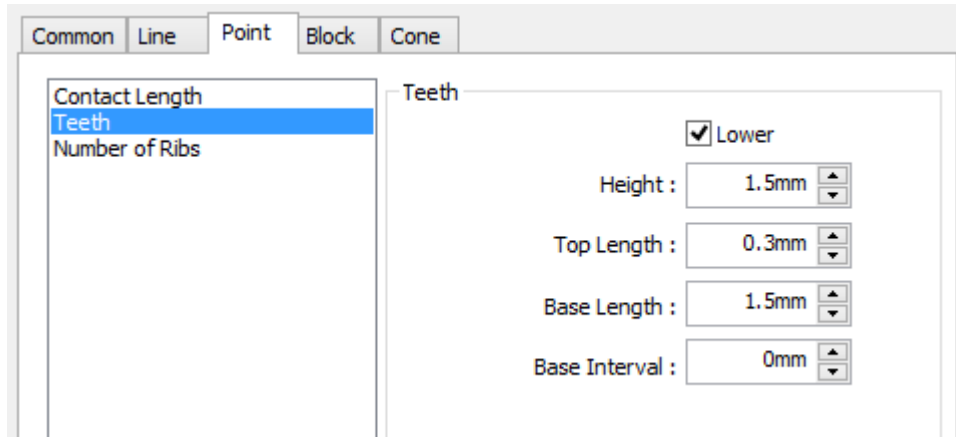


Illustrative Image indicating How to interpret the Contact Length parameters



Teeth

Enables lower teeth for support. Lower teeth are created if support make contact on an up-facing surface. If support make contact on a platform, no teeth are created.



Teeth parameters

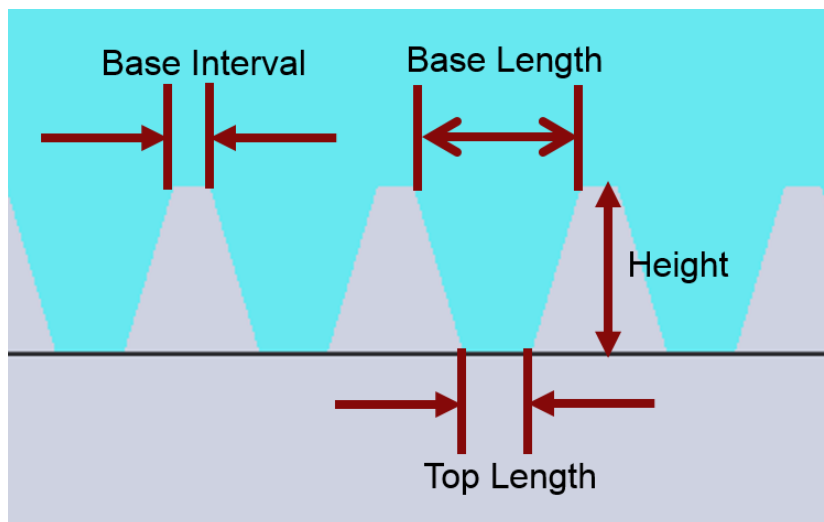
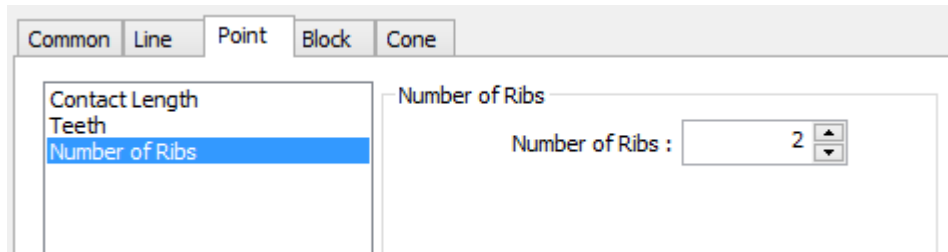


