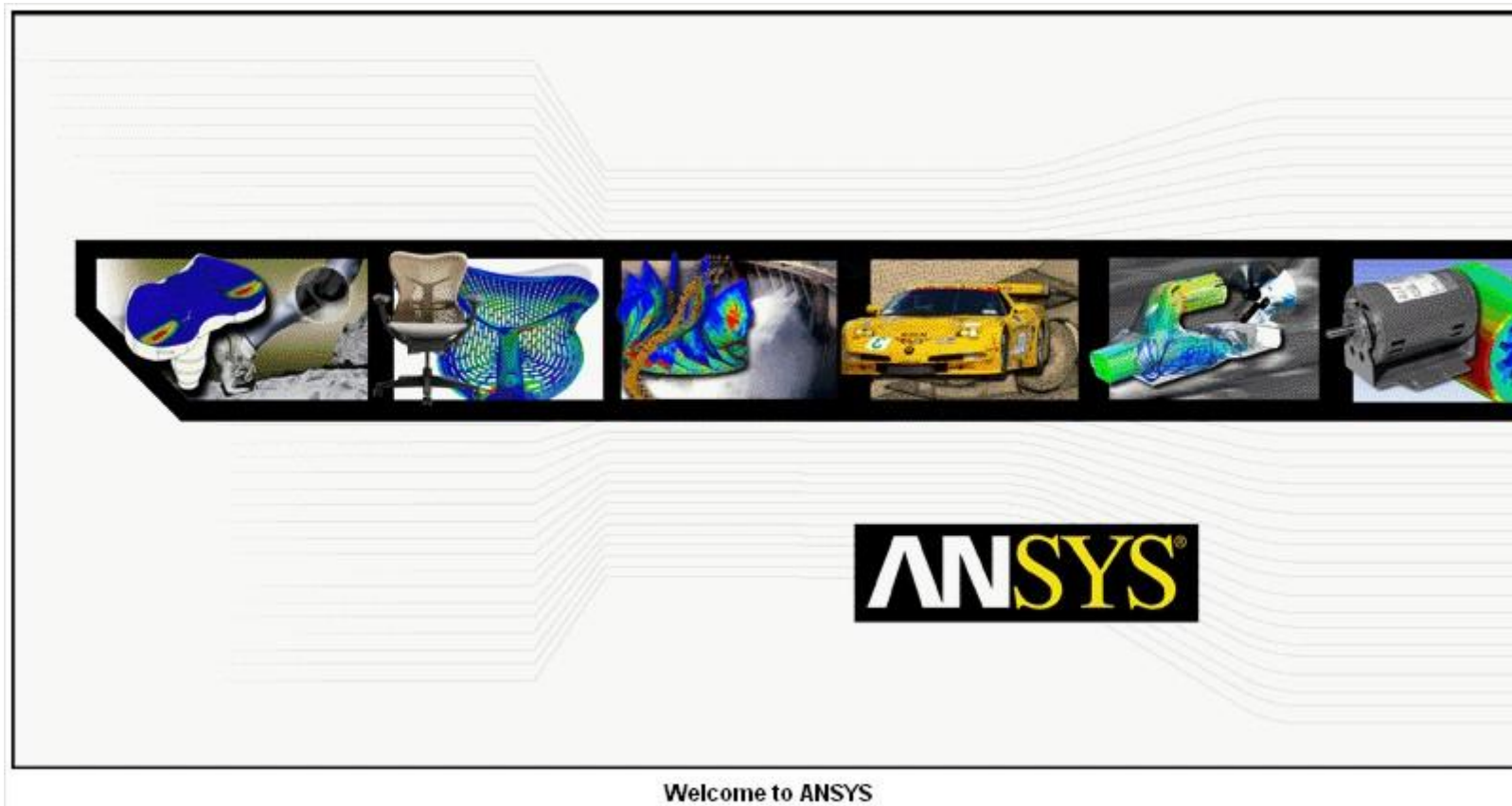


# Rīgas Tehniskā universitāte Materiālu un Konstrukciju institūts

**Uzdevums:** Plātnes galīgais elements - SHELL 63

**Programma:** ANSYS 9

**Autori:** S. Ručevskis



# SHELL 63 – plātes galīgais elements

## Mezglu punkti

I, J, K, L

## Brīvības pakāpes

UX, UY, UZ, ROTX, ROTY, ROTZ

## Ģeometriskas konstantes

TK(I), TK(J), TK(K), TK(L),

## Materiāla īpašības

EX, EY, EZ, (PRXY, PRYZ, PRXZ or NUXY, NUYZ, NUXZ), DENS, GXY, DAMP

## Virsmas slodzes

konstante **1** (I-J-K-L) (+z normāles virzienā)

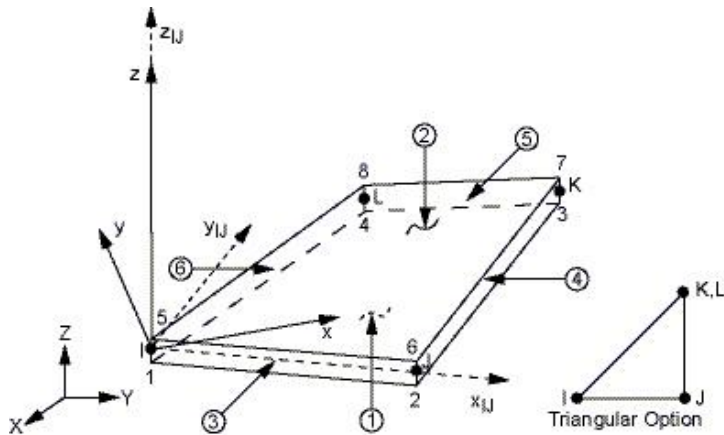
konstante **2** (I-J-K-L) (-z normāles virzienā)

konstante **3** (J-I)

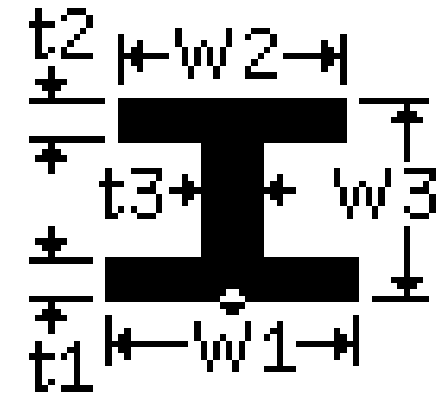
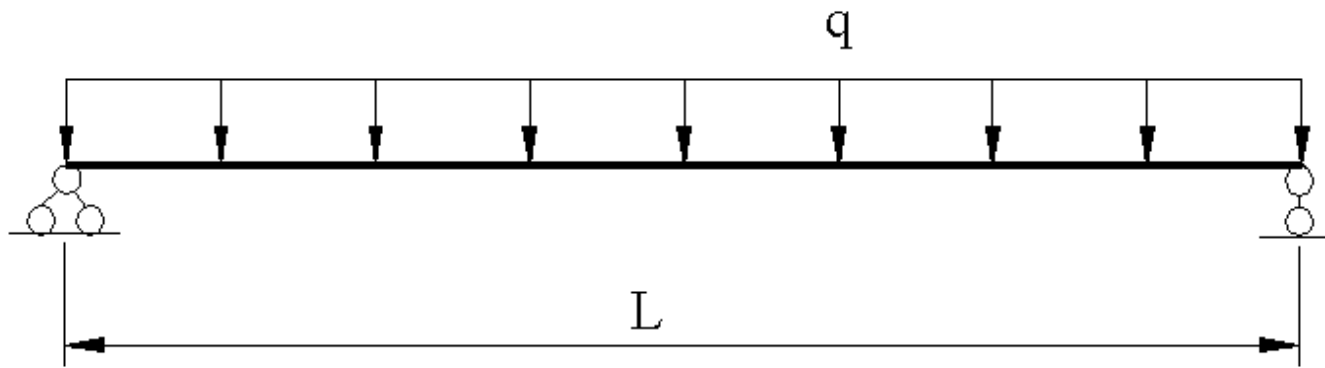
konstante **4** (K-J)

konstante **5** (L-K)

konstante **6** (I-L)



## 3D sijas modelēšana ar SHELL 63 elementiem



$$\begin{aligned} L &= 5 && \text{[m]} \\ q &= 15 && \text{[kN/m]} \end{aligned}$$

$$\begin{aligned} W1 &= 0.1 && \text{[m]} \\ W2 &= 0.1 && \text{[m]} \\ W3 &= 0.2 && \text{[m]} \\ t1 &= 0.008 && \text{[m]} \\ t2 &= 0.008 && \text{[m]} \\ t3 &= 0.0055 && \text{[m]} \end{aligned}$$

## Datu ievadišana



L = 5 Enter

q = 15000 Enter

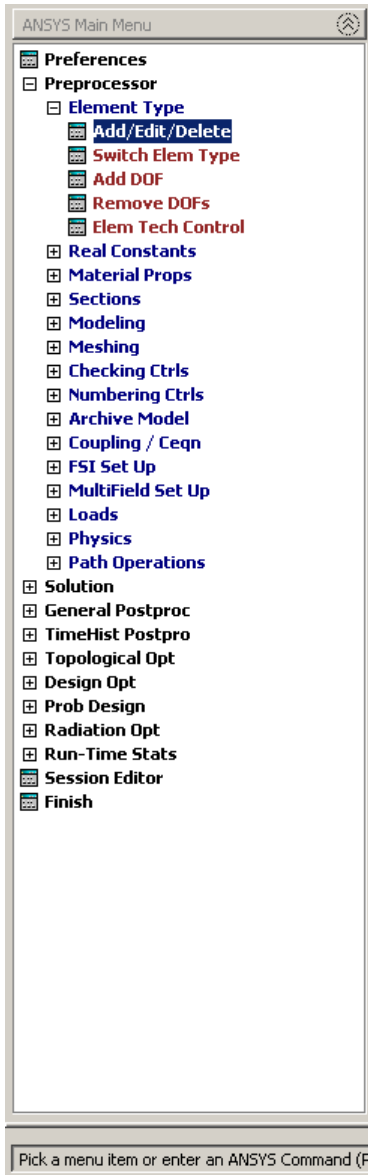
W1 = 0.1 Enter

W3 = 0.2 Enter

t1 = 0.008 Enter

t3 = 0.0055 Enter

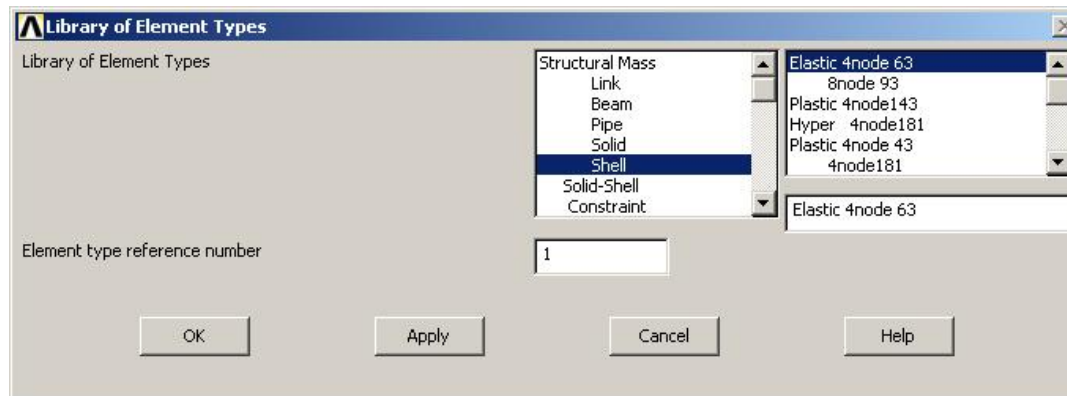
# Elementa tipa definēšana – SHELL 63



(1) Preprocessor/  
Element Type/  
Add/Edit/Delete



(2) Add...

