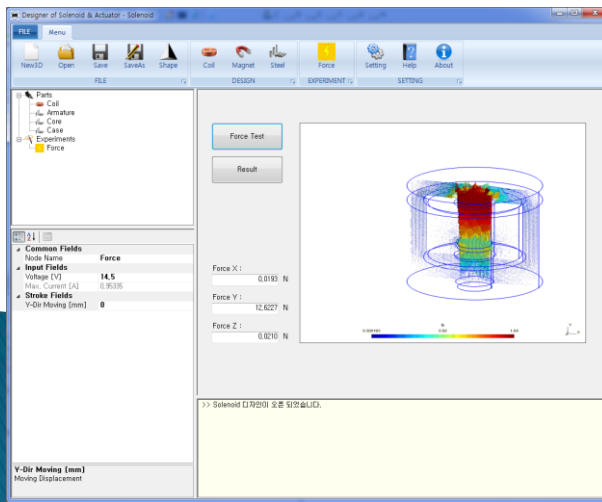


DoSA-3D User Manual

Solenoid Example



2022-06-05

zgitae@gmail.com

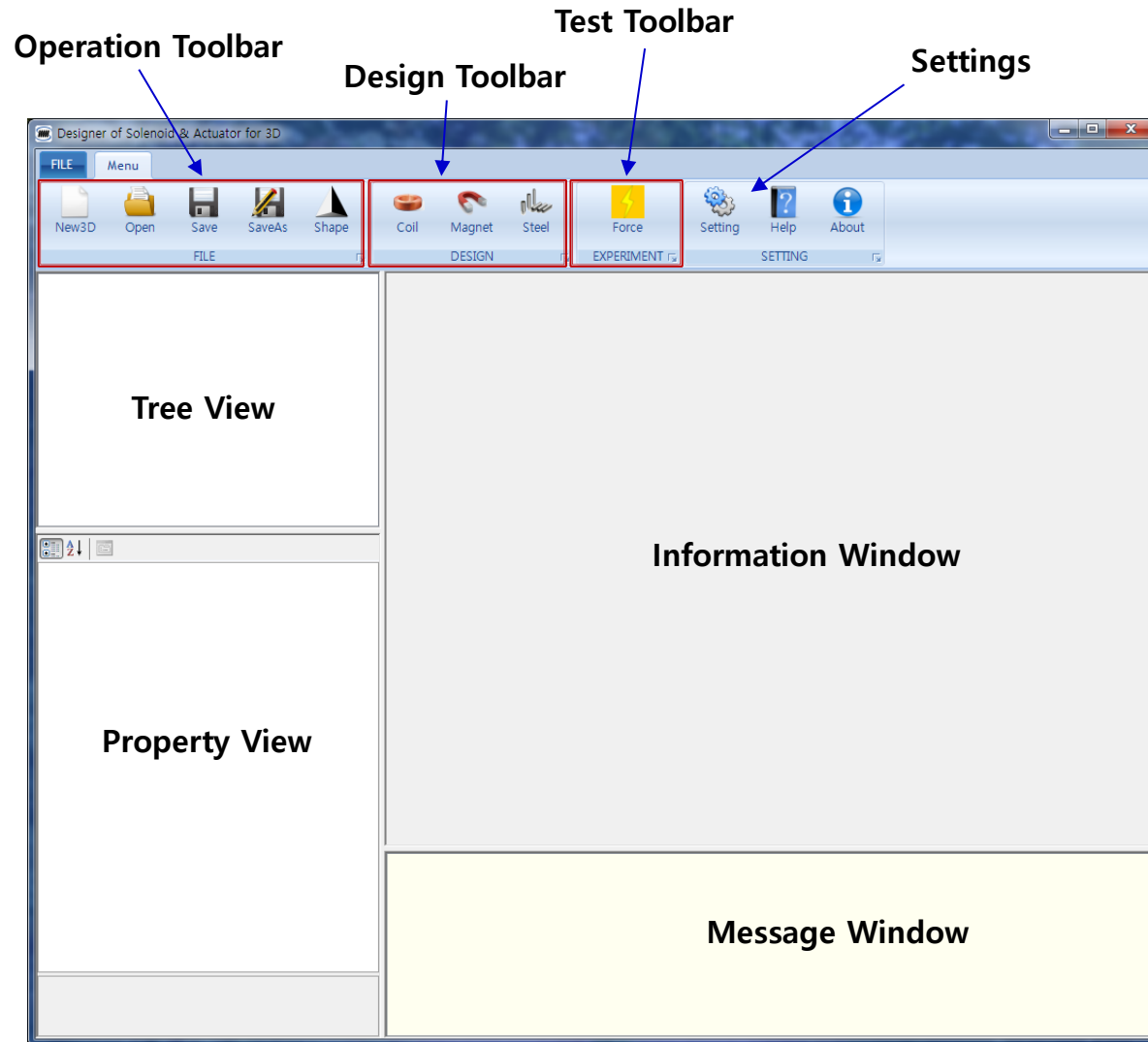
DoSA Structure

PC Requirement

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



Program Structure



Toolbar

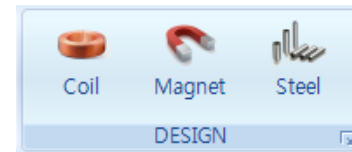
1. Operations

- ✓ 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

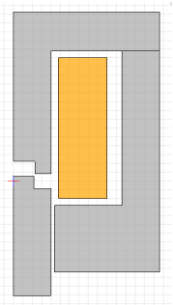


Work process

Product Design

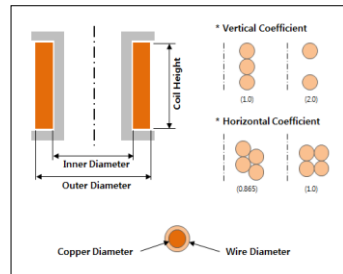
1. Geometry design

Geometry



2. Part design

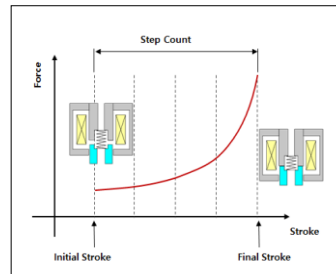
Components



Virtual Test

3. Test condition

Test Condition

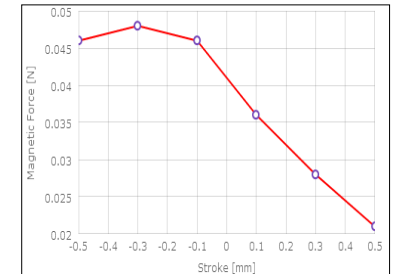


4. Virtual Test (Autorun)