Image Illustrating How to interpret Teeth parameters on Actual Teeth

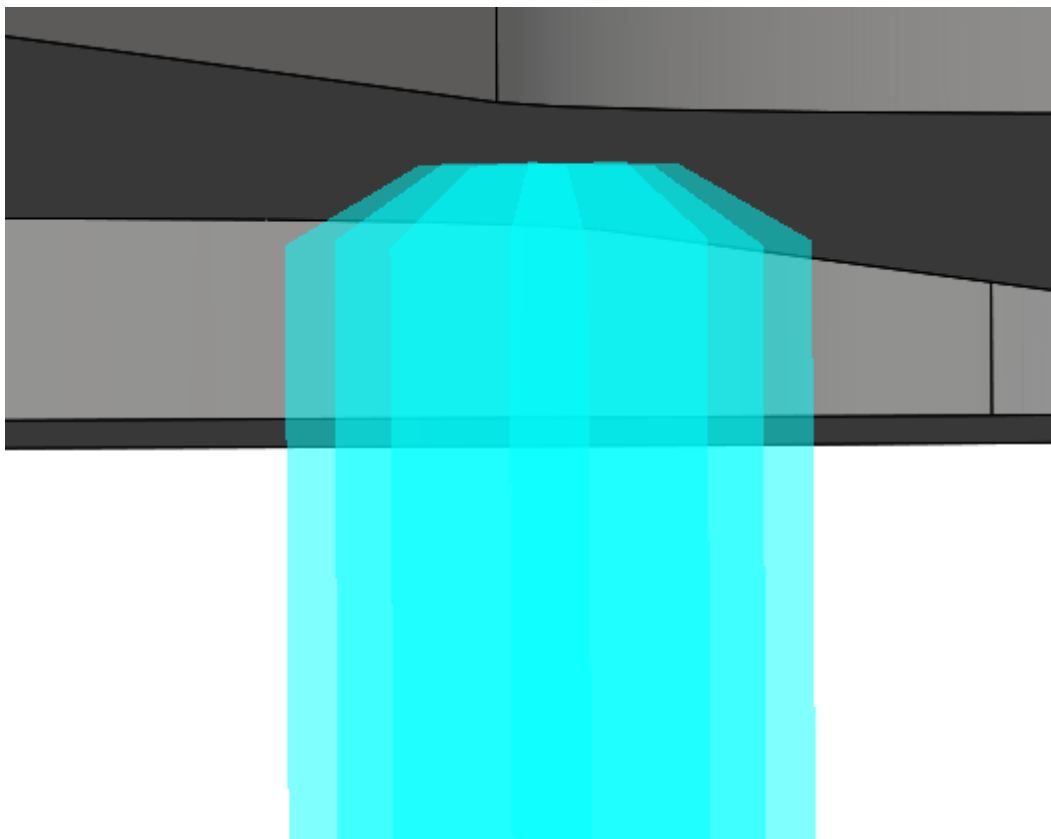


Numbers of Ribs

Define the number of ribs that make up the support.



Number of ribs parameter



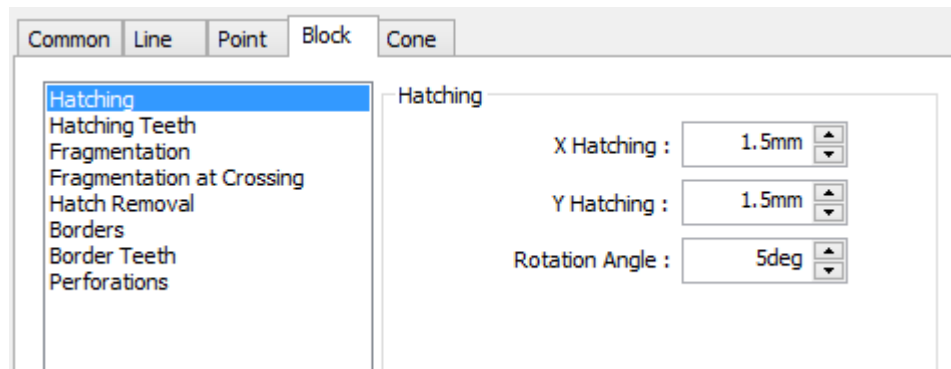
Illustrative Display of Multiple ribs for Point Support



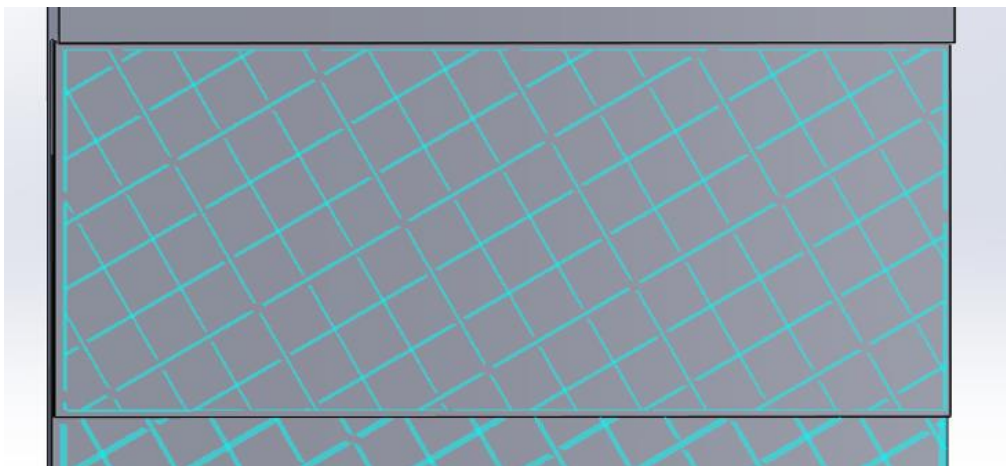
Block Parameters

Hatching

Grid of X and Y lines which are separated at a certain distance (X Hatching and Y Hatching). Rotation angle define the angle between X and Y Line.



