ANSYS Simulation (2)

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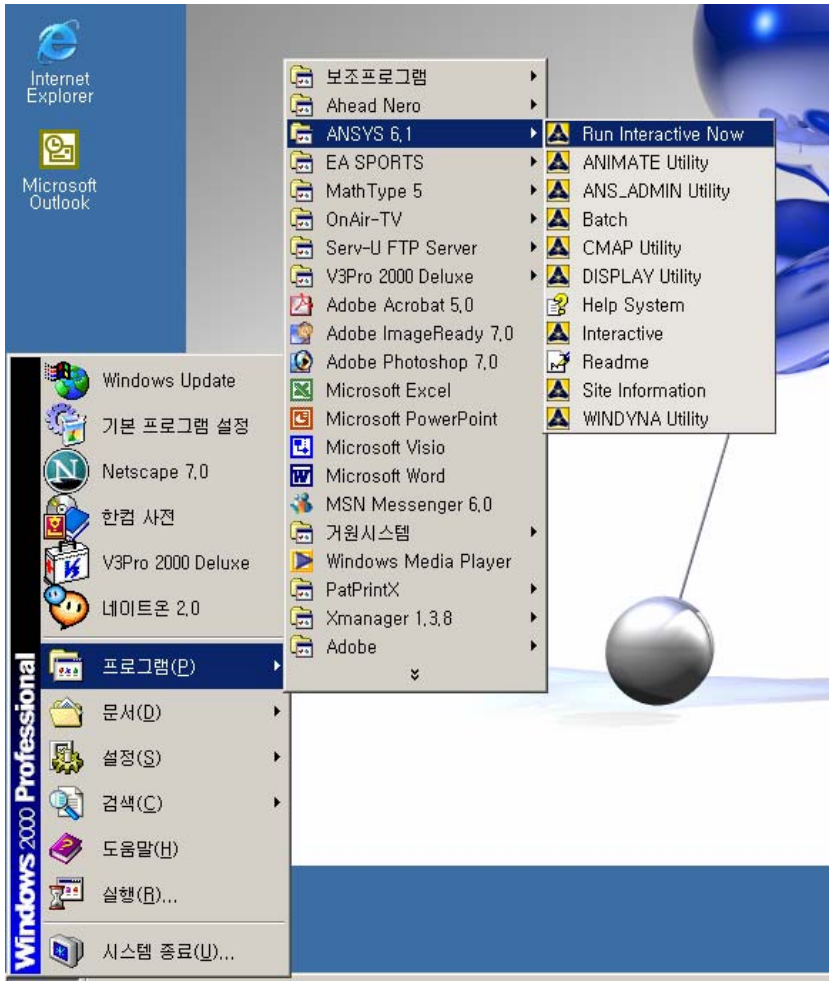
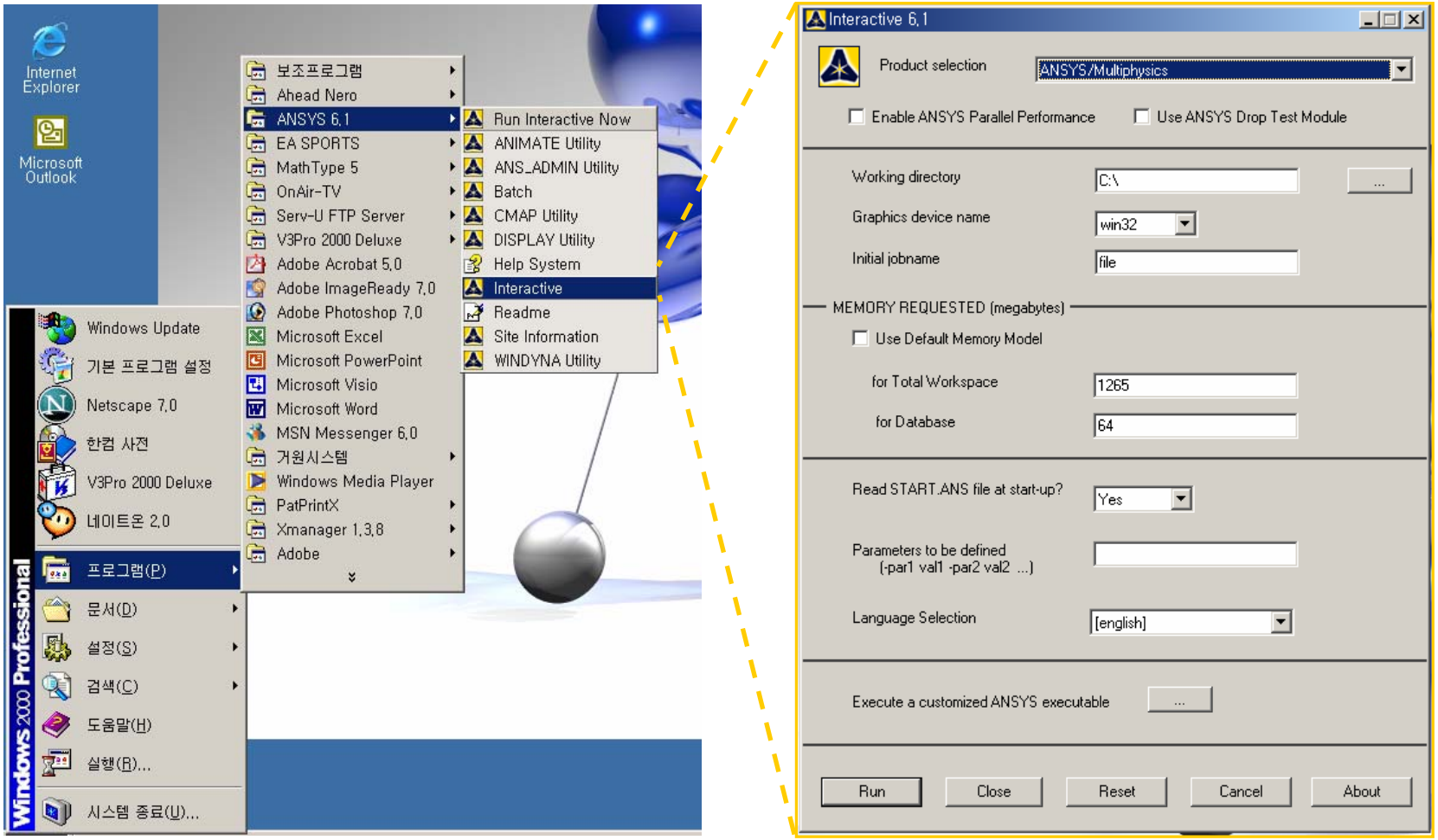
ANSYS 실습

- ***ANSYS*** *구동* : “Run Interactive Now” 메뉴를 선택



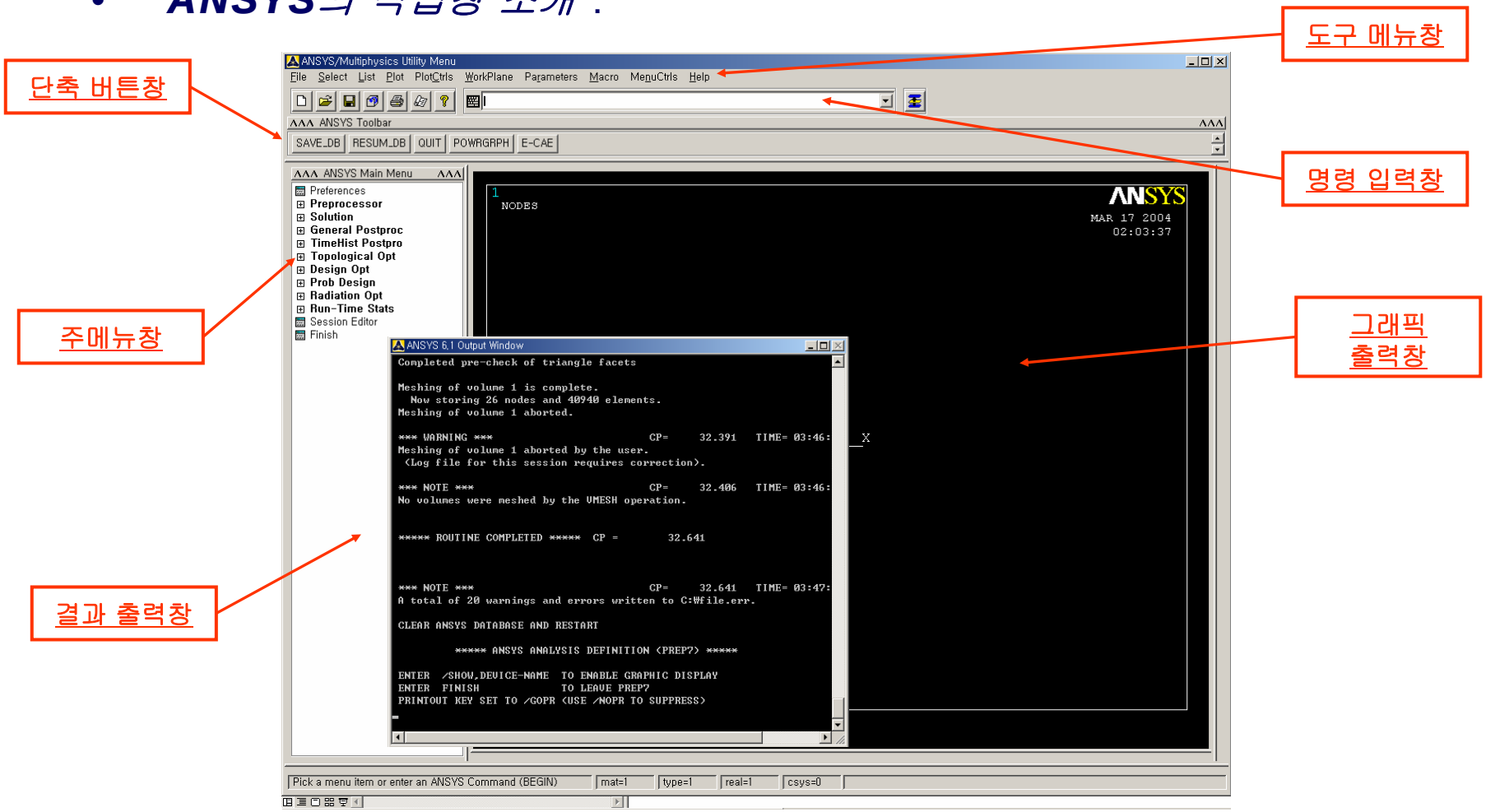
ANSYS 실습 (cont'd)

- *환경 설정* : "Interactive" 메뉴를 선택



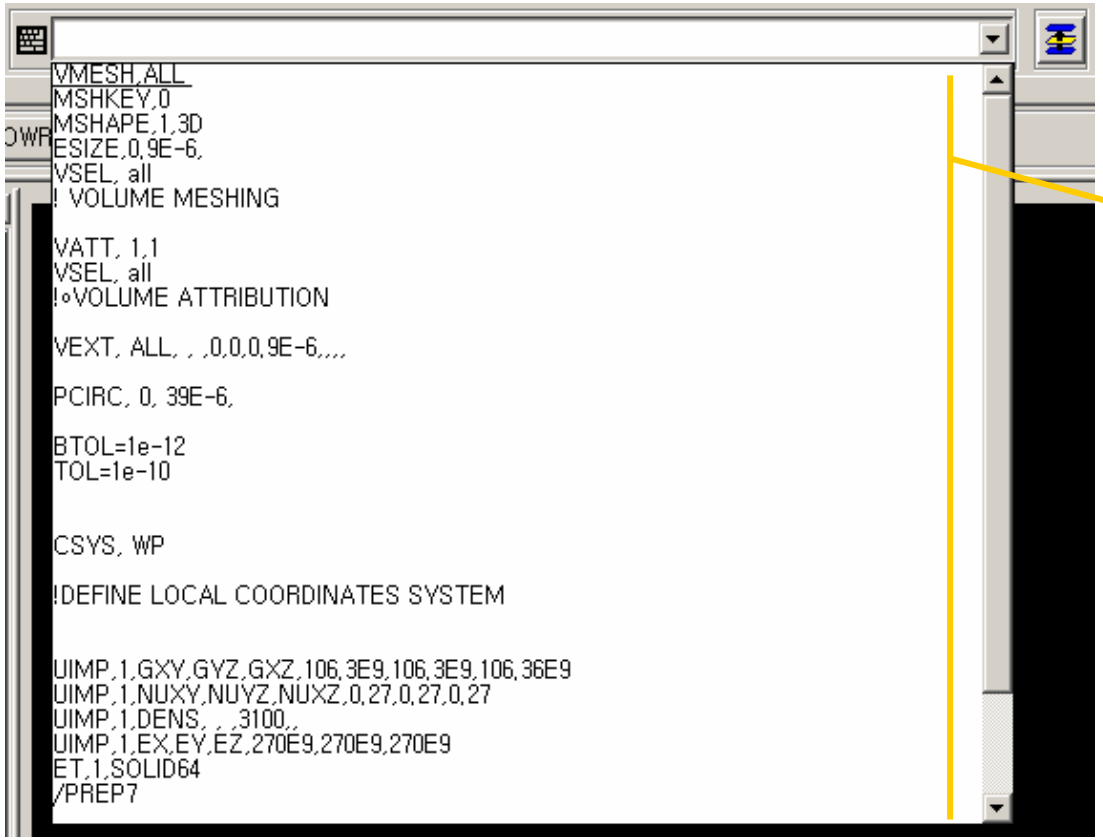
ANSYS 실습 (cont'd)

- ***ANSYS**의 작업창 소개* :



