ADVANCED MACHINING
BETP 3584
MULTI-AXIS PROFILE CONTOURING IN 4/5 AXIS MACHINING

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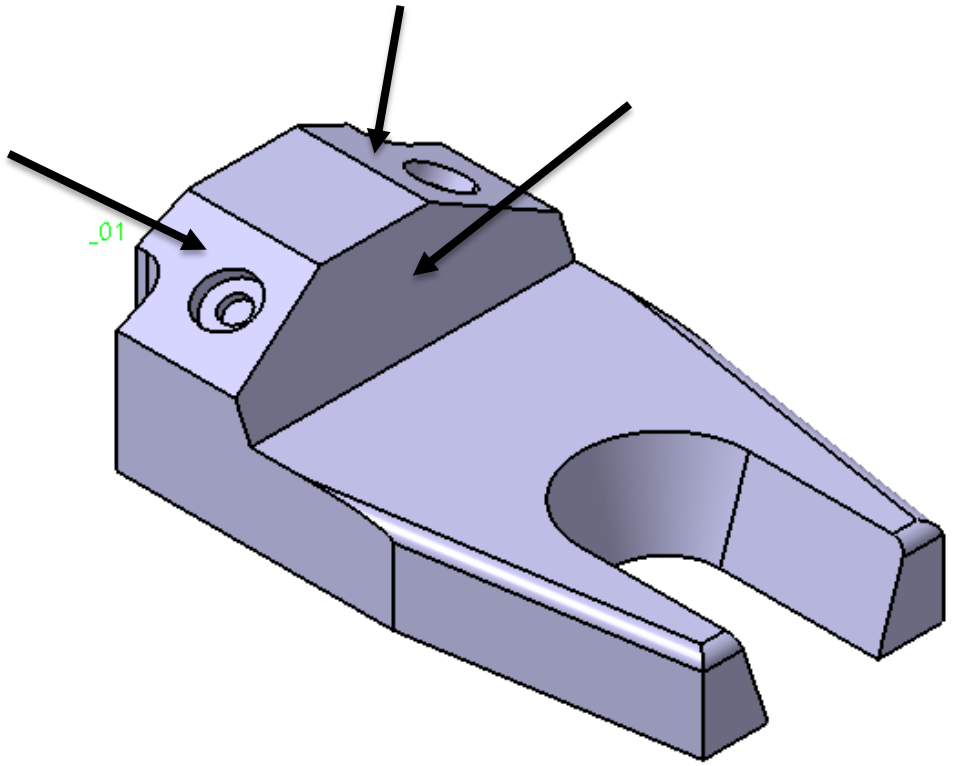
Multi-Axis Profile Contouring

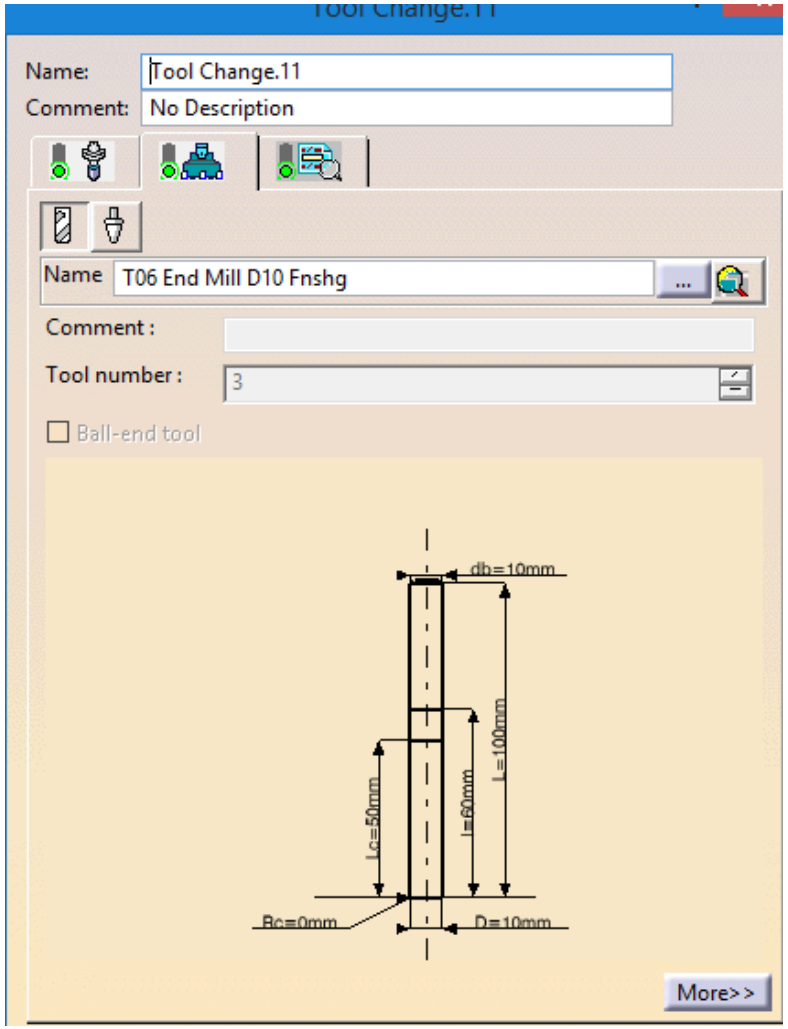
- Multi-Axis Profile Contouring is actually an advancement from Profile Contouring Operation in 3-Axis Machining.
- Despite performing profile contouring process on the 3-Axis surfaces, Profile Contouring can also be utilized to machine on slanted or angled surfaces which also known as 4/5 Axis surfaces.
- Multi-Axis Profile Contouring ONLY appropriate for 5-Axis Indexing program NOT simultaneous motion.
- Ultimately, Multi-Axis Profile Contouring offering broaden flexibility in preparing CAM program for any given CAD model.

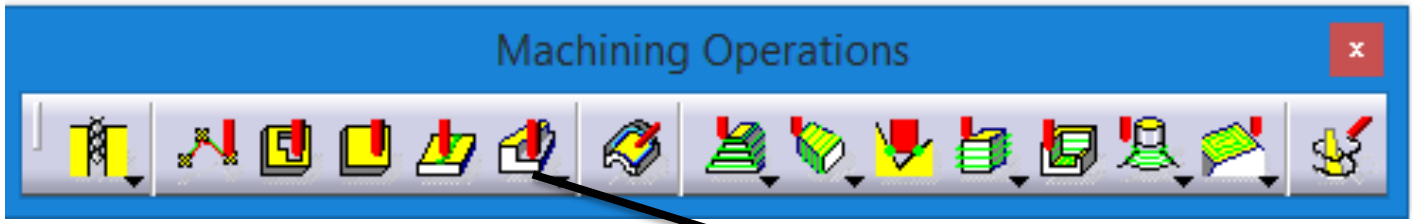
Multi-Axis Profile Contouring



- ✓ From the given CAD Model, there are **few areas** have been **identified appropriate to perform Multi-Axis Profile Contouring**.
- ✓ In **chapter 4**, **Angled or Chamfer profiles** are machined by using **Isoparametric Operation** in 3-Axis as well as 5-Axis way.
- ✓ However, this time **Multi-Axis Profile Contouring** shall be utilized **to machine approximately the same profiles** which definitely resulted faster in programming time and greater surface finish quality.

Multi-Axis Profile Contouring

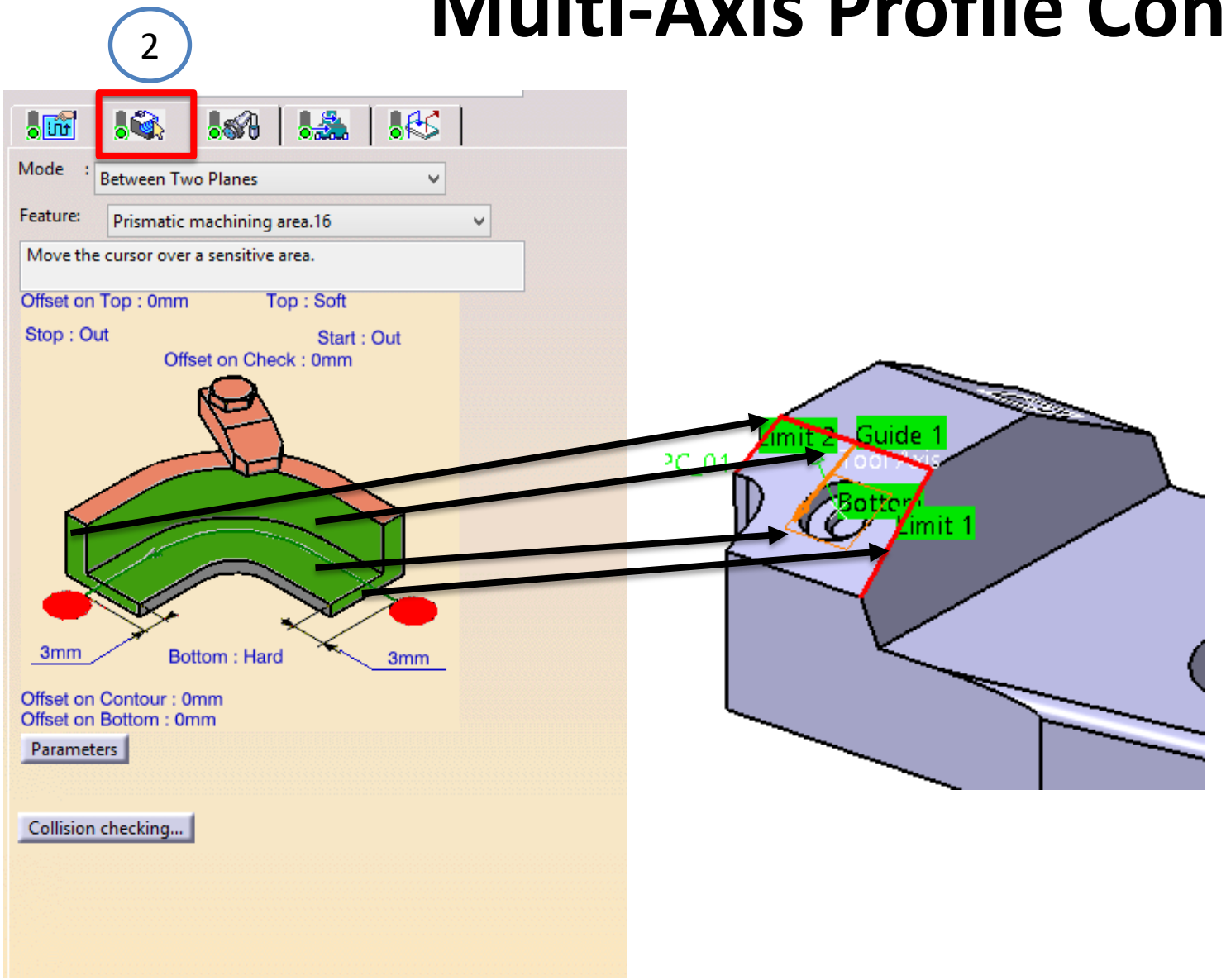




Profile Contouring

- ✓ **Multi-Axis Profile Contouring** is actually using **Profile Contouring Definition** as the main operation
- ✓ Create and insert the desired Cutting Tool in the Resource List as well as in the Manufacturing Program
- ✓ Select the right **CUTTING TOOL– END MILL D10.0**