Hatching parameters



Illustrative Image indicating Hatching Applied → X =1.5 units and Y=1.5 units; Rotation angle defined as 45 degrees.

Hatching Teeth

Line supports contains teeth profiles on the top and on the bottom. Enables Upper and Lower teeth for support. Lower teeth are created if support make contact on an up-facing surface. If support make contact on a platform, no teeth are created.

Common	Line	Point	Block	Cone
<div> <div> Hatching Hatching Teeth Fragmentation Fragmentation at Crossing Hatch Removal Borders Border Teeth Perforations </div> <div> Hatching Teeth <div> <input checked="" type="checkbox"/> Upper <input checked="" type="checkbox"/> Lower </div> <div> Height : 1.5mm 1.5mm </div> <div> Top Length : 0.1mm 0.4mm </div> <div> Base Length : 1.5mm 1.5mm </div> <div> Base Interval : 0.2mm 0.2mm </div> </div> </div>				

Hatching Teeth Parameters

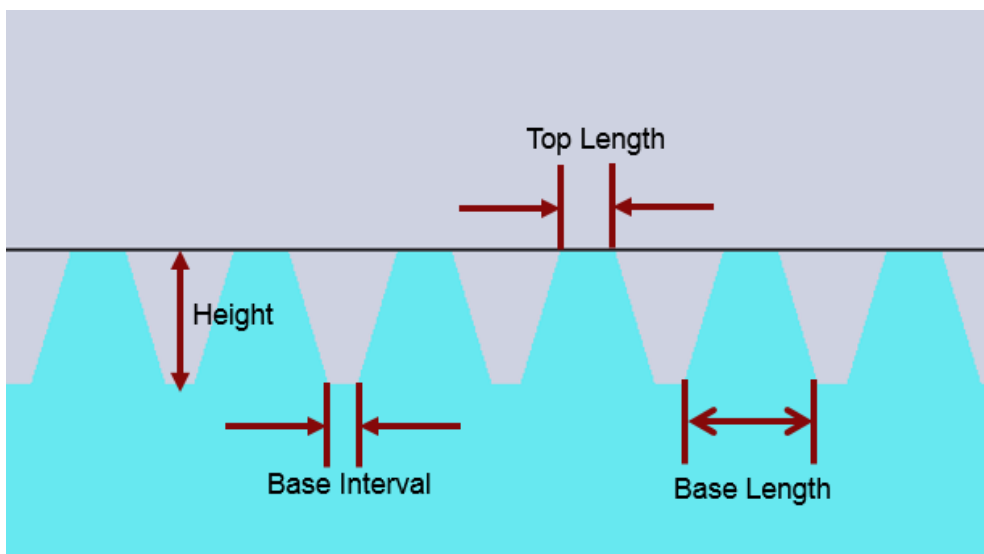


Image illustrating How to interpret Teeth Parameters on Upper and Lower teeth on Hatching Teeth

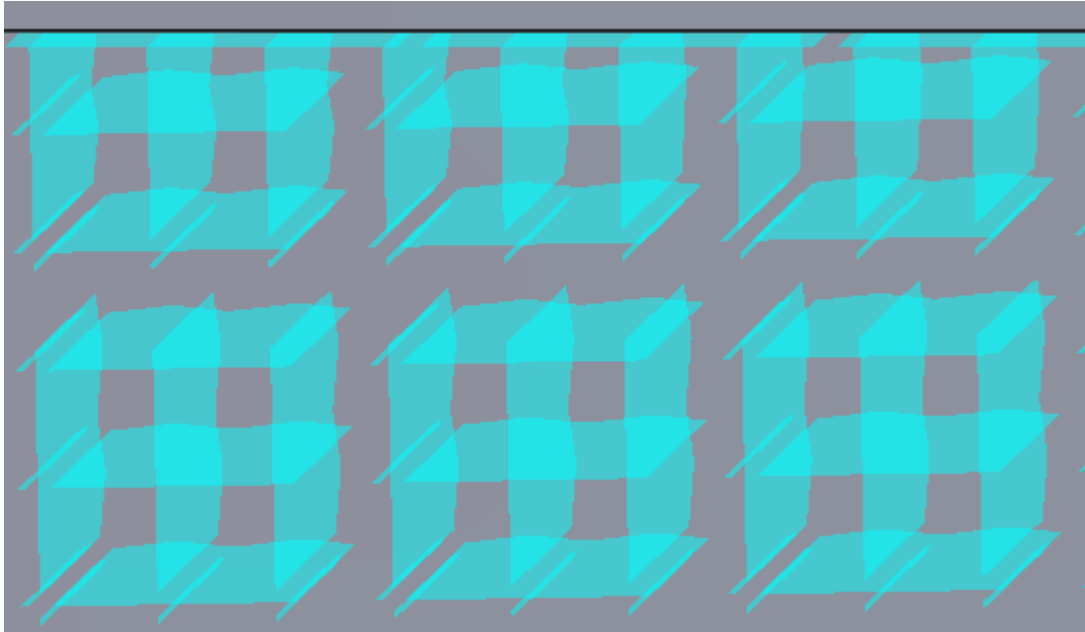
Fragmentation

Generates a small gap in the hatching for the support.