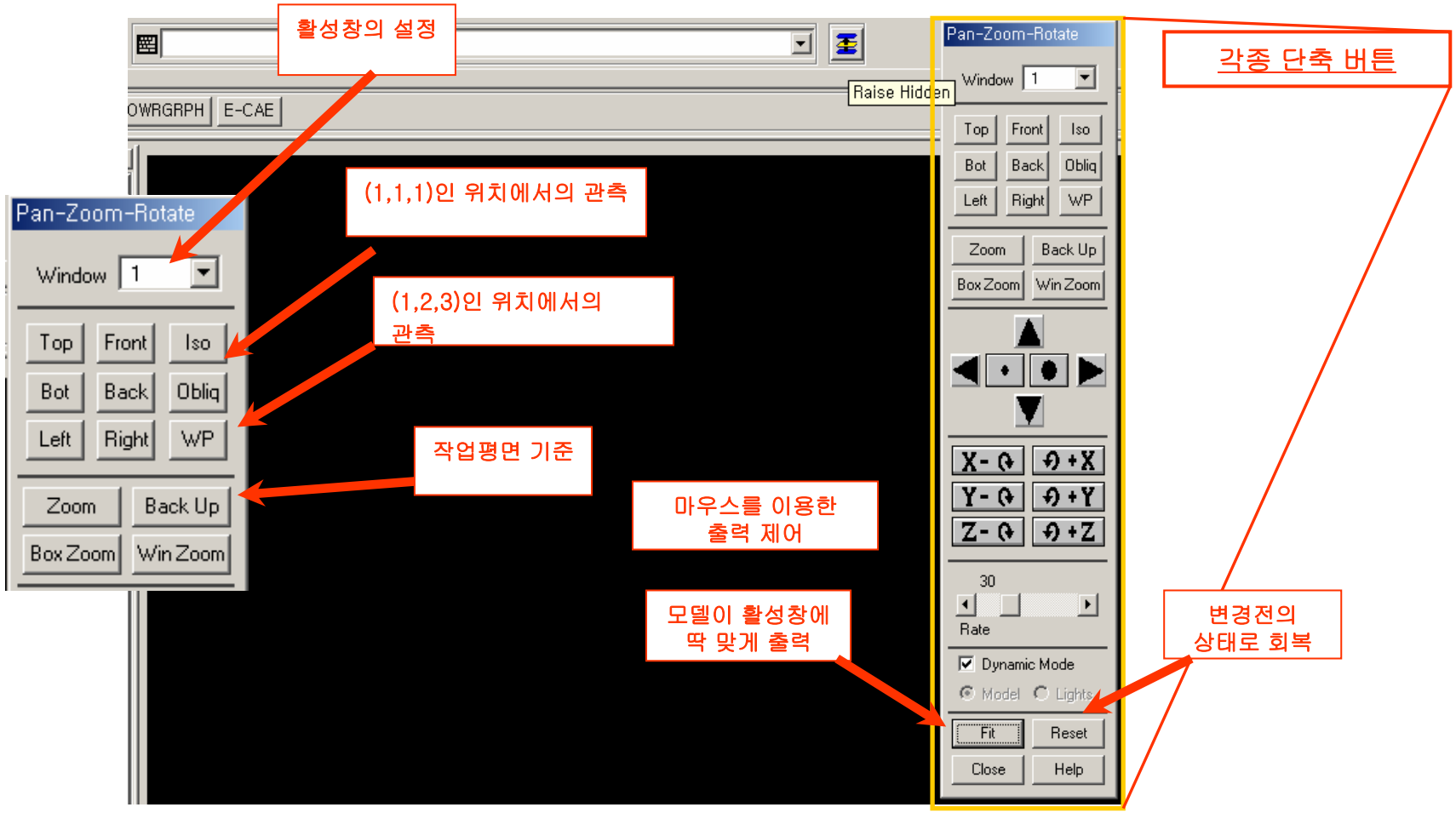
ANSYS 실습 (cont'd)

- *입력창의 사용법* :



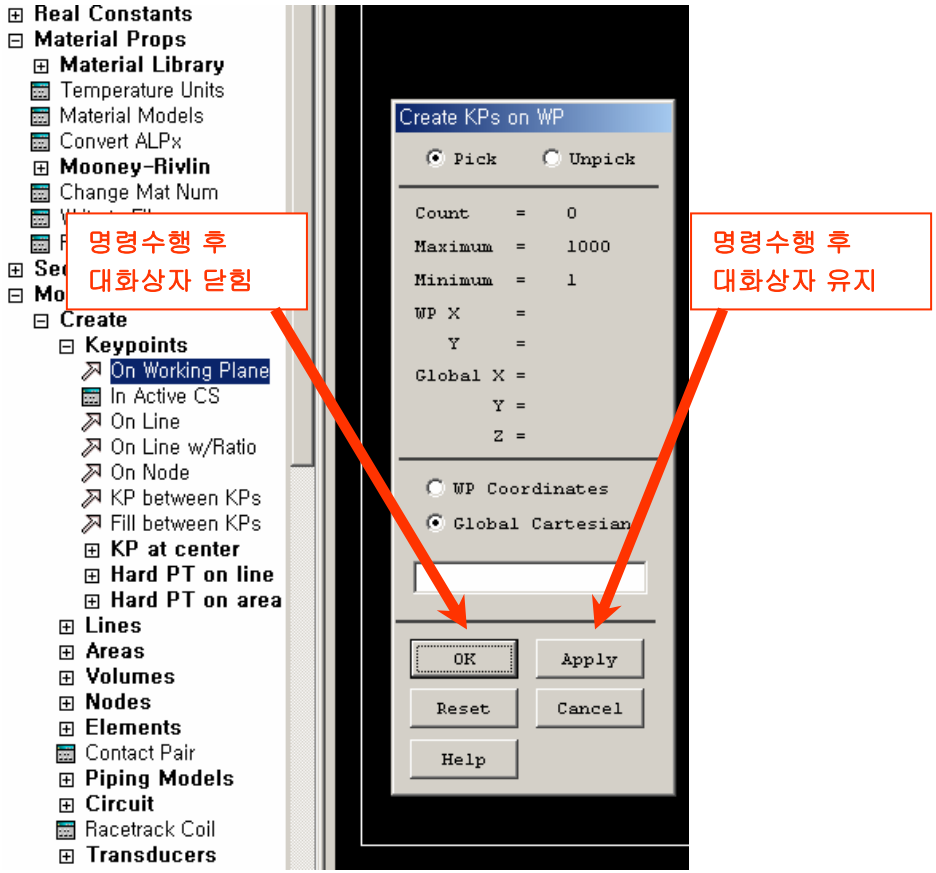
ANSYS 실습 (cont'd)

- *도구모음상자의 사용법* :



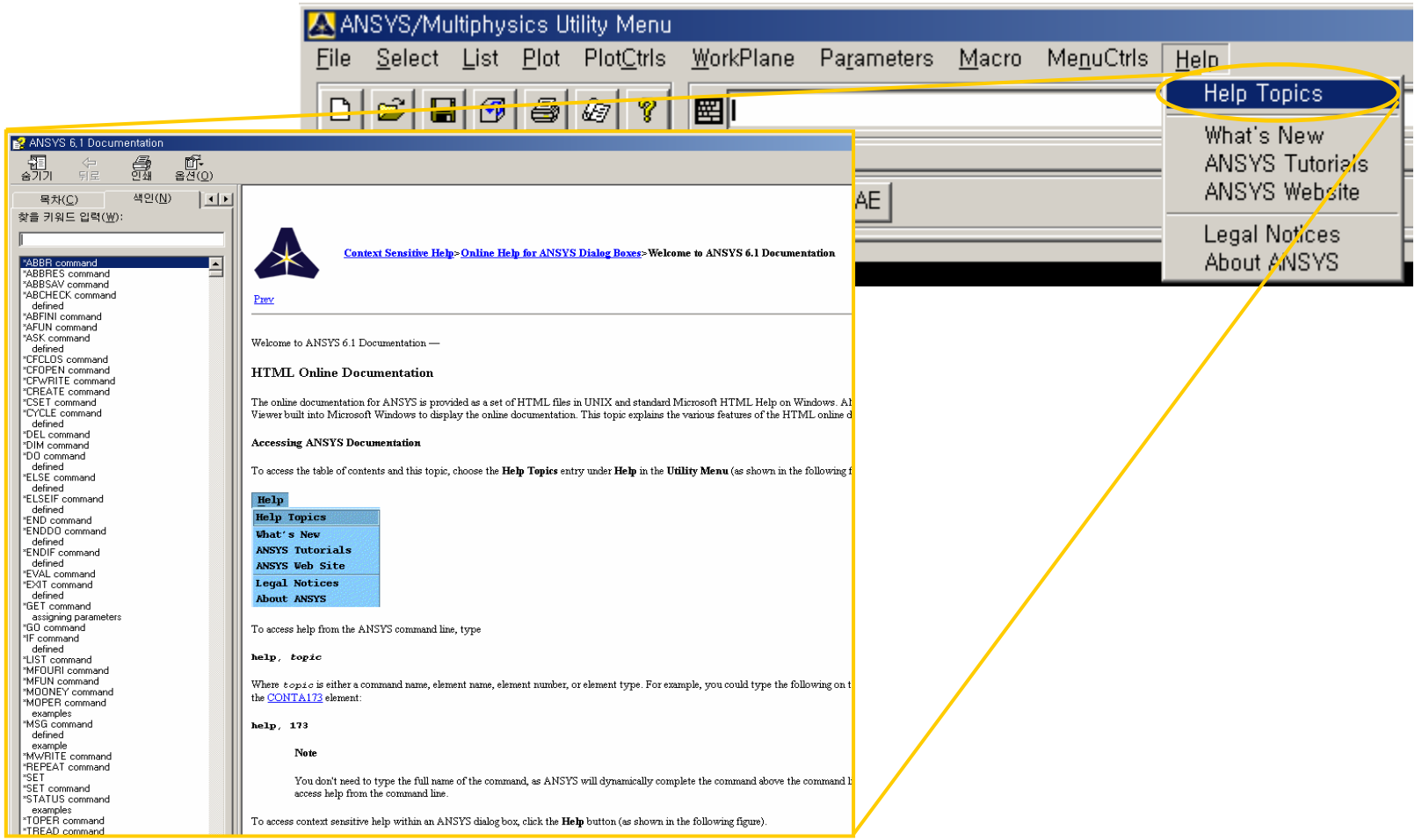
ANSYS 실습 (cont'd)

- *대회상자의 사용법* :



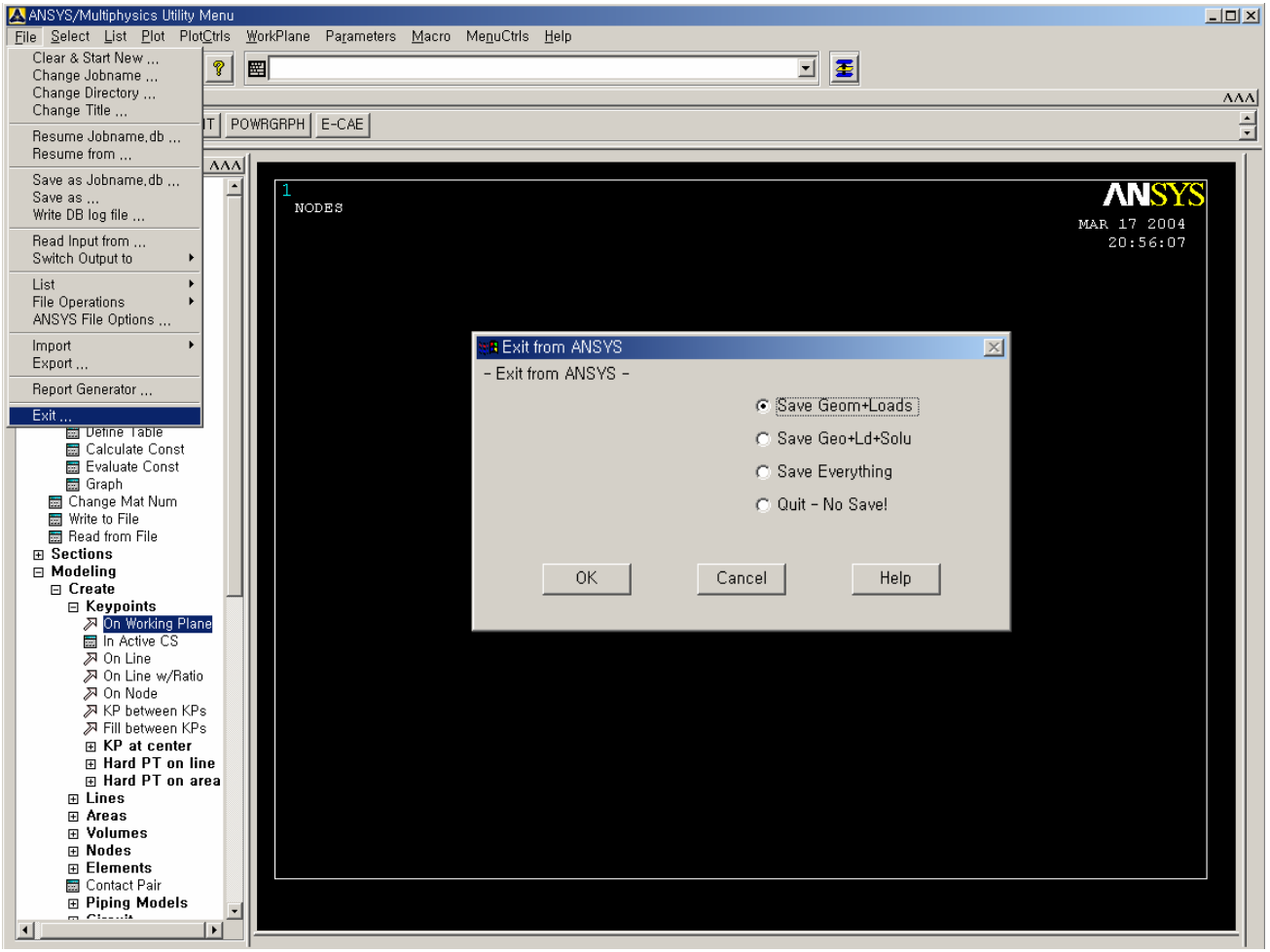
ANSYS 실습 (cont'd)

- *도움말 시스템* :



