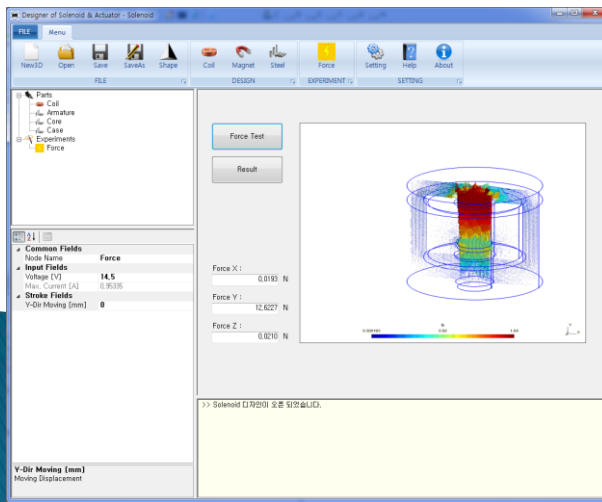# DoSA-3D User Manual

Solenoid Example

2022-03-19
GiTae Kweon (zgitae@gmail.com)
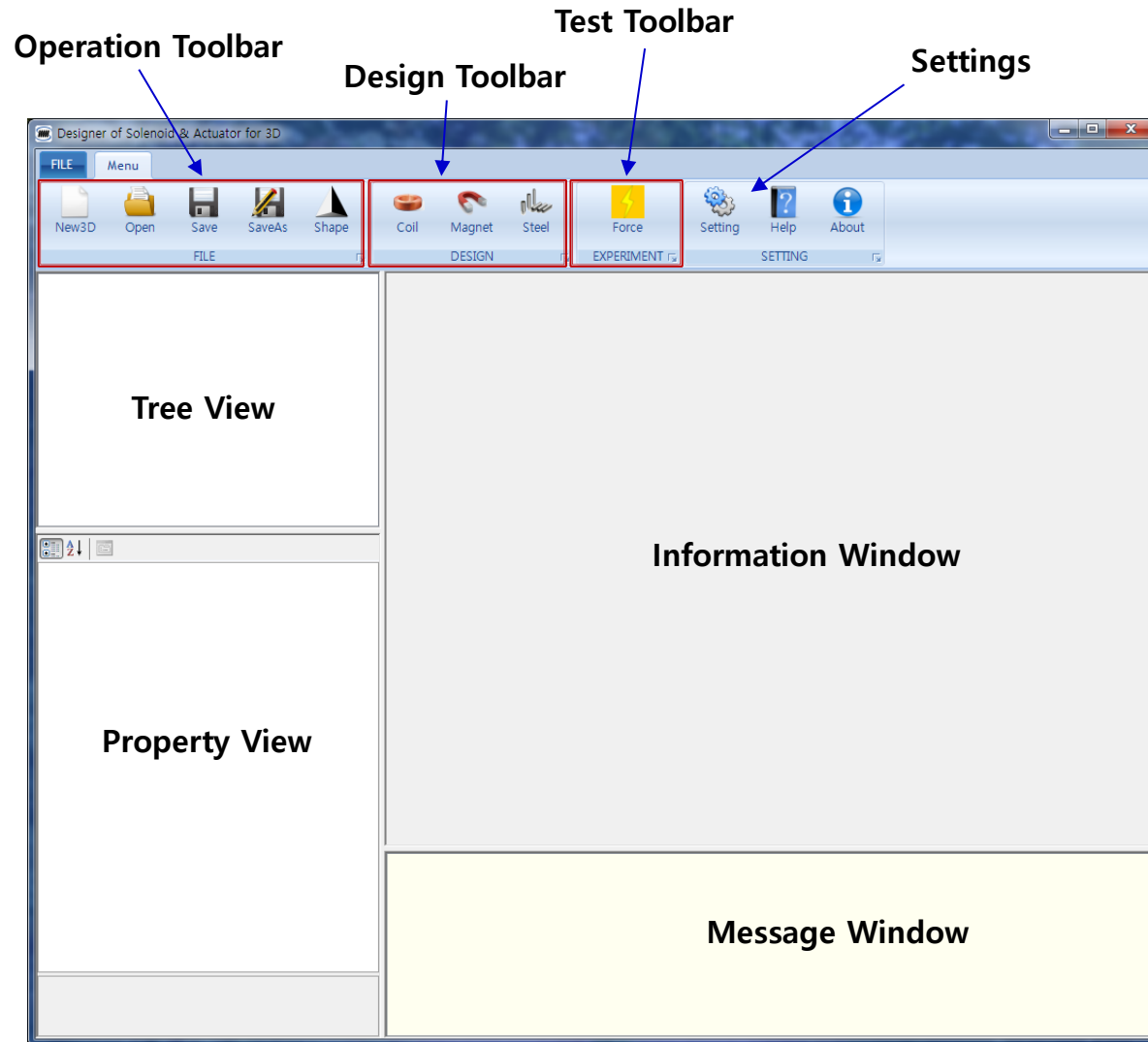
DoSA Structure

