ADVANCED MACHINING
BETP 3584
ISOPARAMETRIC OPERATION FOR FILLET, ARC AND CHAMFER PROFILES

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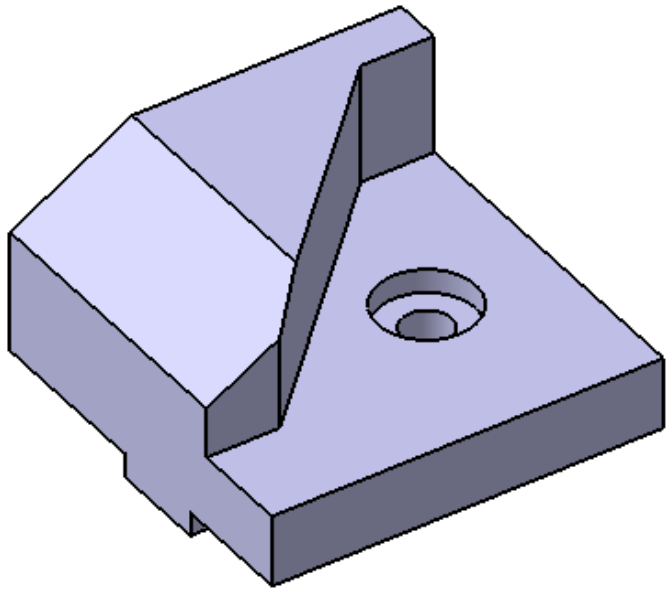
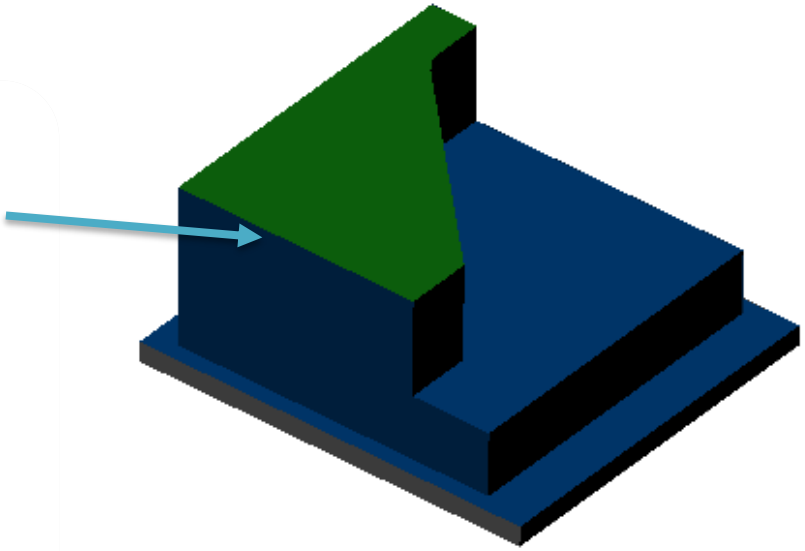
Isoparametric Operation

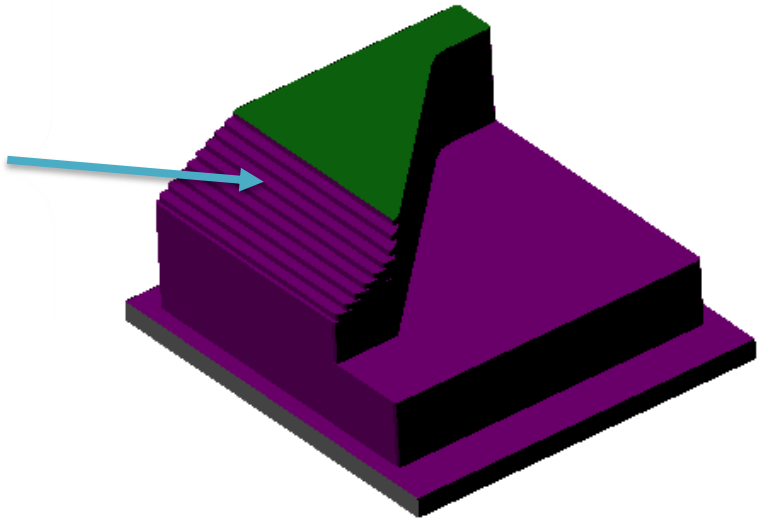
- Isoparametric Operation is specially designed for profiles with angles, chamfer or fillet shapes.
- In addition, Isoparametric Operation sometimes can also be utilized for uneven surfaces or also called as sculptured profiles depending on the quality of the CAD model.
- Isoparametric Operation available in 3-Axis as well as 5-Axis
- Thus, this operation offering broaden flexibility in preparing CAM program for any given CAD model.

Isoparametric Operation



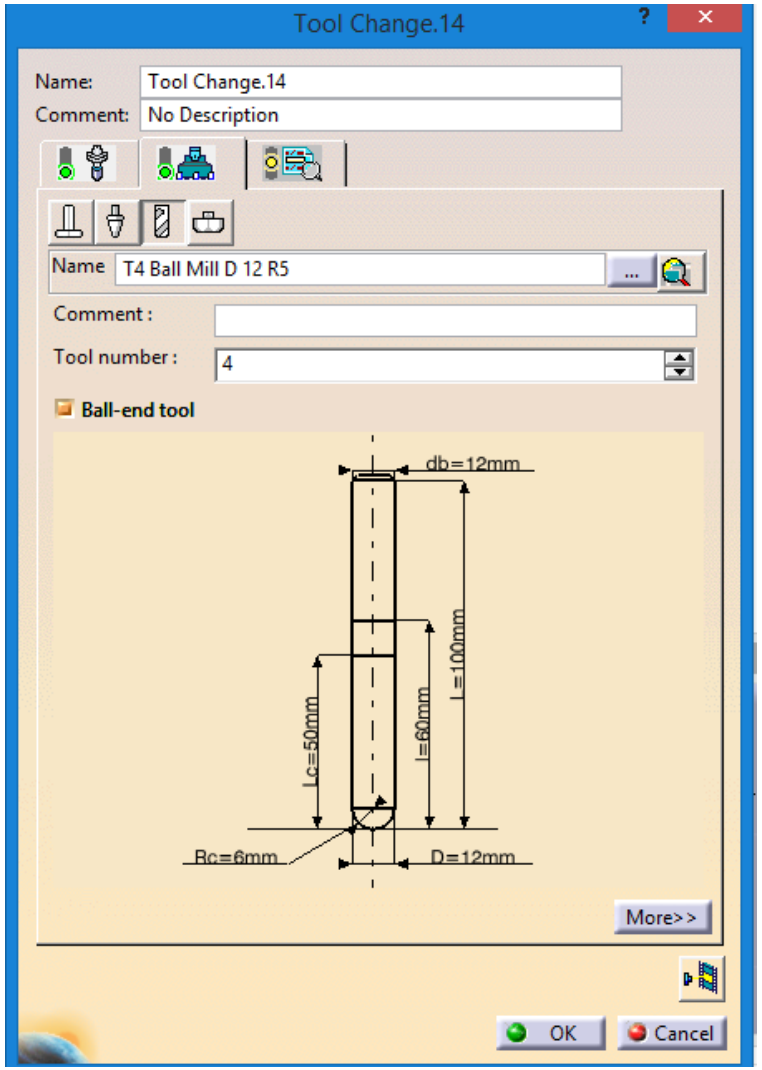
Original CAD Model

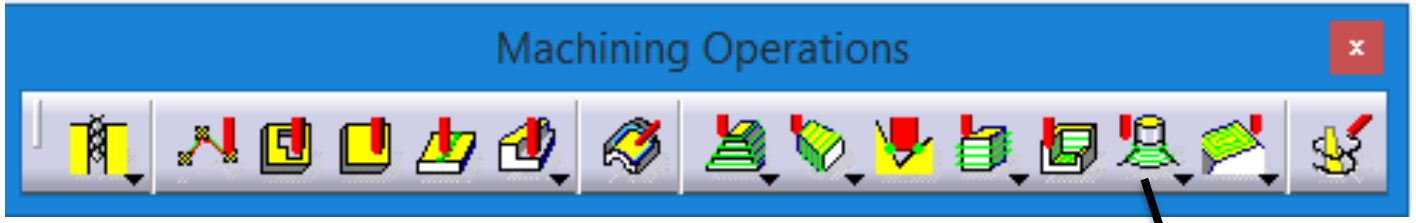


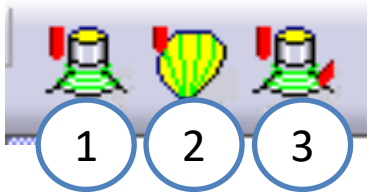


- From **previous chapter**, there were **two (2) Roughing Methods** that been used.
- Hence, in **Isoparametric Operation** there are also **two (2) approaches** to cater those Roughing Methods chosen.
- **Specific area or profile** is the **chamfer or angle area.**

Isoparametric Operation



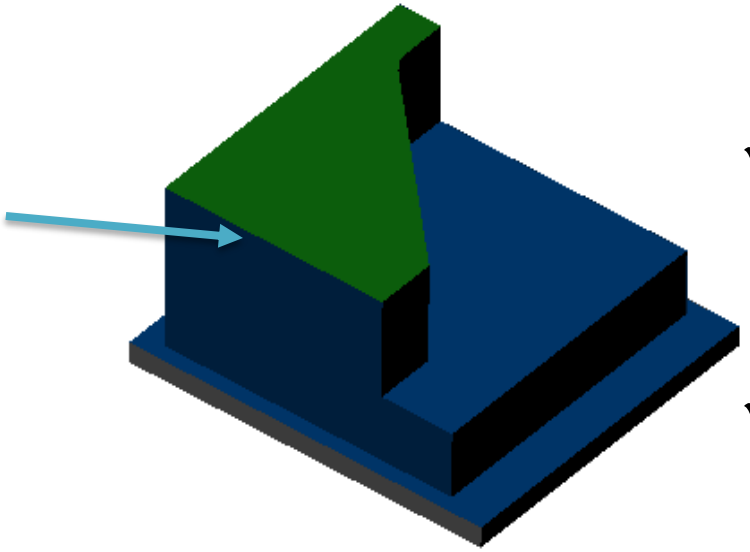




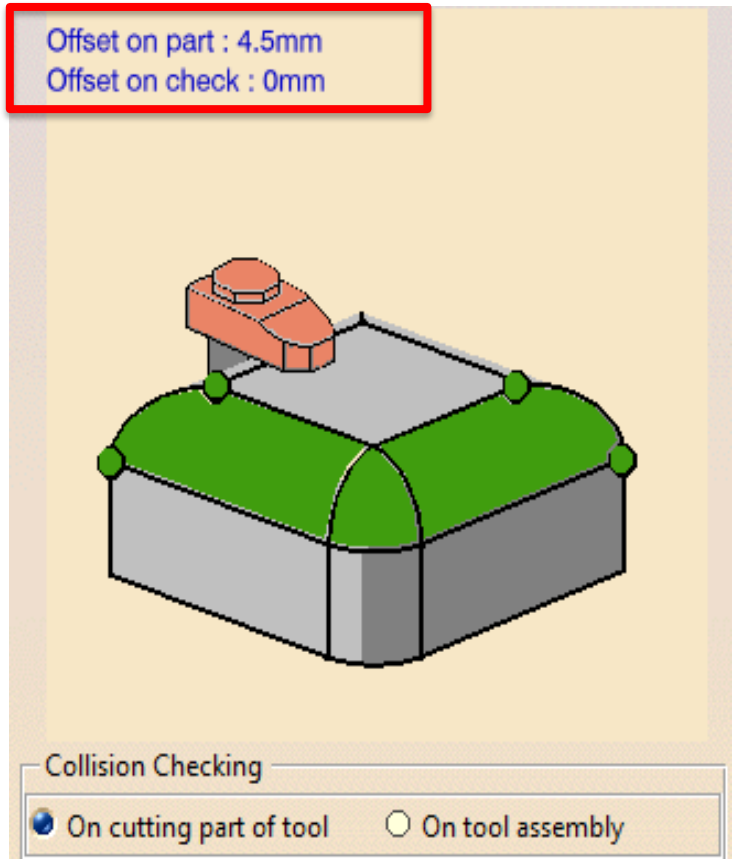
- ✓ Create and insert the desired Cutting Tool in the Resource List as well as in the Manufacturing Program
- ✓ Select the right **CUTTING TOOL – Ball Nose D12 R6**
- ✓ **Isoparametric Operation** using **tip of the cutting tool**
- ✓ Thus, **ONLY BALL Mill** is the **most appropriate tool** to be used.