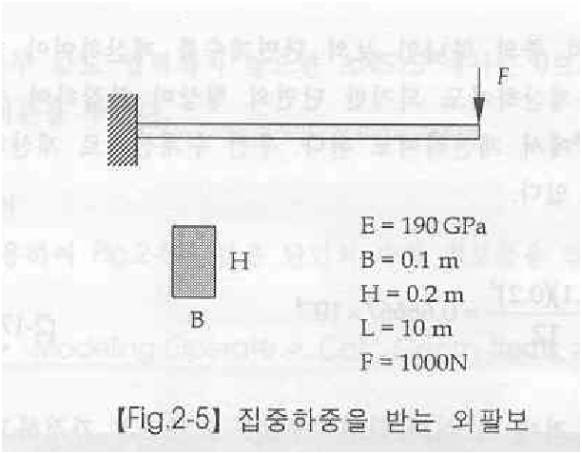
ANSYS 실습 (cont'd)

- *도움말 시스템 : **'OK' button**을 눌러 종료*



GUI를 통한 ANSYS 예제

- ***Beam****의 단면 및 속성 확인*



【Fig.2-5】 집중하중을 받는 외팔보

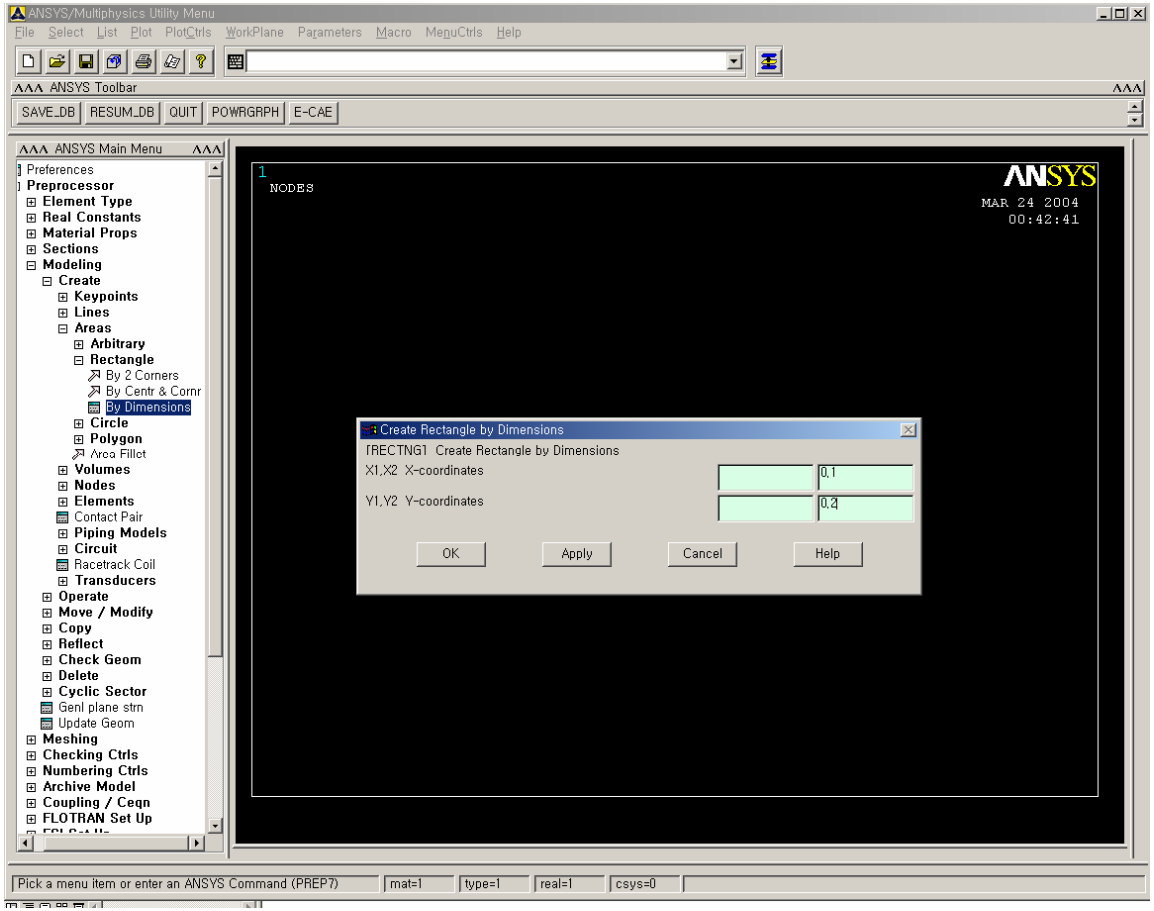
- Analytical solution of moment of inertia :

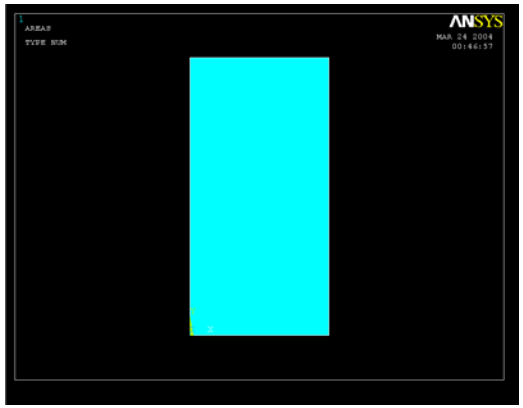
$$I_{xx} = \frac{bh^3}{12} = \frac{(0.1)(0.2)^3}{12} = 0.66667 \times 10^{-4}$$

GUI를 통한 ANSYS 예제 (cont'd)

- *단면의 모델링* :

Preprocessor > Modeling > Create > Areas > Rectangle > By Dimensions

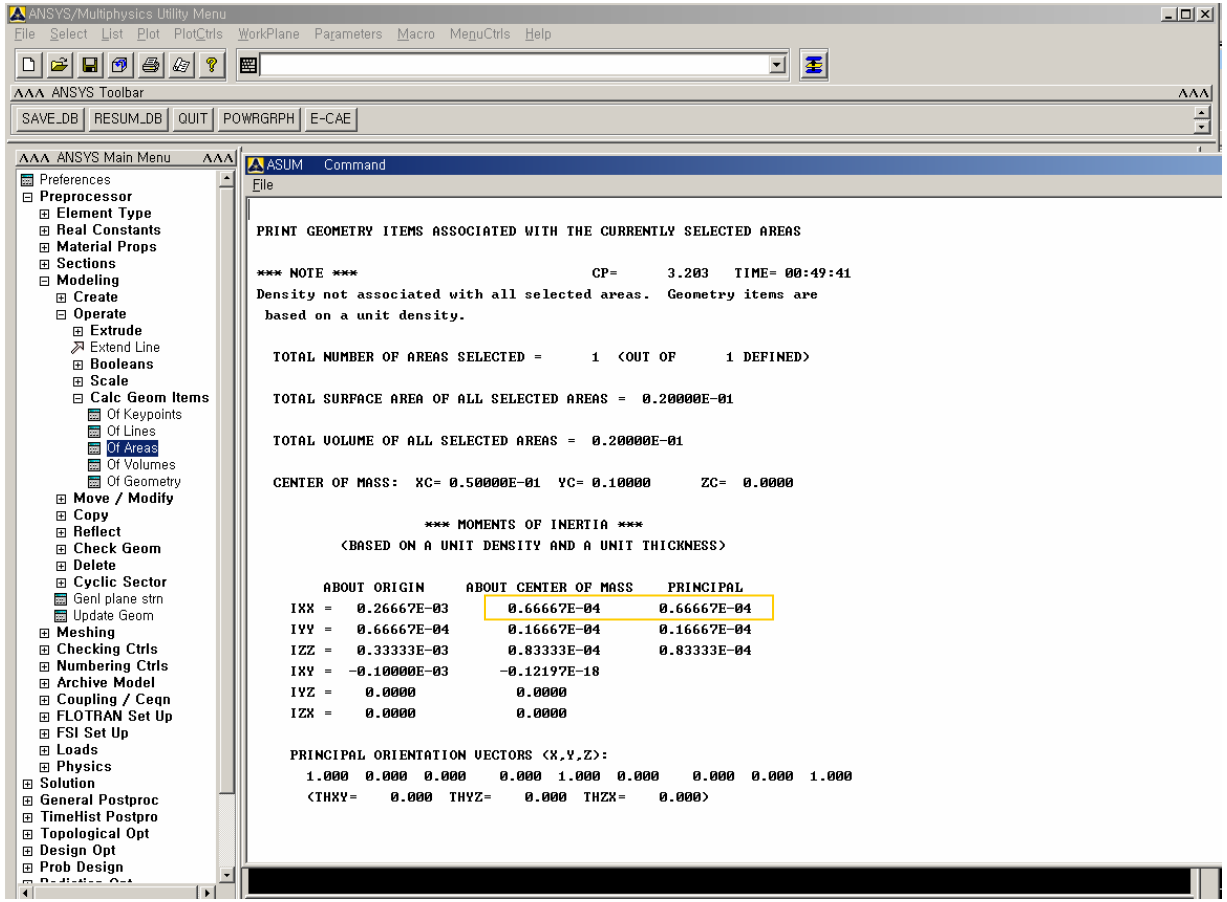




GUI를 통한 ANSYS 예제 (cont'd)

- *단면 속성의 확인* :

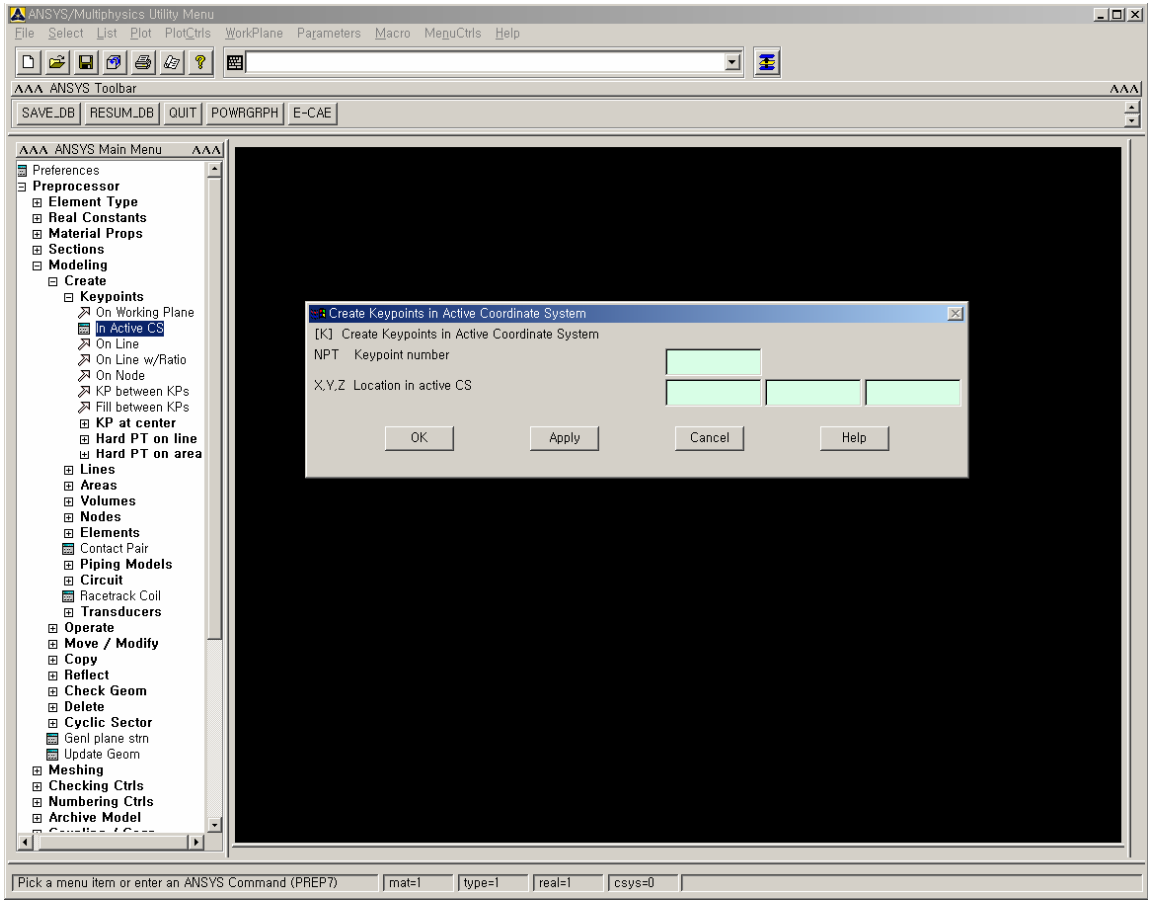
  Preprocessor > Modeling > Operate > Calc Geom Items > Rectangle > Of Areas



GUI를 통한 ANSYS 예제 (cont'd)

