

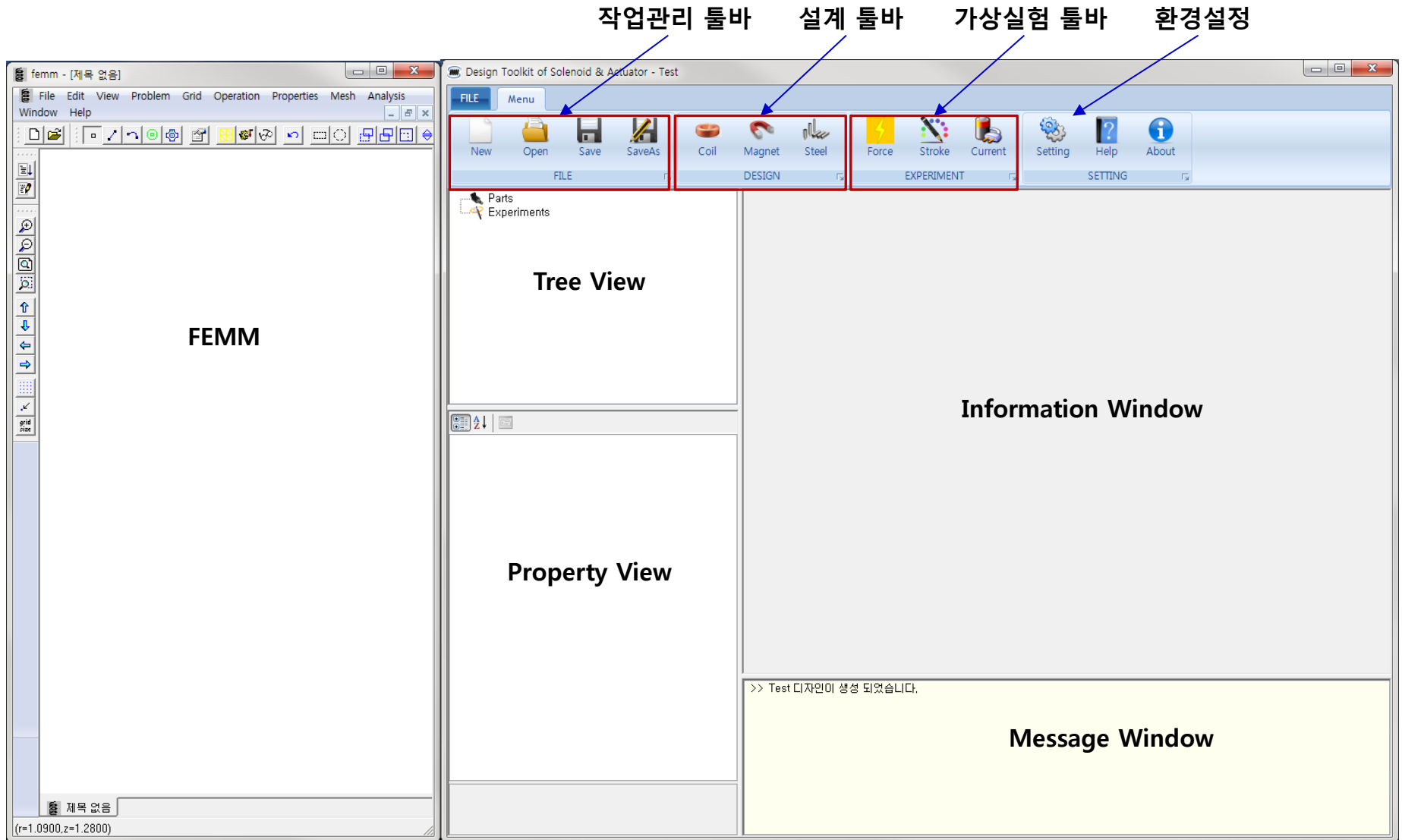
# DoSA 사용 메뉴얼

Solenoid 예제

2017-11-07

<http://OpenActuator.org>

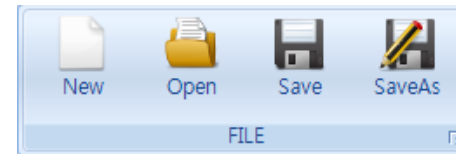
# 프로그램 구성



# 프로그램 Toolbar

## 1. 작업관리

- ✓ New : 신규작업 생성
- ✓ Open : 이전작업 열기
- ✓ Save : 작업 저장
- ✓ SaveAs : 다른 이름으로 저장



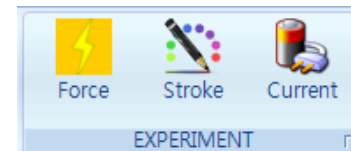
## 2. 설계

- ✓ Coil : 권선 추가 및 사양 설계
- ✓ Magnet : 영구자석 추가 및 사양 설정
- ✓ Steel : 연자성체 추가 및 사양 설정



