RENISHAW
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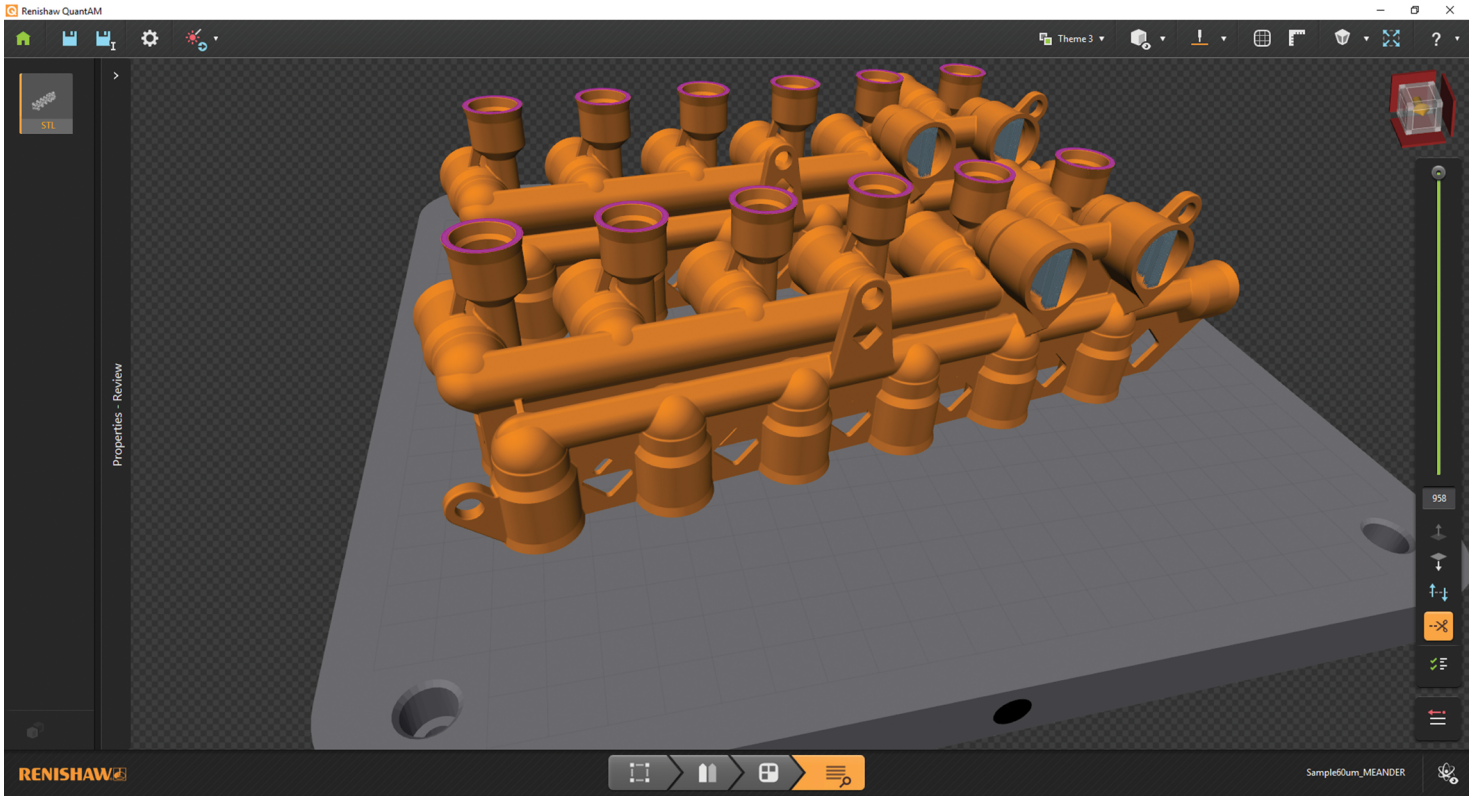
QuantAM V6.1: Build preparation software



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Contents

1. Legal notices

This quick-start guide covers the Renishaw QuantAM build preparation software version 6.1.

1.1. Patents

Features of the Renishaw QuantAM build preparation software are the subject of one or more of the following patents and/or patent applications:

CN 105102160	CN 105228775	CN 105492188	CN 105492981	CN 106457393	CN 107206494	CN 107771123	CN 108189390
CN 108515182	CN 108829942	CN 109177153	CN 111545754	CN 112055630	EP 2956261	EP 2956262	EP 3007879
EP 3014369	EP 3119587	EP 3221075	EP 3302939	EP 3323533	EP 3323534	EP 3357606	EP 3566798
EP 3787817	IN 394466	IN 411680	JP 6482476	US 10191476	US 10335901	US 10493562	US 10500641
US 10639879	US 10890893	US 10994335	US 11104121	US 11117360	US 11267052	US 11478856	US 11559941
US 11565346	US 11752694	US 12030245	US 2024-0083108	US 9669583			

1.2. Warranty

Unless you and Renishaw have agreed and signed a separate written agreement, the equipment and/or software are sold subject to the Renishaw Standard Terms and Conditions supplied with such equipment and/or software, or available on request from your local Renishaw office.

Renishaw warrants its equipment and software for a limited period (as set out in the Standard Terms and Conditions), provided that they are installed and used exactly as defined in associated Renishaw documentation. You should consult these Standard Terms and Conditions to find out the full details of your warranty.

Equipment and/or software purchased by you from a third-party supplier is subject to separate terms and conditions supplied with such equipment and/or software. You should contact your third-party supplier for details.

2. Set-up

2.1. Installation and activation

1. After you have purchased Renishaw QuantAM build preparation software you will receive an email from Renishaw.
2. Follow the instructions in the email to install and activate Renishaw QuantAM.

NOTE: QuantAM does not support directories containing Unicode symbols.

2.2. Configuration

QuantAM build preparation software is preconfigured for Renishaw additive manufacturing systems.

2.3. Recommended PC specification

- Processor CPU – 2020 (or later), 2.8 GHz (or higher) Intel or AMD processor.
- Operating system – Windows® 10 64-bit (version 1607 or later) or Windows® 11 64-bit.
- Memory – 16 GB RAM (or higher).
- Storage drive – Internal Solid State Drive (SSD) with 128 GB of space for processing and storage for build files.
- Monitor/display – Minimum resolution 1280 × 1024. For high-definition (HD) display, use a monitor with a resolution of 1920 × 1080.
- Graphics card – 2 GB or higher dedicated (graphics card supporting DirectX 9 and above).

NOTE: You will need sufficient local administrator privileges to install the software.

The QuantAM user interface can be used with a regular Windows-compatible mouse or a space mouse.

It is recommended that QuantAM is installed on a drive with at least 10 GB of free space, for faster computation.

3. Build preparation process

3.1. Introduction

Using QuantAM to prepare your 3D data for an additive manufacturing (AM) build is a very simple process, with only a few steps required to create a build file. If you are preparing an .mtt build file using STL or various other supported CAD file formats, there are four stages involved in the build preparation process. If you are preparing a build file from an .mtt or .renam file format, there are five stages.

1. Orientation

Position your part in an optimal orientation.

2. Support

Add support to your model, where required.

3. Layout

Create layout for your models on the build plate.

4. Review

Review and generate slices and scan paths for your model and generate build file.

5. Build file viewer

Assign lasers for a multi-laser build, configure parameters, optimise TEMPUS™ technology settings, review and create a build file.

Four stages must be completed to generate the AM build preparation file

Optional fifth stage

3.2. Training

Renishaw offers training courses to assist you in getting the best out of QuantAM software. Use the contact information provided in section 7, “Contact details”, to connect with Renishaw and explore the range of available training options.

4. User interface

4.1. Introduction

The user interface of QuantAM is described in the following sections:

Section 4.2, Start page

Section 4.3, Generic QuantAM functions

Section 4.4, Stage 1 of build preparation – ‘Orientation’

Section 4.5, Stage 2 of build preparation – ‘Support’

Section 4.6, Stage 3 of build preparation – ‘Layout’

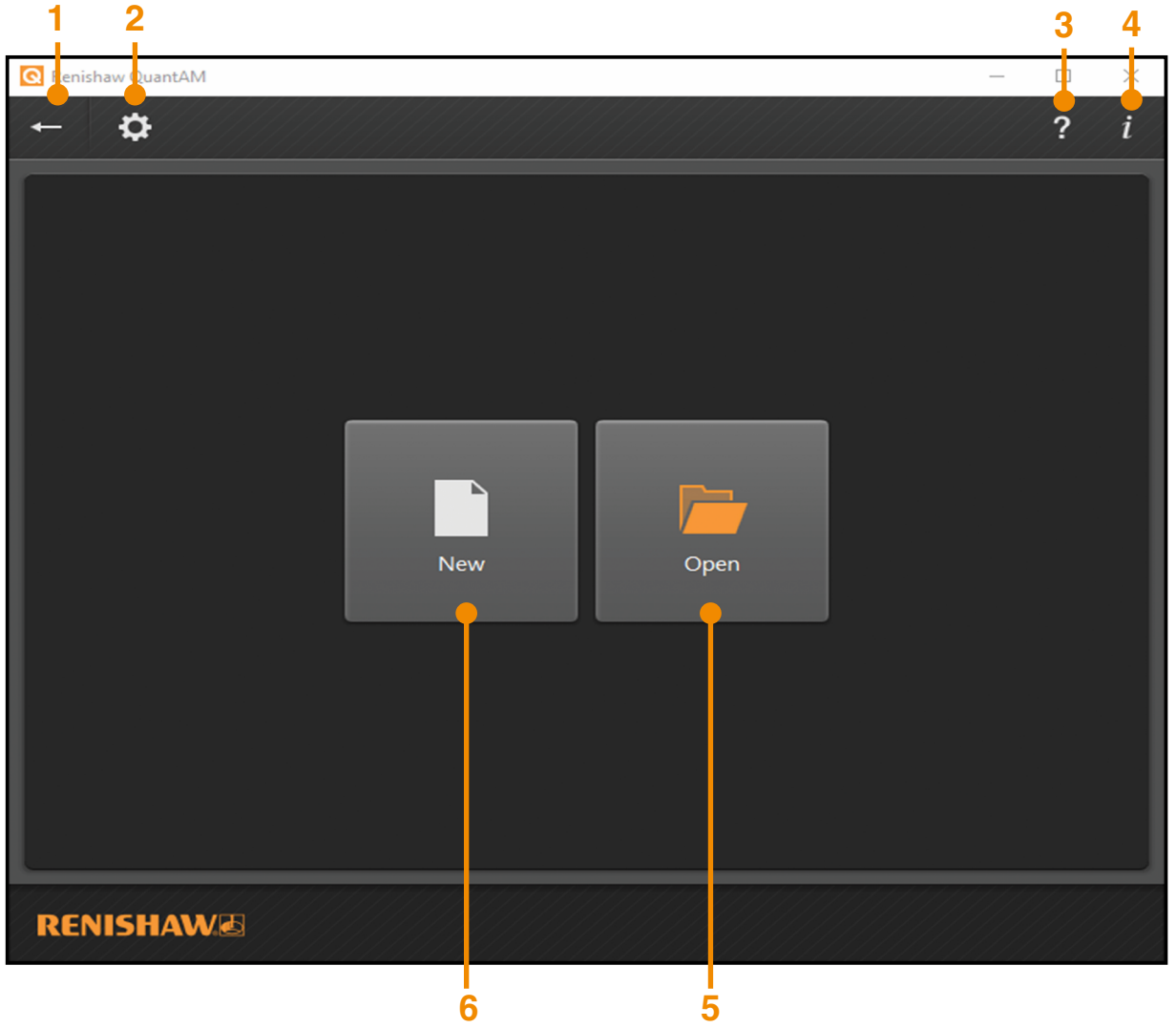
Section 4.7, Stage 4 of build preparation – ‘Review’

Section 4.8, Build file viewer

Section 5, QuantAM Dental

Section 6, Keyboard shortcuts

4.2. Start page



1 

Start or Navigate to 3D View

Allows you to navigate to the start page of the QuantAM application. If you are on the start page, an arrow labelled 'Navigate to 3D View' is displayed. Click the arrow to return to the '3D View'.

2 

Settings

Click the 'Settings' button to display the 'Settings' dialog box. This enables you to configure the parameters for 'Build Preparation' and 'Build File Viewer' and update the 'General' settings according to your preference.

In the 'Build Preparation' menu there are three separate tabs to update the default configuration of the 'Build', 'Support' and 'Dental'. All tabs, their function, and the displayed UI elements are described in the table below.

NOTE: The 'Dental' tab is displayed only if the relevant QuantAM dental licence is activated. For more information see section 5, "QuantAM Dental".

Tabs in the Settings dialog box	Controls	Description
Build Preparation > Build	**Machine and Build Volume**	'Machine': Use the 'Machine' drop-down list to select the default Renishaw AM machine for executing all your builds. The selection includes AM250, AM400 and RenAM 500 series AM systems (including 500S, 500D and 500Q machine variants).
		'Build Volume': Select a build volume ('Default' or reduced build volume 'RBV') for all the builds loaded in the build preparation stage.
		'Substrate Dimensions': Use the drop-down list to configure a default substrate dimension ('246 × 246' or '248 × 248') for all your builds loaded in the build preparation stage. Select a '246 × 246' substrate if the build plate is manufactured using a material with a higher coefficient of linear thermal expansion to allow thermal expansion of the build plate during the manufacturing process.
		'Auto Build Time': Toggle to automatically calculate the 'Build Time Estimation' in the review stage of build preparation.
	Material Details	'Default Material': Set a default material for all your builds in the build preparation stage. You can change the default build material at any stage during the build preparation process.
	Units	'Import Units': Configure the measurement of the imported files in millimetres (mm) or inches (in).
		'Display Units': Configure the display measurement units.

Tabs in the Settings dialog box	Controls	Description
Build Preparation > Build	**Co-ordinate System**	'Part Co-ordinate System': Toggle to disable the display of the part in its original co-ordinate system instead of adjusting the part placement as per the build plate co-ordinate system.
		'Z Offset': Configure a default Z offset between the model and the build plate for all your build files.
	Scale Models	'Apply Uniform Scaling': Toggle to enable or disable uniform scaling for all the builds about the co-ordinate system. If you do not wish to apply a uniform scaling, disable the 'Apply Uniform Scaling' button and enter the scaling amount in the 'X Axis', 'Y Axis' and 'Z Axis' field.
		'Apply Scaling to Imported Supports': Toggle to apply the defined scaling to all the imported supports.
	Healing	'Slice Healing': Toggle to automatically heal the open slices.
Build Preparation > Support	**Support**	'Delete Supports Confirmation': Enable the toggle button to receive a confirmation prompt when deleting supports.
		'Default Support Style': Use the drop-down list to select a default support style for all your builds.
	Imported Support	'Merge Support': Toggle to merge all the imported supports as one triangulation for quick selection and better performance.
Build File Viewer	**Machine and Build Volume**	'Machine': Set a default machine for all your builds in the build file viewer stage. The selection includes AM250, AM400 and RenAM 500 series AM systems (including 500S, 500D and 500Q machine variants).
		'Build Volume': Select a build volume ('Default' or reduced build volume 'RBV') for all the builds loaded in the build file viewer stage.
		'Substrate Dimensions': Use the drop-down list to configure a default substrate dimension ('246 × 246' or '248 × 248') for all your builds in the build file viewer stage. Select a '246 × 246' substrate if the build plate is manufactured using a material with a higher coefficient of linear thermal expansion to allow thermal expansion of the build plate during the manufacturing process.

Tabs in the Settings dialog box	Controls	Description
General	**Miscellaneous**	‘Language’: Select the language of the user interface (UI). **NOTE:** This option is disabled for selection in QuantAM software version 6.1. The ‘English (United Kingdom)’ UI language is applied by default.
		‘Currency’: Select a default currency for the calculation of ‘Cost Parameters’ in stage 4 of build preparation – ‘Review’.
	Export Path	Configure a default location for exporting different file types such as .stl, .amx, .csv, .mtt/renam, .ooc.