PC Requirement

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

Open Actuator Project

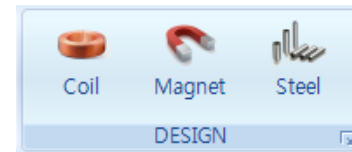# Program Structure

Open Actuator Project

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
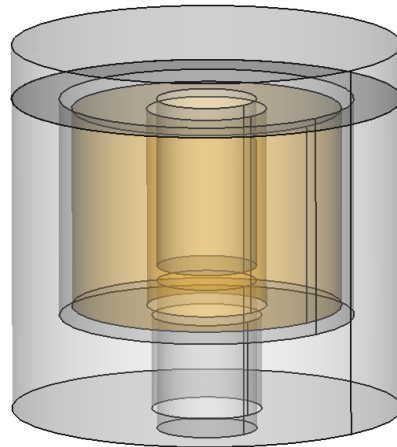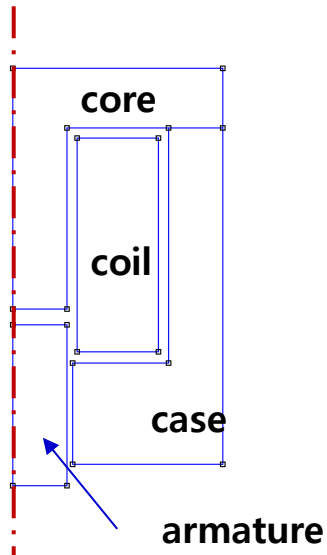- ✓ Steel : Add a steel and determine specifications

3. Virtual Test

- ✓ Force : Magnetic force estimation

Open Actuator Project

Analysis Model

Analysis Model

1. Model Shape

core

coil

case

armature

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)

Open Actuator Project

New design

1. Toolbar > Click New Button

2. Design Name : "Solenoid"

3. Shape File (STEP) : Select Solenoid.step (provided with this tutorial document)

[Precautions for the Shape Model]

DoSA-3D still has the following functional limitations.

가. Limitation of Coil Shape
  - Coil center axis should be Y axis direction.
  - The current is applied like a cylindrical coil.
   (Square coils can cause some differences)

나. Moving Part
  - The moving part still supports only one component..

New Design dialog:

Design Name : Solenoid

Shape File (STEP) : _Work₩DoSA-3D_Work₩Solenoid.step

Limited functionality

1. Coil Shape
  – Coil center axis should be Y axis.
  – The current is applied like a cylindrical coil.

2. Moving Part
  – The moving part still supports only one component.
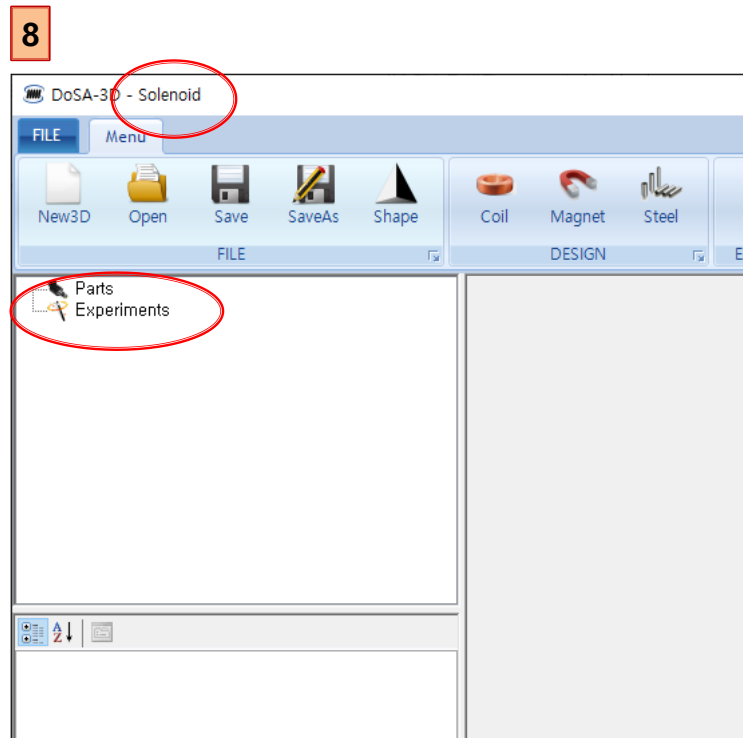
OK   Cancel

Open Actuator Project
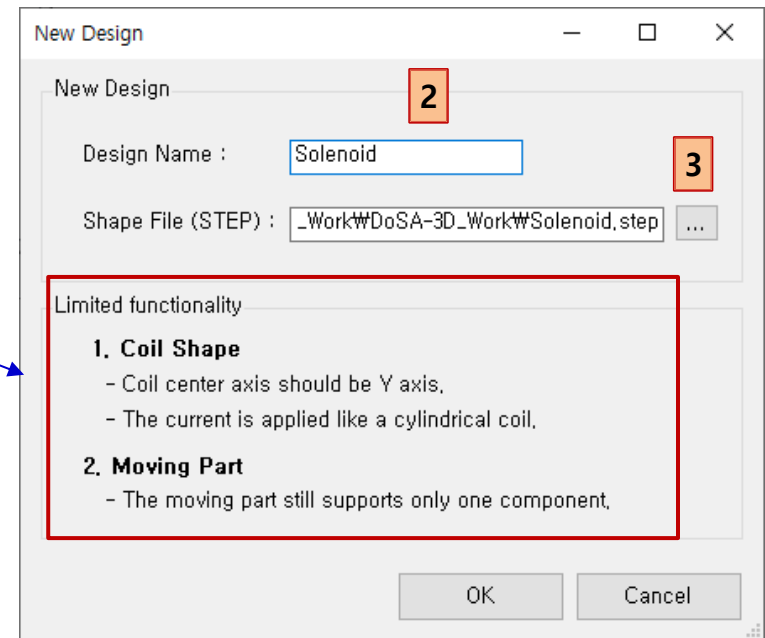
New design

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.