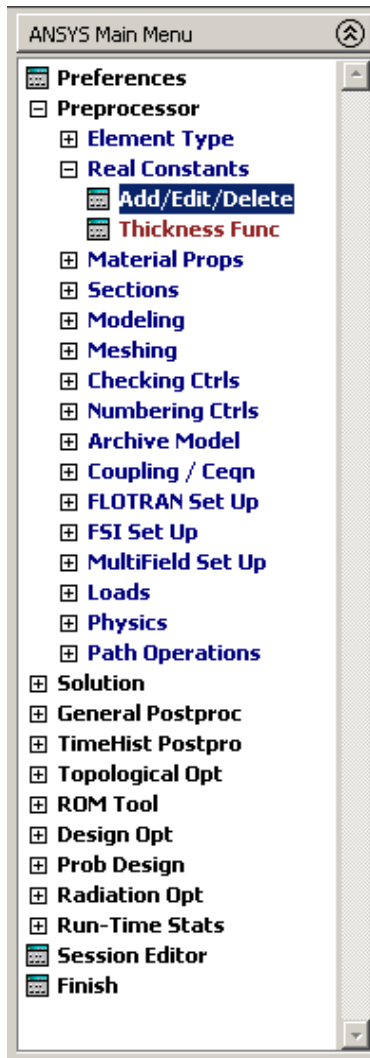


(3) Shell

4node 63

(4) OK

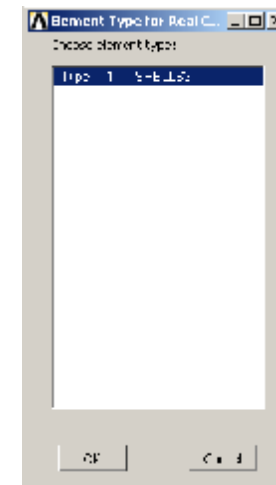
# Ģeometrisko konstanšu definēšana



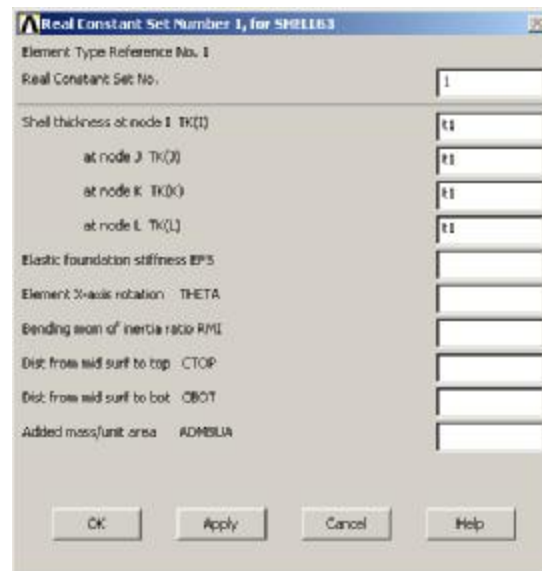
(1) Preprocessor/  
Real Constants/  
Add/Edit/Delete



(2) Add...



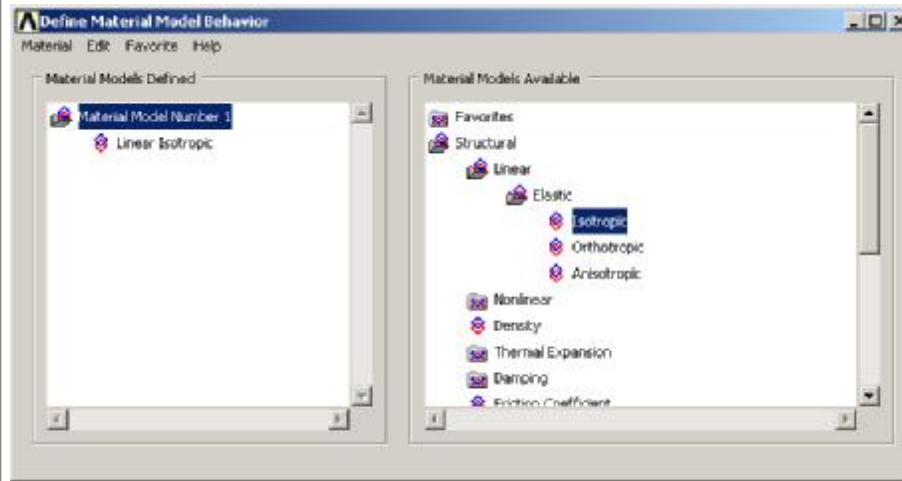
(3) Type 1  
Shell 63



(4) 2 Plātnes biezuma definēšana  
RC1 = t1  
RC2 = t3

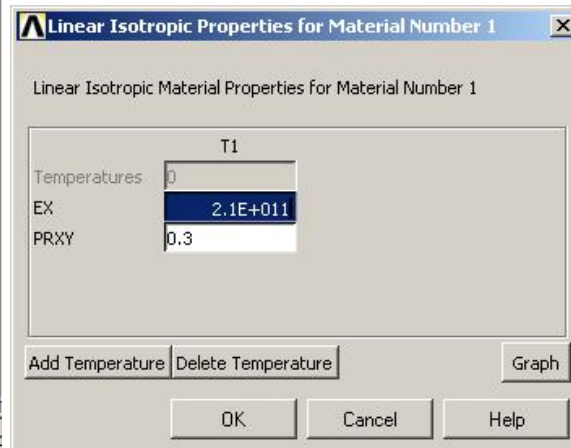
# Materiāla īpašību definēšana

(1) Preprocessor/  
Material Props/  
Material Models



(2) Material Model Number

Structural  
Linear  
Elastic  
Isotropic



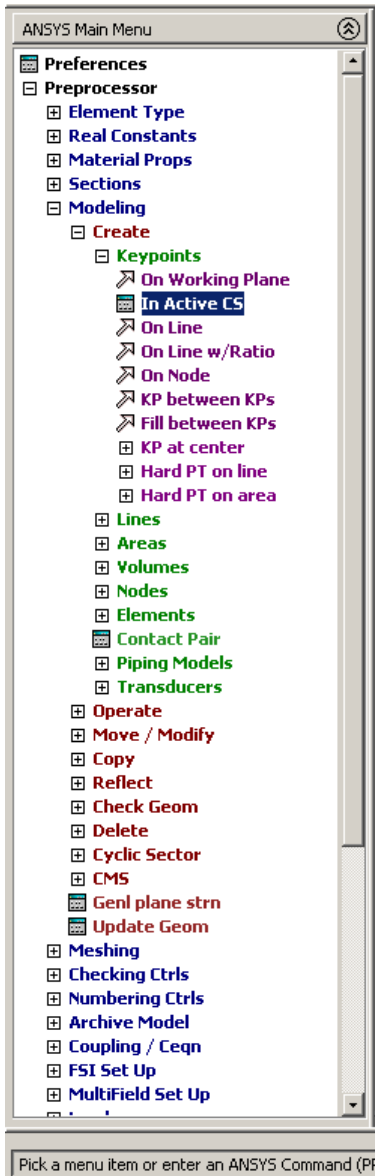
(3)  $E_x = 2.1E+011$  [Pa] *Elastības modulis*

$\nu = 0.3$  *Puasona koeficients*

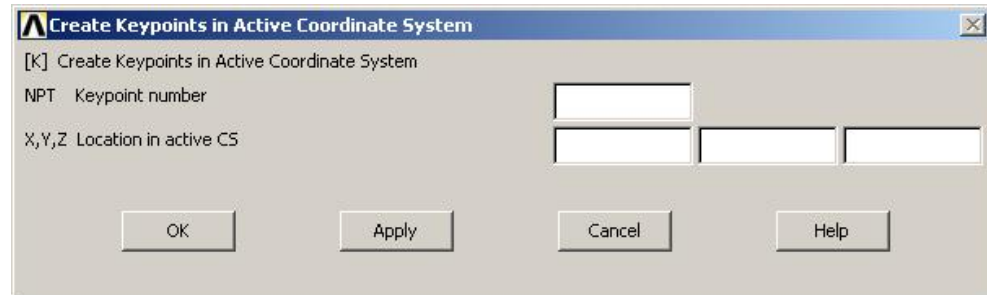
OK



# Koordinātu mezglu definēšana

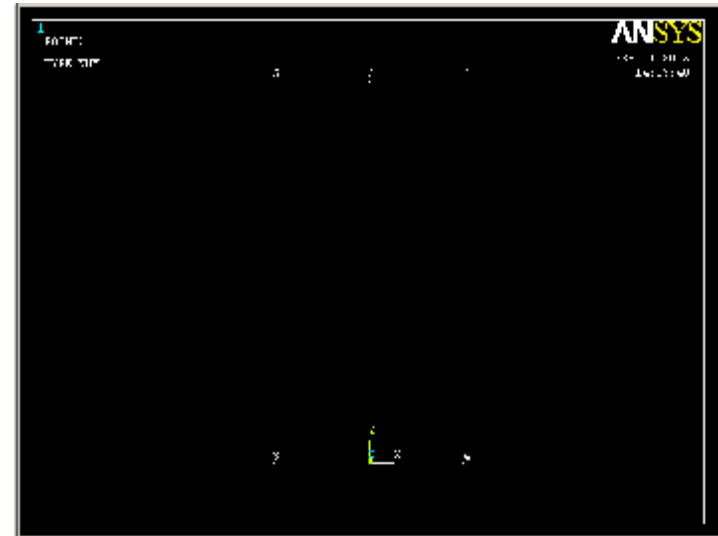


(1) Preprocessor/  
Modeling/  
Create/  
Keypoints/  
In Active CS



(2)

| NPT | X,    | Y, | Z |
|-----|-------|----|---|
| 1   | 0     | 0  | 0 |
| 2   | 0     | W3 | 0 |
| 3   | -W1/2 | 0  | 0 |
| 4   | W1/2  | 0  | 0 |
| 5   | -W1/2 | W3 | 0 |
| 6   | W1/2  | W3 | 0 |