3 

Help User (F1)

Open the quick-start guide in the PDF viewer installed on your system. You can access the quick-start guide from all the stages during the build preparation process.

4 

About QuantAM

Display the product licence and trade mark information about the Renishaw QuantAM software.

5 

Open

Open a model or build file in the QuantAM application. Click to choose and open models or build files as .stl files or various CAD formats (‘Browse Model...’), projects as .amx files (‘Browse AMX...’) or build files as .mtt or .renam files (‘Browse Build File...’). Selecting and opening a build file (.mtt or .renam) opens the ‘Build File Viewer’ stage (see Section 3.8). The ‘Build File Viewer’ stage enables you to rapidly prepare a build using the selected file. This is useful when you wish to make necessary revisions to a build file before executing it on an AM system.

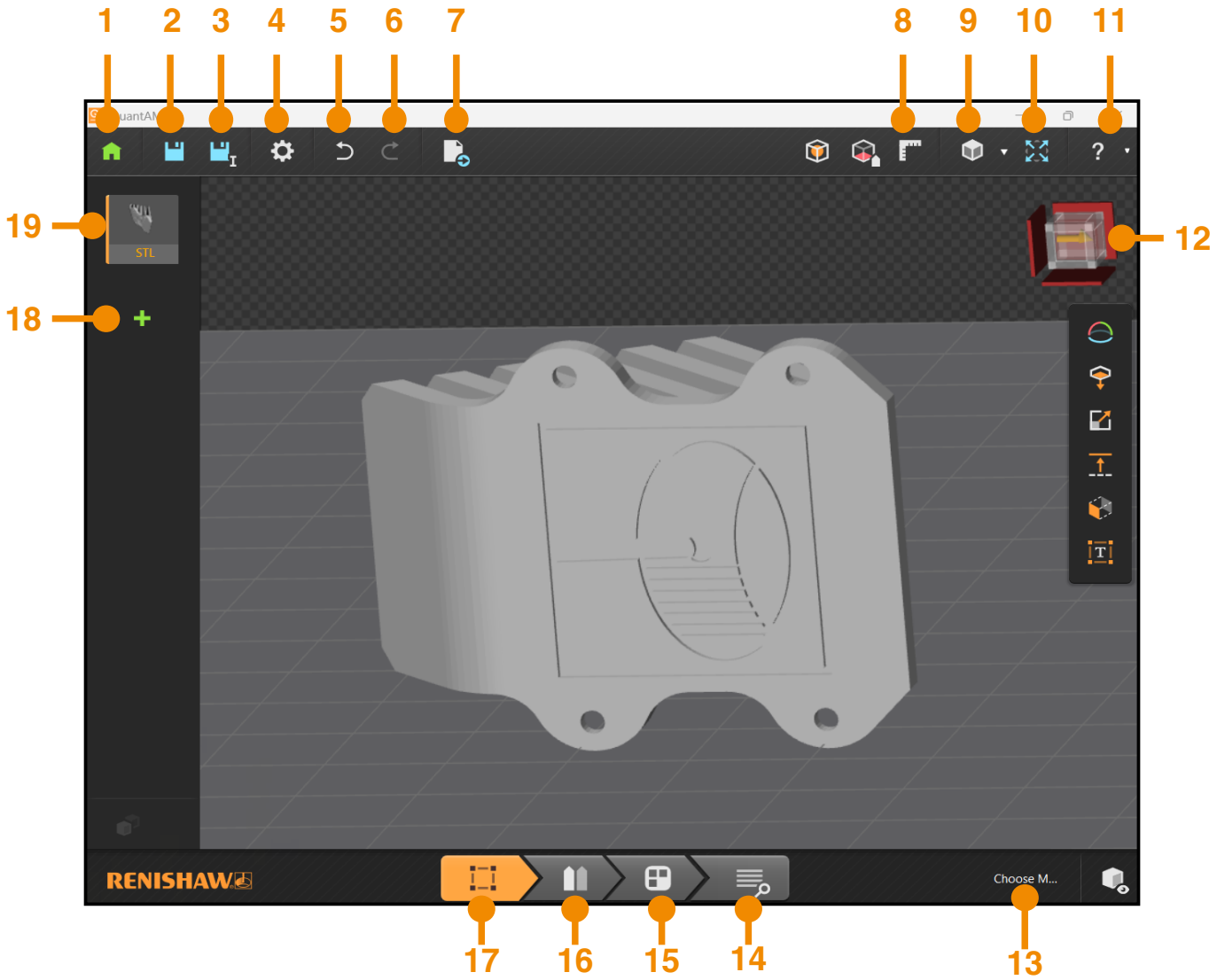
NOTE: You can browse your device and network drives for the supported files. If you open a file from the network directory, a message is displayed informing you that the file you are trying to open is stored on a network, and opening it can degrade the performance of QuantAM.

6 

New

Opens a new blank workspace, into which you can select and import CAD data of the following types: .amx, .catpart, .cli, .ctm, .prt, .sab, .sat, .sldprt, .step, .stl, .stp, .x_b or .x_t.

4.3. Generic QuantAM functions



The generic QuantAM functions are those functions that are available in all four stages of the build preparation process. All the four stages of the build preparation process also have additional functions which are specific to that stage. Each stage, and its functions, are described in the following sections.

NOTE: All Ctrl + [number] shortcuts refer to keyboards with a number pad. For users without a number pad, such as laptop, use Ctrl + Windows key + [number].

1 

Navigate to Start Page

Open the start page of the QuantAM application. If you are on the start page, an arrow labelled ‘Navigate to 3D View’ is displayed at the same position. Click the arrow to return to the ‘3D View’.

2 

Save (Ctrl + S)

Save the project (model, support and scan path parameters) as a QuantAM project file (.amx file) in a location of your choice.

3 

Save As (Ctrl + Shift + S)

Save a copy of the project (model, support and scan path parameters) as a QuantAM project file (.amx file) in a location of your choice.

4 

Settings

Configure the default parameters of the QuantAM application. For more information, see section 4.2, “Start page”.

5 

Undo (Ctrl + Z)

Undo the last action and revert to the previous state.

6 

Redo (Ctrl + Y)

Redo the previously undone action.

7 

Export (Ctrl + E)

Click to export the components of a project as ‘Only Part (Cluster)’, ‘Only Support’, ‘Both Part or Supports’ or ‘Exposures’.

NOTE: The ‘Export’ button is only available in the ‘Orientation’ and ‘Support’ stages of build preparation.

8 

Show/Hide 2D Measurement (K)

Display or hide the ruler around the edge of the build plate window. The ruler helps you to position the parts, text, and other elements of your build. You can define the unit of measurement as millimetres (mm) or inches (in).

NOTE: This button is not functional when the models are viewed using the 'Perspective View (Ctrl + 8)' function.

9a 

Perspective View (Ctrl + 8)

Optimise the rendering to add a more natural view to the model. Toggle between the 'Perspective View' and 'Orthographic View' using the keyboard shortcut (Ctrl + 8) or use the drop-down menu.

9b 

Orthographic View (Ctrl + 8)

All the models opened in QuantAM are displayed in orthographic projection by default. The model is represented by right angles and parallel lines.

10 

Zoom to Extents (Ctrl + 0)

Click to fit the entire part on the build plate window. Use the mouse controls to adjust the zoom level to fit all the models on the build plate window and view the entire build.

11 

Help User (F1)

Click to open the QuantAM quick-start guide. Click the down arrow to display the following options (11a and 11b):

11a 

Help User (F1)

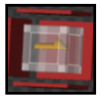
Open the QuantAM quick-start guide in a new window. It is accessible from all the stages of build preparation.

11b 

Keyboard Shortcut (Ctrl + F1)

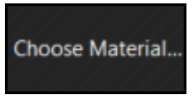
Displays grouped lists of keyboard shortcuts. Click anywhere on the screen to close. For more information, see section 6, "Keyboard shortcuts".

NOTE: There are six grouped lists of keyboard shortcuts in the build preparation stage and four in the build file viewer stage.

12 

Navicube

Change the view of the part. You can navigate to the predetermined views by selecting the edges, corners and planes of the ‘Navicube’. Alternatively, you can click and drag the ‘Navicube’ to display a view that suits your need. Use keyboard shortcut (Ctrl + 9) to toggle between different ’Navicube’ types to display only the edges, corners or planes for quick selection. The direction of the orange arrow inside the ‘Navicube’ identifies the front view of the build plate.

13 

Choose Material File

Select a material for your build. Click to open the ‘Material Details’ window and select the required material from the ‘Material’ drop-down menu. The tabs contain detailed information about the selected material, including the associated material parameters such as ‘Slicing’, ‘Hatching’, ‘Shell and Core’, ‘Order’ and ‘Scanning’. If you wish to apply a material, select it from the drop-down menu and click ‘OK’.

13a 

Import Material File (Ctrl + M)

Click to open the ‘Import Material File’ dialog box. Browse and add a new material file to the QuantAM application from your device or network drives.

14 

Review

The fourth stage of the build preparation process. Generate slices and scan paths for your model before exporting the build file.

15 

Layout

The third stage of the build preparation process. Create virtual prototypes of the models on the build plate to effectively utilise the available space on the build plate.

16 

Support

The second stage of the build preparation process. Add supports to your part to prevent costly build failures.

17 

Orientation

The first stage of the build preparation process. Position your part in an optimal orientation for a better quality build and surface finish.

18 

Import CAD Data

Click to open the 'Import model' dialog box. Select the CAD data you wish to import (.catpart, .ctm, .amx, .prt, .sab, .sat, .stl, .x_t, .stp, .step, .x_b, .sldprt or .cli) into the workspace. Alternatively, you can import files or models by dragging and dropping them on the 'Import CAD data' button on the access bar.

NOTE: If you drag-and-drop unsupported files, an error message is displayed informing you that the selected file format is not supported by the application.

When importing .cli files, you are prompted to select whether it is a 'Slices' type file or a 'Scanpaths' type file. Slice CLI files contain layer information for all parts in the file. Scanpath CLI files contain scan information for just one part. The CLI slice thickness must match any existing slices and the material file selected.

---

19 

Model thumbnail

Displays a thumbnail with the format of the model file currently open in the QuantAM workspace. The orange shadow indicates that the model file is displayed in the build plate window. Hover the mouse over the thumbnail to view the file name and file type.

Zoom

Use the scroll bar to zoom in and out of the model displayed in the build plate window.

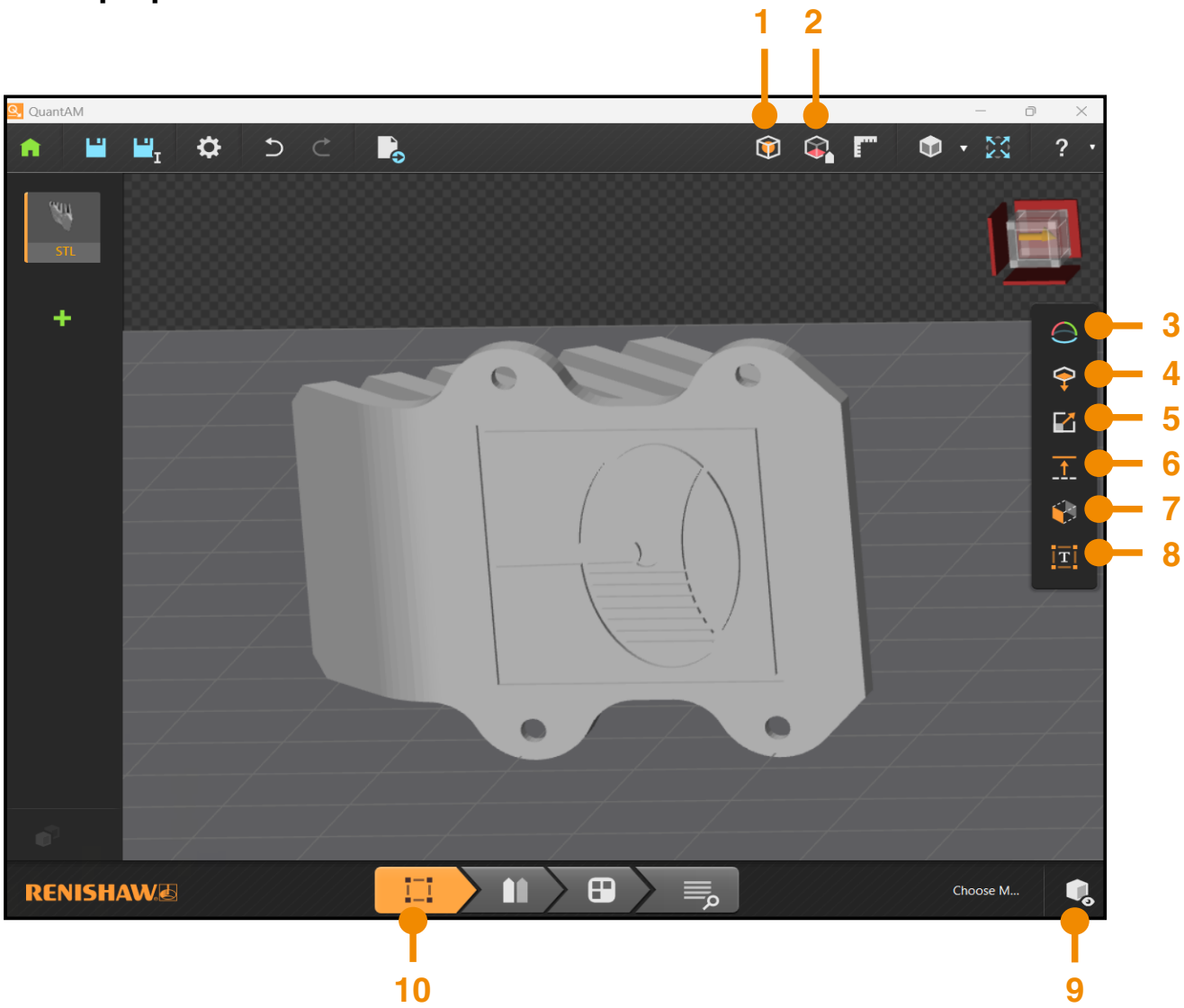
Pan

To move the build image inside the build plate window, right-click anywhere in the build plate window and drag the mouse in the required direction.

Rotate

To rotate the view of the build plate window, click anywhere in the build plate window and drag the mouse in the required direction.

4.4. Stage 1 of build preparation – ‘Orientation’



1 

Show/Hide Bounding Box (B)

Display or hide the bounding box around the model. The bounding box helps you to position the model on the build plate and avoid a collision between closely spaced parts. This function is available in both ‘Orientation’ and ‘Layout’ stages.

2 

Show/Hide Support Region Colour (C)

Automatically highlight regions on the part that QuantAM determines to be in need of added supports. Regions that are more likely to require support are highlighted in red. Regions that are less likely to require support are highlighted in yellow. This function is available in both ‘Orientation’ and ‘Support’ stages.

3 

Part Orientation (O)

Tilt and rotate the model relative to the build plate before adding the supports. Three rotation rings in the X (red ring), Y (green ring) and Z (blue ring) axis are displayed around the model. Hover the mouse pointer over the required axis to view the corresponding axis rotate ring. To rotate the model, click and drag the axis rotate ring to the required angle. Alternatively, you can also enter a precise angle value in the ‘X’, ‘Y’, ‘Z’ fields available in the ‘Part Orientation’ dialog box and click ‘Apply’.

4 

Select Downward Surface (D)

Select any surface of your model and set it as the downward facing surface on the build plate.

5 

Scale Part (X)

Scale the model in the X, Y and Z axes. This enables easy upscaling or downscaling of the part without modifying the original CAD data. You can also enable the ‘Uniform Scaling’ button to synchronise the scaling across the three axes.

6 

Z Offset (Q)

Define an offset value between the model and build plate. The Z offset provides a sufficient distance for adding suitable supports.