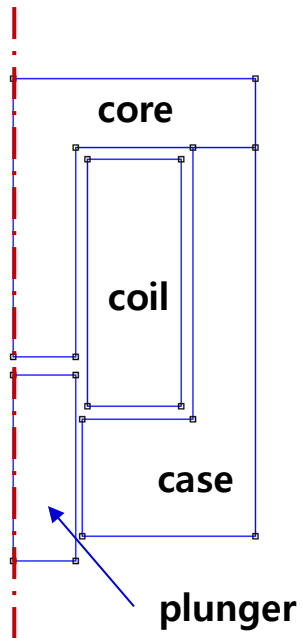
## 3. 가상실험

- ✓ Force : 구동부 자기력 예측
- ✓ Stroke : 변위별 자기력 예측
- ✓ Current : 전류별 자기력 예측



# 해석모델 설명

## 1. 형상 모델



## 2. 제품 사양

### 가. 코일권선

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

### 나. 전원

- Voltage : 14.5V

( 작업 예제파일 : DoSA 설치 디렉토리 > Samples > Solenoid )

# Design 생성

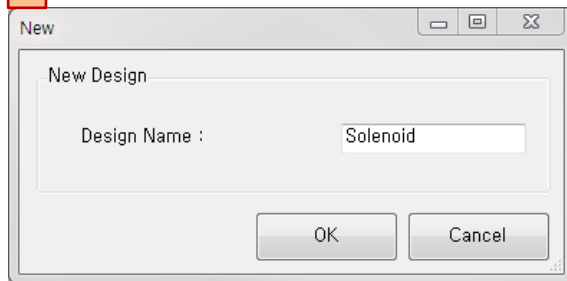
1. Toolbar > New 버튼 클릭



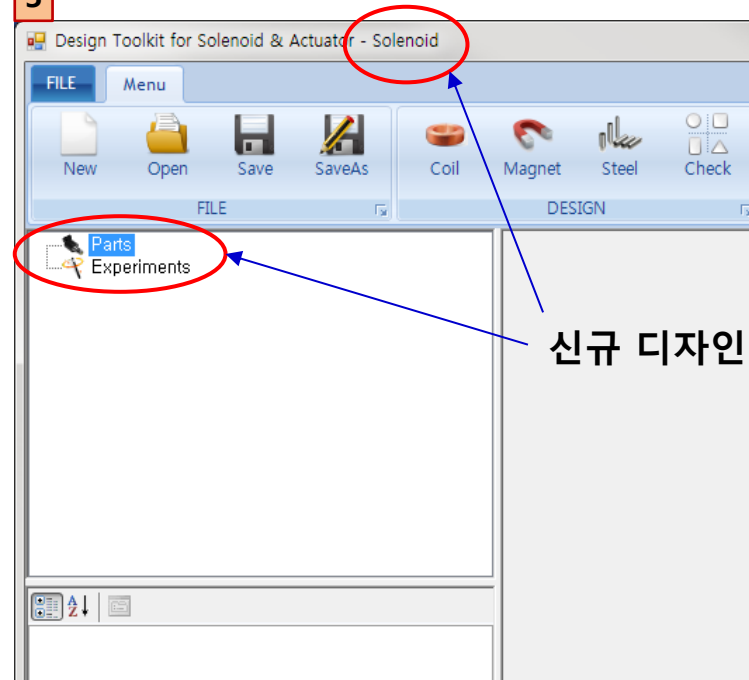
2. Design Name : 작업 명칭 입력 ( Solenoid )

3. OK 클릭

2



3



신규 디자인 생성

# Coil 생성

1. Toolbar > Coil 버튼 클릭



2. Coil Name 입력 : "coil"

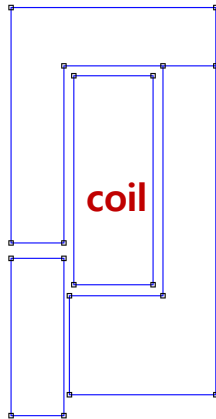
3. Coil 형상 입력

- ✓ 코일 위치 : Base\_X 4.8, Base\_Y -2
- ✓ 좌하 점 : X 0, Y 0 (상대 좌표)
- ✓ 우상 점 : X 0.6, Y 16 (상대 좌표)