Virtual Test

5. Results

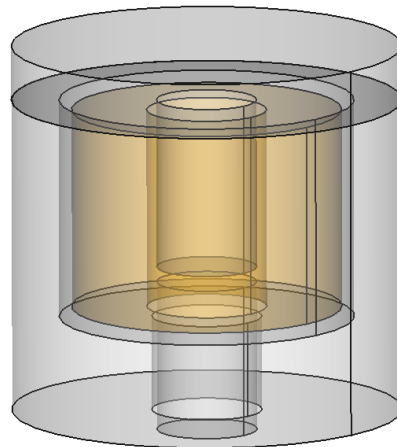
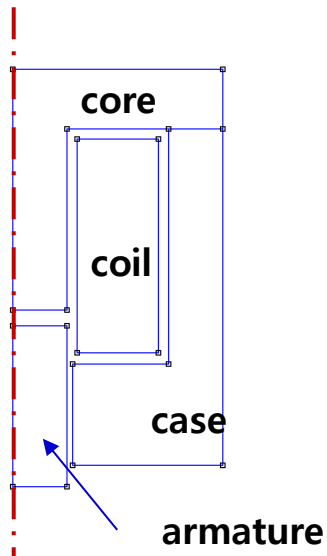
Results



Analysis Model

Analysis Model

1. Model Shape



Solenoid.step

2. Product Specifications

A. Coil Turns

- Coil Turns : 1040 turns
- Coil Resistance : 15.2 Ohm

B. Power

- Voltage : 14.5V

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

New design

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



[Cautions for the Shape Model]

DoSA-3D still has the following functional limitations.

A. Shape constraint

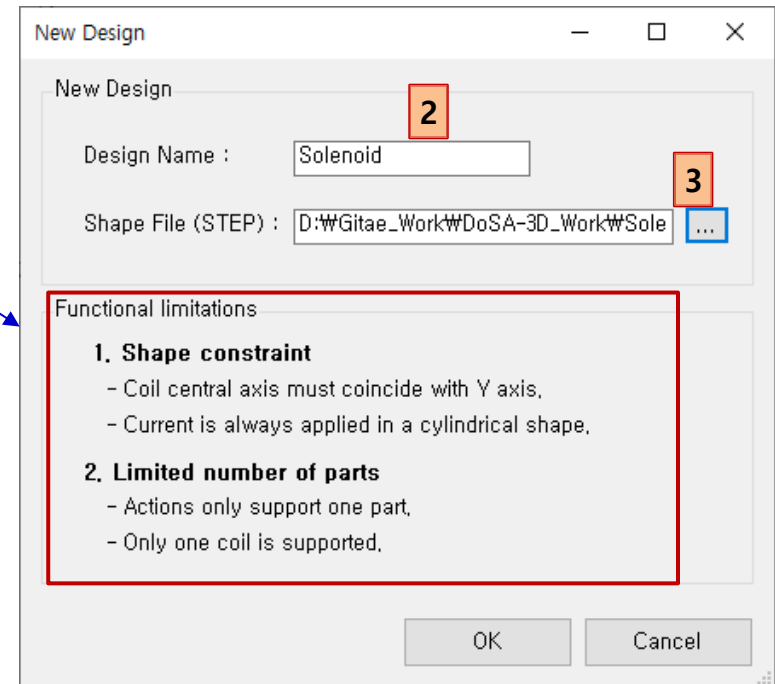
- Coil central axis must coincide with Y axis.
- The current is always applied in cylindrical form.
(Polygon coils can cause some differences)

