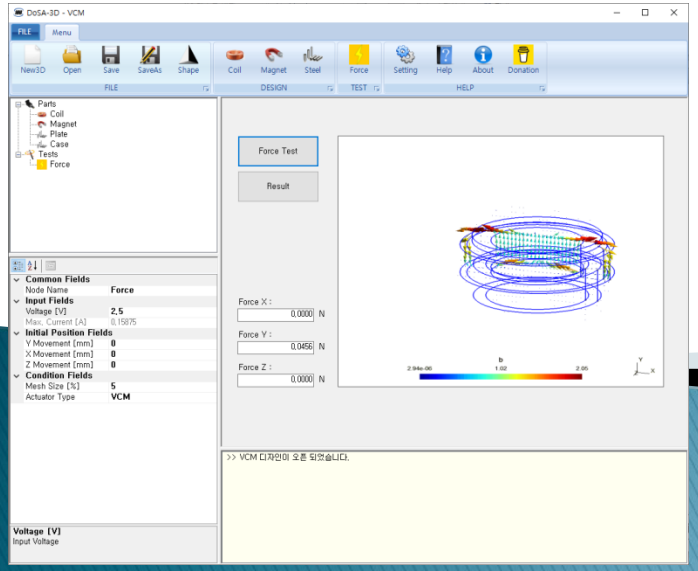
DoSA-3D User Manual

Voice Coil Motor Example

(Speaker, Auto-Focus, Linear Vibrator)



2022-05-28

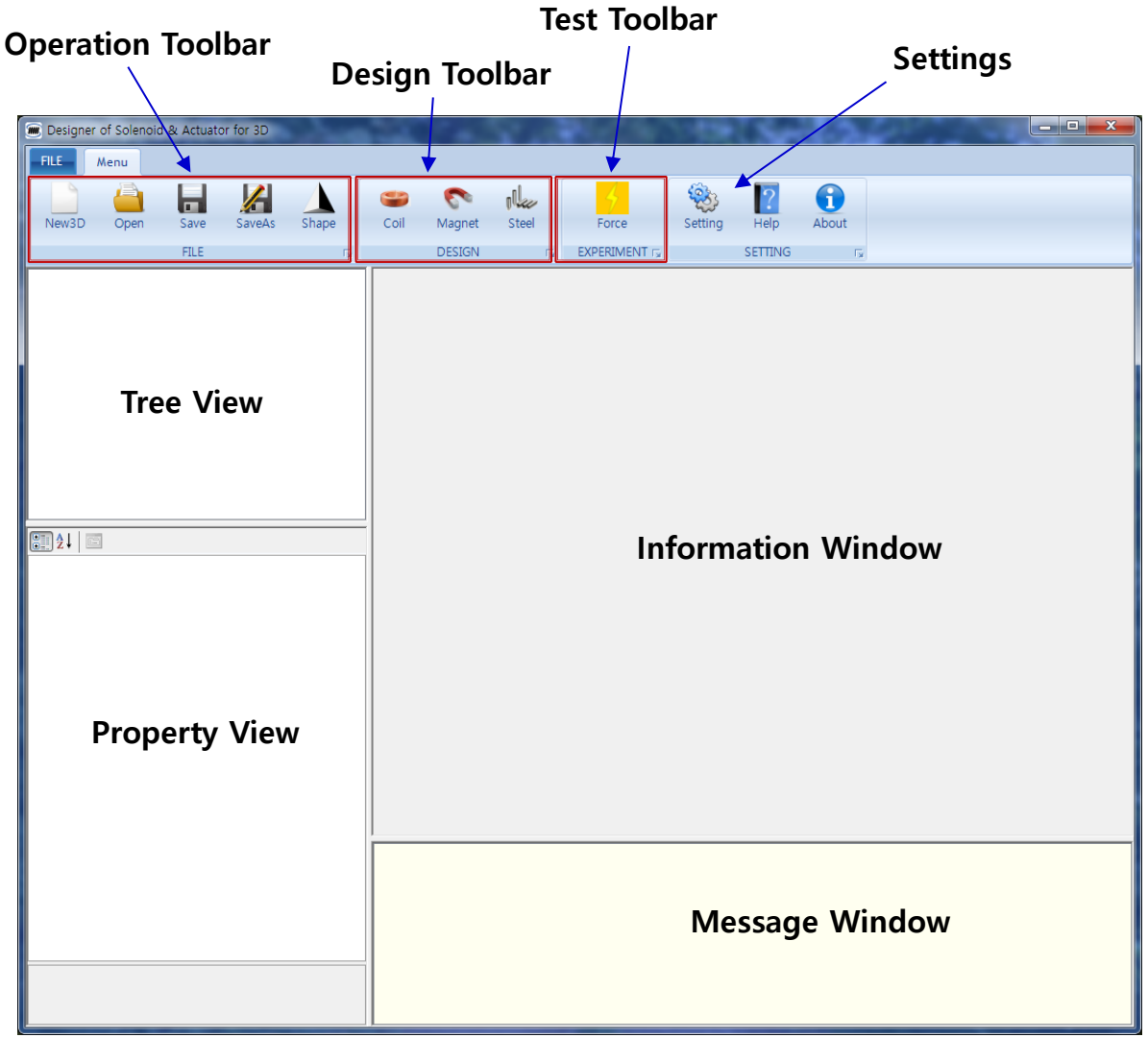
zgitae@gmail.com

DoSA Structure

PC Requirement

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

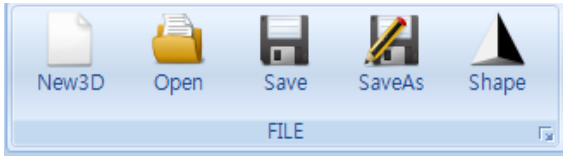
Program Structure



Toolbar

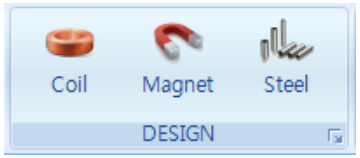
1. Operations

- ✓ 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

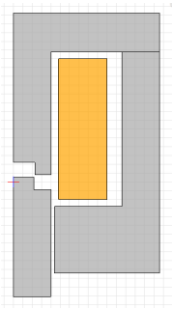
Work process

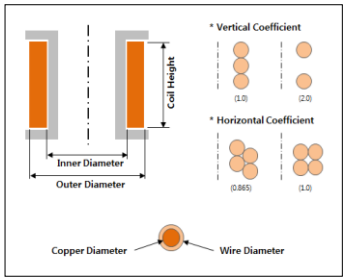
Product Design

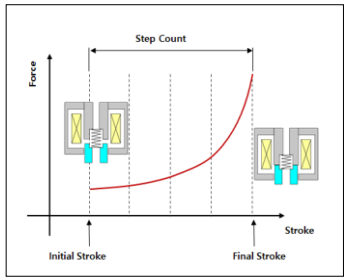
Virtual Test

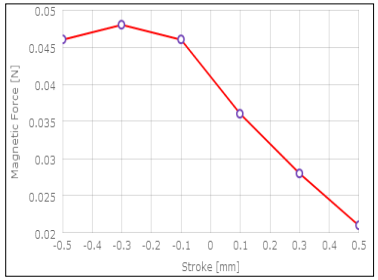
1. Geometry design
2. Part design
3. Test condition
4. Virtual Test (Autorun)
5. Results