1 – Contour Driven
2 – Isoparametric Machining
3 – Multi-Axis Contour Driven

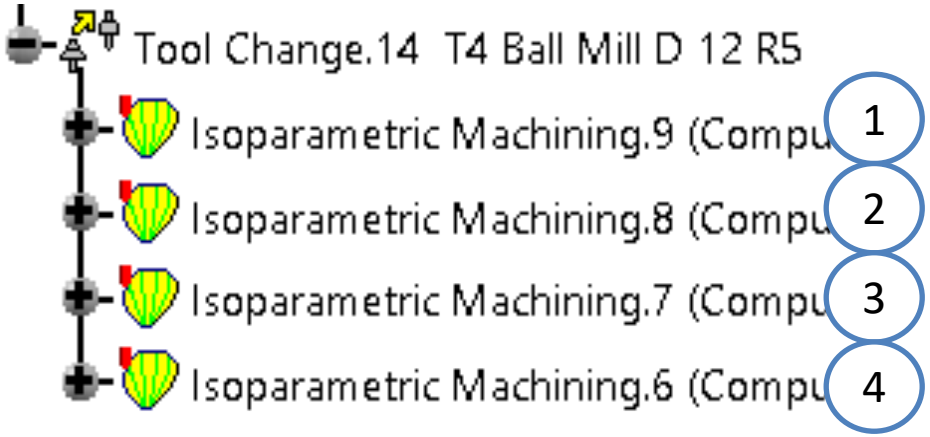
Isoparametric Operation



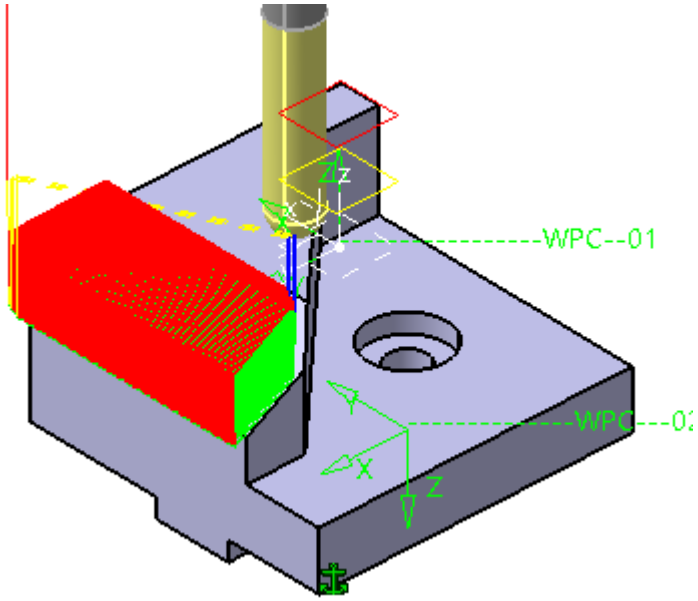
- ✓ The **1st approach** is to machine the area from the **result of Roughing Conventional Method.**
- ✓ In this approach, **OFFSET ON PART** method shall be used to allow levels of depth of cut.
- ✓ It is noticeable **in Isoparametric Operation** there is **NO option of Depth of Cut** given.
- ✓ Thus, **alternative way to perform different level of depth of cut** in Isoparametric Operation is **OFFSET ON PART.**



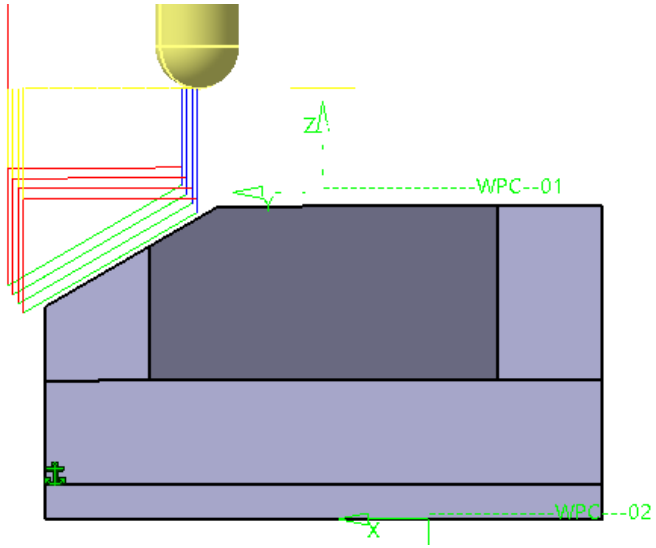
Isoparametric Operation



Specification TREE – Isoparametric Operation with OFFSET on PART - FOUR (4) Levels



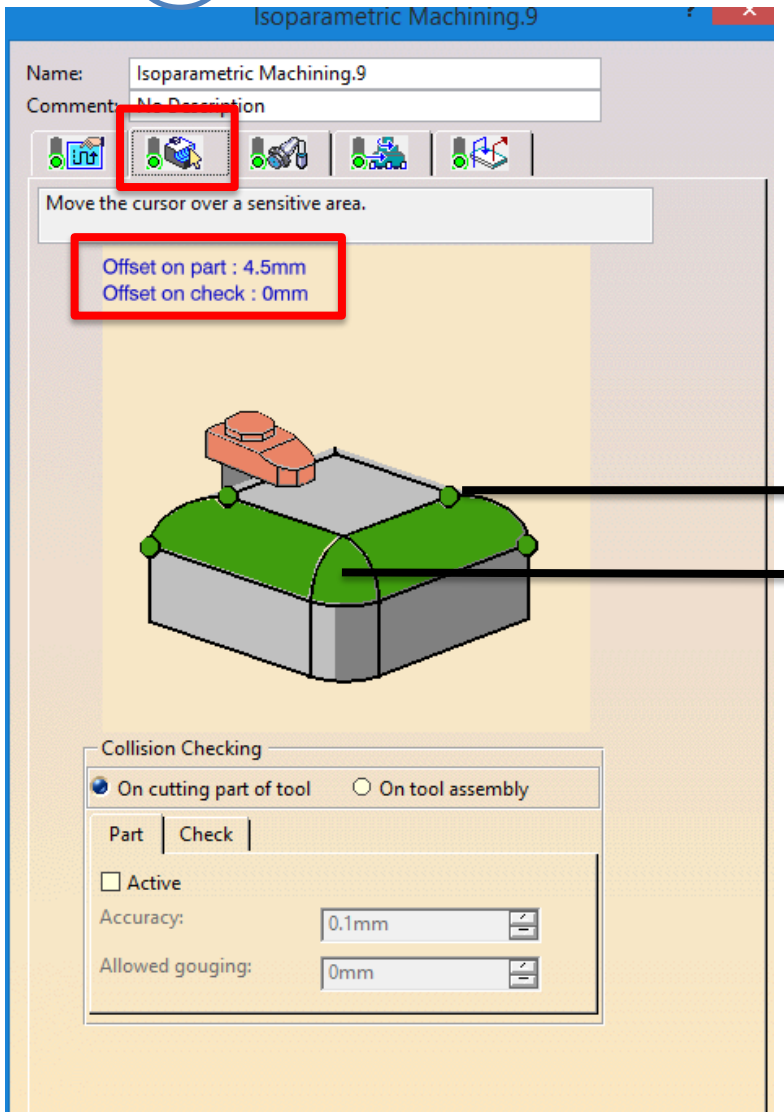
Isometric VIEW

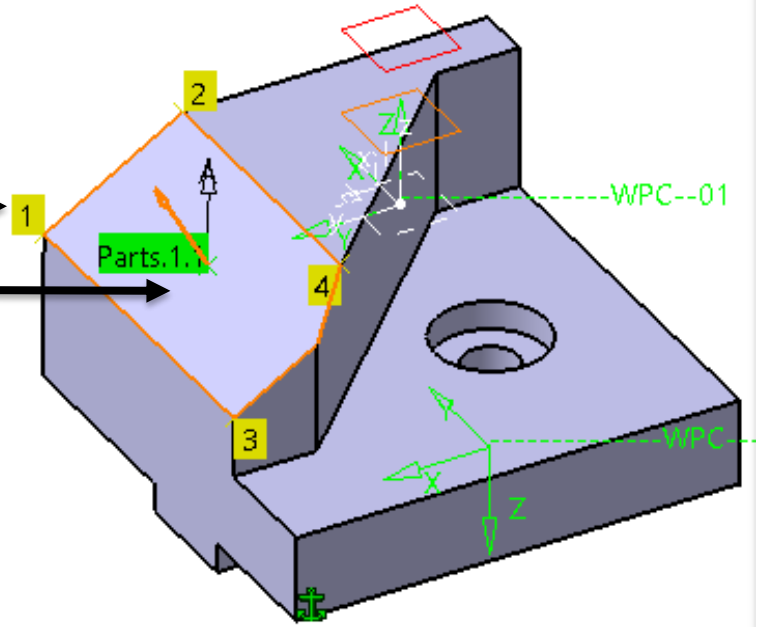


Side VIEW
4 Different Levels

Isoparametric Operation

2

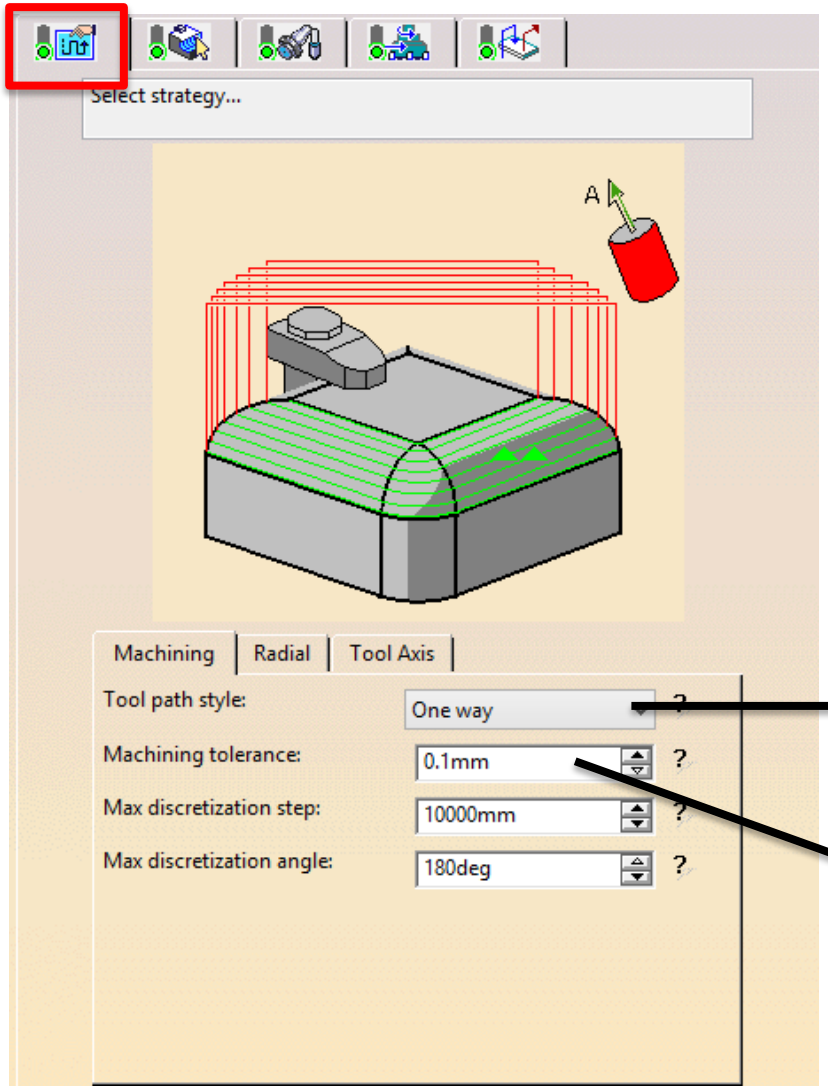


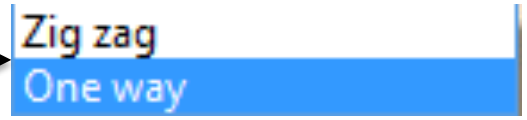


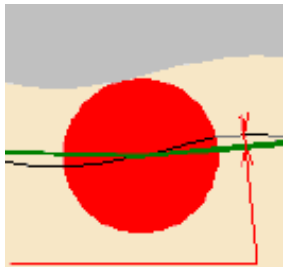
- ✓ In TAB – 2, there are two (2) geometries that need to be defined namely Part (Surface to machine) and Closed Points as the guide
- ✓ The **sequence of Points** selected **influent** the type of **machining strategy**.
- ✓ The **machining strategy** are **Zig – Zag / One – Way** and **Bottom to Top or opposite.**
- ✓ Usually **combination of Zig-Zag & Bottom to Top** machining strategy are **commonly used**.

Isoparametric Operation

1

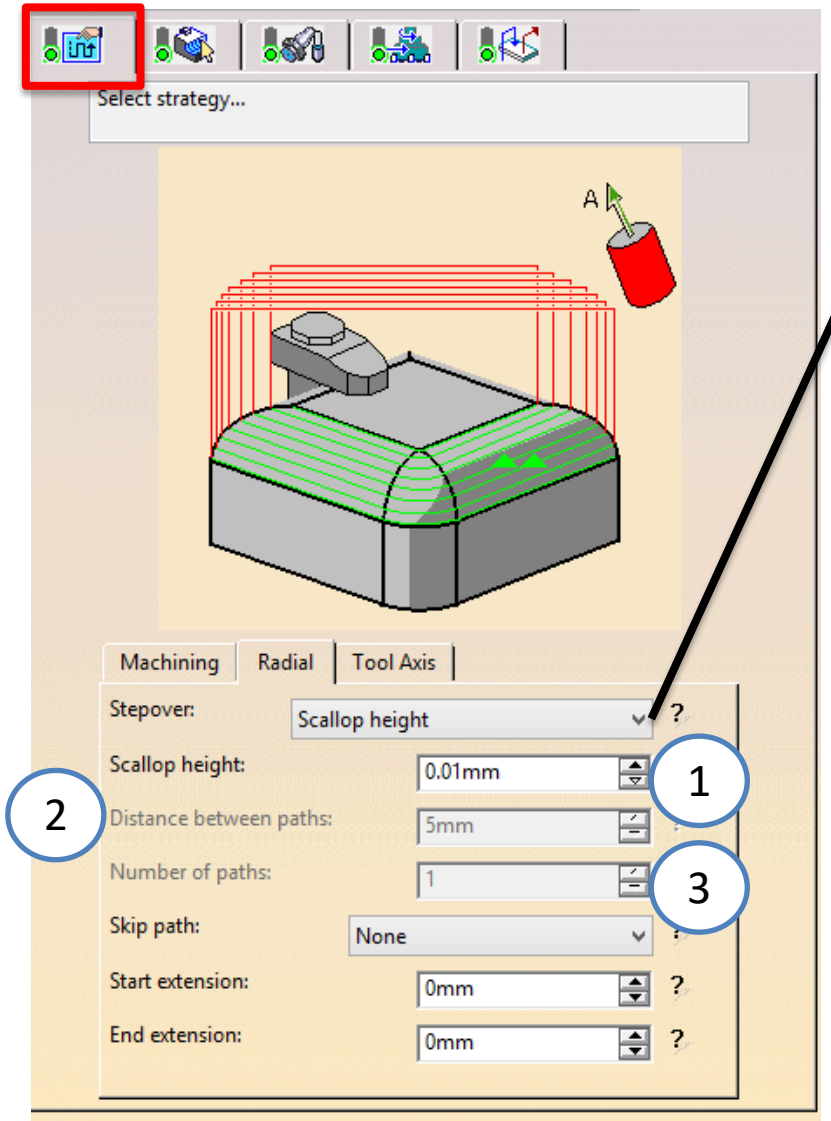


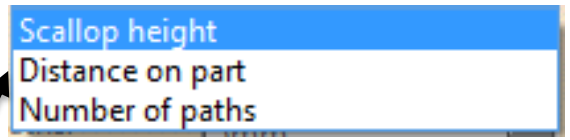


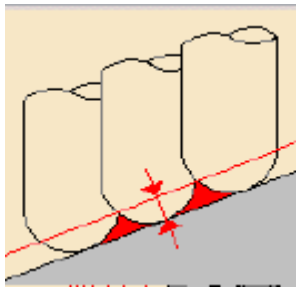


- ✓ In **TAB – 1**, there are **Tool Path Style** or **Machining Strategy** can be determined.
- ✓ As mentioned earlier, **Zig – Zag strategy** is **commonly used** due to **shorter machining time**.
- ✓ On the other hand, **Machining Tolerance** representing **how fine one path to another or one point to another point.**
- ✓ **The smaller the number** is in Machining Tolerance will **give better result in dimensional.**