7 

Extrude (E)

Extrude the surfaces of your model. This can be useful when small adjustments are required to be made to a part without accessing the original CAD model, such as adding a build plate removal allowance. Click and select the surfaces of the model you wish to extrude. Enter a precise value in the ‘Distance’ field and click ‘Apply’. All the selected surfaces are extruded over the defined distance.

8

Part Label (L)

Add text or a label to the part. Use the drag-and-drop function to place the label or text anywhere on the part surface. Use the ‘Label’ dialog box to update the text, font and font size, and select either to emboss or engrave it at the required depth. If the label area does not fit on the part, QuantAM does not allow you to apply the label. When the label correctly fits on the part, the text box is highlighted in green and the ‘Apply’ button is enabled in the ‘Label’ dialog box.

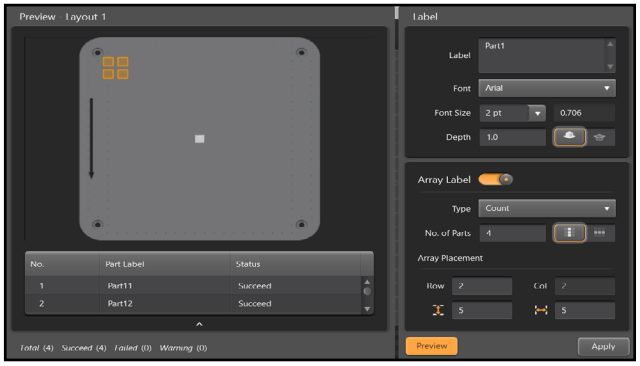
NOTE: This button disabled for selection when the models are viewed using the ‘Perspective View (Ctrl + 8)’ function.

8a

Array Labelling

Toggle to explore additional options to add part specific labels when creating an array of parts. For example, parts could be TestBar1, TestBar2, TestBar3, etc. The ‘Type’ drop-down in the ‘Label’ dialog box enables you to select the ‘Count’ or ‘Label CSV’ option. If ‘Count’ is selected, the labels are generated with an incremental numerical count. If ‘Label CSV’ is selected, the ‘Import Label CSV’ option allows you to import a list of customised labels in CSV format.

The ‘Preview’ function displays the array that is generated and highlights any label that could fail to generate.



	A	B	C
1	Part number	Part label	
2	1	A	
3	2	B	
4	3	C	
5	4	D	
6			

9 

Part Cluster Viewer

Click to display information about the part including, ‘Part Cluster ID’, ‘Part Name’, ‘Type’, ‘Status’, and ‘X’, ‘Y’ and ‘Z’ position. Within the ‘Part Cluster Viewer’ window there are three buttons: ‘Add Part to Cluster’, ‘Boolean’ and ‘Delete’. Each newly imported part is added to the cluster and treated as one part for supporting and slicing.

Parts imported as a cluster are treated as a single part.

9a 

Add Part to Cluster

Click to select and add additional models (.catpart, .ctm, .prt, .sab, .sat, .stl, .x_t, .stp, .step, .x_b, .sldprt) to the cluster in the workspace.

9b 

Boolean

Click when multiple parts in a cluster need to be merged as a single part with one scanning strategy. Otherwise, parts in the cluster will have separate scanning strategies and can cause overlaps.

9c 

Delete

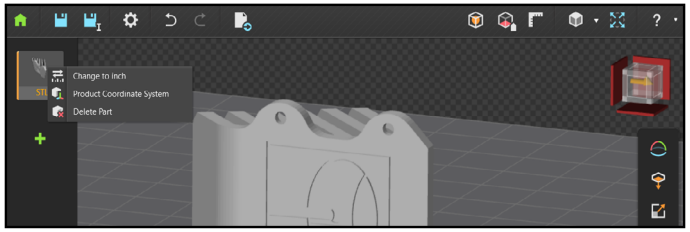
Remove parts from the cluster.

10 

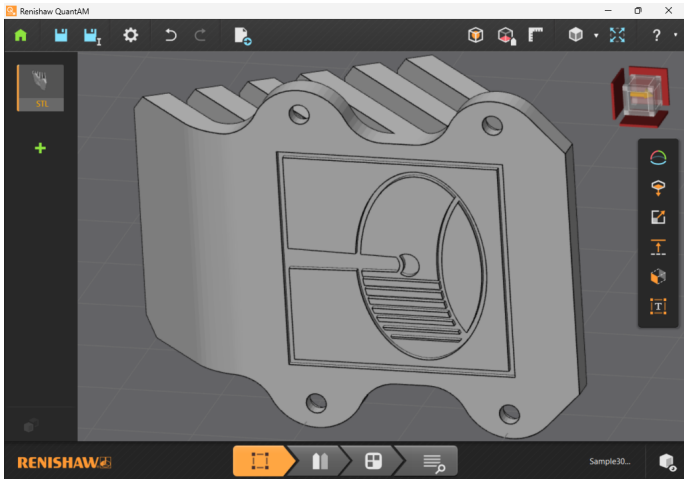
Orientation Stage

The first stage of the build preparation process. Position your part in an optimal orientation for obtaining a better quality build and surface finish.

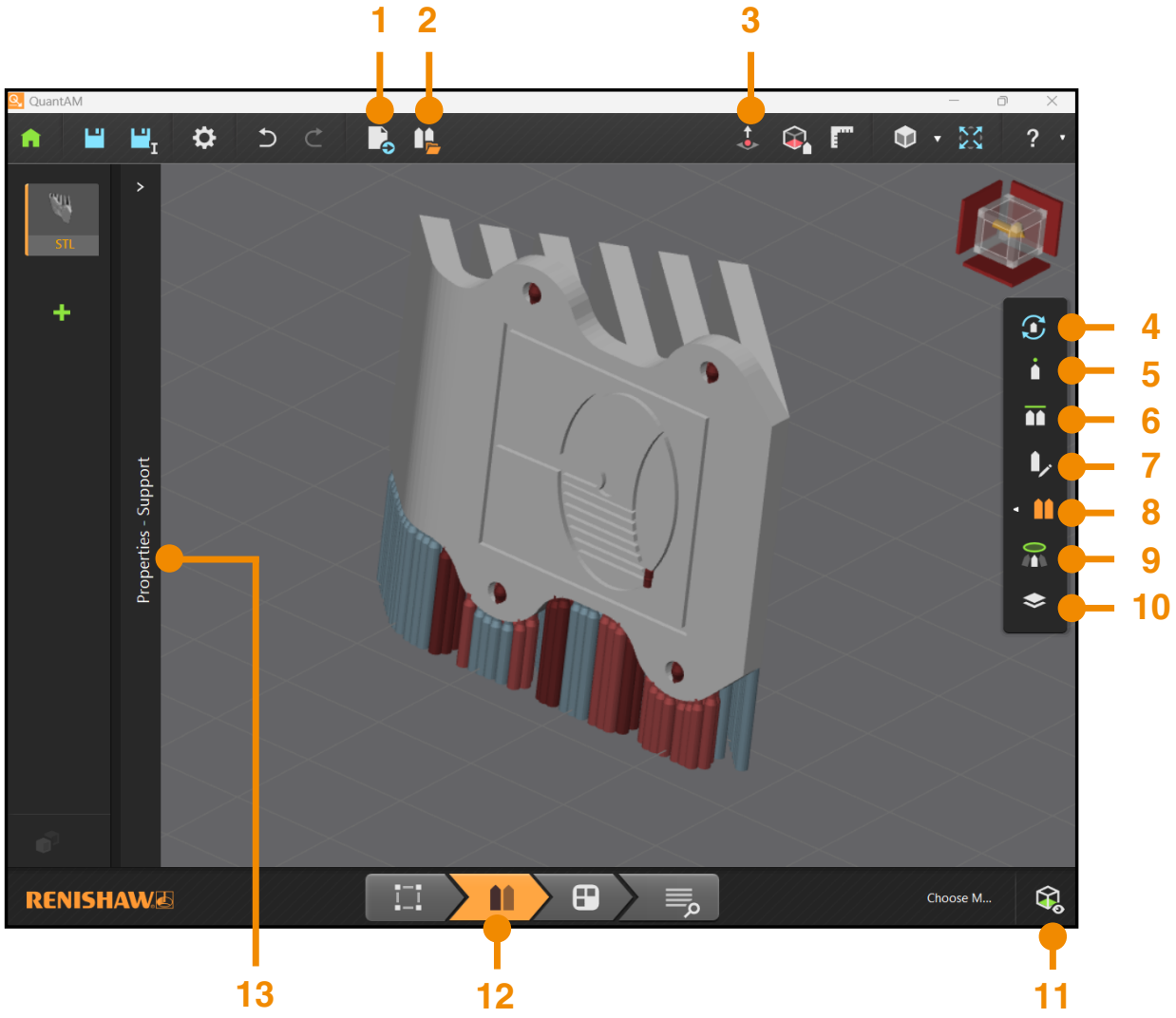
NOTE: In the ‘Orientation’ stage, right-click on the model thumbnail displayed in the access bar to open a context-sensitive menu. It displays some additional functionality for the model as shown in the screenshot below.



NOTE: In the ‘Orientation’ and ‘Support’ stage, use the keyboard shortcut (H) to highlight the details of the displayed model.



4.5. Stage 2 of build preparation – ‘Support’



1 

Export (Ctrl + E)

In the ‘Support Stage’ of build preparation, use the ‘Export’ button to save the components of a build or the complete build. Click to export the models as ‘Only Part (Cluster)’, ‘Only Support’, ‘Both Part and Supports’ or ‘Exposures’ and click ‘OK’ to save the export file in a location of your choice.

2 

Import Supports (Ctrl + I)

Import externally generated support files in .ctm or .stl file format. Select the support file you want to import and click ‘Open’. Enable the ‘Merge Support’ toggle button from the ‘Settings’ dialog box to merge all the imported supports as one triangulation for quick selection and better performance. For more information, see section 4.2, “Start page”.

3 

Section (V)

Section the active model to ease the process of adding support.

Select the arrow displayed in the workspace to change its colour from grey to blue and drag the section up or down as required. Double-click the arrow to reverse the direction of the section. Additionally, you can place the arrow anywhere on the build plate using the drag-and-drop function to get a better view while sectioning the model or support.

Click to display options 3a, 3b and 3c. Use the keyboard shortcut (Ctrl + K) to toggle between the three options.

3a 

Clip All

Section both the part and supports.

3b 

Clip Part Only

Section the part and view only the supports.

3c 

Clip Supports Only

Section the supports and view only the part.

4 

Auto Generate Point Supports (A)

Automatically generate point supports for the model. An ‘Auto Support Generation’ dialog box indicates the progress.

5 

Enable/Disable Point Supports (P)

Enables you to generate a point support from a user defined point on an overhanging surface of the model.

6 

Enable/Disable Line Supports (L)

Enables you to define and generate a line of grouped supports for the model. Enable the ‘Line Supports’ button and define the start point on the model using the left mouse button, drag the mouse pointer, and right-click on the end point to create a line support.

7 

Support Edit Mode (M)

Select a support and click the ‘Support Edit Mode’ button. This highlights the selected support and displays a control with three axes around it. You can use the control to drag-and-drop the support around the three axes to achieve the required support orientation.

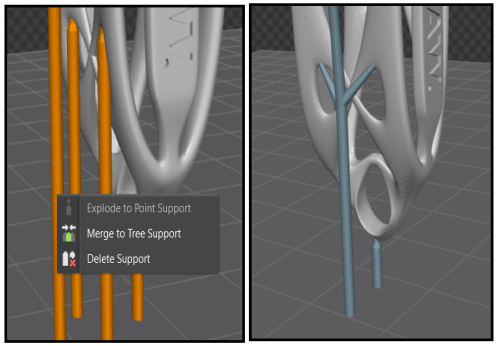
8 

Support Selection

Select the supports with a single click. To manually select one or more supports, press the Ctrl key and select the required supports. The selected supports are highlighted in orange. Any intersecting or penetrating supports are highlighted in red, unless you have configured 'Penetration Lengths' for your supports using the 'Properties – Support' menu.

NOTE: To select multiple supports, hold down the Shift key while left-clicking and dragging the mouse pointer over the desired supports to highlight them all.

NOTE: After selecting the supports, right-click on the selected supports to open a context-sensitive menu. This displays some additional functionality for modifying the support as shown in the screenshot below.



NOTE: After selecting the supports, right-click on the selected supports to open a context-sensitive menu. This displays some additional functionality for modifying the support as shown in the screenshot below.

Click the arrow to display the following options (8a, 8b and 8c):

8a 

Select All Supports (Ctrl + A)

Select all the supports available for the model.

8b 

Select Supports Intersecting with Part (Ctrl + Alt + P)

Select all the supports that penetrate the part beyond the ‘Penetration Lengths’ configured for your supports in the ‘Properties – Support’ menu.

8c 

Select all Intersecting Supports (Ctrl + Alt + A)

Select all the supports that intersect with each other.

9 

Enable Region Selection (G)

Specify the areas on the model where support is required, instead of applying supports to all downward facing surfaces. This also enables you to apply different support strategies to specific regions. It can be used in conjunction with the ‘Show/Hide Support Region Colour’ tool (C) and the ‘Region Viewer’ (R) to apply support exactly where it is required. The slider enables you to expand or reduce the size of the selected region.

10 

Display Slices (S)

View the model and support slices whilst remaining in the ‘Support Stage’. Click the ‘Display Slice’ button to display the progress of model slice generation. If you select ‘Display Slices’, and have not specified a material file, you are prompted to do so before the slices are generated. The slice controls tools are displayed after generating the slices. Drag the slider on the slice control toolbar to view any particular slice within the displayed model. For more information on additional tools, including ‘Go to Next Layer’, ‘Go to Previous Layer’, ‘Flip Clipped Region’, ‘Show/Hide Clipped Region’, ‘Update Slices’ and ‘Slice Properties’, see section 4.7, “Stage 4 of build preparation – ‘Review’”.

11 

Region Viewer (R)

After selecting a required region using the ‘Region Selection Tool’, click the ‘Region Viewer’ button to display the selected region. Add more regions to the selection using the ‘Add Region to List’ button. Each newly added region is identified by a different ‘Region ID’ and ‘Region Name’. Enable the check box in the ‘Lock Region’ column against the required region to prevent the system from creating supports for the selected regions of the part. Click ‘Delete’ to remove any region from the list.

12 

Support Stage

The second stage of the build preparation process. It allows you to add supports to your model to prevent costly build failures.

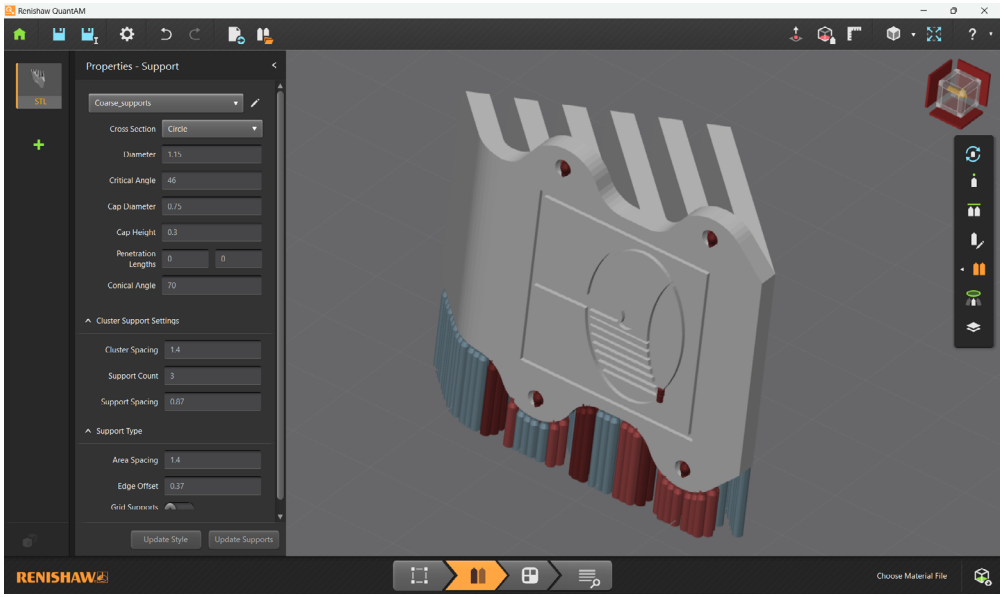
13

Properties – Support

Configure the parameters for the supports. Click anywhere on the ‘Properties – Support’ bar to open the menu and select the chevron to close it. Use the drop-down menu in the ‘Properties – Support’ bar to select any built-in or pre-defined support style for your build. Parameters such as the geometric properties of an individual support, ‘Cluster Support Settings’ and ‘Support Type’ can be edited as required. You can enable the ‘Grid Supports’ toggle button to create grid type supports for your build.