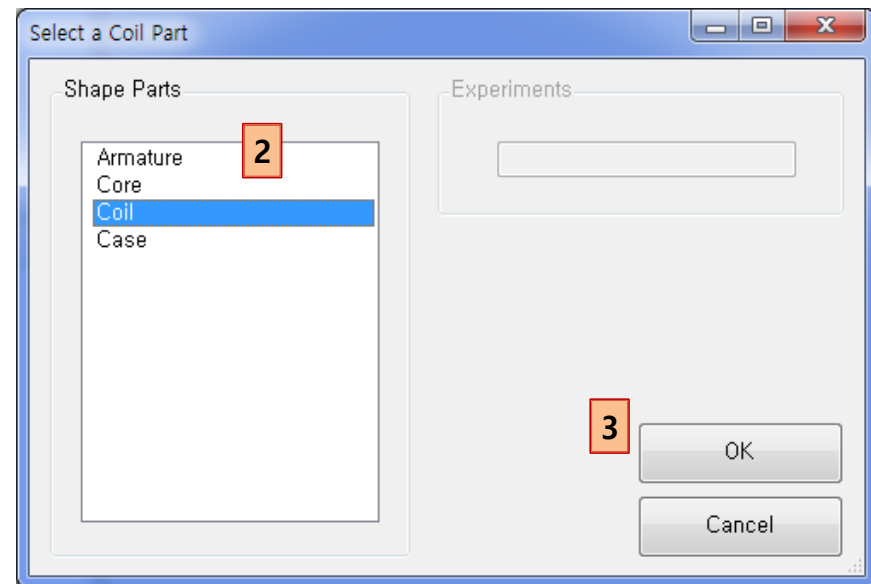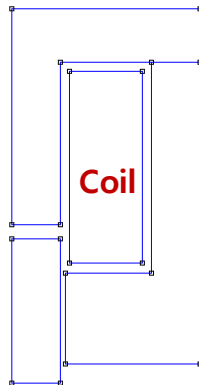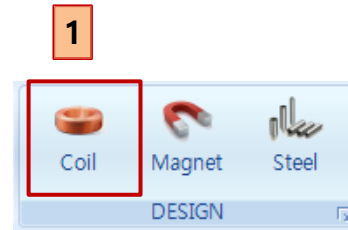Open Actuator Project
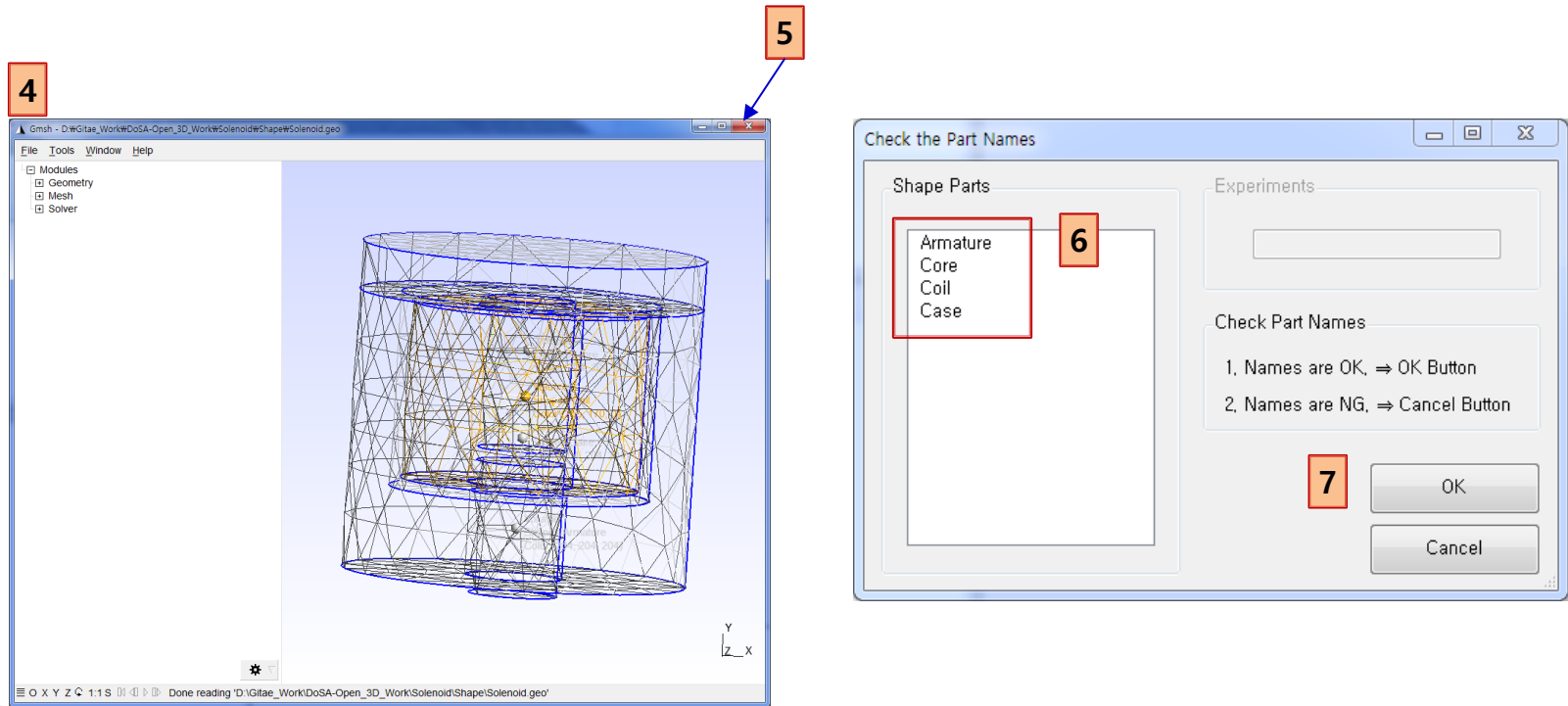
New design