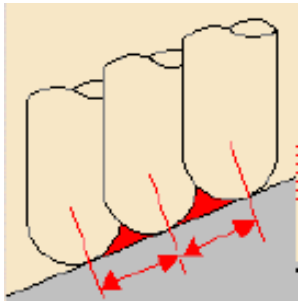
Isoparametric Operation



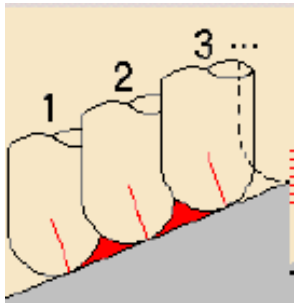




1 Scallop Height



2 Distance on Part

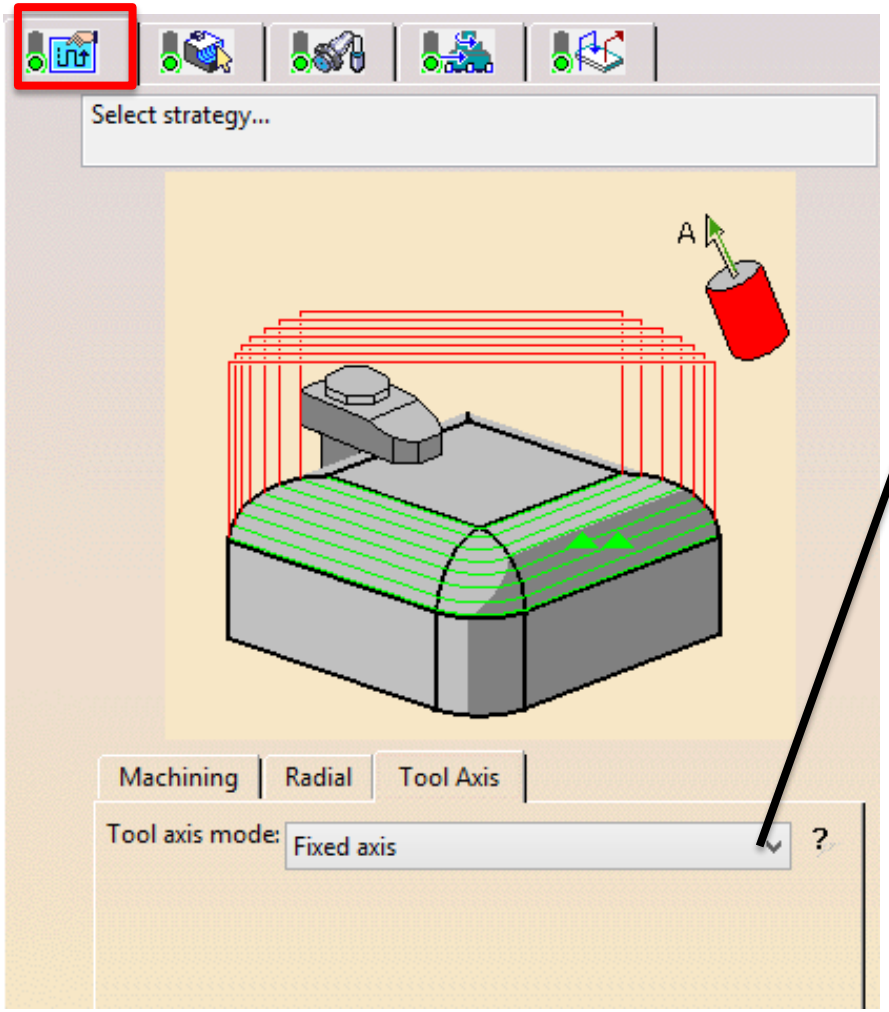


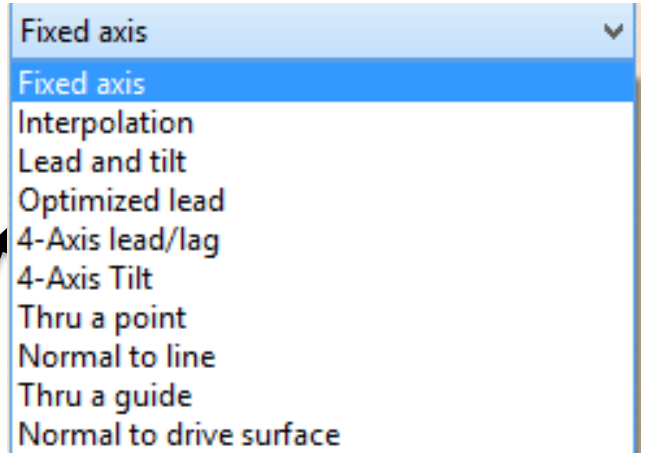
3 Number of Paths

- ✓ Still in **TAB – 1**, Radial – Options to the users on determining the types of **STEPOVER** or **calculation of distance one path to another**.
- ✓ There are **THREE (3) options** of **STEPOVER** given namely **Scallop Height, Distance on Part & Number of Paths.**
- ✓ **Scallop Height** is the most **common STEPOVER** being used.
- ✓ **The smaller the number** is in Machining Tolerance will give **better result in Surface Finish** BUT **increase number of blocks** in the posted program.

Isoparametric Operation

1

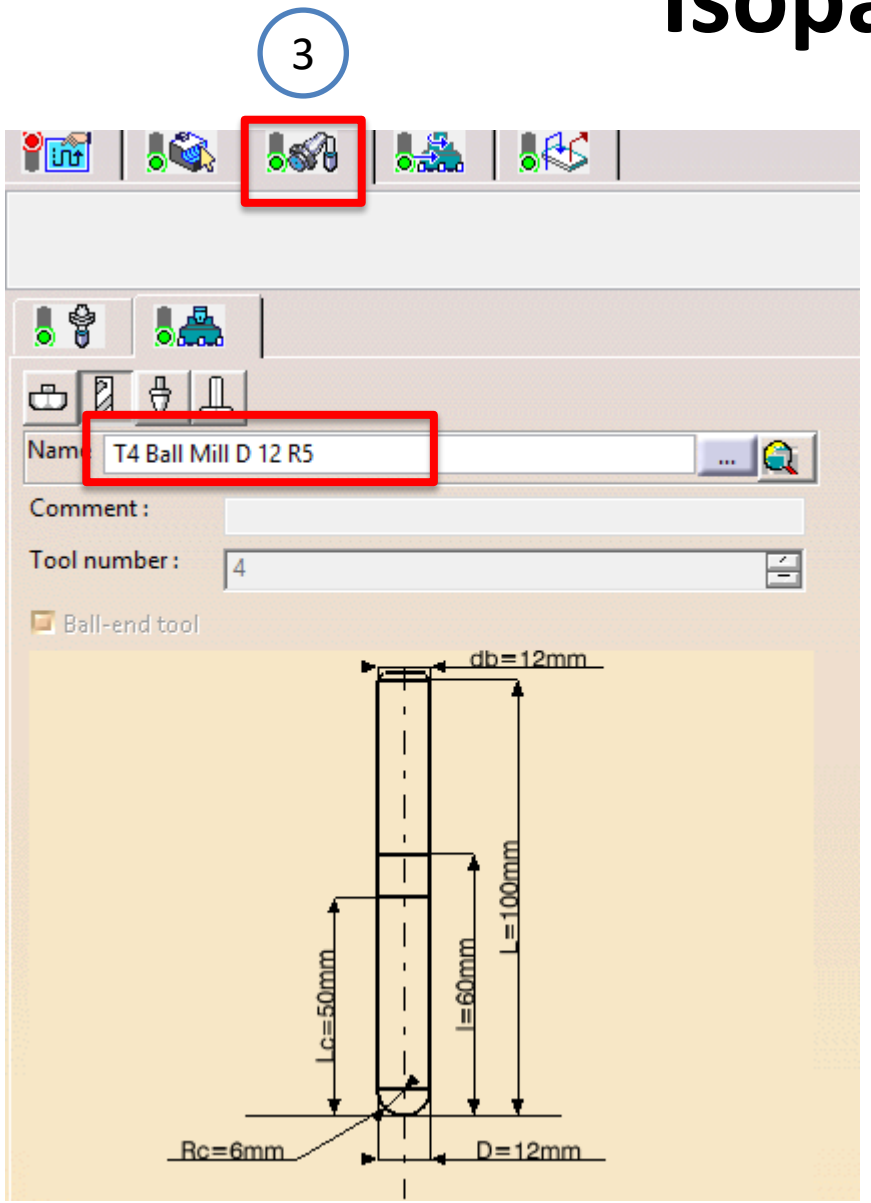


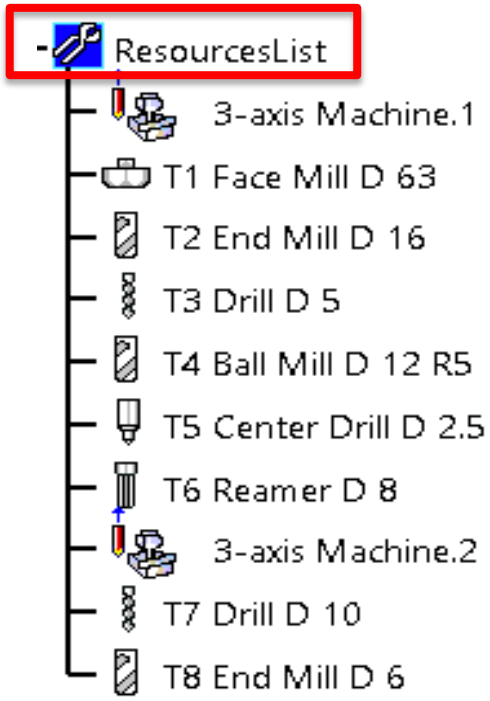


Options of Tool Axis

- ✓ Still in **TAB – 1**, Tool Axis – This setting **differentiate between 3, 4 & 5 Axis Machining** depending on the type of Tool Axis selected.
- ✓ **FIXED AXIS** the only **Tool Axis** referring to the **3-Axis Machining.**
- ✓ **The rest of the Tool Axis** options are options for **4 & 5-Axis Machining** to be used at various situations.

Isoparametric Operation

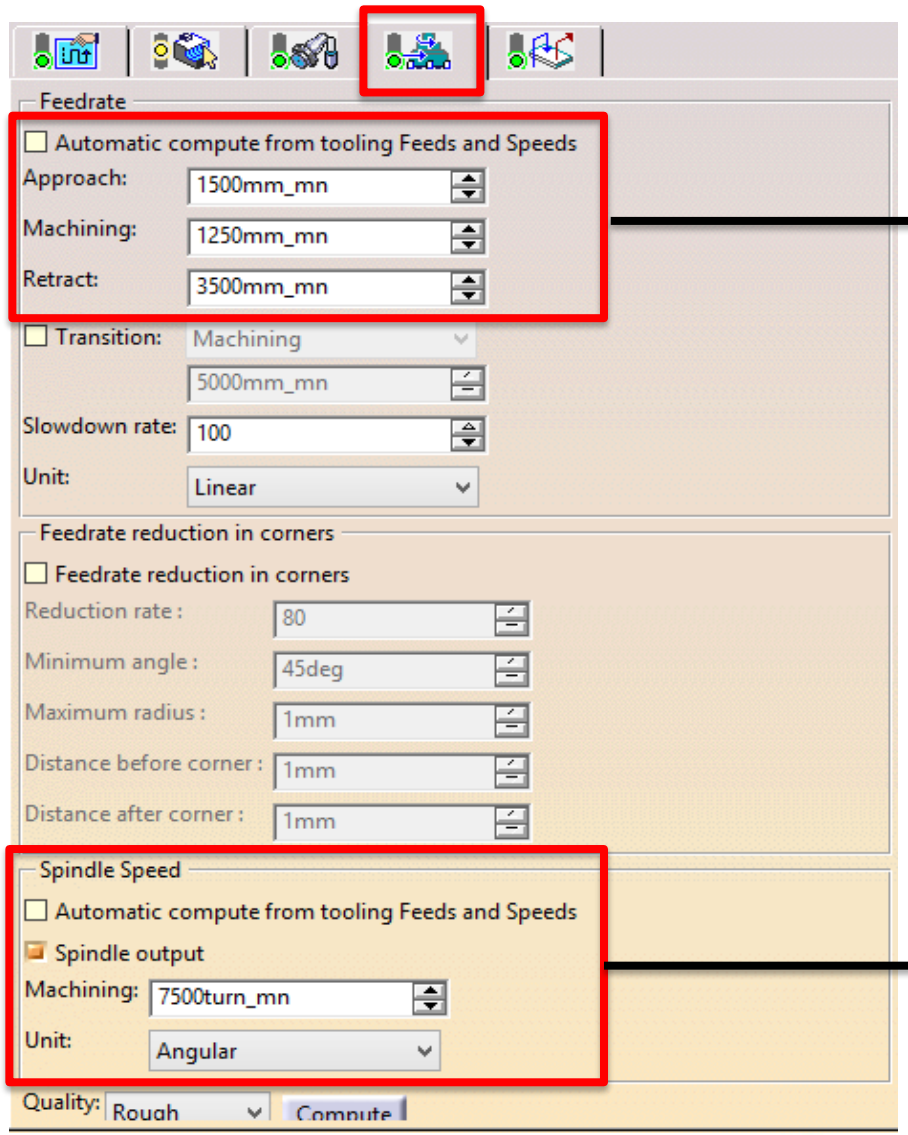




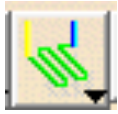
- On the TAB-3, user **need to check cutting tool specification** is correct according to the machining process to be used.
- This is very important **to ensure the right machining simulation is calculated**.
- **No changes is allowed** to be done here.
- If there is **any modification needs to be made**,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