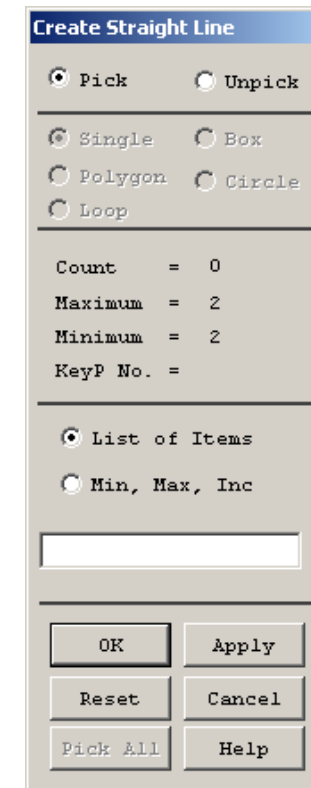
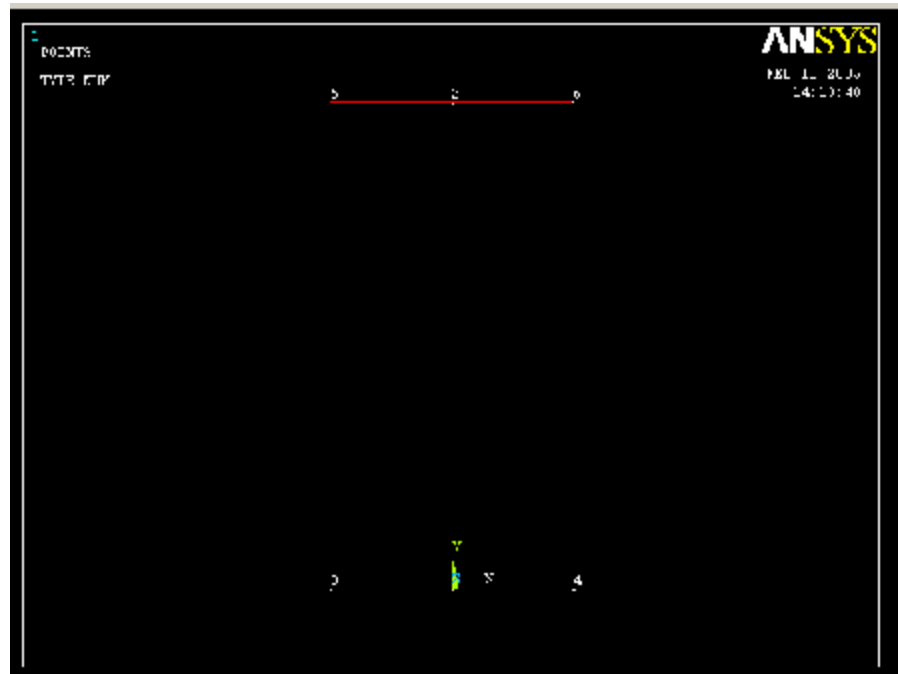
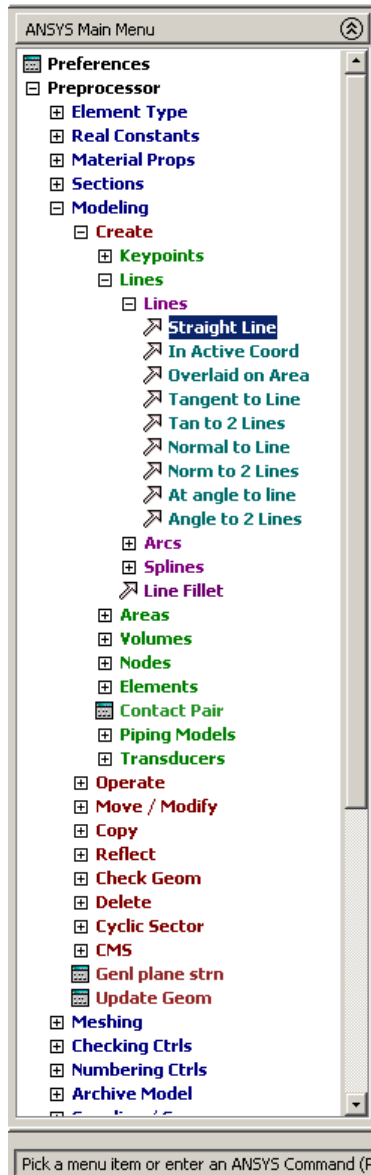


## Līniju izveide

(1) Preprocessor/  
Modeling/  
Create/  
Lines/  
Lines/  
Straight Line

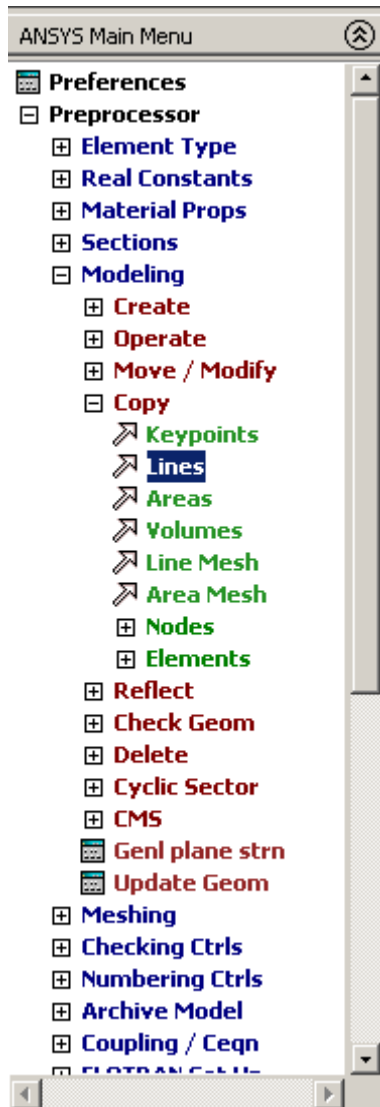
(2) Savienot

punktu Nr.1 ar punktu Nr.2  
punktu Nr.3 ar punktu Nr.4  
punktu Nr.5 ar punktu Nr.6