- *두 점의 생성* : ***(0, 0, 0)***

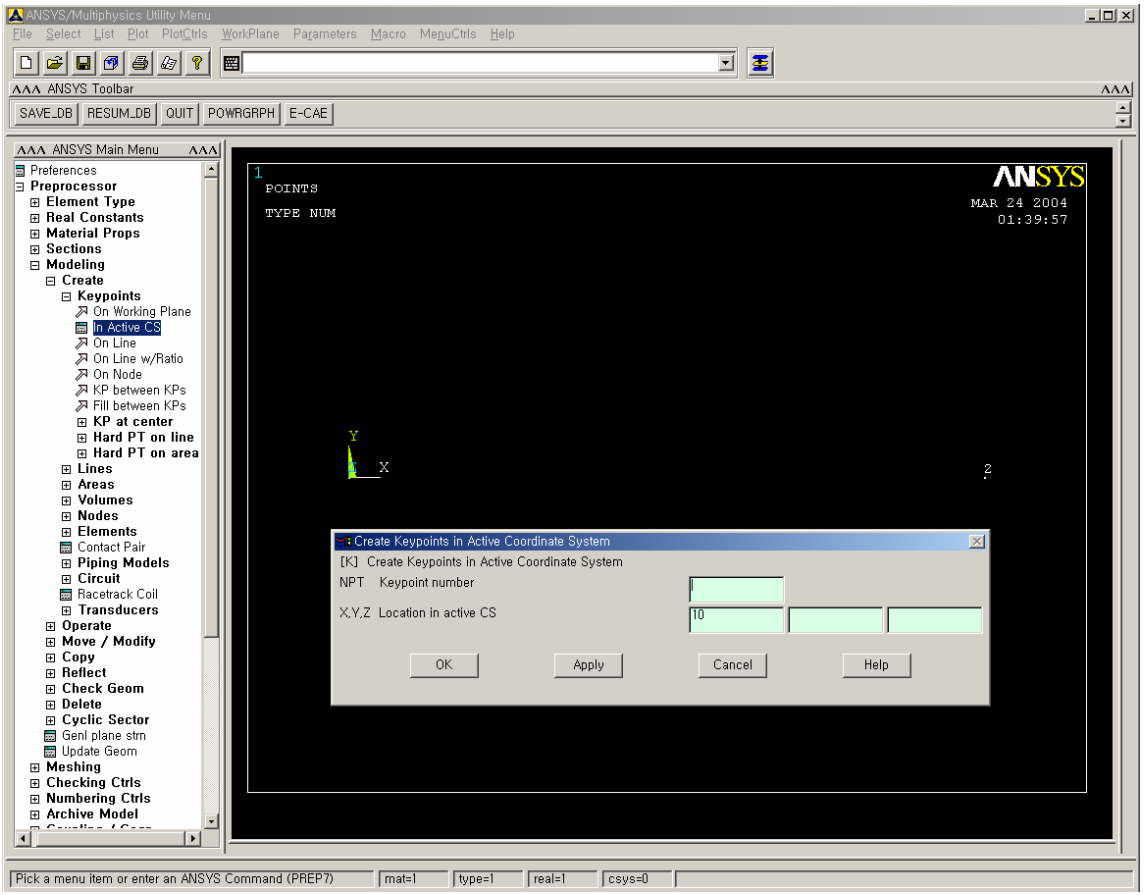
Preprocessor > Modeling > Create > Keypoints > In Active CS



GUI를 통한 ANSYS 예제 (cont'd)

- *두 점의 생성* : ***(10, 0, 0)***

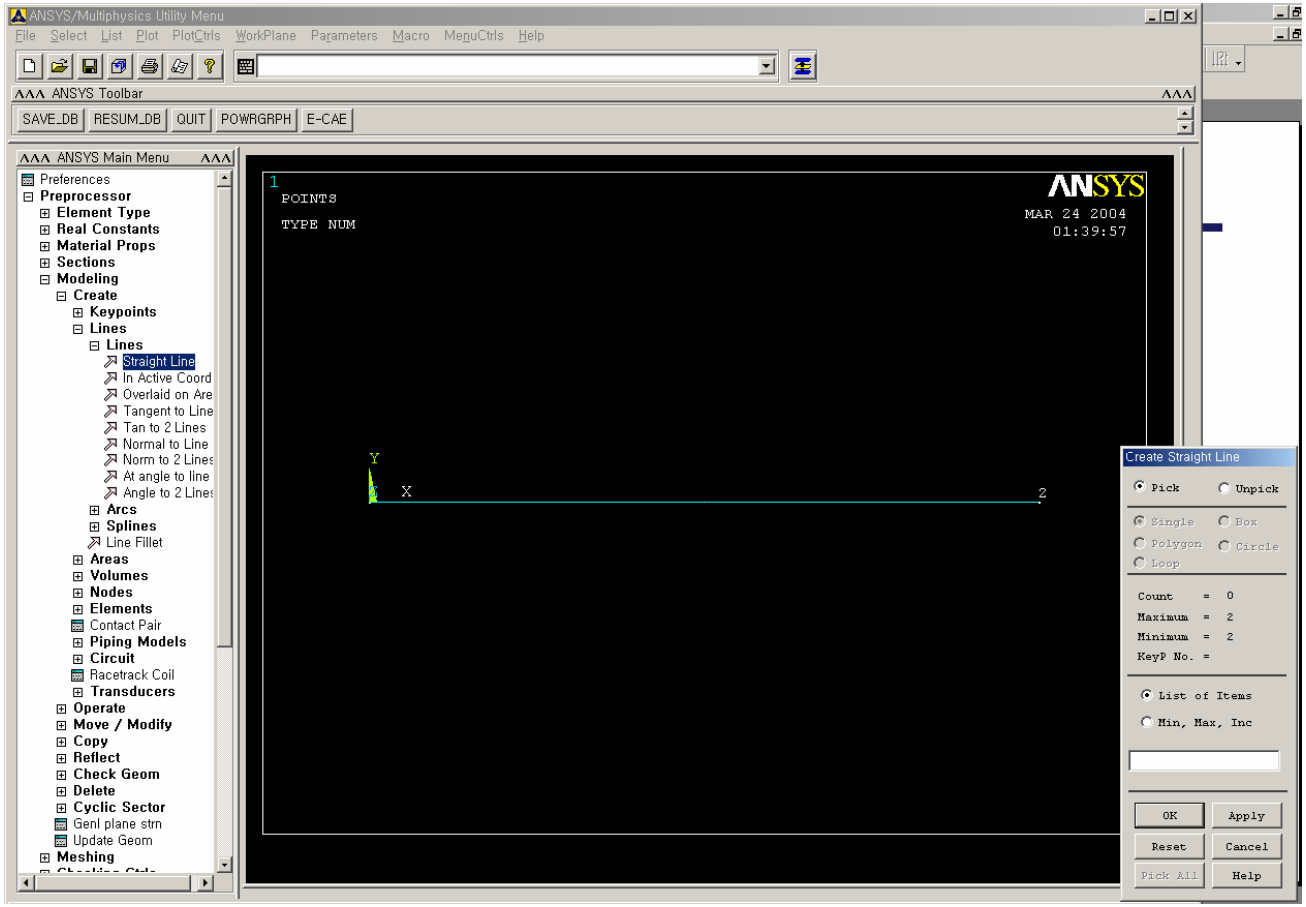
Preprocessor > Modeling > Create > Keypoints > In Active CS



GUI를 통한 ANSYS 예제 (cont'd)

- *직선의 생성* :

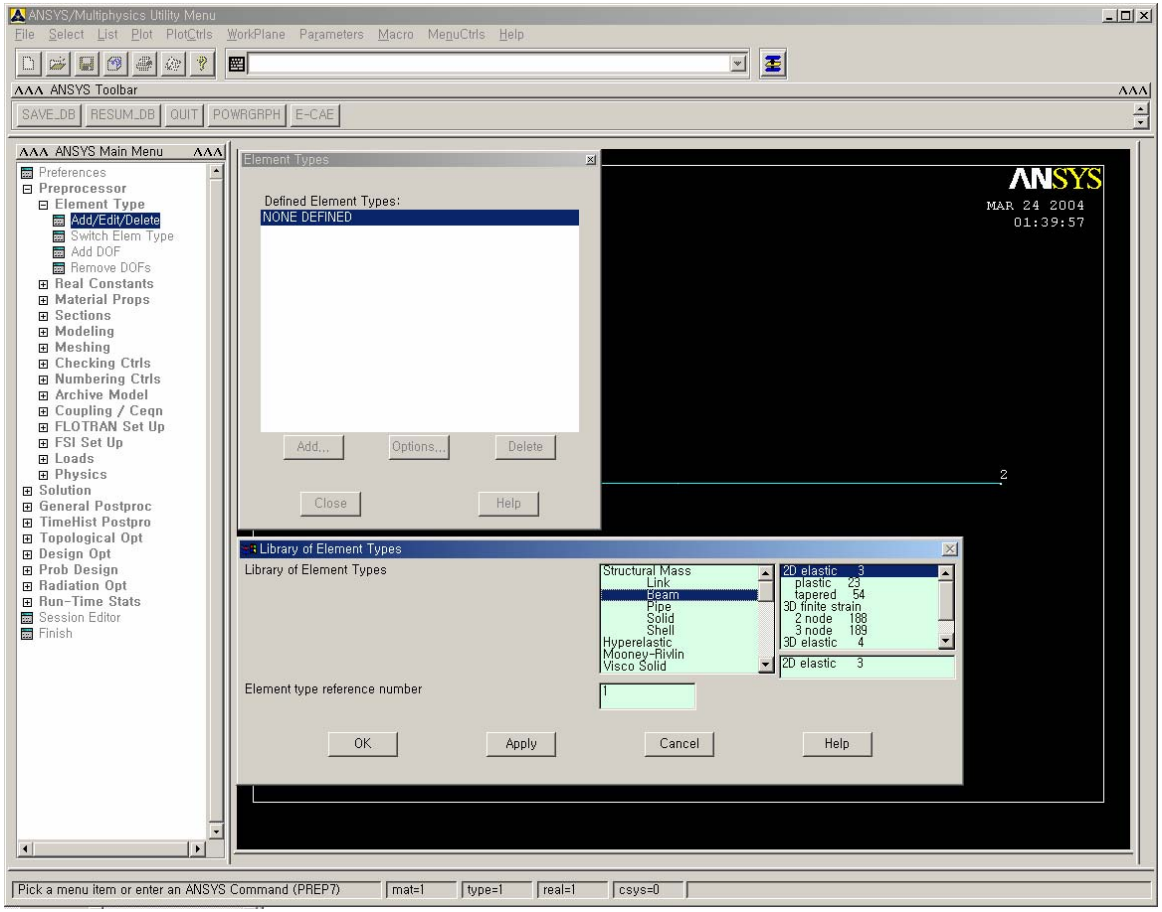
Preprocessor > Modeling > Create > Lines > Lines > Straight Line



GUI를 통한 ANSYS 예제 (cont'd)

- *해석에 사용될 요소의 종류 선택* :

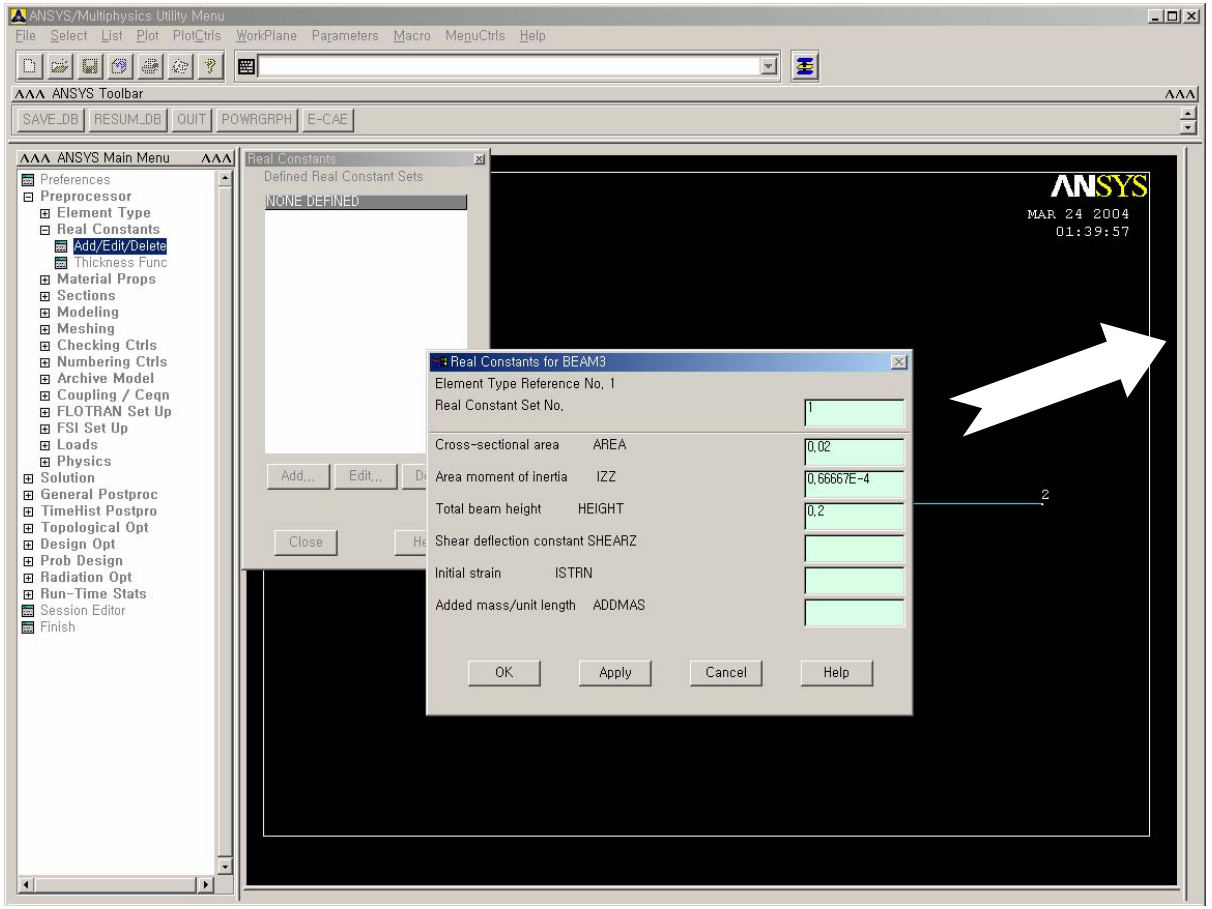
  Preprocessor > Element type > Add/Edit/Delete …



GUI를 통한 ANSYS 예제 (cont'd)

- *요소의 종류에 따른 요소 상수의 성질* :

