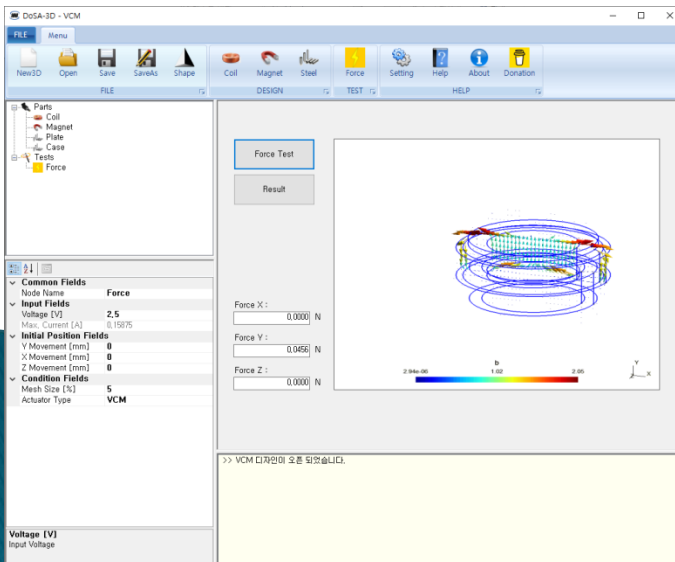


# DoSA-3D User Manual

**Voice Coil Motor Example**  
( Speaker, Auto-Focus, Linear Vibrator )



2022-06-05

zgitae@gmail.com

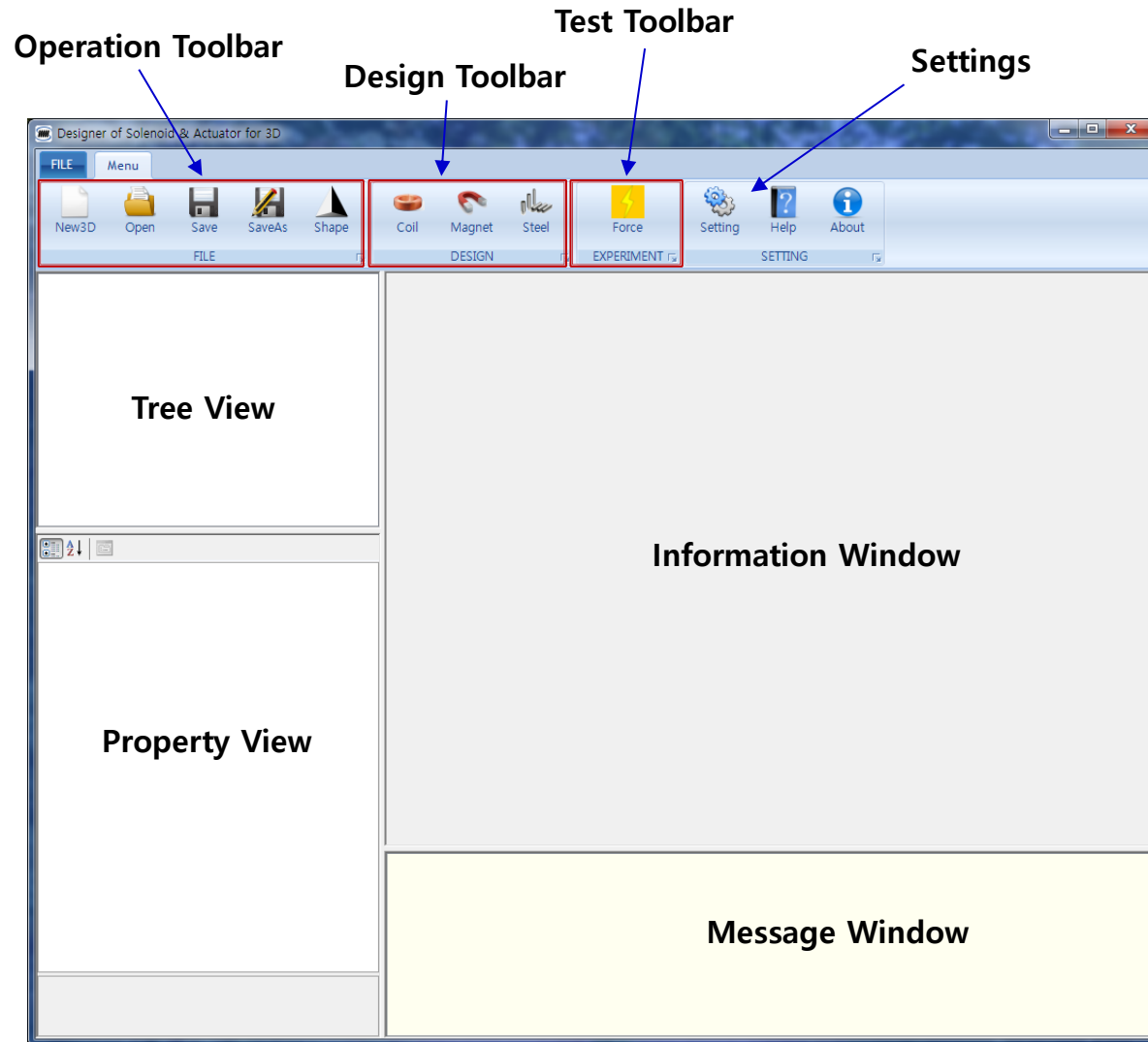
# DoSA Structure

# PC Requirement

- CPU : 4 Core and above
- RAM : 16GB and above



# Program Structure



# Toolbar

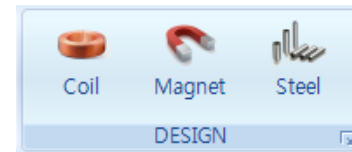
## 1. Operations

- ✓ New : Create a new design
- ✓ Open : Open previous design
- ✓ Save : Save the design
- ✓ SaveAs : Save in different name
- ✓ Shape : Check the 3D Shape



## 2. Design

- ✓ Coil : Add a coil and specification design
- ✓ Magnet : Add a magnet and determine specifications
- ✓ Steel : Add a steel and determine specifications