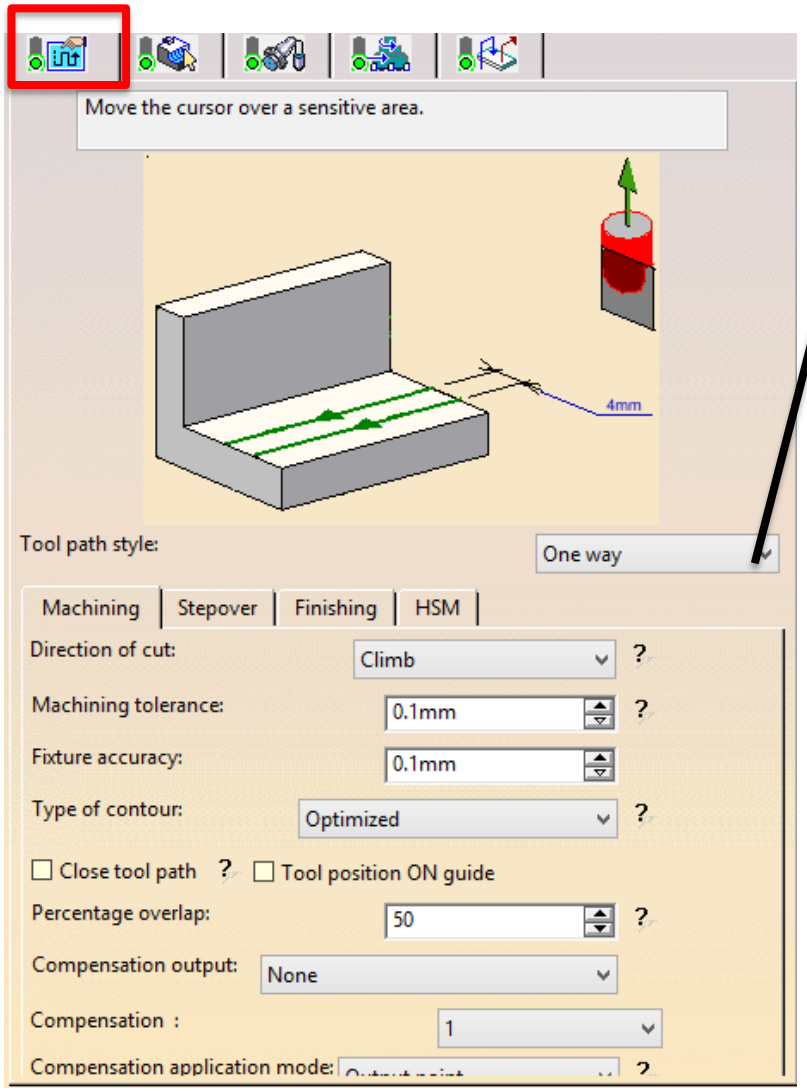
Multi-Axis Profile Contouring

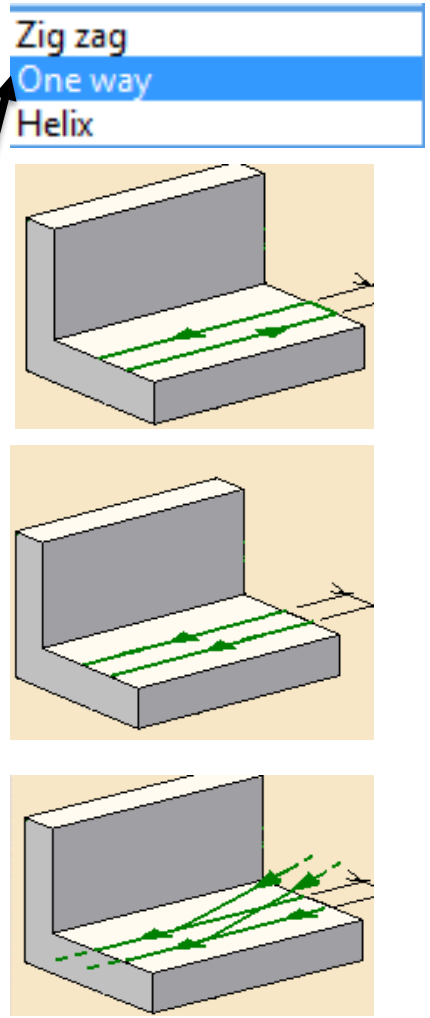


- ✓ In TAB – 2, there are **Four (4) geometries** that need to be defined namely **Bottom Surface**, **Guiding Element** (Machining Guide), **Limit 1** and **Limit 2** (start and stop).
- ✓ **Bottom Surface** is **very important** because this surface will be the **reference surface for the Tool Axis**.
- ✓ In **Multi-Axis Profile Contouring** there is no **Tool Axis options**.
- ✓ **Tool Axis** will be **automatically change perpendicular** to the chosen **Bottom Surface**.

Multi-Axis Profile Contouring

1





Zig Zag

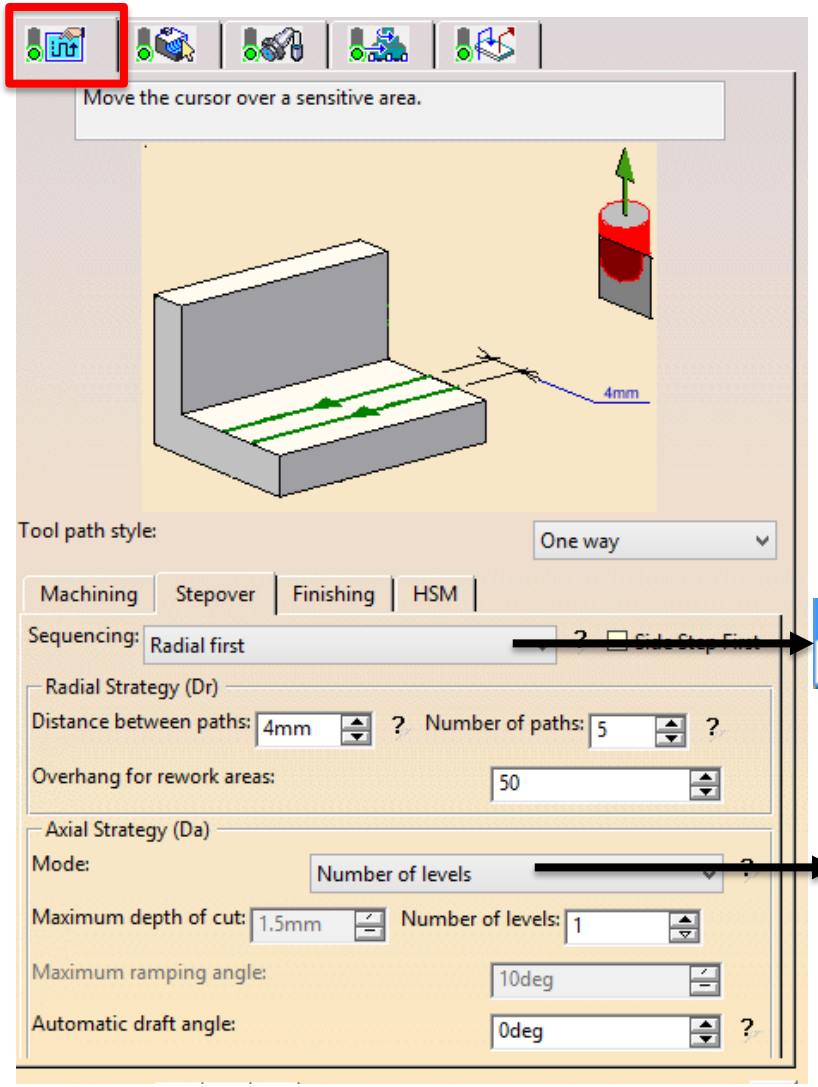
One Way

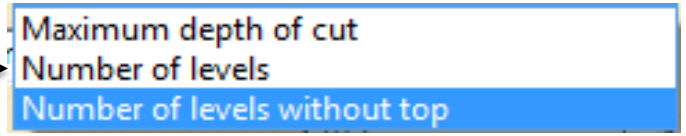
Helix

- ✓ In **TAB – 1**, there are **Tool Path Style** or **Machining Strategy** can be determined namely Zig Zag, One Way and Helix.
- ✓ The best machining strategy is One Way. Better surface finish and longer tool life shall be gained if this strategy is chosen.
- ✓ On the other hand, **Machining Tolerance** representing **how fine one path to another or one point to another point.**
- ✓ **The smaller the number** is in Machining Tolerance will **give better result in dimensional.**

Multi-Axis Profile Contouring

1

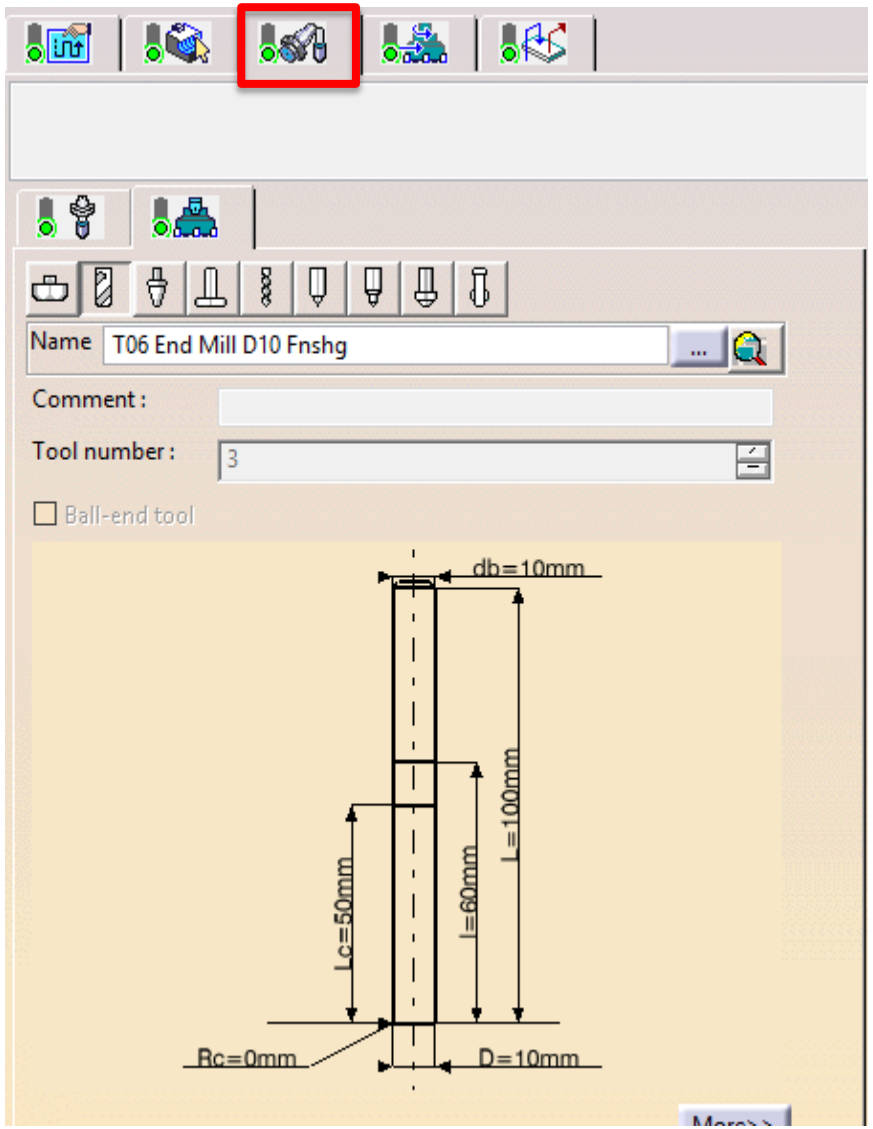


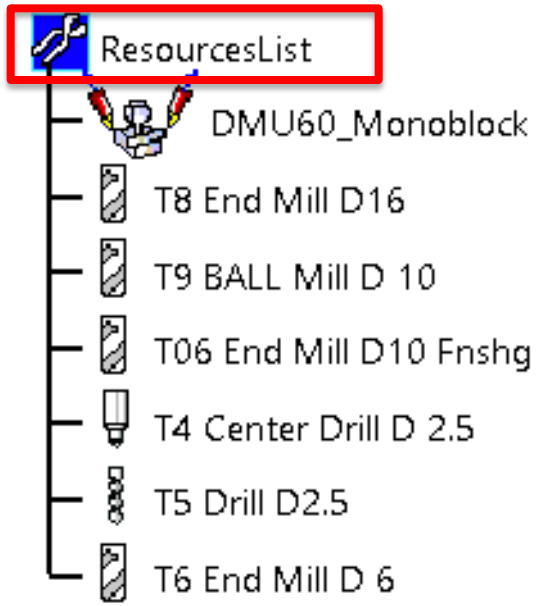


- ✓ Still in **TAB – 1**, STEPOVER – There are Radial & Axial Strategy to be determined here.
- ✓ User can choose the **sequence** of tool path calculation either **Radial or Axial first**.
- ✓ On the other hand, there are **THREE (3) options** offered in **Axial Strategy** namely **Maximum Depth of Cut, Number of Level**s and **Number of Levels Without Top**.
- ✓ Options of **Maximum Depth of Cut** and **Number of Levels** can **ONLY** be used **IF Top Surface** is **defined**.

Multi-Axis Profile Contouring

3

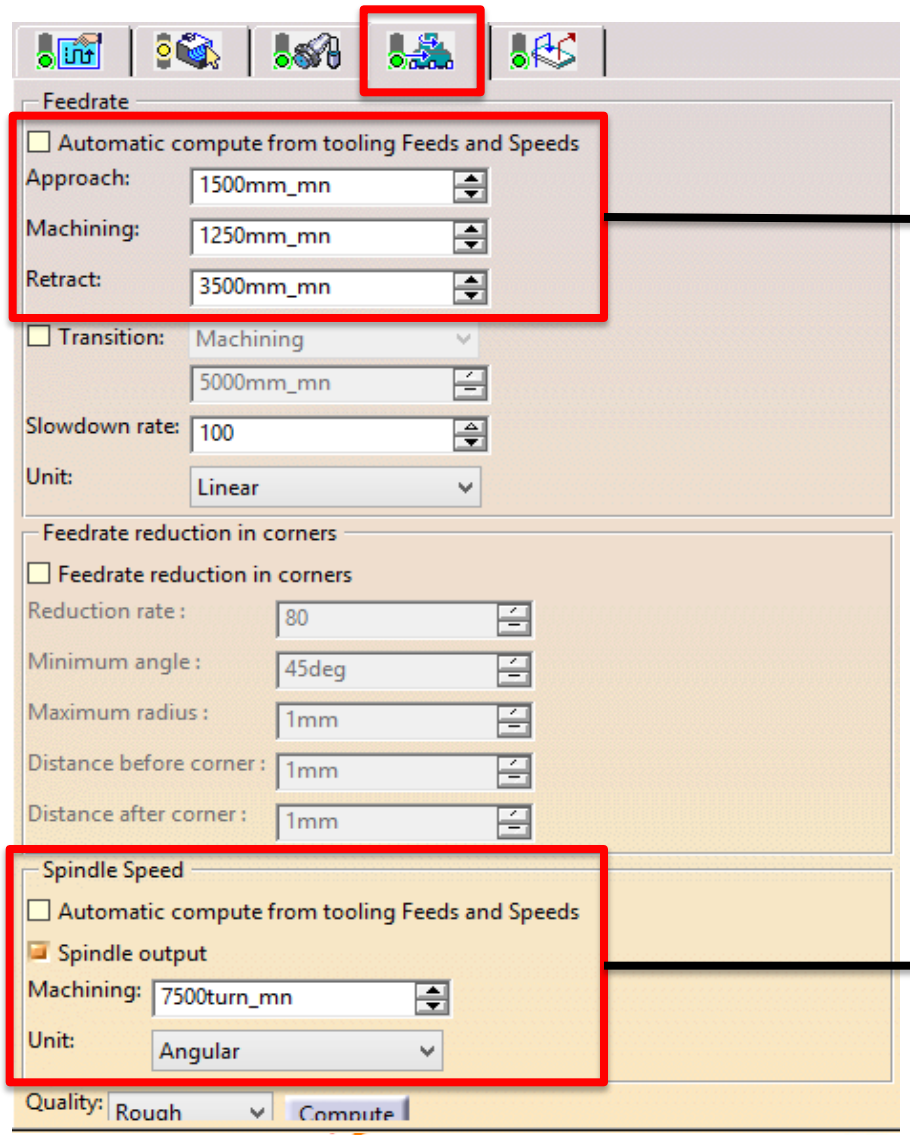




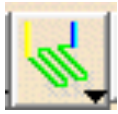
- On the TAB-3, user **need to check cutting tool specification** is correct according to the machining process to be used.
- This is very important **to ensure the right machining simulation is calculated**.
- **No changes is allowed** to be done here.
- If there is **any modification needs to be made**, user need to go back to the **Resources List** and make necessary changes there.