B. Limited number of parts

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

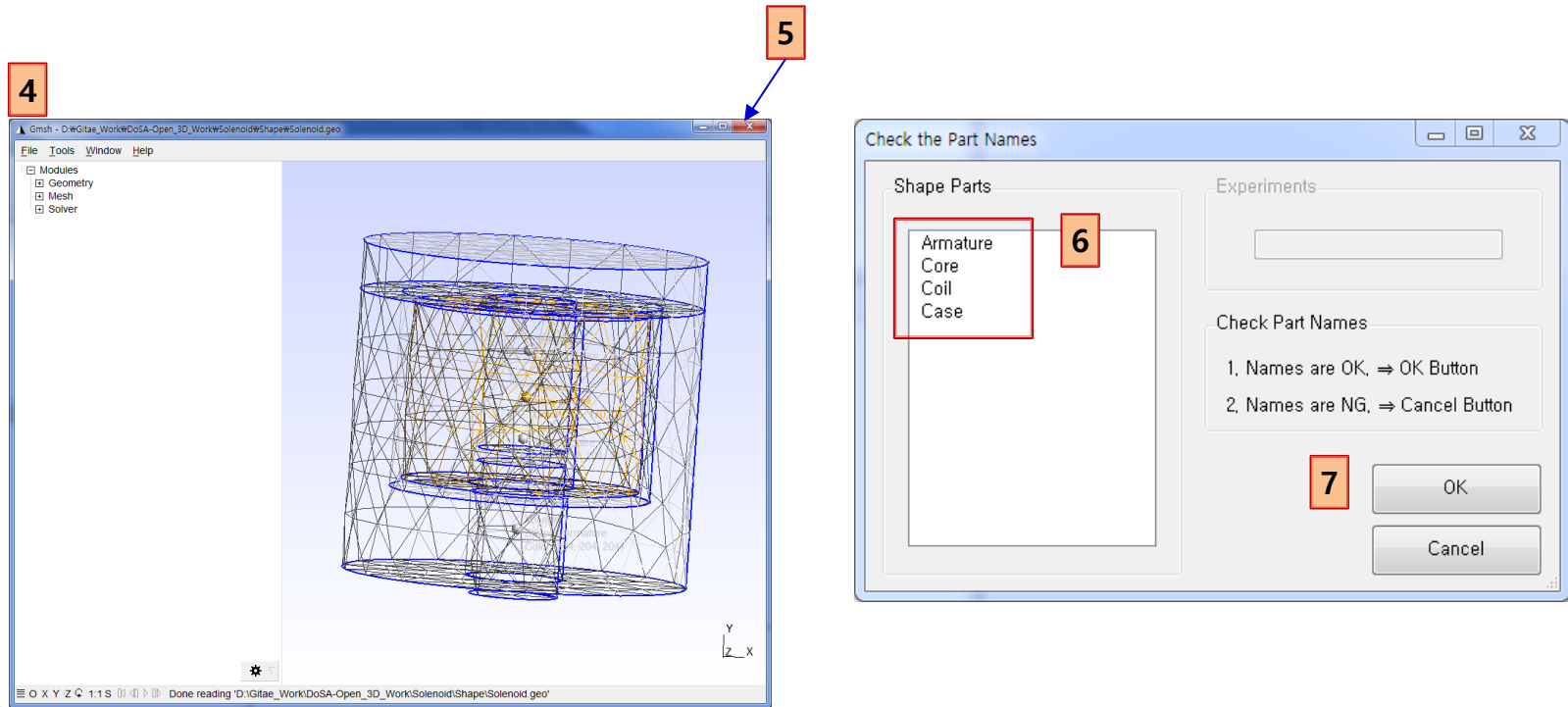
C. Drawing Guide

- https://solenoid.or.kr/data/Drawing_Guide_ENG.pdf



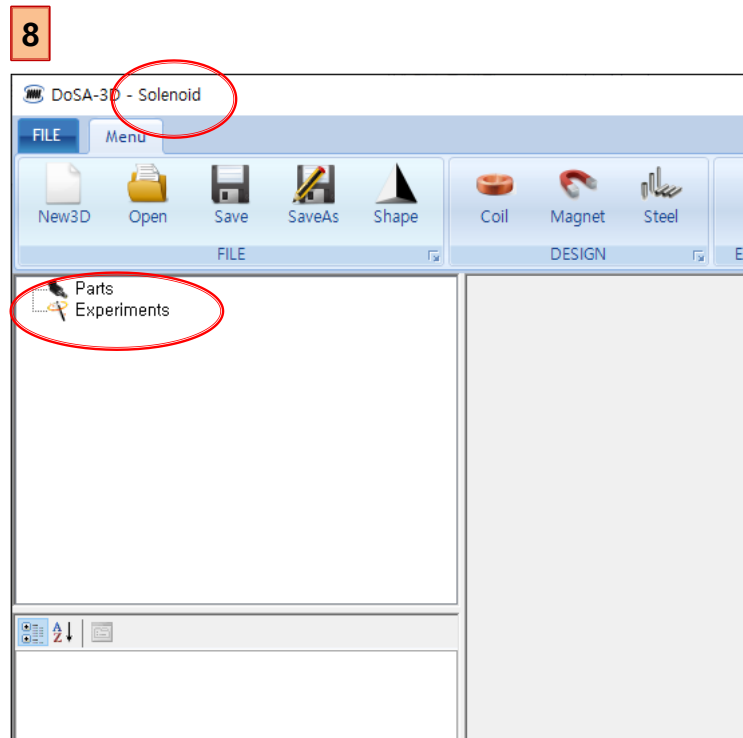
New design

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

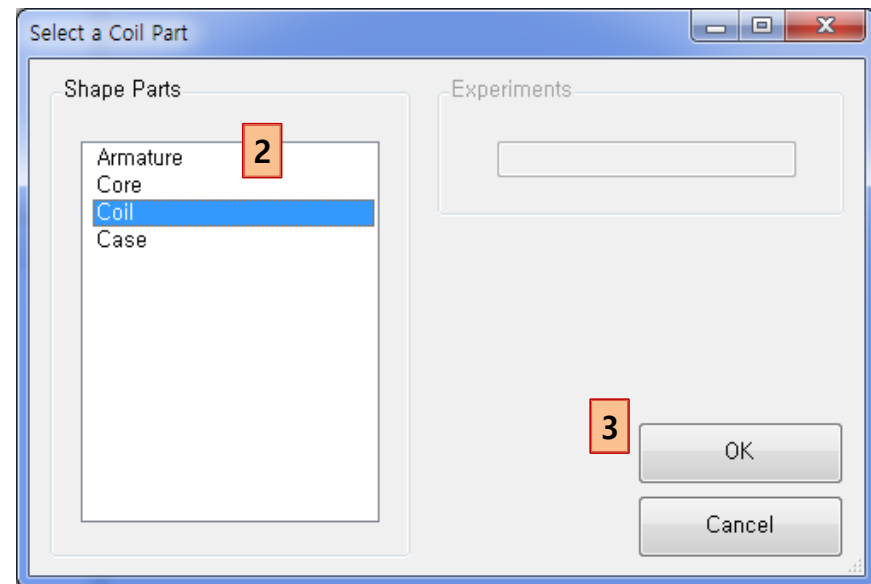
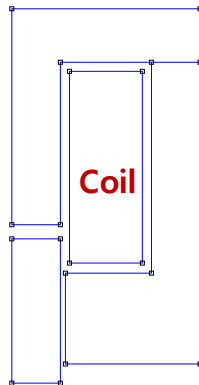
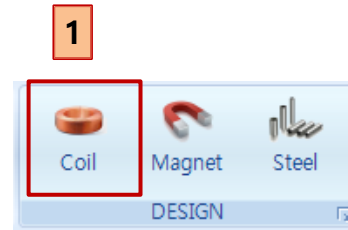
8. Check the design creation.



Parts Design

Add a Coil

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



Coil design

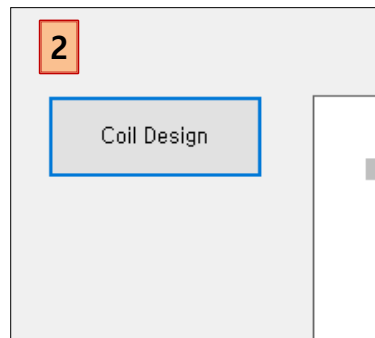
1. Input Coil specifications

- ✓ Inner Diameter : 9.6
- ✓ Outer Diameter : 21.6
- ✓ Coil Height : 16
- ✓ Copper Diameter : 0.27