Select pre-defined support styles from the drop-down menu, under the heading ‘Built-In’. Alternatively, create a new support style by duplicating an existing support style using the ‘Create New Support Style’ button. User-generated support styles are listed in the drop-down menu, under the heading ‘Custom’. Click the ‘Update Style’ button to update any changes made to the custom support style. To see an updated preview of the supports in the build plate window, select all the supports shown in the preview and click the ‘Update Supports’ button.

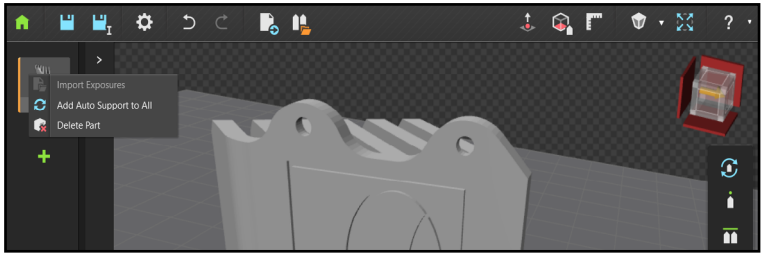
Several support cross-sections are available for selection. QuantAM displays supports as individual points in geometric space and sizes based on a nominal diameter. For circular, square and hexagonal cross-sections a solid support will be generated. For a cross support, individual support border scans are generated for each vector.



All the available settings and their descriptions are listed in the table below:

Tabs in the Settings dialog box	Controls	Description
General Support Settings	**Cross Section**	Use the drop-down list to select the type of cross-section for your support.
	Diameter	Enter a value for the diameter required for the support.
	Critical Angle	Enter a value for the critical angle.
	Cap Diameter	Enter a value for the diameter required for your support head.
	Cap Height	Enter a value for the height required for your support head.
	Penetration Lengths	Enter a value for the length by which you want the support to penetrate the part.
	Conical Angle	Enter a value for the conical angle required for the support head.
Cluster Support Settings	**Cluster Spacing**	Enter a value for the distance required between two clusters.
	Support Count	Enter the number of supports required within each cluster.
	Support Spacing	Enter a value for the distance required between the supports within a cluster.
Support Type	**Area Spacing**	Enter a value for the area spacing required between the point supports.
	Edge Offset	Enter a value for the offset required from the edge of the region requiring support to the boundary of support contour.
Grid Support Settings	**X Grid Spacing**	Enter the spacing required between consecutive grids in the X axis.
	Y Grid Spacing	Enter the spacing required between consecutive grids in the Y axis.
	Grid Orientation	Enter the angle at which the grid support is required to be rotated.
	Support Count	Enter the number of supports required within each cluster of a grid.
	Support Distance	Enter a value for the distance required between the supports within the cluster of a grid.

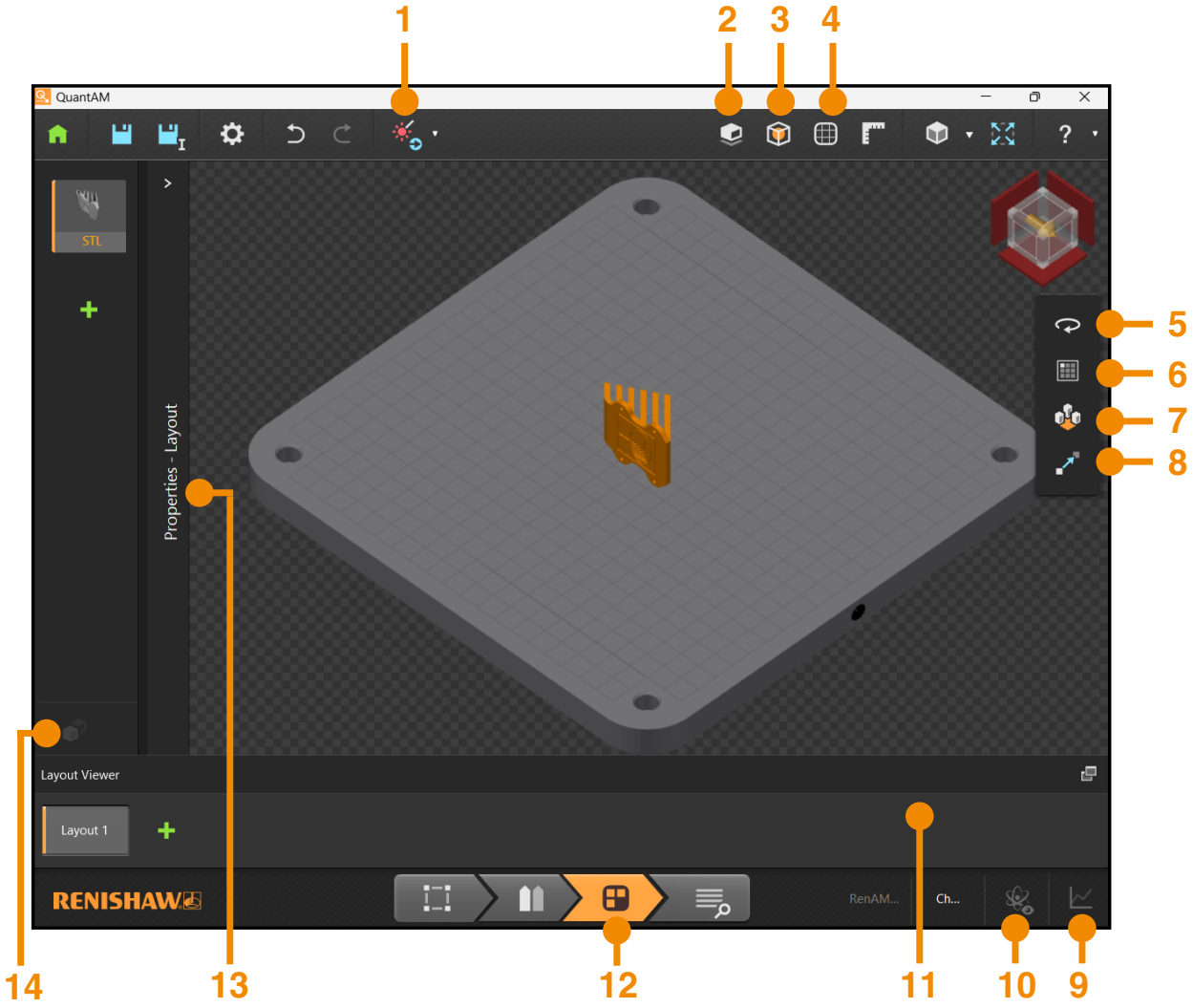
NOTE: In the ‘Support’ stage of the build preparation process, right-click on the selected model thumbnail to display the options for the model as shown in the screenshot below.

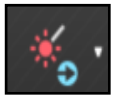


NOTE: If a support is highlighted in blue, it is not intersecting the part apart from at the cap or another support. A dark blue support is an isolated internal support, and a light blue support is an isolated substrate to part support.

If the support is in red, the support is intersecting another object. Dark red indicates that the support is intersecting the part somewhere along its length in addition to at the cap. Light red indicates intersecting supports.

4.6. Stage 3 of build preparation – ‘Layout’



1 

Export

Click to open an ‘Export .mtt File’ dialog box. Click the down arrow to display the following options (1a, 1b and 1c).

1a 

Export .MTT (Ctrl + E)

Export the build file in .mtt file format and save it to a desired location.

1b 

Export .STL

Export the triangulation data of the build file in .stl file format and save it to a desired location.

1c 

Export Other

Export the screenshot of the build file in .JPG format and save it to a desired location.

NOTE: If a material file is not selected in the previous stages, the ‘Material Details’ dialog box will prompt you to select a material for your build.

---

2 

Show/Hide Silhouette (U)

Show or hide the silhouette of the selected model on the build plate.

3 

Show/Hide Bounding Box (B)

Show or hide the bounding box around the selected model. The bounding box helps you to position the model on the build plate and to avoid overlap with adjacent models.

4 

Show/Hide Build Plate (H)

Show or hide the build plate beneath the model.

5 

Rotate Part (R)

Rotate the selected model on the build plate. You can use the rotation ring above the model (with angular display in degrees) to drag-and-drop the model to a required angle. Alternatively, you can enter a precise angle value in the ‘Z Rotate’ dialog box and click ‘Apply’.

6 

Instancing (I)

Make multiple copies of the selected model and place them at a user-defined distance on the X and Y axes of the build plate. Select the model and click the ‘Instancing’ button. A bounding box is displayed around the selected model. Drag the arrow around the bounding box in the required direction to create multiple instances of the selected model. Alternatively, you can use the ‘Instancing’ dialog box to define the number of model instances you want on the build plate in number of rows and columns.

7 

Nesting (N)

Define the spacing between the instances of a part on the build plate and optimise the use of the build volume. Select the required parts and click the ‘Nesting’ button. Enter the distance you want between the instances of the part and click ‘Apply’.

8 

Translation (Y)

Move the selected model instances in ‘Absolute’ or ‘Relative’ position across the build plate in a more precise manner, instead of using the drag-and-drop function. Click the ‘Translation’ button and select either the ‘Absolute’ or ‘Relative’ radio button. Enter the required values in the ‘X’ and ‘Y’ fields and click ‘Apply’. The selected instances of the part move to the new position as defined.

9 

Build Plot Viewer (Ctrl + P)

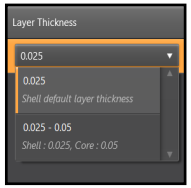
Click to display a graph with ‘Total Number of Layers’ and ‘Cross Sectional Area’ in mm^2. A graphical distinction between the amount of combined build and the amount of support in the build is shown in the graph. To view the area plot for supports available in the build, enable the ‘Support’ checkbox on the top right corner of the graph. You can pan and zoom the graph using the mouse controls.

10 

Material Viewer

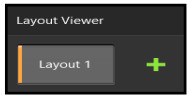
View several tabs containing information about the build. The tabs include ‘General’, ‘Strategy’, ‘Control’, ‘Order’, ‘Volume’, ‘Upskin’, ‘Downskin’, ‘Shell and Core’, ‘Core Strategy’, ‘Scan Volume’, ‘Scan Upskin’, ‘Scan Downskin’, ‘Scan Exposures’ and ‘Scan Core’.

There are buttons on the ‘Material Viewer’ dialog box that enable you to ‘Import Parameters CSV’ (Ctrl + I)’, ‘Export Selected Tab Data to Parameters CSV’ and ‘Export Parameters CSV File (Ctrl + E)’. You can also float or dock the material viewer dialog box based on your display requirements.

10a 

Layer Thickness

The only editable field in ‘Material Viewer’ is ‘Layer Thickness’. If a material file with ‘Shell and Core’ set-up is selected, the layer thickness must be selected using the drop-down box. The only way to edit other parameters is to export the build parameters in a .csv file format using the ‘Export Selected Tab Data to Parameters CSV’ or ‘Export Parameters CSV File’ button. This file can be edited using Microsoft Excel or a similar tool such as Minitab, and then re-imported using the ‘Import Parameters CSV’ button. Using this method, a different scan strategy for each part within the project (.amx) file can be allocated.

11 

Layout Viewer

In the ‘Layout’ stage, you can create more than one layout for a part and each layout can have a different material applied to its model. All layouts are saved in the same QuantAM project file (.amx file). You can float or dock the ‘Layout Viewer’ dialog box based on your display requirements. Select the ‘Add layout’ button to create an empty second layout, and import the required parts. Right-click on a layout in the ‘Layout Viewer’ dialog box and use the menu to rename or delete the selected layout.

12 

Layout

The third stage of the build preparation process. This enables you to define a layout for the models on the build plate.

13 

Properties – Layout

Enables you to view the parameters of the layout. Click anywhere on the 'Properties – Layout' bar to open the flyout menu and click the chevron to close it. Parameters including 'Part Name', 'Part ID', 'Part Z Height', 'Number of Layers', 'Part Volume' and 'Total Support Volume' can be viewed.

If you have selected multiple parts, then the 'Properties – Layout' bar displays the parameters including 'Build Height', 'Total Number of Parts', Number of Layers', 'Total Part Volume', and 'Total Support Volume'.

NOTE: If you have imported a Scanpath CLI file, a build style must be applied to each of the styles present in the CLI. Use the 'Choose Build Style' drop-down menu in the 'Properties – Layout' bar to select the appropriate build style for each ID in the .cli file.

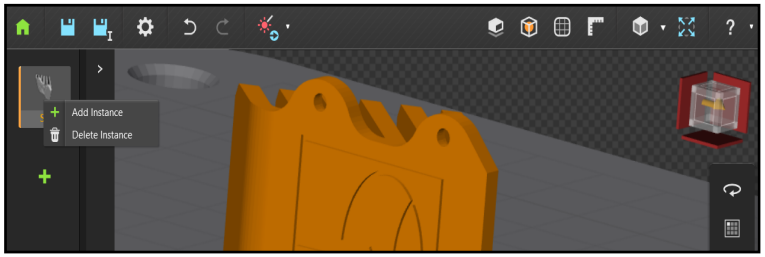
14 

Show/Hide Current Layout Parts

This button allows you to show either all the parts saved in the .amx project file or only those used in the current layout.

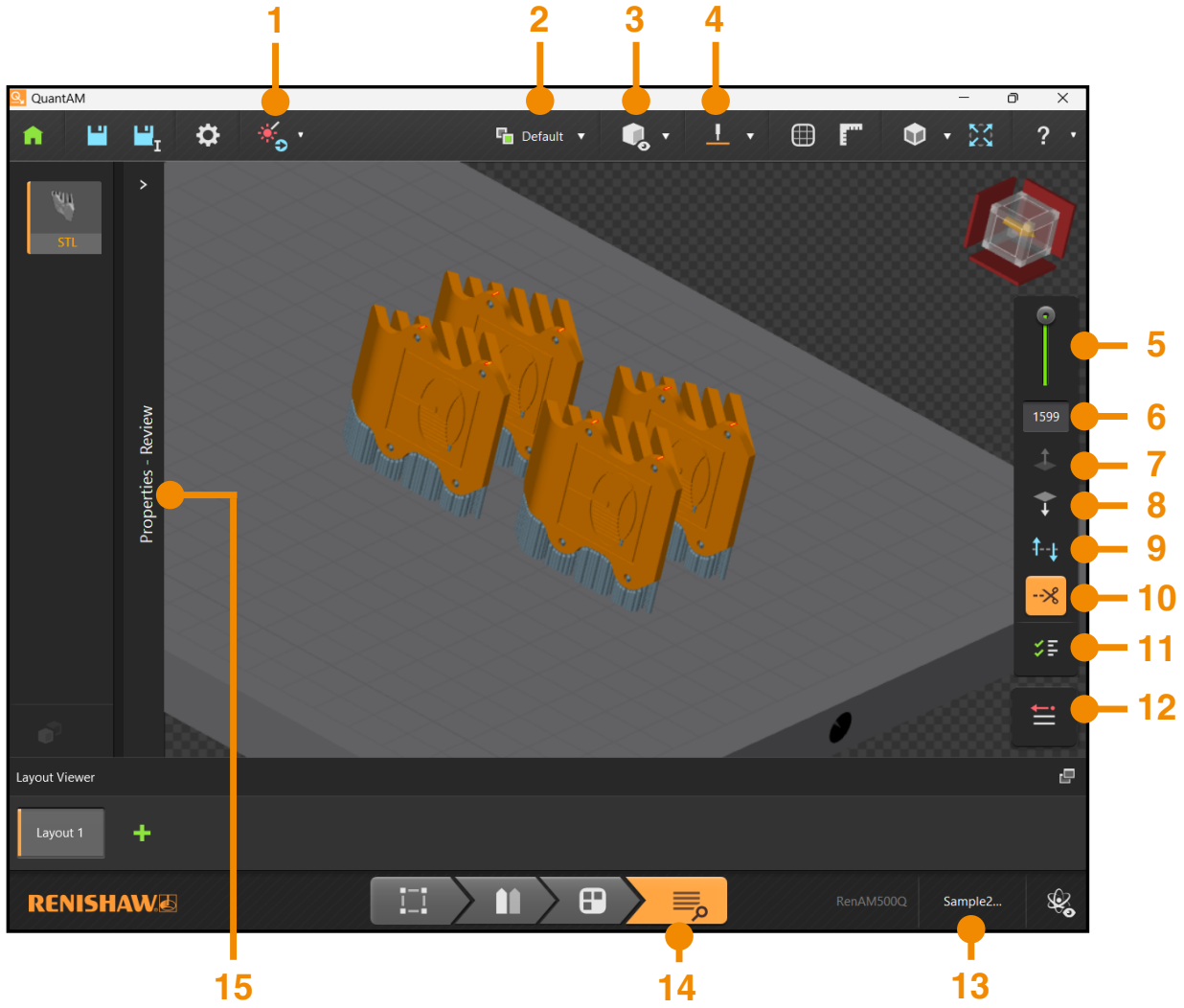
NOTE: In the 'Layout' stage, the front edge of the build plate near to the AM system door is identified by a black dot.