Multi-Axis Profile Contouring

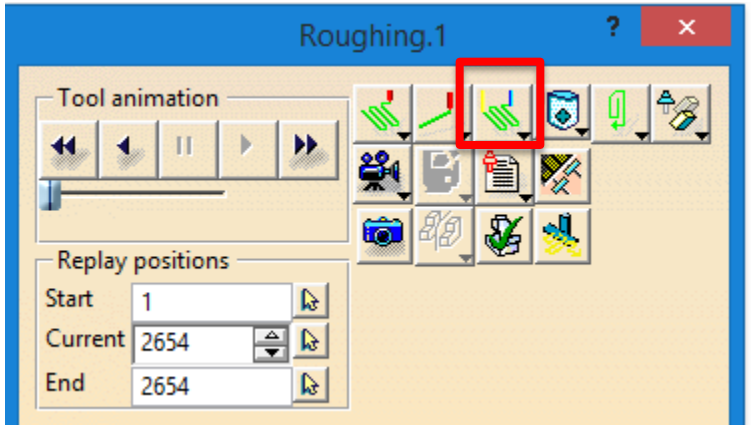
4



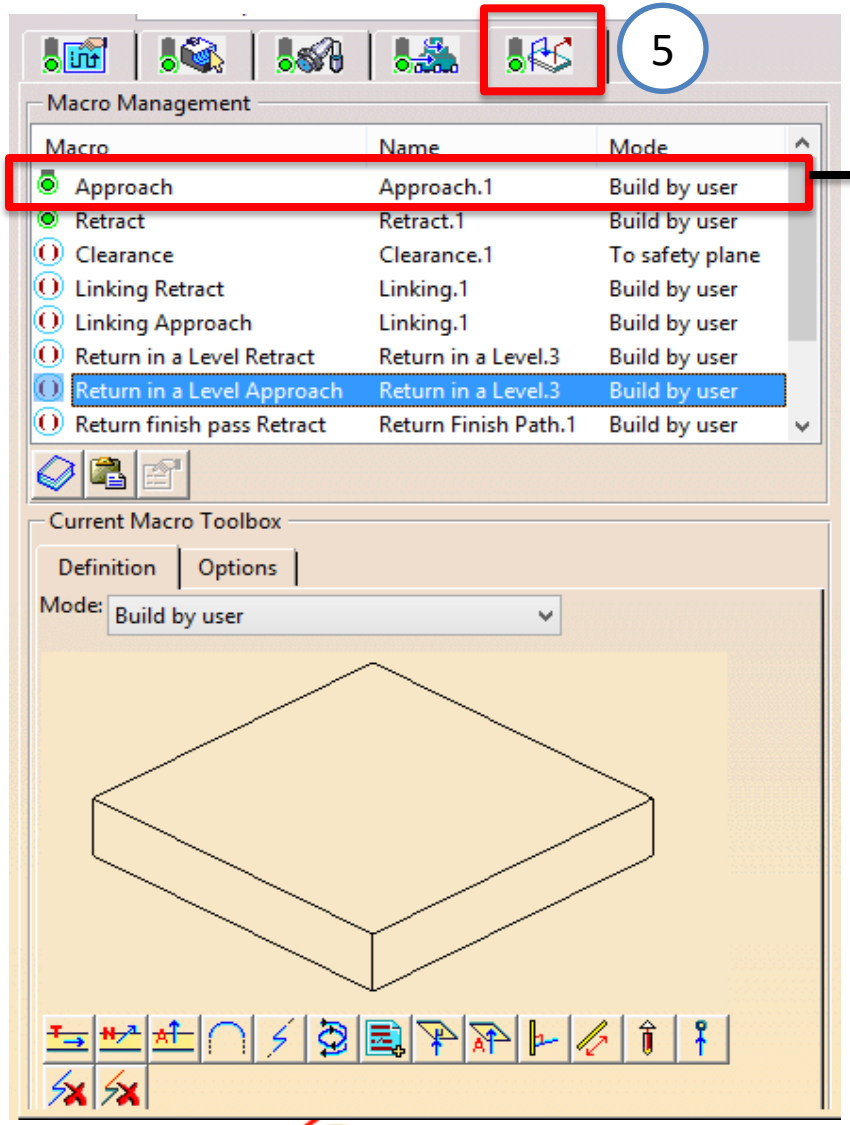
- There are **THREE (3) types** of **Feed Rates** which need to be defined namely **Approach, Machining & Retract.**
- **Color Coding** representing each Feed Rate are
  - **Approach = Yellow**
  - **Machining = Green**
  - **Retract = Blue**
- To view this, user needs to **change the setting** in **simulation TAB** into **Color Mode**.



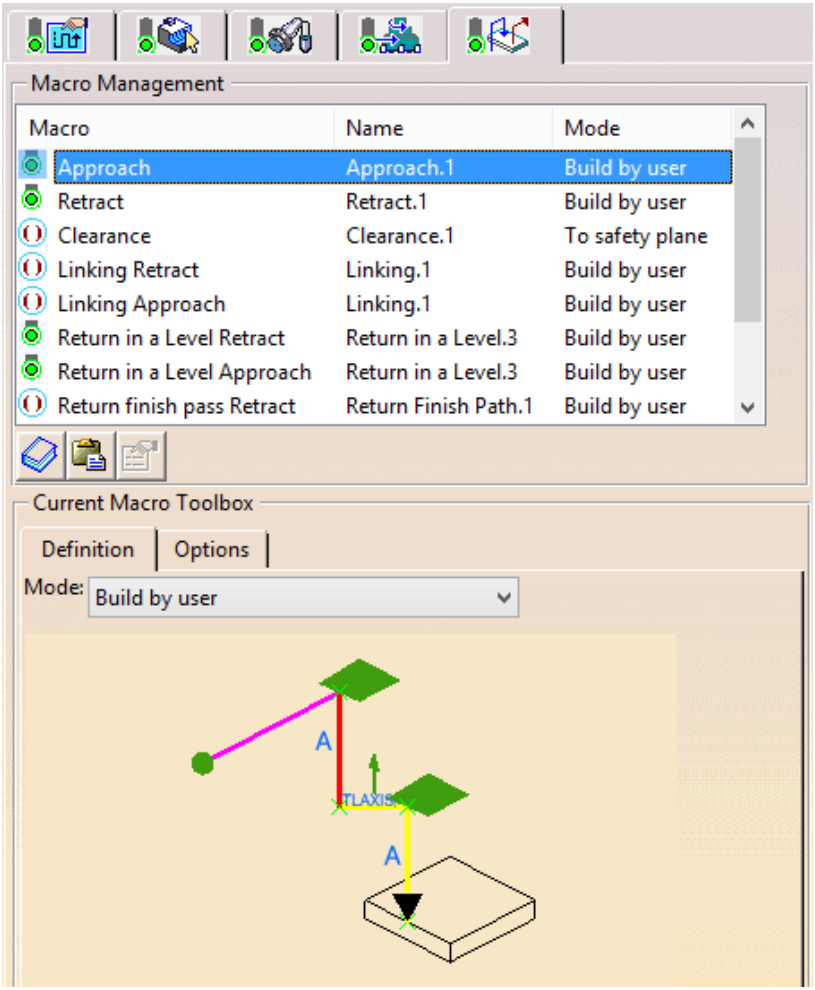
❑ **Another Setting** that needs to be defined is **Spindle Speed** which **relying on the size, type & material** of the **cutting tool** as well as the **workpiece**.



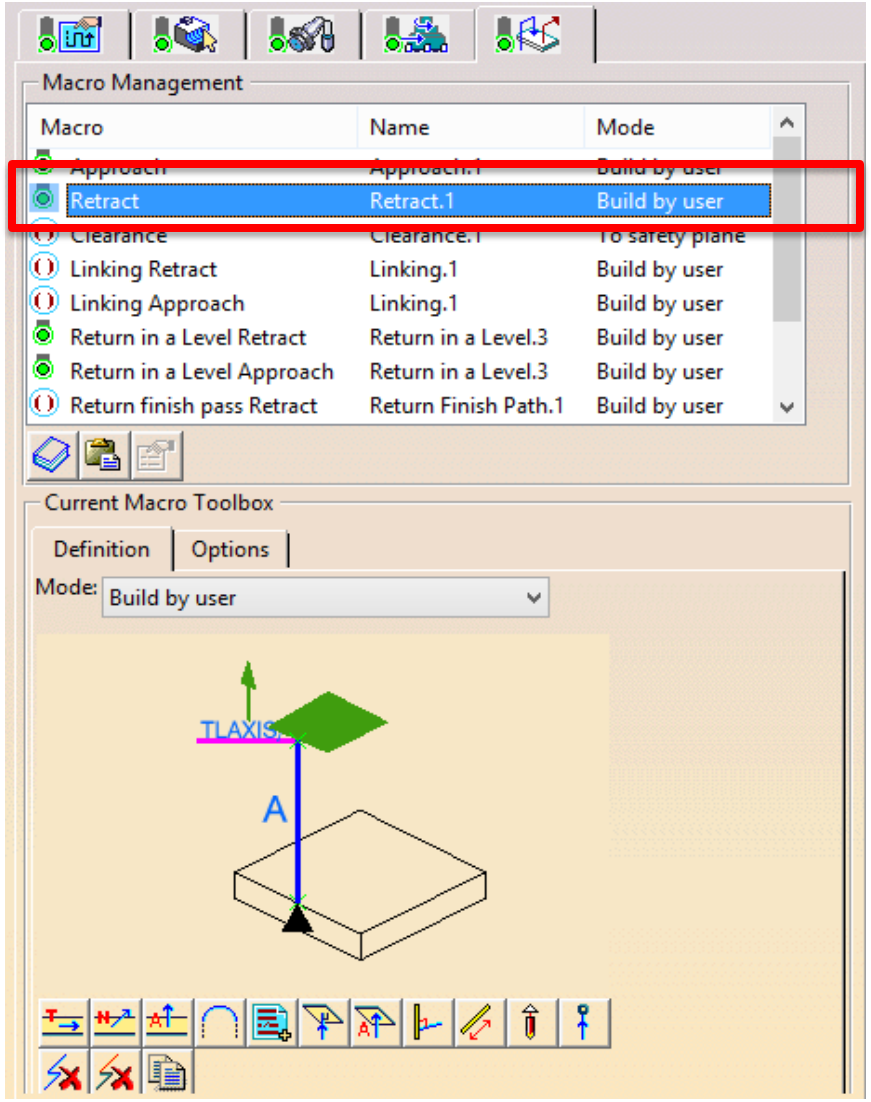
Multi-Axis Profile Contouring



- **Macro Setting** for **Approach** consists of, **Axial To Plane, Tool Axis, Axial To Plane and Motion to Point**.
- Meanwhile, **Macro Setting** for **Retract** consists of **Axial To Plane, Tool Axis and Axial To Plane**.



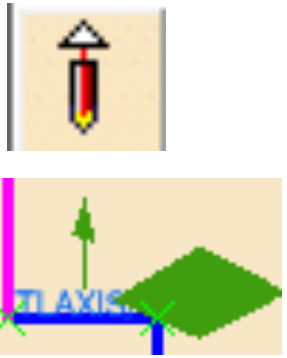
Multi-Axis Profile Contouring



- Since **Multi-Axis Profile Contouring** is using **for 4/5 Axis position** thus **Tool Axis** is **very important** to **maintain** the **cutting tool position 90 degree before** and **after machining** is done.

- **Tool Axis** is **very useful** to be used in **4/5 Axis motion** to **decrease possibility of collision**. Same goes to **Approach Macro Setting**.

- **Cutting tool** will be **approaching and leaving** the **workpiece** in **90 degree – 3 Axis** motion before make **any tilting motion** towards the machining profile.