- X Interval – Defines value of X direction gap.
- Y Interval – Defines value of Y direction gap.
- Separation Width - Width of the gaps in the hatching.

Common	Line	Point	Block	Cone
<div> <div> Hatching Hatching Teeth Fragmentation Fragmentation at Crossing Hatch Removal Borders Border Teeth Perforations </div> <div> Fragmentation <div> <input checked="" type="checkbox"/> Fragmentation </div> <div> X Interval : 60mm 60mm </div> <div> Y Interval : 60mm 60mm </div> <div> Separation Width : 0.2mm 0.2mm </div> </div> </div>				

Fragmentation parameters



Illustrative Image indicating Fragmentation applied to support

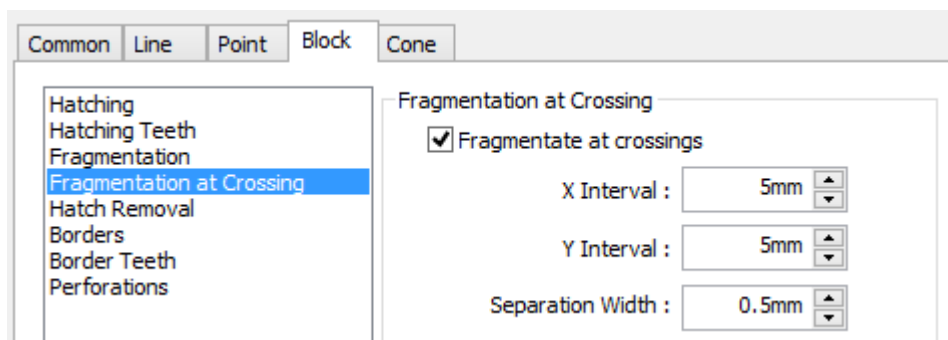
Fragmentation at Crossing

Generates a small gap in the hatching for the cross support.

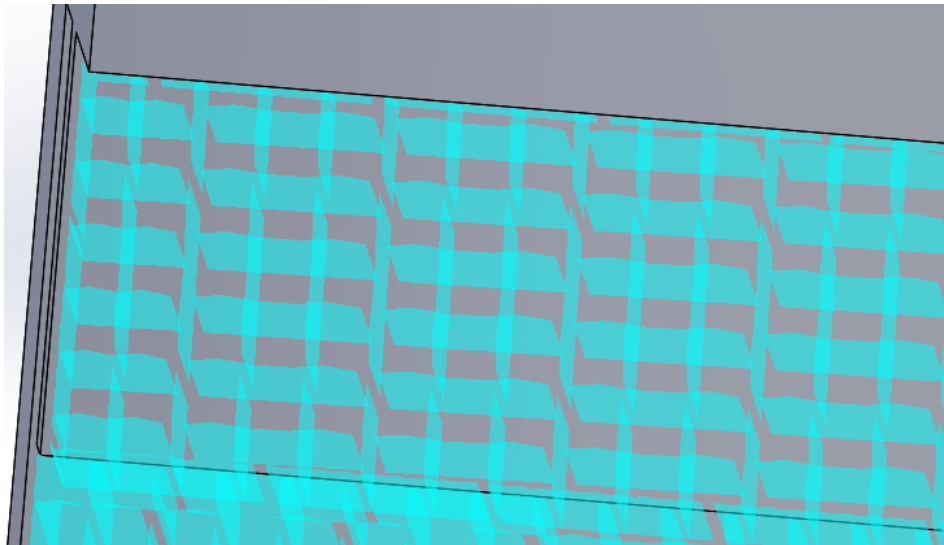
X Interval – Defines value of X direction gap.

Y Interval – Defines value of Y direction gap.

Separation Width - Width of the gaps in the hatching.