## 3. Virtual Test

- ✓ Force : Magnetic force estimation

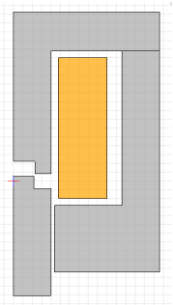


# Work process

## Product Design

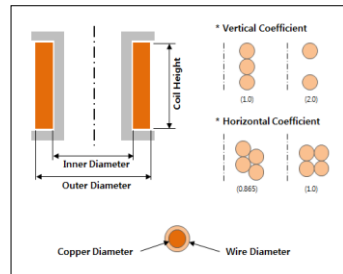
### 1. Geometry design

Geometry



### 2. Part design

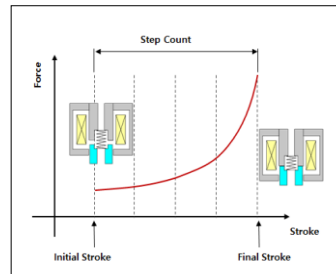
Components



## Virtual Test

### 3. Test condition

Test Condition

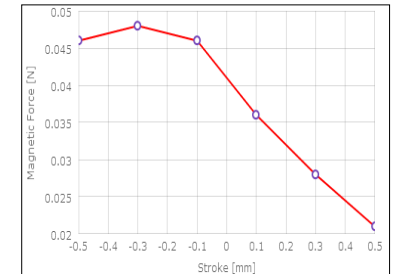


### 4. Virtual Test (Autorun)

Virtual Test

### 5. Results

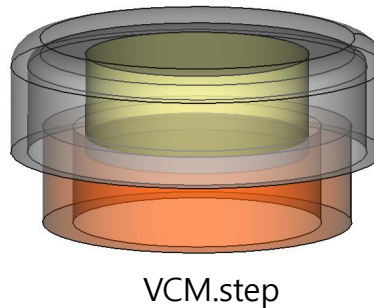
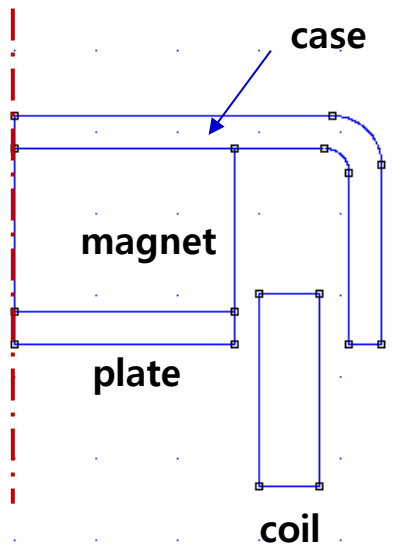
Results



# Analysis Model

# Analysis Model

## 1. Shape Model



## 2. Product Specifications

### A. Coil

- Coil Turns : 126 turns
- Coil Resistance : 15.75 Ohm

### B. Magnet

- Material : NdFeB 40
- Magnetization Direction : 90 (UP)

### C. Power

- Voltage : 2.5V

( Example Files : DoSA-3D Install Directory > Samples > VCM)



# New design

1. Toolbar > Click New button
2. Design Name : "VCM"
3. Shape File (STEP) : Select VCM.step ( provided with this tutorial document )



## [ Cautions for the Shape Model ]

DoSA-3D still has the following functional limitations.

### A. Shape constraint

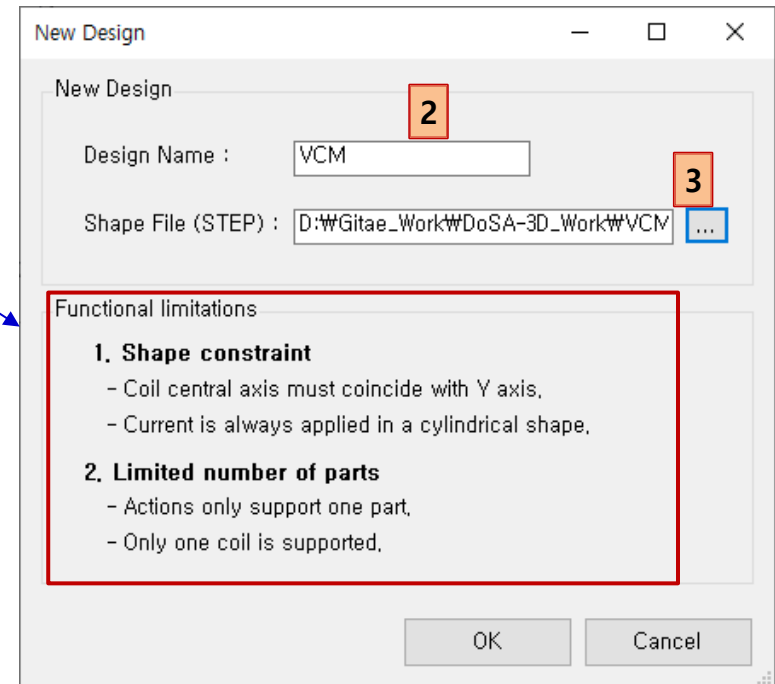
- Coil central axis must coincide with Y axis.
- The current is always applied in cylindrical form.  
( Polygon coils can cause some differences )

### B. Limited number of parts

- Actions only support one part.
- Only one coil is supported.

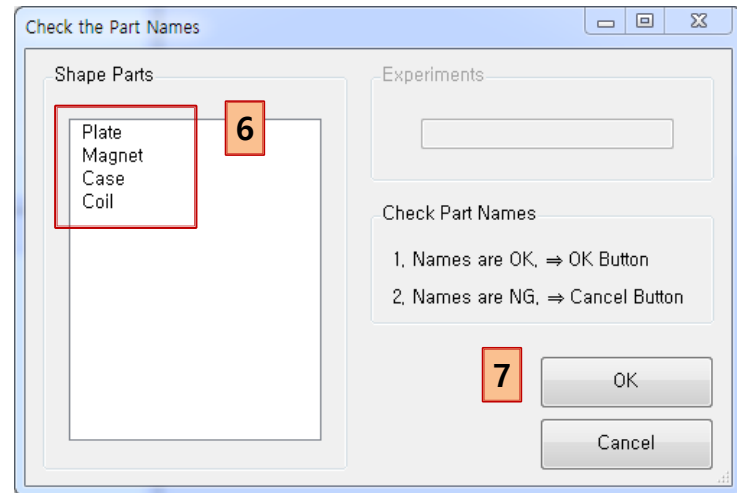
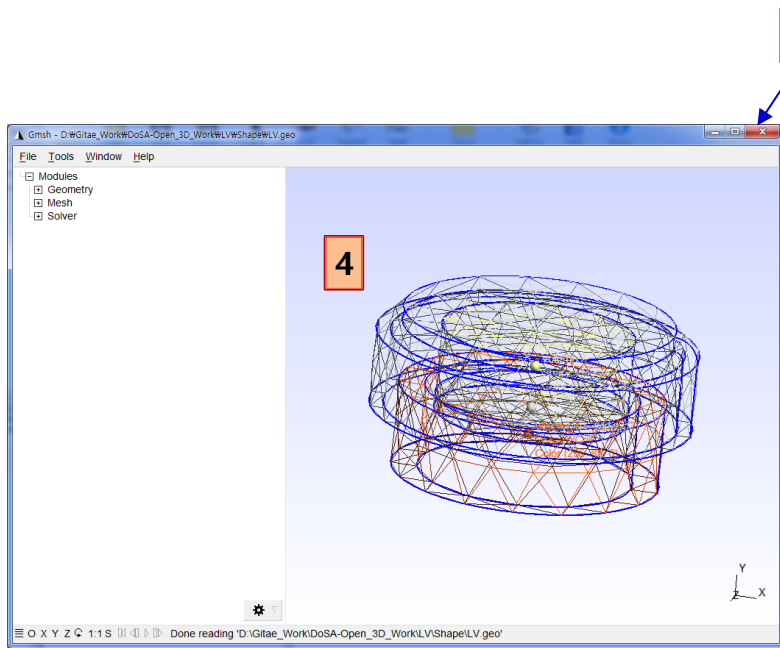
### C. Drawing Guide