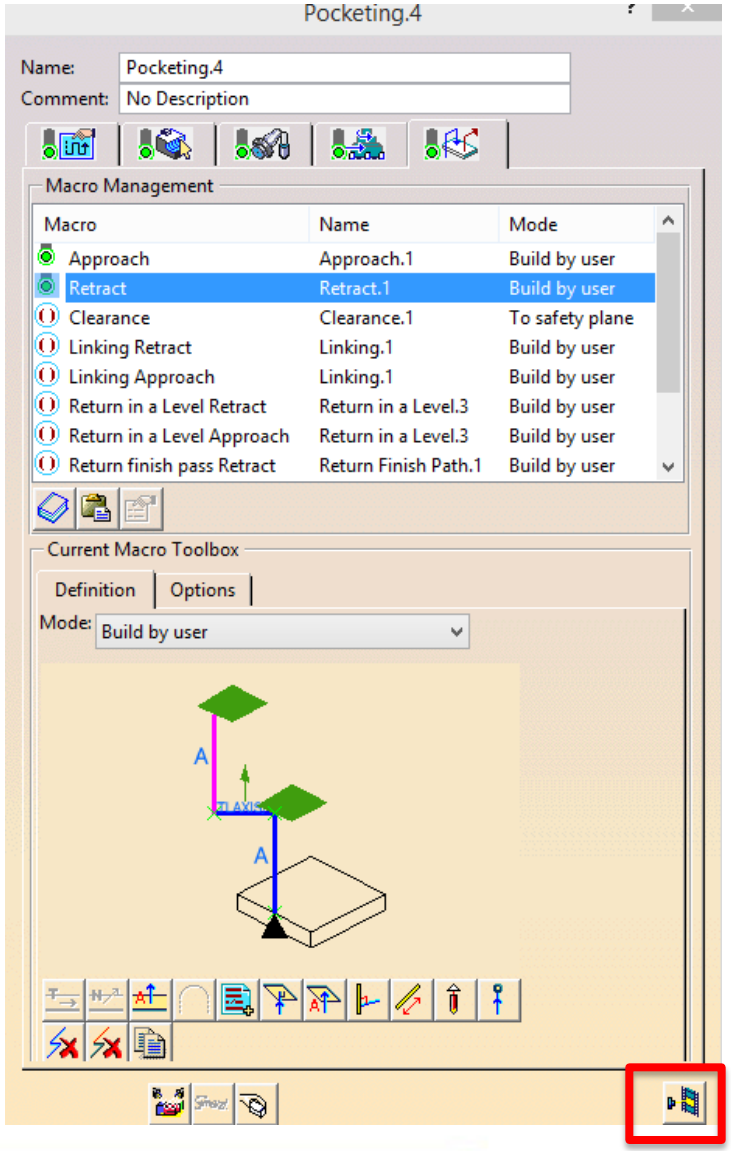


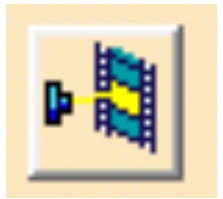
Macro Setting – Tool Axis

Multi-Axis Profile Contouring

- Once ALL settings from **TAB 1 – TAB 5** are **done**, **machining tool paths** is now can be calculated by hitting the icon **Tool Paths Reply**.

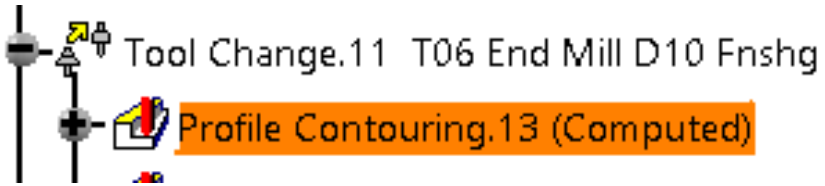
- This icon located at the bottom right of every TAB and appears the same on every machining operation offered.

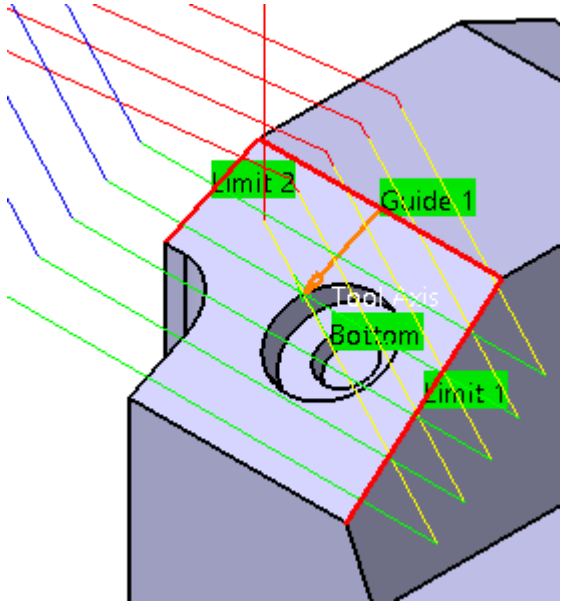




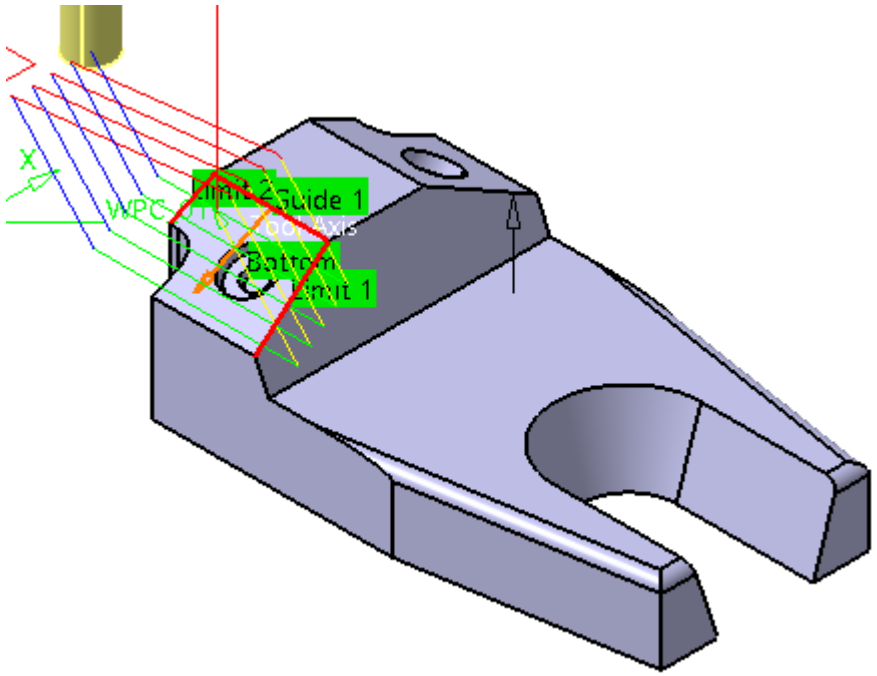
Tool Paths Reply

Multi-Axis Profile Contouring

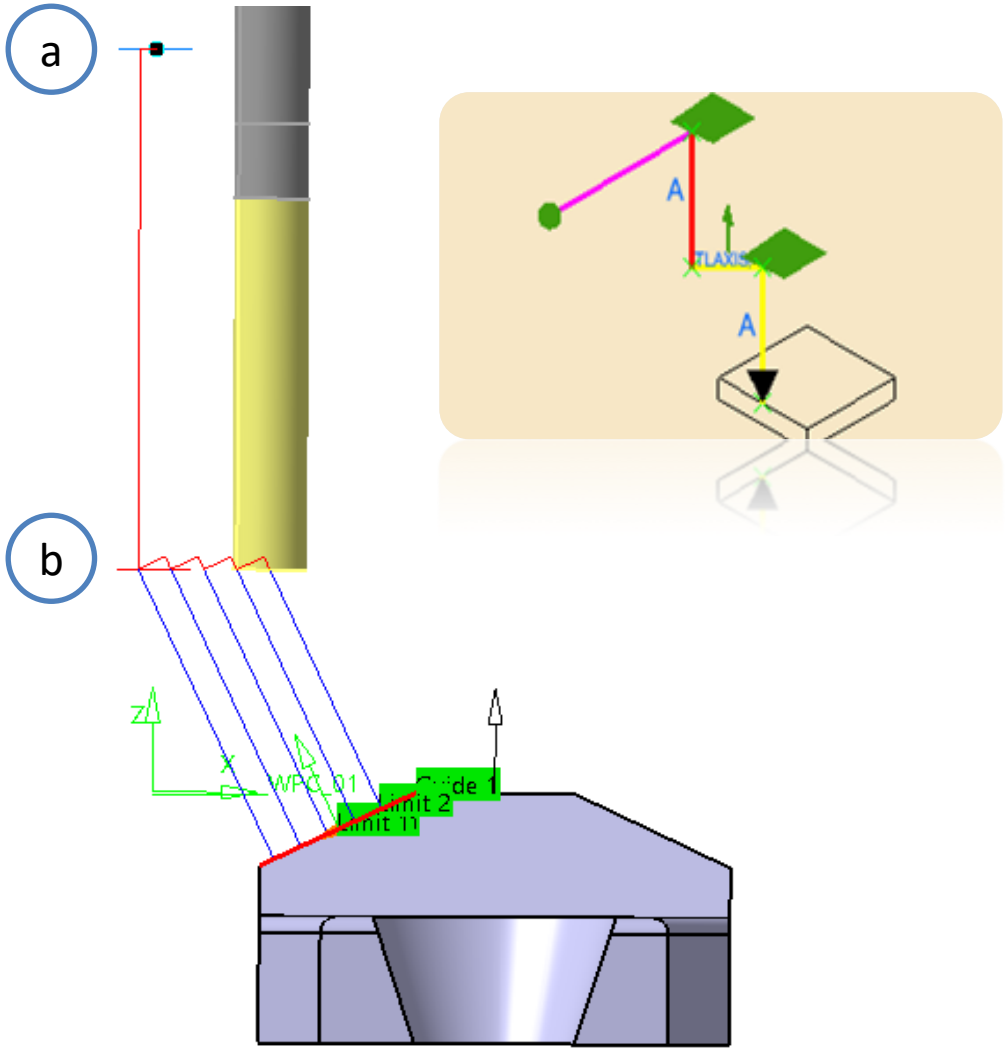




- **Specification TREE** – Multi-Axis Profile Contouring – 1st Side

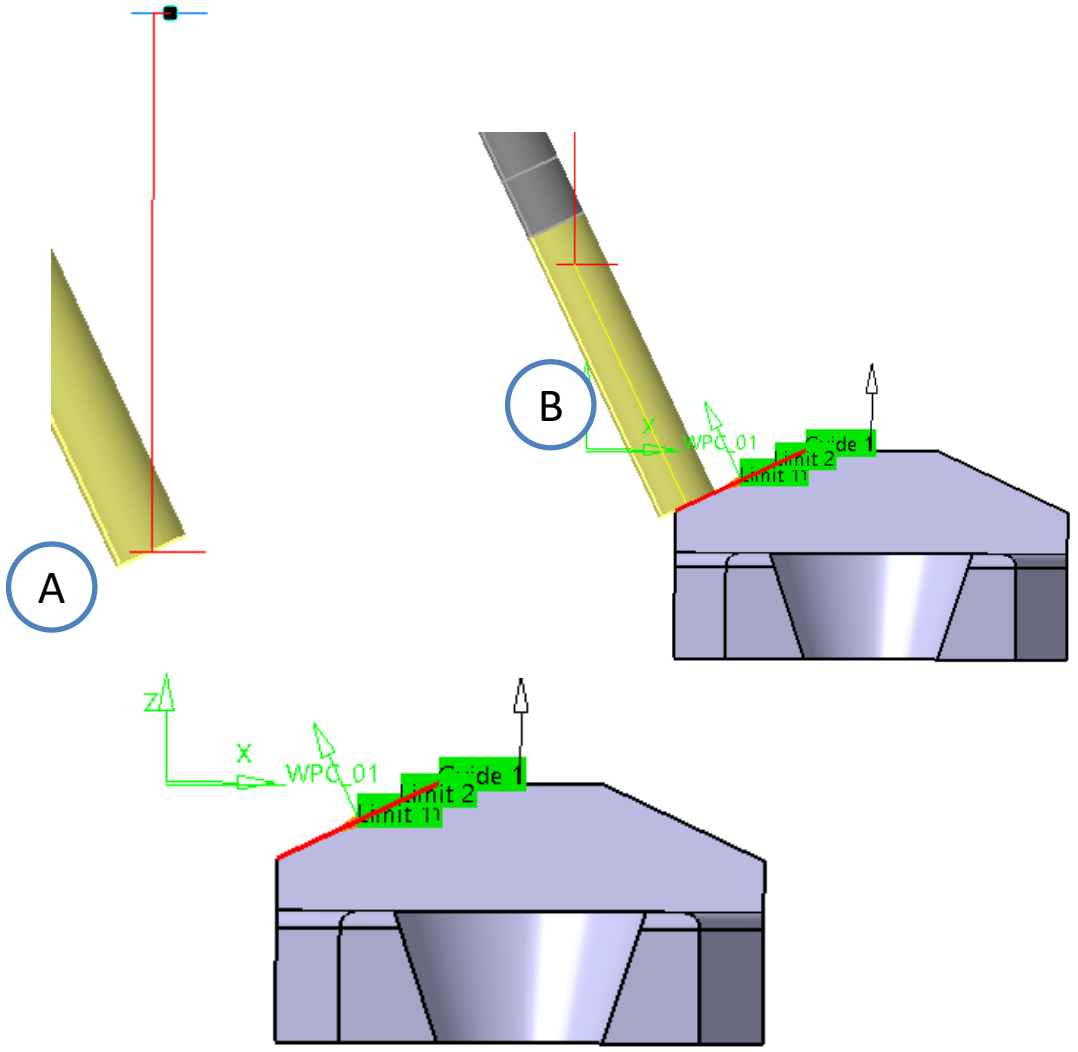


Multi-Axis Profile Contouring



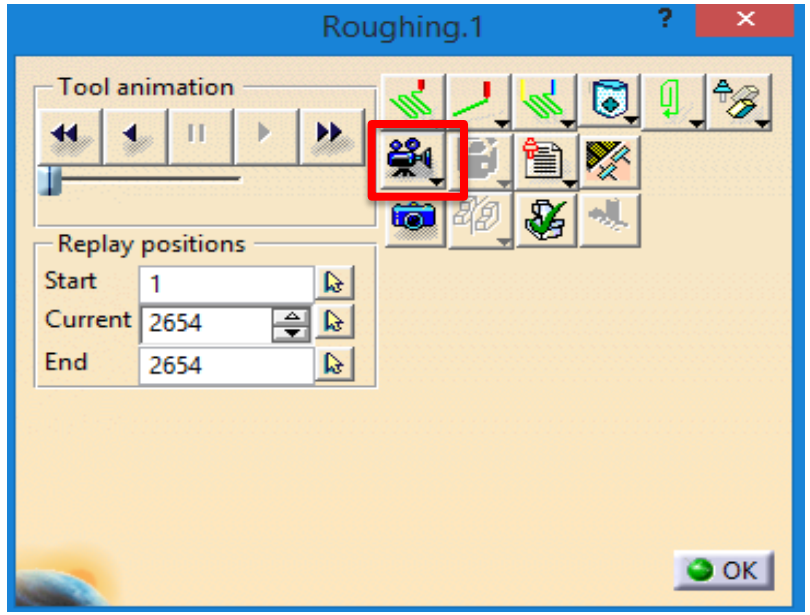
- From **Machining Tool Paths calculation**, it is **obviously seen** that the **cutting tool** is **approaching the material** in a **straight 90 degree motion (from plane "a" – "b")**
- This is **due to the Approach Macro Setting set** which **shows the function** of **Tool Axis** motion.
- The **cutting tool** is **ONLY allowed** to tilt on certain height of the plane set.