Isoparametric Operation

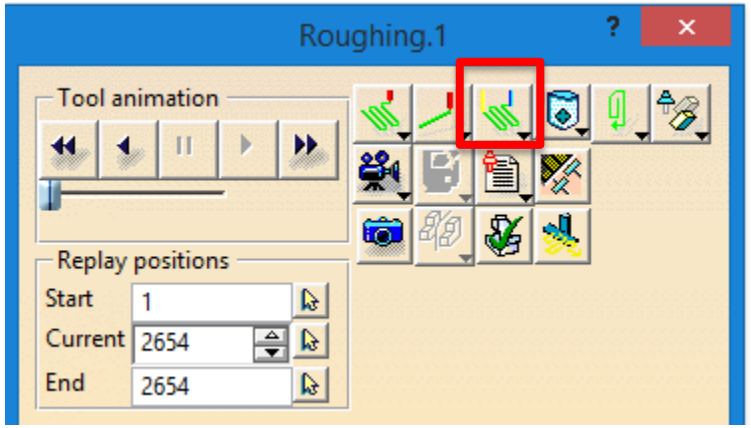
4



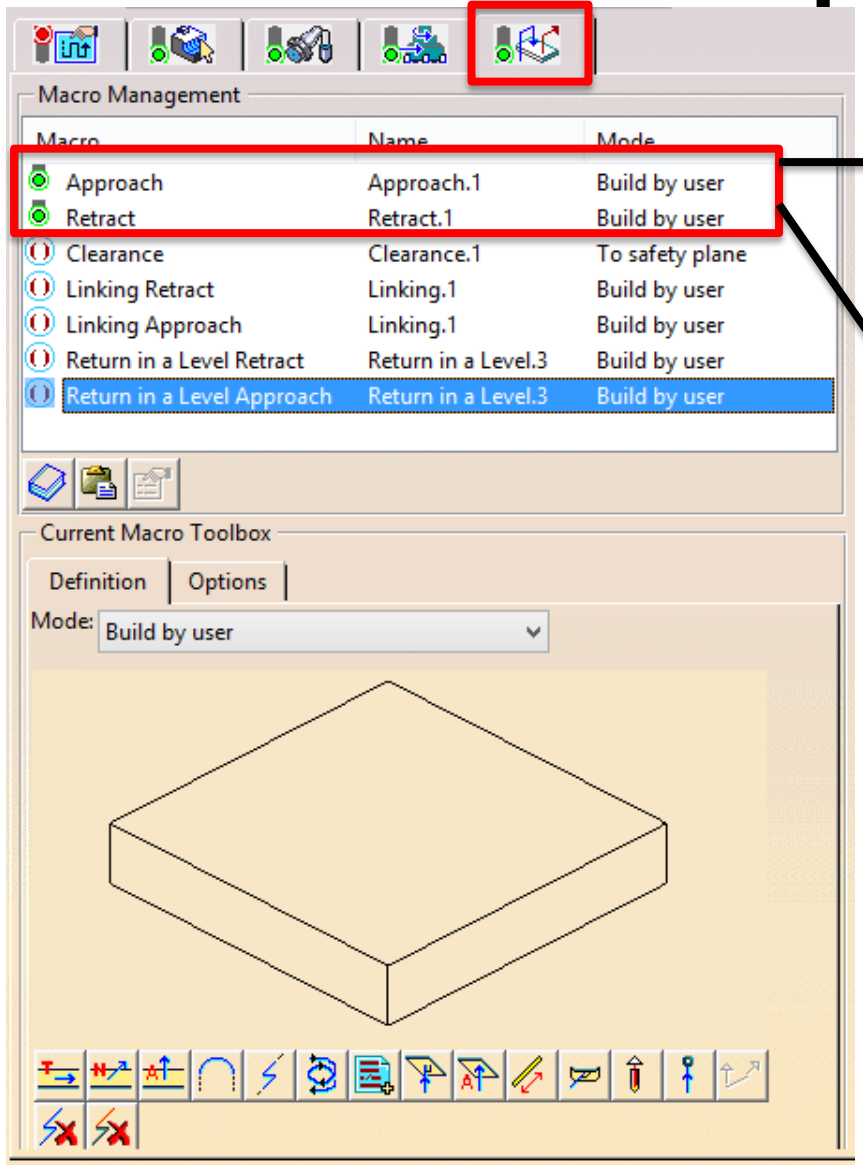
- There are **THREE (3) types** of **Feed Rates** which need to be defined namely **Approach, Machining & Retract.**
- **Color Coding** representing each Feed Rate are
  - **Approach = Yellow**
  - **Machining = Green**
  - **Retract = Blue**
- To view this, user needs to **change the setting** in **simulation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

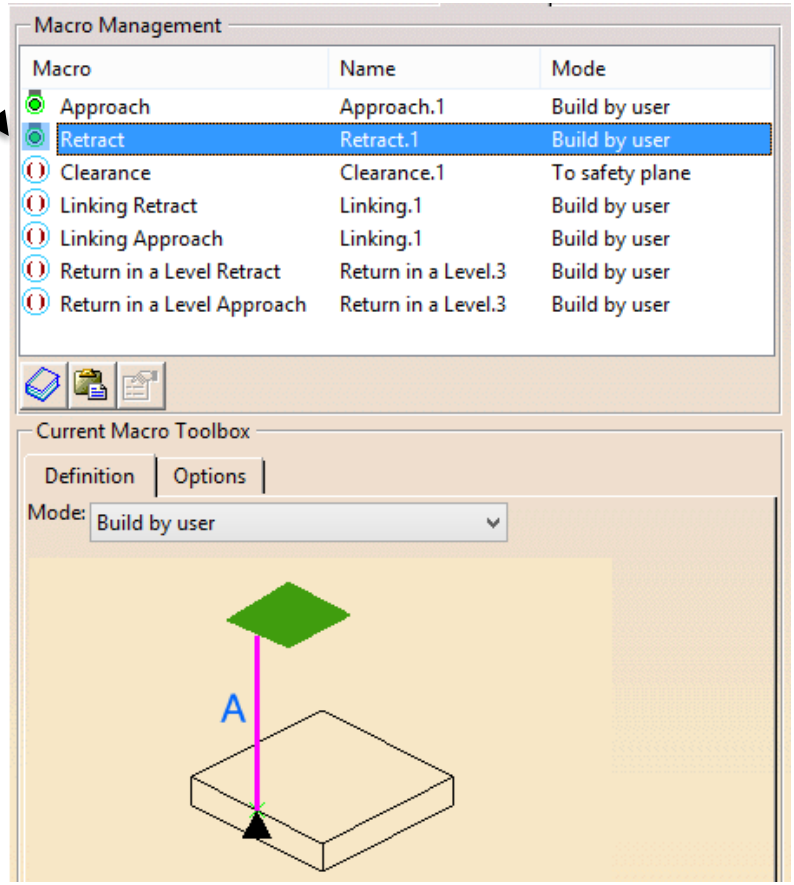


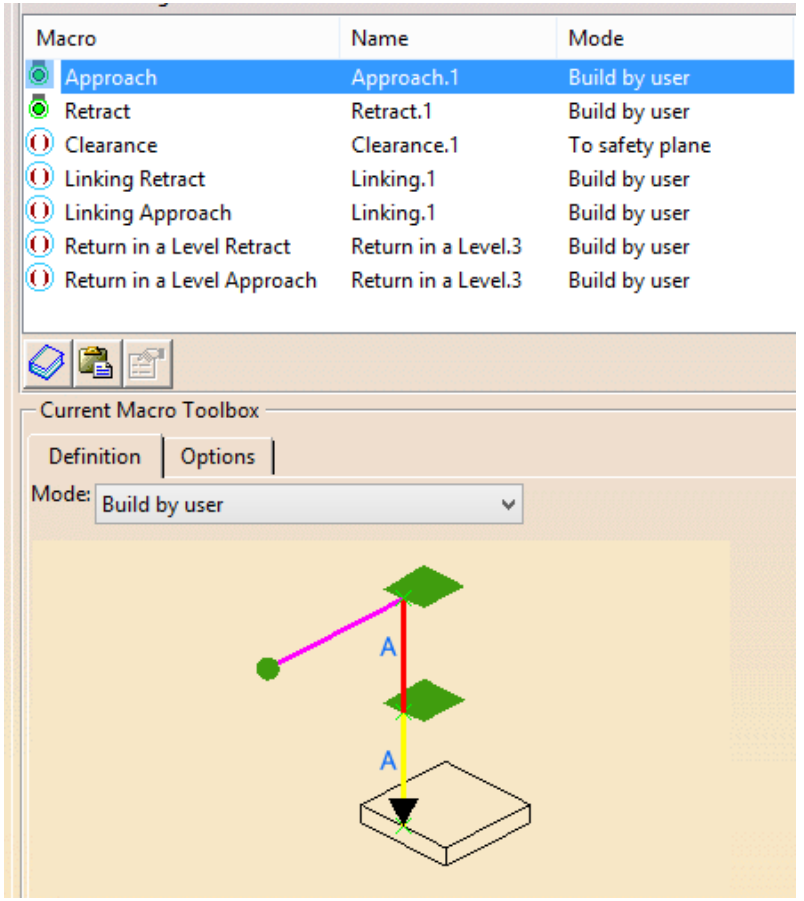
❑ **Another Setting** that needs to be defined is **Spindle Speed** which **relying on the size, type & material** of the **cutting tool** as well as the **workpiece**.



5 Isoparametric Operation





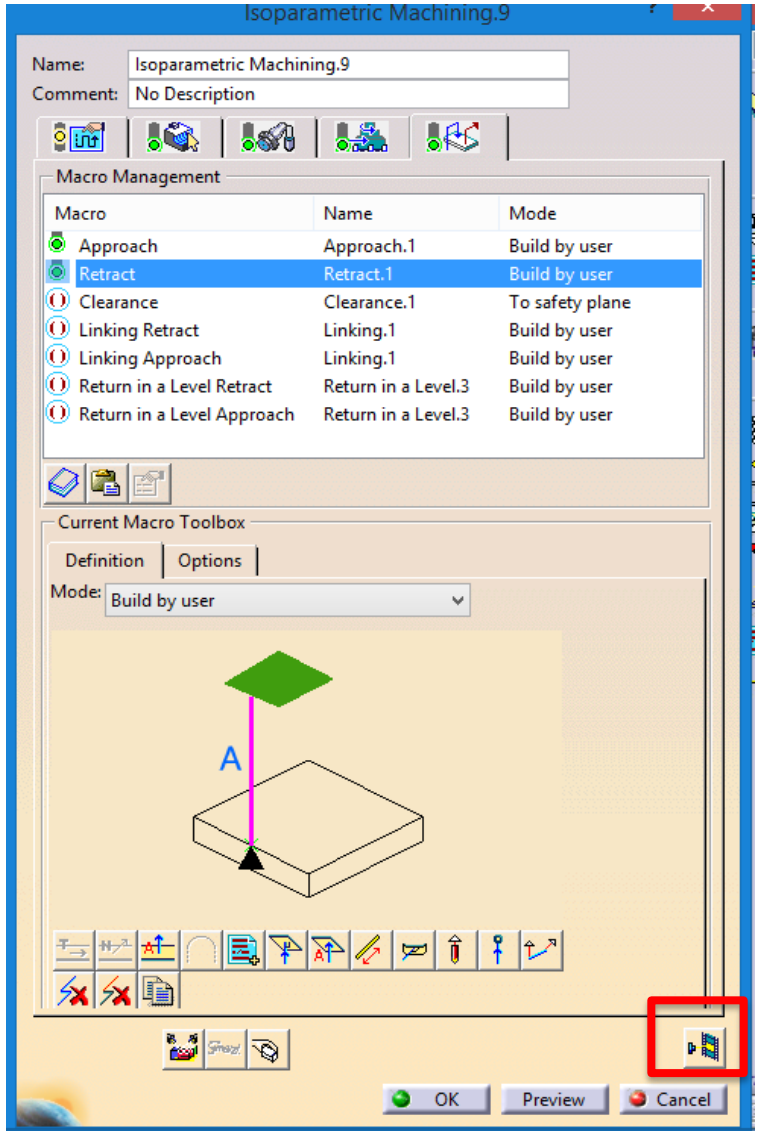


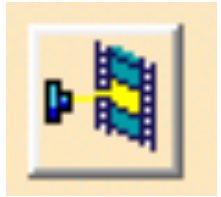
- **Macro Setting – ONLY Approach & Retract** motion are need to be **actived**

Isoparametric Operation

- 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.