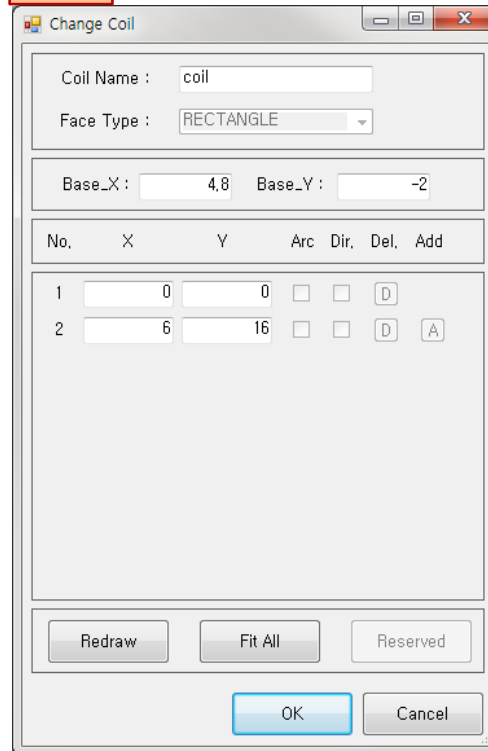
4. 화면 조정 : Fit All 버튼 사용

5. OK 버튼 클릭

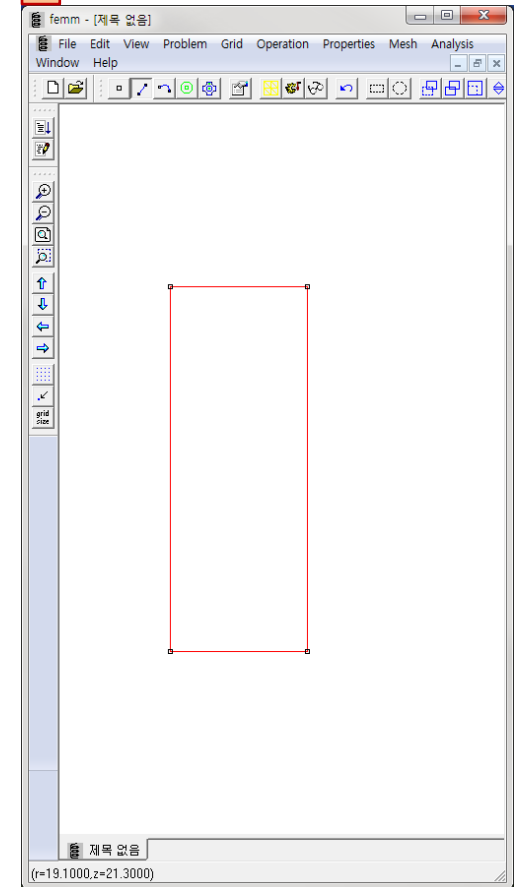
6. 형상 확인 (FEMM 창)



2~4



5



# Coil 설계

## 1. Coil 기구사양 입력

- ✓ Part Material : Copper 선택
- ✓ Current Direction : IN 선택 (안쪽 방향)
- ✓ Moving Parts : FIXED 선택 (고정 부품)
- ✓ Coil Wire Grade : Enameled\_IEC\_Grade\_2 선택
- ✓ Copper Diameter : 0.27 mm 입력
- ✓ Horizontal Coefficient : 기본값
- ✓ Vertical Coefficient : 기본값
- ✓ Resistance Coefficient : 기본값

## 2. Coil 사양 계산

- ✓ Design Coil 버튼 클릭

2

Coil Design

1

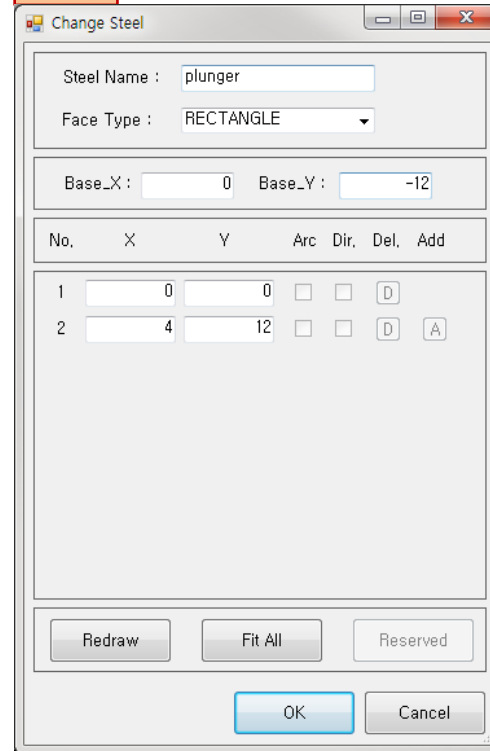
Common Fields	
Node Name	coil
Specification Fields	
Part Material	Copper
Current Direction	IN
Moving Parts	FIXED
Calculated Fields	
Coil Turns	1040
Coil Resistance [ $\Omega$ ]	15,20945
Coil Layers	20
Turns of One Layer	52
Design Fields (optional)	
Coil Wire Grade	Enameled_IEC_Grade_2
Inner Diameter [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