2. Calculate the coil specification

- ✓ Click "Coil Design" button

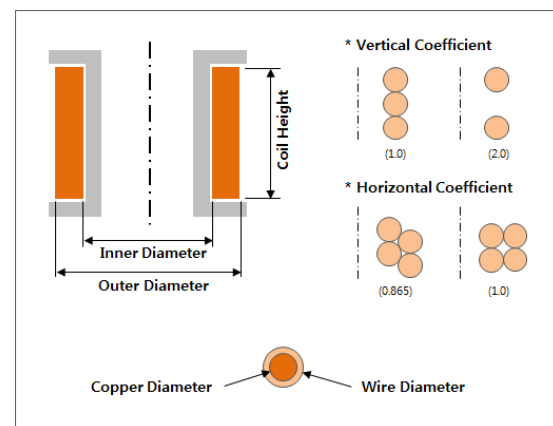
3. Check the coil specification



Common Fields	
Node Name	Coil
Specification Fields	
Part Material	Copper
Curent Direction	IN
Moving Parts	FIXED
Calculated Fields	
Coil Turns	1040
Coil Resistance [Ω]	15,20945
Coil Layers	20
Turns of One Layer	52
Design Fields (optional)	
Coil Wire Grade	Enameled_IEC_Grade_2
Inner Diameter [mm]	9.6
Outer Diameter [mm]	21.6
Coil Height [mm]	16
Copper Diameter [mm]	0.27
Wire Diameter [mm]	0.31072
Coil Temperature [$^{\circ}\text{C}$]	20
Horizontal Coefficient	0.9
Vertical Coefficient	0.98
Resistance Coefficient	1

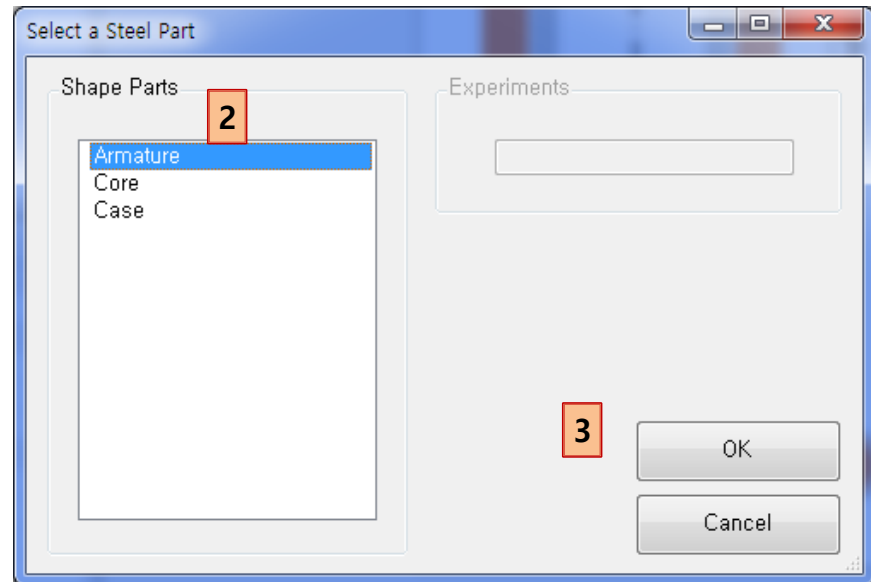
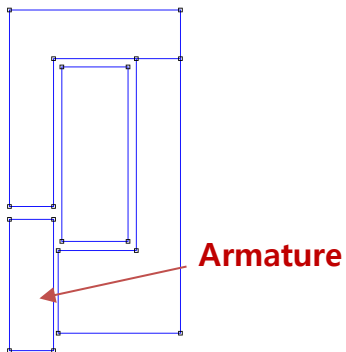
1