In the 'Layout' stage, right-click on the selected model thumbnail to open a context-sensitive menu. The context-sensitive menu provides you the options to add and delete instances of the model as shown in the screenshot below.



NOTE: If you have imported a .cli file as slices or scan paths, all the tools and features in the orientation and supports stages are disabled and you are directly taken to the layout stage.

4.7. Stage 4 of build preparation – ‘Review’

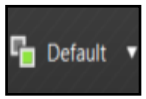


1 

Export .MTT (Ctrl + E)

Select a location to save the export file. Select the down arrow to display two options: 'Export .MTT' (Ctrl + E) and 'Export Other'.

Click the 'Export Other' button to export the build in QuantAM Build Image (.jpg), QuantAM scan path (.qsp) or zip file format. Exporting the build as an .mtt file is the final stage of build preparation.

2 

Theme (Ctrl + T)

Change the colour theme for the scan path and layers according to your preference. There are four different colour themes available.

3 

View Part and Layer (Ctrl + J)

Toggle between 'View Part and Layer' and 'View only Layer'.

4 

Exposure Lines (Ctrl + H)

Toggle between a view of the scan path as 'Exposure Lines', 'Exposure Points' and 'Energy Density Map'.

In an 'Energy Density Map', red indicates high energy density regions and green indicates low energy density regions. If you have selected 'Energy Density Map', the 'Steps through the Scan Blocks (F2)' button is disabled.

5 

Slider bar pointer

View the layers within a build. Select and drag the slider to view any layer of the build. A slice number indicator is available below the slider. Any slice or heal errors are displayed in red.

6 

Slice number indicator

Displays the slice number of the build you are currently viewing. Enter a value in the slice number indicator field to view a specific layer in the preview.

7 

Go to Next Layer

Show the next layer in the cut plane.

8 

Go to Previous Layer

Show the previous layer in the cut plane.

9 

Flip Clipped Region

Reverse the direction of the visible model in the cut plane progression. This button is disabled for a transparent model by default.

10 

Show/Hide Clipped Region

Toggle between viewing the transparent model and the solid model, with the cut plane highlighted.

11 

Slice Properties

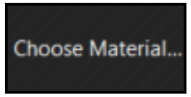
In the review stage, click to display build information including the ‘Part ID’, ‘Layer No.’, ‘Z offset’ and ‘Healed’. It also displays the number of slices within the build that require healing to rectify any errors in the imported CAD data, without the need to return to the original CAD model.

In the support stage, click to display build information including the ‘Layer No.’, ‘Z offset’ and ‘Healed’.

12 

Steps through the Scan Blocks (F2)

Step through each layer of a build using the scroll bar. Use the scroll bar to view the order and sequence of each scan line. Drag the slider to view the position of the laser, or use the arrow buttons ‘Previous Move’ or ‘Next Move’ to change the slider position. Whilst dragging the slider, an information box displays the scan number, X and Y position, length of next scan and length of previous scan.

13 

Material Details

Select the material file you want for your build. Once selected, you can view detailed material information including ‘Slicing’, ‘Hatching’, ‘Shell and Core’, ‘Order’ and ‘Scanning’. Use the ‘Material’ drop-down to change the selected material file and associated parameters.

14 

Review

The fourth stage in the build preparation process. Review slices and scan paths for the build before exporting it as an .mtt build file.

NOTE: The time to slice the models and generate scan path when switching to the Review stage depends on the size of the model loaded in QuantAM.

---

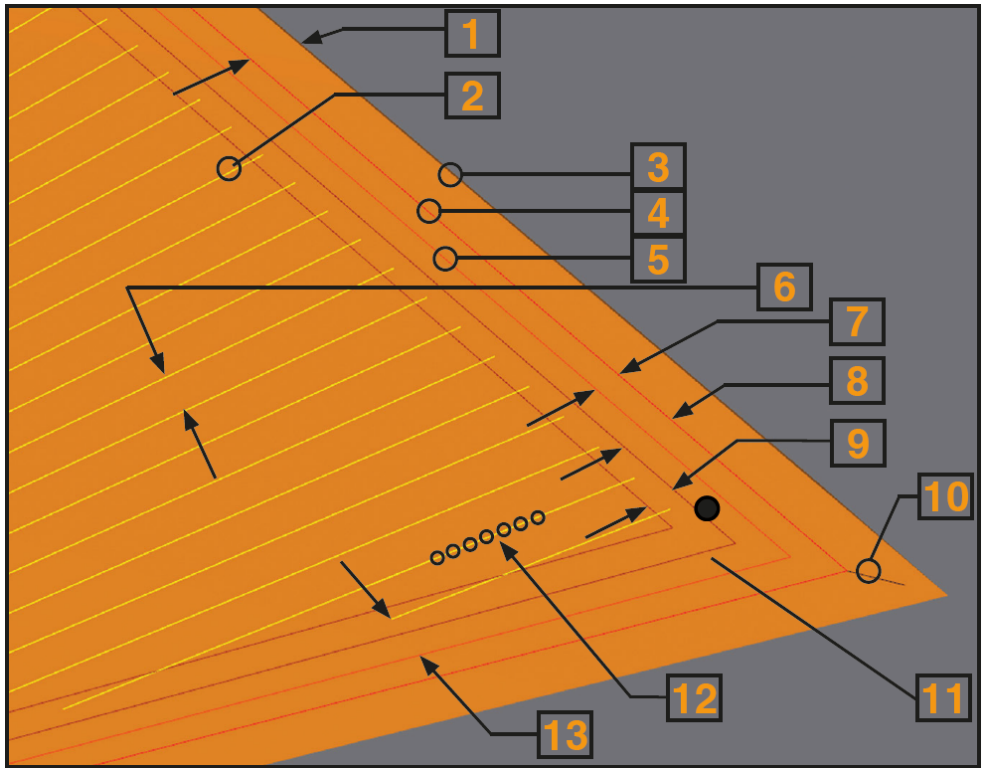
15 

Properties – Review

Review the properties of the build file. Click anywhere on the 'Properties – Review' bar to open and display information including 'Build Time Estimation', 'Total Cost', 'Build Information', 'Machine Information', 'Default Build Parameters' and 'Cost Parameters'. The build time and cost estimate are calculated based on the material file selected. The dosing time can be edited based on the machine in use. It is only used for time estimation and does not affect the machine performance.

4.7.1. Key parameters in a scanning strategy

The following illustration represents the key parameters in a scan strategy. For more information, see the Material Editor quick-start guide (Renishaw part no. H-5800-3988).



Key	
1	Beam compensation (radius)
2	Fill hatch
3	Edge of .stl file
4	Border(s)
5	Additional border
6	Hatch distance
7	Border distance
8	Fill contour offset
9	Fill contour distance
10	Blocked path
11	Fill contours
12	Point distance
13	Hatch offset

4.8. Build file viewer

4.8.1. Introduction

If you are creating builds for execution on a Renishaw AM system, or optimising TEMPUS technology settings to create .renam build files, you need to complete one additional stage of the build preparation process before you export your build. This stage allows you to configure the build parameters, assign the lasers to your build and if required, configure the .renam build file for faster processing and maximum laser utilisation – boosting productivity and reducing part costs.

You can choose to create and export an .mtt or a .renam build file using this stage. The .renam file is created based on the TEMPUS technology which aims to deliver up to a 100% increase in AM productivity without compromising on part quality. It can synchronously control the laser, elevator and recoater assembly by commanding the AM system to fire the laser during the recoating process. The .renam build file enhances the overall AM process efficiency.

NOTE: Build file optimisation using TEMPUS technology also depends on factors such as sorting of models on the build plate, laser assignment strategy, and layout modification.

The .renam build files are not supported by AM250, AM400 and RenAM 500M. QuantAM allows you to export build files for these machines only in .mtt file format.

From the ‘Start’ page, open an .mtt or .renam file. For more information, see section 4.2, “Start page”.

The ‘Build file viewer’ has five stages, ‘Layout’, ‘Laser Parameters’, ‘Assignment’, ‘Sorting And Ordering’ and ‘Review’.

In the ‘Layout’ stage, you can rotate the model relative to the build plate and move the selected model instances in ‘Absolute’ or ‘Relative’ position across the build plate. You can also combine multiple .mtt files.

In the ‘Laser Parameters’ stage, you can update build parameters for each part, and build styles within the build file.

In the ‘Assignment’ stage, you can select and assign lasers to the parts and build styles available in your build. This can be done automatically by QuantAM, or manually configured.

In the ‘Sorting And Ordering’ stage, you can configure the parameters for executing the build on an AM system. This stage provides you the option to configure an optimised build file (.renam) to improve the efficiency of the AM system.

In the ‘Review’ stage, you can verify the laser assignment by reviewing the build layer-by-layer. You can also scan through each layer line-by-line. When the review is complete, you can export the build file in .mtt or .renam format, ready to be built on a Renishaw AM system.

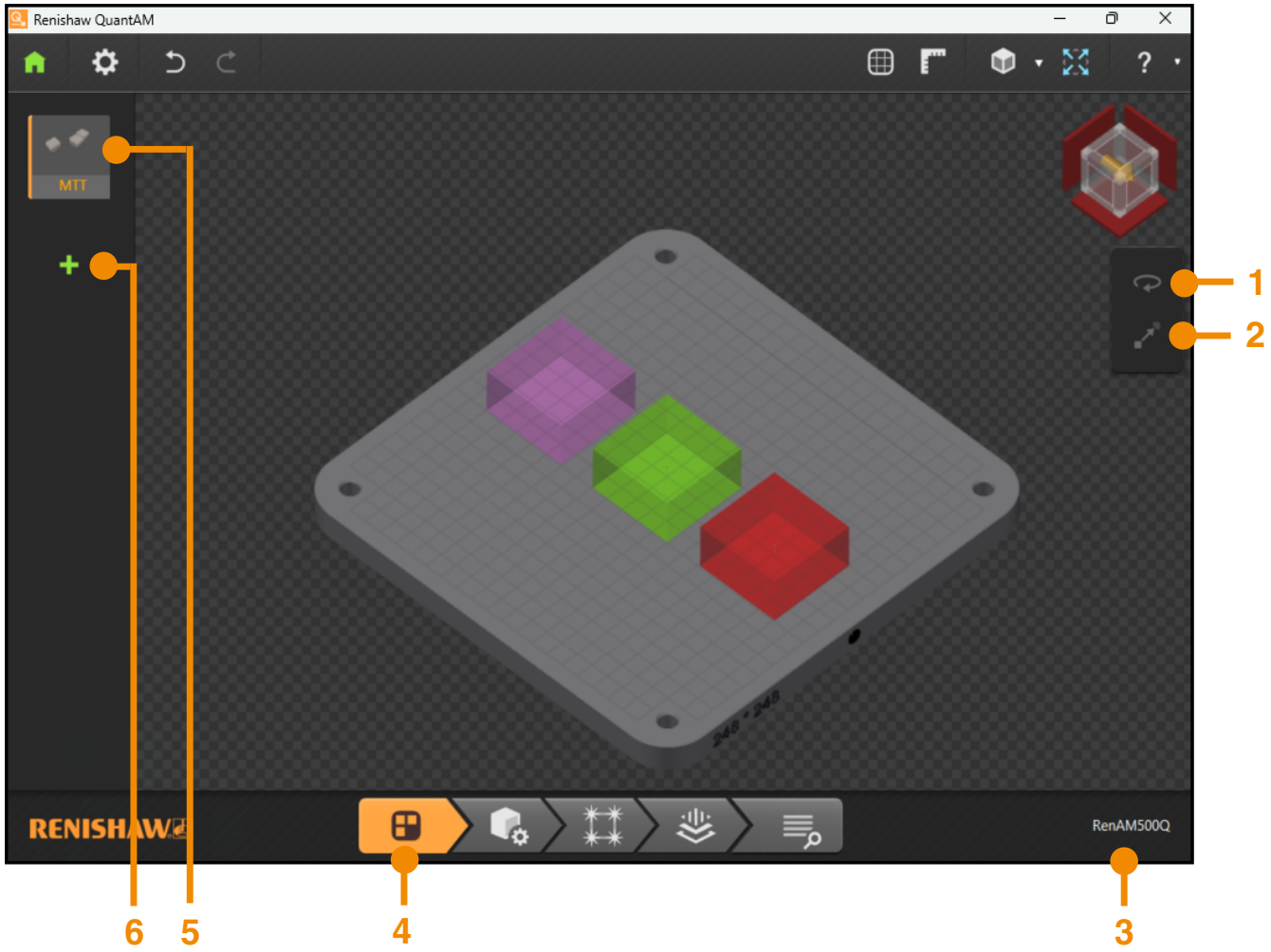
NOTE: If you open a .renam build file in the ‘Build file viewer’ stage, the ‘Laser Parameters’ and ‘Assignment’ stages are disabled. In this case you are directed to the ‘Sorting And Ordering’ stage after the ‘Layout’ stage.

TEMPUS™ is a software-driven technology in the laser powder bed fusion (LPBF) metal additive manufacturing process, introduced by Renishaw to maximise productivity by reducing the overall build processing time. The technology aims to establish seamless communication between the advanced software and hardware components of the Renishaw AM system to enable it to process more layers in the same amount of time when compared with traditional powder bed technology. By synchronising the laser, elevator, and recoater actions, this technology allows the AM system to fire the laser while the recoater adds a new layer of material powder.

TEMPUS technology is available as a retrofit to enhance the additive manufacturing productivity of the Renishaw’s existing single and multi-laser RenAM 500 series AM systems. To configure the build file with optimised TEMPUS settings, you need to prepare the build file in Renishaw’s advanced file format (.renam) using QuantAM.

NOTE: Build files in .renam file format can be only executed on systems that are equipped with TEMPUS technology. For further information about purchase plans, contact your Renishaw, see section 7, “Contact details”.

4.8.2. Stage 1 of Build file viewer – ‘Layout’



1 

Rotate Part (R)

Rotate the selected part about its centre. Select the part, click ‘Rotate’, and enter the rotation value in the ‘Z Rotate’ dialog box. Alternatively, use the rotation ring above the selected model.