Geometry → Components → Test Condition → Virtual Test → Results





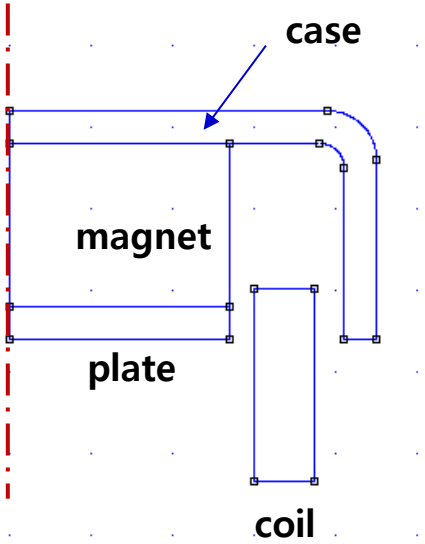


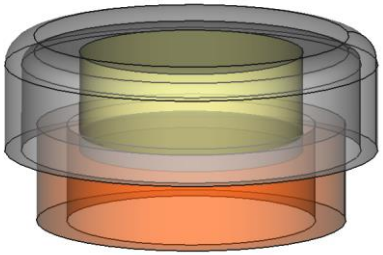


Analysis Model

Analysis Model

1. Shape Model





VCM.step

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)

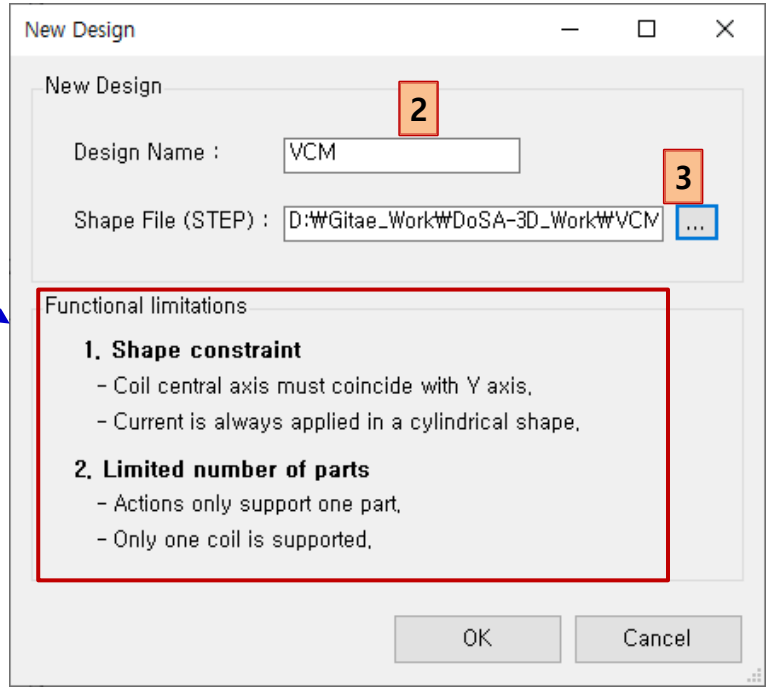
[Cautions for the Shape Model]