- [https://solenoid.or.kr/data/Drawing\\_Guide\\_ENG.pdf](https://solenoid.or.kr/data/Drawing_Guide_ENG.pdf)



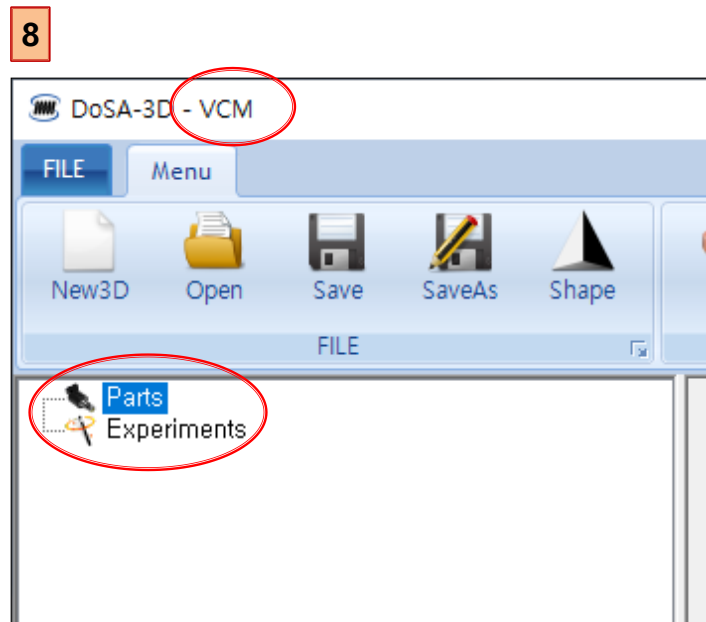
# New design

4. Check the solenoid shape in Gmsh.
5. Exit the Gmsh.
6. Check the part names.
7. Click the OK button if there are no problem with the shape and part names.



# New design

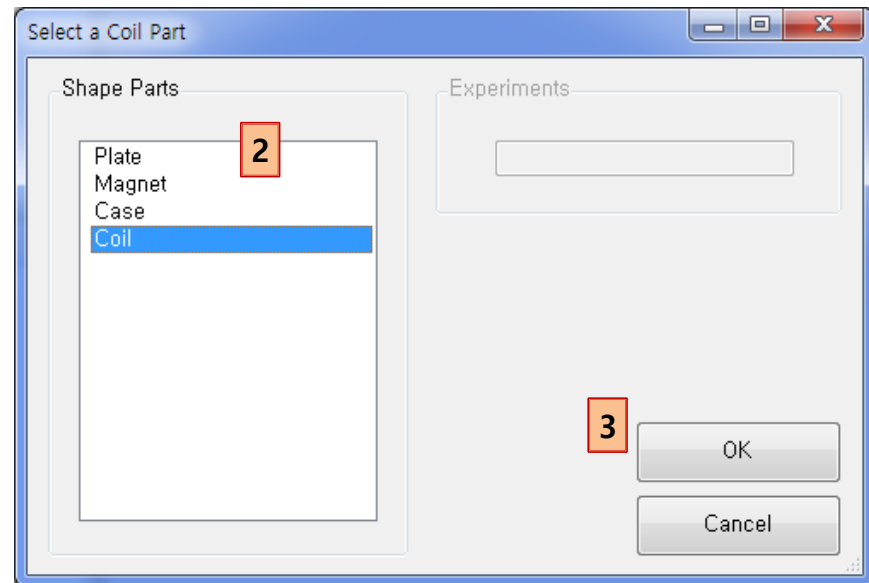
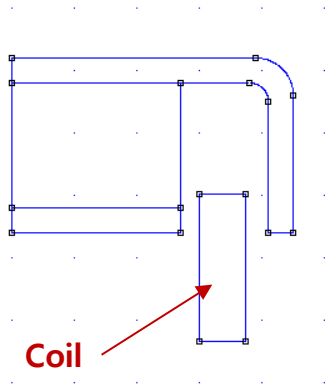
8. Check the design creation.



# Parts Design

# Add a coil

1. Toolbar > Click Coil button
2. Select "Coil" in the list box.
3. Click the OK button.



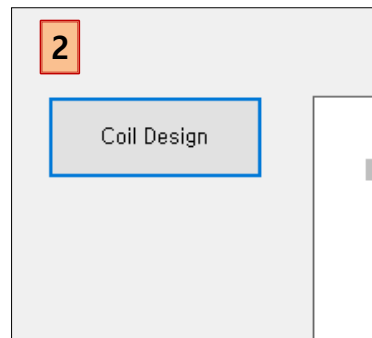
# Coil design

Select the magnetic force calculation part

1. Input the coil instrumental specifications
  - ✓ Moving Parts : **MOVING**
  - ✓ Coil Wire Grade : Bonded\_IEC\_Grade\_1B
  - ✓ Inner Diameter : 3
  - ✓ Outer Diameter : 3.73
  - ✓ Coil Height : 1.18
  - ✓ Copper Diameter : 0.045
  - ✓ Horizontal Coefficient : 0.95 (Bonded Type)
  - ✓ Vertical Coefficient : 1.13 (Bonded Type)
  - ✓ Resistance Coefficient : 1.1 (Bonded Type)