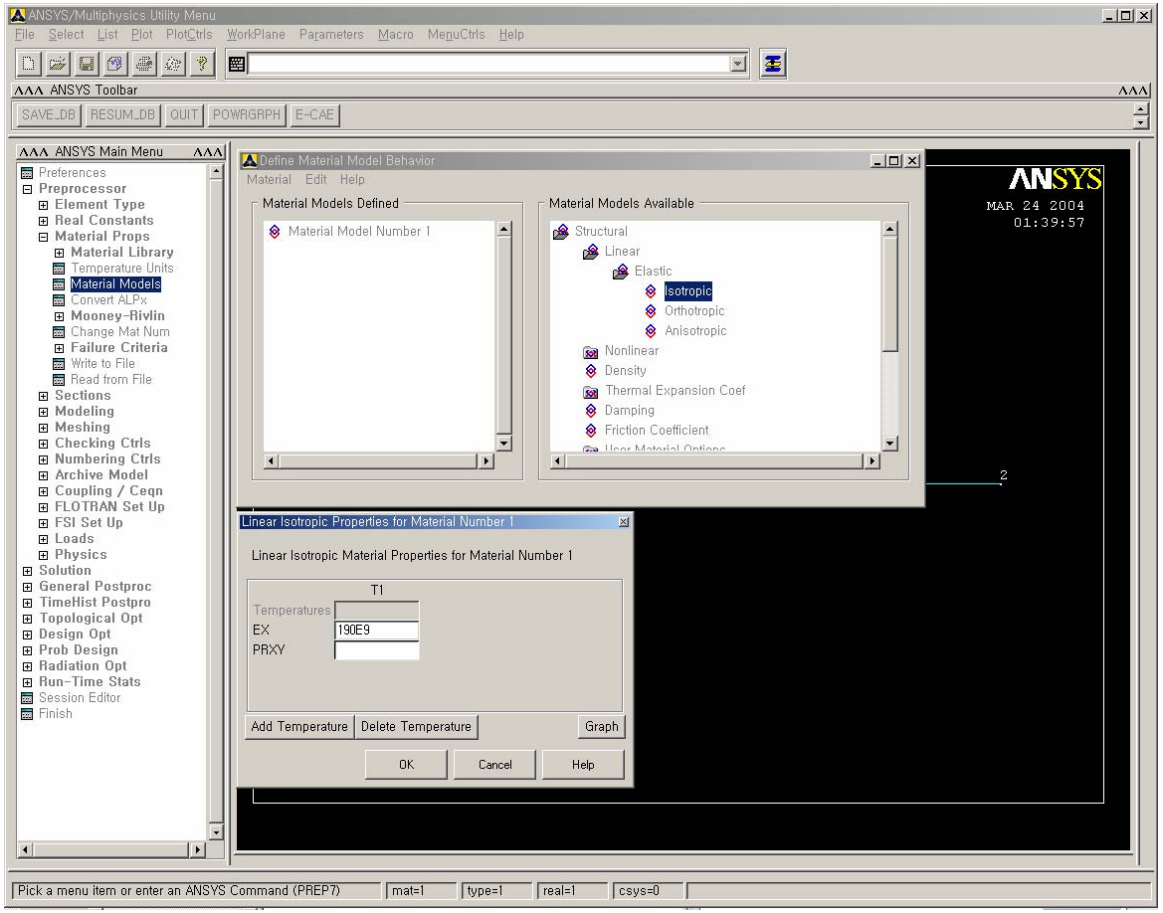
Preprocessor > Element type > Add/Edit/Delete …



GUI를 통한 ANSYS 예제 (cont'd)

- *재료 물성치의 입력* :

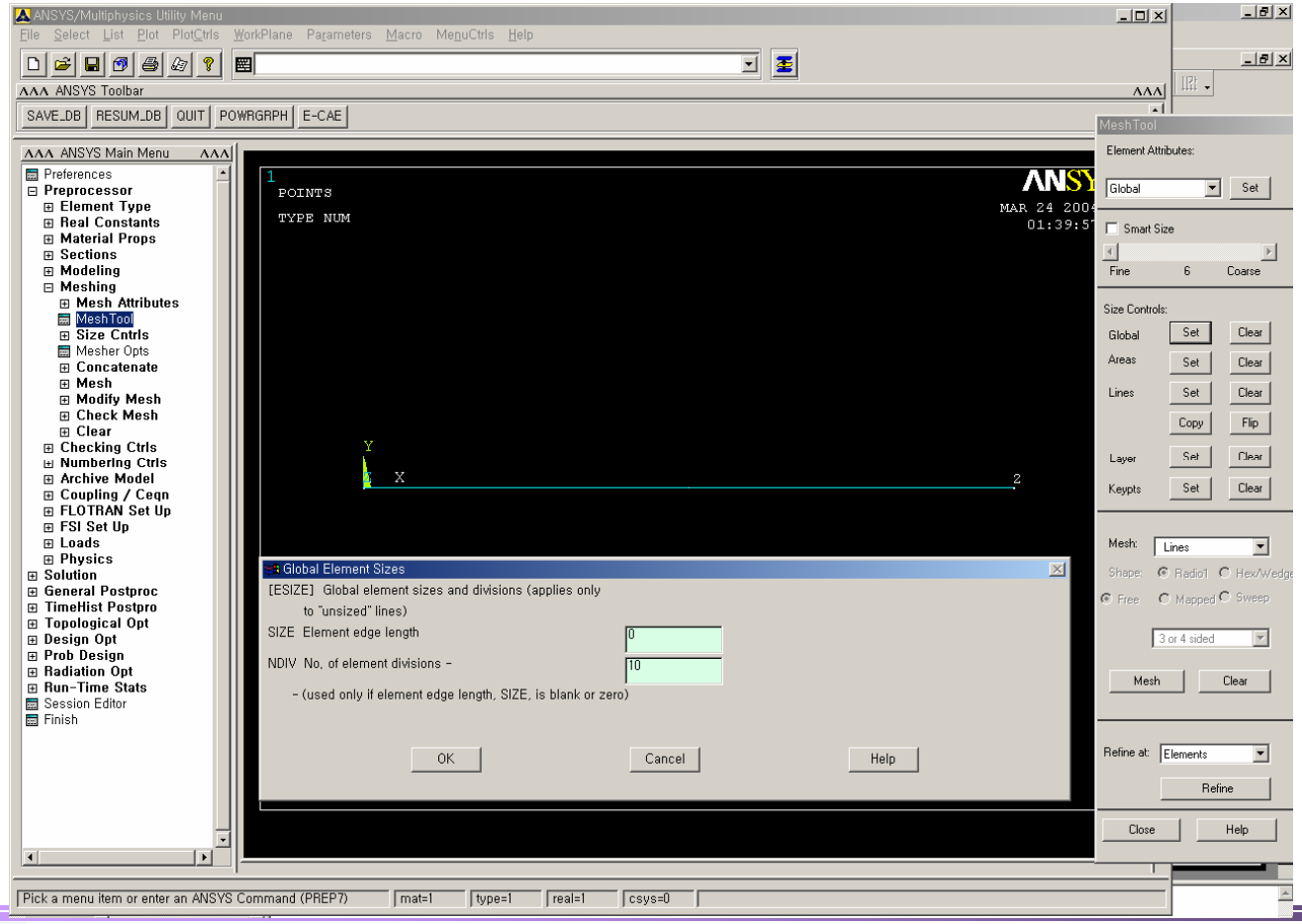
Preprocessor > Material Props > Material Models …



GUI를 통한 ANSYS 예제 (cont'd)

- *요소망 밀도의 조절* :

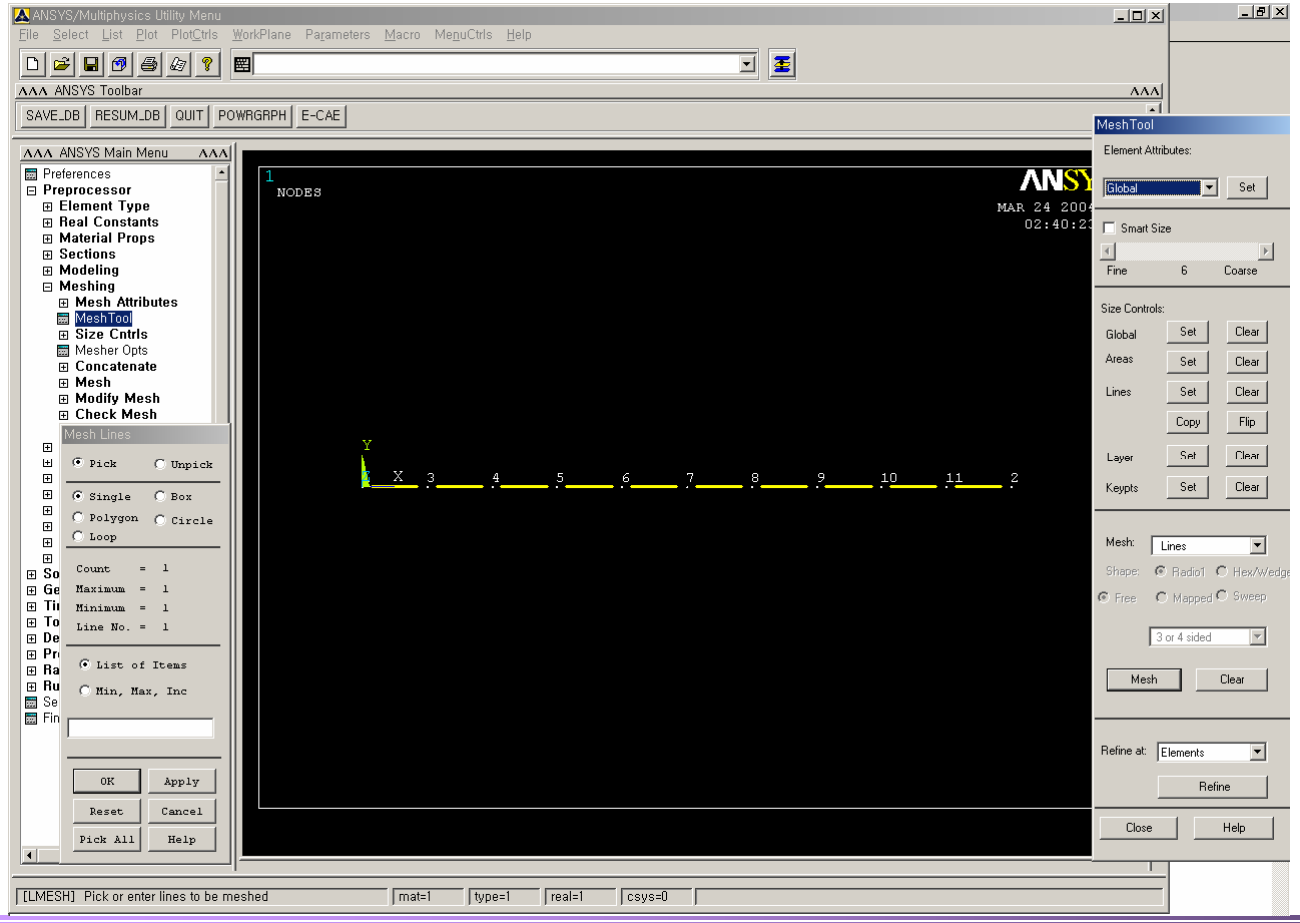
Preprocessor > Meshing > Mesh Tool > Global – set …



GUI를 통한 ANSYS 예제 (cont'd)

- *요소망 밀도의 조절* ***(cont'd)*** :

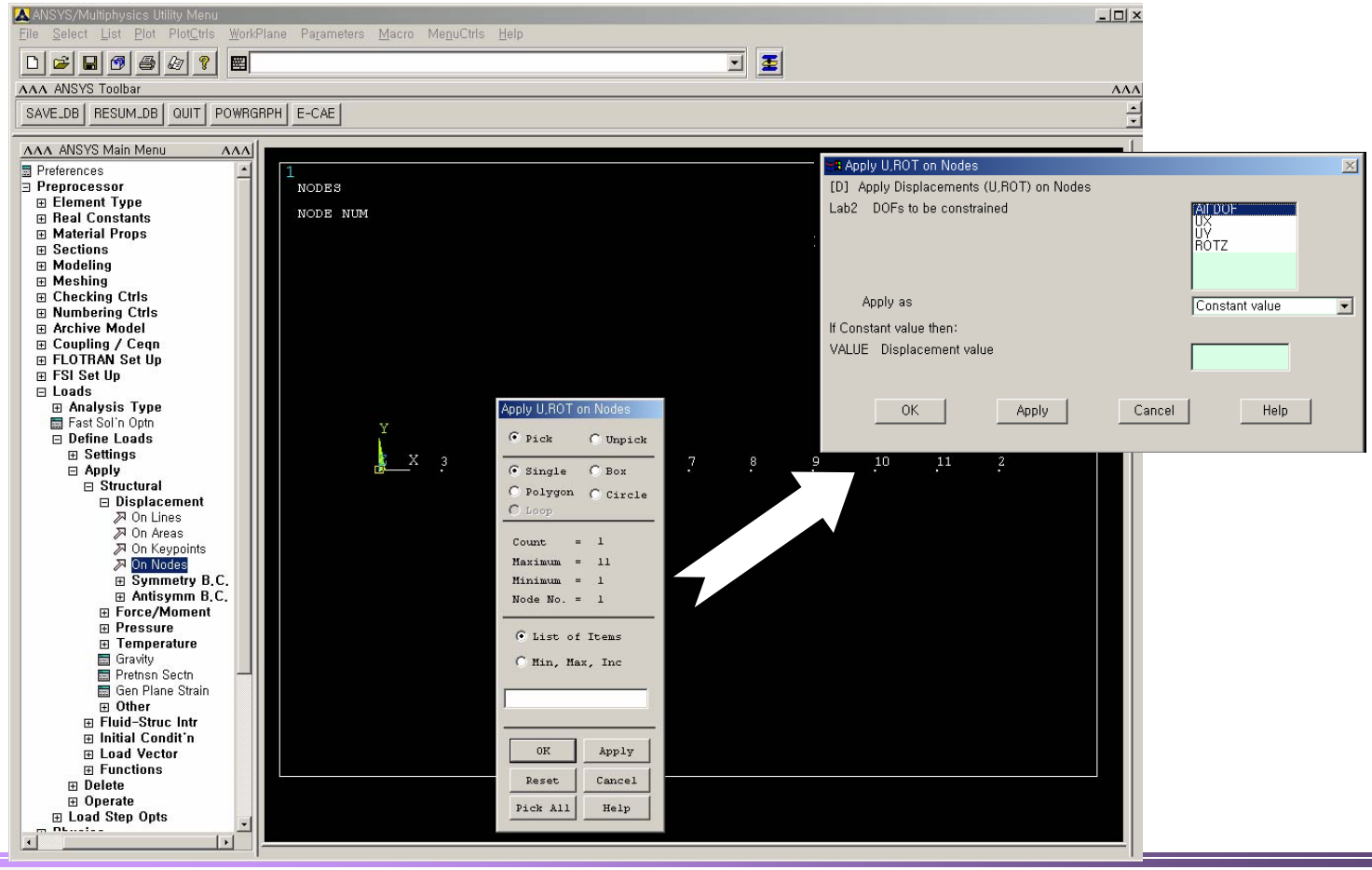
  Preprocessor > Meshing > Mesh Tool > Mesh …