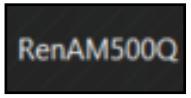
NOTE: This button is enabled only for .mtt build files opened in QuantAM. While rotating an .mtt build file, the scan strategies are also rotated and may not be optimal. Only rotate parts before slicing/applying the scan strategy.

2 

Translation (Y)

Move the part in ‘Absolute’ or ‘Relative’ terms. Select the parts you wish to move, click ‘Translation’, select ‘Absolute’ or ‘Relative’, enter the X and Y values, and click ‘Apply’.

NOTE: This button is enabled only for .mtt build files opened in QuantAM.

3 

Build Settings

Display the currently selected Renishaw AM system. Click the banner to open the ‘Build Settings’ dialog box and change the selected machine and build volume. The model of selected Renishaw AM system affects the build parameters, including laser assignment. Ensure to select the machine variant with the correct number of lasers at this stage. A multi-laser system must be selected to enable laser assignment. You can also select the required ‘Machine’ and ‘Build Volume’ using the ‘Setting’ button. For more information, see section 4.2, “Start page”.

NOTE: The .renam file format does not support ‘RBV’ as build volume. Make sure that the ‘Build Volume’ is selected as ‘Default’ while creating a .renam build file.

4 

Layout Stage

This is the first stage of the ‘Build file viewer’ process where the layout of the model can be adjusted as required before moving to the ‘Laser Parameters’ Stage.

5 

Model thumbnail

Displays the thumbnail and format (.mtt or .renam) of the build files currently open in the QuantAM workspace. The orange shadow indicates that the model file is currently displayed in the build plate window. Hover the mouse over the thumbnail to view the file name and file type.

In the 'Layout' stage, right-click on the model thumbnail displayed in the access bar to display the following options:

5a 

Delete

Delete the selected build file from the work space.

5b 

Validate

Export a validation report of the selected build files in text file format and save it to a desired location. This is a support tool intended for QuantAM application engineers or end users to investigate and troubleshoot data issues in .mtt or .renam build files.

5c 

File Information

View the file information related to the selected .renam build file, including 'File Version', 'Original Program and Version', and 'File Validation Status'. This option is not available for .mtt build file.

6 

Import Build File

Select and add the build files (.mtt or .renam) into the workspace. Alternatively, you can import supported files by dragging and dropping them onto the 'Import Build File' button.

NOTE: If you drag-and-drop unsupported files, an error message is displayed informing you that the selected file format is not supported by the application.

NOTE: Use the following controls to adjust the layout of the models in an .mtt build file. These controls are not applicable for .renam build file.

To create instances of a model, use the copy (Ctrl + C) and paste (Ctrl + V) functions.

To move a model instance, keep the Alt key pressed and drag the instance to the required location on the build plate.

To delete a model instances, select the instances and press the delete key.

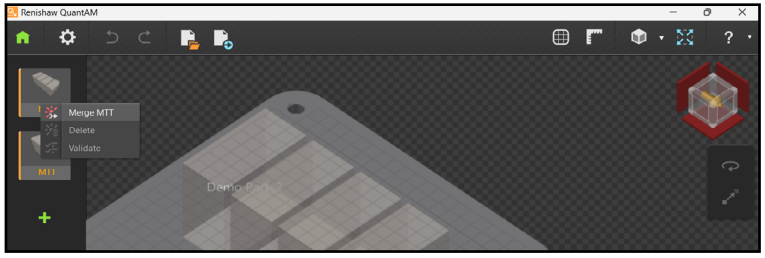
NOTE: If the machine and build volume configuration of the imported .renam build file does not match the current default settings, these settings will be automatically updated to match the build file configuration.

For .mtt build files, the machine and build volume configuration will be automatically updated to match the laser assignment strategy of the import build file.

If you select two or more .mtt build files on the access bar and right-click, a context-sensitive menu is displayed. It provides you the option to merge the selected .mtt files (see the screenshot below) to facilitate the merging of parts and/or supports from multiple build files.

Click the ‘Merge .MTT’ button to create an additional .mtt file, merging all the selected models within the first selected build file. This feature allows you to merge the .mtt files, provided the layer thicknesses are the same or multiples of each other.

NOTE: The system does not allow you to merge .renam build files as they contain timing data.



NOTE: Duplicating, rotating, or moving the models on the build plate can impact the applied scanning strategy and may result in increased build time and reduced part quality.

4.8.3. Stage 2 of Build file viewer – ‘Laser Parameters’

1 

Import Parameters CSV (Ctrl + I)

Import your own set of parameters in .csv format. Parameters can be developed in .csv format outside of QuantAM, using applications such as Microsoft Excel or Minitab.

2 

Export Parameters CSV (Ctrl + E)

Export the parameters of the opened build in .csv format. Edit the exported .csv file using applications such as Microsoft Excel or Minitab. Import the updated .csv file using the 'Import Parameters CSV' button, to apply new parameters for your build.

3 

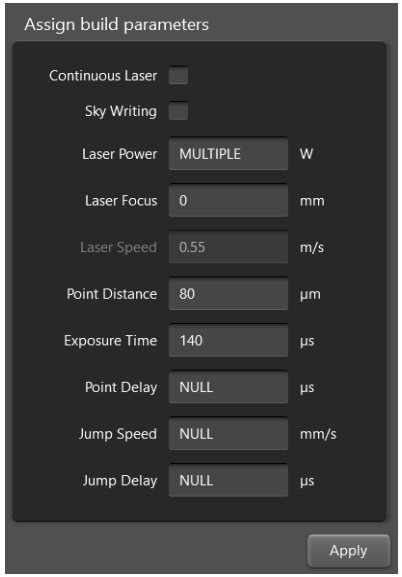
Laser Parameters

View and update build parameters for each part within a build and each build style within each part. Click anywhere on the 'Laser Parameters' bar to open.

4 

Assign Build Parameters

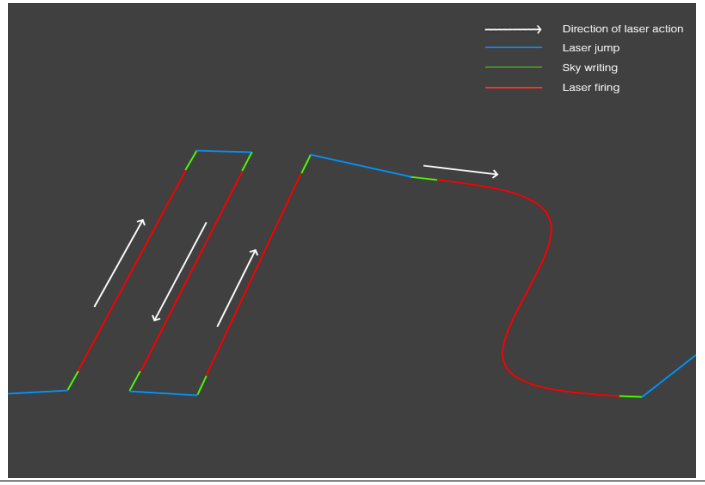
Manually override the default build parameters. Click 'Assign Build Parameters' to display the 'Default Build Parameters' dialog box. Update the required fields to make any changes to the default build parameters and click 'Apply'.



NOTE: The laser parameters with ‘NULL’ values indicate that the build file does not contain the corresponding data. In this case, the system will assign the default value based on the selected AM machine.

The laser parameters with ‘MULTIPLE’ values indicate that one or more build styles within the selected part are assigned different values, or the selected parts are assigned different build parameter values.

You can control the parameters of the build listed in the table below.

Controls	Description
Continuous Laser	Enable the check box to emit a continuous laser stream between two point exposures. If it is disabled, the laser stream will be intermittent with a point jump delay between two point exposures.
Sky Writing	Enable the check box to prepare the laser before the start and end of each scan path, enabling the machine to extend the laser toolpath beyond the part geometry on each hatch and contour. The laser is turned off as it reaches the end of the geometry, then follows the extended toolpath, turning back on when it returns to the geometry. This ensures that any inertia in the laser optics does not impact the laser positional accuracy during the manufacturing process, leading to better control over the melt pool and reducing the likelihood of defects. Below is an illustration showing laser action on a geometry consisting of three hatch lines and a polygon when the sky writing is enabled. 

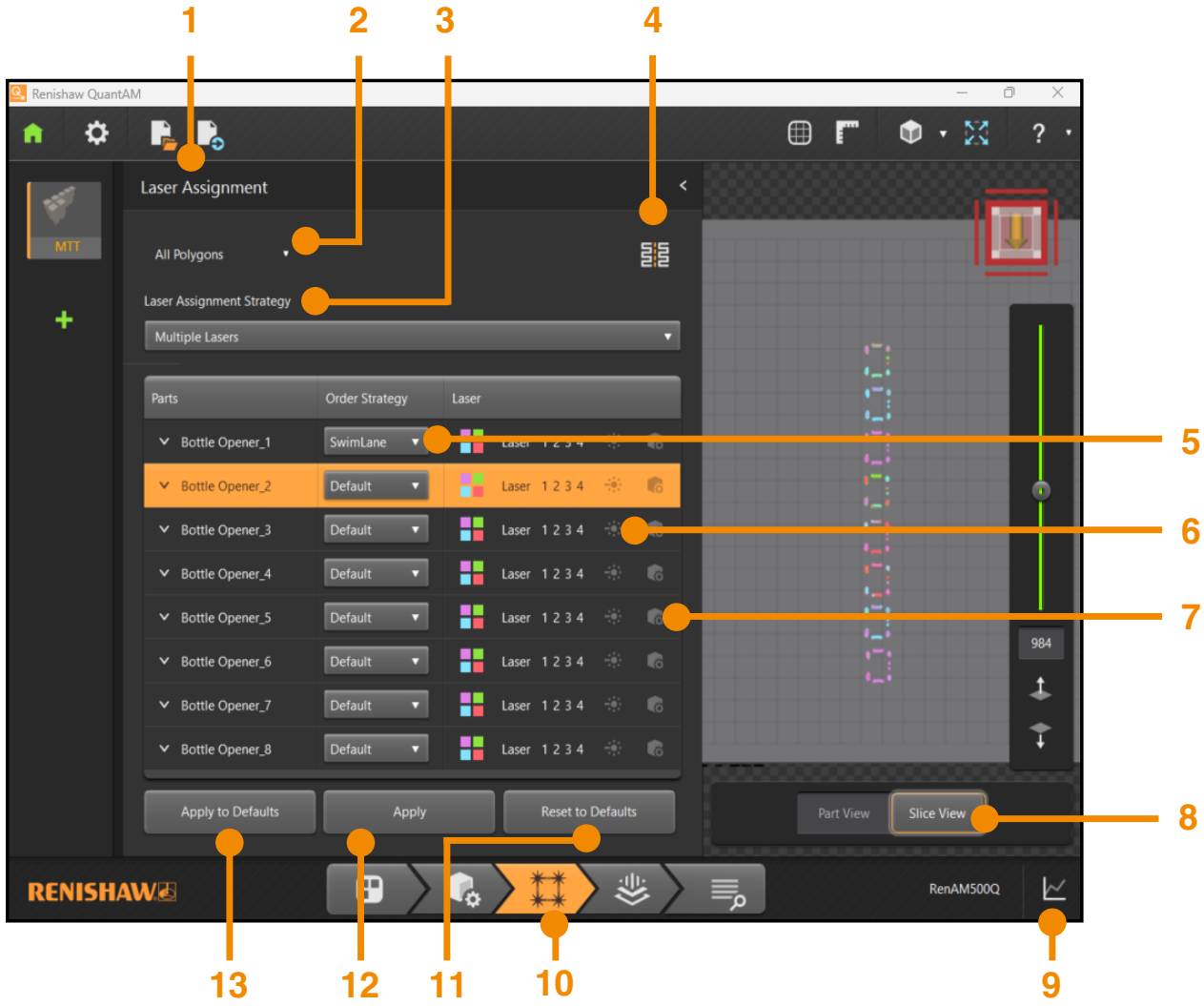
Controls	Description
Laser Power	Enter the power at which the laser needs to fire for a particular part or build style.
Laser Focus	Enter the offset required to adjust the position of the laser's focal point relative to the material's surface. Changing the focal lens position will result in an increased beam diameter. For AM systems, the minimum value is –30 mm and the maximum value is +30 mm. For RenAM 500 series systems, the minimum value is –10 mm and the maximum value is +10 mm. Values can be incremented in units of 1 mm.
Laser Speed	Enter the laser speed for a specific part or build style. **NOTE:** You can update the 'Laser Speed' only if the 'Continuous Laser' check box is selected. In this case, the 'Point Distance', 'Exposure Time' and 'Point Delay' are disabled for editing.
Point Distance	Enter the distance required between two consecutive exposure points along a scan path.
Exposure Time	Enter the duration for which the laser must be focused on each specific exposure point along a scan path.
Point Delay	Enter the time delay required between two consecutive exposure points along the scan path.
Jump Speed	Enter the laser speed required while jumping between scan sections or hatch lines.
Jump Delay	Enter the duration the laser requires to settle in designated positions before or after jumps between scan sections or hatch lines.

5 

Laser Parameters Stage

This is the second stage of the 'Build file viewer' process where you can individually update the build parameters for each part and build style within each part.

4.8.4. Stage 3 of Build file viewer – 'Assignment'



1 

Laser Parameters

Assign lasers to each part or build style for multi-laser builds. Click anywhere on the ‘Laser Assignment’ bar to open. Laser assignment can be done automatically by QuantAM, or manually configured.

2 

Vector selector

Select a particular build style applicable for the selected parts or all parts within the build. For example, if you select ’03 Border’ from the list, the border scans for the selected parts within the build are selected. If parts are pre-selected, it will only select the borders from the selected part list.

3 **Laser Assignment Strategy**

Choose laser allocation as ‘Single Laser’ or ‘Multiple Lasers’.

4 

Split Hatches

Files sliced in build preparation software other than QuantAM can have all stripes assigned to one build style. Click the ‘Split Hatches’ button to separate the stripes into individual regions to allow effective multi-laser assignment on each stripe.

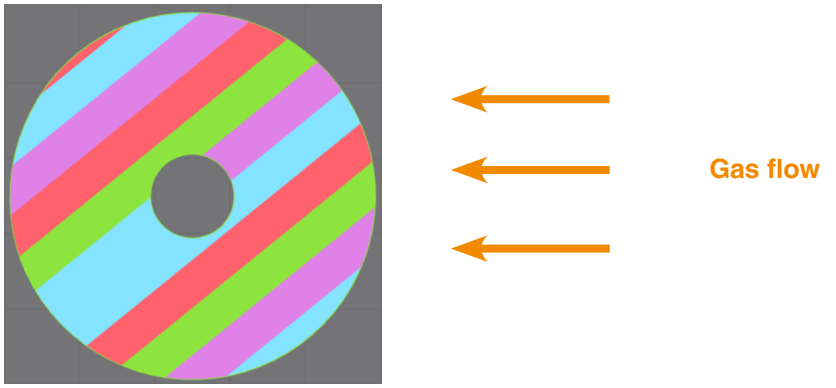
NOTE: When you click the ‘Split Hatches’ button, a message is displayed informing you that the operation will invalidate all laser assignments and the default laser will be applied. Make sure that the ‘Split Hatches’ function is used before assigning lasers to the parts within the build.

5 **Order Strategy**

Choose the required laser strategy for the selected part as ‘Default’ or ‘Swimlane’.

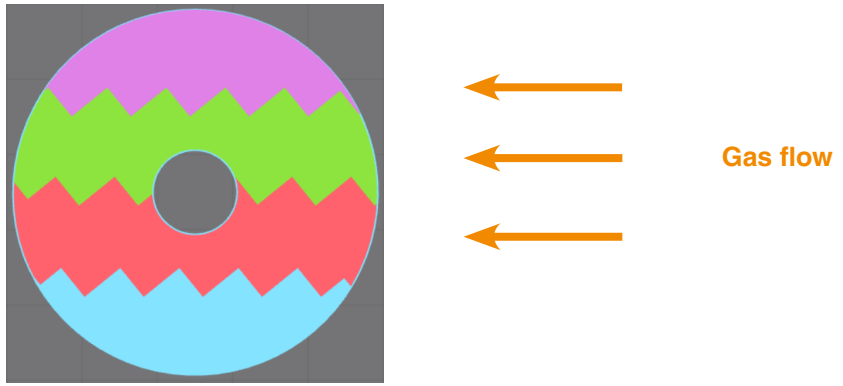
5a **Default**

Select this option to automatically assign lasers in the best way to minimise layer time, independent of their position. This may result in an increased idle time, multiple laser overlap zones and extended jump time, leading to delays.