2. Calculate the coil specification
  - ✓ Click the "Coil Design" button

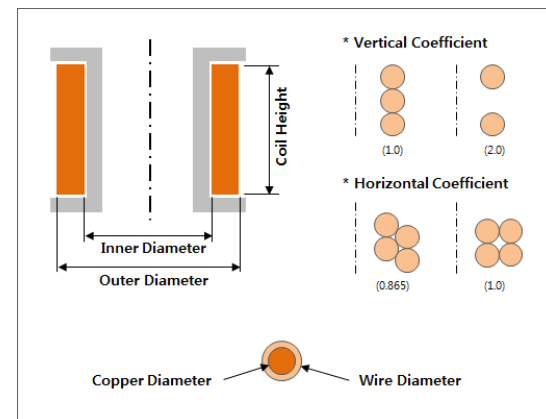
3. Check the coil specification



|   |                     |
|---|---------------------|
| <b>Common Fields</b>                    |                     |
| Node Name                               | Coil                |
| <b>Specification Fields</b>             |                     |
| Part Material                           | Copper              |
| Curent Direction                        | IN                  |
| Moving Parts                            | MOVING              |
| <b>Calculated Fields</b>                |                     |
| Coil Turns                              | 126                 |
| Coil Resistance [ $\Omega$ ]            | 15,74769            |
| Coil Layers                             | 6                   |
| Turns of One Layer                      | 21                  |
| <b>Design Fields (optional)</b>         |                     |
| Coil Wire Grade                         | Bonded_IEC_Grade_1B |
| Inner Diameter [mm]                     | 3                   |
| Outer Diameter [mm]                     | 3,73                |
| Coil Height [mm]                        | 1,18                |
| Copper Diameter [mm]                    | 0,045               |
| Wire Diameter [mm]                      | 0,04953             |
| Coil Temperature [ $^{\circ}\text{C}$ ] | 20                  |
| Horizontal Coefficient                  | 0,95                |
| Vertical Coefficient                    | 1,13                |
| Resistance Coefficient                  | 1,1                 |

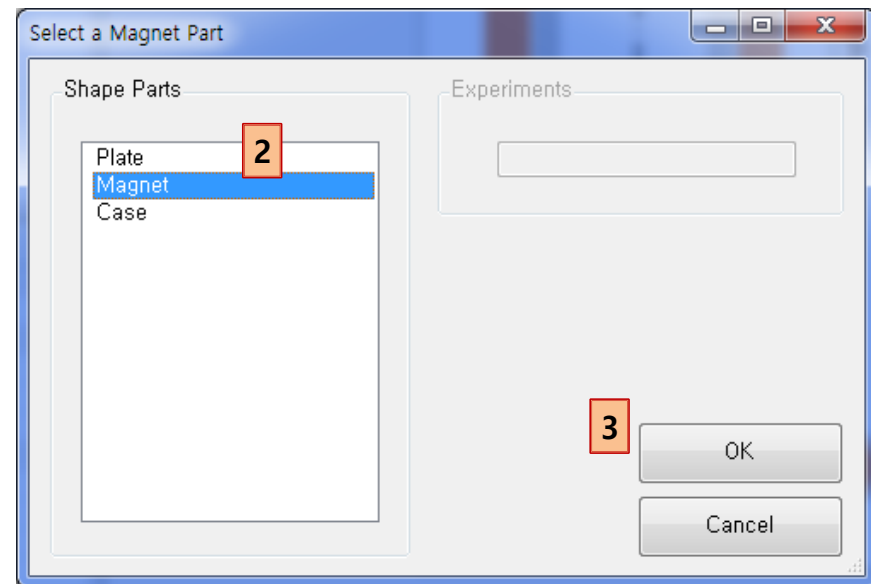
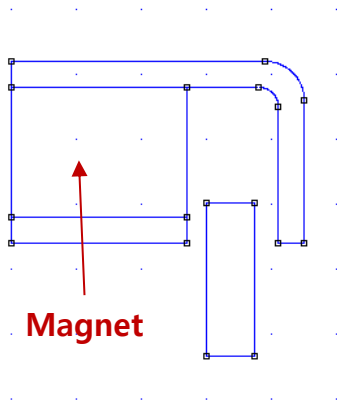
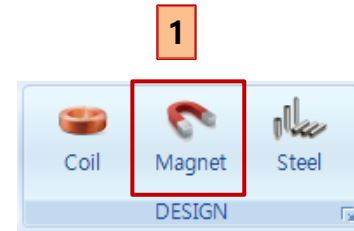
1

3



# Add a magnet

1. Toolbar > Click Magnet button
2. Select "Magnet" in the list box.
3. Click the OK button.



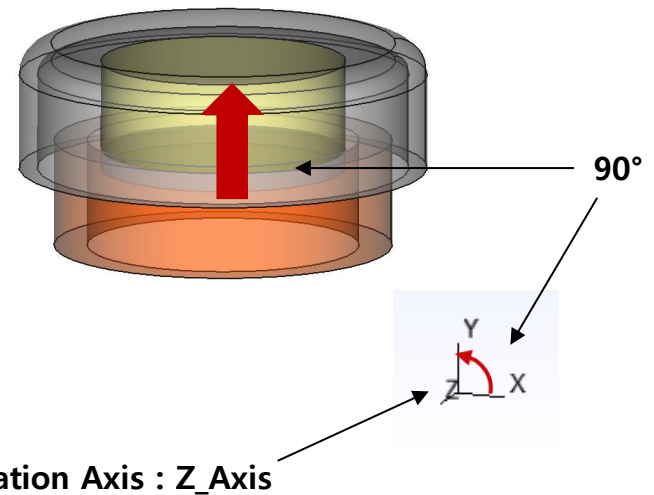
# Magnet setting

## 1. Magnet Settings

- ✓ Use default values

1

|                               |                 |
|-------------------------------|-----------------|
| ✓ <b>Common Fields</b>        |                 |
| Node Name                     | <b>Magnet</b>   |
| ✓ <b>Specification Fields</b> |                 |
| Part Material                 | <b>NdFeB_40</b> |
| Hc                            | 969969          |
| Br                            | 1,26497         |
| Moving Parts                  | <b>FIXED</b>    |
| ✓ <b>Magnetization Fields</b> |                 |
| Rotation Axis                 | <b>Z_AXIS</b>   |
| Rotation Angle                | <b>90</b>       |





# [Ref.] Magnet magnetization

## 1. Understanding magnet magnetization direction

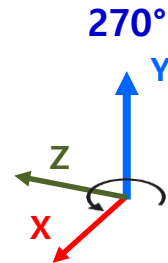
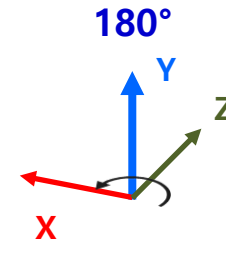
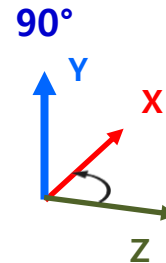
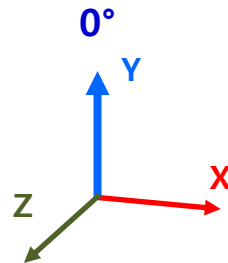
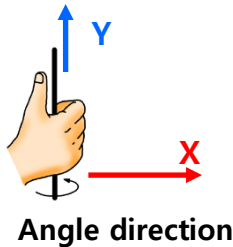
- Magnet magnetization direction: X axis direction
- Rotation Axis : The axis of rotation of the X axis
- Rotation Angle : the angle the X axis rotates