Multi-Axis Profile Contouring



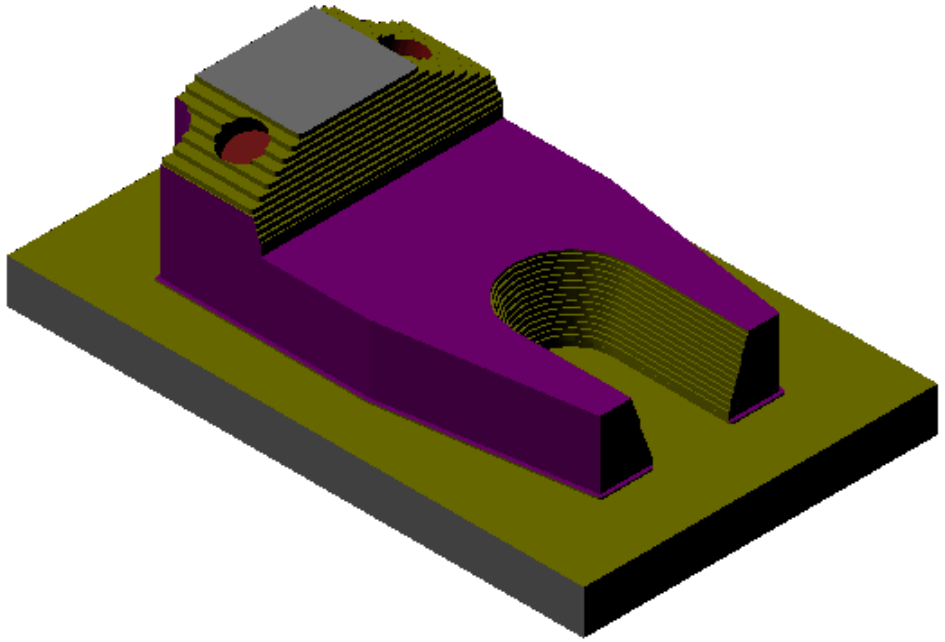
- The **cutting tool** is **started to tilt towards the machining surface** illustrated by **"A"**
- Meanwhile, **"B"** exhibits the cutting tool **begins machining process** on the **respected surface perpendicularly**.
- Ultimately, **Macro Setting** is **very useful** in **directing the cutting tool motions** according to the **users specification** which on the same time **improving the flexibility** in preparing **CAM Program.**

Multi-Axis Profile Contouring

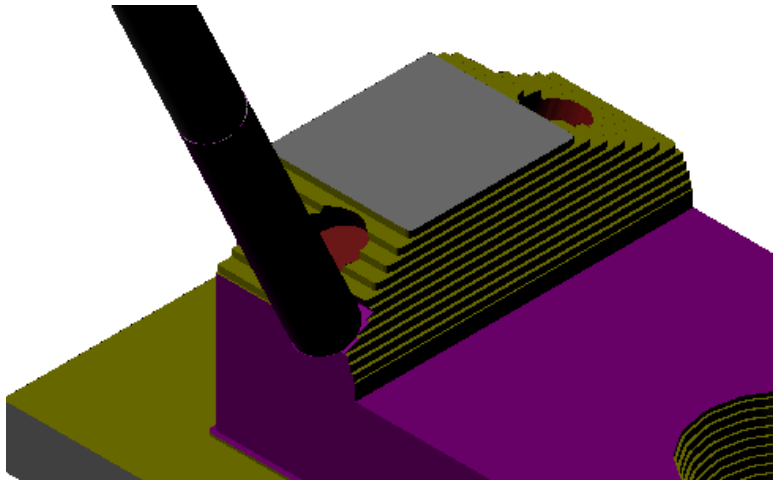


- There are THREE (3) options given by CATIA in viewing the full machining simulation. The description are as follows
  - 1 = Play video from last saved result
  - 2 = Full Video
  - 3 = Mixed Photo / Video
- Select 2nd icon to Play video from beginning. 
- Once satisfied with full machining simulation then just click OK to return back to previous window

Multi-Axis Profile Contouring

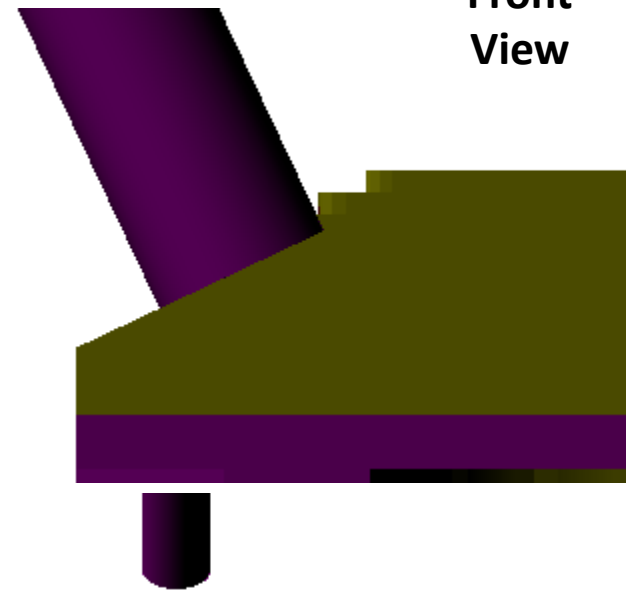


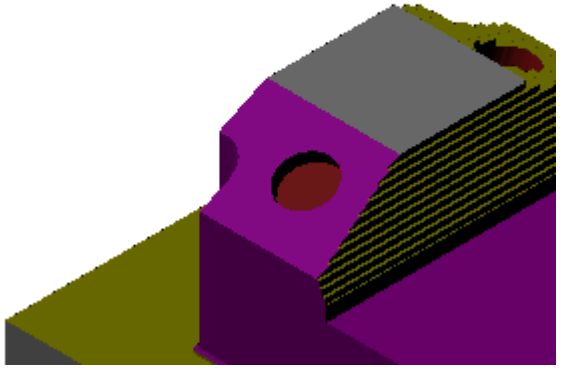
End Simulation of Roughing Operation +
Finishing Profile Contouring Operation +
Multi-Axis Pocketing Operation



Multi-Axis Profile
Contouring– in progress

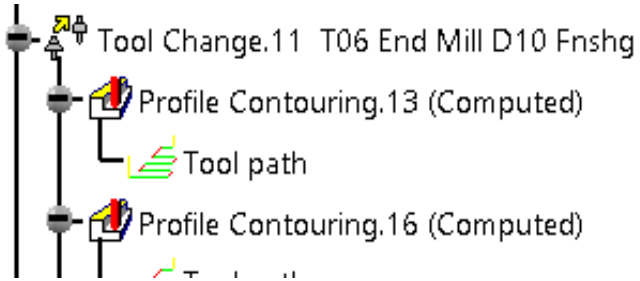
Front
View



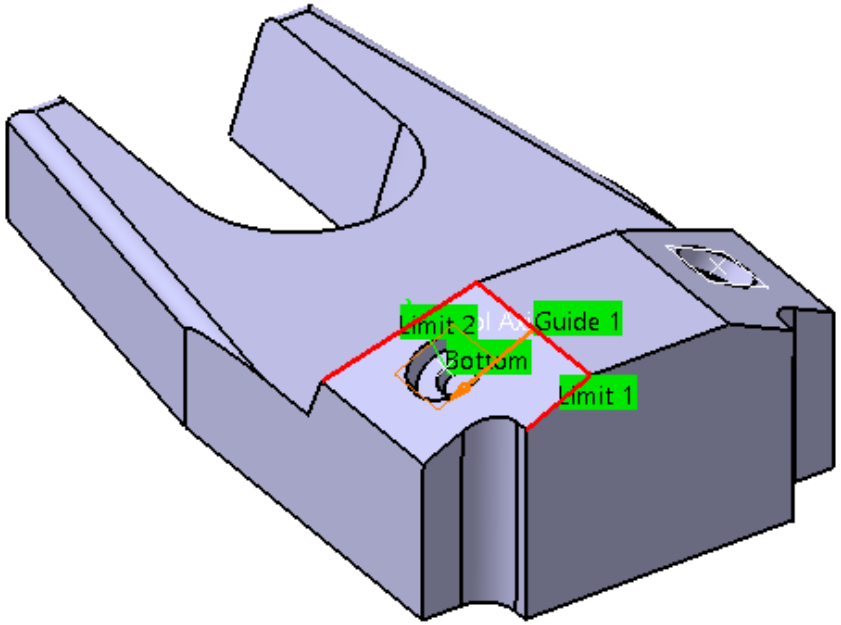


Multi-Axis Profile Contouring -
Completed

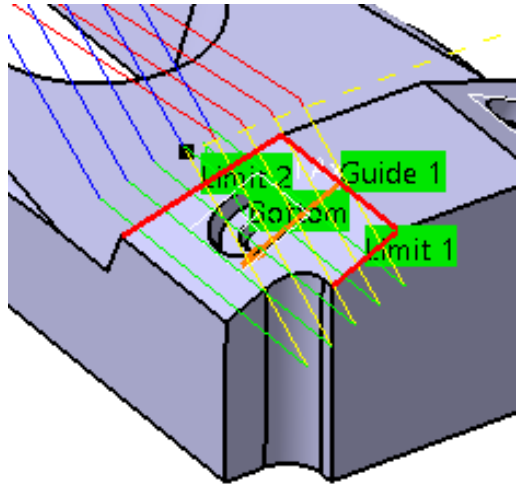
Multi-Axis Profile Contouring



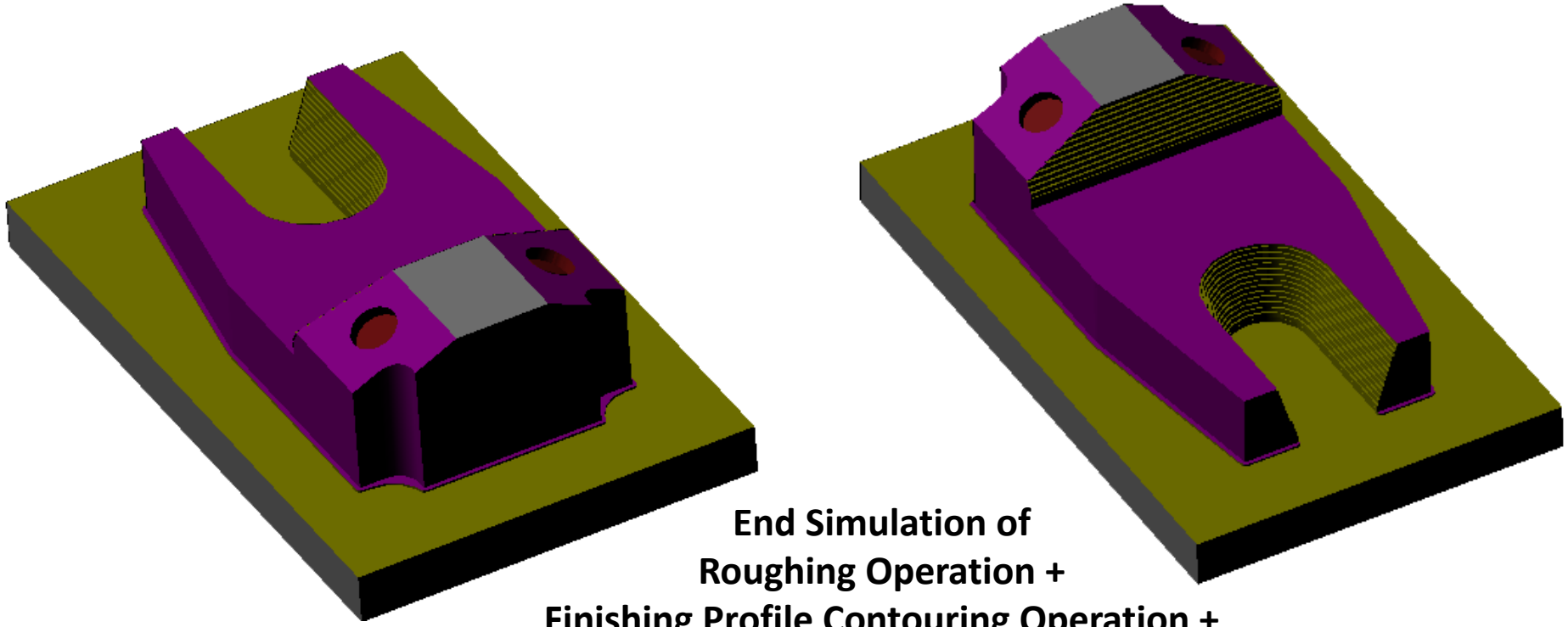
- **Specification TREE** – Profile Contou – 1st Side
- Once complete, COPY & PASTE same operation for the 2nd Hole.
- ONLY change TAB 2- Geometry – Bottom, Guide Element & Top Surface