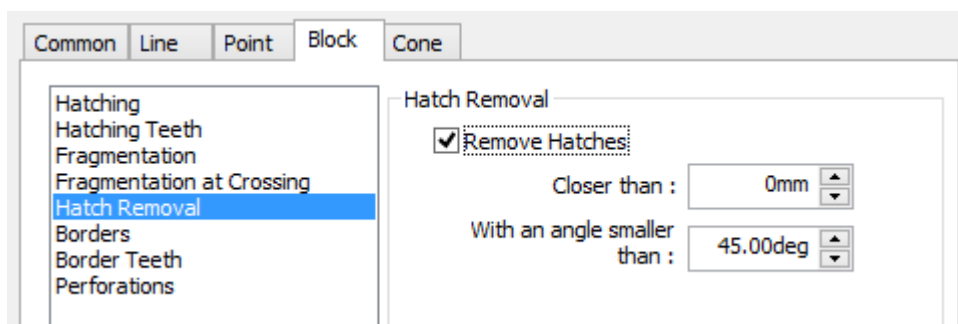
Fragmentation Crossing parameters



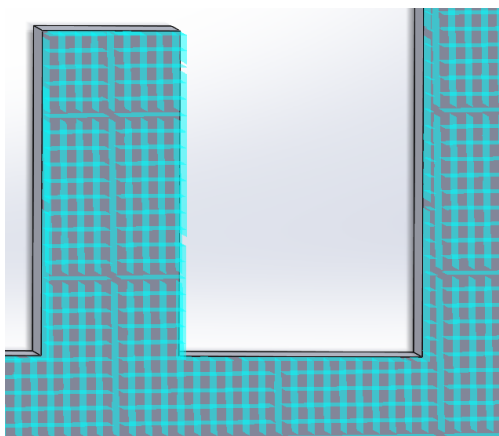
Illustrative Image indicating Fragmentation Crossing applied to Support

Hatch Removal

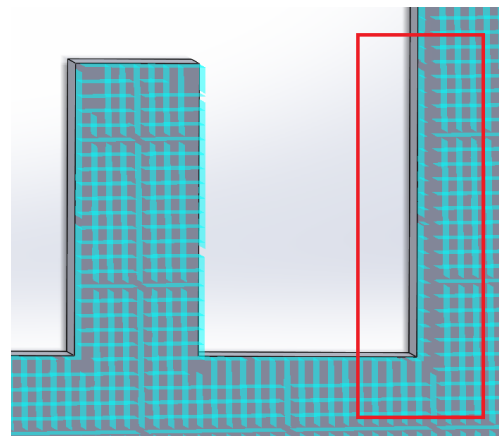
Small hatches are created when small hatch size and small angle are defined. To remove these hatches, use hatch removal.



Hatch Removal parameters



Before



After applying Hatch Removal highlighted

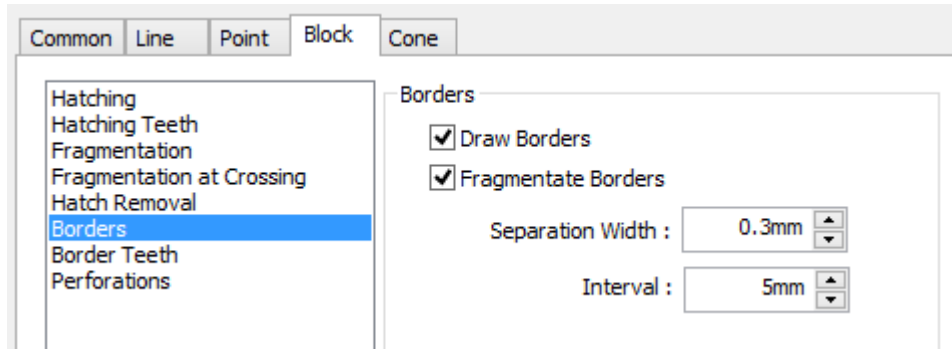


Borders

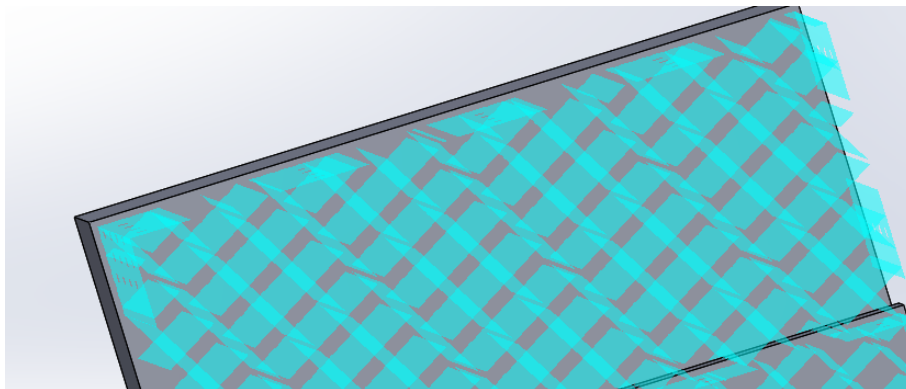
Supports will be reinforced with an additional contour wall.