# Plunger 생성

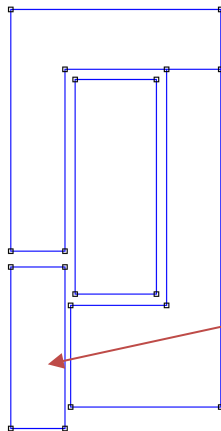
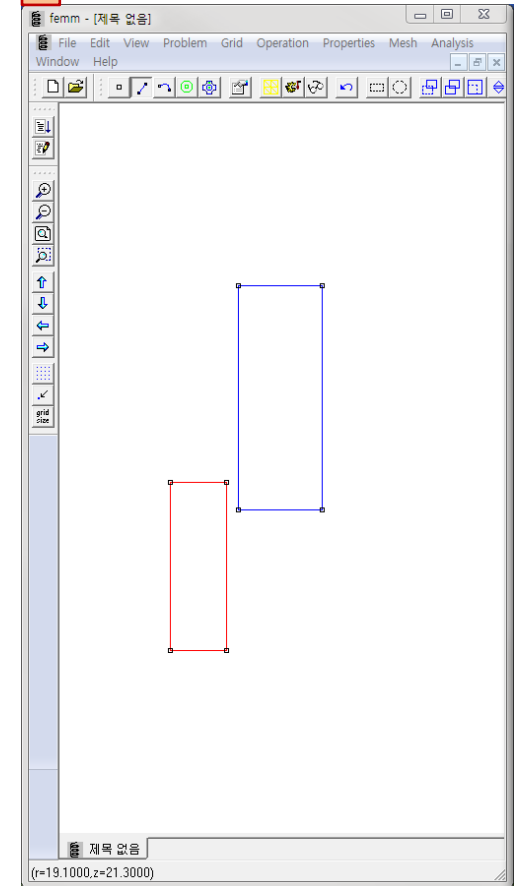
1. Toolbar > Steel 버튼 클릭
2. Steel Name 입력 : "plunger"
3. Face Type : RECTANGLE
4. Plunger 형상 입력
  - ✓ Plunger 위치 : Base\_X 0, Base\_Y -12
  - ✓ 좌하 점 : X 0, Y 0 (상대 좌표)
  - ✓ 우상 점 : X 4, Y 12 (상대 좌표)
5. 화면 조정 : Fit All 버튼 사용
6. OK 버튼 클릭
7. 형상 확인 (FEMM 창)



2~5



6



plunger

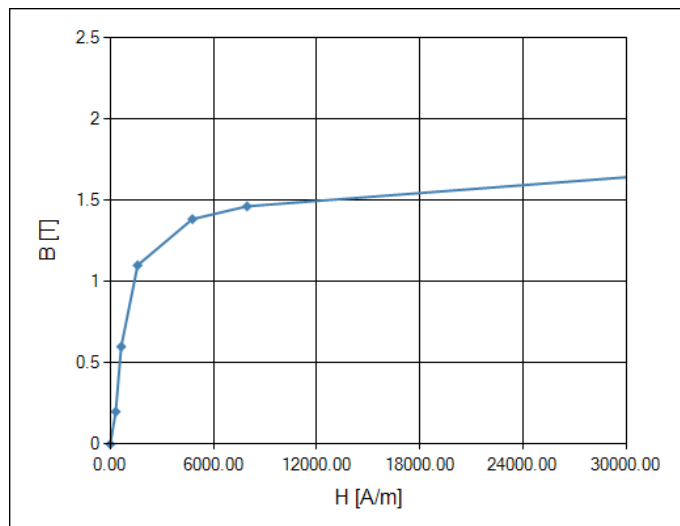


# Plunger 설정

## 1. Plunger 속성 설정

- ✓ Part Material : 430 Stainless Steel 선택
- ✓ Moving Parts : Moving 선택 (동작 부품)

[ BH 곡선 ]



1

Common Fields	
Node Name	plunger
Specification Fields	
Part Material	430 Stainless Steel
Moving Parts	MOVING

# Core 생성

1. Toolbar > Steel 버튼 클릭



2. Steel Name 입력 : "core"

3. 좌표점 추가 (총6개) : 'A' 버튼 클릭

4. Core 형상 입력

✓ Core 위치 : Base\_X 0, Base\_Y 1.2

✓ 1 점 : X 0, Y 0

✓ 2 점 : X 4, Y 0

✓ 3 점 : X 4, Y 13.6

✓ 4 점 : X 15.6, Y 13.6

✓ 5 점 : X 15.6, Y 18

✓ 6 점 : X 0, Y 18

5. 화면 조정 : Fit All 버튼 사용

6. OK 버튼 클릭

7. 형상 확인 (FEMM 창)

2~3

No.	X	Y	Arc	Dir	Del	Add
1			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> A