Tool Paths Calculation on another Side

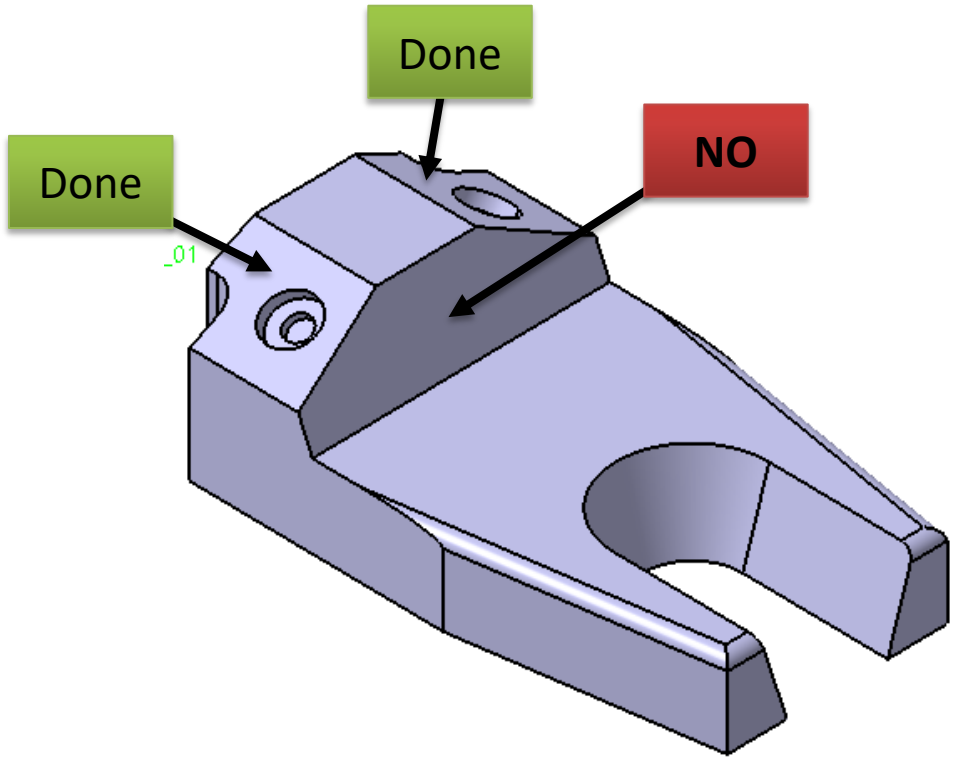


Multi-Axis Profile Contouring



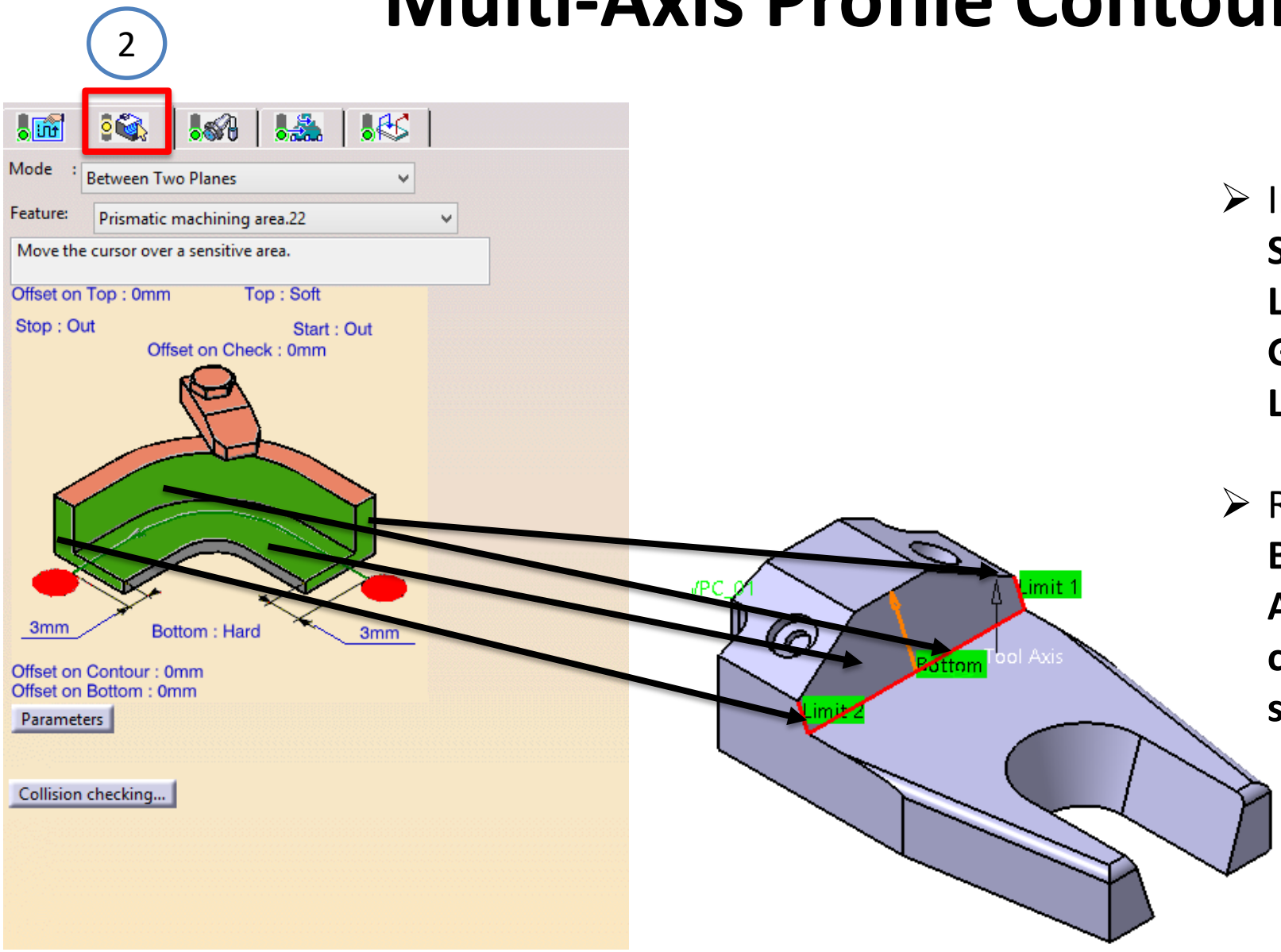
End Simulation of Roughing Operation + Finishing Profile Contouring Operation + Multi-Axis Pocketing Operation + Multi-Axis Profile Contouring

Multi-Axis Profile Contouring



- By using **Multi-Axis Profile Contouring two (2) slanted areas** have been **successfully machined**.
- Now, **only one (1) area left** to be machined possibly **using the same machining operation** (**Multi –Axis Profile Contouring**).
- The **following steps** shall **guide** on **how to perform Multi-Axis Profile Contouring Operation** on that **particular area**.

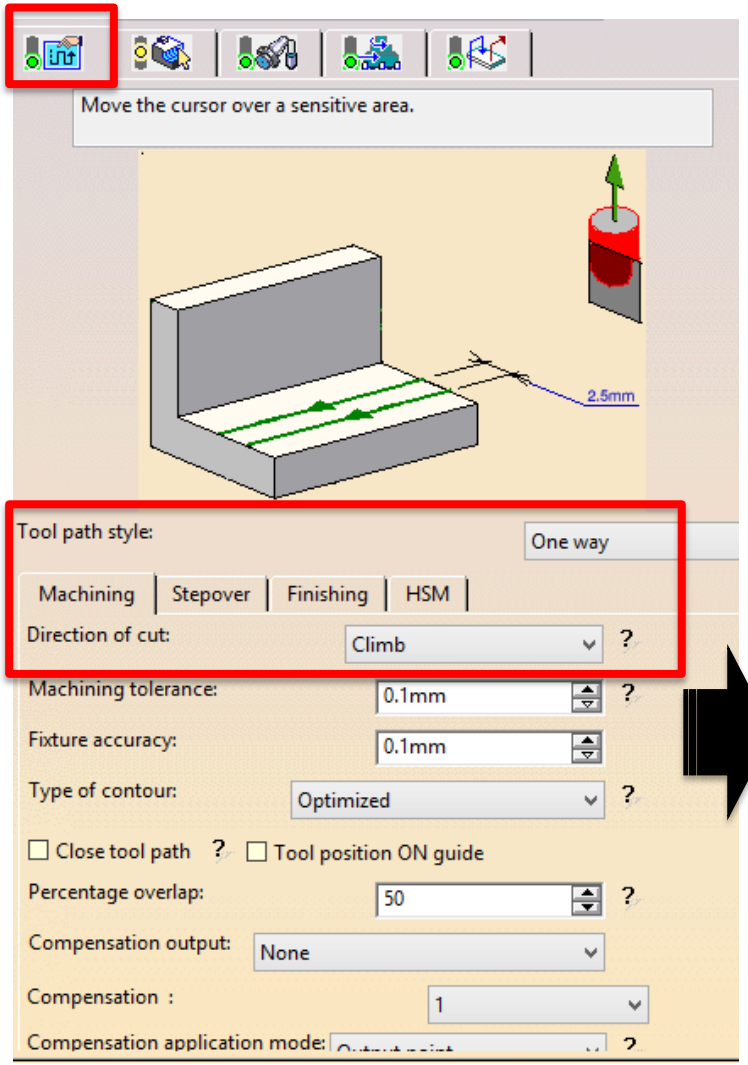
Multi-Axis Profile Contouring

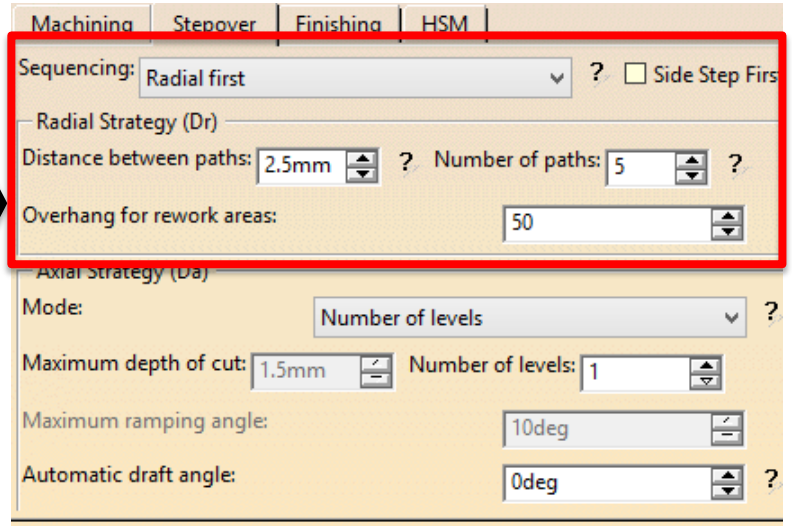


- In this situation, the **Slanted Surface** is defined as **Bottom**, **Lower Line** is defined as **Guiding Element**, **Right Line** as **Limit 1** and **Left Line** as **Limit 2**.
- Remember, the moment **Bottom is defined**, the **Tool Axis** will be **automatically calculated perpendicular** to the **surface selected**.