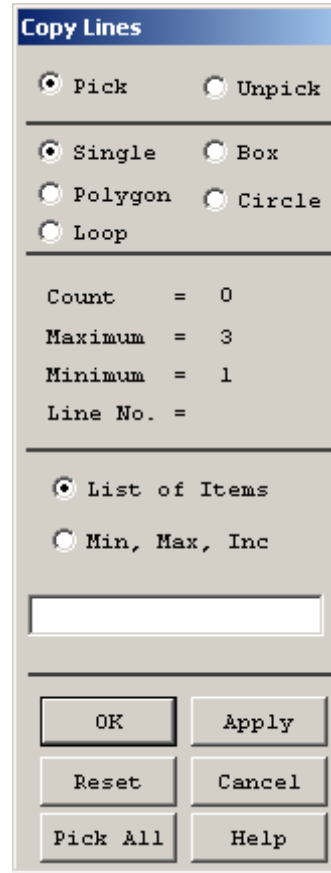


(3) OK

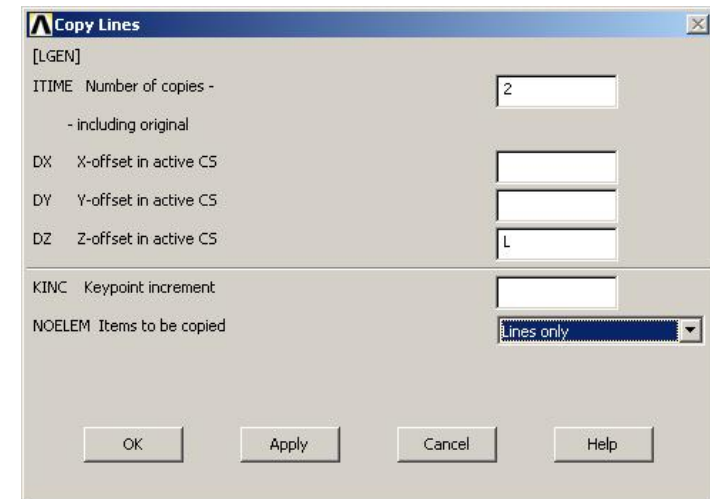
# Līniju kopēšana



(1) Preprocessor/  
Modeling/  
Copy/  
Lines/

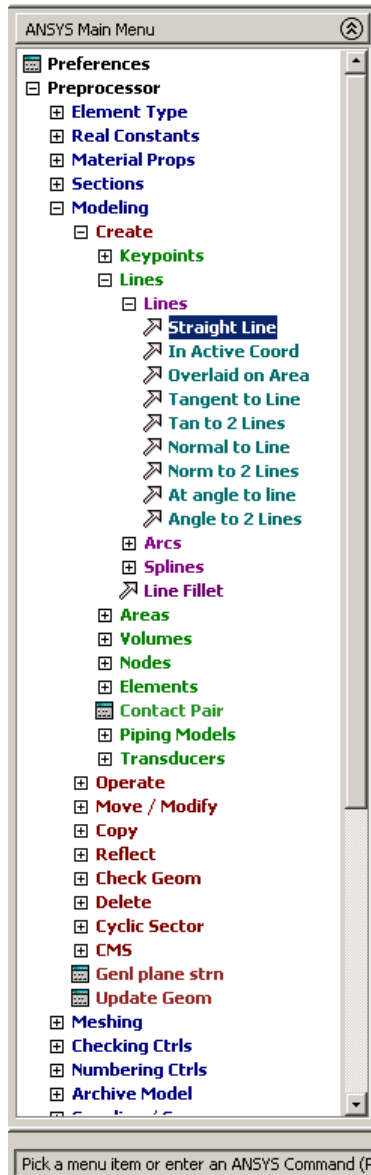


(2) Pick All



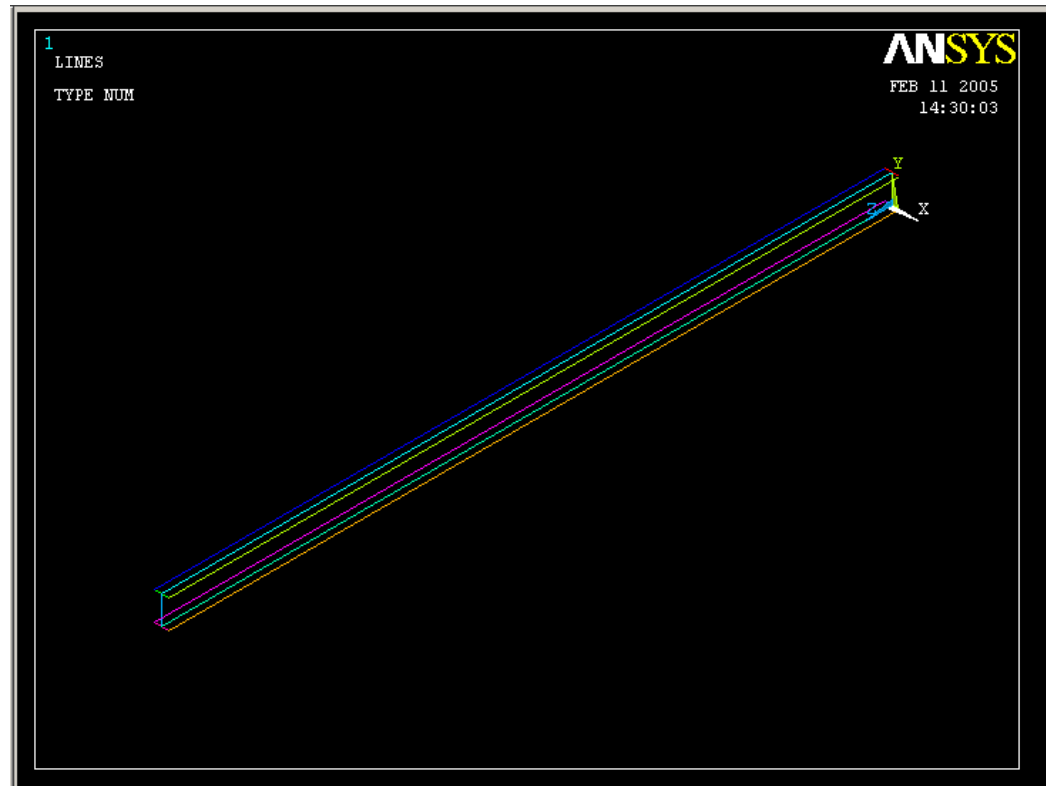
(3) Z-offset = L

# Līniju izveide

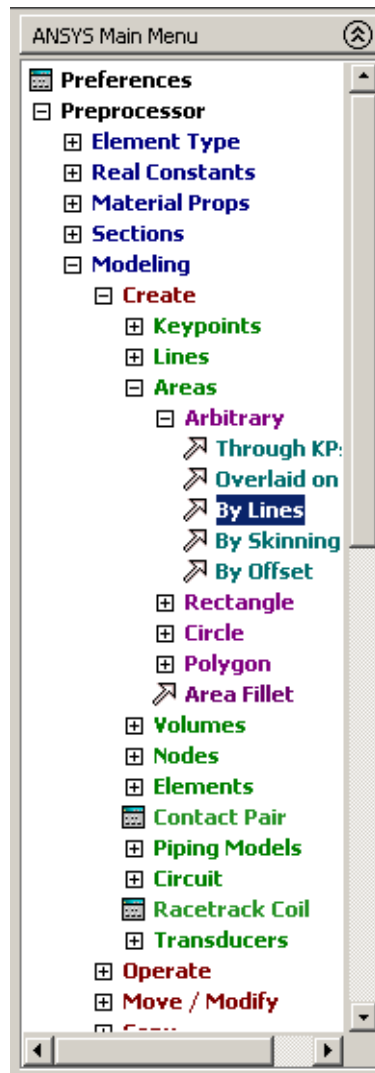


(1) Preprocessor/  
Modeling/  
Create/  
Lines/  
Lines/  
Straight Line

(2) Savienot punktus izveidojot siju no  
plātņu elementiem

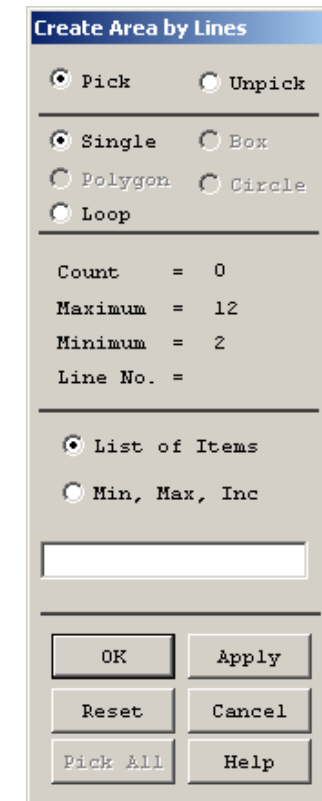
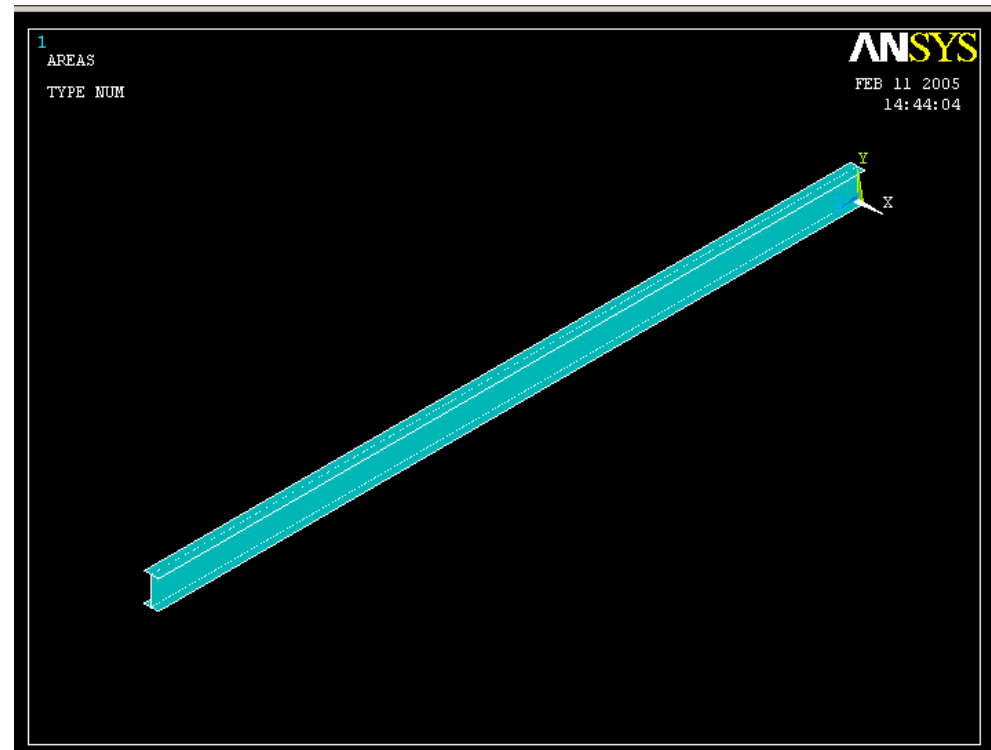


## Laukumu izveide

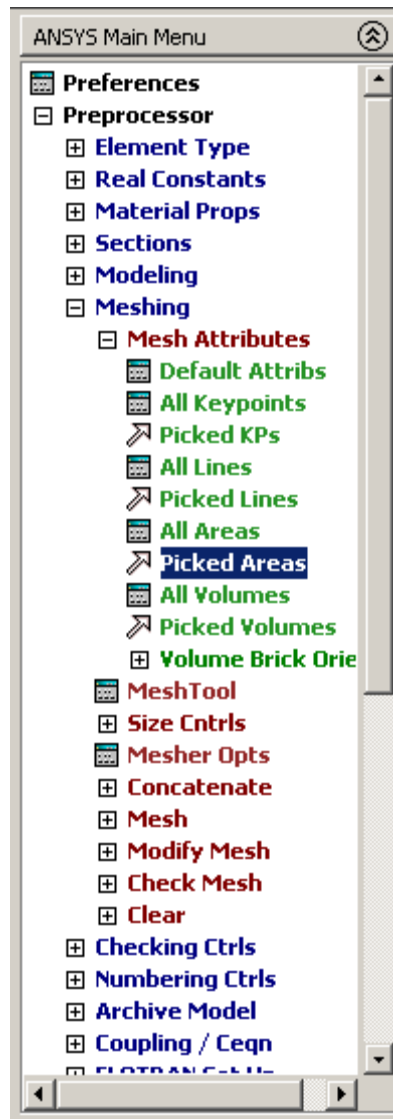


(1) Preprocessor/  
Modeling/  
Create/  
Areas/  
Arbitrary/  
By Lines

(2) Izveido 3 laukumus savienojot  
līnijas pretēji pulksteņa virzienam



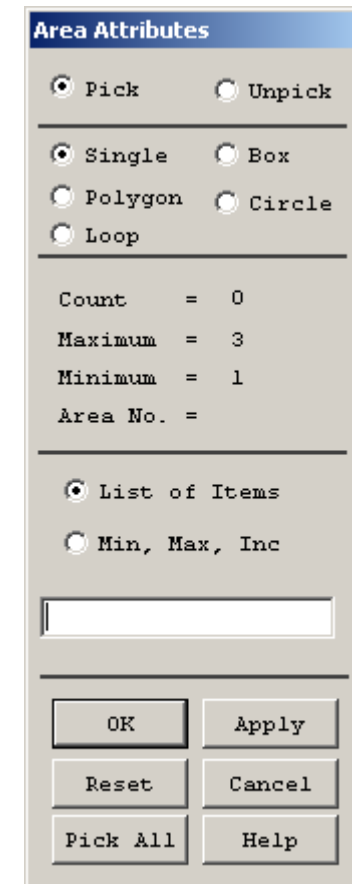
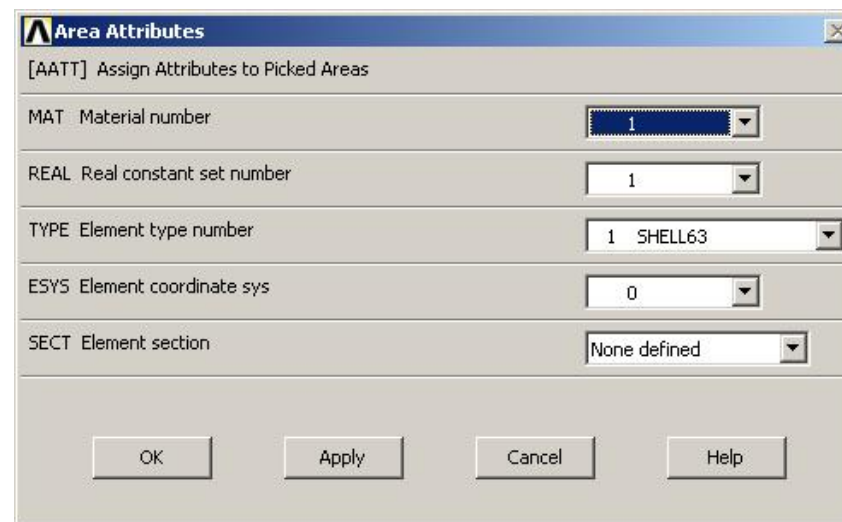
## Elementu ģeometrisko konstanšu piešķiršana



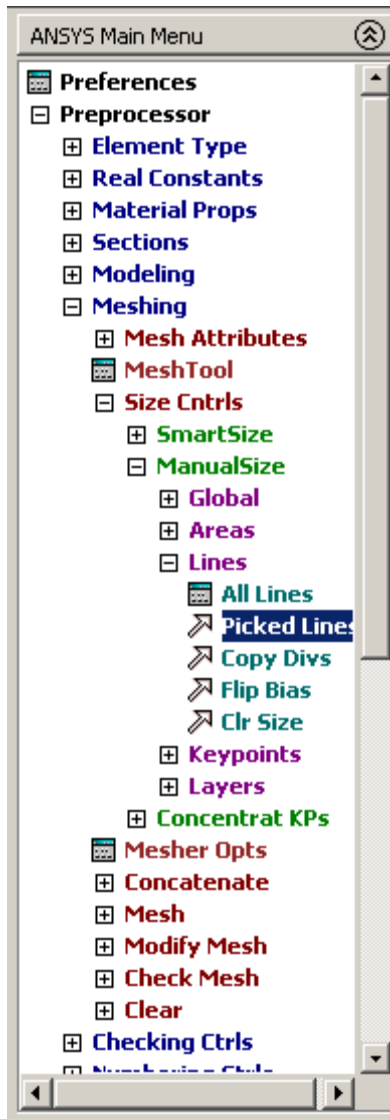
(1) Preprocessor/  
Meshing/  
Mesh Attributes/  
Picked Areas/