5b **Swimlane**

The swimlane order strategy splits the selected components into distinct lanes that run parallel to the gas flow. The number of lanes created corresponds to the number of lasers assigned to the selected component, with each lane assigned to a single laser. This order strategy sequences the lasers in such a way that the heat and material changes caused by the laser operating upstream (in terms of gas flow) does not affect the downstream laser's performance. Additionally, it can also make TEMPUS sequencing more efficient, thereby reducing the build time.



6 

Assign Lasers

Manually assign one or more lasers to any part or build style using the check box. The preview of your build will be updated to match the colour of the assigned laser for easier differentiation. If more than one laser is assigned to any part, that part will be displayed in yellow.

NOTE: A build file is compatible with a RenAM 500 series machine only if all the lasers assigned in the build file are installed on the machine. For example, a build file with four lasers assigned cannot be executed on a RenAM 500S machine with one laser.

However, if there are parts in the build file that do not have an assigned laser, the system will automatically assign the highest available laser to these parts. For example, on a RenAM 500Q machine, if a build file with four parts has lasers L1, L2, and L3 assigned to three parts and one part is unassigned, the system will assign the highest laser, L4, to the fourth part.

7 

Laser Assignment Parameters

Define the laser assignment parameters for the part based on the selected order strategy. The following parameters can be updated:

NOTE: If the order strategy for the selected parts is set to 'Default' or if parts selected are applied with different order strategies, only the 'Sequence ID' can be updated using the laser assignment parameters function.

Controls	Description
Laser Load Balancing	Enable the check box to evenly distribute the load of the selected laser onto the chosen part.
No. of Hatch Line Overlap	Enter the number of overlapping hatch lines required between adjacent swimlanes. If you enter 1, an additional hatch line will be created for each swimlane, resulting in two overlapping hatch lines.
Split Borders	Enable this option to split the border and assign the same laser to the borders based on the laser assigned to the swimlane. If this option is disabled, a single laser will be used to melt the border, regardless of swimlane.

Controls	Description
Border Overlap	Enter the required distance for border overlap after being split along the swimlane.
Sequence ID	Enter the priority for laser assignment to the selected parts. All parts with the same sequence ID will be assigned simultaneously.

8 

Part View/Slice View

Toggle between a view of the part and a view of each layer. When 'Slice View' is selected, a slider toolbar is displayed, which enables you to drag and view the part slices within the build. Select and drag the slider to view the required slice. An interactive 'Layer number indicator' is available below the slider to display the slice number. Click 'Go to Next Layer' and 'Go to Previous Layer' to navigate up and down the cut plane.

9 

Laser Plot Viewer (Ctrl + P)

View a 'Timing Plot' graph displaying 'Laser Time/Layer' or 'Laser %/Layer' data. Use the 'Graph View' drop-down menu to toggle between these two graphs. The 'Sampling Step' causes the graph to use a moving average and can be adjusted by typing the number of layers to average. Click 'Refresh' to regenerate the graph with the updated sampling step value.

10 

Assignment Stage

This is the third stage of the 'Build file viewer' process where lasers are assigned to the parts for preparing a multi-laser build.

11

Reset to Defaults

Restore the laser assignment of the selected part or build style to their original default.

12

Apply

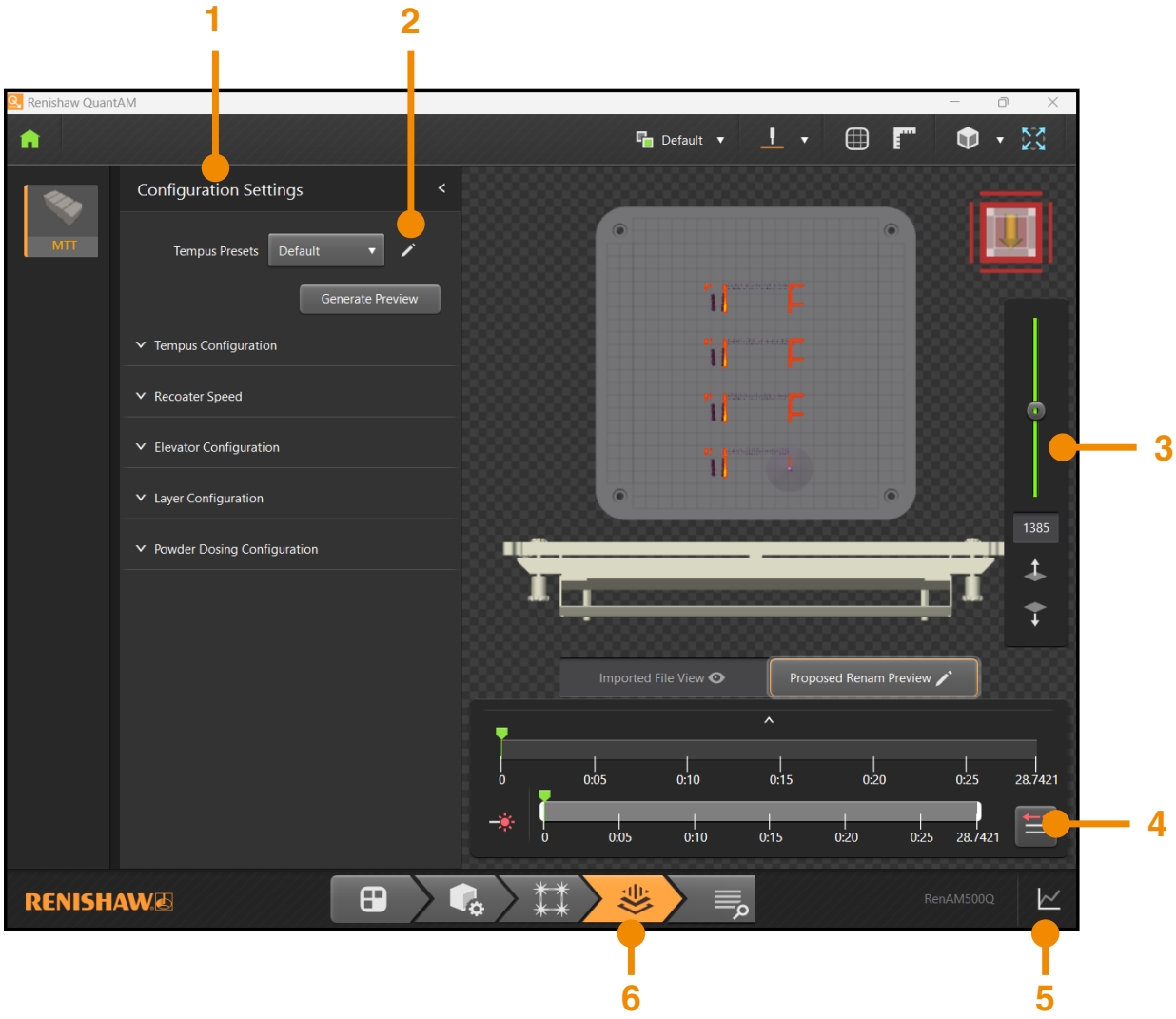
Automatically assign a laser to the selected parts or build styles based on the selection made in 'Laser Assignment Strategy'. Using this option overrides any manual assignment that you have made previously.

13

Apply to Defaults

Assign a laser to unassigned (default – grey) parts and build styles based on the option selected in 'Laser Assignment Strategy'. Using this option does not override any laser assignment that you have made previously.

4.8.5. Stage 4 of Build file viewer – ‘Sorting and Ordering’



The ‘Sorting and Ordering’ stage enables you to switch between the preview of the file that was imported and the preview of .renam file that would be exported based on the current configuration settings. You can switch between the previews using the ‘Imported File View’ and ‘Proposed RENAM Preview’ tabs, available at the bottom of the build plate window.

NOTE: Skip this stage if you are planning to export the build file in an .mtt format. Directly review and export your build file in the ‘Review’ stage.

The preview of an .mtt build can be viewed only in the ‘Imported File View’ tab and it displays only the selected layer and the corresponding laser assignments. However, the preview of the .renam build file in both the ‘Imported File View’ and the ‘Proposed RENAM Preview’ tabs displays the movement of the recoater assembly in addition to the layer and the corresponding laser assignment.

1 

Configuration Settings

When creating a .renam build, use the ‘Configuration Settings’ bar to customise your build file. The .renam build file enables you to increase the efficiency of the build production in a Renishaw AM system compared to an .mtt build file. TEMPUS technology utilises the .renam build file; it cannot be used with .mtt build files.

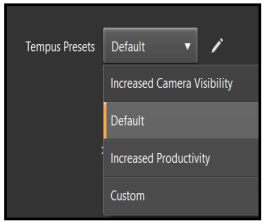
Click anywhere on the ‘Configuration Settings’ bar to open the flyout menu and click the chevron to close it. Use the ‘TEMPUS Presets’ drop-down menu to apply a pre-defined or custom configuration to your build file. All the controls of the ‘Configuration Settings’ and their function are described in the table below.

Tabs in the Settings dialog box	Controls	Description
TEMPUS Preset	**Default**	Apply the standard pre-defined TEMPUS configuration values for your build file. This will optimise system productivity and reduce build time. Typically, this preset will reduce the build time by approximately 7 seconds per layer when compared to an .mtt file. Using this preset, the laser may be visible in the camera images captured by the on-machine camera. You cannot modify any other configuration settings with this preset selected.
	Increased Camera Visibility	Generate productivity-enhanced build files while allowing the camera to capture the build images of the unmelted powder layer, and fully melted powder layer. The laser will not fire when the recoater is above the powder bed, and the recoater will pause to enable the camera to capture images. Typically, this preset will reduce the build time by approximately 2 seconds per layer, when compared to an .mtt file.
	Increased Productivity	Creates productivity-optimised build files with co-ordinated recoater, elevator and laser actions. It applies the same configuration as that of the ‘Default’ TEMPUS preset but with an increased recoater ‘Forward Speed’.

Tabs in the Settings dialog box	Controls	Description
TEMPUS Preset	**Custom**	Configure all the build parameters available in the 'Configuration Settings' bar according to your preference and save the custom configuration with a new name.
TEMPUS Configuration	**Include Camera Pauses**	Enable this option to pause the firing of lasers while the recoater is above the powder bed, allowing the on-machine camera to capture the build images of the unmelted powder layer, and fully melted powder layer. Disable this option override the pauses required by the on-machine camera to capture the images of the powder bed without the laser being visible in the images. This allows you to maximise the build productivity, but the laser actions will be visible in camera images.
	Recoater Width	Enter the physical dimension of the recoater within the accepted range.
	Recoater Time Safe Zone	Enter the time by which the laser action is to be delayed with respect to recoater width and recoater speed. It is intended to prevent the firing of lasers on the recoater.
Recoater Speed	**Forward Speed**	Enter the speed of the recoater in the forward direction within the accepted range.
	Backward Speed	Enter the speed of the recoater in the backward direction within the accepted range.
Elevator Configuration	**Elevator Dip**	Enter the distance by which the elevator will drop when the recoater is moving in the backward direction. This elevator dip reduces the likelihood of the recoater interacting with the powder bed on the way back.
	Elevator Speed	Enter the speed at which the elevator moves in the upward and downward directions, within the accepted range.
Layer Configuration	**Minimum Layer Duration**	Enter the execution time delay required between the consecutive layers of your build, within the accepted range.
	Delays between Borders and Hatches	Enable the check box to add a time delay while sequentially scanning borders and hatches. This helps in avoiding spatters and minimising downstream effects, preventing the condensed matter from affecting the lasers aligned with the melted part of the hatches, ensuring better print quality and accuracy. This option is available for selection in custom TEMPUS Preset, if the 'Include Camera Pauses' checkbox is enabled.
Powder Dosing Configuration	**Dose Quantity**	Enter the percentage of powder required to be spread in each layer of your build, within the accepted range.
	Temporary Dose Quantity	Enter the percentage of powder required to be spread in the number of layers defined in the 'Active for' field.
	Active for	Enter the number of layers defined for which the 'Temporary Dose Quantity' is applicable.

NOTE: To account for minor mechanical variations between machines, the speed of the recoater will be adjusted to maintain the timing specified in the build file.

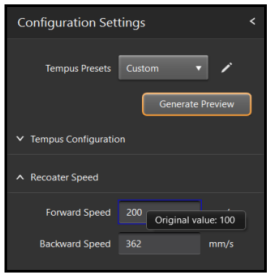
NOTE: After updating the 'Configuration Settings', click 'Generate Preview' to view the updated preview of the .renam build file. If you do not choose to define any TEMPUS presets, QuantAM will load the 'Default' TEMPUS preset for the 'Proposed Renam Preview'.

2 

Custom TEMPUS Preset

Modify the parameters by typing an acceptable numeric value in the highlighted text boxes. After updating the configuration values, click the pencil icon next to the 'TEMPUS Presets' button and save the configuration with a new name. If you do not enter a valid input for the customisable parameter, the related text box will be highlighted in red, and the system displays the acceptable range. After updating the configuration settings, click 'Generate Preview' to preview your build.

NOTE: If you modify the parameters of an imported .renam build file, the text box of the updated parameter is highlighted in blue (see the screenshot below). Hover the mouse over the text box to see the original value.



3 

Slice Control Toolbar

View the slices within the build. For more information, see section 4.8.6, "Stage 5 of Build file viewer – 'Review'".

4 

Steps through the Scan Paths

Step through each layer of the build. For more information, see section 4.8.6, "Stage 5 of Build file viewer – 'Review'".