3



Add an Armature

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



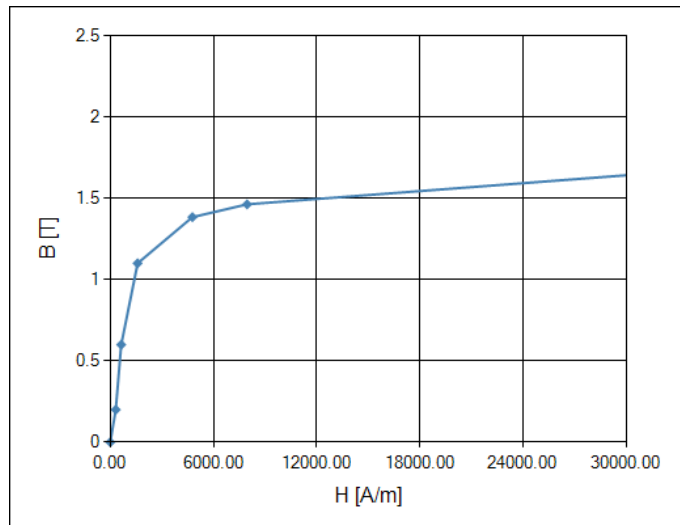
Armature setting

1. Armature setting

- ✓ Part Material : SUS_430
- ✓ Moving Parts : **MOVING**

Select the magnetic force calculation part

[BH 곡선]

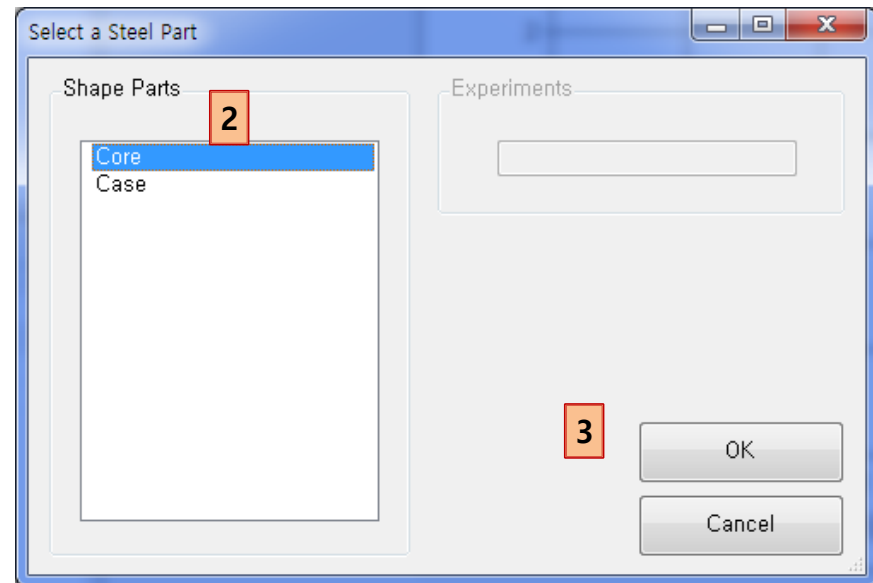
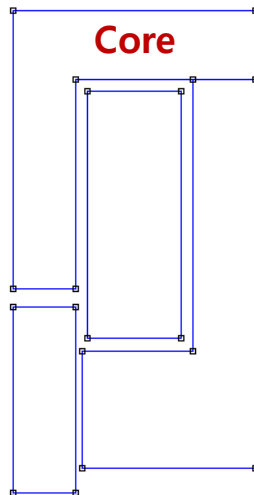
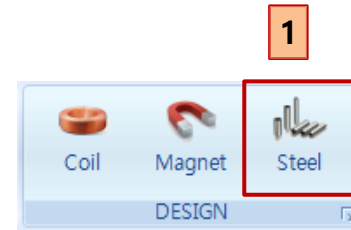


1

Common Fields	
Node Name	Armature
Specification Fields	
Part Material	SUS_430
Moving Parts	MOVING

Add a core

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

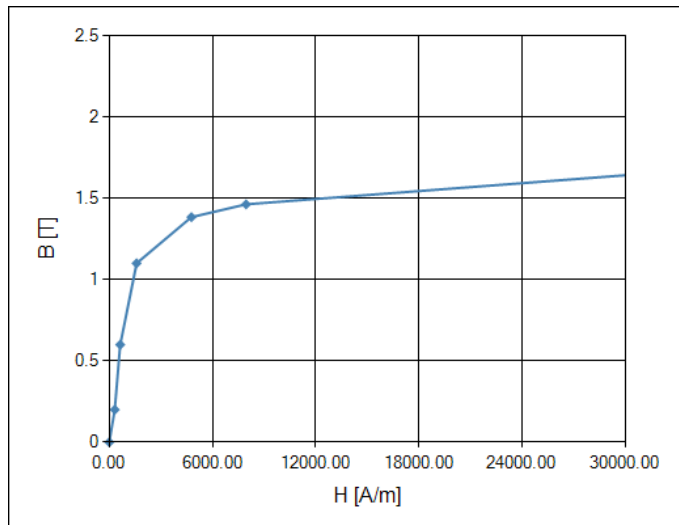


Core setting

1. Core settings

- ✓ Part Material : SUS_430

[BH 곡선]