(2) Izvēlēties plauktiņu laukumus (1,2)  
un piešķirt RC set NR.1

(3) Izvēlēties sienīgas laukumu (3)  
un piešķirt RC set NR.2

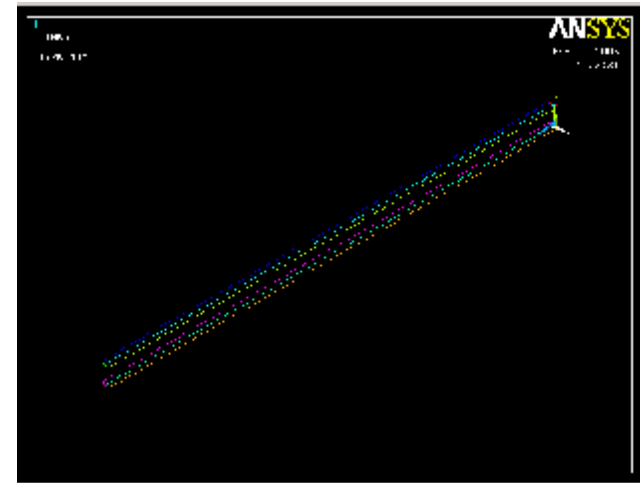
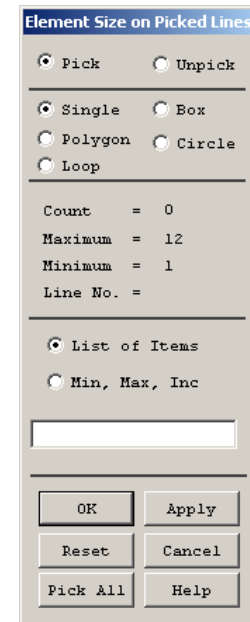
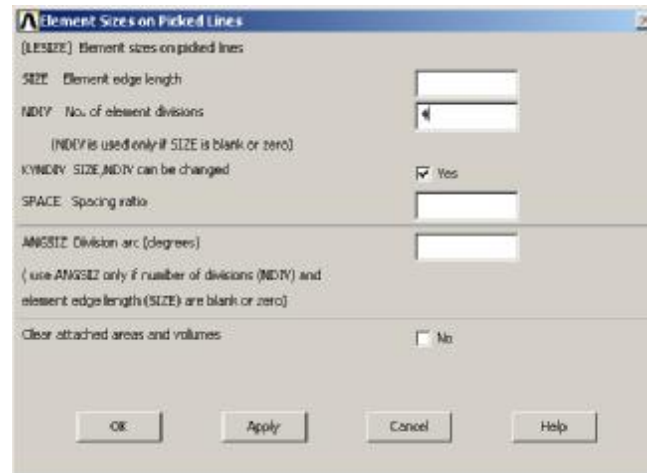


# Laukumu dalīšana Galīgajos Elementos

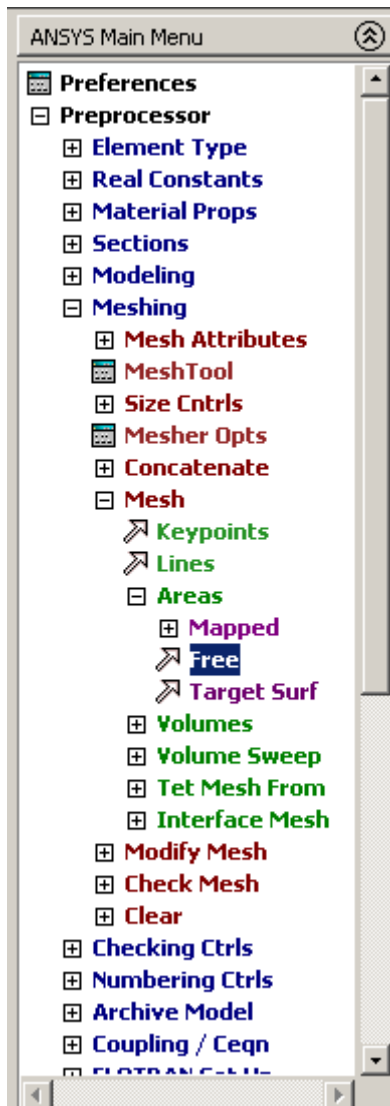


(1) Preprocessor/  
 Meshing/  
 Size Cntrls/  
 ManualSize/  
 Lines/  
 Picked Lines

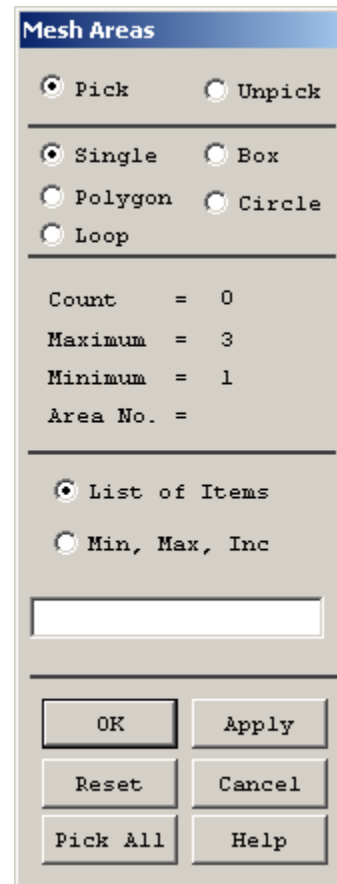
(2) Līnijas 2, 3, 5, 6 = NDIV 4  
 Līnijas 1, 4 NDIV 8  
 Līnijas 7-12 NDIV 50



## Laukumu dalīšana Galīgajos Elementos

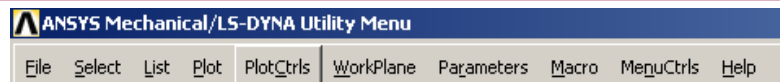


(1) Preprocessor/  
Meshing/  
Mesh/  
Areas/  
Free

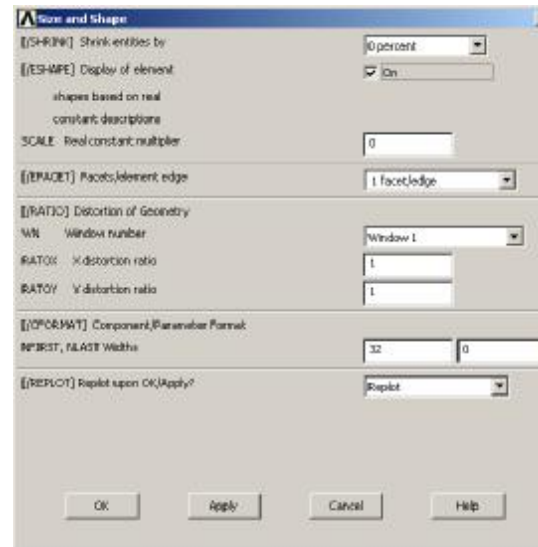
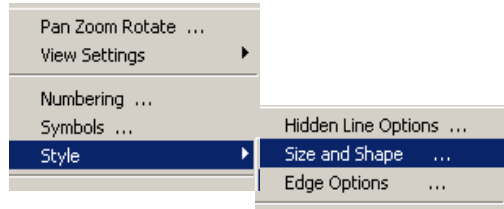


(2) Pick All

# Sijas šķērsriezums izometriskajā skatā

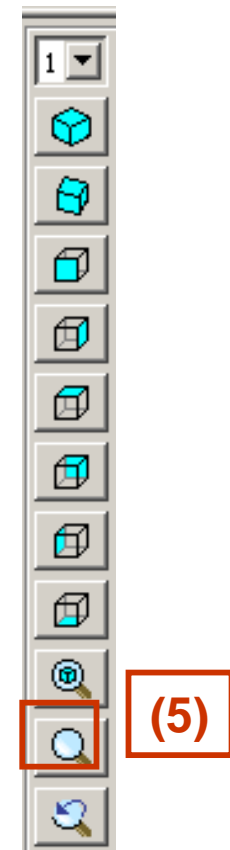
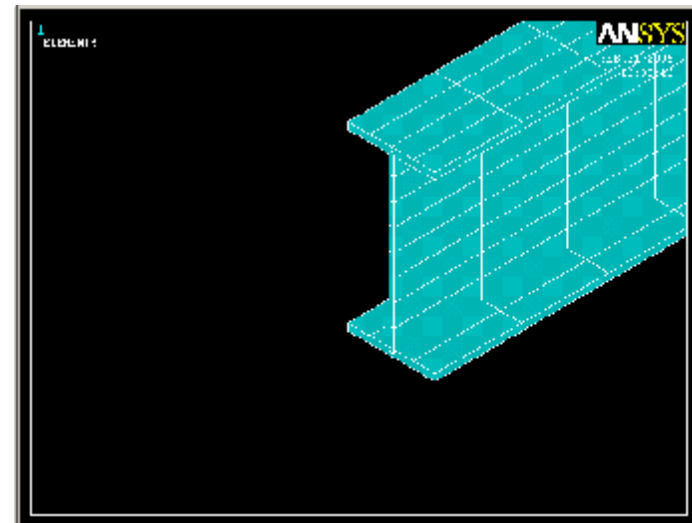
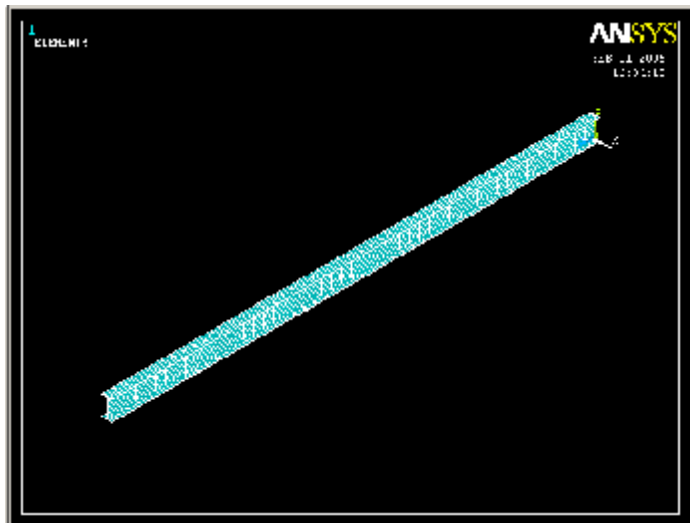