5 

Laser Plot Viewer (Ctrl + P)

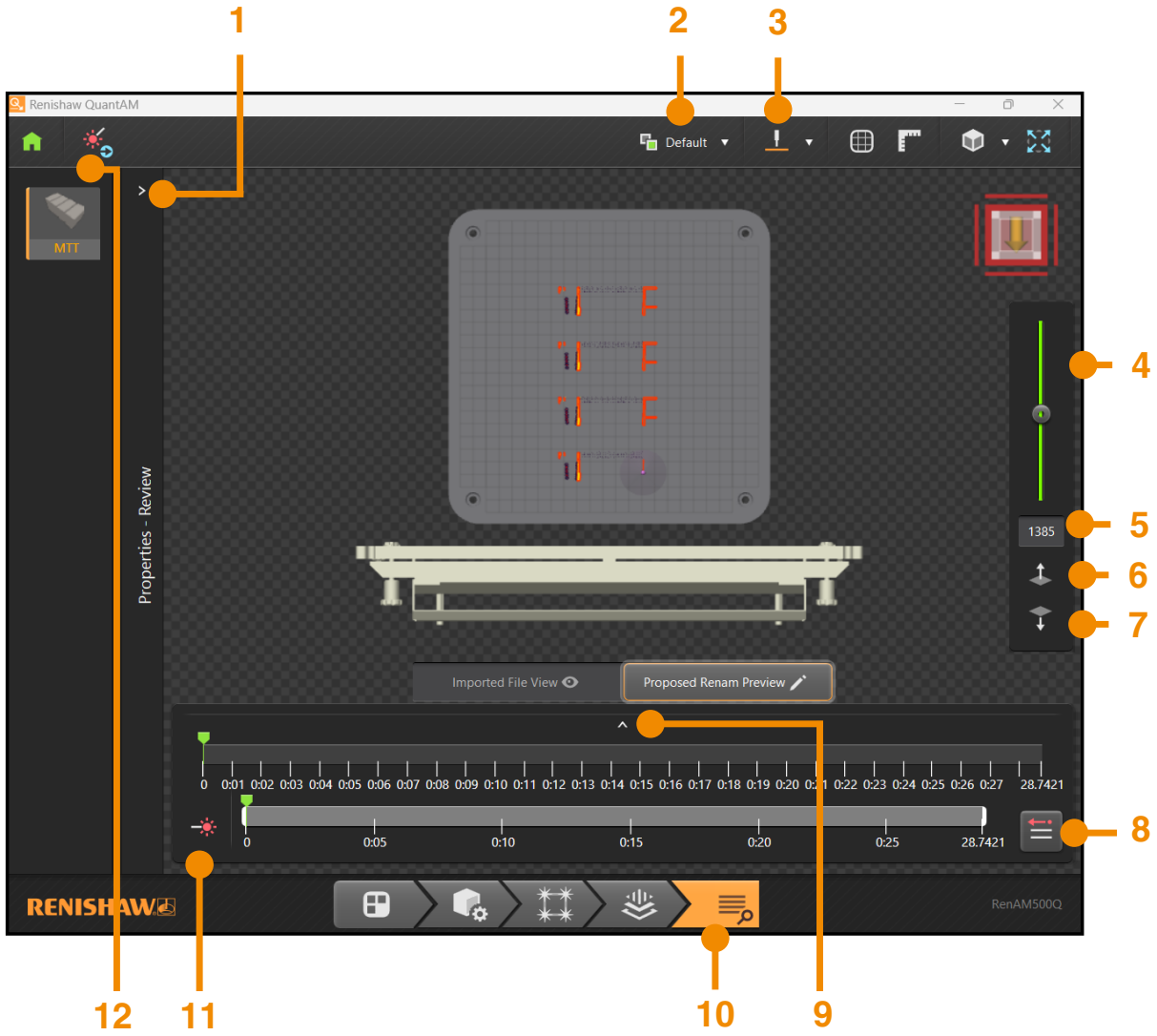
View a ‘Timing Plot’ graph displaying ‘Time/Layer’ data. You can use this graph to compare the timing information of the imported build file and the proposed .renam build file.

6 

Sorting and Ordering Stage

This is the fourth stage of the ‘Build file viewer’ process where you can review and configure the settings for your .renam build file before exporting it in the ‘Review’ stage.

4.8.6. Stage 5 of Build file viewer – ‘Review’



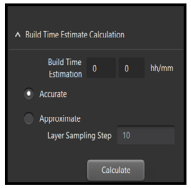
The ‘Review’ stage enables you to switch between the preview of the build file that was imported and the preview of the .renam file that would be exported based on the TEMPUS configuration made in the sorting and ordering stage. You can switch between the previews using the ‘Imported File View’ and ‘Proposed RENAM Preview’ tab, available at the bottom of the build plate window.

1

Properties – Review

Enables you to review the properties of the build. Click anywhere on the ‘Properties – Review’ bar to open the flyout menu and click the chevron to close it. The following parameters are displayed:

1a



Build Time Estimate Calculation

Use the ‘Accurate’ or ‘Approximate’ option to calculate the ‘Build Time Estimation’. If you select the ‘Approximate’ option, you must specify an appropriate value in the ‘Layer Sampling Step’ field.

1b

Default Build Parameters

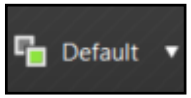
This displays the build parameters such as ‘Jump Speed’, ‘Jump Delay’, ‘Point Delay’, ‘Focus Jump Speed’ and ‘Dosing Time’. You can edit the ’Dosing Time’ for an .mtt build file. This parameter is only used for calculating the build time estimation and does not affect the real world machine performance.

1c

(Renam) Layer Specific Parameters

This enables you to review parameters specific to .renam build files, including ‘Elevator Height’ and ‘Recoater Y Position’.

2



Theme (Ctrl + T)

Change the colour theme for the scan path and layers according to your preference. Four colours are available.

3

Exposure Lines (Ctrl + H)

Toggle between the view of the scan path as ‘Exposure Lines’, ‘Exposure Points’ and ‘Energy Density Map’. In an ‘Energy Density Map’, red indicates high energy density regions and green indicates low energy density regions.

NOTE: If you have selected the ‘Energy Density Map’ scan path, the ‘Steps through the Scan Path’ button is disabled.

4 

Layer slider bar

View the layers within a build. Select and drag the slider to view a particular layer in the build. An interactive ‘Layer number indicator’ is available below the slider.

5 

Layer number indicator

Displays the layer number you are currently viewing. Enter a value in the layer number indicator field to display the corresponding layer in the preview.

6 

Go to Next Layer

Display the next layer in the section.

7 

Go to Previous Layer

Display the previous layer in the section.

8 

Steps through the Scan Paths

Step through each layer of a build.

Click to open two time-based scroll bars that enable you to see the order and sequence of the scan path within a selected layer. The bottom scroll bar displays the timeline for the selected layer. Drag either end of the bottom slider to change the start and stop times of the selected layer. Drag the top slider to view the position of the laser on the selected layer within the timeline defined by the bottom slider. Use the up arrow on the top of the slider toolbar to view the build parameters of the layer at the laser position defined using the top scroll bar.

9 

Build style viewer

Show or hide build parameters of the layer at the laser position defined using the time-based scroll bars. Click the arrow above the time-based scroll bars to open an additional menu. Information including ‘Laser’, ‘Laser Co-ordinates’, ‘Build Style’, ‘Element ID’, ‘Focus’, ‘Power’, ‘Point Distance’, ‘Exposure Time’, ‘Point Delay’, ‘Jump Speed’ and ‘Jump Delay’, ‘Sky Writing’ are displayed. As you scroll though the layers in the build, the displayed parameters are updated.

10 

Review Stage

This is the fifth stage of the ‘Build file viewer’ process where the laser assignment can be reviewed and adjusted as necessary. When the review is complete, export the build file to be executed on a Renishaw AM system.

11 

Laser Options

Select the laser you wish to view when stepping through scan paths.

12 

Export Build File (Ctrl + M)

Export the build file in any of the following formats:

12a **.mtt**

Build file containing sequential laser actions.

12b **.renam**

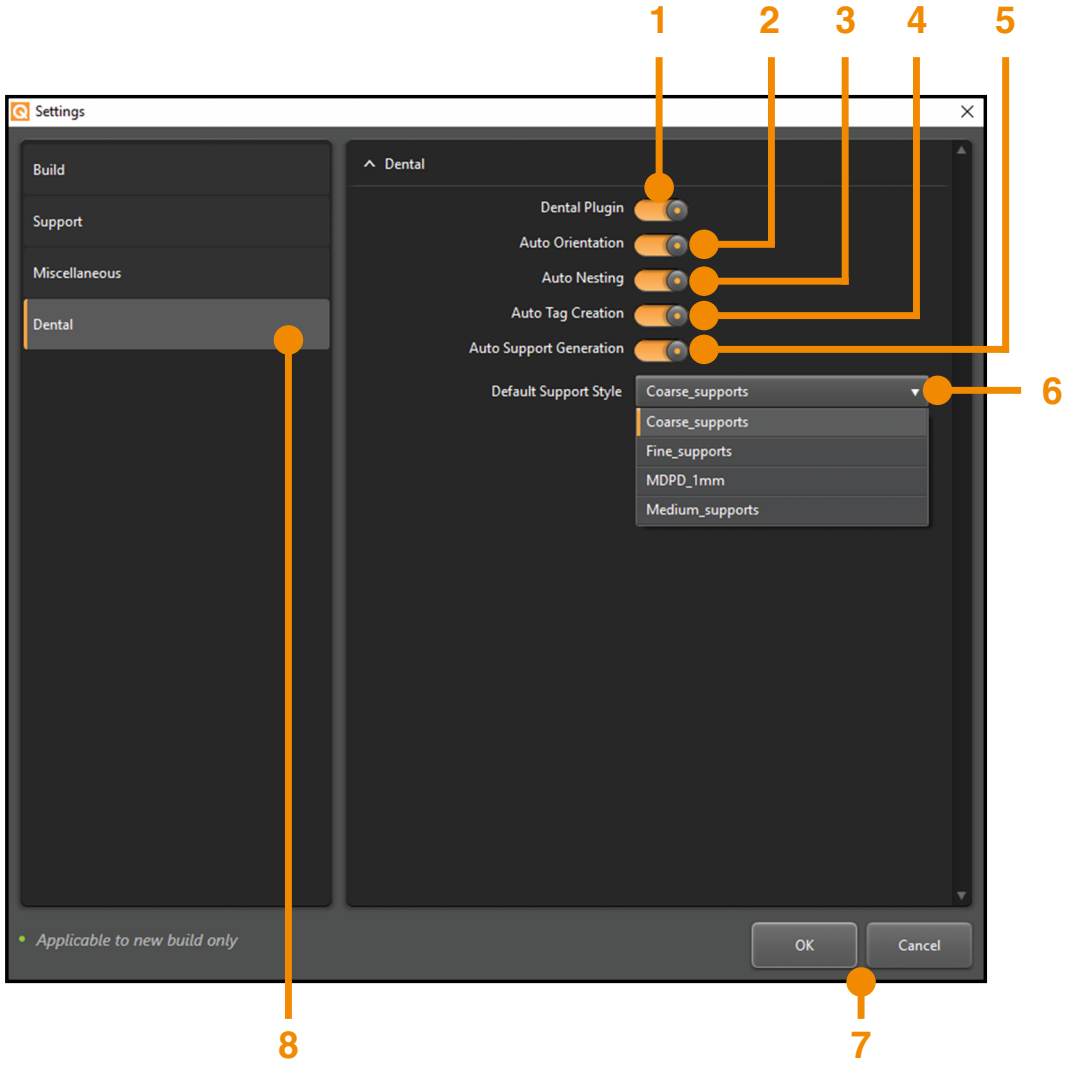
Build file containing optimised laser actions, timing information and system commands to increase the efficiency of the Renishaw AM system.

When you have completed all stages of preparing your build, the final stage is to export it into a file (.mtt or .renam) that can be executed on a Renishaw AM system.

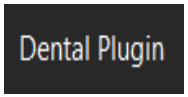
NOTE: The .mtt file can be executed on any Renishaw AM system, but does not benefit from the productivity enhancements of TEMPUS technology.

NOTE: If you have not assigned a laser to any part within your build, then a message is displayed informing you that the system will assign a default laser to all the unassigned build styles before exporting the file.

5. QuantAM Dental



NOTE: The 'Dental' tab is displayed only if the relevant QuantAM dental licence is activated. For purchasing the licence, contact Renishaw. For more information, see section 7, "Contact details".

1 

Dental Plugin

From the 'Start' page (section 4.2, "Start page"), click 'Settings' and open the 'Dental' menu. Toggle the dental features within QuantAM Dental 'On' or 'Off'.

2 

Auto Orientation

Toggle the 'Auto Orientation' feature for parts imported into QuantAM Dental 'On' or 'Off'. 'Auto Orientation' utilises data within the imported CAD model to orientate it on the build plate.

3 

Auto Nesting

Toggle the 'Auto Nesting' feature for parts imported into QuantAM Dental 'On' or 'Off'.

4 

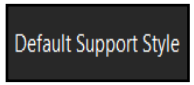
Auto Tag Creation

Toggle the 'Auto Tag Creation' feature for parts imported into QuantAM Dental 'On' or 'Off'. Tags can be printed next to each part to enable you to easily identify parts visually. Within QuantAM Dental, tags can be searched for to enable you to locate where on a build a specific part is located.

5 

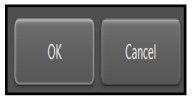
Auto Support Generation

Toggle the 'Auto Nesting' feature for parts imported into QuantAM Dental 'On' or 'Off'.

6 

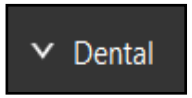
Default Support Style

Choose the style of default support: 'Coarse', 'Fine', 'MDPD_1mm' or 'Fine'.

7 

OK/Cancel

Confirm the selection or cancel and return to the previous screen.

8 

Dental

Open the ‘Dental’ drop-down menu to view the range of functionality you want to enable and disable.

NOTE: In QuantAM Dental, when you select ‘Import CAD data’, the ‘Import model’ dialog box will open but the range of file types that can be imported is reduced. Only .amx, .ctm and .stl files can be imported into the workspace.

---

6. Keyboard shortcuts

NOTE: All Ctrl + [number] shortcuts refer to keyboards with a number pad. For users without a number pad, such as laptops, use Ctrl + Windows key + [number].

6.1. Orientation, Support, Layout and Review shortcuts

There are six groups of keyboard shortcuts described in the following shortcuts. They are as follows:

Section 6.2: Mouse control

Section 6.3: Common shortcuts

Section 6.4: Orientation stage

Section 6.5: Support stage

Section 6.6: Layout stage

Section 6.7: Review stage

6.2. Mouse control

Scene rotation	Left button
Pan operation	Right button
Zoom camera	Mouse scroll

6.3. Common shortcuts

Fit to screen	Ctrl + 0	Right view	Ctrl + 6	Save active build	Ctrl + S
Top view	Ctrl + 1	Isometric view	Ctrl + 7	Save as active build	Ctrl + Shift + S
Bottom view	Ctrl + 2	Toggle orthographic/perspective view	Ctrl + 8	Rectangular zoom	Z + Left Click + Drag
Front view	Ctrl + 3	Toggle navicube style	Ctrl + 9	Import model	Ctrl + O
Back view	Ctrl + 4	Show/hide 2D measurement	K	Leave selected function	Esc
Left view	Ctrl + 5	Keyboard shortcuts	Ctrl + F1		

6.4. Orientation stage

Part orientation	O	Model transparent/opaque	T	Wireframe	W
Scale part	X	Hard edges	H	Undo	Ctrl + Z
Extrude part	E	Set downward surface	D	Redo	Ctrl + Y
Show/hide bounding box	B	Change Z offset	Q	Export part	Ctrl + E
Show/hide support region colour	C	Part label	L		

6.5. Support stage

Auto supports	A	Export parts/supports	E	Enable/disable line support mode	L
Enable/disable point support mode	P	Slicing	S	Select all supports	Ctrl + A
Region selector	G	Region viewer	R	Select all intersecting supports	Ctrl + Alt + A
Support edit mode	M	Wireframe	W	Select all part intersecting supports	Ctrl + Alt + P
Section	V	Update supports	U	Toggle support clipping options	Ctrl + K
Show/hide support region colour	C	Undo	Ctrl + Z	Select/deselect multiple instances	Ctrl + Left click
Model transparent/opaque	T	Redo	Ctrl + Y	Translate supports	Alt + Left click + Drag
Hard edges	H	Import supports	Ctrl + I	Auto minima supports	Ctrl + Alt + M

6.6. Layout stage

Rotation tool	R	Copy	Ctrl + C	Select/deselect multiple instances	Ctrl + Left click
Nesting	N	Paste	Ctrl + V	Move part	Alt + Left click + Drag
Show/hide bounding box	B	Undo	Ctrl + Z	Material viewer	Ctrl + M
Instancing	I	Redo	Ctrl + Y	Export .MTT	Ctrl + E
Translation	Y	Select all instances	Ctrl + A	Build plot	Ctrl + P
Show silhouette	U	Delete instance	Delete		

6.7. Review stage

Show next slice or scan path	Page up	Model transparent/opaque	Ctrl + T	Toggle colour theme	Ctrl + T
Show previous slice or scan path	Page down	Toggle part layer view	Ctrl + J	Export .MTT	Ctrl + E
Show first slice or scan path	Home	Toggle exposure	Ctrl + H	Show/Hide substrate	H
Show last slice or scan path	End	Material viewer	Ctrl + M	Steps through the scan blocks	F2

7. Contact details

For support or assistance with QuantAM software, please contact Renishaw:

Phone number: +44 (0) 1453 524 524

Hours of work: Monday to Friday 08:00 to 17:00 hr (UTC and DST)

Email: **quantam.support@renishaw.com**

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www.renishaw.com/contact

#renishaw

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