### ▼ Magnetization Fields

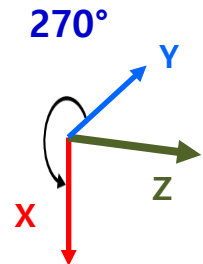
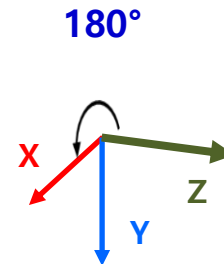
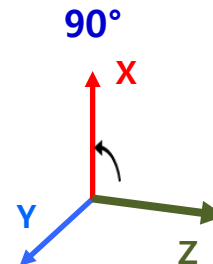
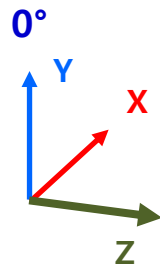
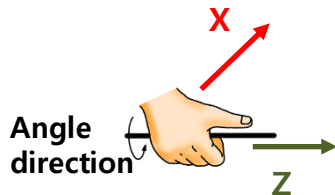
|                |        |
|----------------|--------|
| Rotation Axis  | Z_AXIS |
| Rotation Angle | 90     |

## 2. Magnetization direction setting

- Rotation Axis : Y\_Axis

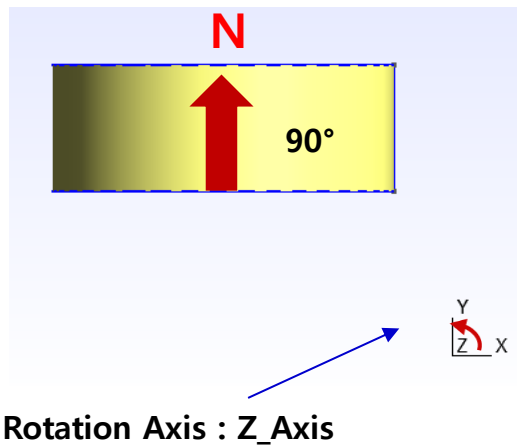


- Rotation Axis : Z\_Axis

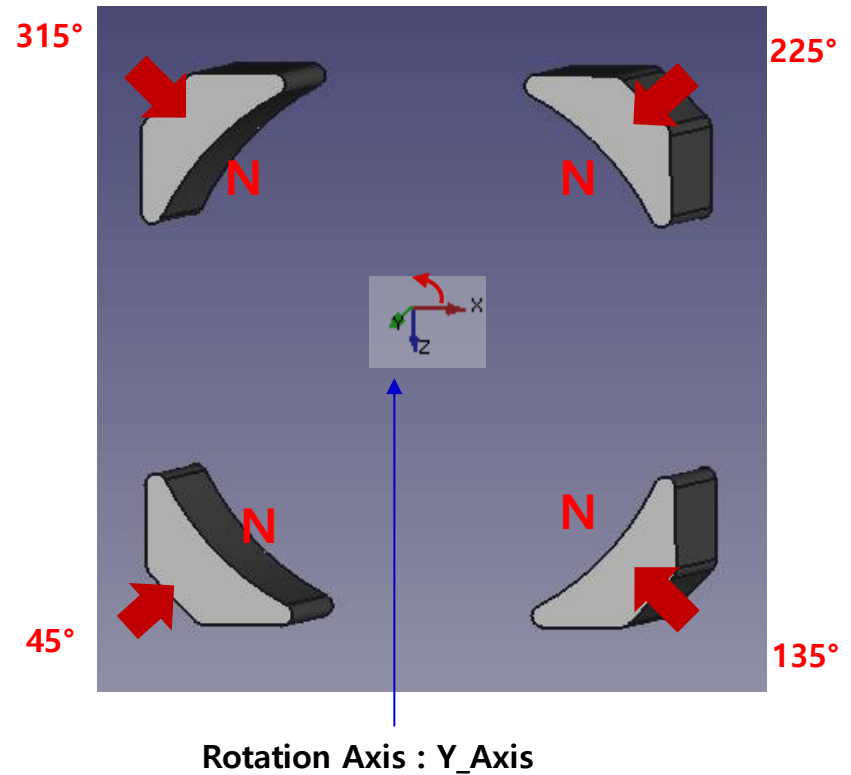


# [Ref.] Magnetization Setting of Magnet

- ✓ Rotation Axis : Z\_Axis
- ✓ Rotation Angle : 90°

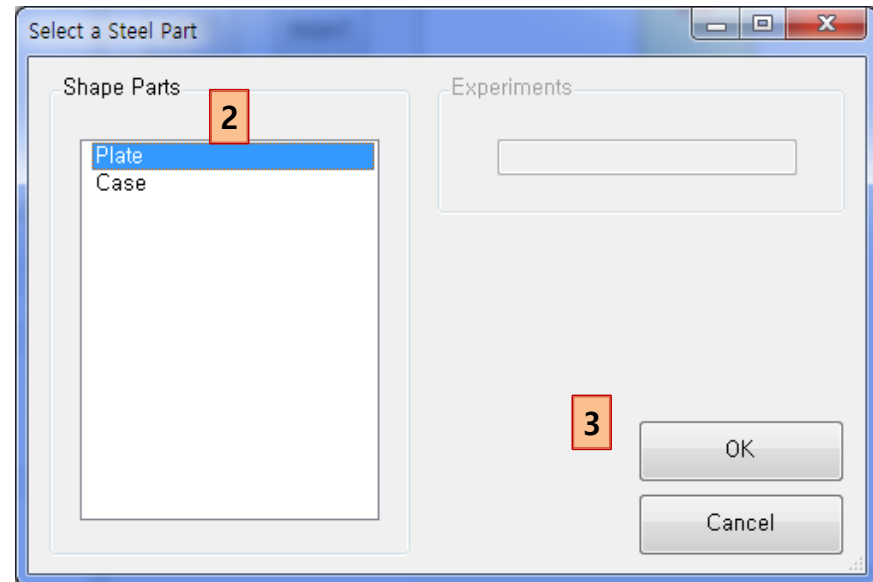
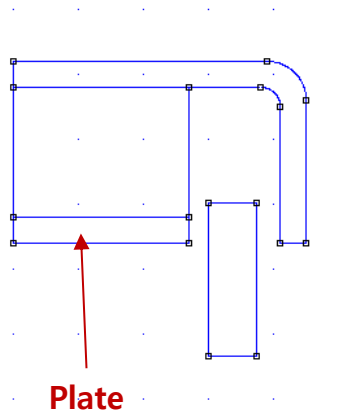
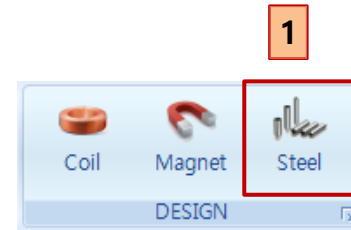