Fragmentate Borders – When this option is selected, a small gap is generated in borders

- Separation Width – Gap distance
- Interval - Distance between the two a gap



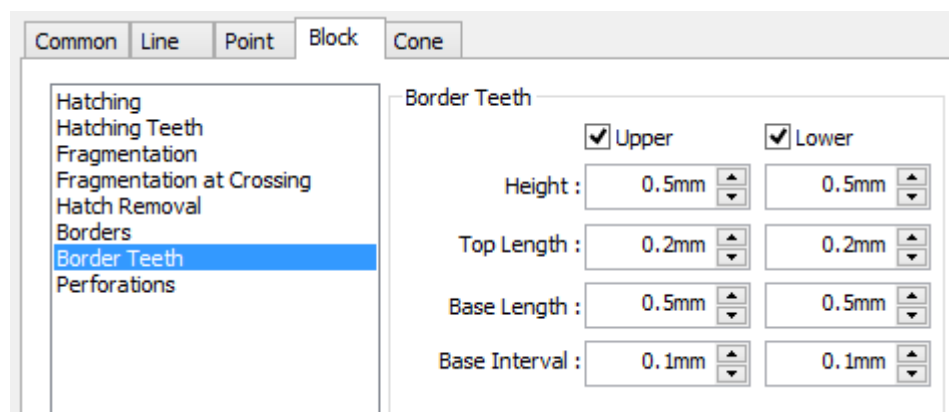
Border Parameters



Illustrative Image indicating fragmented border applied to support

Border Teeth

Supports contains teeth profiles on the top and on the bottom. Enables Upper and Lower teeth for support. Lower teeth are created if support make contact on an up-facing surface. If support make contact on a platform, no teeth are created.



Border Teeth parameters

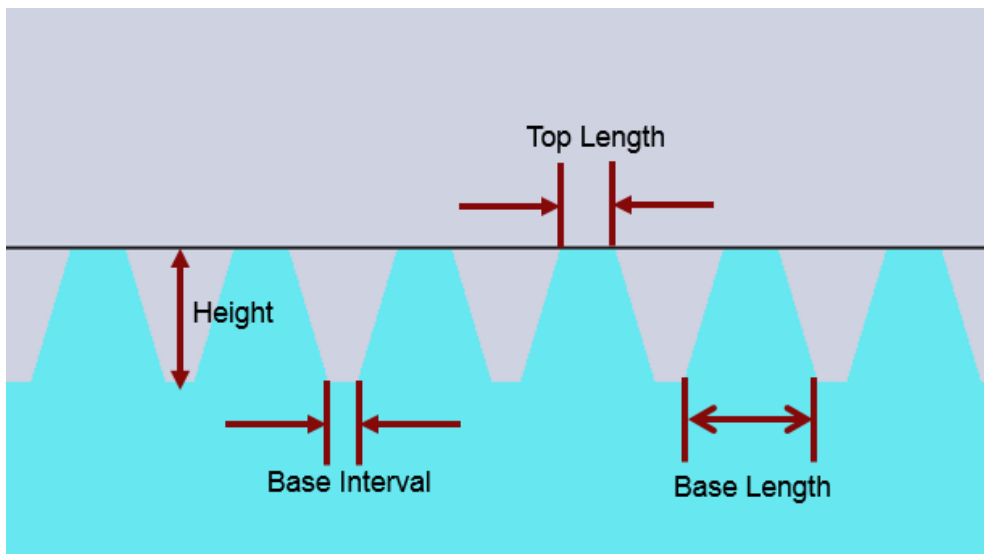


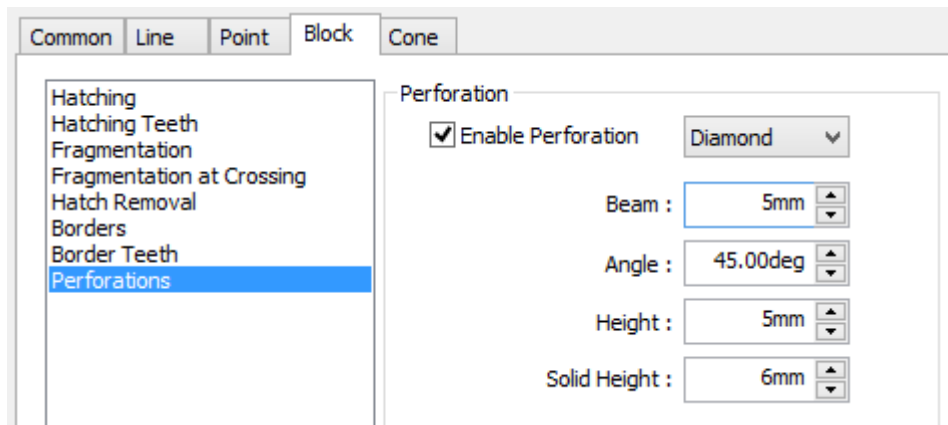
Image indicating How to interpret Border Teeth Parameters on Actual Teeth

Perforation

There are two kind of perforations possible:

Diamond

When this perforation option is selected, the shape and the size of the perforations are user defined by setting four parameters to create diamond shape perforations.