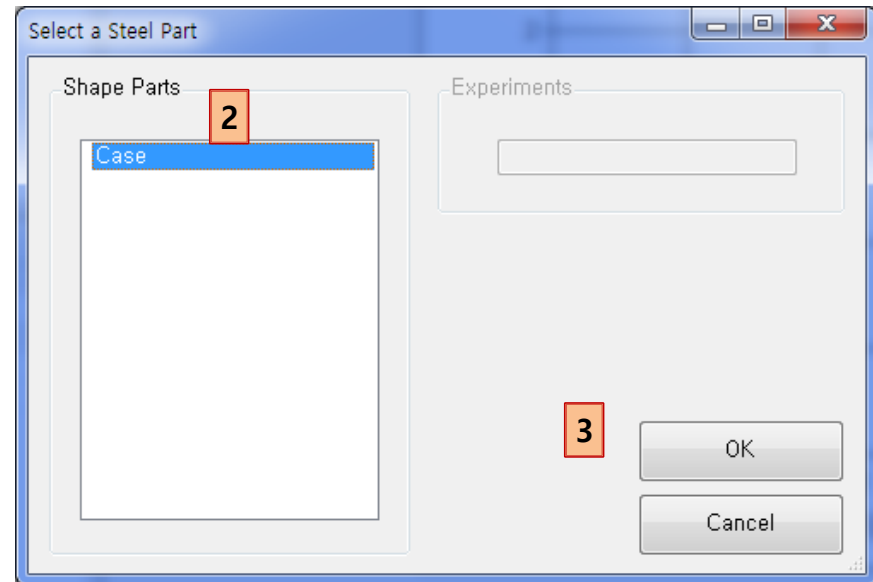
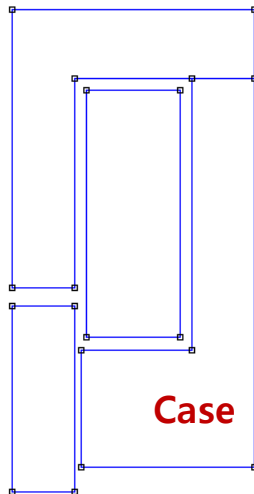
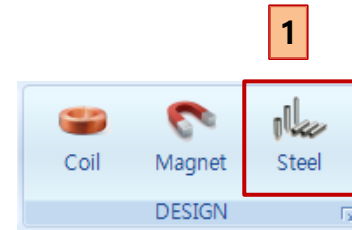


1

Common Fields	
Node Name	Core
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.

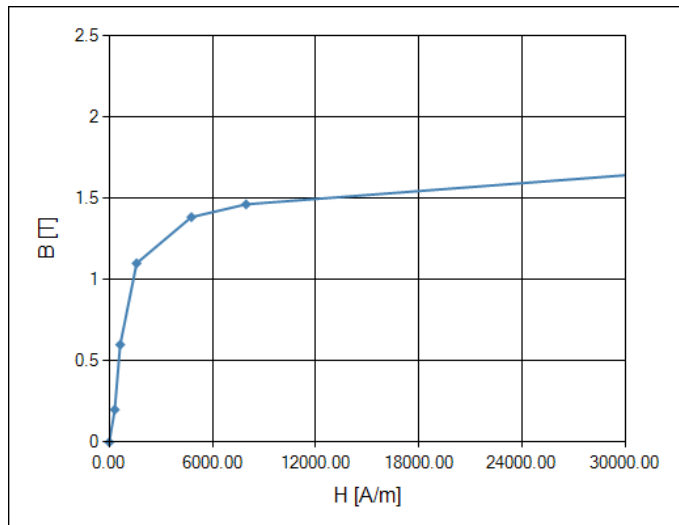


Case setting

1. Case Settings

✓ Part Material : SUS_430

[BH 곡선]



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



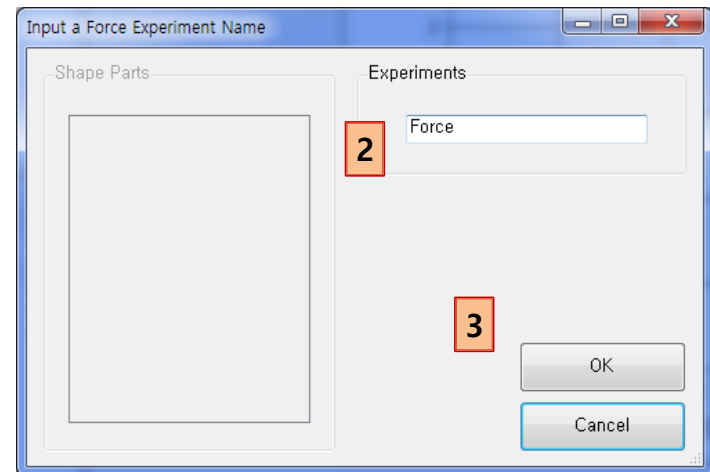
2. Force Test Name : "Force"