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



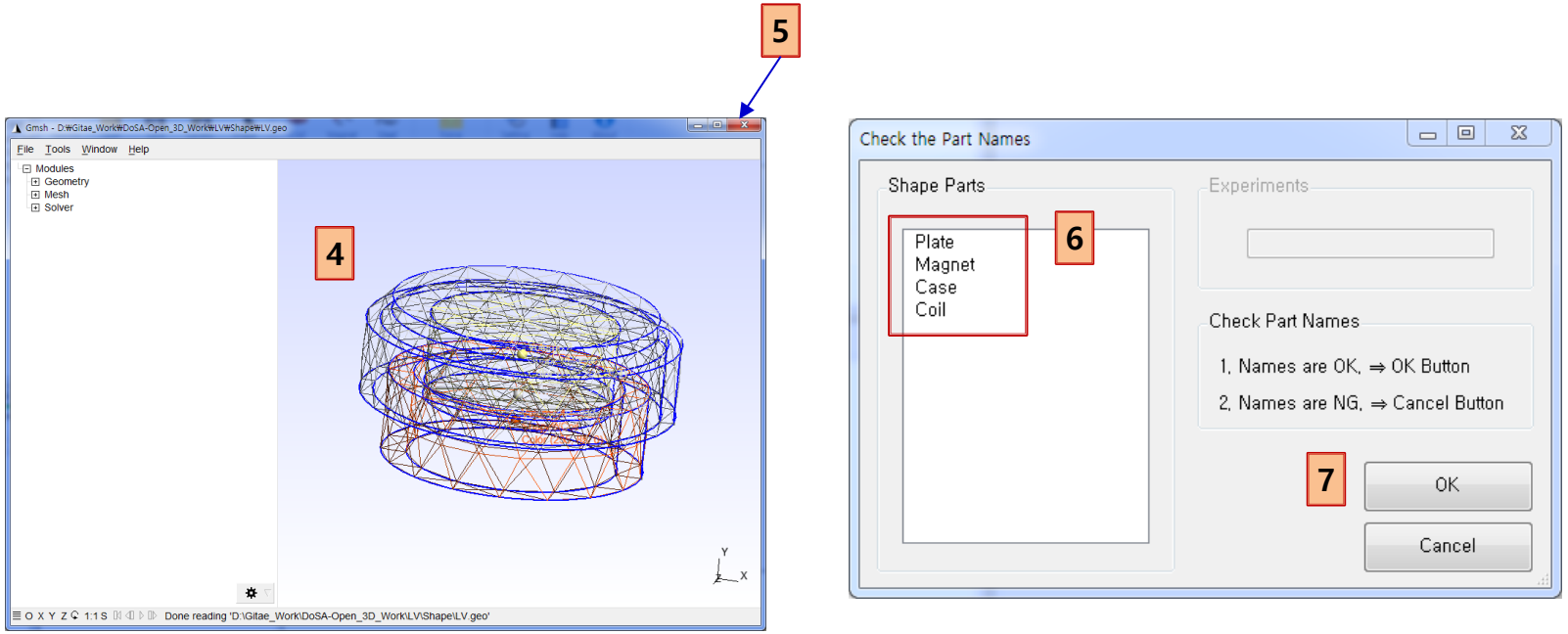
New design

4. Check the solenoid shape in Gmsh.

5. Exit the Gmsh.

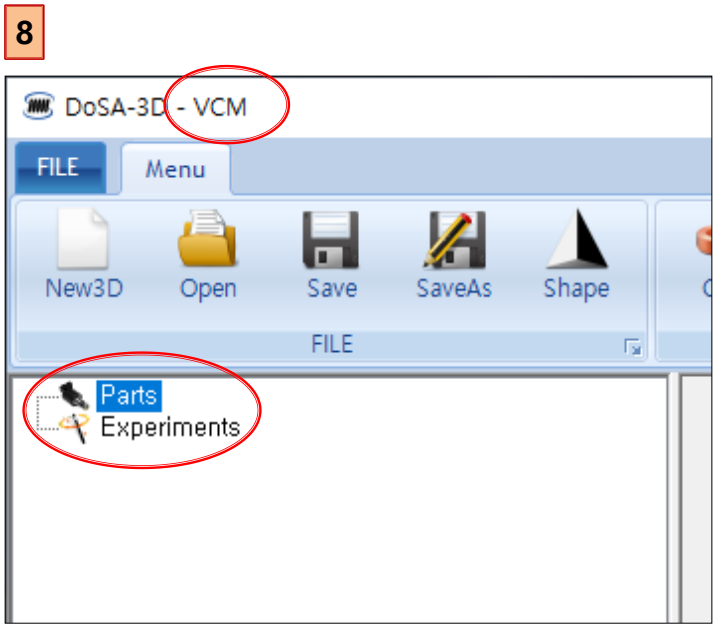
6. Check the part names.

7. Click the OK button if there are no problem with the shape and part names.



New design

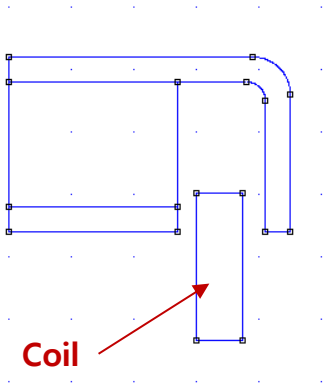
8. Check the design creation.

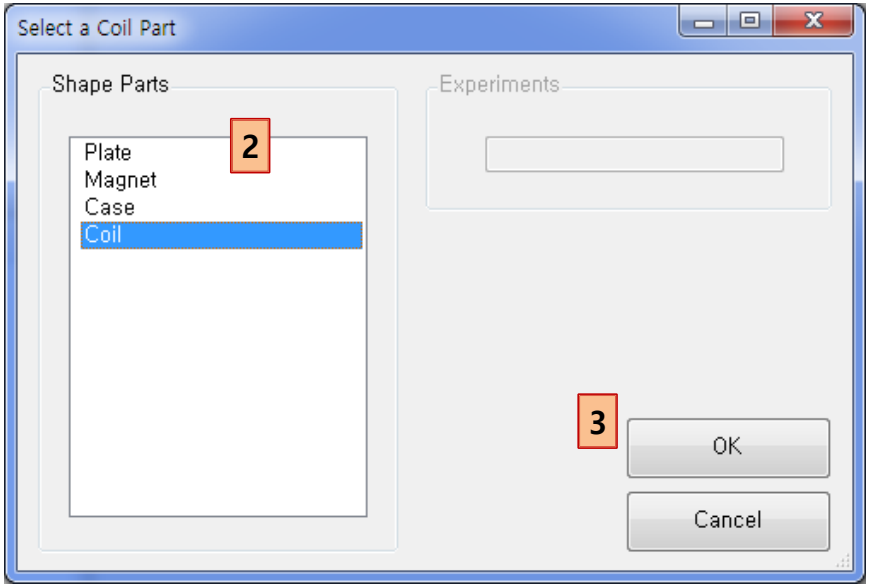


Parts Design

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)

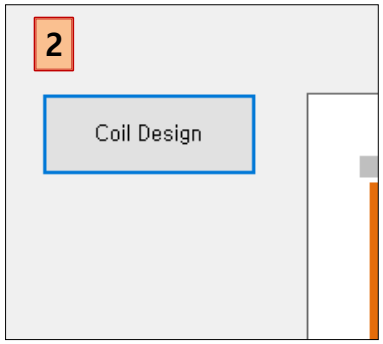
2. Calculate the coil specification
   - ✓ Click the "Coil Design" button

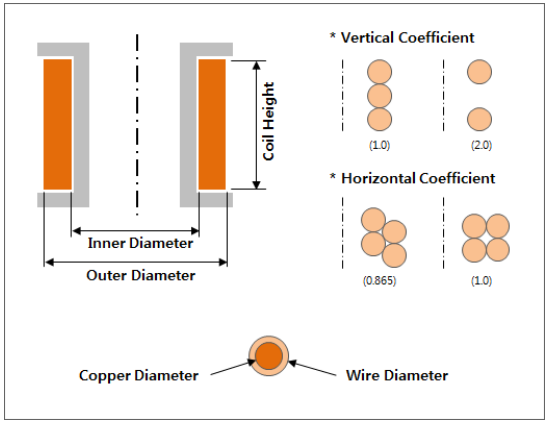
3. Check the coil specification

Common Fields	
Node Name	**Coil**
Specification Fields	
Part Material	**Copper**
Curent Direction	**IN**
Moving Parts	**MOVING**
Calculated Fields	
Coil Turns	**126**
Coil Resistance [Ω]	**15.74769**
Coil Layers	6
Turns of One Layer	21
Design Fields (optional)	
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 [℃]	**20**
Horizontal Coefficient	**0.95**
Vertical Coefficient	**1.13**
Resistance Coefficient	**1.1**