- ✓ Rotation Axis : Y\_Axis
- ✓ Rotation Angle : 45°, 135°, 225°, 315°



# Add a plate

1. Toolbar > Click Steel button
2. Select "Plate" in the list box.
3. Click the OK button.

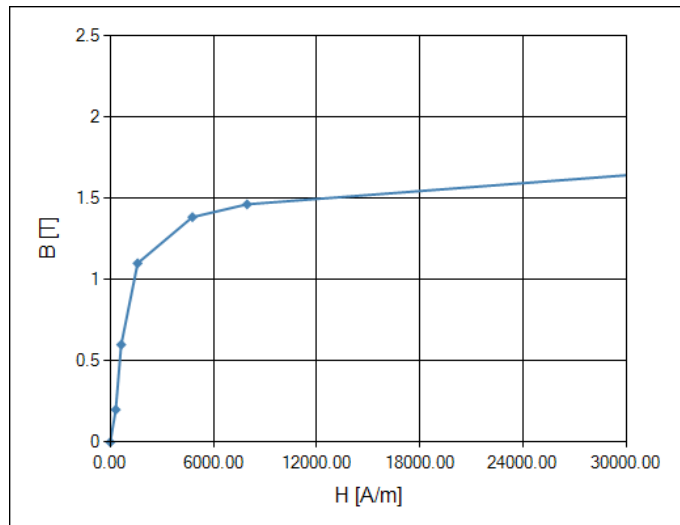


# Plate setting

## 1. Plate settings

✓ Part Material : SUS\_430

[ BH Curve ]

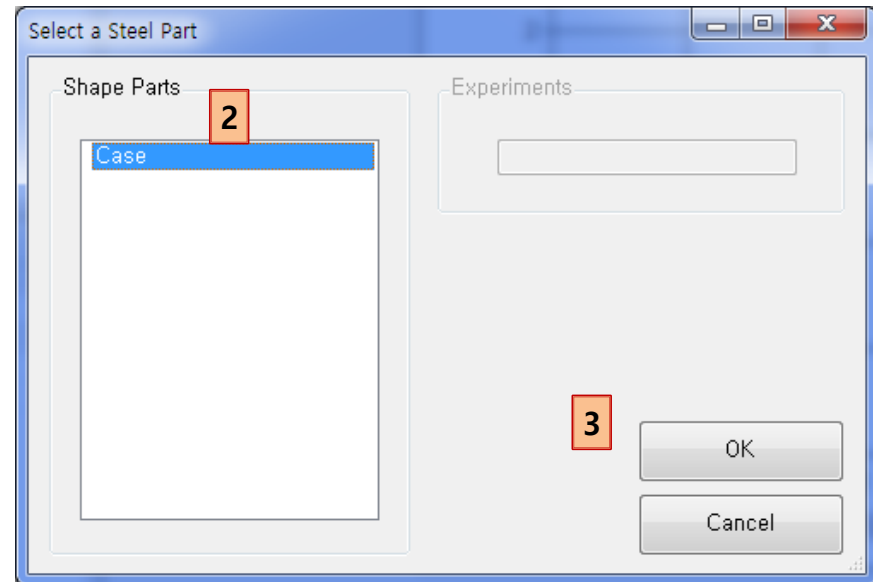
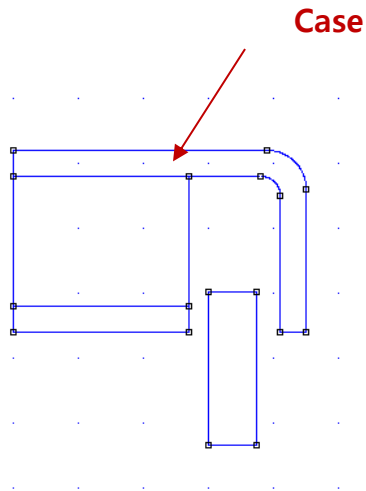
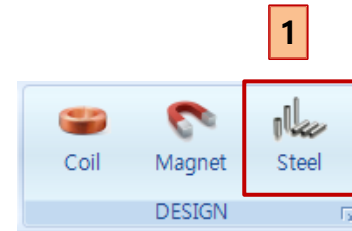


1

|                      |         |
|----------------------|---------|
| Common Fields        |         |
| Node Name            | Plate   |
| Specification Fields |         |
| Part Material        | SUS_430 |
| Moving Parts         | FIXED   |

# Add a case

1. Toolbar > Click Steel button
2. Select "Case" in the list box.
3. Click the OK button.

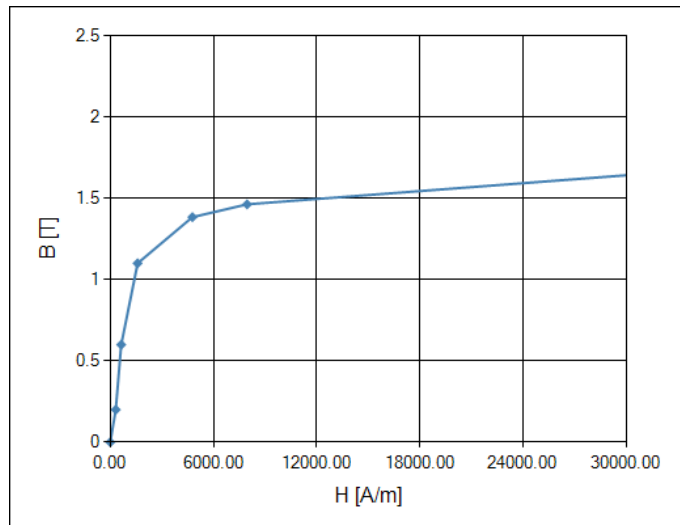


# Case setting

## 1. Case Setting

✓ Part Material : SUS\_430

[ BH Curve ]



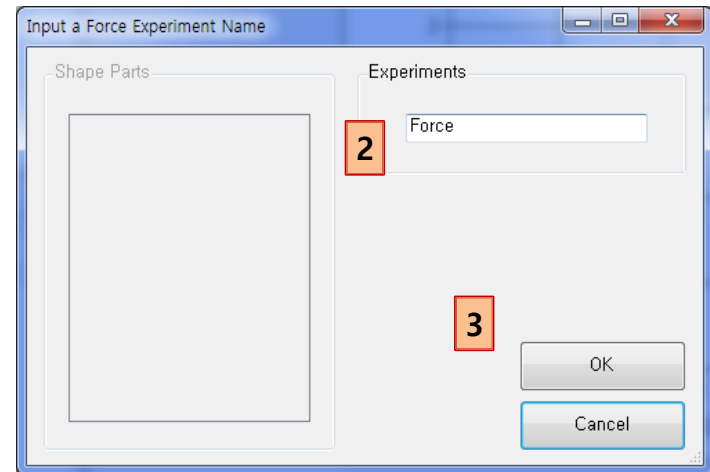
1

| Common Fields        |         |
|----------------------|---------|
| Node Name            | Case    |
| Specification Fields |         |
| Part Material        | SUS_430 |
| Moving Parts         | FIXED   |