8. Check the design creation.

Open Actuator Project

Parts Design

Add a Coil

1. Toolbar > Click Coil button

2. Select "Coil" in the list box.

3. Click the OK button.

Open Actuator Project

Coil design

1. Input Coil specifications
   - ✓ Inner Diameter : 9.6
   - ✓ Outer Diameter : 21.6
   - ✓ Coil Height : 16
   - ✓ Copper Diameter : 0.27

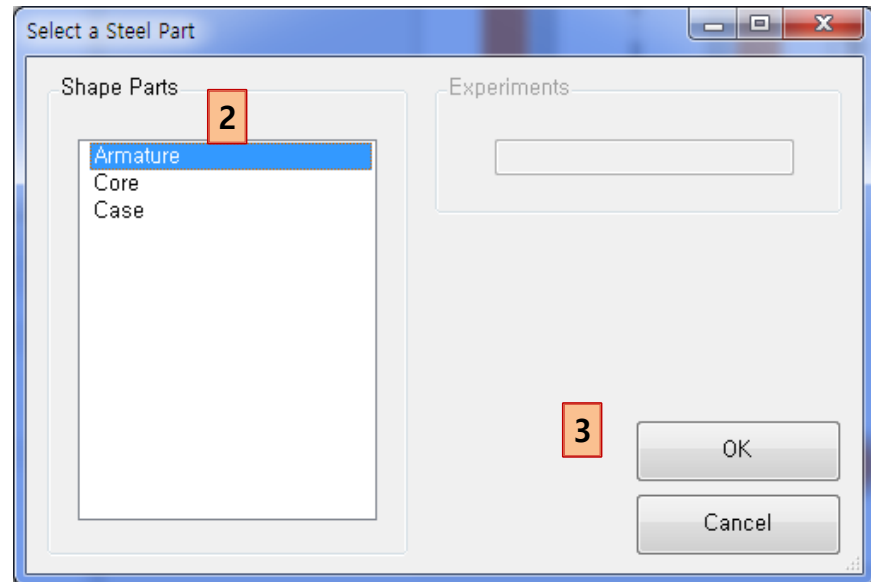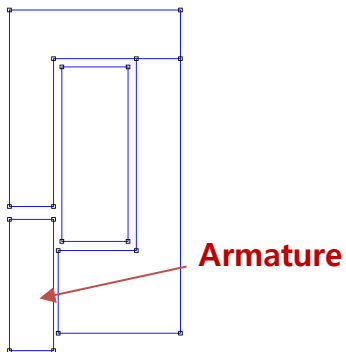2. Calculate the coil specification
   - ✓ Click "Coil Design" button

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 [℃]	**20**
Horizontal Coefficient	**0.9**
Vertical Coefficient	**0.98**
Resistance Coefficient	**1**

3

1

2

Coil Design

Inner Dia

Open Actuator Project

Add an Armature

1
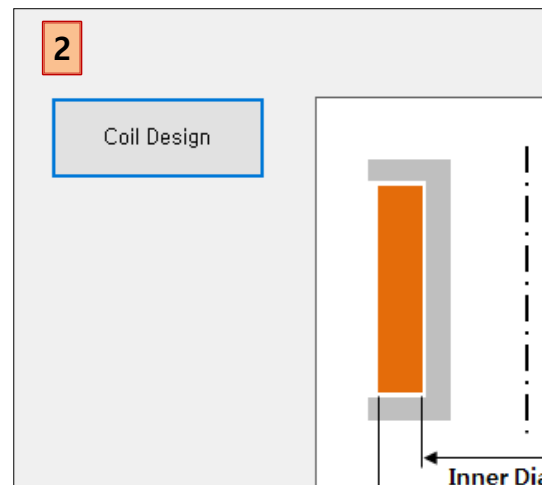
1. Toolbar > Click Steel button

2. Select "Armature" in the list box.

3. Click the OK button.

Armature

Coil   Magnet   Steel

DESIGN

Select a Steel Part

Shape Parts   Experiments
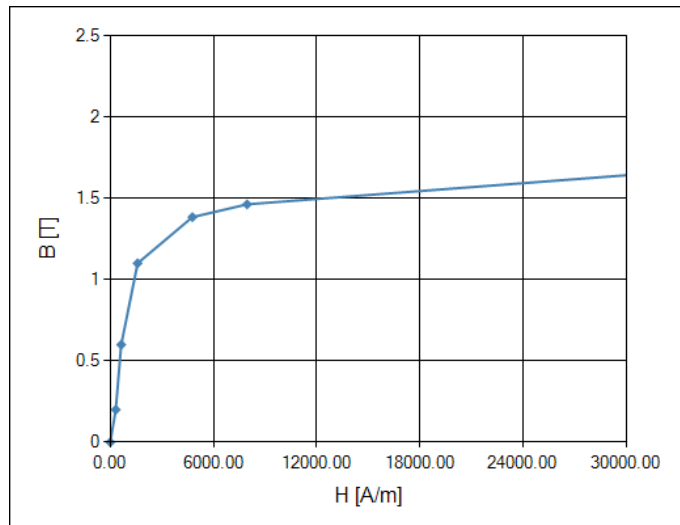
2

Armature
Core
Case

3   OK

Cancel

Armature setting

1. Armature setting
   - ✓ Part Material : SUS_430
   - ✓ Moving Parts : **MOVING**

[BH 곡선]