1

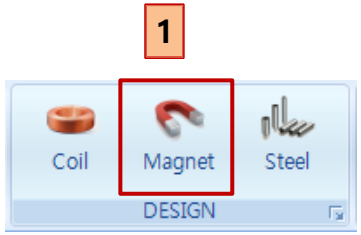
3

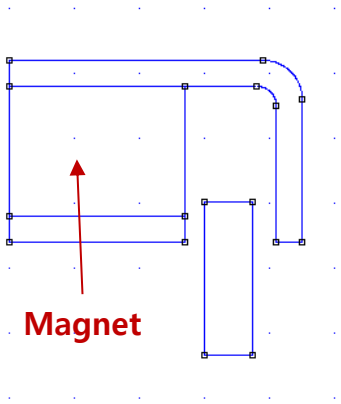


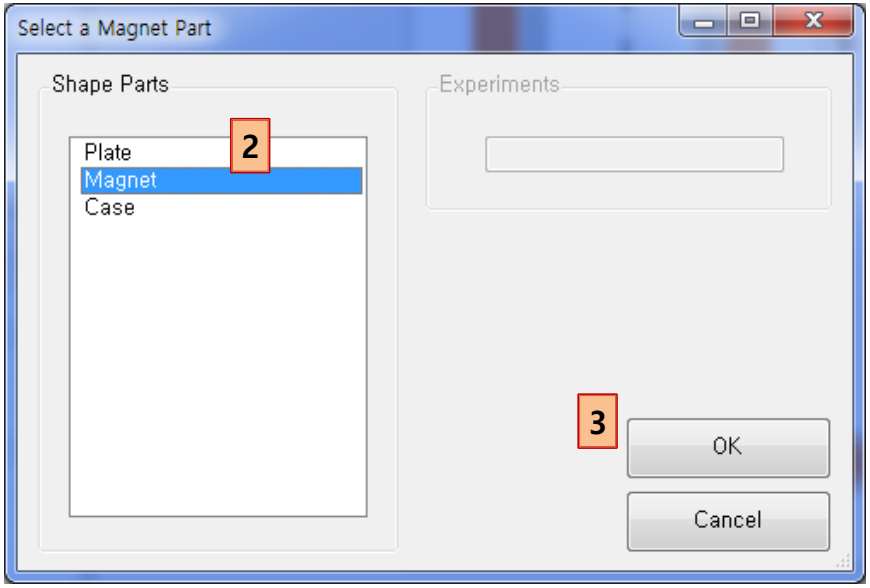


Add a magnet

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





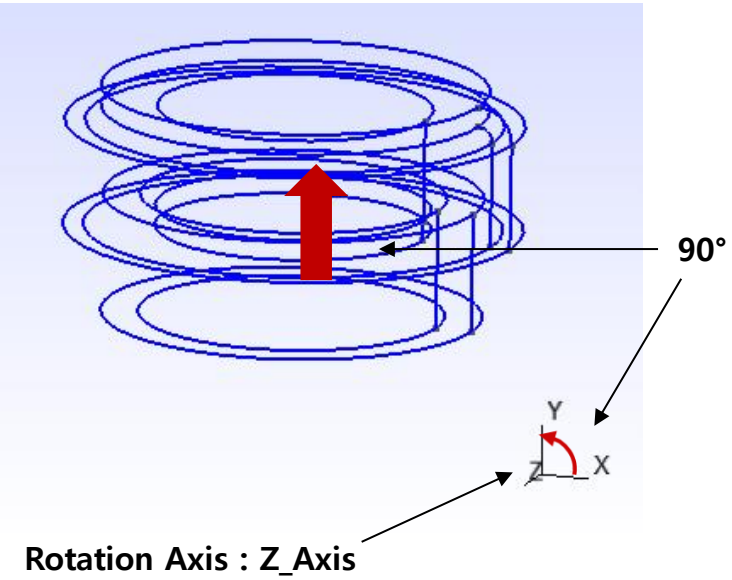


Magnet setting

1. Magnet Settings
   - ✓ Use default values

1

Common Fields	
Node Name	**Magnet**
Specification Fields	
Part Material	**NdFeB_40**
Hc	969969
Br	1.26497
Moving Parts	**FIXED**
Magnetization Fields	
Rotation Axis	**Z_AXIS**
Rotation Angle	**90**



[Ref.] Magnet magnetization

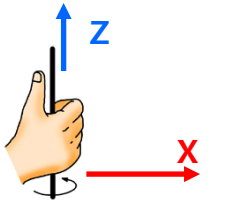
1. Understanding magnet magnetization direction

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

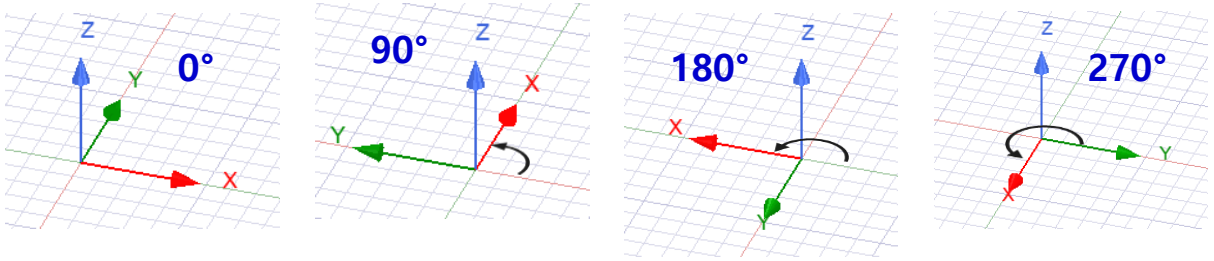
Magnetization Fields	
Rotation Axis	Z_AXIS
Rotation Angle	90