GUI를 통한 ANSYS 예제 (cont'd)

- *경계조건의 적용* :

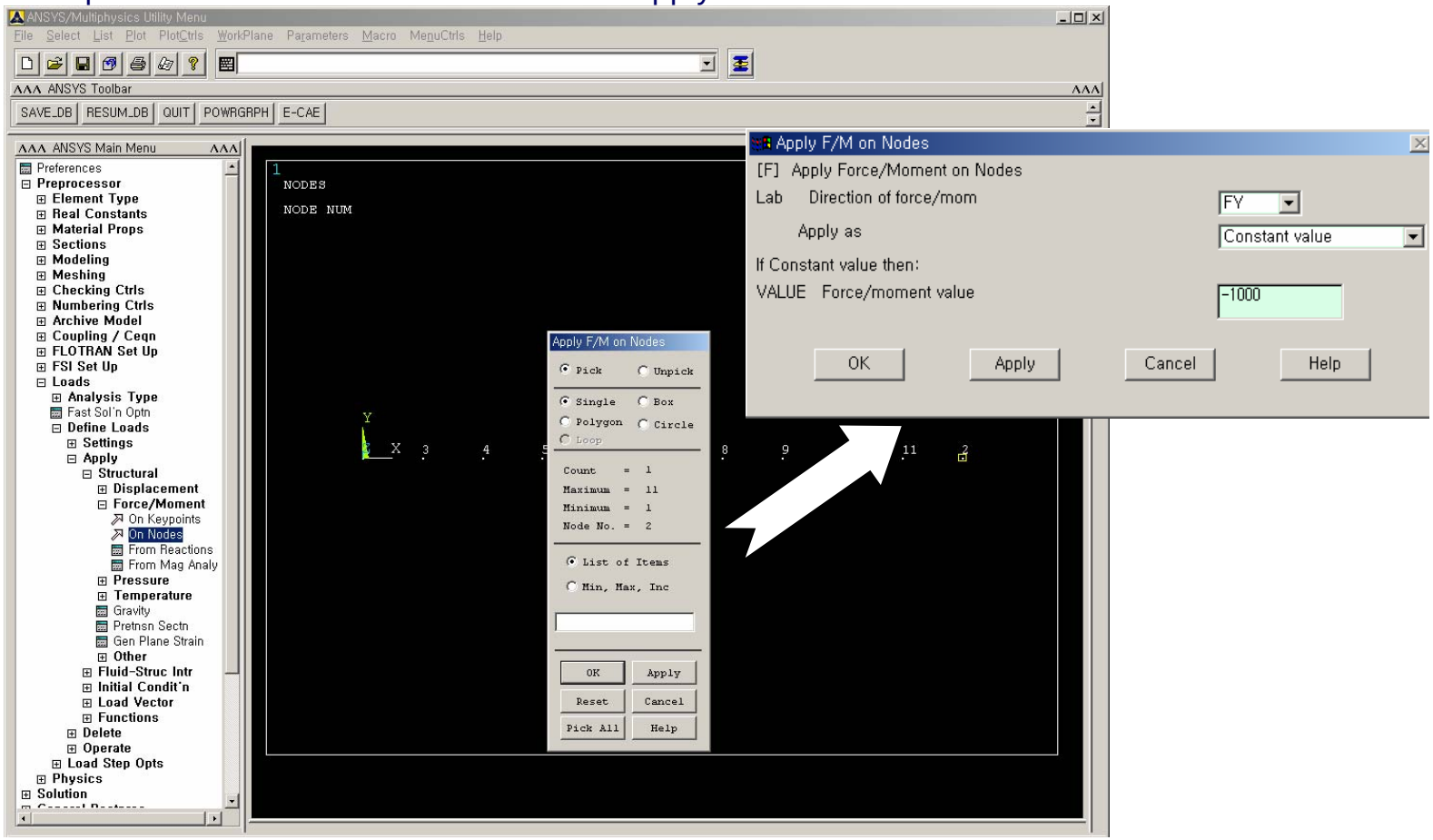
Preprocessor > Loads > Define Loads > Apply > Structural > Displacement > On Nodes



GUI를 통한 ANSYS 예제 (cont'd)

- *하중조건의 적용* :

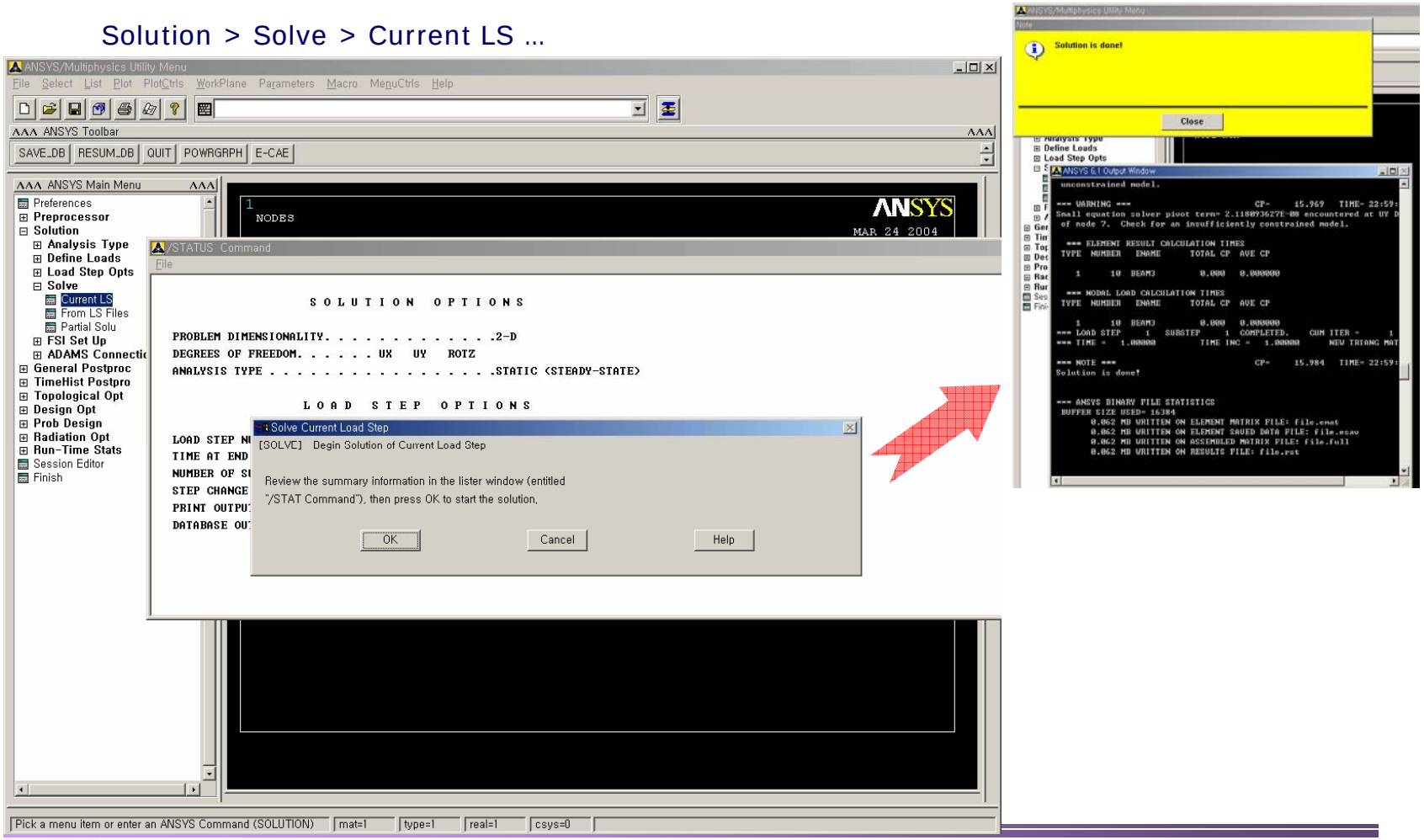
Preprocessor > Loads > Define Loads > Apply > Structural > Force/Moment > On Nodes



GUI를 통한 ANSYS 예제 (cont'd)

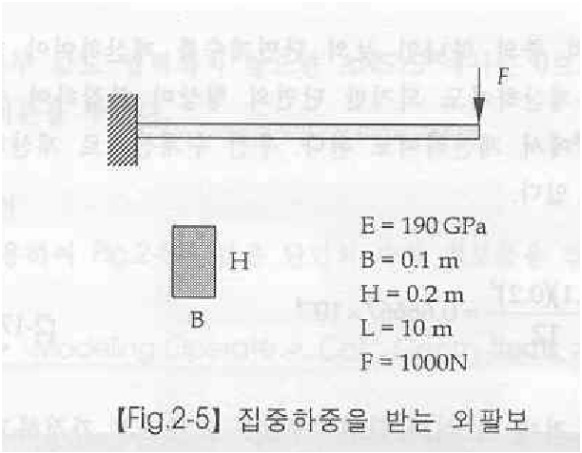
- *해석 단계* :

Solution > Solve > Current LS …



GUI를 통한 ANSYS 예제 (cont'd)

- *해석결과의 출력 및 검증* :



【Fig.2-5】 집중하중을 받는 외팔보

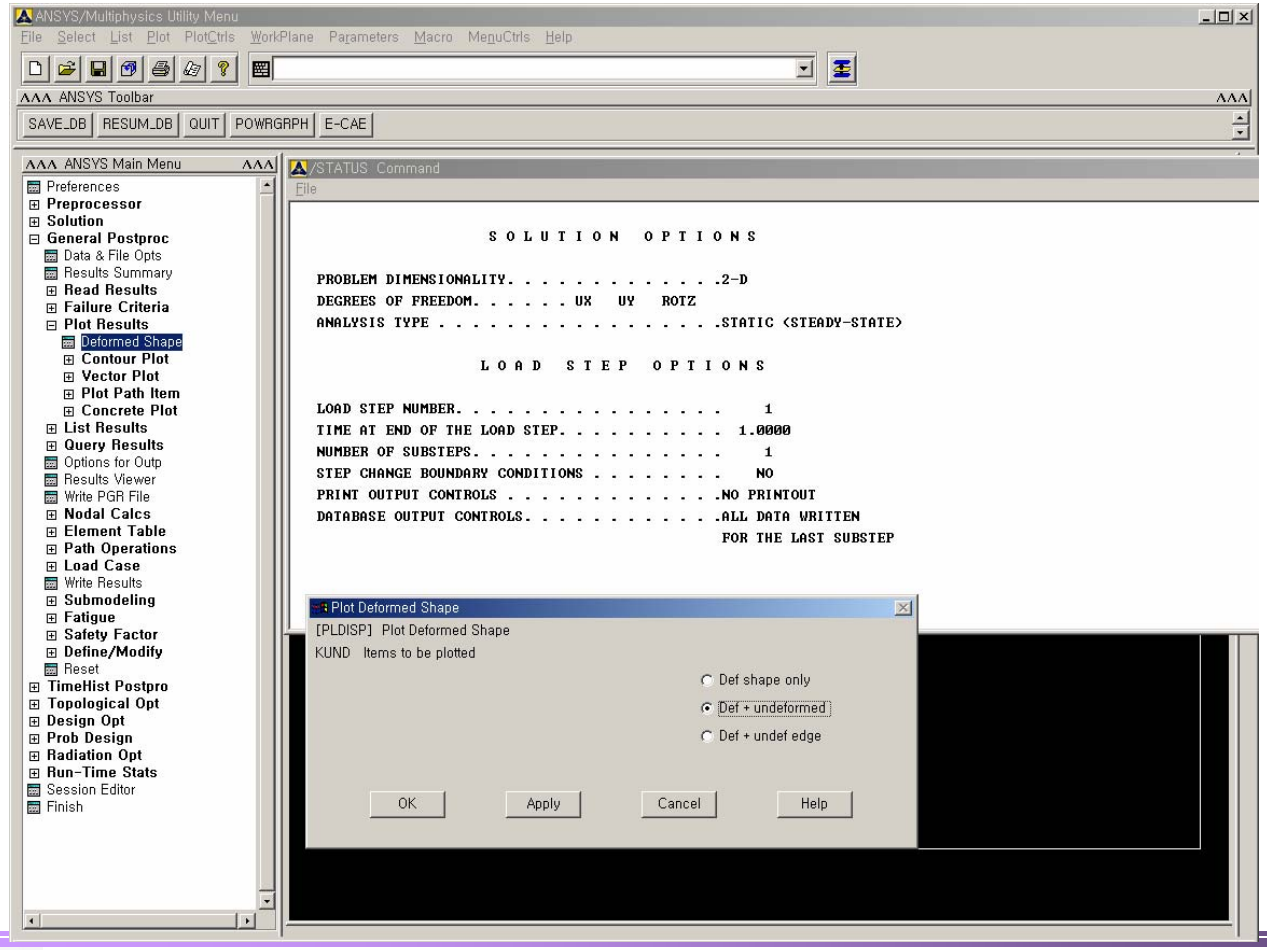
- Analytical solution of beam deflection

$$\delta = \frac{PL^3}{3EI} = \frac{(-1000)(10)^3}{(3)(190\times10^9)(0.66667\times10^{-4})} = -0.0263$$

GUI를 통한 ANSYS 예제 (cont'd)