Open Actuator Project

Add a core

1

1. Toolbar > Click Steel button

2. Select "Core" in the list box.

3. Click the OK button.

Core

Coil   Magnet   Steel

DESIGN

Select a Steel Part

Shape Parts   Experiments

2

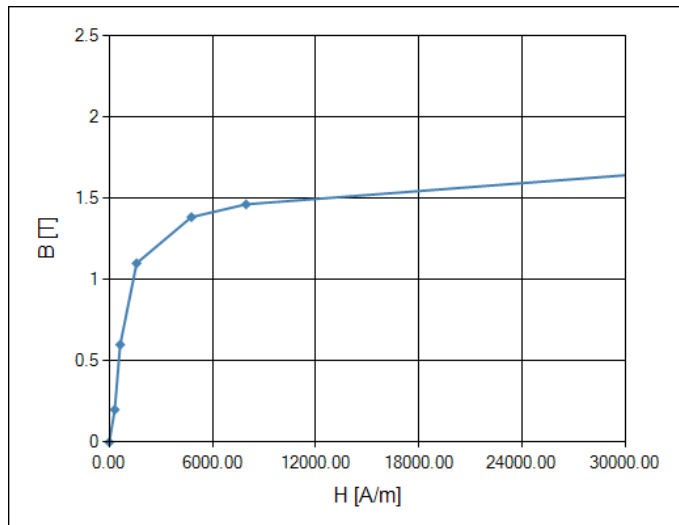Core
Case

3   OK

Cancel

Open Actuator Project
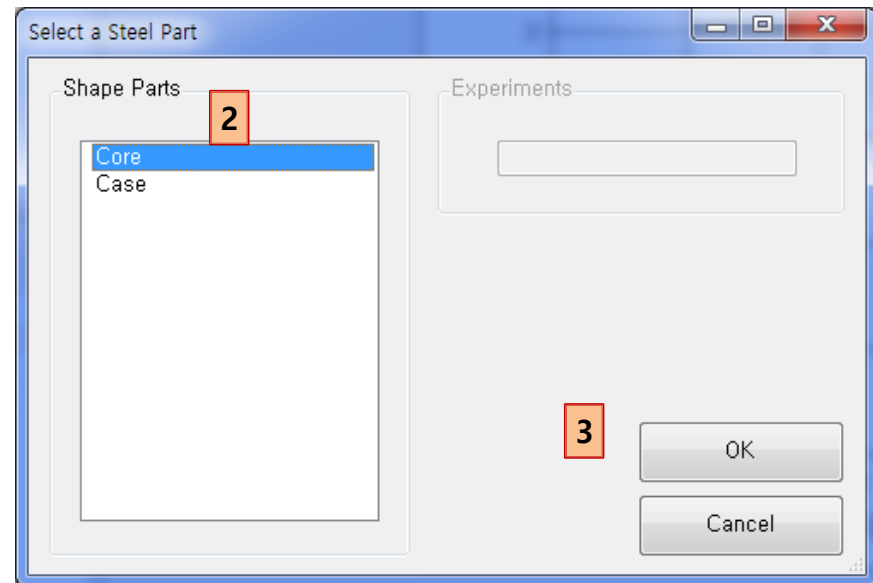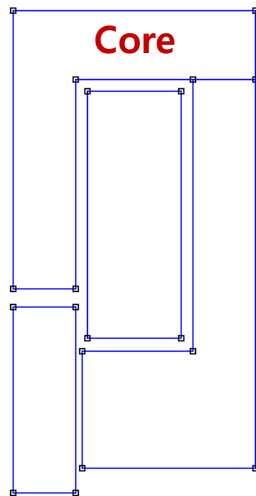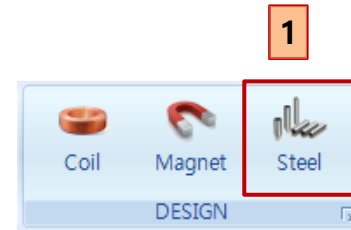
Core setting

1. Core settings

  ✓ Part Material : SUS_430

1

Common Fields	
Node Name	**Core**
Specification Fields	
Part Material	**SUS_430**
Moving Parts	**FIXED**

[BH 곡선]