4~5

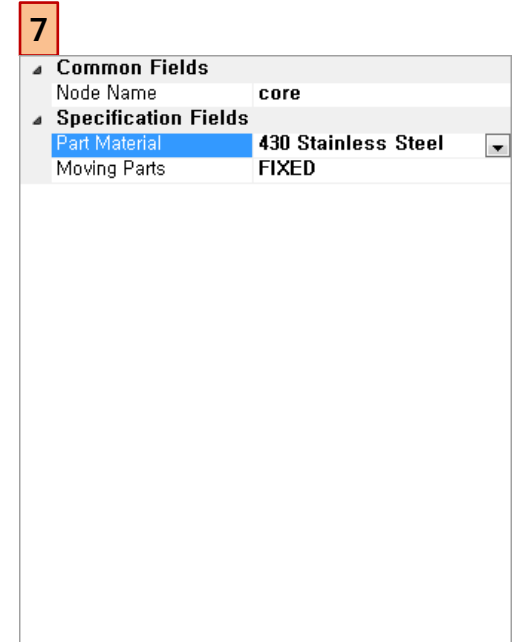
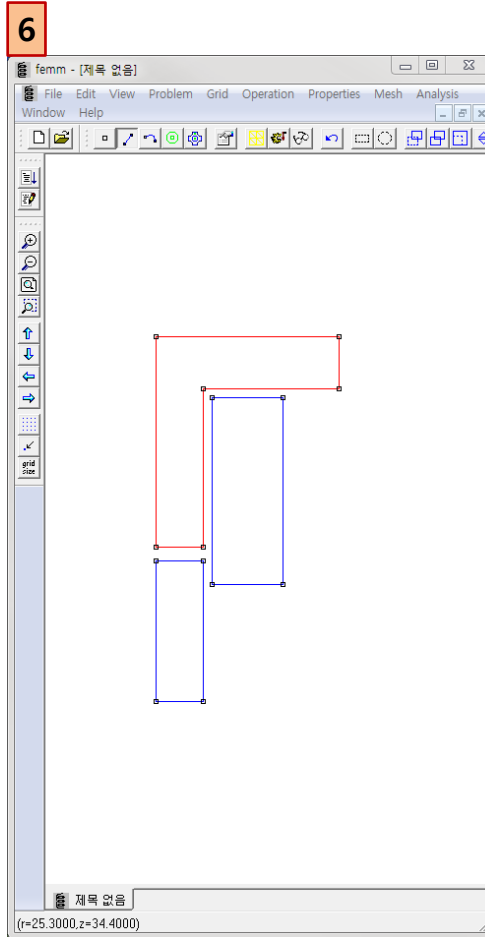
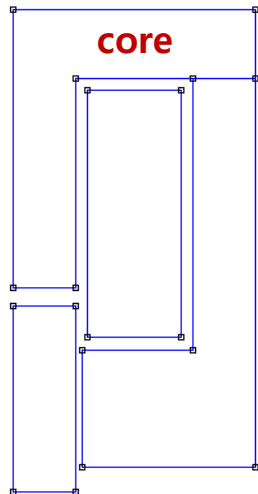
No.	X	Y	Arc	Dir	Del	Add
1	0	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	4	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	4	13.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	15.6	13.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	15.6	18	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	0	18	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> A

# Core 설정

6. 형상 확인 (FEMM 창)

7. Core 속성 설정

- ✓ Part Material : 430 Stainless Steel
- ✓ Moving Parts : FIXED



# Case 생성

1. Toolbar > Steel 버튼 클릭



2. Steel Name 입력 : "case"

3. 좌표점 추가 (총6개) : 'A' 버튼 클릭

4. Case 형상 입력

✓ Case 위치 : Base\_X 4.4, Base\_Y -10.4

✓ 1 점 : X 0, Y 0

✓ 2 점 : X 11.2, Y 0

✓ 3 점 : X 11.2, Y 25.2

✓ 4 점 : X 7.4, Y 25.5

✓ 5 점 : X 7.4, Y 7.6

✓ 6 점 : X 0, Y 7.6

5. 화면 조정 : Fit All 버튼 사용

6. OK 버튼 클릭

7. 형상 확인 (FEMM 창)

2~3

Steel Name : case  
Face Type : POLYGON  
Base\_X : 0.0 Base\_Y : 0.0

No.	X	Y	Arc	Dir.	Del.	Add
1			<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
2			<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
3			<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
4			<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
5			<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
6			<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	<input type="button" value="A"/>

Buttons: Redraw, Fit All, Reserved, OK, Cancel

4~5

Steel Name : case  
Face Type : POLYGON  
Base\_X : 4.4 Base\_Y : -10.4

No.	X	Y	Arc	Dir.	Del.	Add
1	0	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
2	11.2	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
3	11.2	25.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
4	7.4	25.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
5	7.4	7.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	
6	0	7.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="button" value="D"/>	<input type="button" value="A"/>

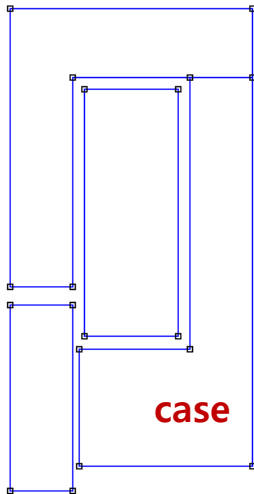
Buttons: Redraw, Fit All, Reserved, OK, Cancel

# Case 설정

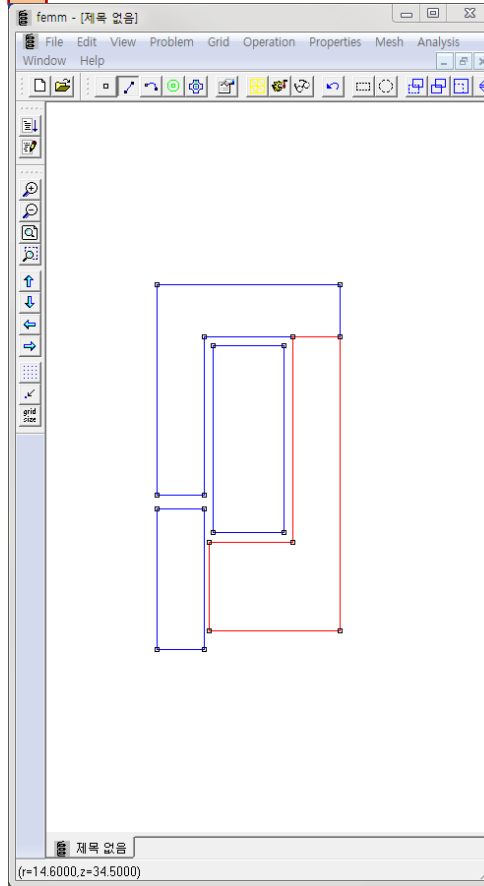
## 6. 형상 확인 (FEMM 창)