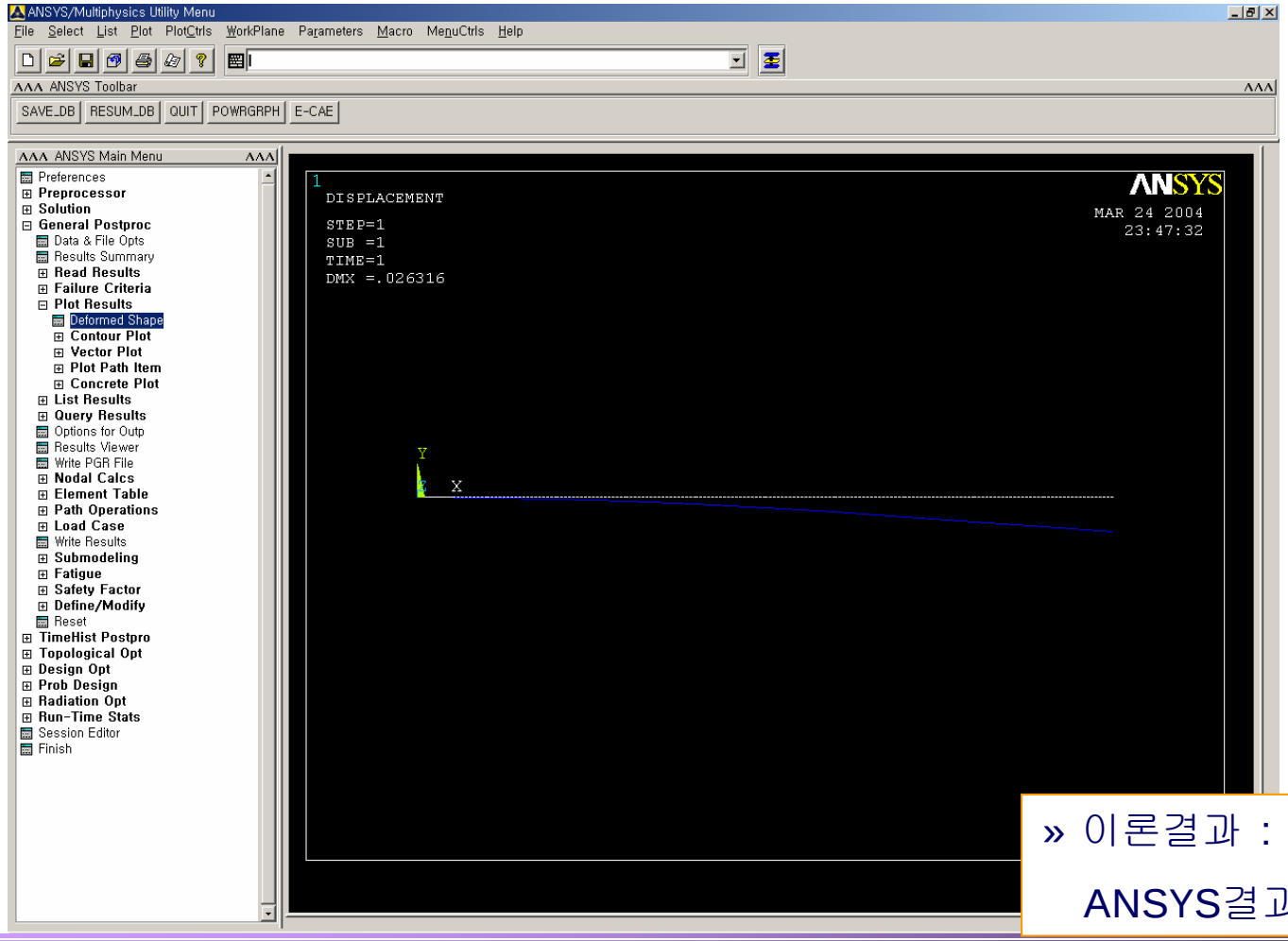
- *해석결과의 출력 및 검증* :

  General > Solve > Current LS …



GUI를 통한 ANSYS 예제 (cont'd)

- ***ANSYS**결과와 이론결과 비교* :

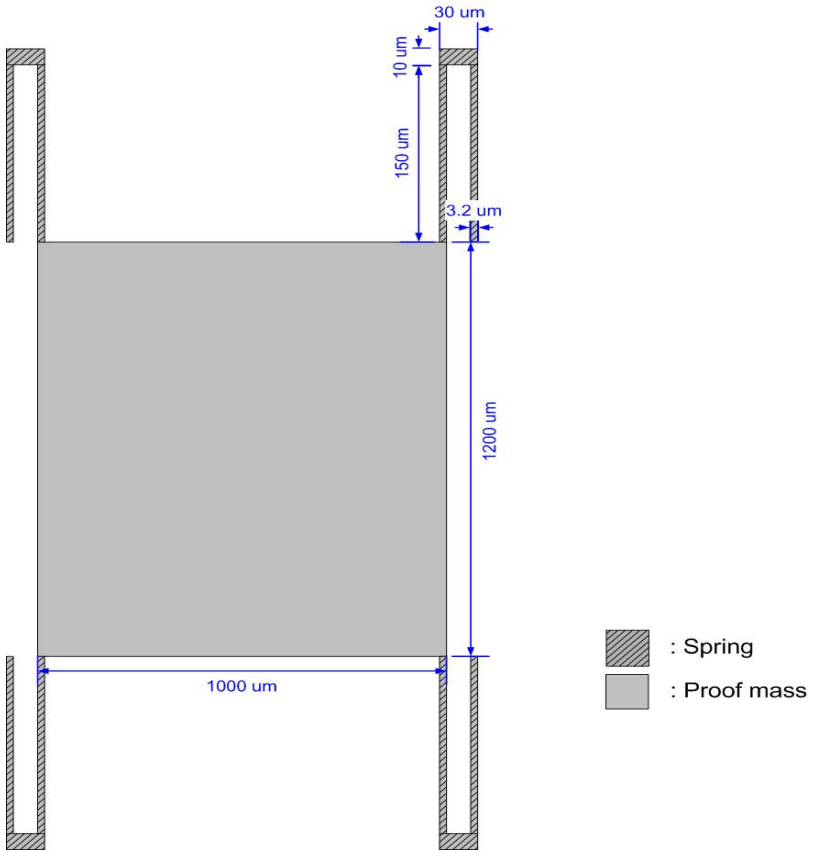


» 이론결과 : -0.0263

ANSYS결과 : -0.0263

Input file 작성을 통한 ANSYS 예제

- 구조물 공진 주파수 해석
  - Schematic



Input file 작성을 통한 ANSYS 예제

- 구조물 공진 주파수 해석 (cont'd)
  - 물성치 입력 및 작업 평면계 설정

```
/COLOR, PBAK, OFF
/PREP7
/TITLE, RESONATOR SIMULATION, March 26, 2004

ET, 1, SOLID64
UIMP,1,EX,EY,EZ,168.9E9,168.9E9,168.9E9,
UIMP,1,DENS, , ,2330,                    ! ρ1 → Spring PART
UIMP,1,NUXY,NUYZ,NUXZ,0.262,0.262,0.262,
UIMP,1,GXY,GYZ,GXZ,66.9E9,66.9E9,66.9E9,
ET, 2, SOLID64
UIMP,2,EX,EY,EZ,168.9E9,168.9E9,168.9E9,
UIMP,2,DENS, , ,0.7*2330,                ! ρ2 → Proof Mass PART
UIMP,2,NUXY,NUYZ,NUXZ,0.262,0.262,0.262,
UIMP,2,GXY,GYZ,GXZ,66.9E9,66.9E9,66.9E9,

CSYS, WP
TOL=1e-9
BTOL, TOL
```

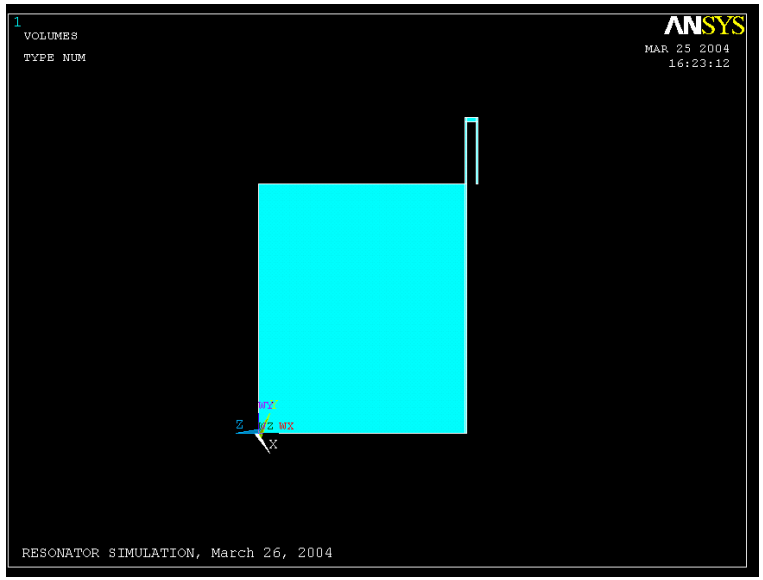
Input file 작성을 통한 ANSYS 예제

- 구조물 공진 주파수 해석 (cont'd)
  - 구조물 치수 정의

```
T = 40E-6

SW = 3.2E-6          ! WIDTH OF SPRING
SL = 150E-6          ! LENGTH OF SPRING

SCW = 30E-6          ! WIDTH OF SPRING CONNECTION
SCH = 10E-6          ! HEIGHT OF SPRING CONNECTION

PW = 500E-6         ! WIDTH OF PROOF MASS
PH = 600E-6         ! HEIGHT OF PROOF
```

Input file 작성을 통한 ANSYS 예제

- 구조물 공진 주파수 해석 (cont'd)
  - 구조물 생성




```
!   PROOF MASS PART

BLOCK, 0, PW, 0, PH, 0, T

!   SPRING PART

BLOCK, PW - SW, PW, 0, PH + SL + SCH, O, T
BLOCK, PW - 2*SW + SCW, PW - SW + SCW, PH, PH + SL + SCH, O, T


BLOCK, PW - SW, PW - SW + SCW, PH + SL, PH + SL + SCH, O, T
```

Input file 작성을 통한 ANSYS 예제

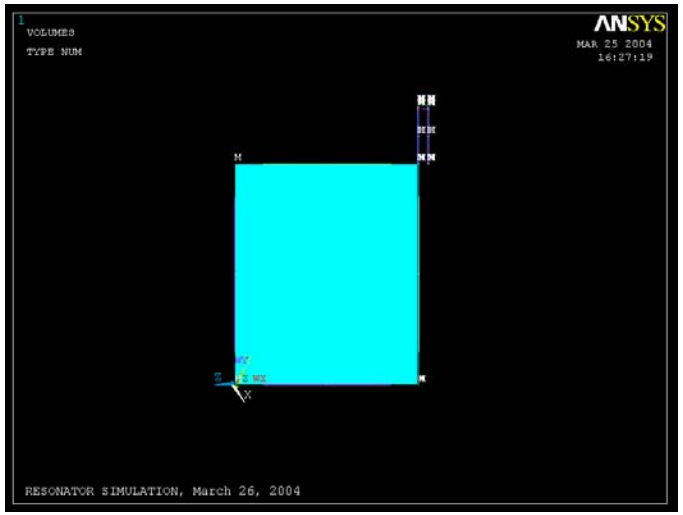
- 구조물 공진 주파수 해석 (cont'd)
  - 구조물 생성

```
!   VOLUME PARTITION
VSEL, ALL
VPTN, ALL

!   VOLUME ATTRIBUTION
    ! WHOLE STRUCTURE
 VSEL, ALL
 VATT, 1, 1

    ! PROOF MASS PART
 VSEL, S, LOC, X, 0, PW
 VSEL, R, LOC, Y, 0, PH
 VATT, 2, 2
```

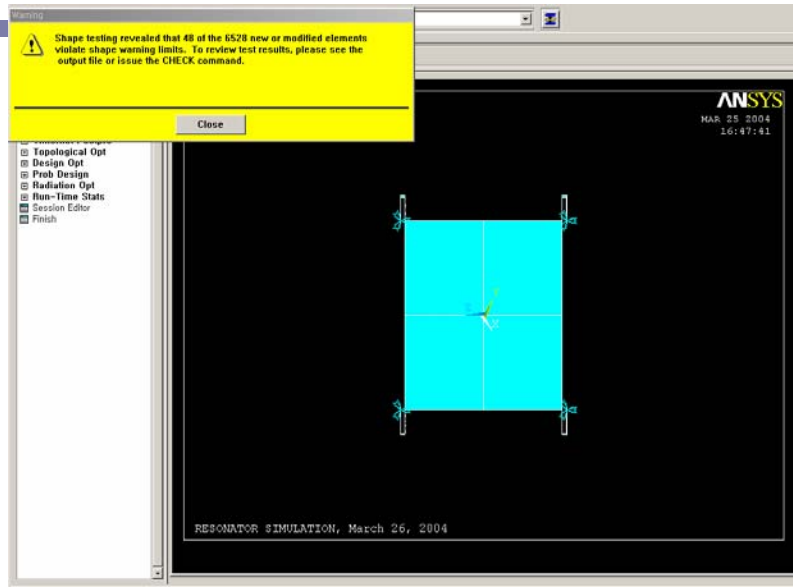
Input file 작성을 통한 ANSYS 예제

- 구조물 공진 주파수 해석 (cont'd)
  - 요소망의 생성

```
N = 100        ! LENGTH OF SPRING
M = 2          ! WIDTH OF SPRING
O = 4          ! THICKNESS OF STRUCTURE

LSEL, S, LOC, X, PW - SW + TOL, PW - TOL
LSEL, A, LOC, X, PW - 2*SW + SCW + TOL, PW - SW + SCW - TOL
LESIZE,ALL,,,M,1

LSEL, S, LOC, Y, PH + TOL, PH + SL - TOL
LESIZE,ALL,,,N,1

LSEL, S, LOC, Z, 0 + TOL, T -TOL
LESIZE,ALL,,,O,1

LSEL, ALL
LESIZE, ALL,,,1,1
```