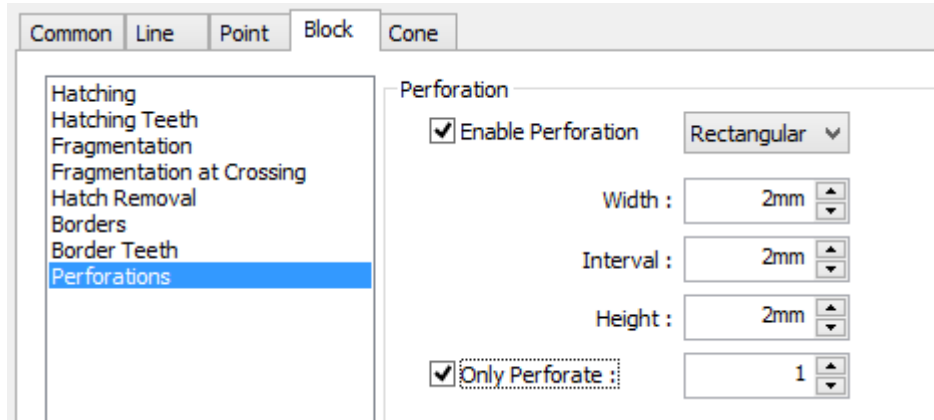
Diamond shape perforation parameters

- Beam - Defines the thickness of the beams.
- Angle - Determines the angle of the perforations.
- Height - The height of the vertical part is set with this parameter.
- Solid Height - The separate parameter Solid Height guarantees a good connection to the platform and the teeth.



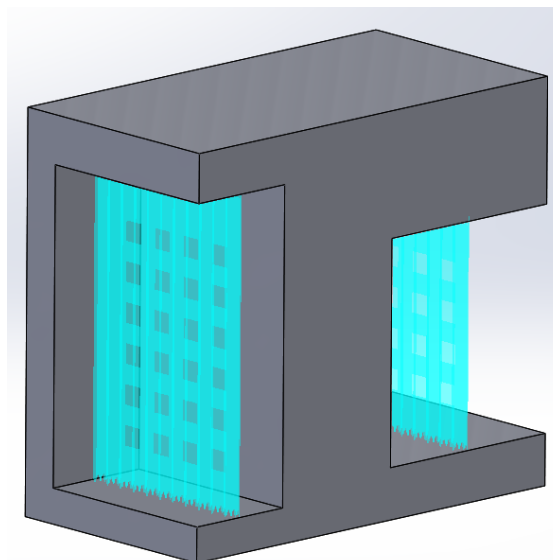
Rectangular

When this perforation option is selected, the shape and the size of the perforations are user defined by setting four parameters to create rectangular shape perforations.



Rectangular perforations parameters

- Width - The width parameter defines the width of the rectangular holes.
- Height - The Height parameter defines the height of the rectangular holes
- Solid Height - The Solid Height parameter guarantees a good connection to the platform and the part.
- Interval - The interval parameter defines the interval between the holes.
- Only perforate rows- The support will only be perforated for the given rows, starting from the bottom. This enables the drainage of resin and ensures stable supports