2. Magnetization direction setting

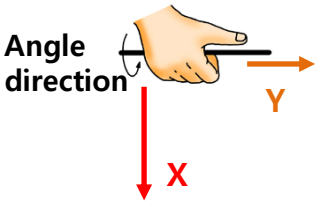
- **Rotation Axis : Z_Axis**

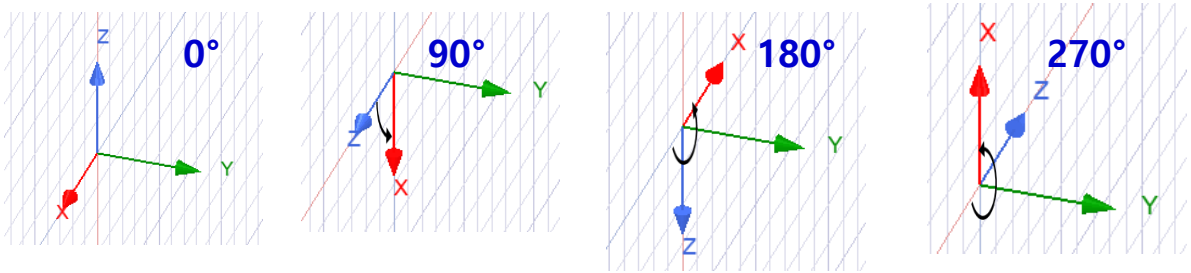


Angle direction



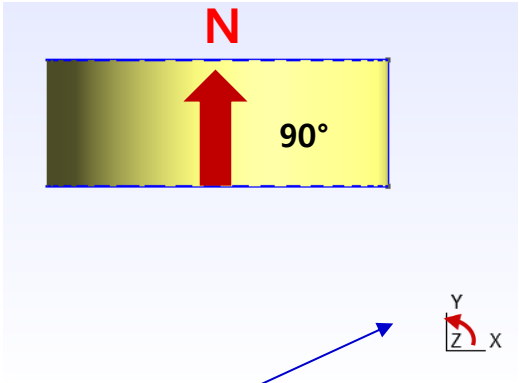
- **Rotation Axis : Y_Axis**





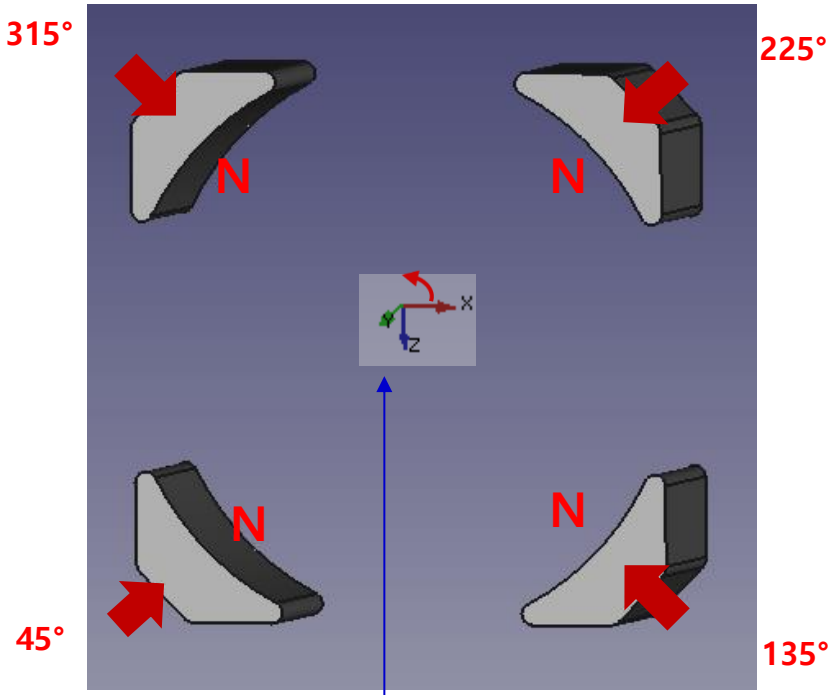
[Ref.] Magnetization Setting of Magnet

- ✓ Rotation Axis : Z_Axis
- ✓ Rotation Angle : 90



Rotation Axis : Z_Axis

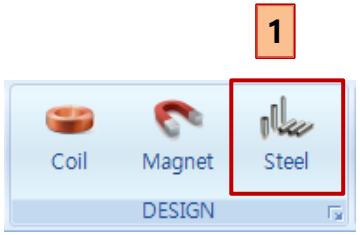
- ✓ Rotation Axis : Y_Axis
- ✓ Rotation Angle : 45°, 135°, 225°, 315°

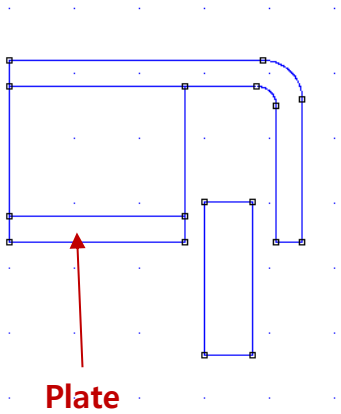


Rotation Axis : Y_Axis

Add a plate

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





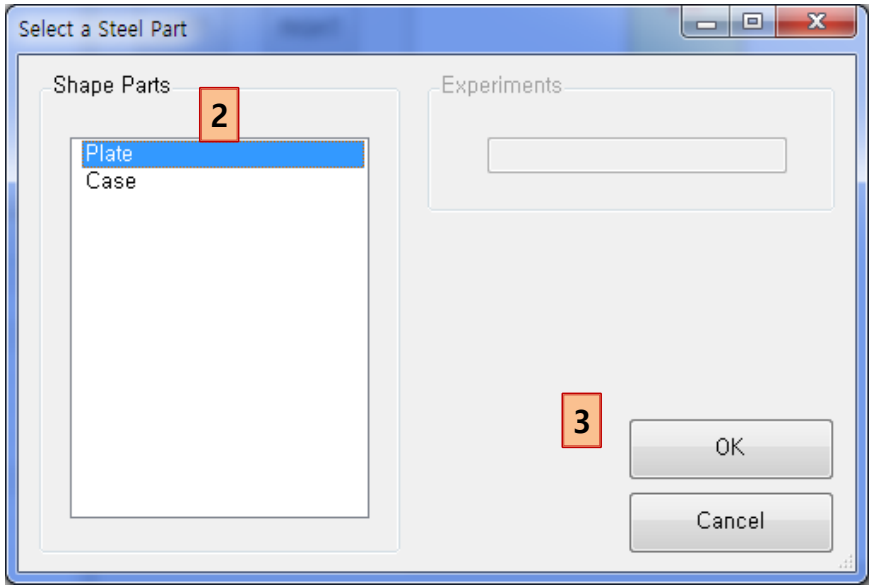
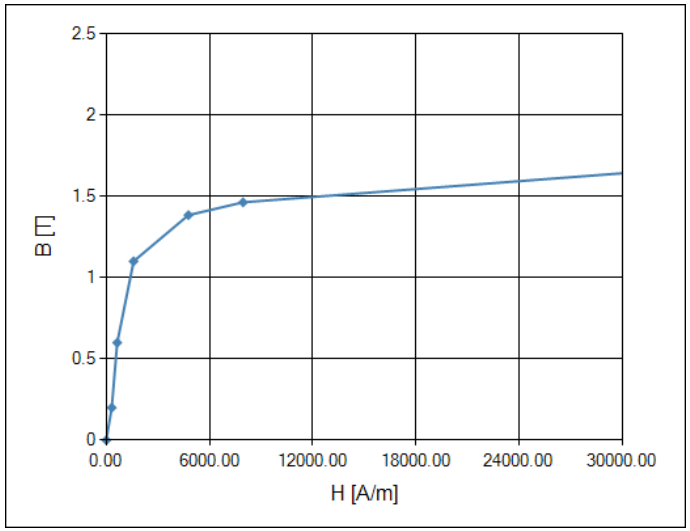


Plate setting

1. Plate settings

   ✓ Part Material : SUS_430

[BH Curve]