(1) PlotCtrls/ Style/ Size and Shape/



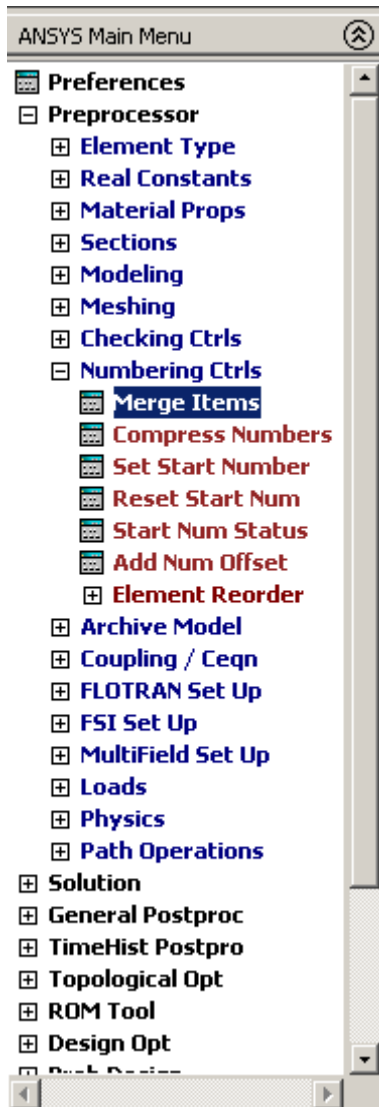
(2) Display of element On

(3) OK

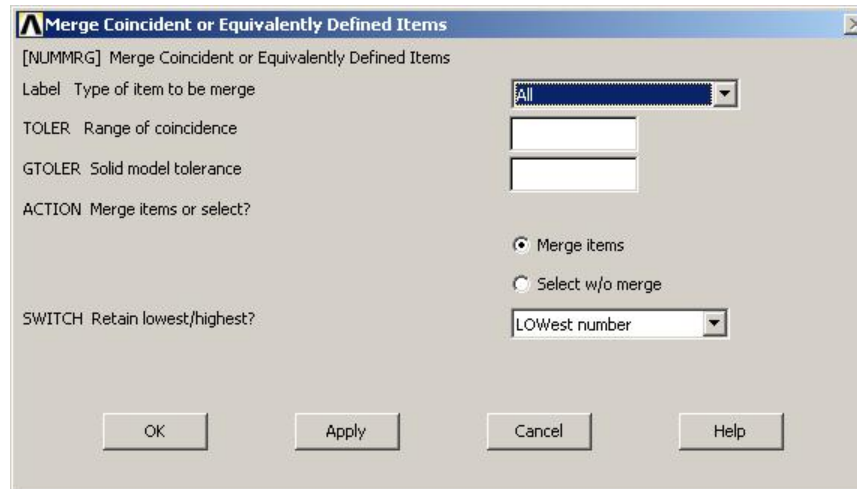




## Mezglu punktu savienošana



(1) Preprocessor/  
Numbering Ctrl/  
Merge Items

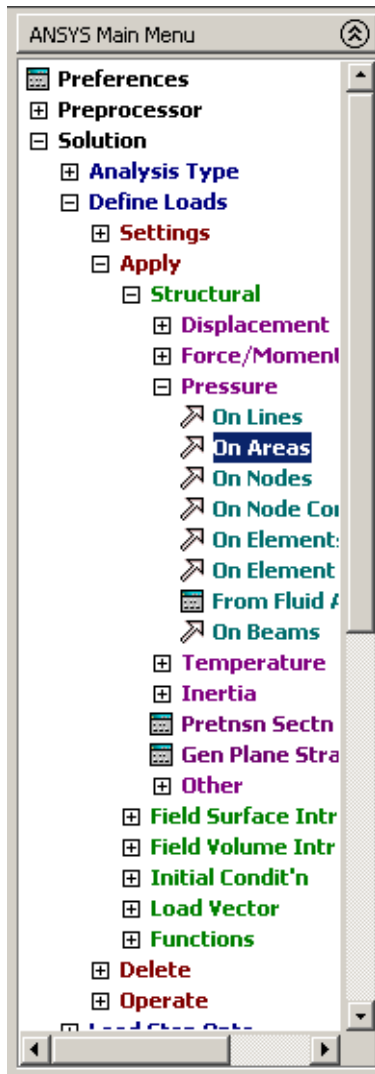


(2) OK

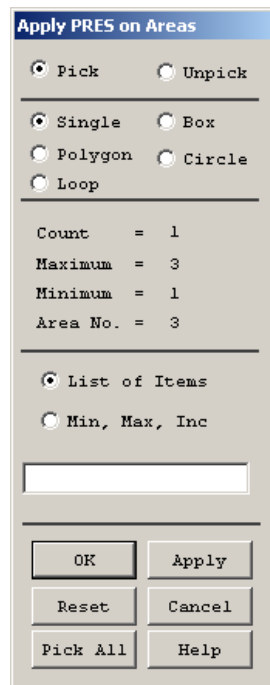




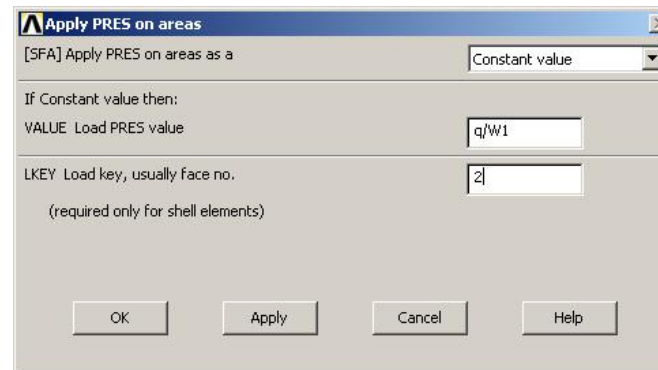
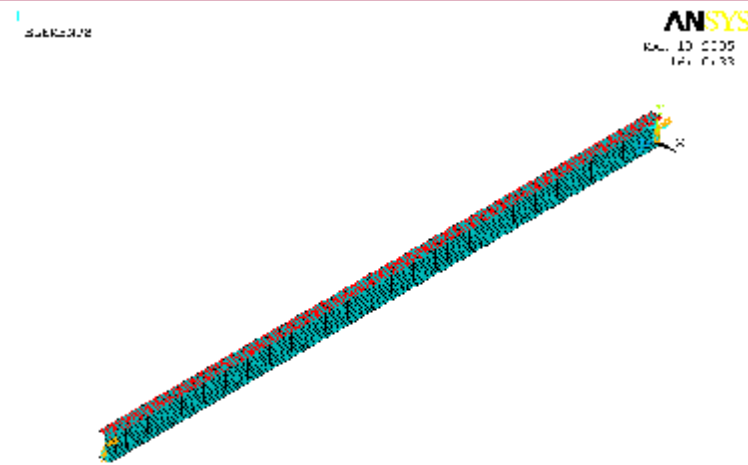
# Sijas slogošana