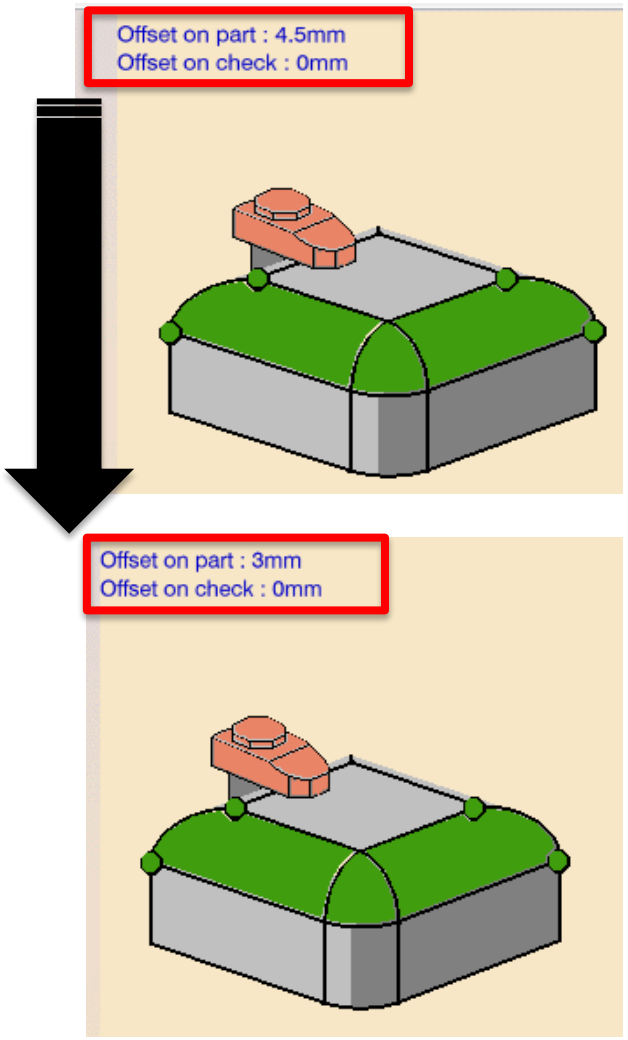


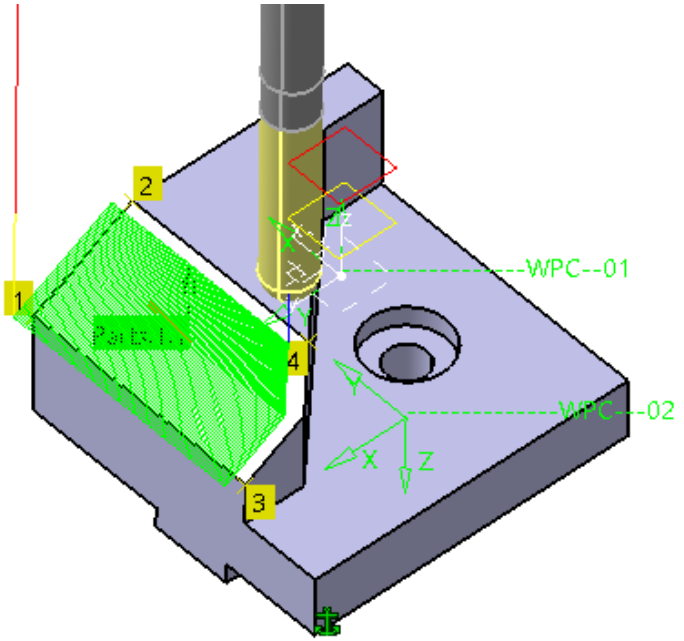


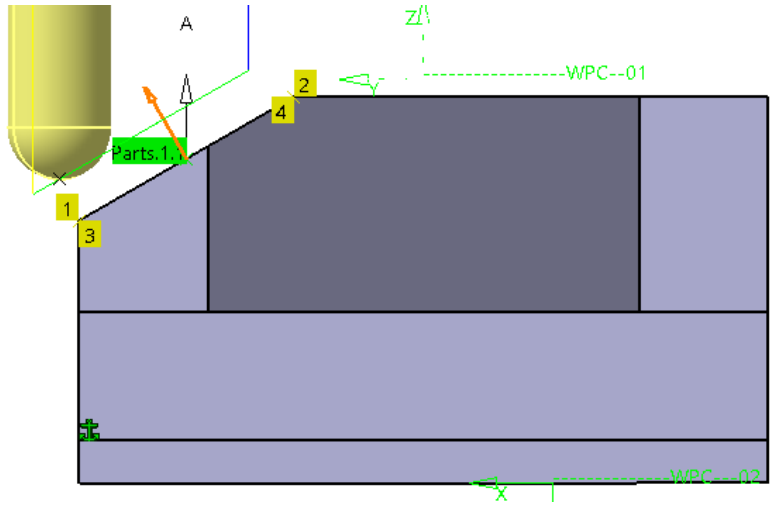
Tool Paths Reply

Isoparametric Operation

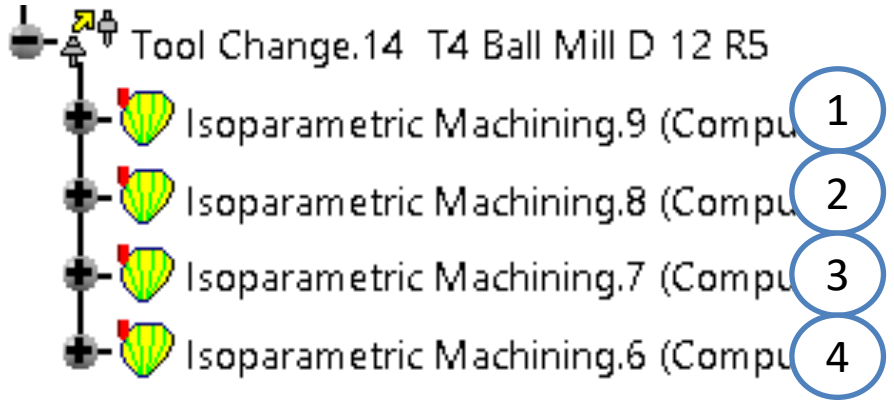
- CATIA will **generate full machining tool paths.**
- **REMEMBER** this Isoparametric Operation has been offset at **4.5mm** from the desired surface.
- Using the function of **COPY & PASTE**, copy the completed Isoparametric Operation and paste on the same operation.
- Now just **change the OFFSET on PART** to any appropriate depth of cut sequence such **as 1.5 mm** at single pass.



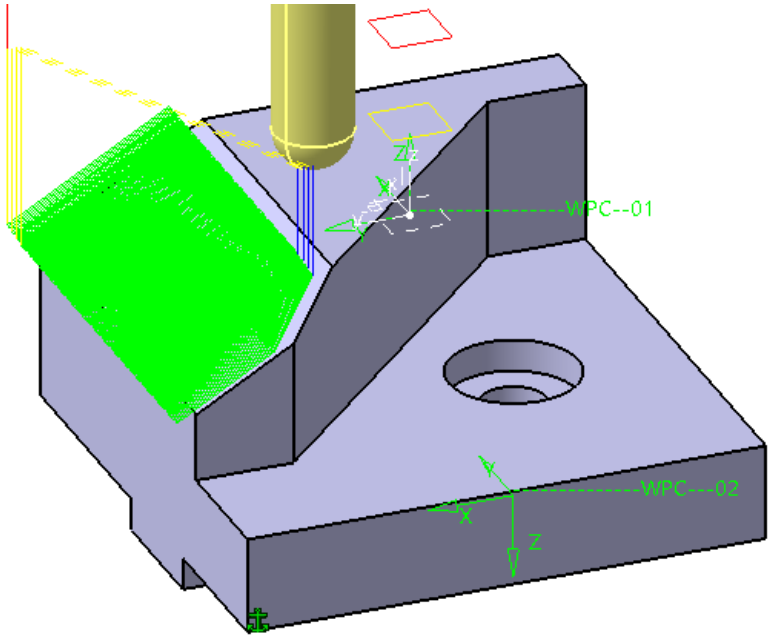




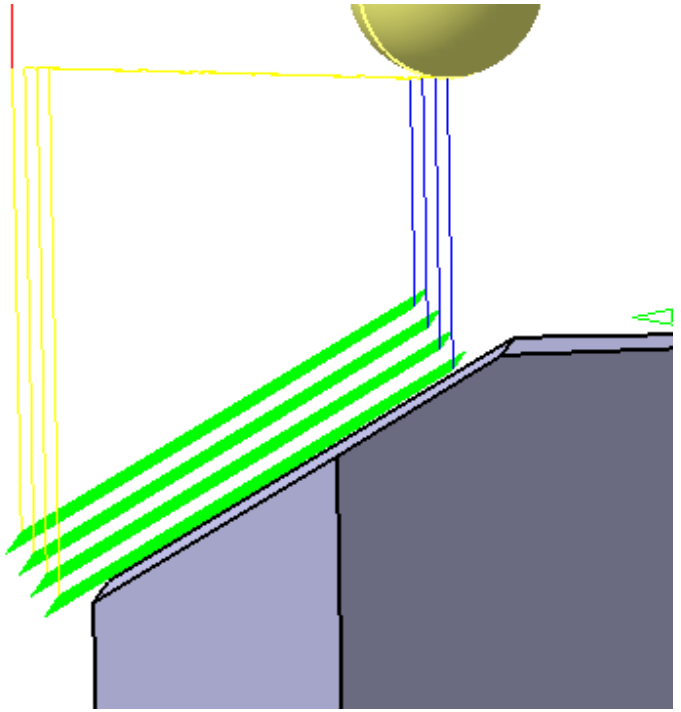
Isoparametric Operation



- **Specification TREE** – Isoparametric Operation with OFFSET on PART - FOUR (4) Levels
- Each level 1.5 mm depth of cut
- From **4.5mm – 3.0mm – 1.5mm – 0mm** OFFSET on PART

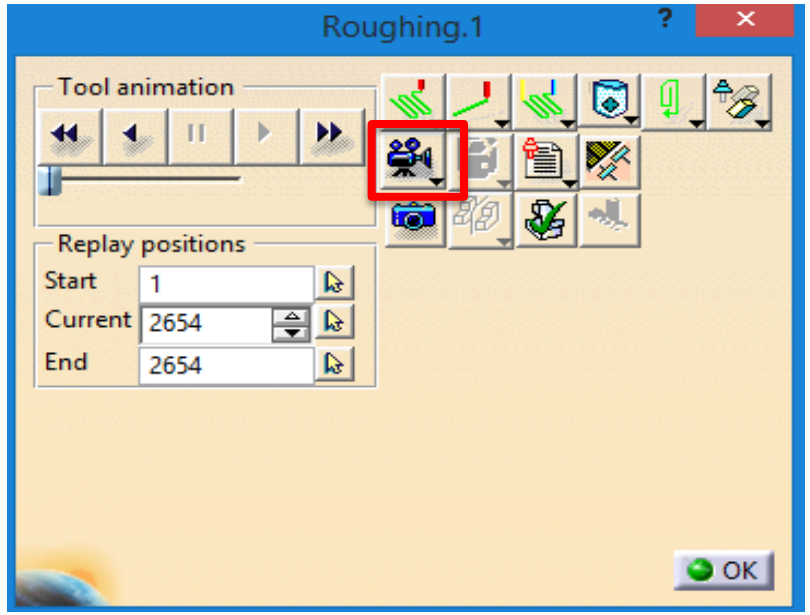


Isometric VIEW



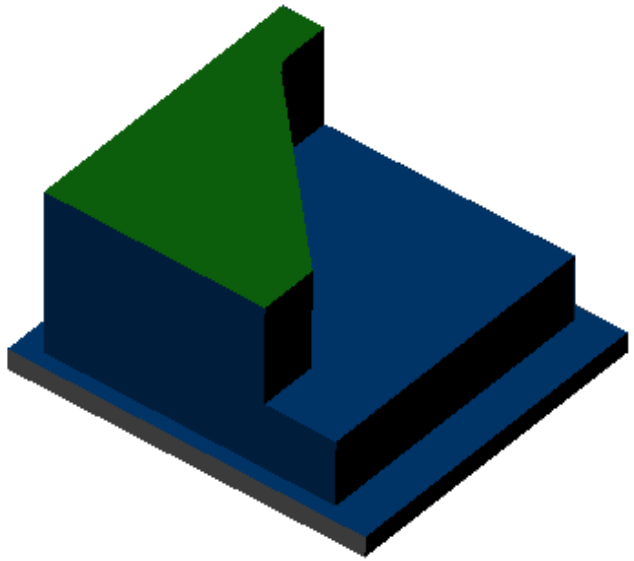
Side VIEW
4 Levels

Isoparametric Operation

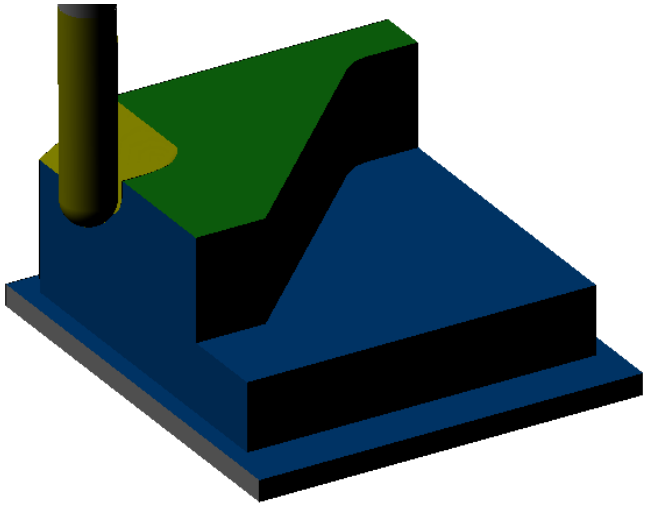


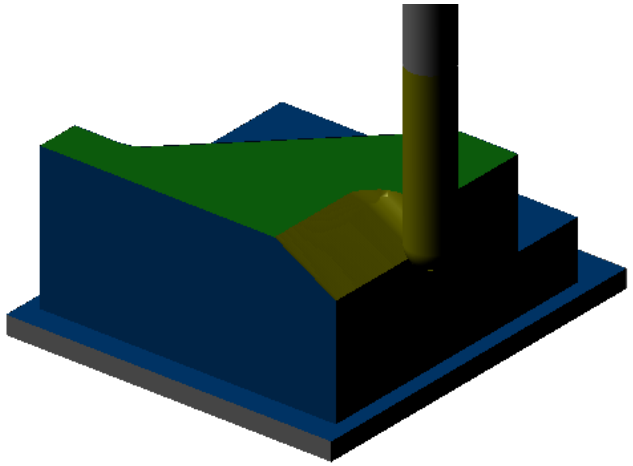
- There are THREE (3) options given by CATIA in viewing the full machining simulation. The description are as follows
  - 1 = Play video from last saved result
  - 2 = Full Video
  - 3 = Mixed Photo / Video
- Select 2nd icon to Play video from beginning. 
- Once satisfied with full machining simulation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