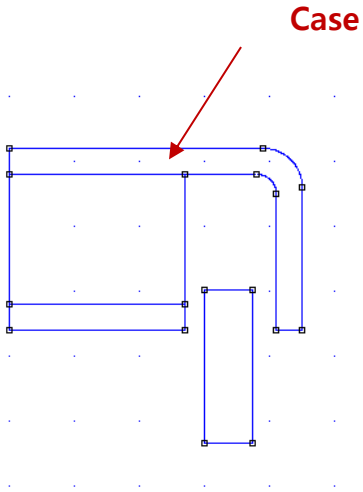


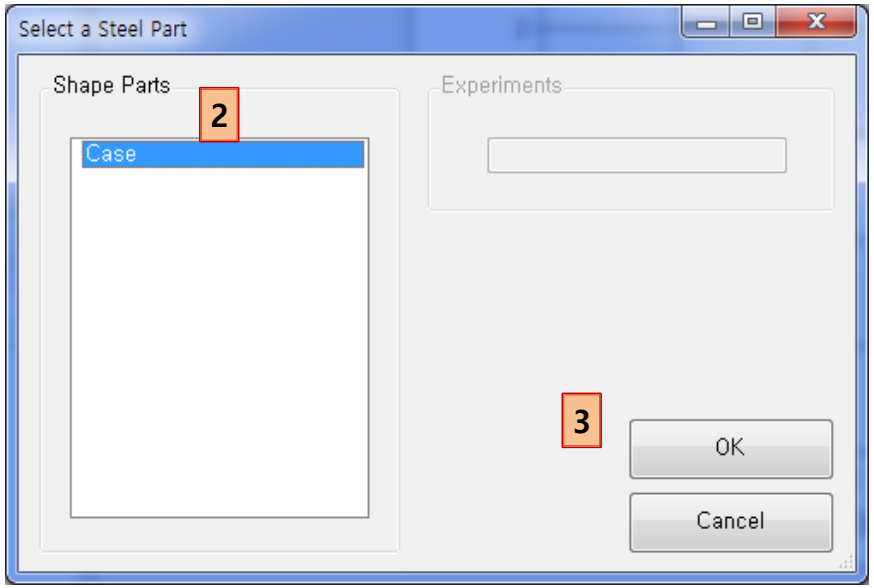
1

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.



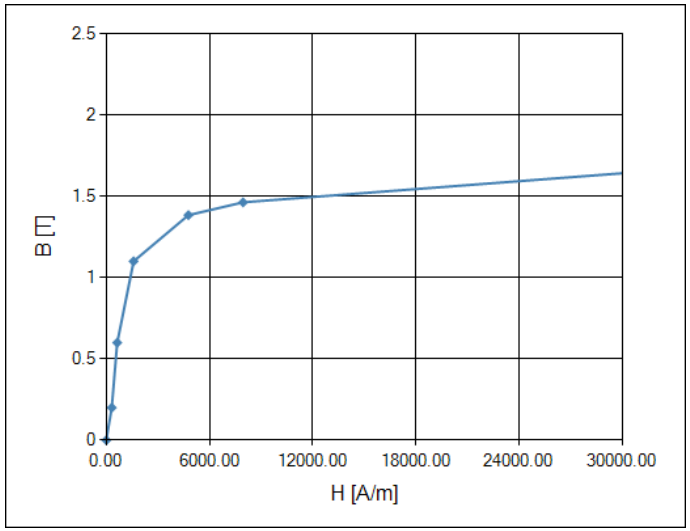


Case setting

1. Case Setting

   ✓ Part Material : SUS_430

[BH Curve]



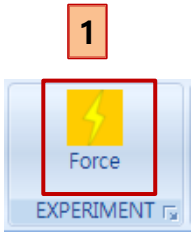
1

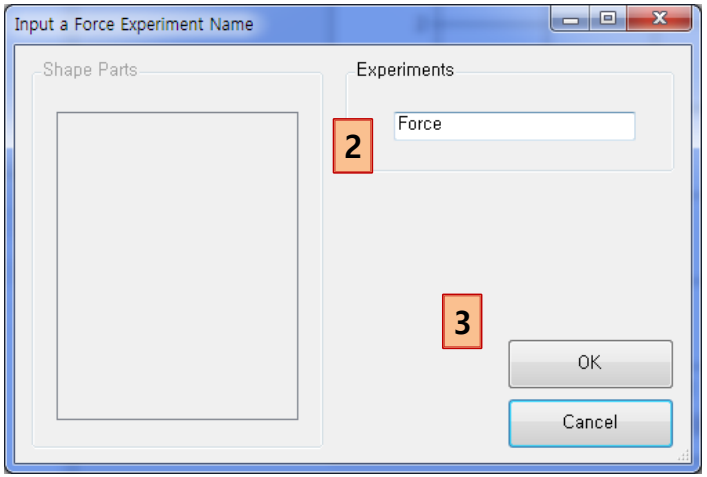
Common Fields	
Node Name	Case
Specification Fields	
Part Material	SUS_430
Moving Parts	FIXED

Virtual Test

Test of the magnetic force

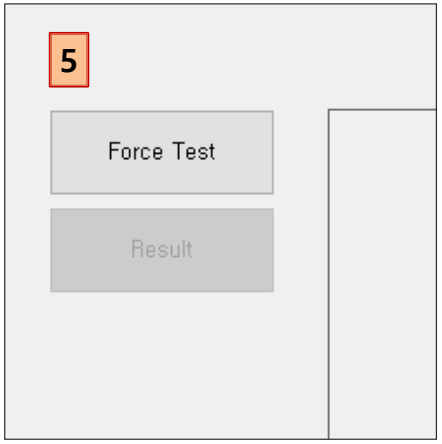
1. Toolbar > Click Force Button
2. Force Test Name : "Force"
3. Click OK button
4. Setting of magnetic force test
   - ✓ Voltage : 2.5
   - ✓ B Rotation Angle : 45
   - ✓ B Vector Resolution : 80
   - ✓ Mesh Size Percent : 5
   - ✓ Actuator Type : **VCM**
6. Click "Force Test" Button





Common Fields	
Node Name	**Force**
Input Fields	
Voltage [V]	**2.5**
Max. Current [A]	0.15875
Initial Position Fields	
Y Movement [mm]	**0**
X Movement [mm]	**0**
Z Movement [mm]	**0**
Post-Processing Fields	
B Rotation Angle [°]	**45**
B Vector Resolution	**80**
Condition Fields	
Mesh Size [%]	**5**
Actuator Type	**VCM**