Open Actuator Project

Add a case

1. Toolbar > Click Steel button

2. Select "Case" in the list box.

3. Click the OK button.

Case

Open Actuator Project
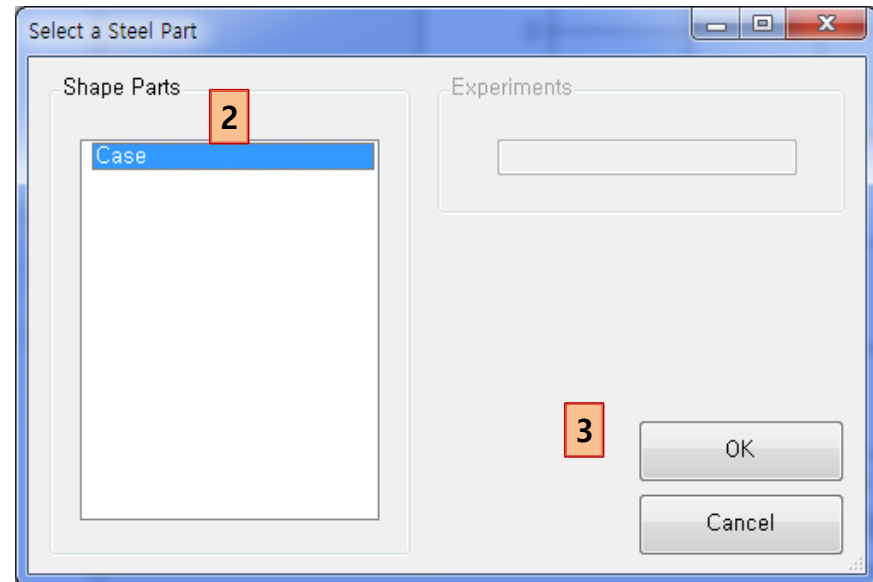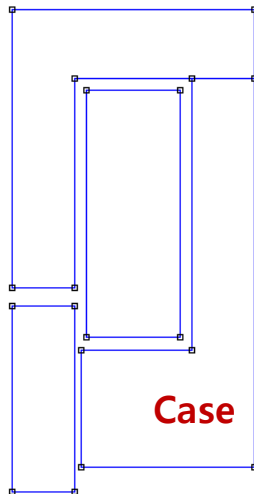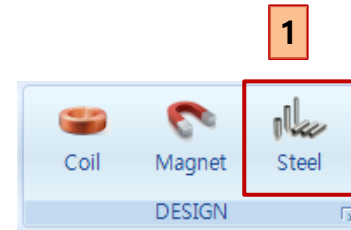
Case setting

1. Case Settings

    ✓ Part Material : SUS_430

1
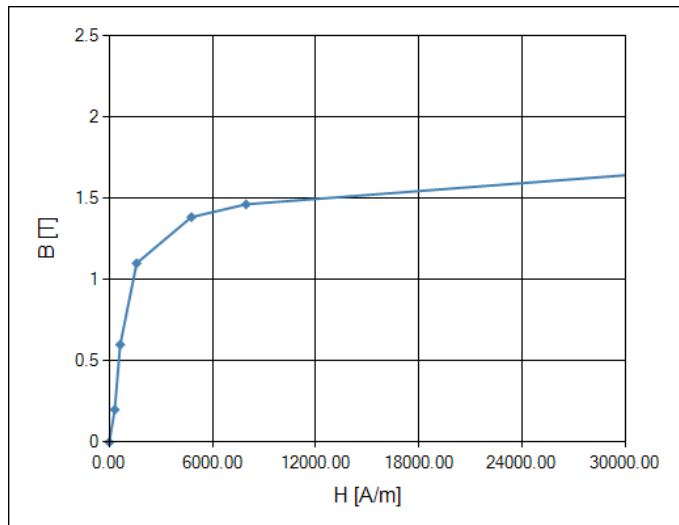
| Common Fields	
Node Name	**Case**
Specification Fields	
Part Material	**SUS_430**
Moving Parts	**FIXED**

[BH 곡선]

Open Actuator Project

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

5. Setting of analysis condition
   - ✓ Mesh Size Percent : 5
   - ✓ Actuator Type : Solenoid

6. Click "Force Test" Button

1

Force

EXPERIMENT

Input a Force Experiment Name

Shape Parts

Experiments

2 Force

3

OK

Cancel
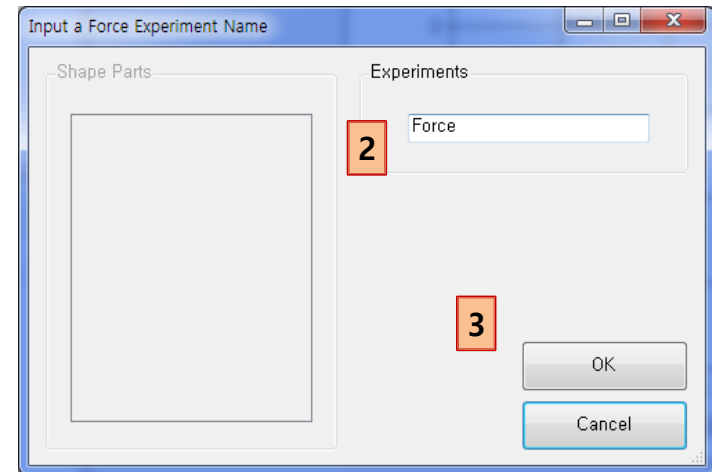
Common Fields	
Node Name	**Force**
Input Fields	
Voltage [V]	**14,5** **4**
Max, Current [A]	0,95335
Initial Position Fields	
Y Movement [mm]	**0**
X Movement [mm]	**0**
Z Movement [mm]	**0**
Condition Fields	
Mesh Size [%]	**5** **5**
Actuator Type	**Solenoid**

6

Force Test

Result

Open Actuator Project
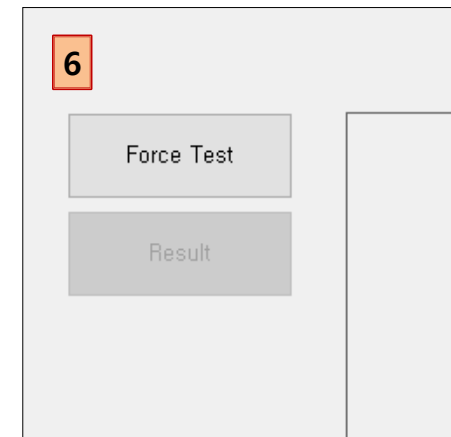
Run the virtual test

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.