## 7. Case 속성 설정

- ✓ Part Material : 1010 Steel
- ✓ Moving Parts : FIXED



6



7

Common Fields	
Node Name	case
Specification Fields	
Part Material	1010 Steel
Moving Parts	FIXED

# 자기력 가상실험

1. Toolbar > Force 버튼 클릭



2. Experiment Name 입력 : "force"

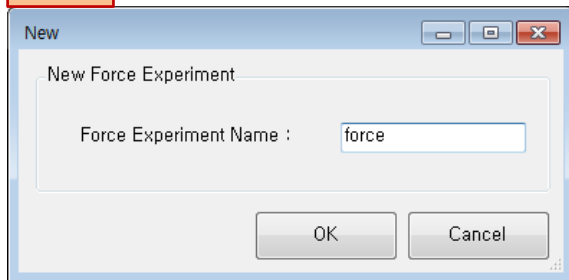
3. OK 버튼 클릭

4. 자기력 가상실험 설정

✓ Voltage : 14.5 V

5. 자기력 가상실험 실행

2~3



4

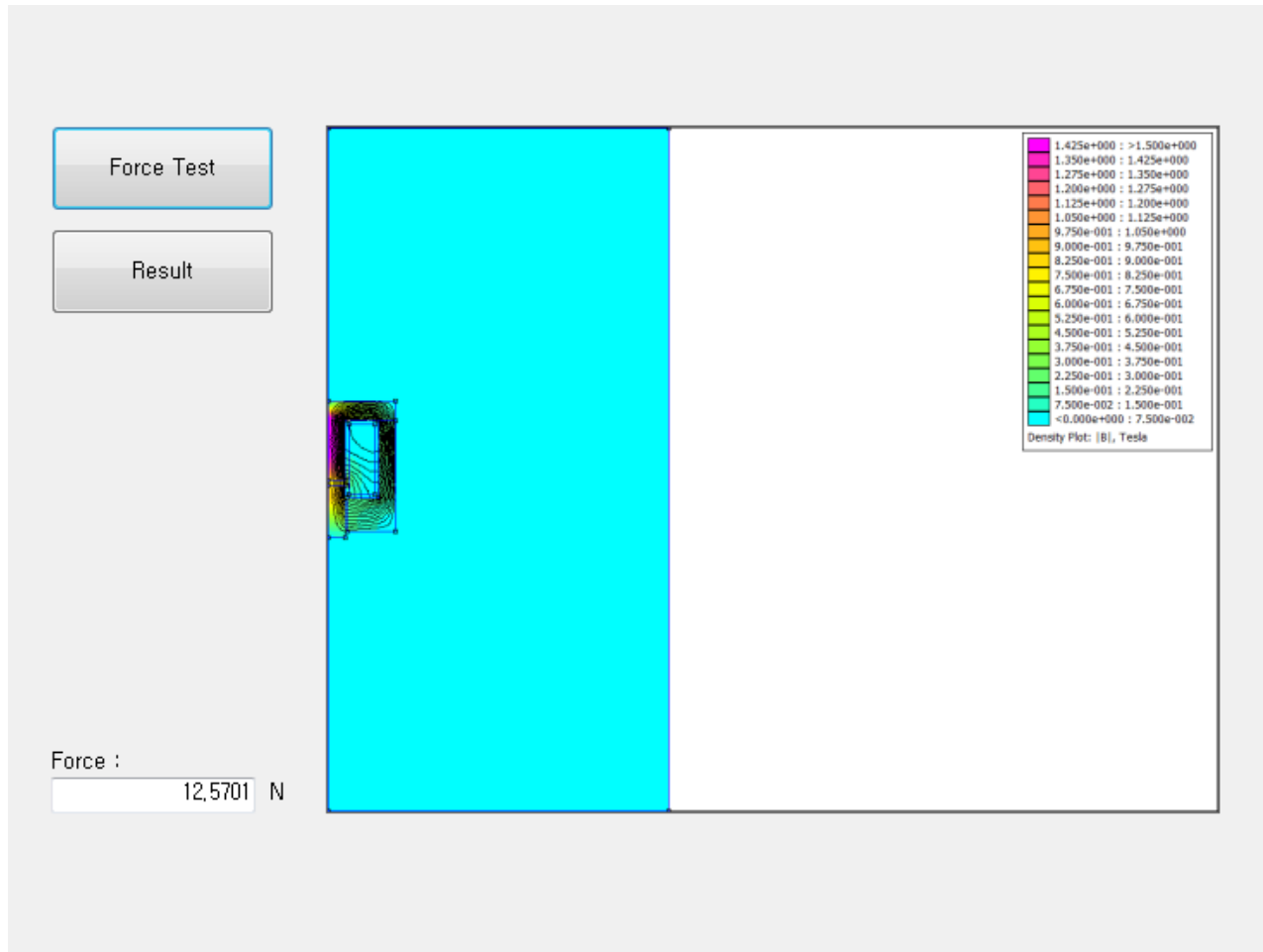
Common Fields	
Node Name	force
Input Fields	
Voltage [V]	14.5
Max. Current [A]	0.95335
Stroke Fields	
Moving Stroke [mm]	0