Isoparametric Operation

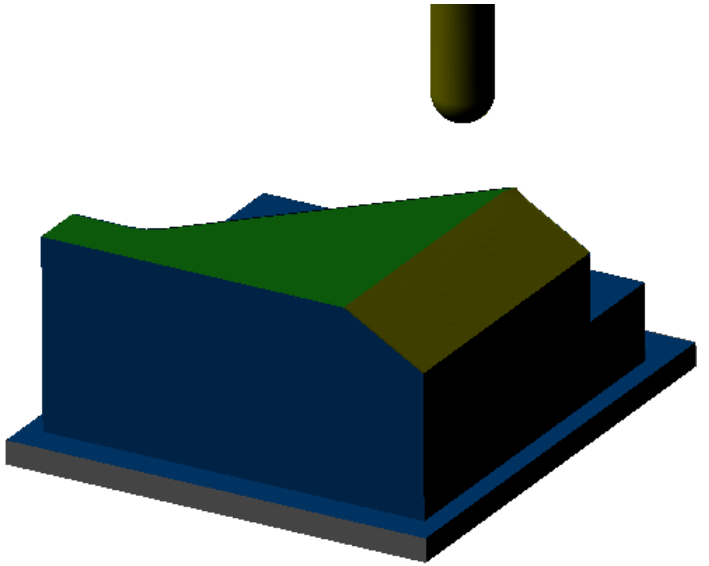


Roughing Conventional Approach – End Simulation



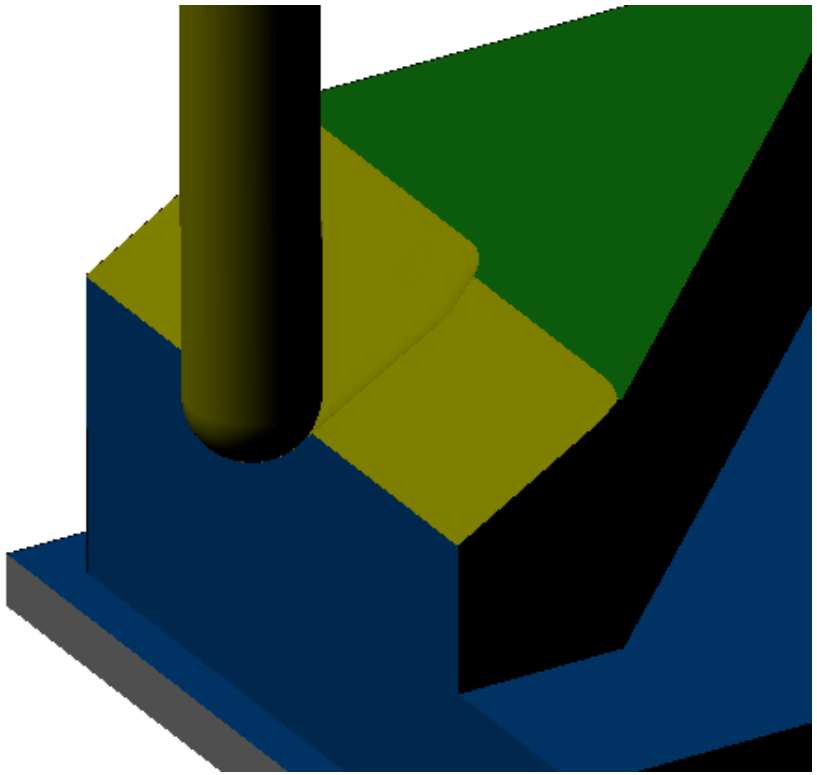


1st Level Isoparametric Operation – Offset on Part 4.0mm

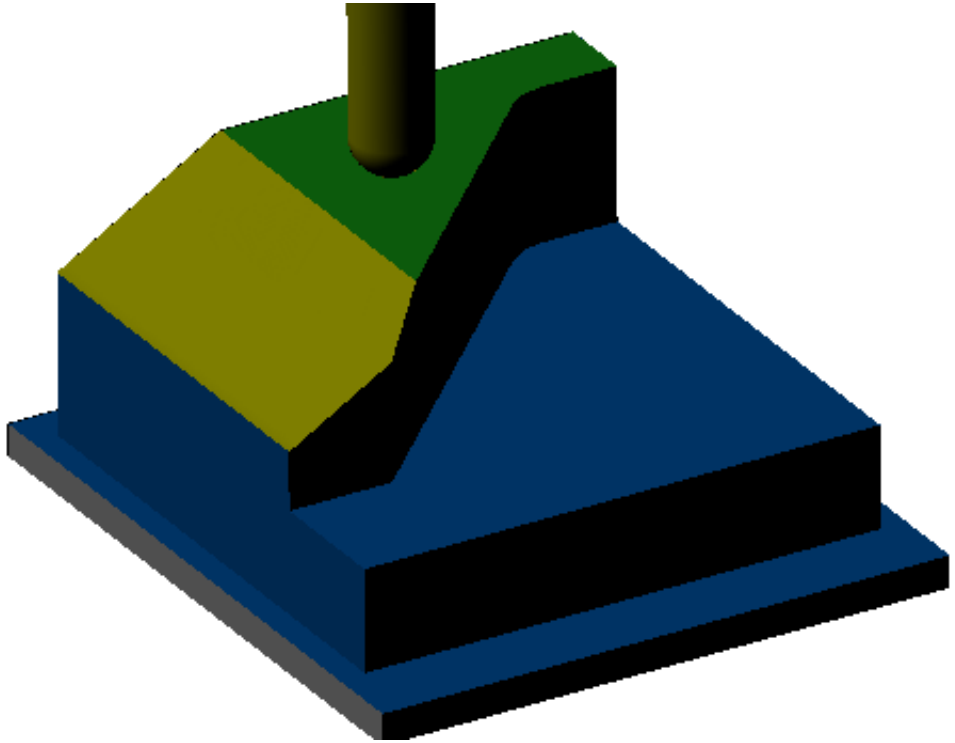


1st Level Isoparametric Operation – Completed

Isoparametric Operation

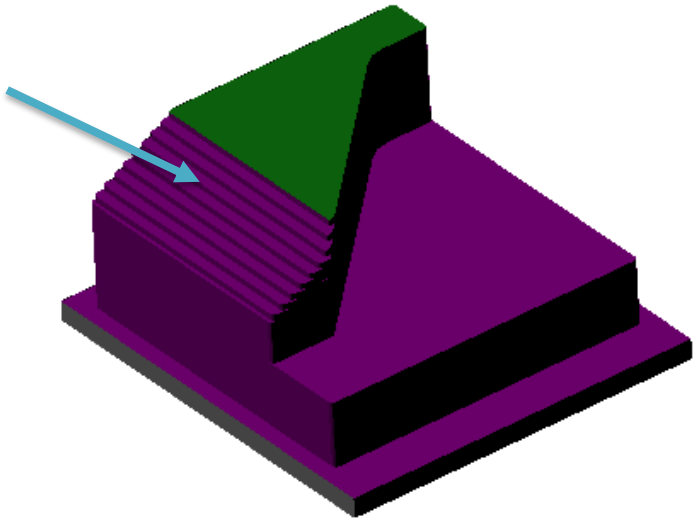


2nd Level Isoparametric Operation in progress

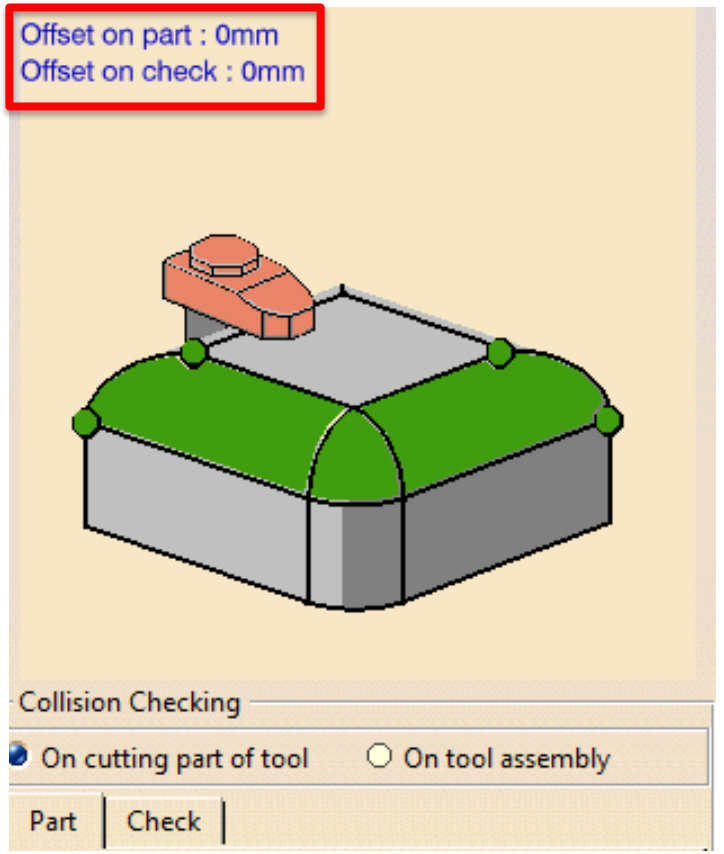


Completed of 4 levels – Isoparametric Operation

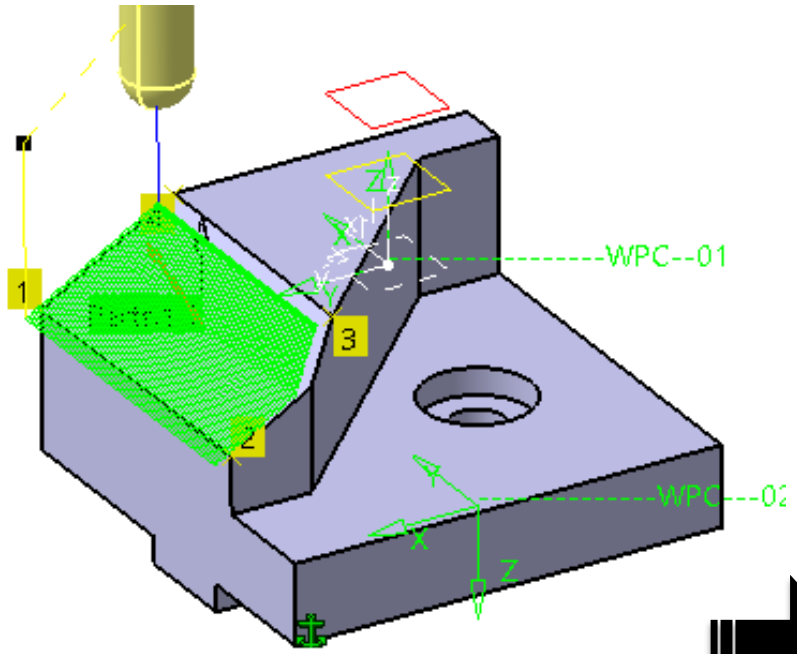
Isoparametric Operation



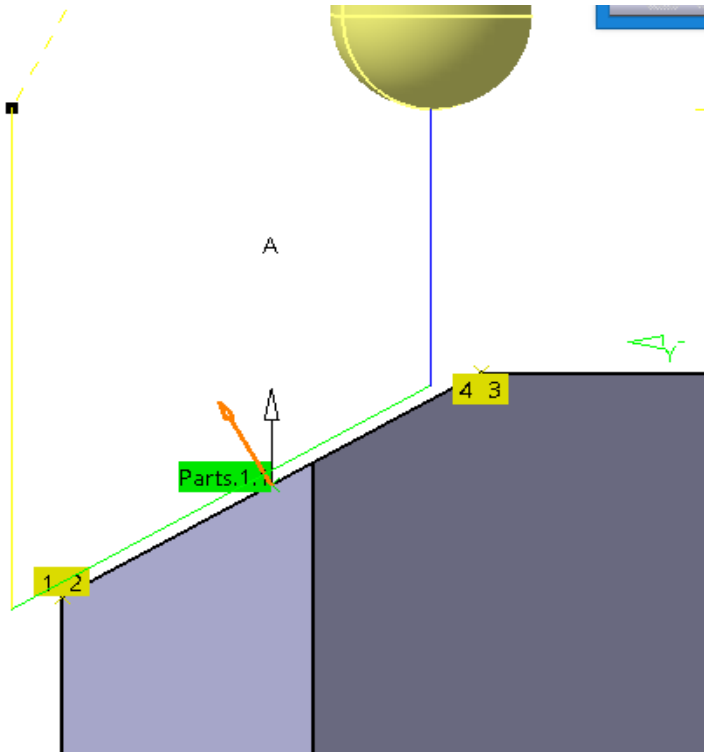
- ✓ The **2nd approach** is to machine the area from the **result of Roughing Operation – New Method**
- ✓ Since **machining tool paths calculation** of this **Roughing Operation** already **included the desired area** by machining **ladder type as semi-finish result**, then **Isoparametric Operation** can be applied straight away with **only 1 level**.
- ✓ In this case, **NO OFFSET ON PART** is necessary indirectly greatly improved machining program as well as machining time.