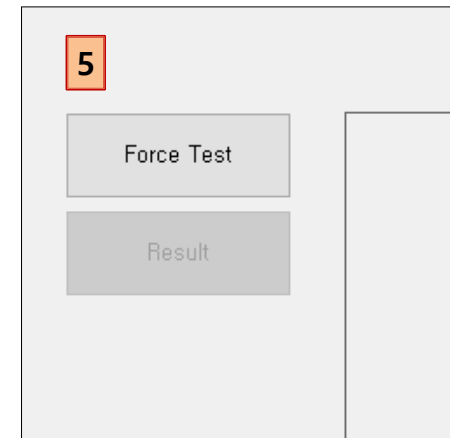
# Virtual Test

# Test of the magnetic force

1. Toolbar > Click Force Button
2. Force Test Name : "Force"
3. Click OK button
4. Setting of magnetic force test
  - ✓ Voltage : 2.5
  - ✓ B Rotation Angle : 45
  - ✓ B Vector Resolution : 80
  - ✓ Mesh Size Percent : 7
  - ✓ Actuator Type : **VCM**
6. Click "Force Test" Button



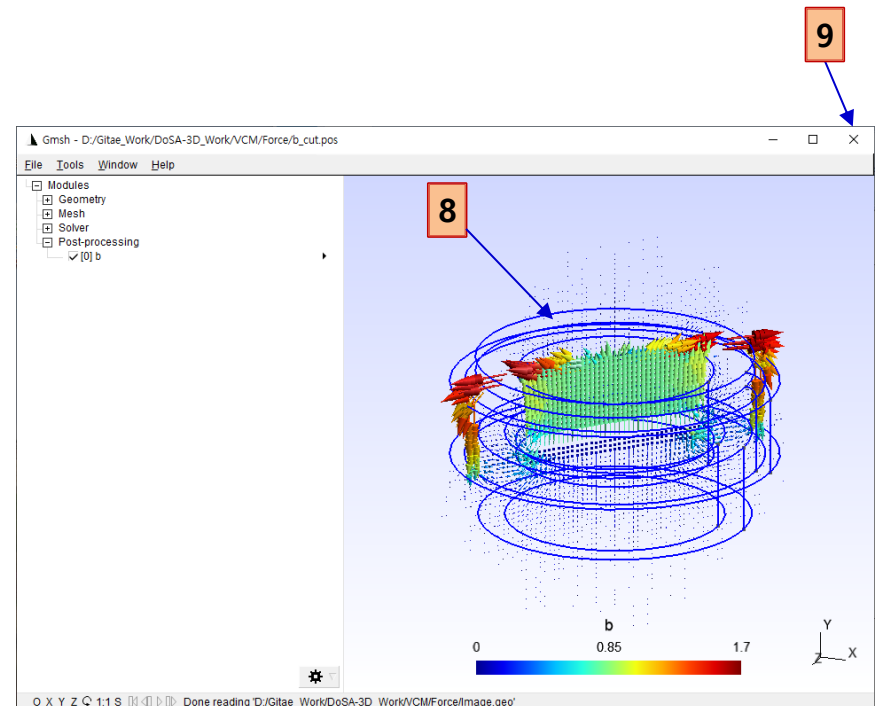
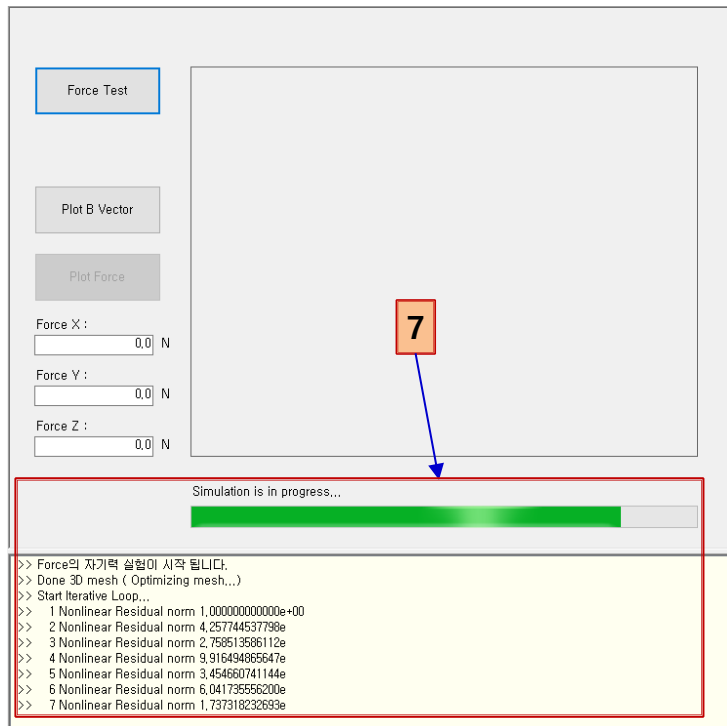
|                           |         |
|---------------------------|---------|
| ▼ Common Fields           |         |
| Node Name                 | Force   |
| ▼ Input Fields            |         |
| Voltage [V]               | 2,5     |
| Max. Current [A]          | 0,15875 |
| ▼ Initial Position Fields |         |
| X Movement [mm]           | 0       |
| Y Movement [mm]           | 0       |
| Z Movement [mm]           | 0       |
| ▼ Post-Processing Fields  |         |
| B Rotation Angle [°]      | 45      |
| B Vector Resolution       | 80      |
| ▼ Condition Fields        |         |
| Mesh Size [%]             | 7       |
| Actuator Type             | VCM     |