5



# 자기력 가상실험 결과

1. Force : 12.57 N



# 변위-자기력 가상실험

1. Toolbar > Stroke 버튼 클릭



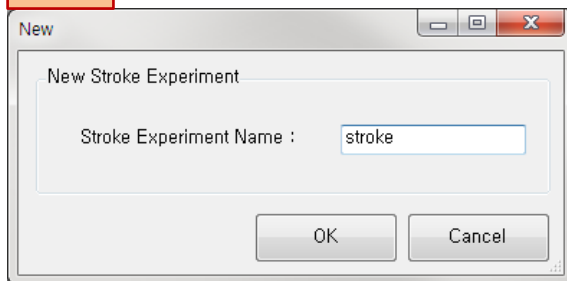
2. Experiment Name 입력 : "stroke"

3. OK 버튼 클릭

4. 자기력-전류 가상실험 설정

- ✓ Voltage : 14.5 V
- ✓ Initial Stroke : 0.0 mm
- ✓ Final Stroke : 1.0 mm
- ✓ Step Count : 5

2~3



4

Common Fields	
Node Name	stroke
Input Fields	
Voltage [V]	14.5
Max. Current [A]	0.95335
Stroke Fields	
Initial Stroke [mm]	0
Final Stroke [mm]	1
Step Count	5



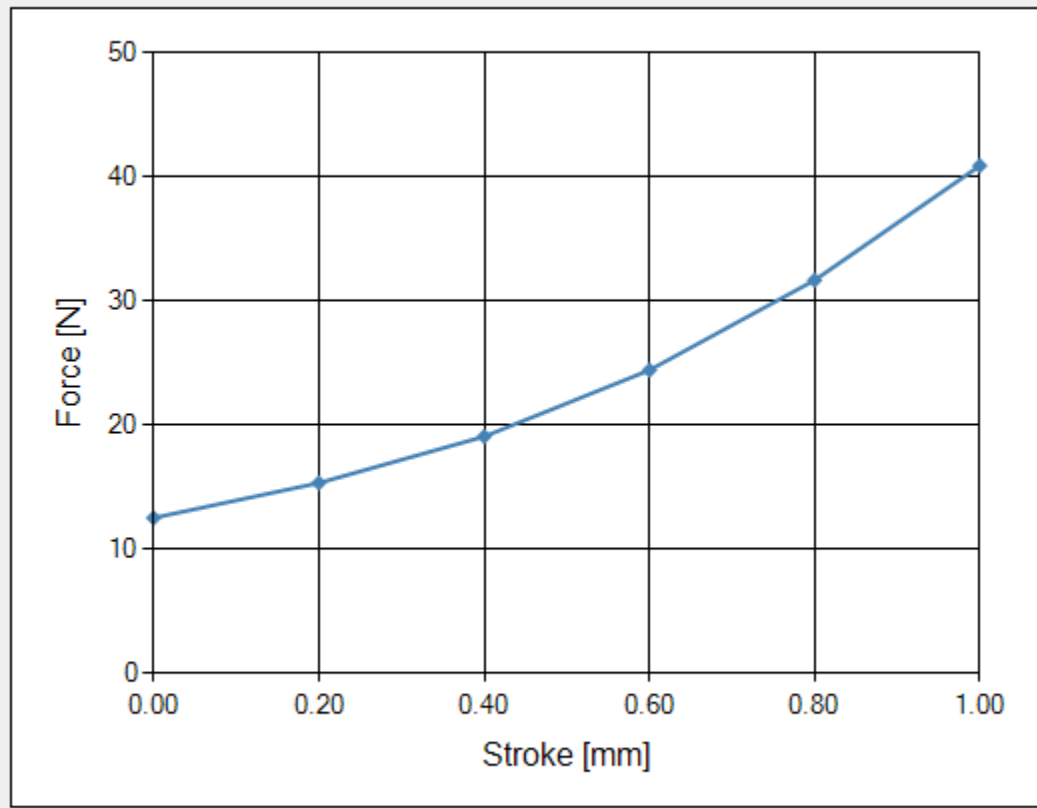
# 변위-자기력 가상실험 결과

1. Information View / Stroke Test 버튼을 클릭

1

Stroke Test

Result



# 전류-자기력 가상실험

1. Toolbar > Current 버튼 클릭



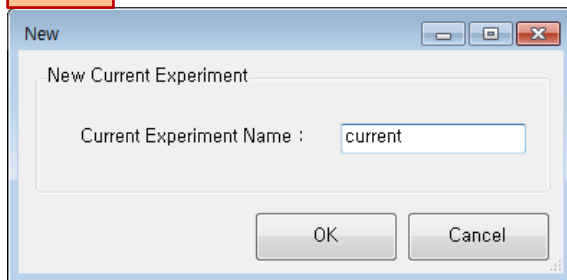
2. Experiment Name 입력 : "current"