(1) Solution/  
Define Loads/  
Apply/  
Structural/  
Pressure/  
On Areas



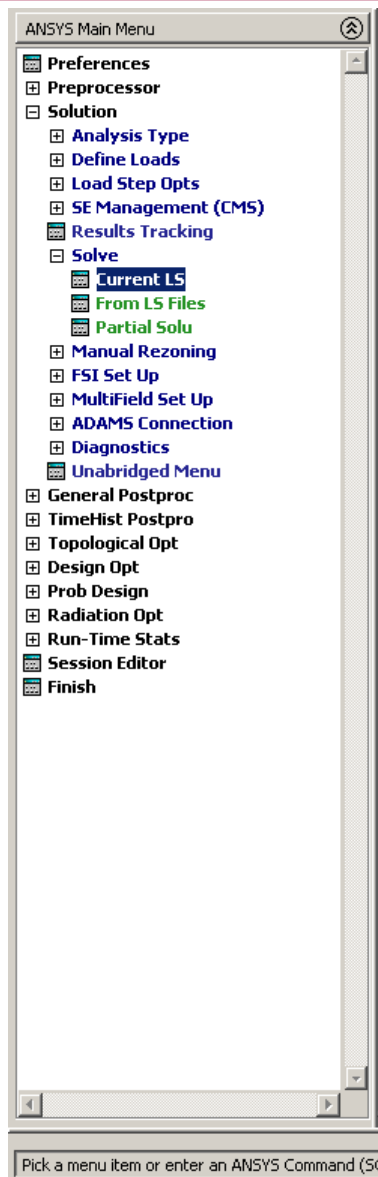
(2) Area No. 3



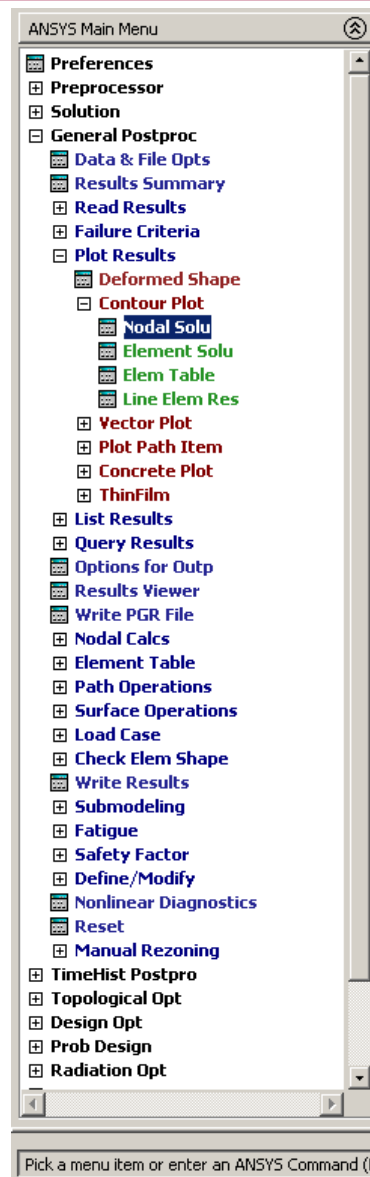
(3) VALUE =  $q/W1$   
LKEY = 2

(4) OK

## Sija aprēķins un rezultātu apstrāde

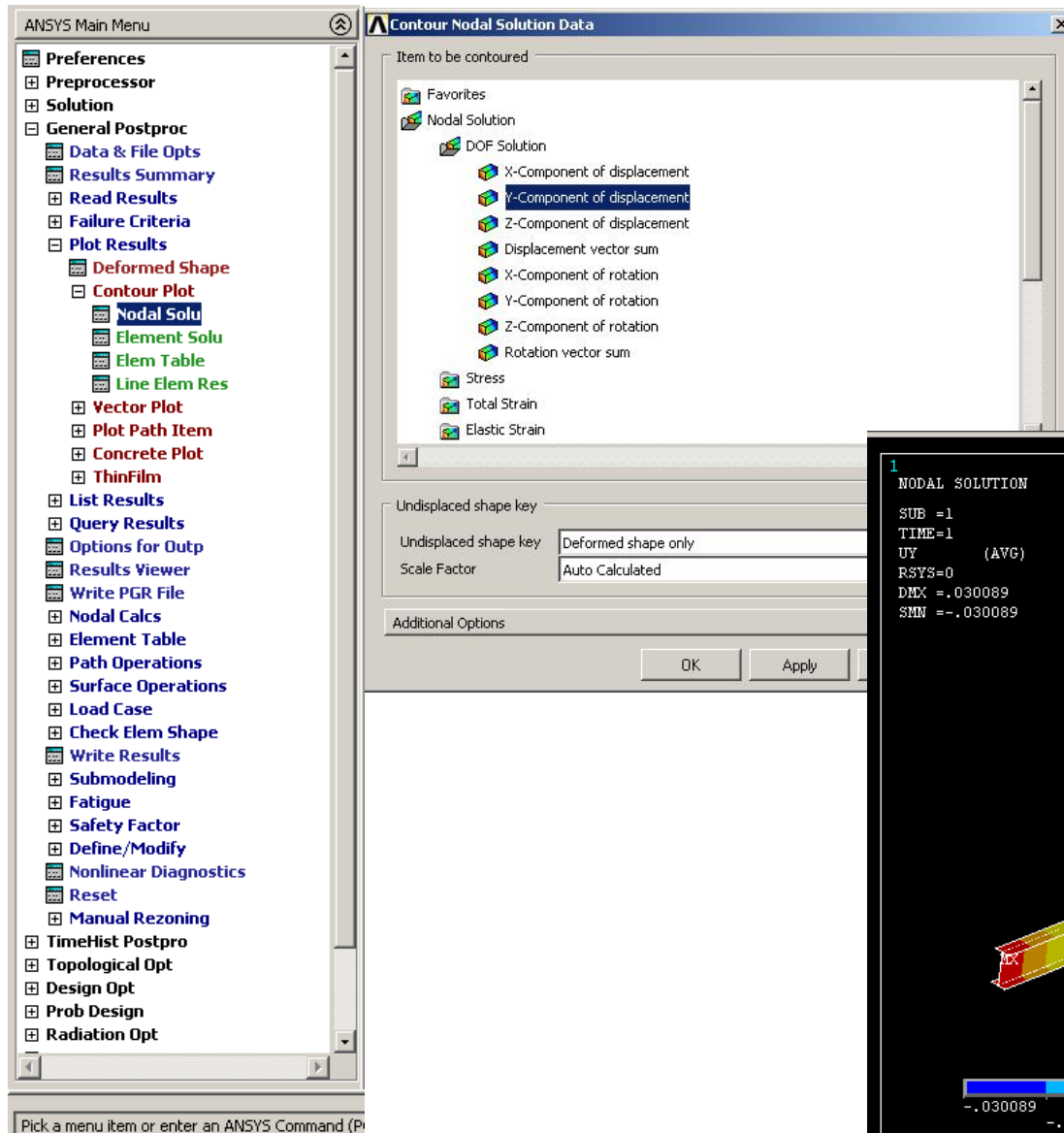


(1) Preprocessor/  
Solution/  
Solve/  
Current LS/

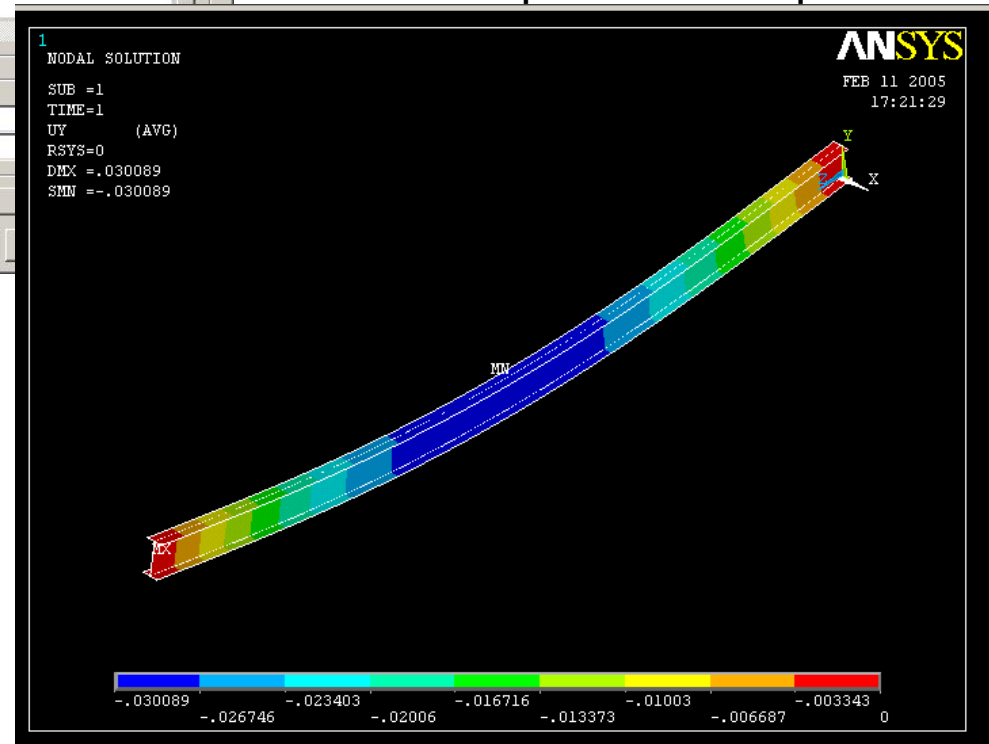


(2) Preprocessor/  
Plot Results/  
Control Plot/  
Nodal Solu/

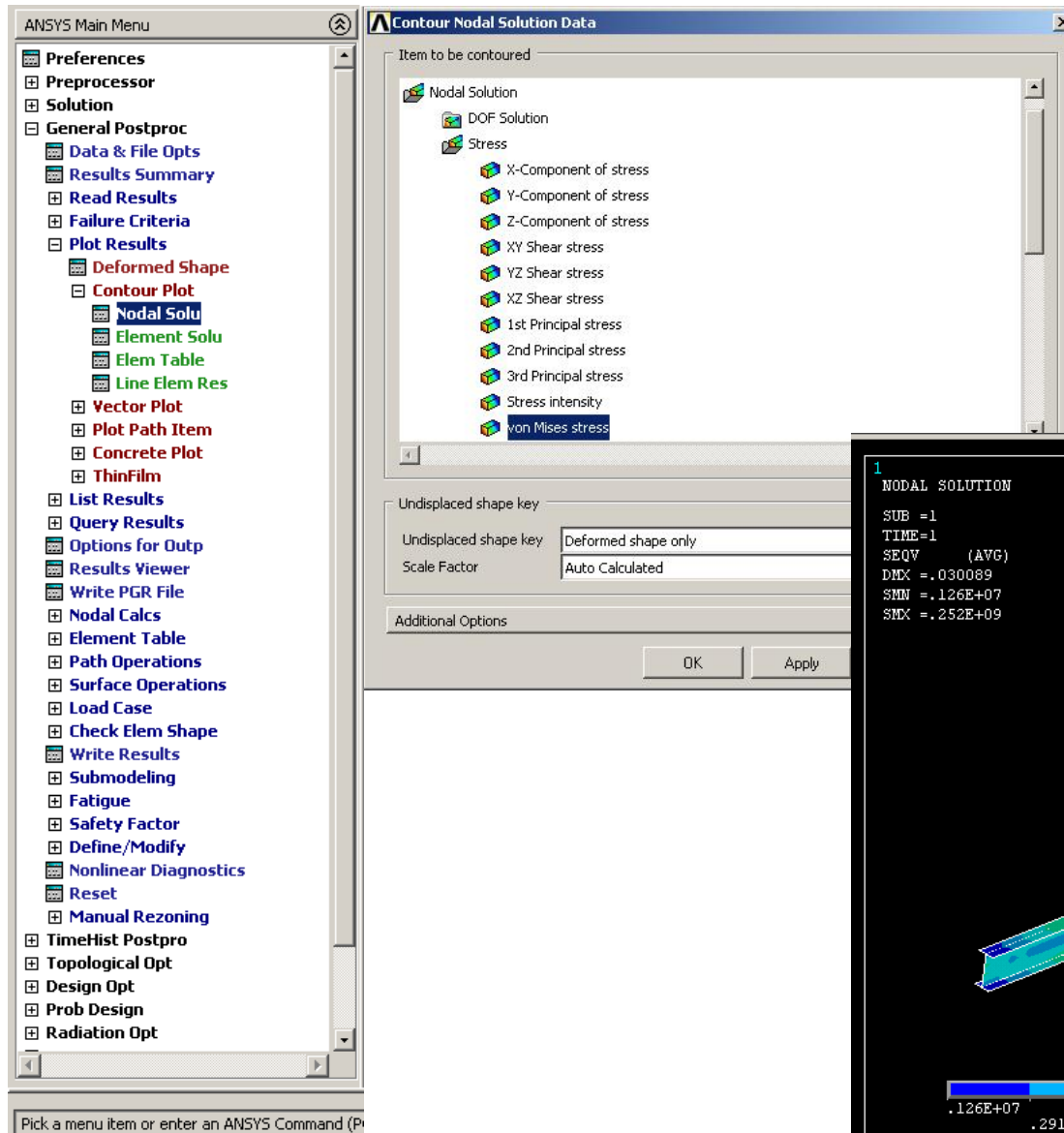
## UY- sijas pārvietojumi



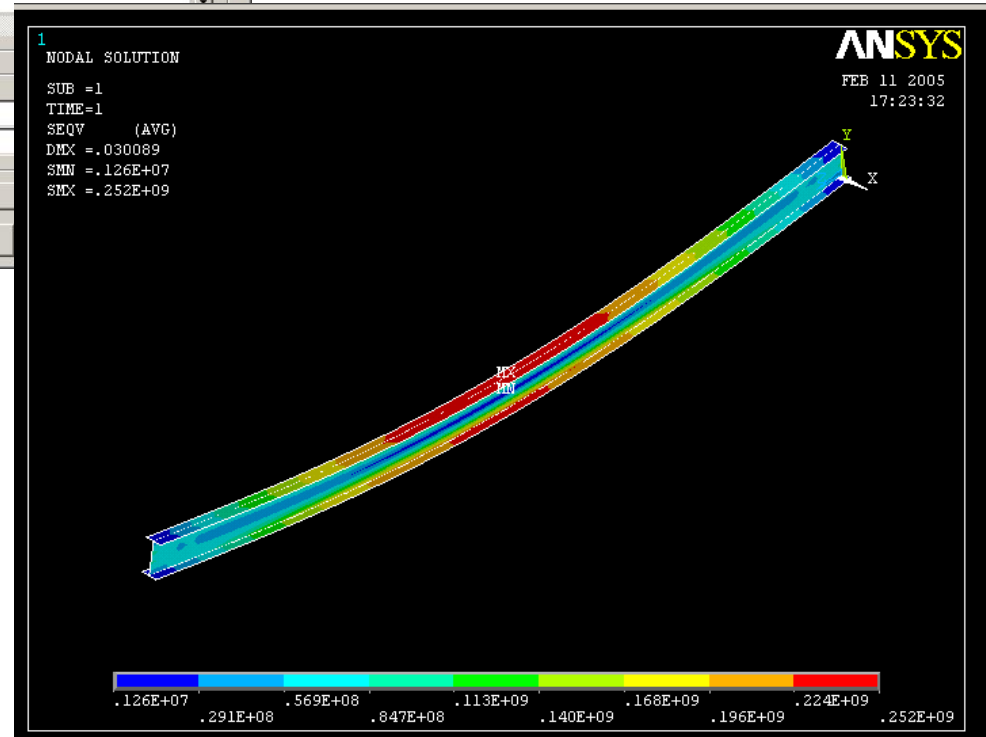
- (1) General Postproc/  
Plot Results/  
Contour Plot/  
Nodal Solu/
- (2) Nodal Solution  
DOF Solution  
Y- Component of displacement