Open Actuator Project
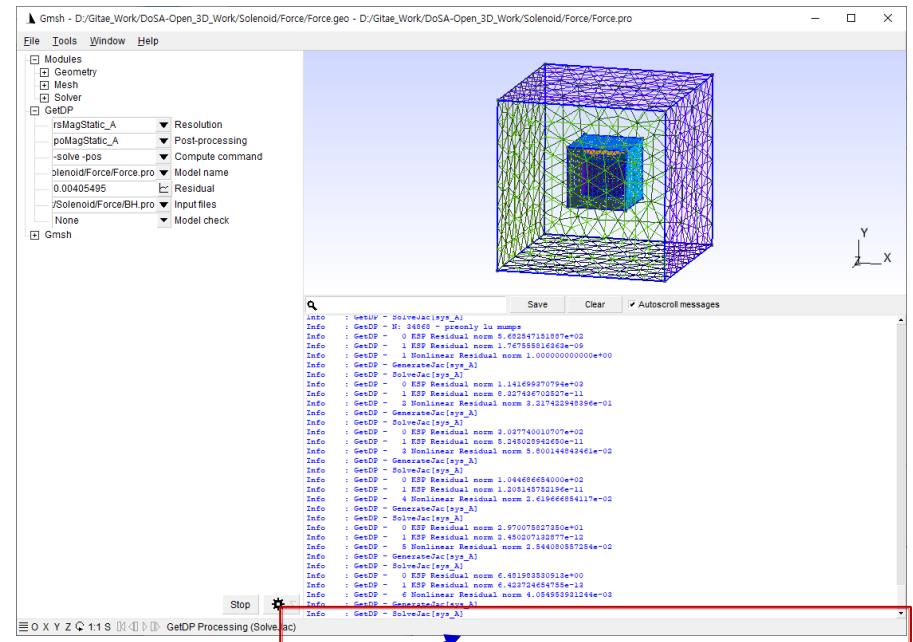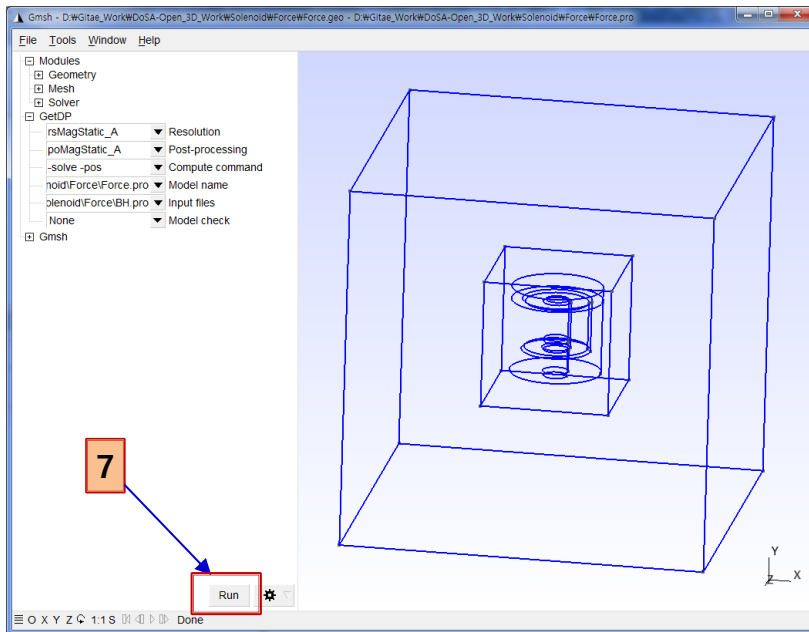
Results of the virtual test

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

10. **Quit the Gmsh.** (When finished, Gmsh is automatically restarted)
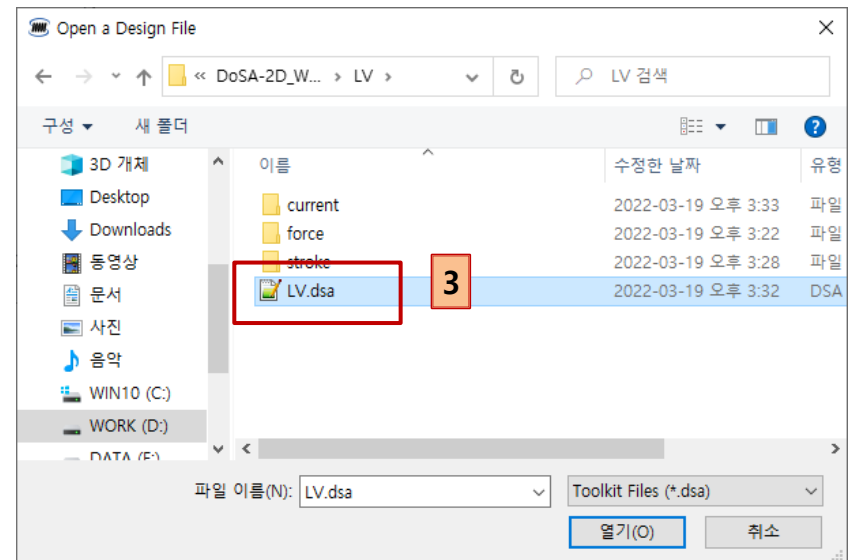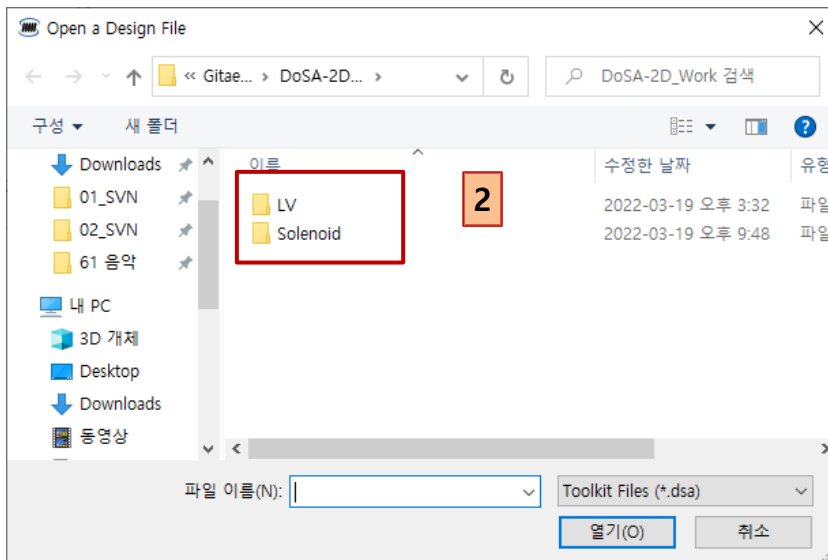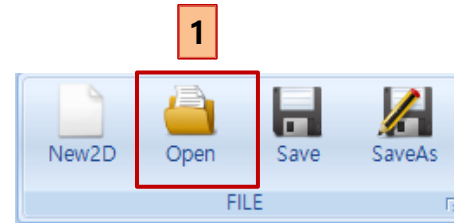
11. Check a magnetic force of the solenoid.