3. OK 버튼 클릭

4. 자기력-전류 가상실험 설정

- ✓ Initial Current : 0.0 A
- ✓ Final Current : 1.5 A
- ✓ Step Count : 5

2~3

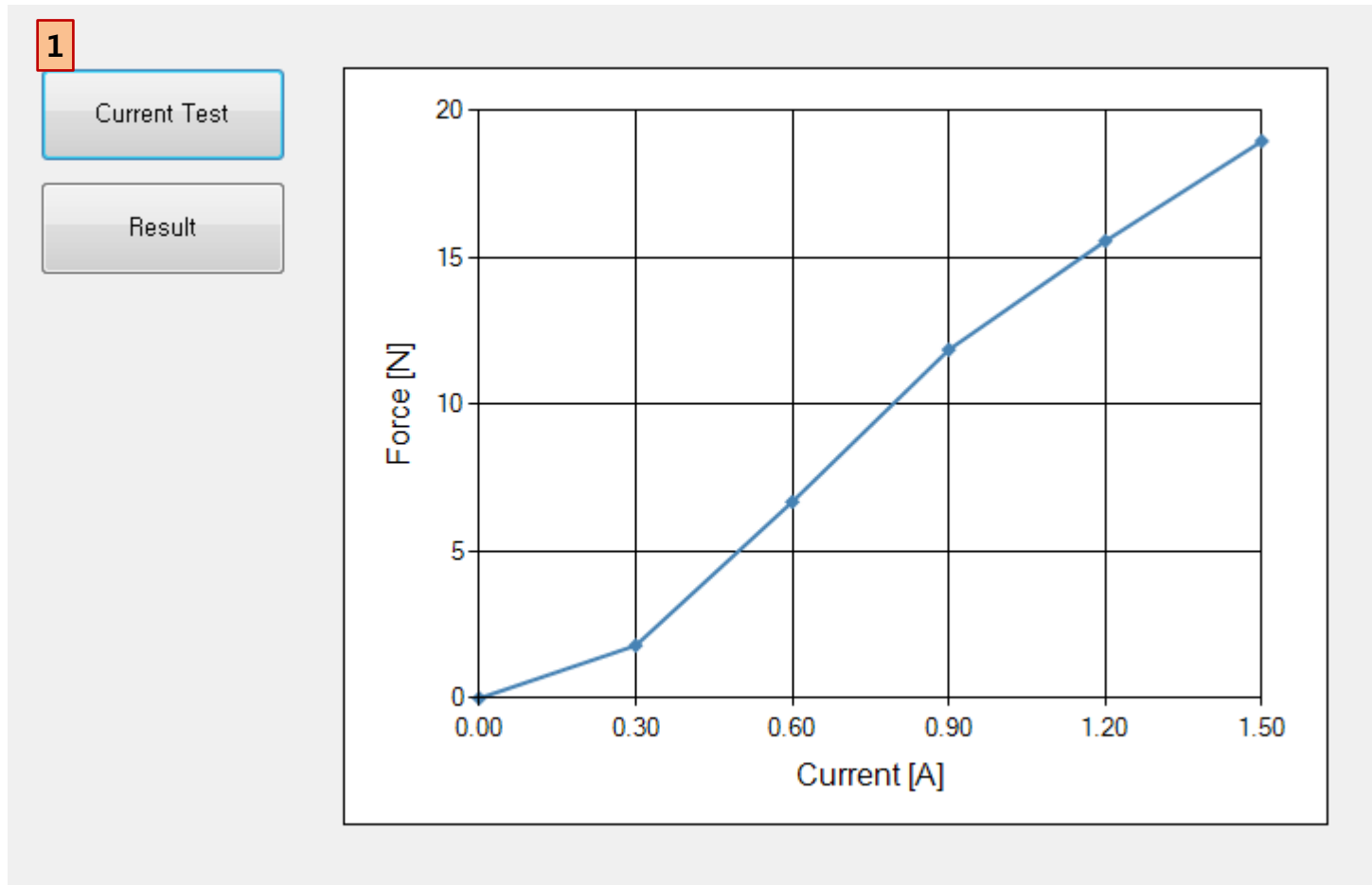


4

Common Fields	
Node Name	current
Current Fields	
Initial Current [A]	0
Final Current [A]	1.5
Step Count	5
Stroke Fields	
Moving Stroke [mm]	0

# 전류-자기력 가상실험 결과

1. Information View / Current Test 버튼을 클릭





**– Thank You –**

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