3. Click OK Button

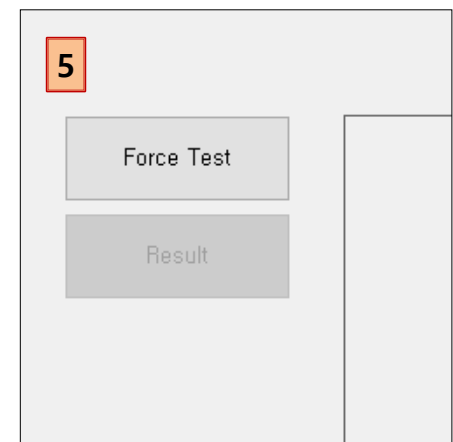
4. Setting of magnetic force test

- ✓ Voltage : 14.5
- ✓ B Rotation Angle : 45
- ✓ Mesh Size Percent : 7
- ✓ Actuator Type : Solenoid

5. Click "Force Test" Button

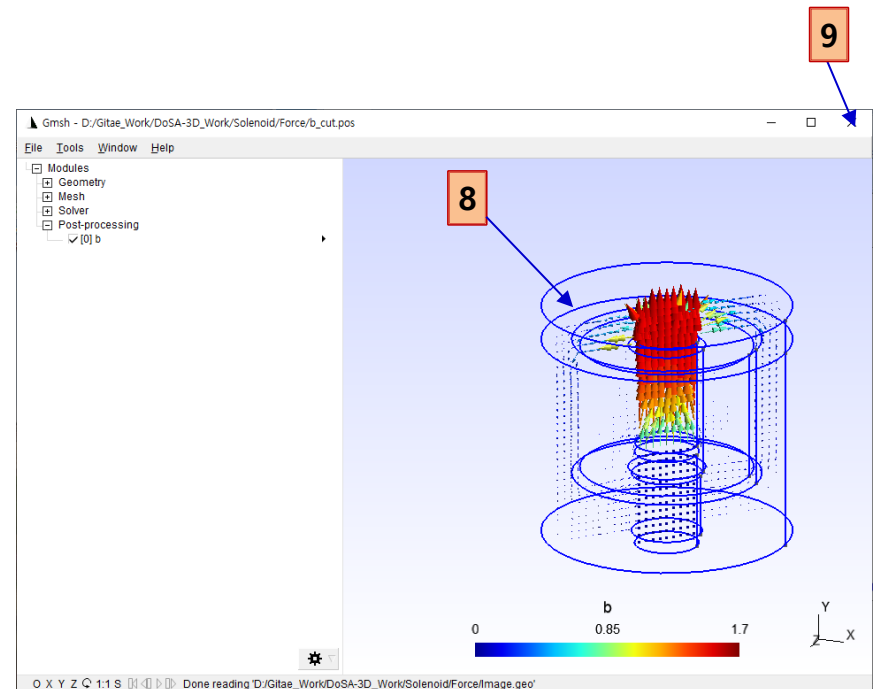
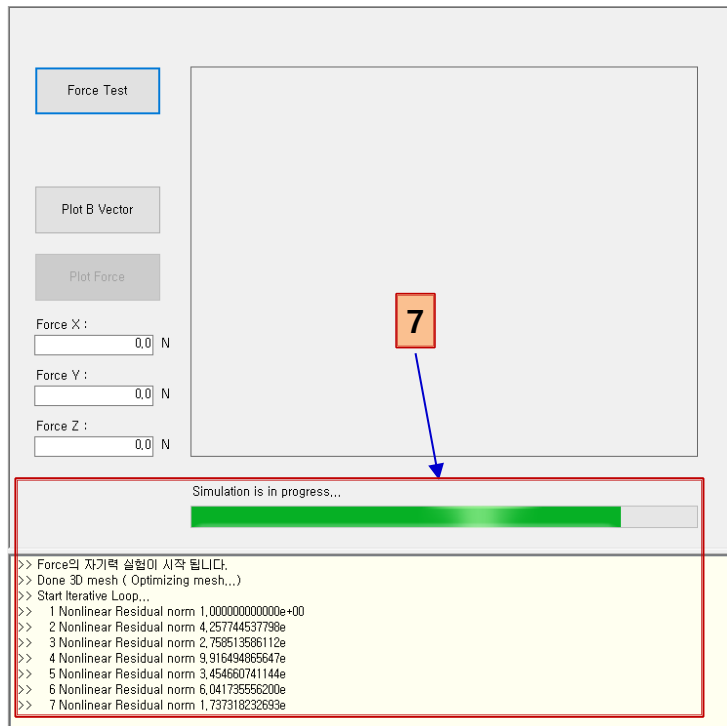


▼ Common Fields	
Node Name	Force
▼ Input Fields	
Voltage [V]	14,5
Max. Current [A]	0,95335
▼ Initial Position Fields	
Y Movement [mm]	0
X Movement [mm]	0
Z Movement [mm]	0
▼ Post-Processing Fields	
B Rotation Angle [°]	45
B Vector Resolution	50
▼ Condition Fields	
Mesh Size [%]	7
Actuator Type	Solenoid