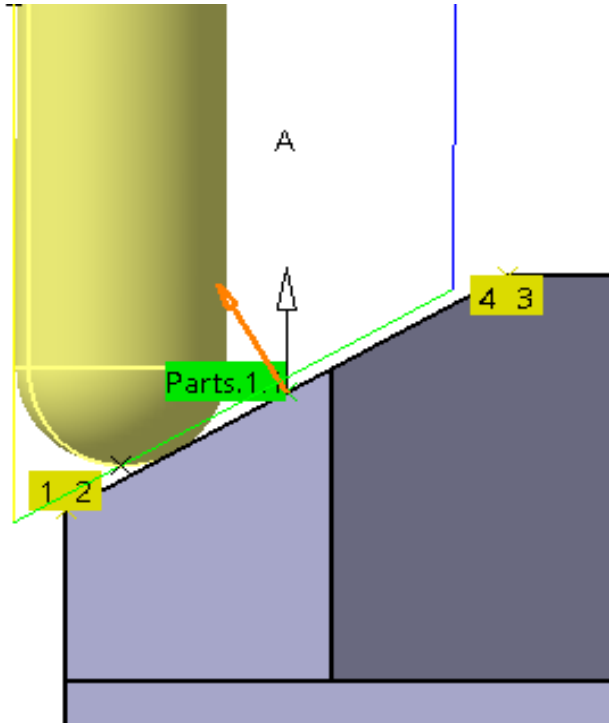
Isoparametric Operation



ONLY 1 Level Isoparametric Operation – Tool Paths Calculation

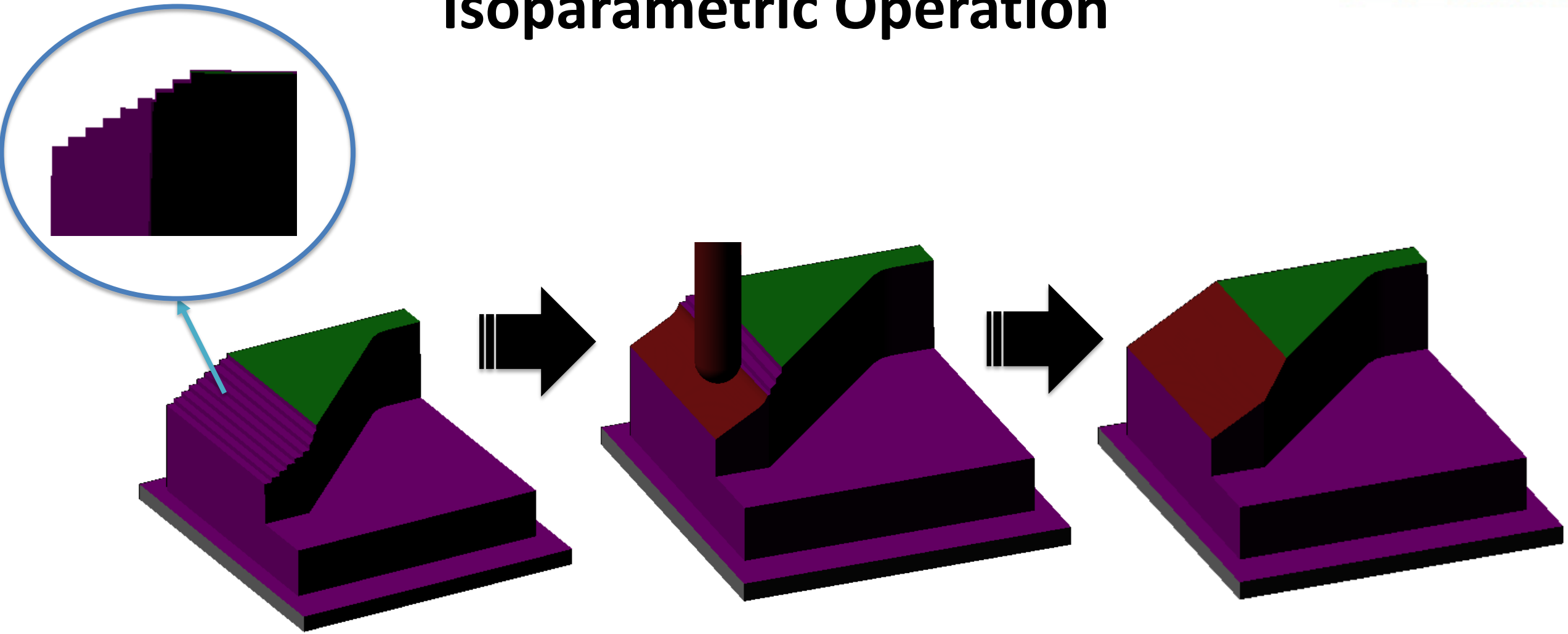


Side View – Isoparametric Operation Tool Paths



Closed Up – Cutting Tool touching workpiece

Isoparametric Operation



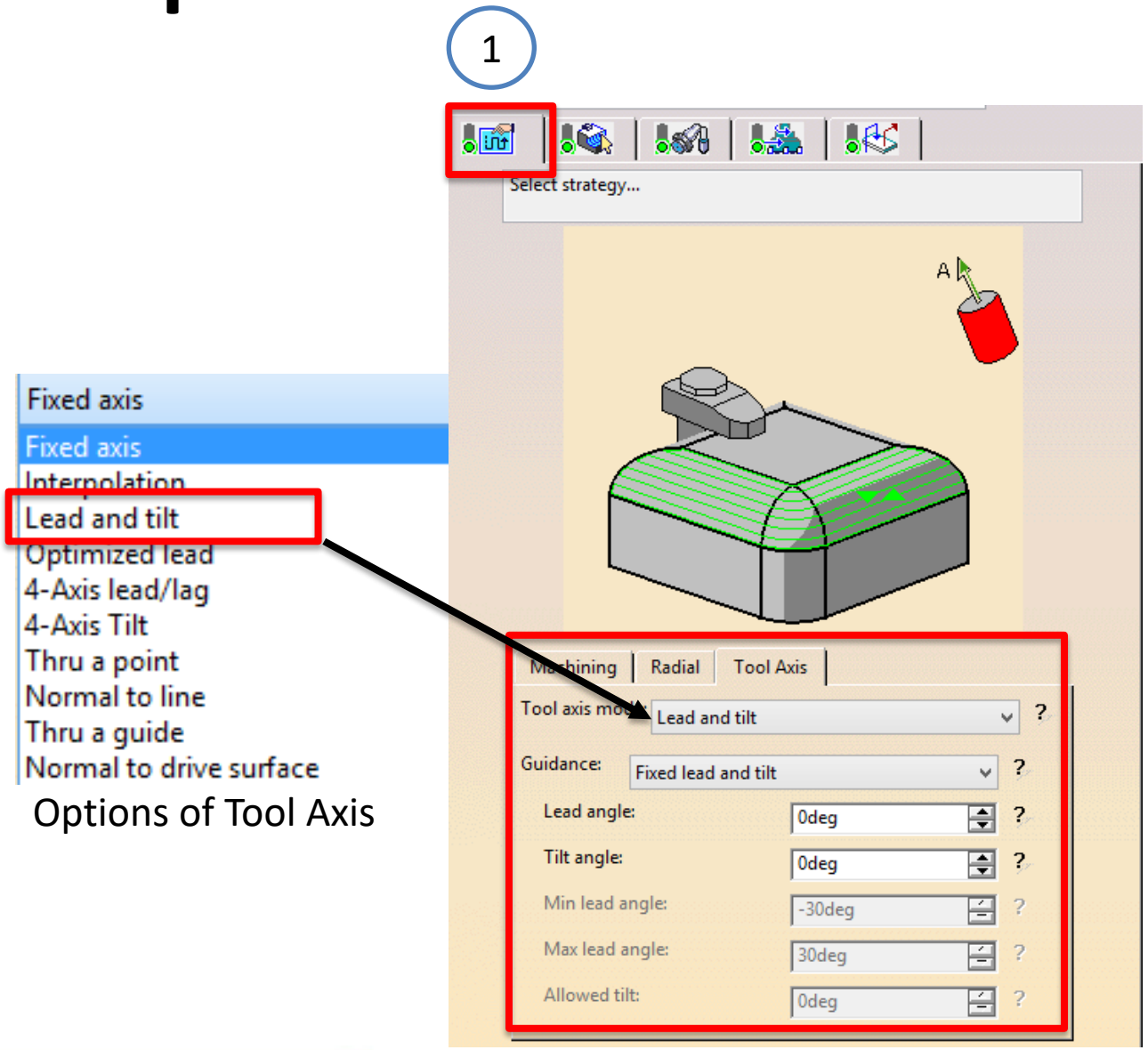
Roughing Operation – End Simulation Result

Isoparametric Operation – In Process

Isoparametric Operation – Completed

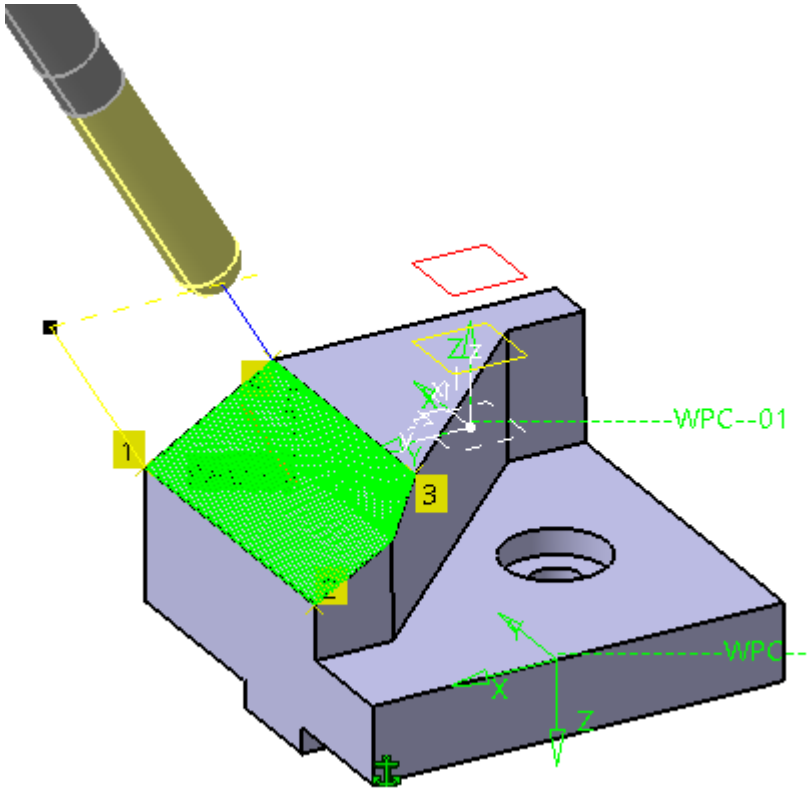
Isoparametric Operation

- ✓ **Isoparametric Operation** can also be utilized **in 4/5 Axis Machining.**
- ✓ **Tool Axis** is the main setting to change according to the profile to be machined.
- ✓ **LEAD & TILT Tool Axis** is the **most common and flexible** in machining **indexing or simultaneous 5-Axis Machining.**

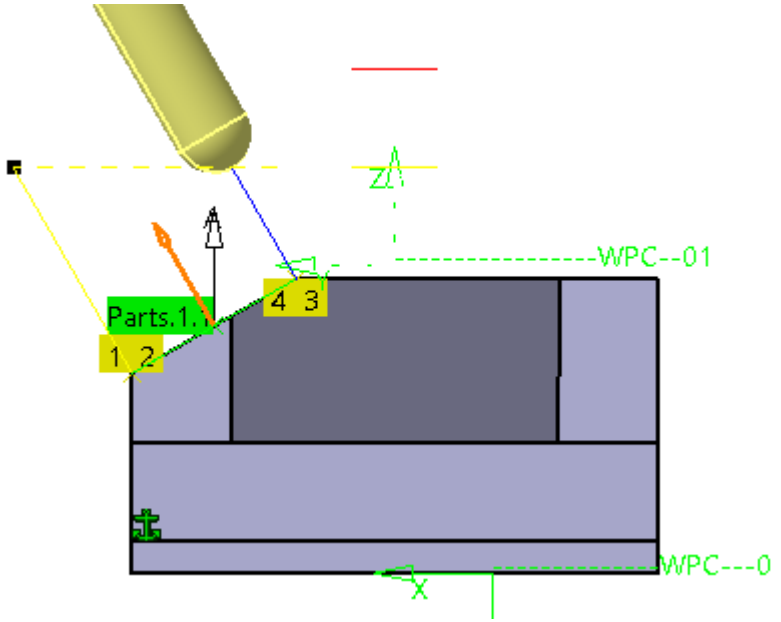


Options of Tool Axis

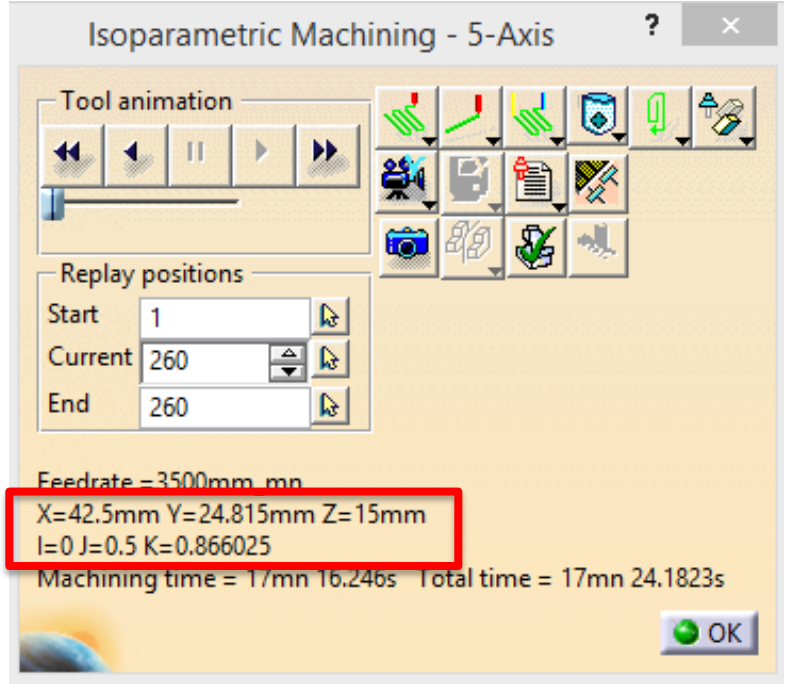
Isoparametric Operation



- Isoparametric Operation – Lead & Tilt Tool Axis Tool Paths Calculation

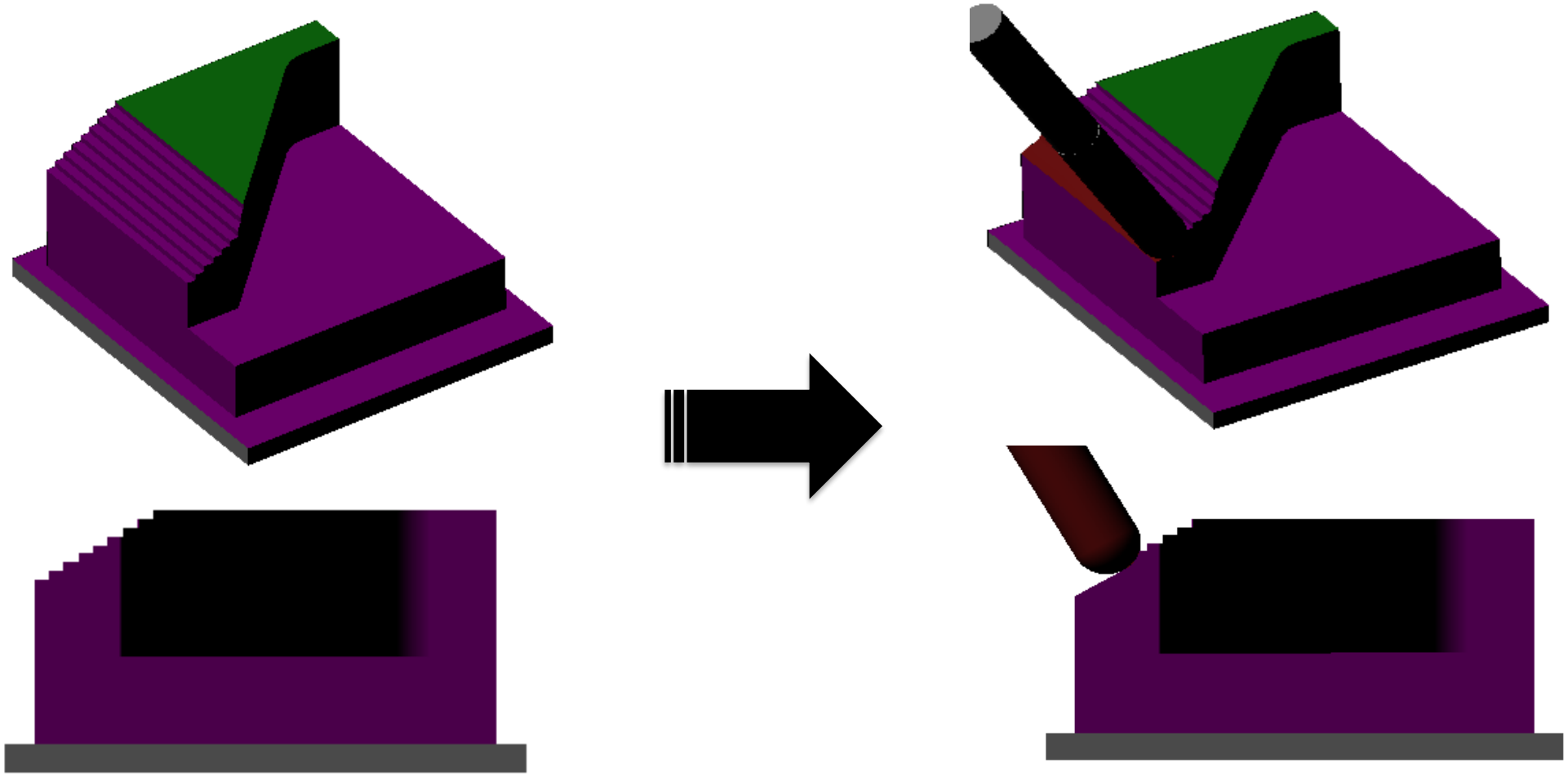


- Isoparametric Operation – Lead & Tilt Tool Axis – SIDE View
- Cutting Tool tilted Perpendicular to the surface