Open Actuator Project
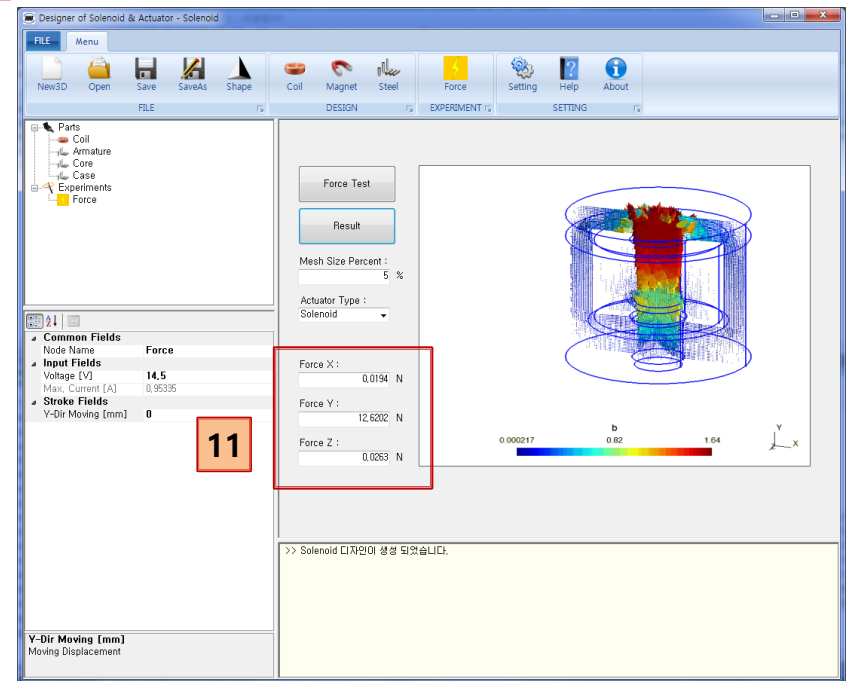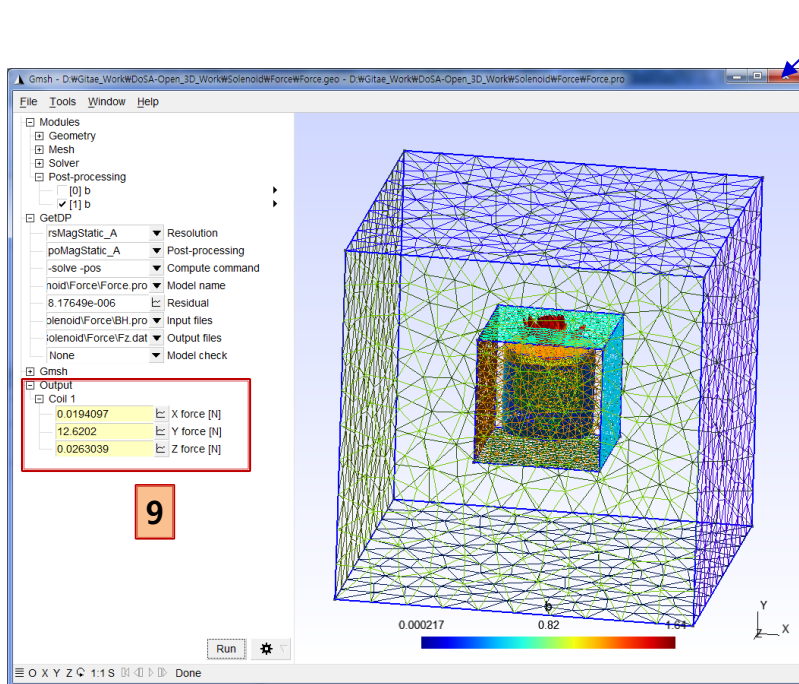
Tips

Open Design

1. Toolbar > Click Open Button

2. Double click the design directory.

3. Double click the design file.

Open Actuator Project

Thank You

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Homepage : http://openactuator.org