Rectangular perforations

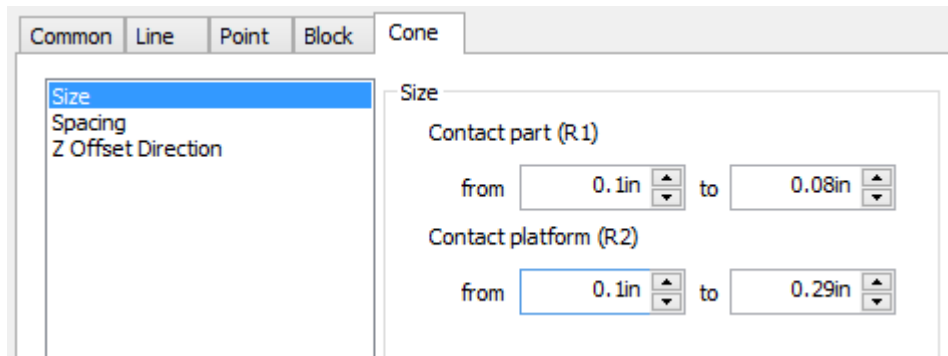


Cones Parameters

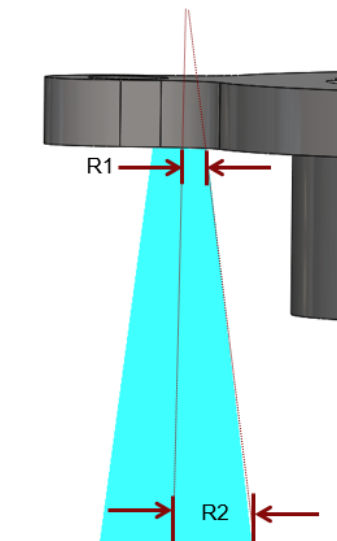
Size

Contact Part – Indicates the size of the cone at the part

Contact to Platform – Indicates the size of the cone at the platform



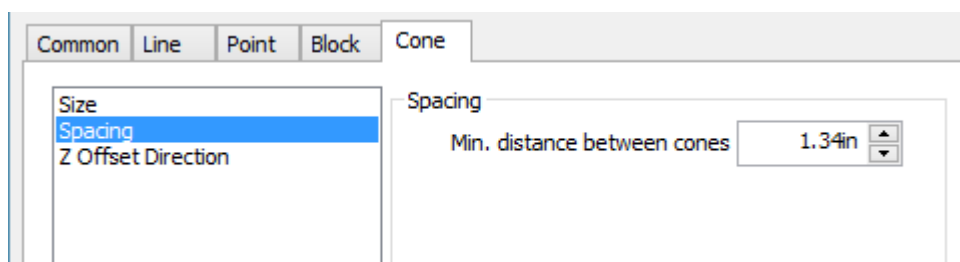
Size Parameter



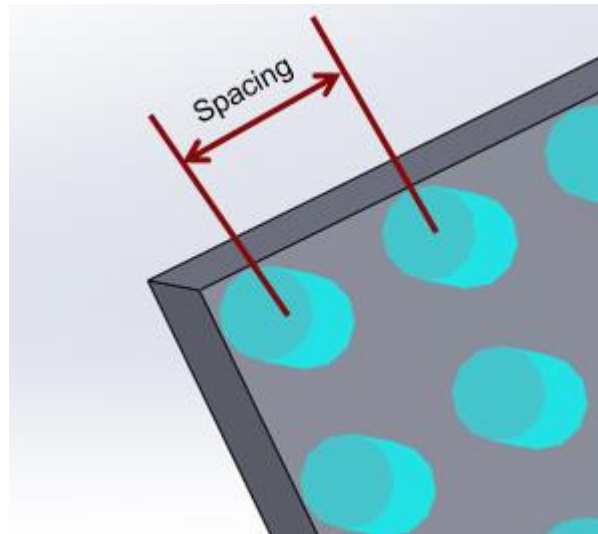
Size parameter applied to support

Spacing

This parameter defines minimum distance between two cones.



Spacing parameter

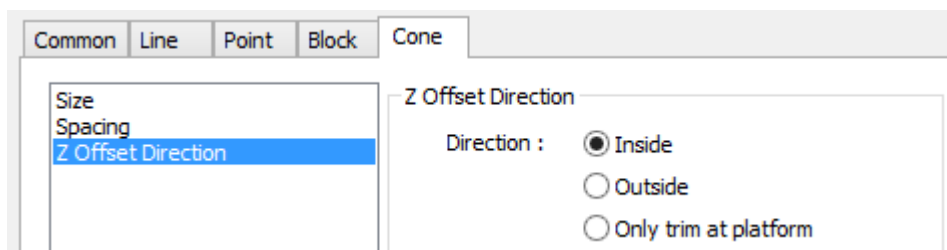


Illustrative Image indicating Spacing between two Cones

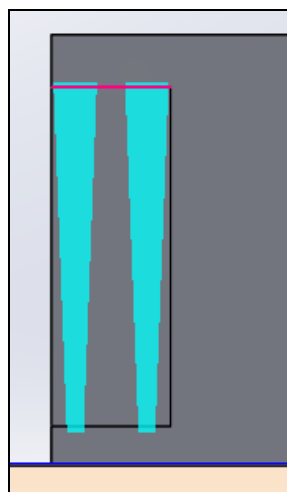
Z Offset

This parameter defines the direction of the Z offset.

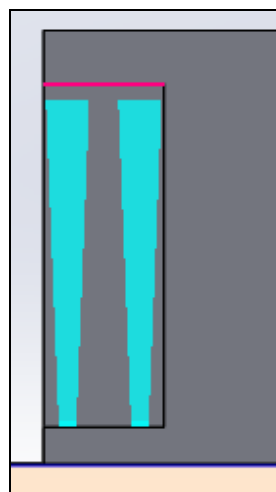
- Inside - Support structure created underneath the surface. So there is a gap between the surface and support
- Outside - Support structure created above the surface. The support goes partly inside the part.
- Only trim at platform - Support structure gets trim at platform.



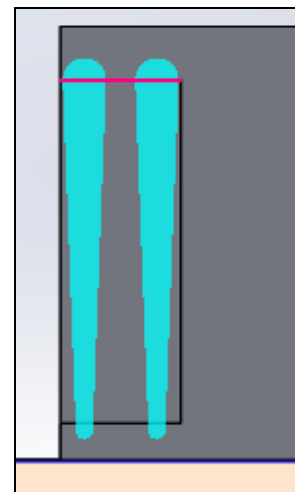
Z Offset Direction



Inside Z offset



Outside Z offset



Only Trim at Platform