Input file 작성을 통한 ANSYS 예제



- 구조물 공진 주파수 해석 (cont'd)
  - 체적 복사 및 경계 조건 입력

```
VSEL, ALL
VSYMM,X,ALL, , , ,0,0
VSEL, ALL
VSYMM,Y,ALL, , , ,0,0
NUMMERG, ALL, TOL
VSEL, ALL
VMESH, ALL

NSEL, S, LOC, X, PW - SW + SCW, PW + SW + SCW
NSEL, R, LOC, Y, PH - TOL, PH + TOL
D, ALL, , , , , , ALL, , , , ,
NSEL, S, LOC, X, PW - SW + SCW, PW + SW + SCW
NSEL, R, LOC, Y, - (PH - TOL), - (PH + TOL)
D, ALL, , , , , , ALL, , , , ,
NSEL, S, LOC, X, - (PW - SW + SCW), - (PW + SW + SCW)
NSEL, R, LOC, Y, PH - TOL, PH + TOL
D, ALL, , , , , , ALL, , , , ,
NSEL, S, LOC, X, - (PW - SW + SCW), - (PW + SW + SCW)
NSEL, R, LOC, Y, - (PH - TOL), - (PH + TOL)
D, ALL, , , , , , ALL, , , , ,

FINISH
```

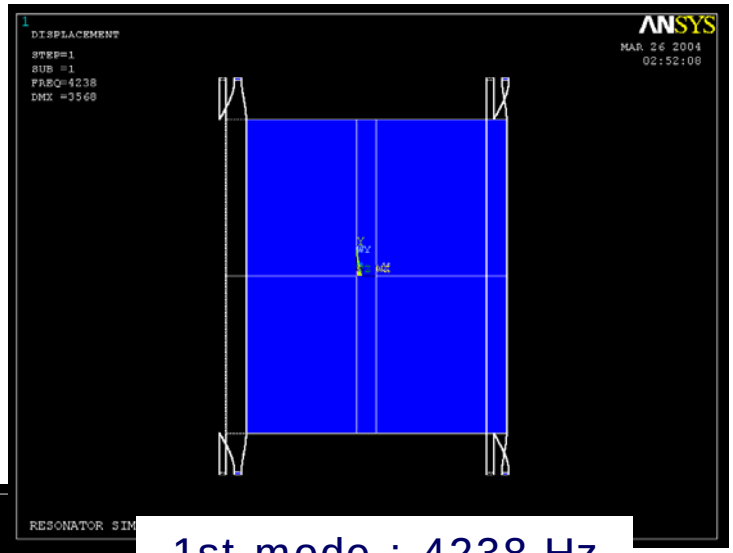
Input file 작성을 통한 ANSYS 예제

- 구조물 공진 주파수 해석 (cont'd)
  - 해석 결과

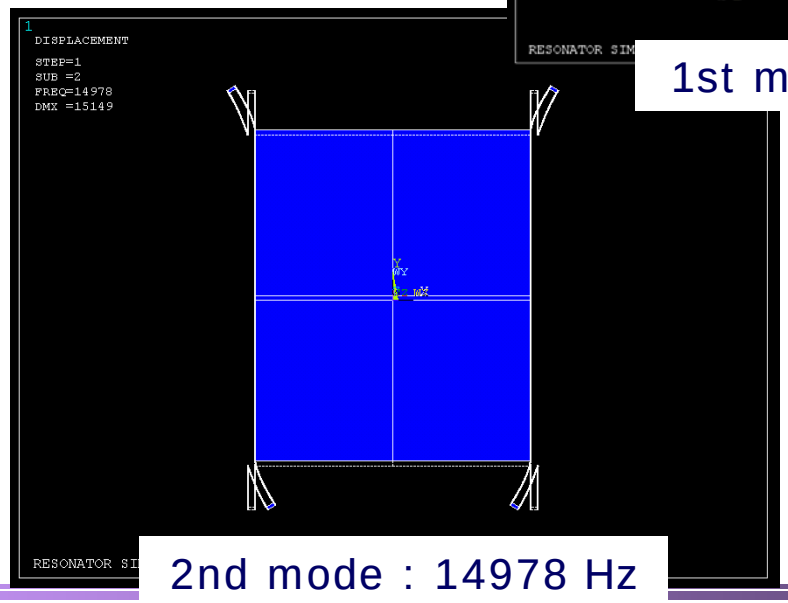
/SOLUTION

NSEL, ALL

ANTYPE, MODAL
MODOPT, LANB, 10
MXPAND, 10
OUTPR, NSOL
SOLVE
FINISH



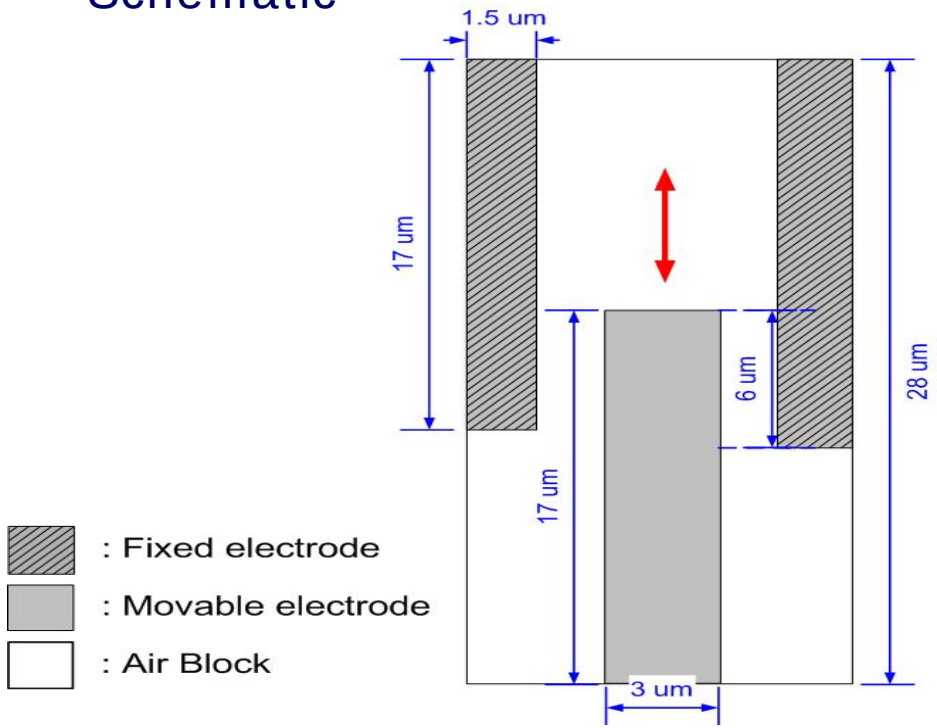
1st mode : 4238 Hz



2nd mode : 14978 Hz

Input file 작성을 통한 ANSYS 예제

- **정전용량 해석**
  - Schematic



$$C = \varepsilon \cdot \frac{A}{d} = 8.854e-12 \times \frac{(6e-6) \times 2}{2e-6} = 5.3124e-11$$

Input file 작성을 통한 ANSYS 예제

- **정전용량 해석** (cont'd)
  - **물성치 입력 및 변수 지정**

```
/COLOR, PBAK, OFF
/PREP7
/TITLE, LATERAL COMB_CAP SIMULATION, March 26, 2004

ET,1,PLANE121

MP,PERX,1,1

! DEFINE DIMENSION OF AIR & COMBS
ARH = 28E-6
ARW = 10E-6

CW = 3E-6
CH = 17E-6
Gap = 2E-6

V1=10
V0=1
```

Input file 작성을 통한 ANSYS 예제

- **정전용량 해석** (cont'd)
  - **구조물 정의**

RECTNG, - ARW/2, ARW/2, - ARH/2, ARH/2

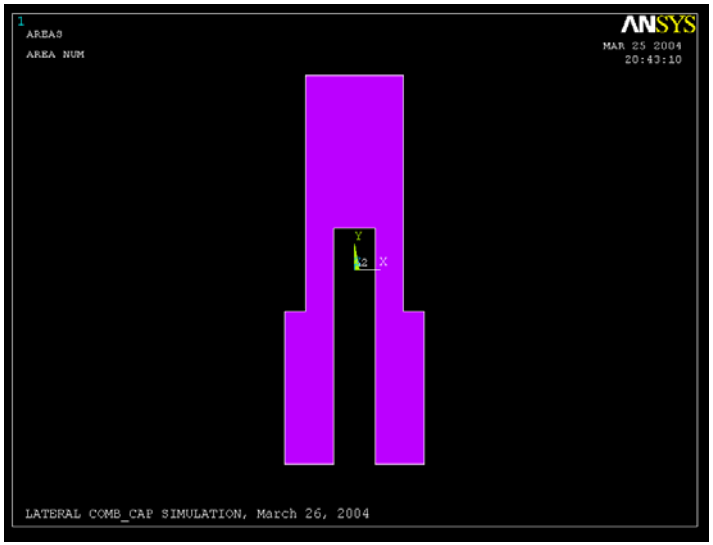
ASEL, ALL
AATT, 1

ASEL, ALL
NUMCMP, AREA

RECTNG, - CW/2, CW/2, - ARH/2, - ARH/2 + CH

RECTNG, - ARW/2, - ARW/2 + CW/2, ARH/2 - CH, ARH/2
RECTNG, ARW/2 - CW/2, ARW/2, ARH/2 - CH, ARH/2

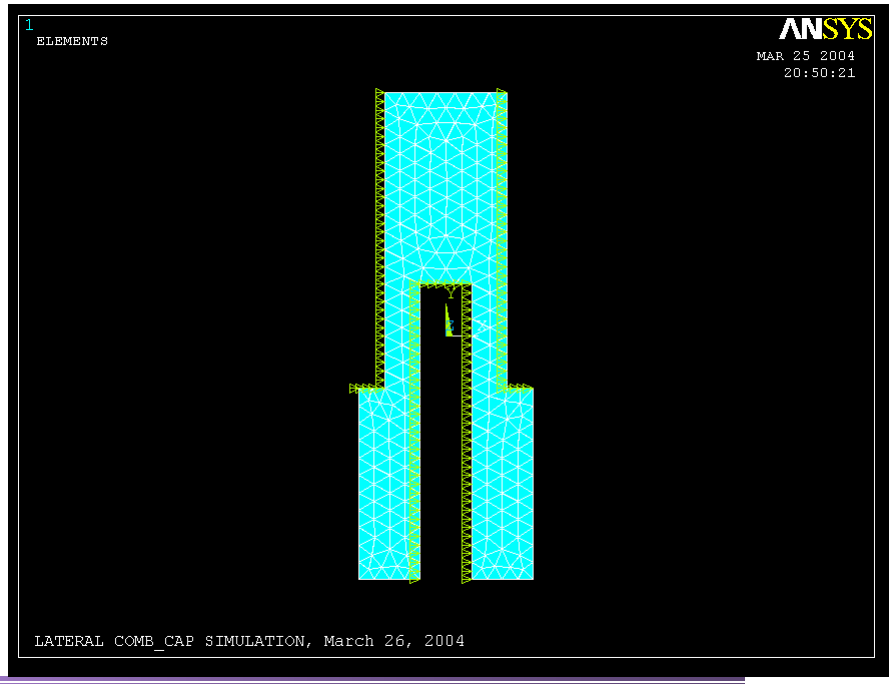
ASBA,1,2,,DELETE,DELETE
ASBA,5,3,,DELETE,DELETE
ASBA,1,4,,DELETE,DELETE



Input file 작성을 통한 ANSYS 예제

- **정전용량 해석** (cont'd)
  - **요소망의 생성 및 경계/전압 부여**

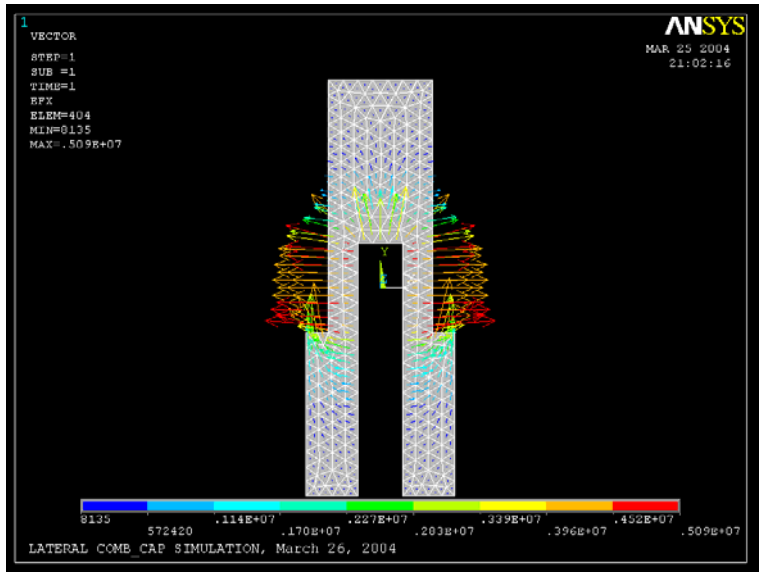
```
MSHAPE,1,2D
ESIZE,1E-6,0
ASEL,ALL
AMESH,ALL

NSEL,S,LOC,Y, - ARH/2, - ARH/2 + CH
NSEL,R,LOC,X, - CW/2, CW/2
D,ALL,VOLT,10
NSEL,S,LOC,Y, ARH/2 - CH, ARH/2
NSEL,R,LOC,X, - ARW/2, - ARW/2 + CW/2
D,ALL,VOLT,1
NSEL,S,LOC,Y, ARH/2 - CH, ARH/2
NSEL,R,LOC,X, ARW/2 - CW/2, ARW/2
D,ALL,VOLT,1

ESEL,ALL
NSEL,ALL
FINISH
```



Input file 작성을 통한 ANSYS 예제

- **정전용량 해석** (cont'd)
  - **해석 결과**

```
/SOLUTION
SOLVE
/POST1
ESEL,S,MAT,,1
ETABLE,SENE,SENE
ETABLE,EFX,EF,X
ETABLE,EFY,EF,Y
/NUMBER,1
PLNSOL,VOLT            ! DISPLAY EQUIPOTENTIAL LINES
PLVECT,EFX,EFY         ! DISPLAY VECTOR ELECTRIC FIELD (VECTOR)
SSUM
*GET,W,SSUM,,ITEM,SENE
C=(W*2)/81
*STATUS,C
FINISH
```



» 이론결과 : 5.312e-11

ANSYS결과 : 8.742e-11