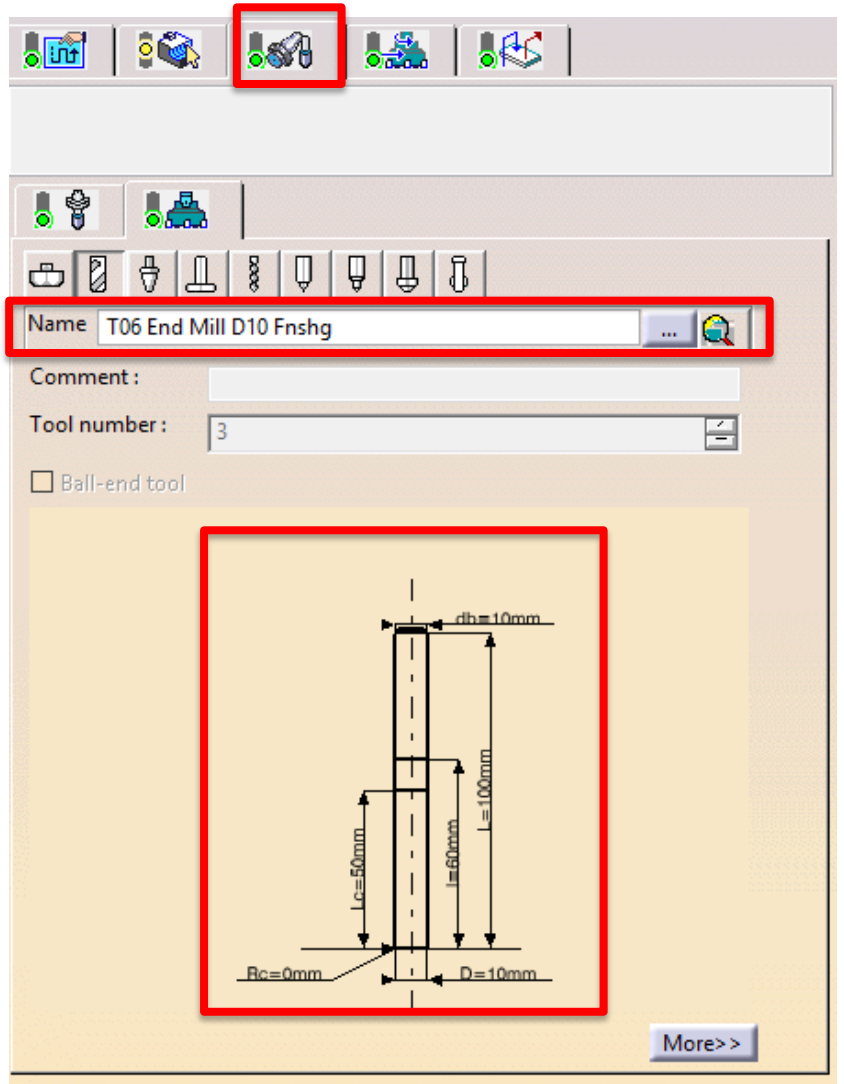
Multi-Axis Profile Contouring

1

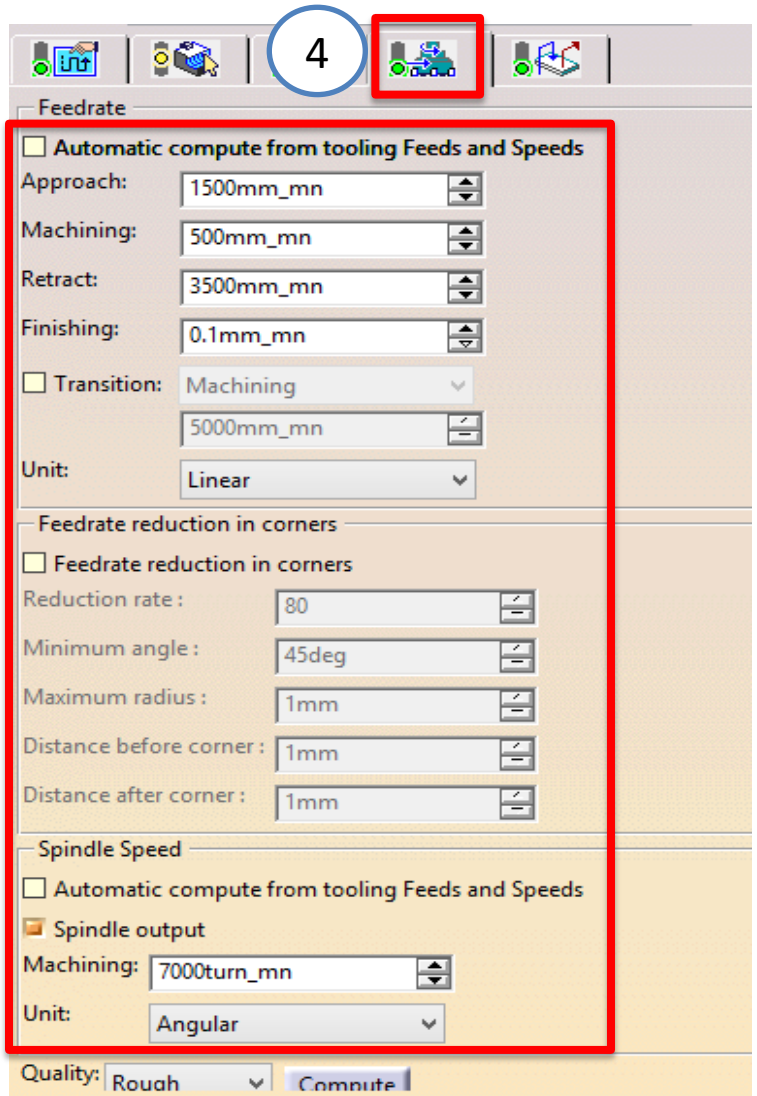


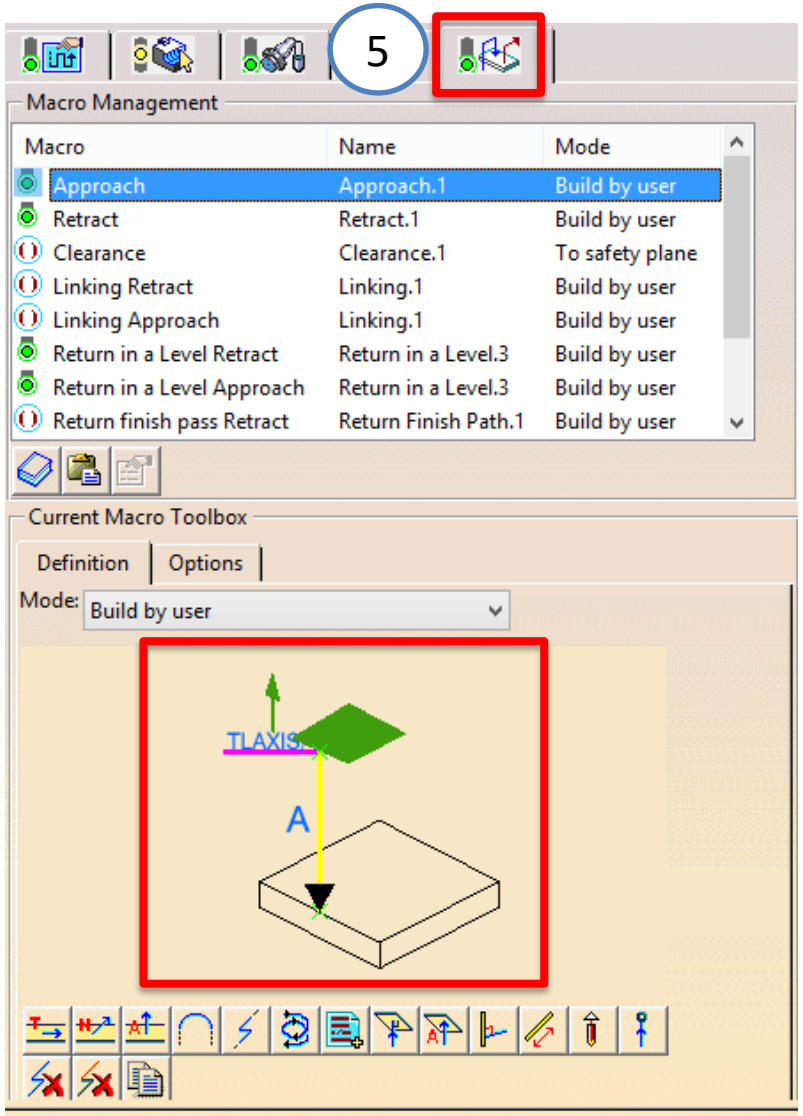


3

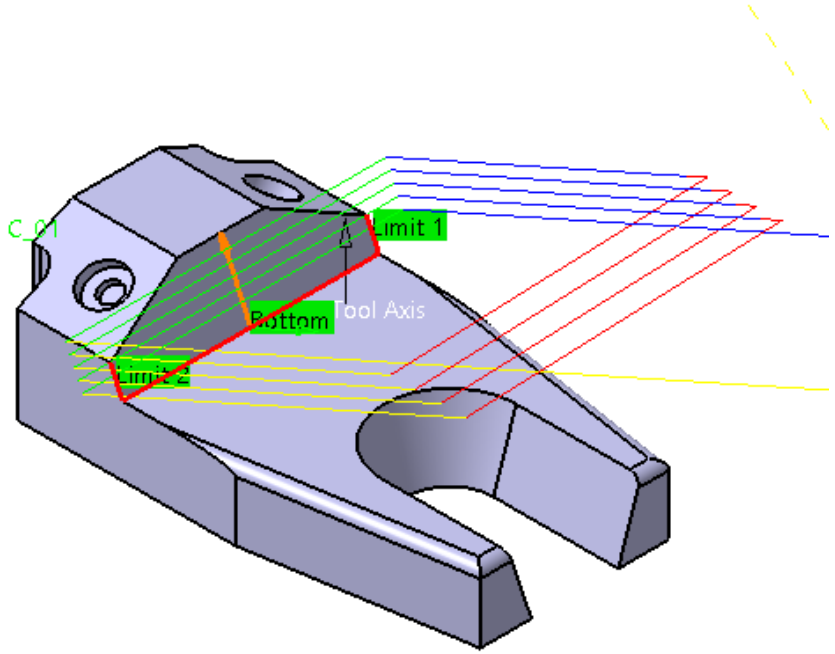


Multi-Axis Profile Contouring

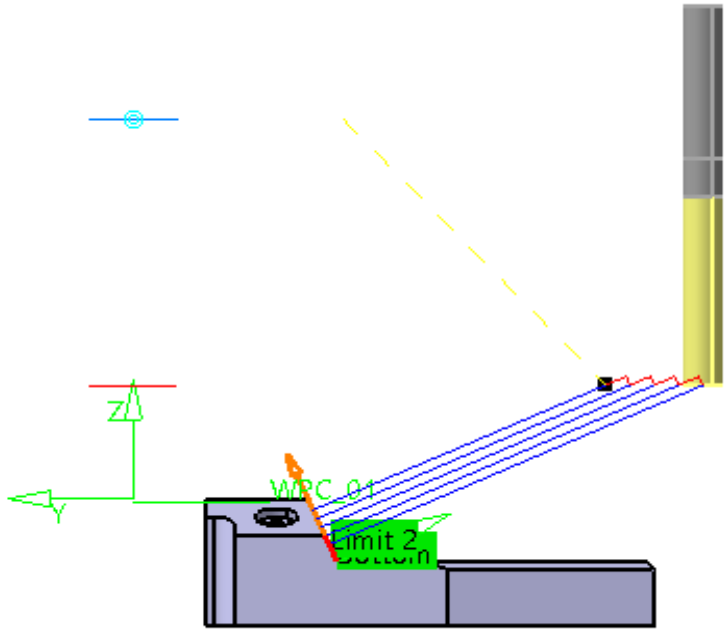




Multi-Axis Profile Contouring

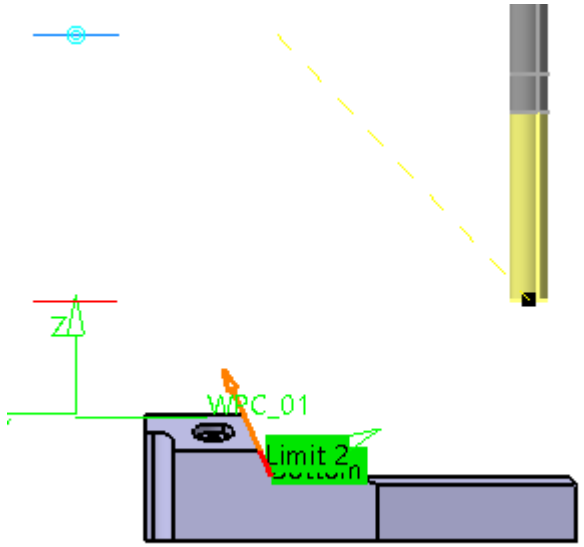


- Tool Paths calculation for slanted front surface – Multi-Axis Profile Contouring
  - **ISOMETRIC VIEW**

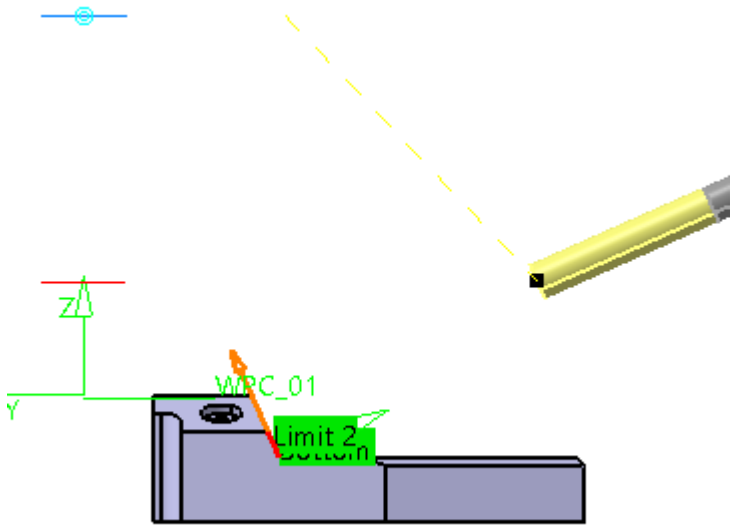


- Tool Paths calculation for slanted front surface – Multi-Axis Profile Contouring
  - **SIDE VIEW**
  - **Cutting Tool Position – 90 Degree**