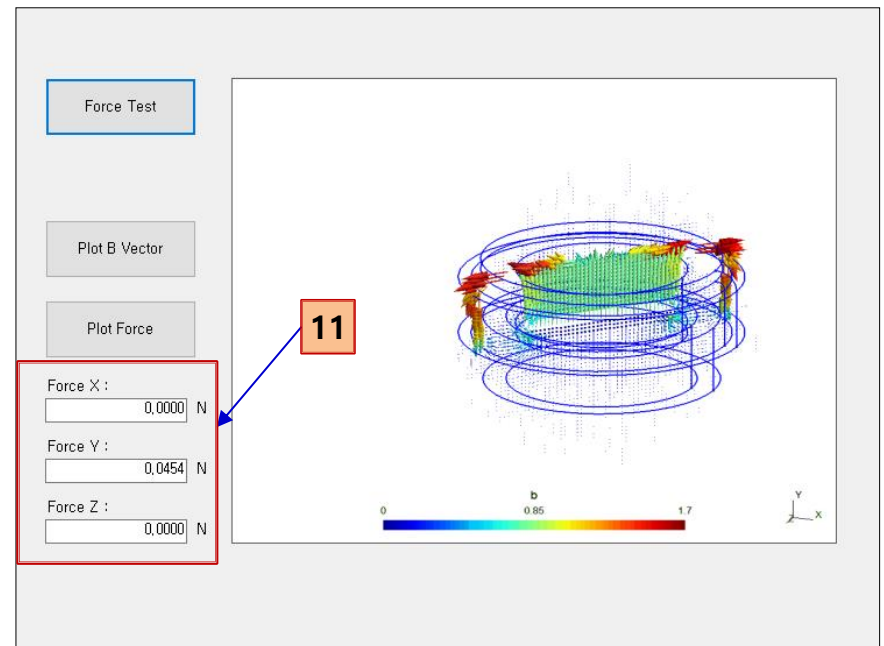
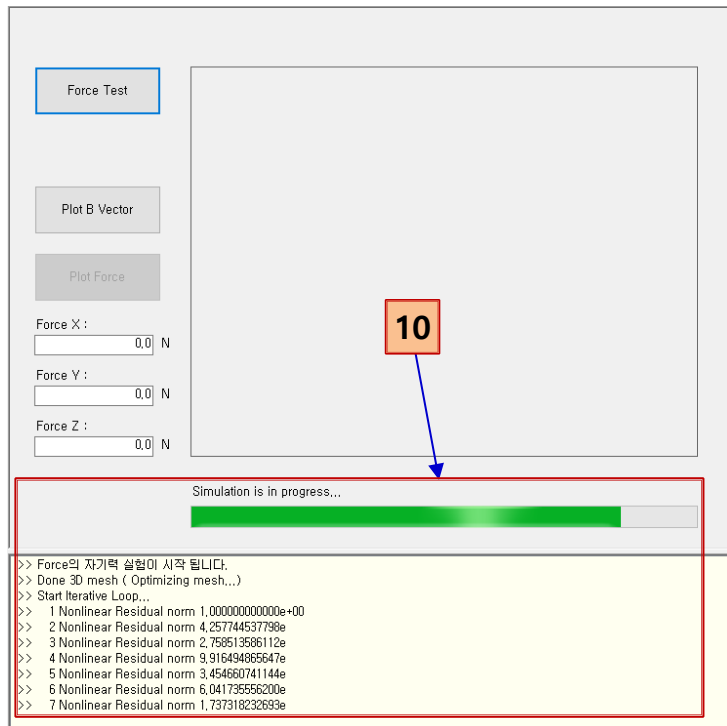
# Run the virtual Test

7. Check the progress of magnetic force analysis.
8. Check the magnetic density after solving. ( The solving time is depend on you system specification )
9. **Quit the Gmsh.**



# Run the virtual Test

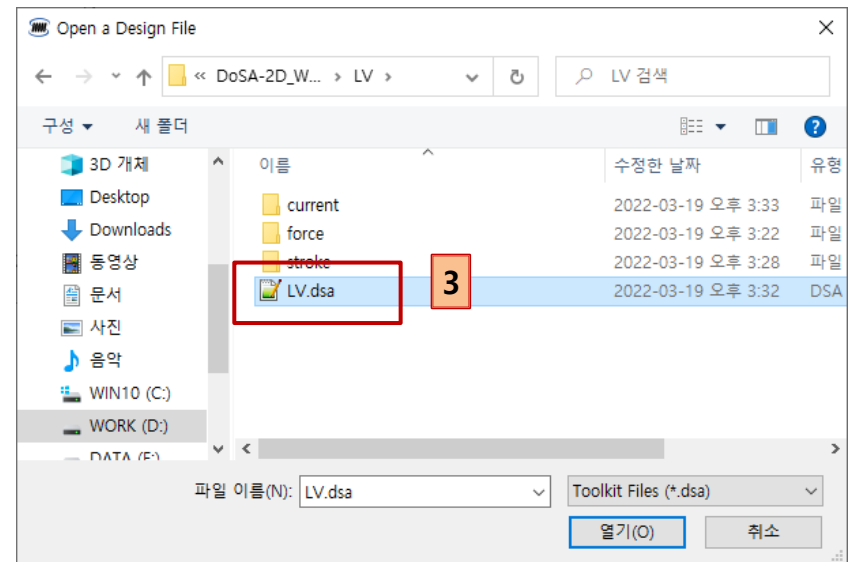
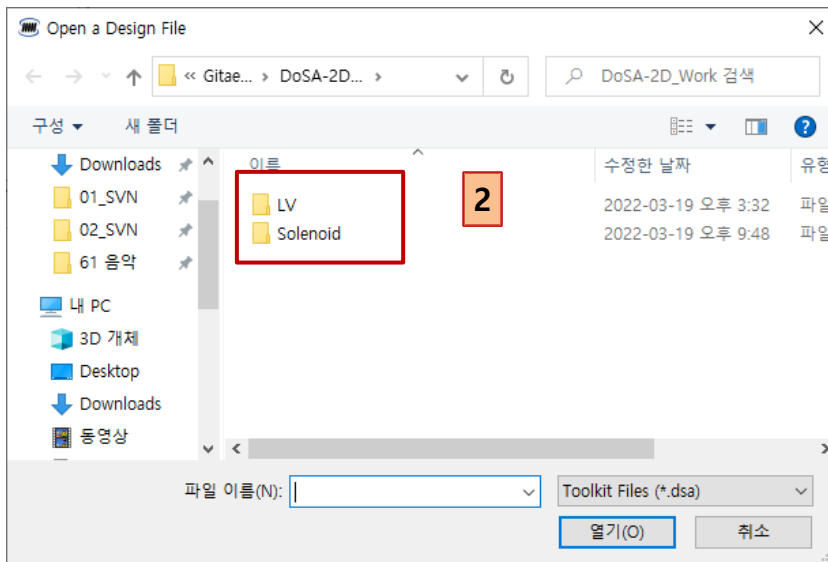
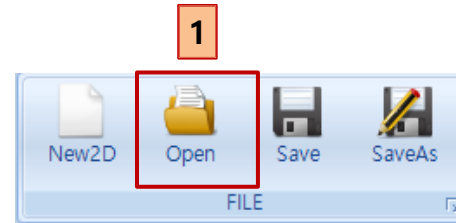
10. In the VCM Type, additional analysis is automatically performed to increase the magnetic force accuracy.
11. Check the magnetic force of the VCM in DoSA-3D.



Tips

# Open Design

1. Toolbar > Click Open Button
2. Double click the design directory.
3. Double click the design file.



# Thank You

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Homepage : <http://openactuator.org>