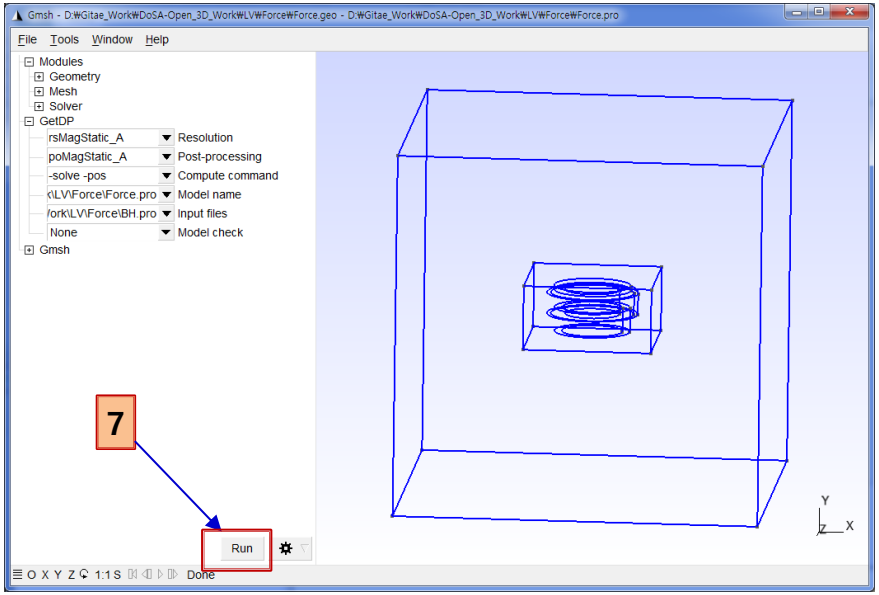
4

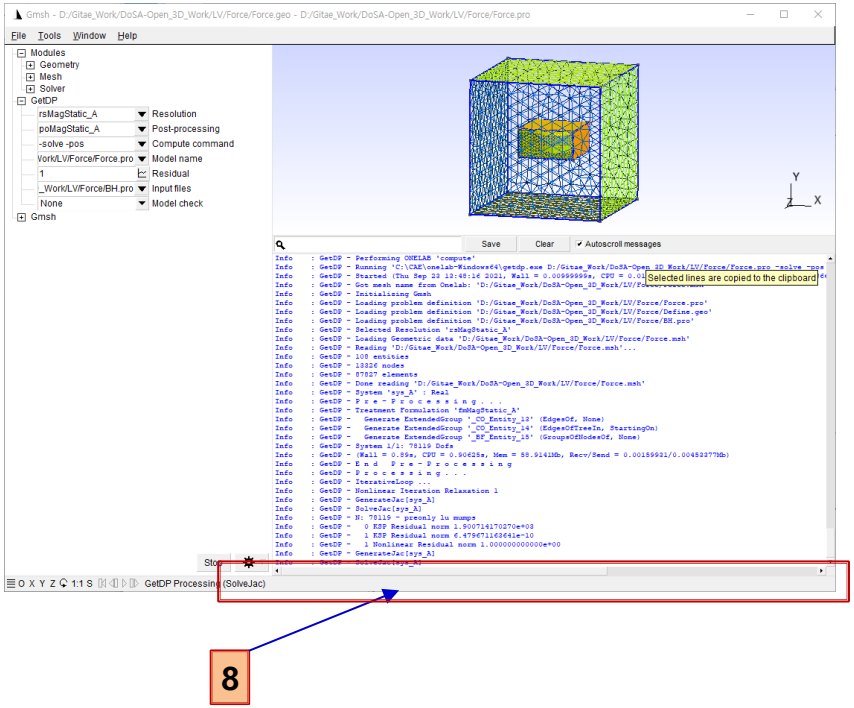


Run the virtual Test

7. Click the Run button after checking the shape.

8. If you want to see the analysis progress, click the status bar of the Gmsh.



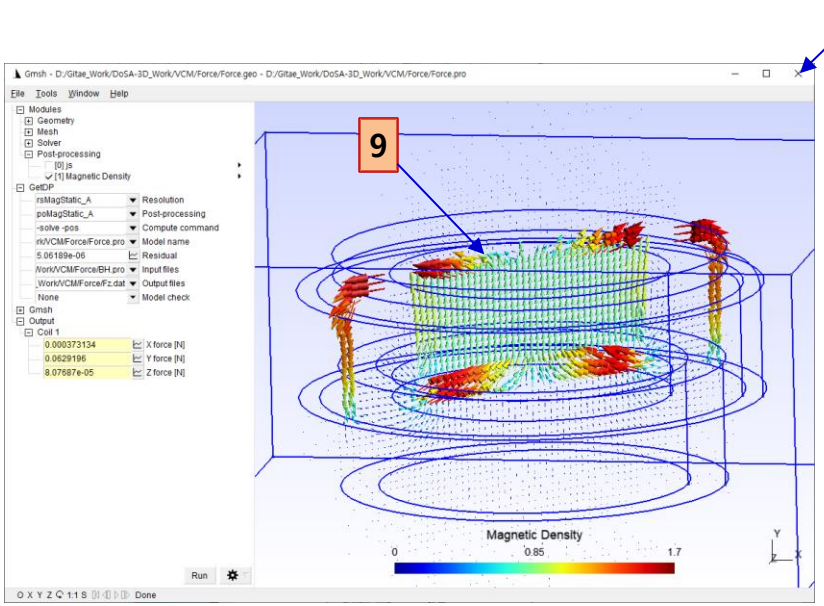


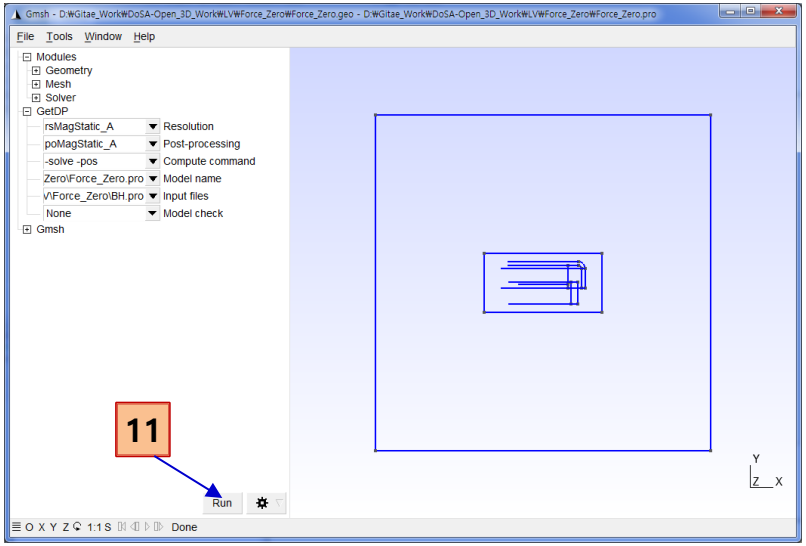
Run the virtual Test

9. Check the magnetic density after solving. (The solving time is depend on you system specification)

10. **Quit the Gmsh.** (When finished, Gmsh is automatically restarted)