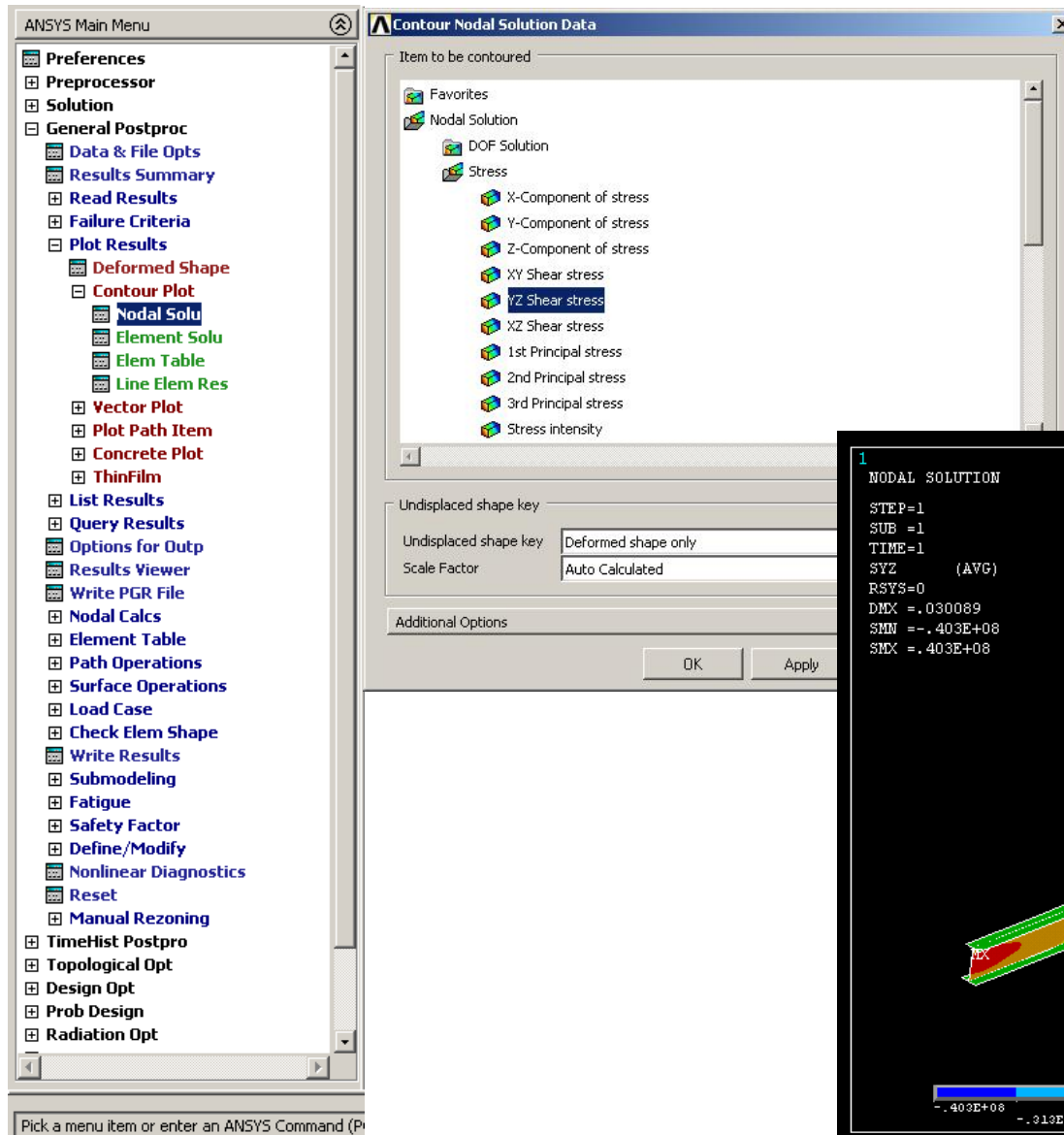
# Sijas ekvivalentie spriegumi



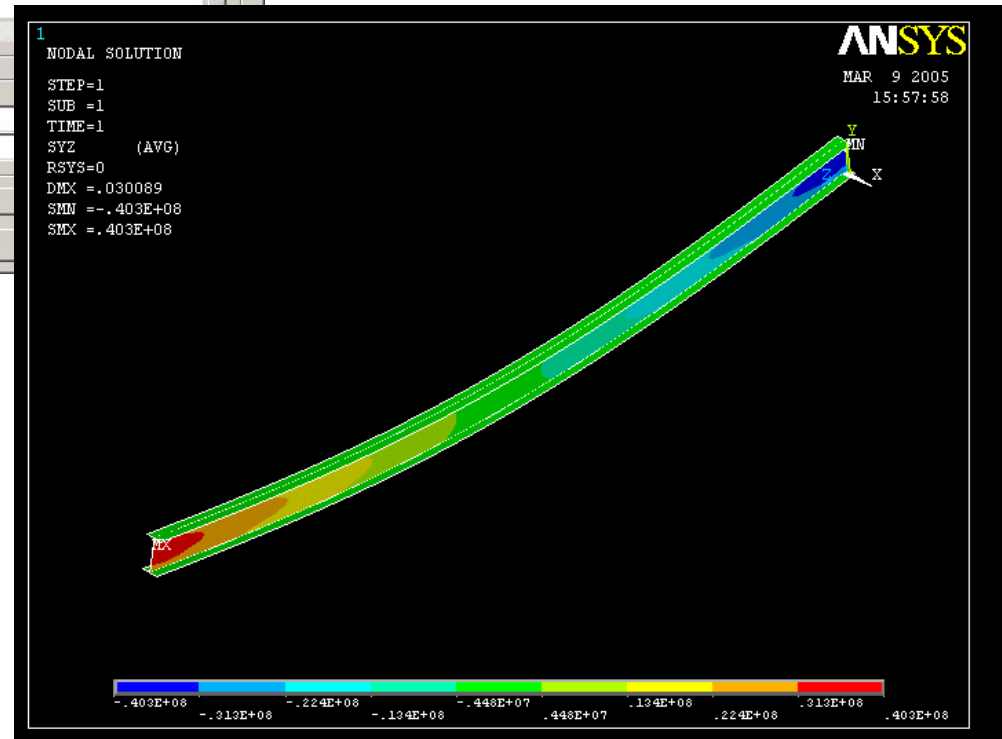
- (1) General Postproc/  
Plot Results/  
Contour Plot/  
Nodal Solu/
- (2) Nodal Solution  
Stress  
von Mises stress



# Sijas tangenciālie spriegumi

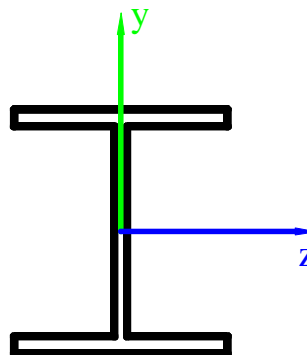


- (1) General Postproc/  
Plot Results/  
Contour Plot/  
Nodal Solu/
- (2) Nodal Solution  
Stress  
YZ Shear stress





## iegūto rezultātu salīdzinājums



|                       | UY [m]  | M [N*m] | Q [N] | $\sigma$ [MPa] | $\tau_{\max}$ [MPa] |
|-----------------------|---------|---------|-------|----------------|---------------------|
| Analītiskais aprēķins | 0.0320  | 46875   | 37500 | 254            | 40.9                |
| BEAM 3                | 0.0299* | 46875   | 37500 | 241*           | -*                  |
| BEAM 189              | 0.0320  | 46200   | 37500 | 263            | 40.2                |
| SHELL 63              | 0.0301  | -*      | -*    | 248            | 40.3                |

## Log fails ar paskaidrojumiem - !\* paskaidrojumi

```
!*Sijas geometrija (m)
*SET,L,5
*SET,q,15000
*SET,w1,0.1
*SET,w3,0.2
*SET,t1,0.008
*SET,t3,0.0055
!*
/PREP7
!* Elementa tipa izvele
!*
ET,1,SHELL63
!*
!* Ģeometrisko konstanšu definēšana
!*
R,1,t1,t1,t1,t1, , ,
!*
R,2,t3,t3,t3,t3, , ,
!*
!* Materiala ipasību definesana (Pa)
!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,2.1E11
MPDATA,PRXY,1,,0.3
!*
!* Koordinātu mezglu punktu definesana
!*
K,1,0,0,0,
K,2,0,W3,0,
```

```
K,3,-W1/2,0,0,
K,4,W1/2,0,0,
K,5,-W1/2,W3,0,
K,6,W1/2,W3,0,
!*
!* Koordinātu mezglu punktu svienosana ar taisnu līniju
!*
LSTR, 1, 2
LSTR, 3, 4
LSTR, 5, 6
!*
!* Līniju kopēšana
!*
FLST,3,3,4,ORDE,2
FITEM,3,1
FITEM,3,-3
LGEN,2,P51X, , , ,L, ,1
!*
!* Koordinātu mezglu punktu svienosana ar taisnu līniju
!*
LSTR, 10, 4
LSTR, 9, 3
LSTR, 12, 6
LSTR, 11, 5
LSTR, 7, 1
LSTR, 8, 2
```

## Log fails ar paskaidrojumiem - !\* paskaidrojumi

!\* Laukumu izveidošana

!\*

FLST,2,4,4

FITEM,2,6

FITEM,2,9

FITEM,2,3

FITEM,2,10

AL,P51X

FLST,2,4,4

FITEM,2,5

FITEM,2,7

FITEM,2,2

FITEM,2,8

AL,P51X

FLST,2,4,4

FITEM,2,11

FITEM,2,1

FITEM,2,12

FITEM,2,4

AL,P51X

!\*

!\* Ģeometrisko konstanšu piešķiršana

!\*

FLST,5,2,5,ORDE,2

FITEM,5,1

FITEM,5,-2

CM,\_Y,AREA

ASEL, , , ,P51X

CM,\_Y1,AREA

CMSEL,S,\_Y

CMSEL,S,\_Y1

AATT, 1, 1, 1, 0,

CMSEL,S,\_Y

CMDELE,\_Y

CMDELE,\_Y1

!\*

CM,\_Y,AREA

ASEL, , , , 3

CM,\_Y1,AREA

CMSEL,S,\_Y

!\*

CMSEL,S,\_Y1

AATT, 1, 2, 1, 0,

CMSEL,S,\_Y

CMDELE,\_Y

CMDELE,\_Y1

!\*

!\* Līniju dalīšana galigos elementos

!\*

FLST,5,4,4,ORDE,4

FITEM,5,2

FITEM,5,-3

FITEM,5,5

FITEM,5,-6

CM,\_Y,LINE

LSEL, , , ,P51X

CM,\_Y1,LINE

CMSEL,,\_Y

!\*

LESIZE,\_Y1, , , ,4, , , , ,1

## Log fails ar paskaidrojumiem - !\* paskaidrojumi

```
FLST,5,2,4,ORDE,2
FITEM,5,1
FITEM,5,4
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,8, , , ,1
!*
FLST,5,6,4,ORDE,2
FITEM,5,7
FITEM,5,-12
CM,_Y,LINE
LSEL, , , ,P51X
CM,_Y1,LINE
CMSEL,,_Y
!*
LESIZE,_Y1, , ,50, , , ,1
!*
!*
!* Dalijums galigos elementos
!*
MSHKEY,0
FLST,5,3,5,ORDE,2
FITEM,5,1
FITEM,5,-3
CM,_Y,AREA
ASEL, , , ,P51X
CM,_Y1,AREA

CHKMSH,'AREA'
CMSEL,S,_Y
!*
AMESH,_Y1
!*
CMDELE,_Y
CMDELE,_Y1
CMDELE,_Y2
!*
!* Mezglu punktu savienošana
!*
NUMMRG,ALL, , , ,LOW
!*
!* Elementa nostaprinājuma definēšana
!* (Mezglis Nr.1)
!*
FLST,2,1,1,ORDE,1
FITEM,2,623
!*
/GO
D,P51X, , , ,UX,UY,, , ,ROTY,ROTZ,
!*
!* Elementa nostaprinājuma definēšana
!* (Mezglis Nr.2)
!*
FLST,2,1,1,ORDE,1
FITEM,2,566
!*
/GO
D,P51X, , , , ,UX,UY,UZ,, , ,ROTY,ROTZ,

!* Sijas slogošana
!*
FLST,2,1,5,ORDE,1
FITEM,2,1
/GO
!*
SFA,P51X,2,PRES,q/W1 ,
!*
!* Sijas aprekins
!*
FINISH
/SOL
/STATUS,SOLU
SOLVE
```