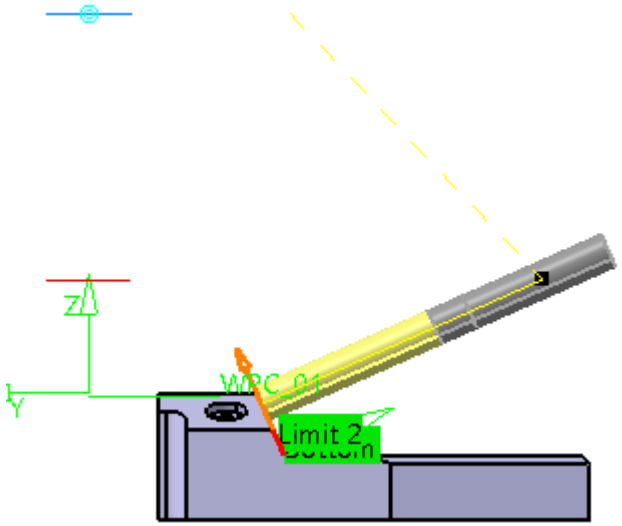
Multi-Axis Profile Contouring



- Cutting Tool approaching in 90 degree on certain defined plane

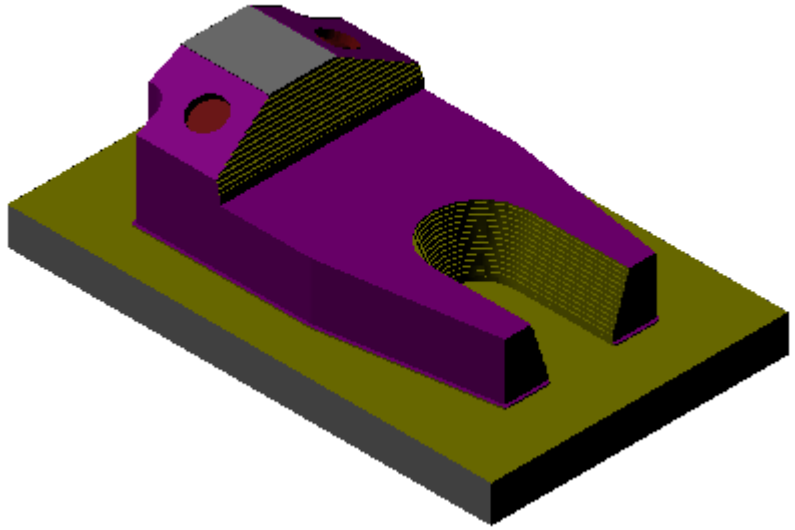


- Cutting Tool started to tilt on certain degree perpendicularly to the selected surface

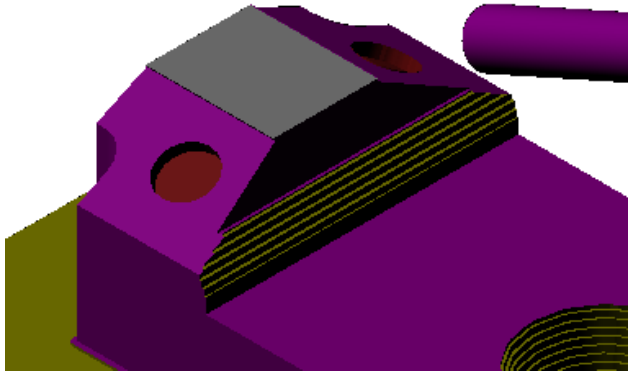


- Cutting Tool begin machining process in tilting position as per defined surface

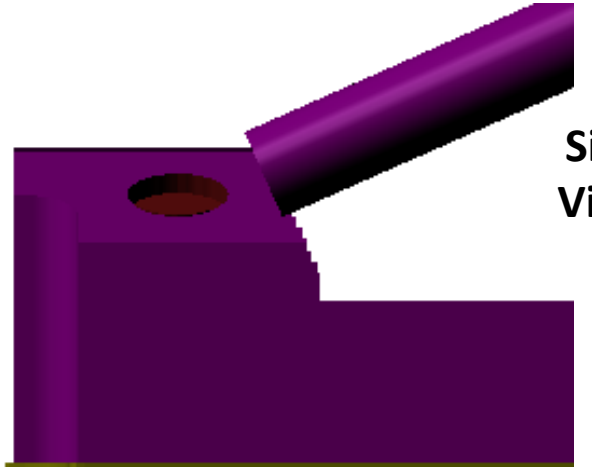
Multi-Axis Profile Contouring



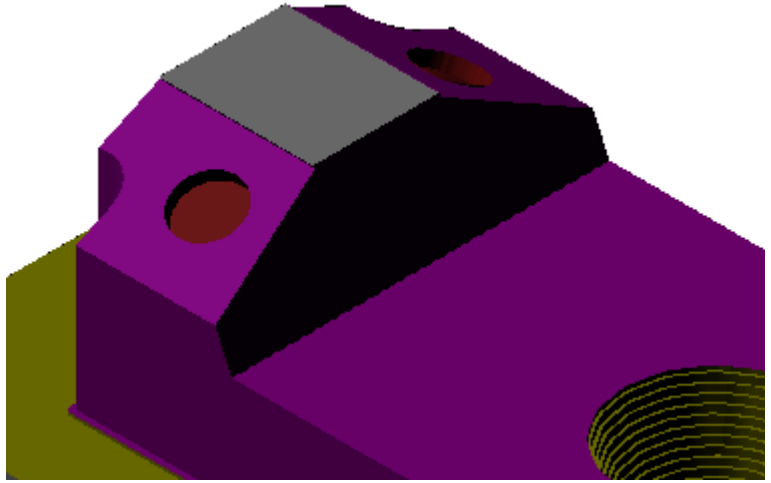
From End Simulation Result



Multi-Axis Profile Contouring front slanted surface in progress

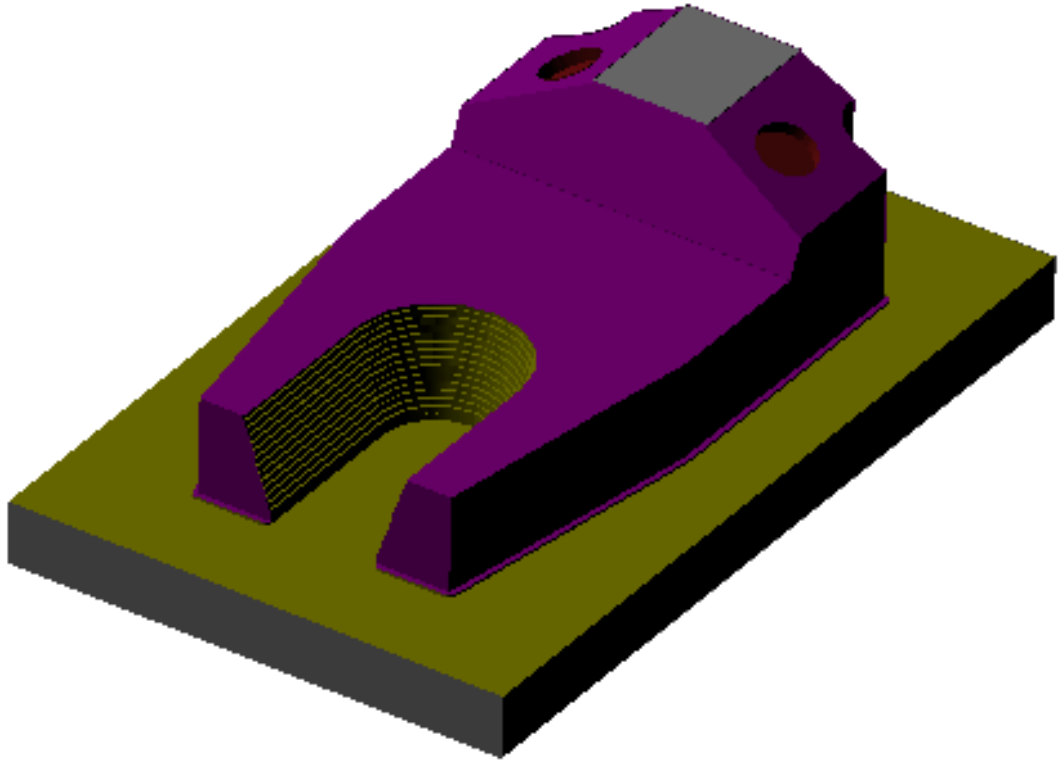


Side View



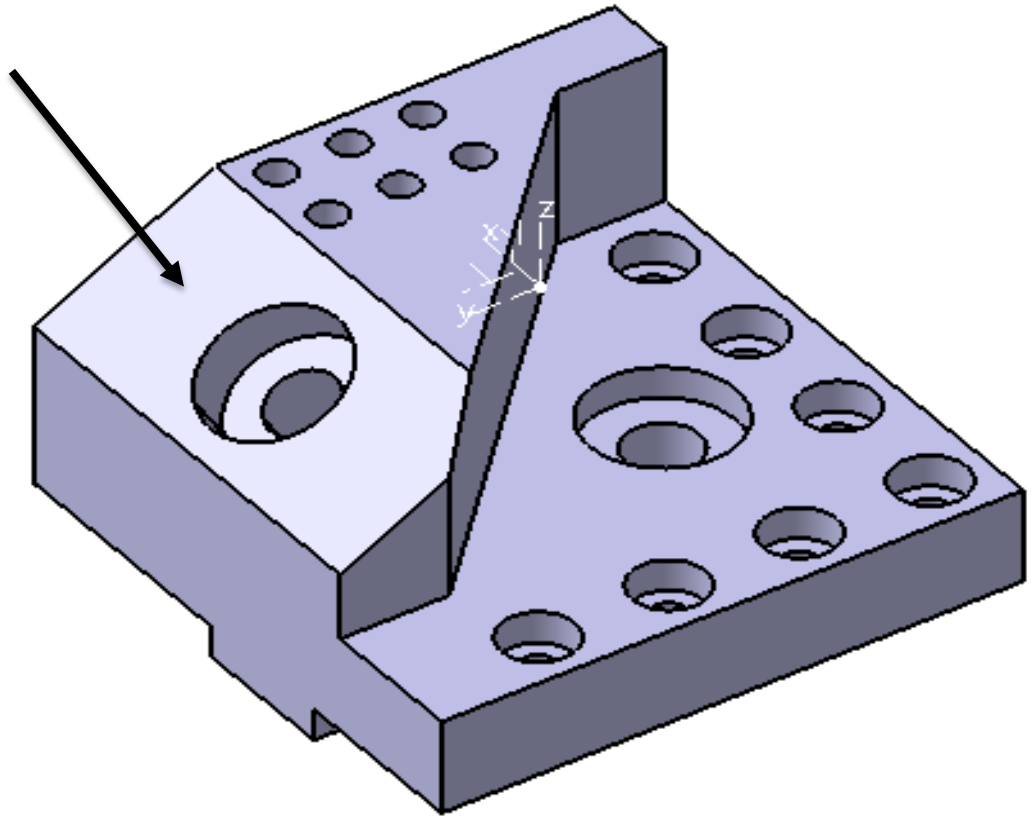
Multi-Axis Profile Contouring - Completed

Multi-Axis Profile Contouring



End Simulation of
Roughing Operation +
Finishing Profile Contouring Operation +
Multi-Axis Pocketing Operation + Multi-Axis Profile Contouring

Multi-Axis Profile Contouring

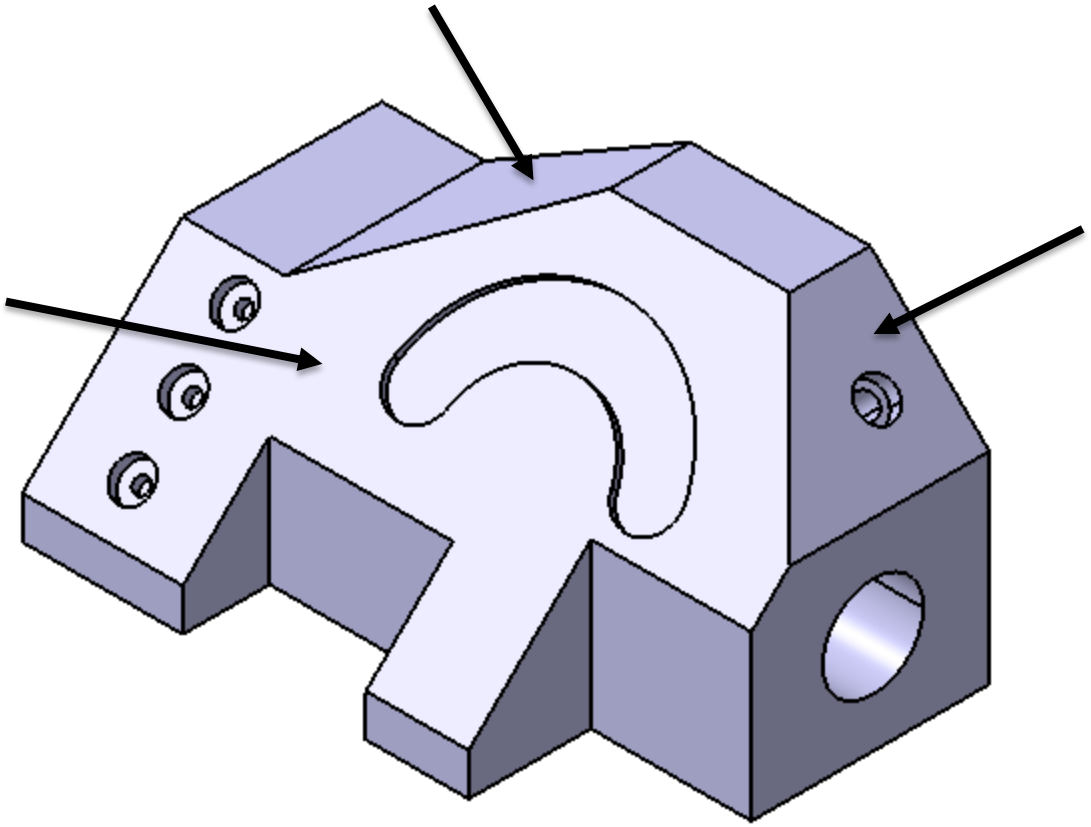


Exercise 1

Please prepare the CAM Programming following the instructions below:

- *Perform Multi-Axis Profile Contouring on the shown location.*
- *Please ensure the best practice of Macro Setting is used.*

Multi-Axis Profile Contouring



Exercise 2

Please prepare the CAM Programming following the instructions below:

- *Perform Multi-Axis Profile Contouring.*
- *Please ensure the best practice of Macro Setting is used.*

Multi-Axis Profile Contouring

ALL THE BEST

THANK YOU