11. Click the run button again. (**VCM type actuators require twice analysis for accuracy**)

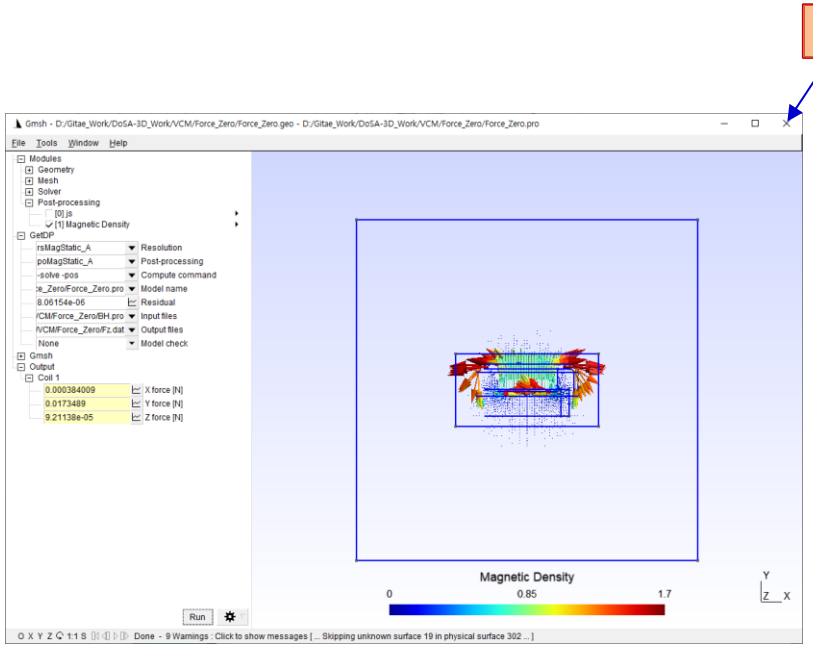


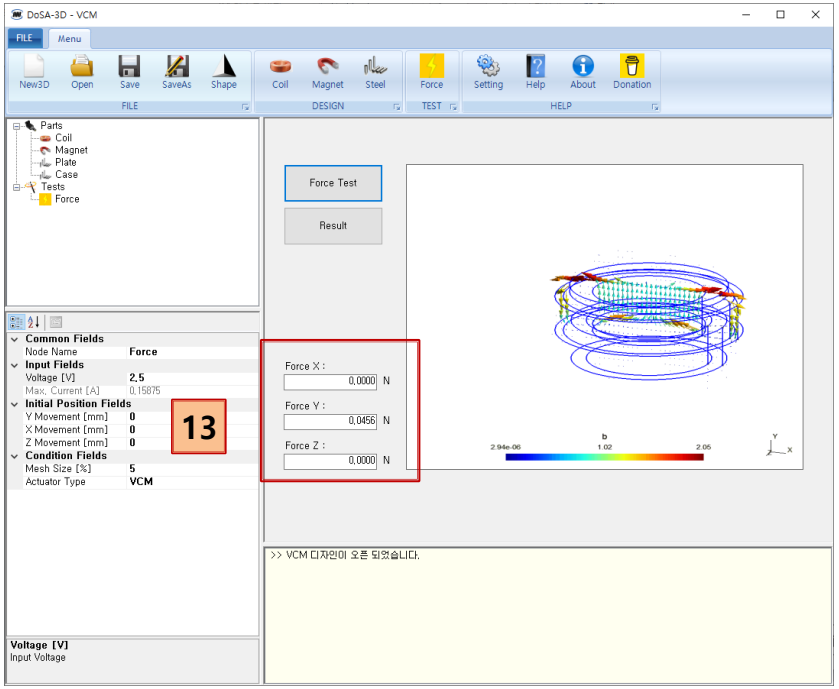


Results of the virtual Test

12. Quit the re-run Gmsh.

13. Check the magnetic force of the VCM in DoSA-3D.

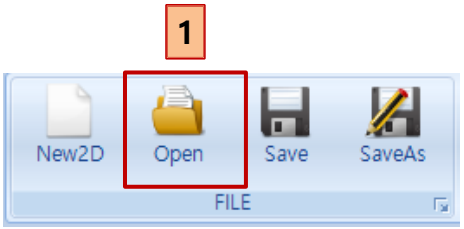


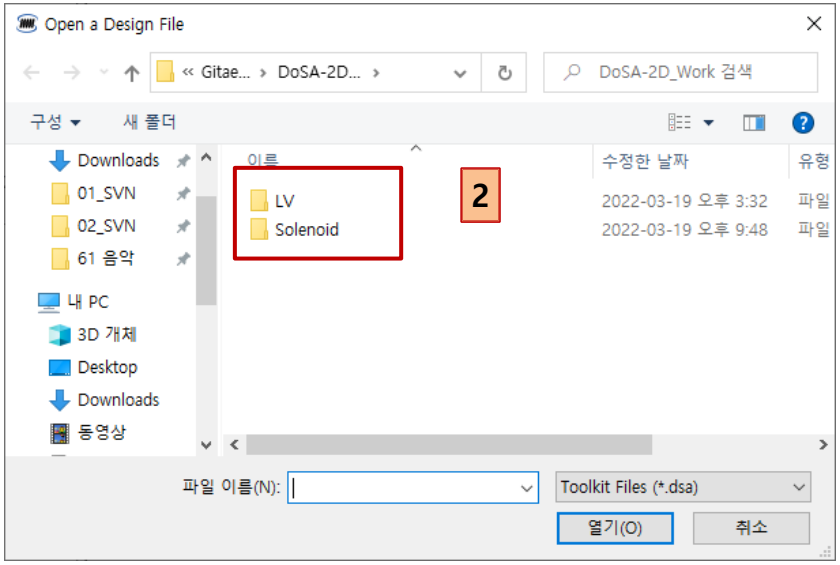


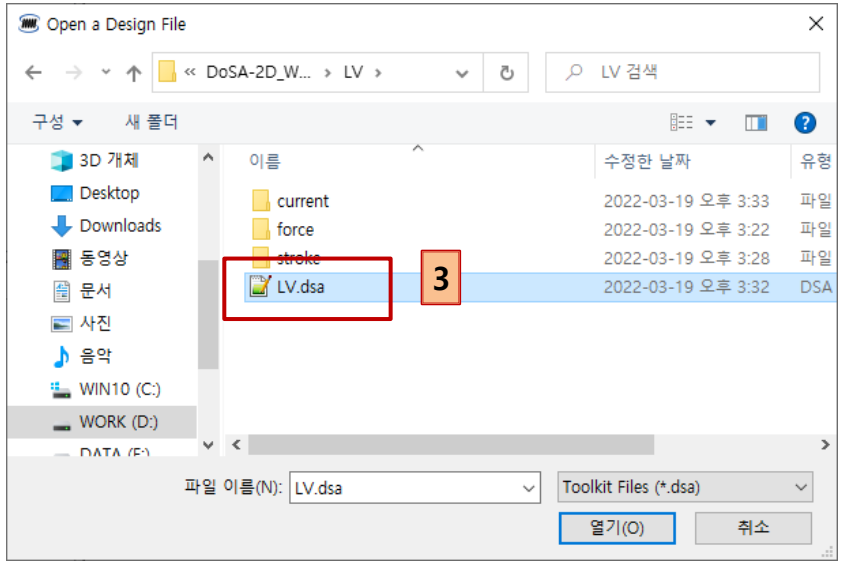
Tips

Open Design

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







Thank You

Email : zgitae@gmail.com
Homepage : http://openactuator.org