- From Tool Paths Simulation window, position I, J & K are NOT in 0 or 1.
- 3-Axis or 90 degree position is indicated by I=0 J=0 K=1

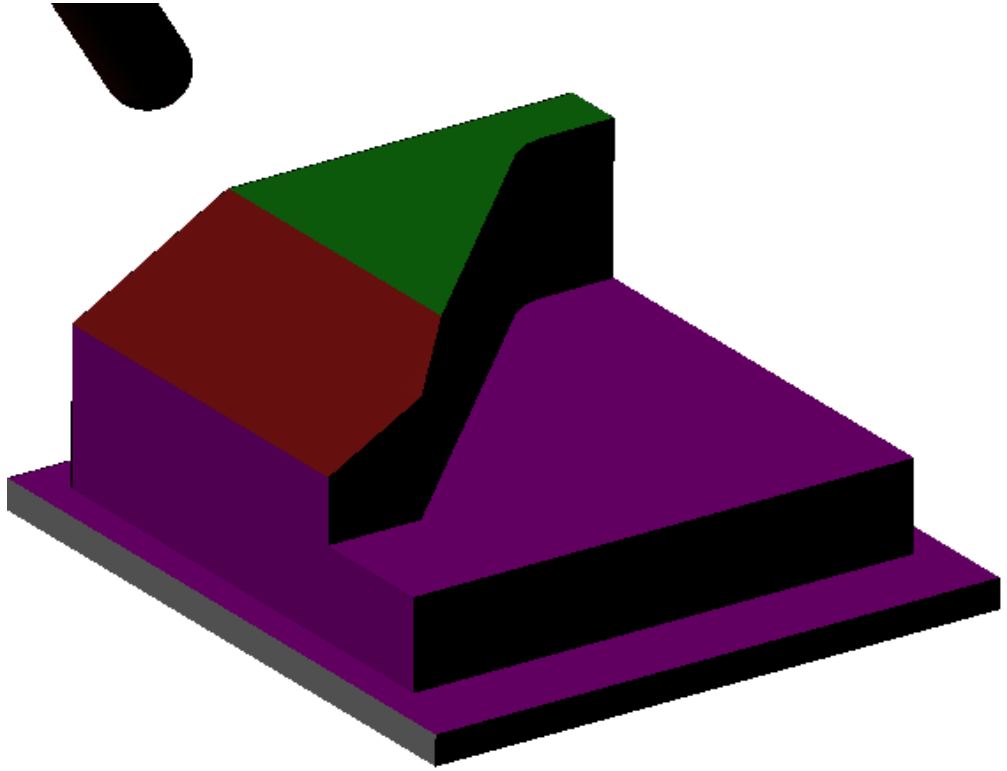
Isoparametric Operation



Roughing Operation – End Simulation Result

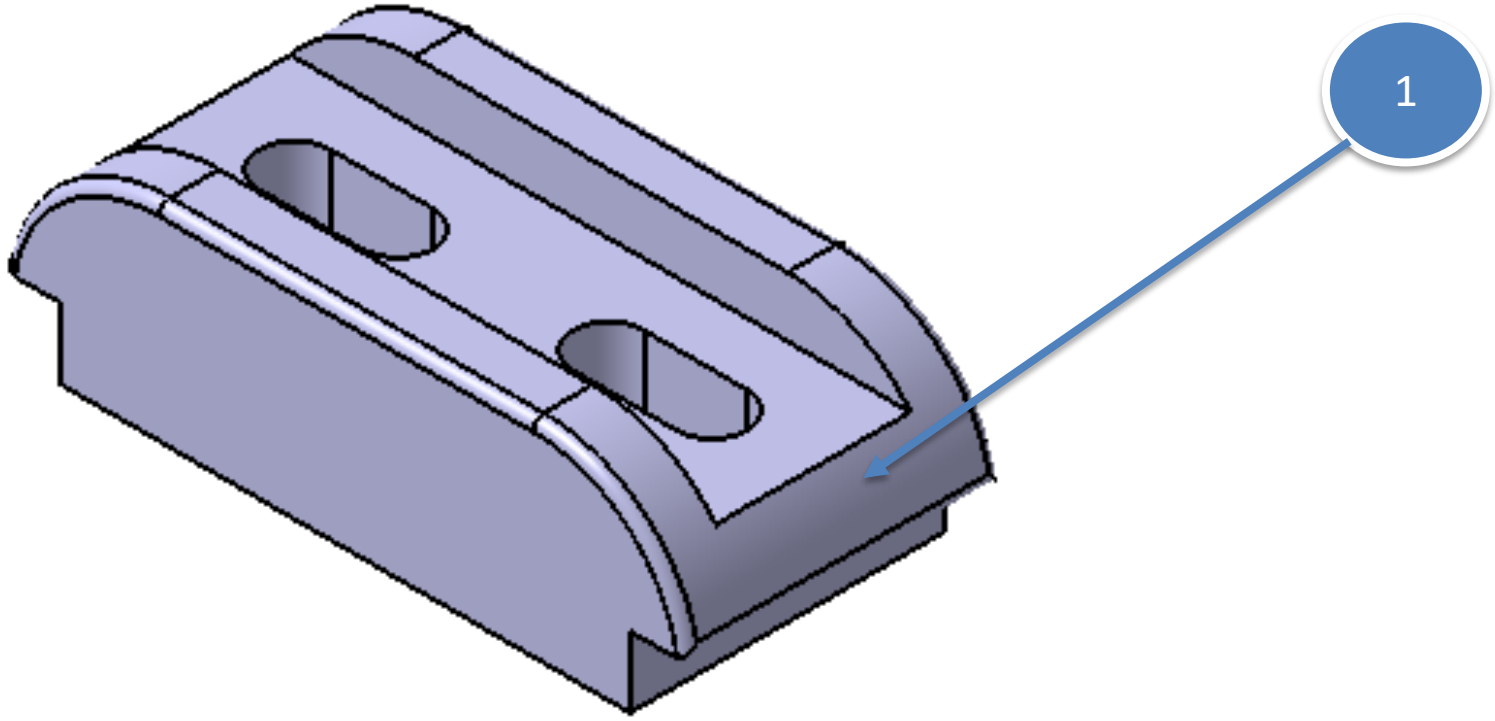
Isoparametric Operation – Lead & Tilt Tool Axis in Process

Multi-Axis Pocketing



Isoparametric Operation – Lead & Tilt Tool Axis – Completed

Isoparametric Operation

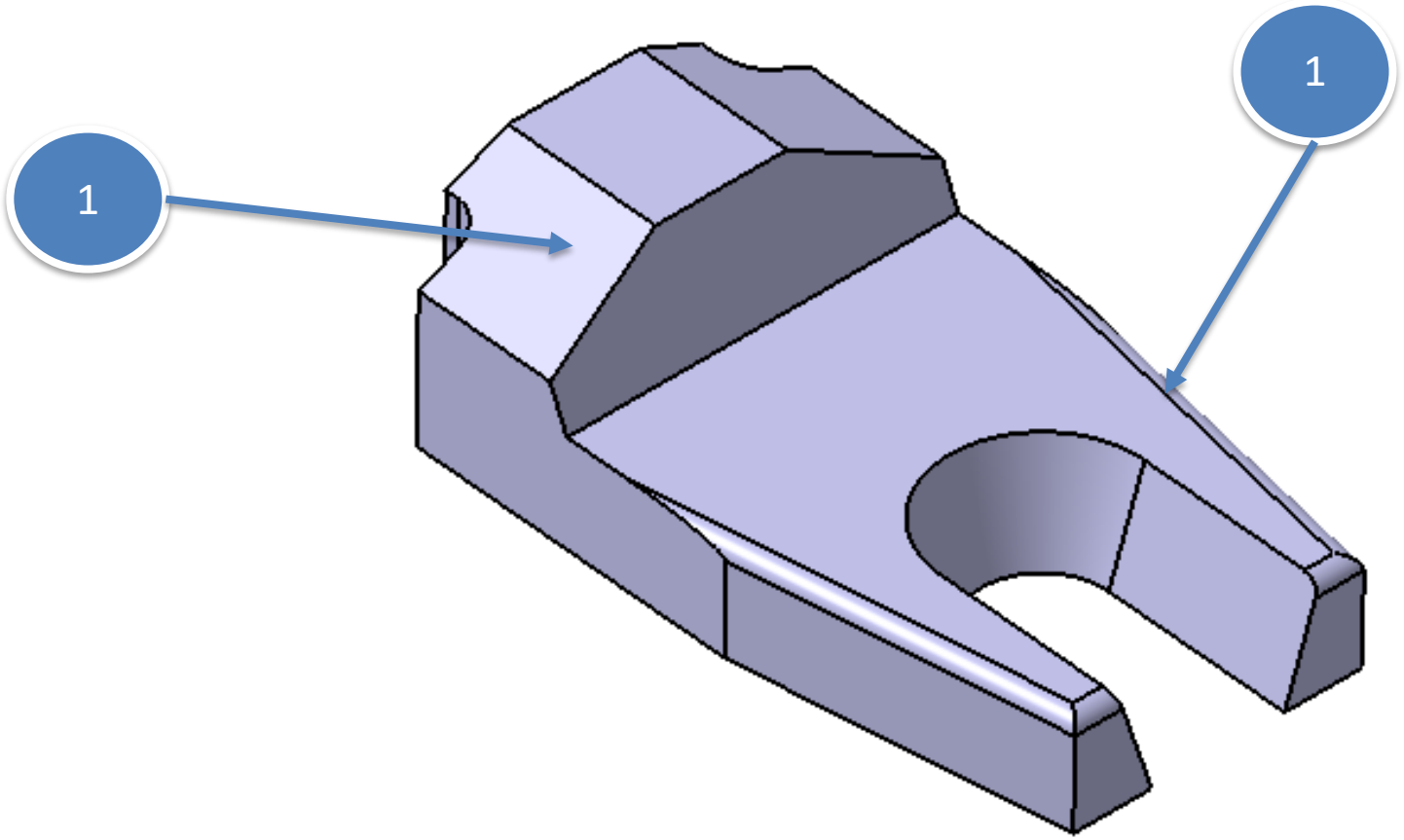


Exercise_1

Please prepare the CAM Programming following the instructions below:

- *Perform Isoparametric process for the numbered areas.*
- *Use smaller depth of cut for roughing process to avoid difficulty in Isoparametric process.*

Isoparametric Operation

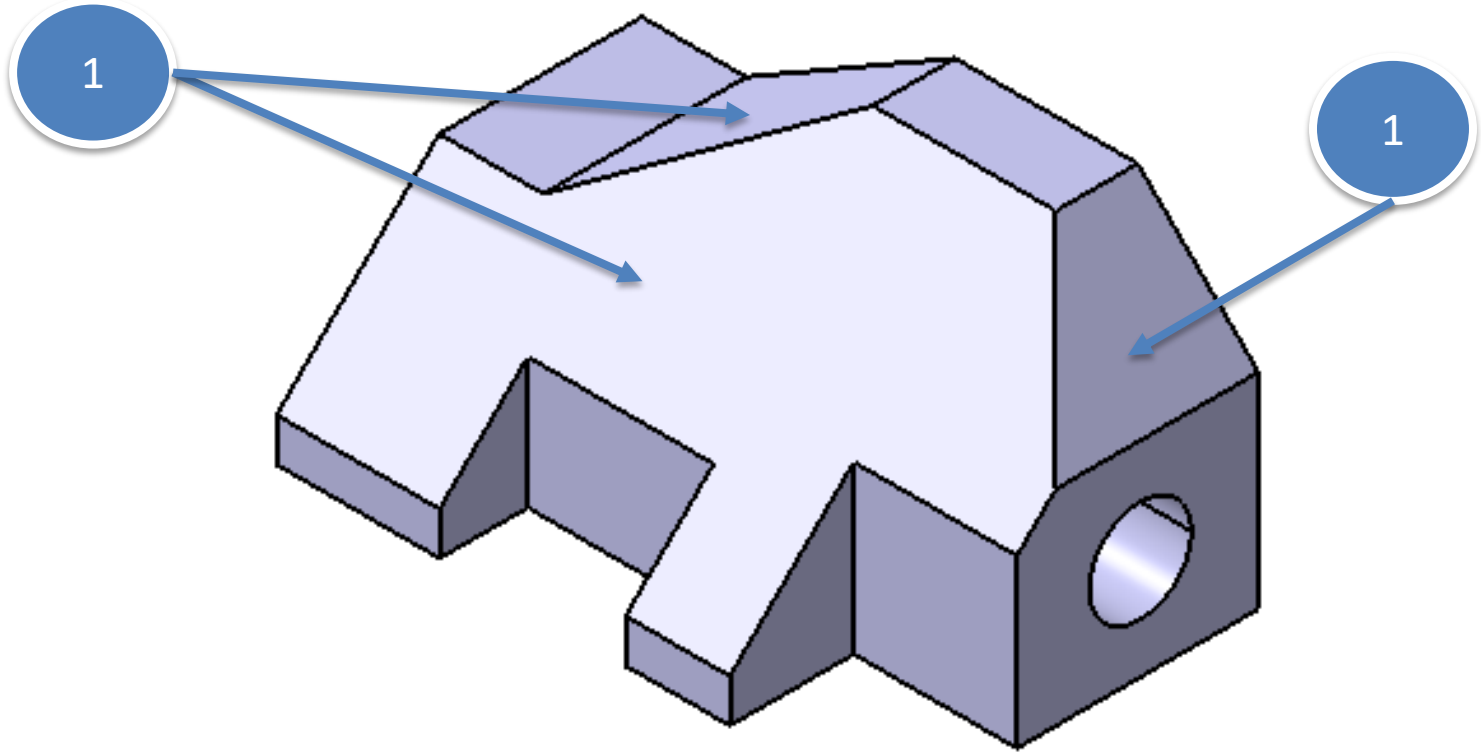


Exercise_2

Please prepare the CAM Programming following the instructions below:

- *Perform Isoparametric process for the numbered areas.*
- *Use smaller depth of cut for roughing process to avoid difficulty in Isoparametric process.*

Isoparametric Operation



Exercise_3

Please prepare the CAM Programming following the instructions below:

- *Perform Isoparametric process for the numbered areas.*
- *Use smaller depth of cut for roughing process to avoid difficulty in Isoparametric process.*

Isoparametric Operation

ALL THE BEST

THANK YOU