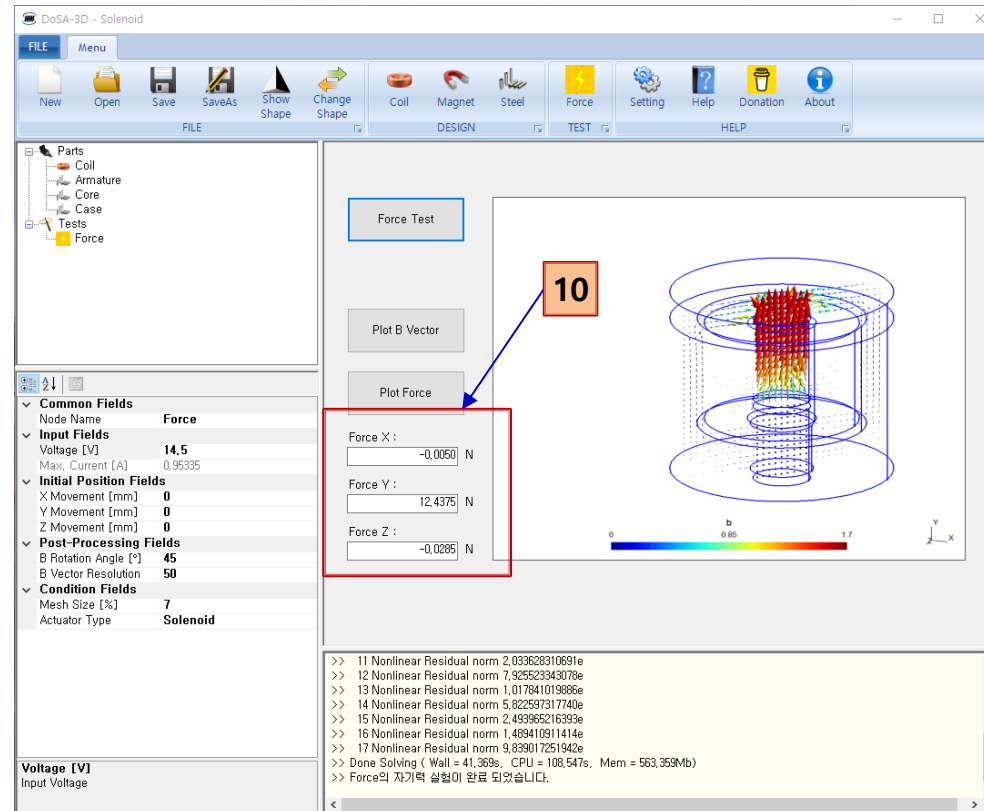
Run the virtual test

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.**



Results of the virtual test

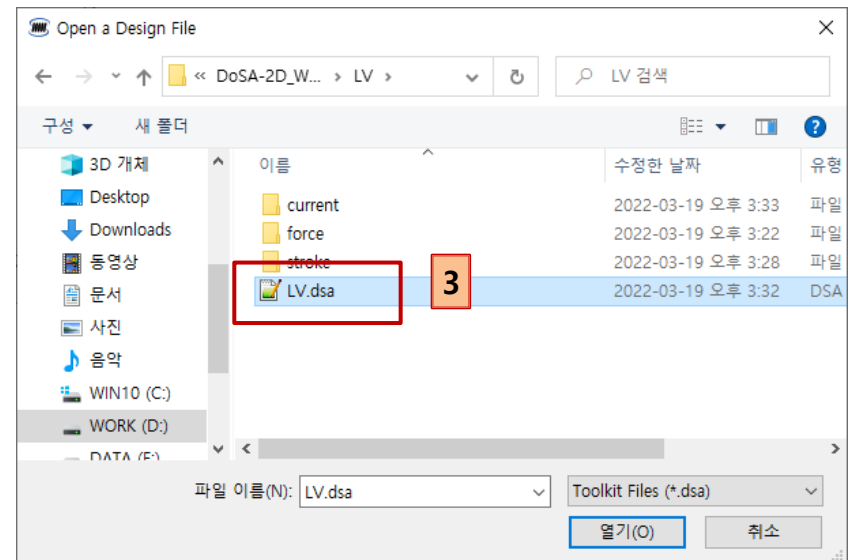
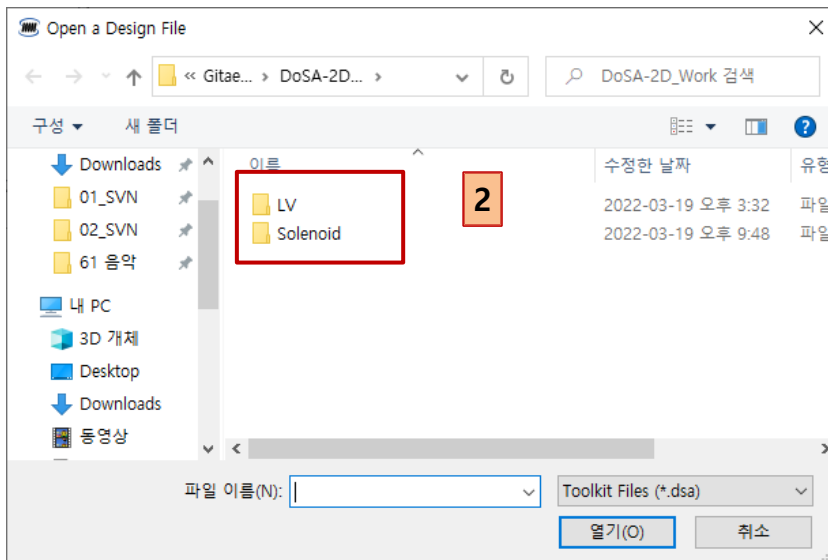
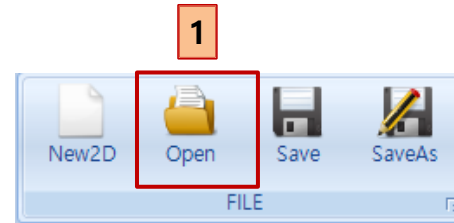
10. Check a magnetic force of the solenoid in DoSA-3D.



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>

