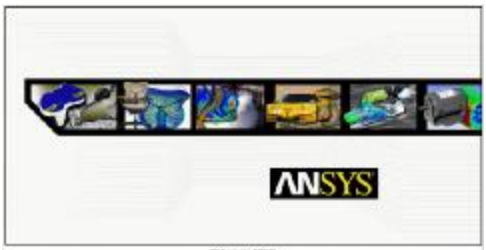
Rīgas Tehniskā universitāte
Materiālu un Konstrukciju institūts

Uzdevums: 2D – sijas elements Beam 3

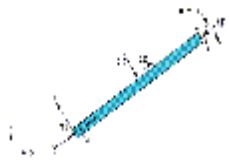
Programma: ANSYS 9

Autori: A. Ivaškovs



Beam 3 2-D sijas elements

Sijas elementa Beam 3 ģeometrija



Mezgli
- I, J

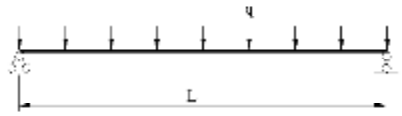
Brīvības pakāpes
- UX, UY, ROTZ

Materiāla īpašības
- AREA, IZZ, HEIGHT,
- SHEARZ, ISTRN, ADDMAS
- EX, ALPX, DENS, GXY, DAMP

Slodzes
- Vienmērīgi izkliedētas slodzes
  - konstante **1** (I-J) (-y normāles virzienā),
  - konstante **2** (I-J) (+x perpendikulārā virzienā),
  - konstante **3** (I) (+x ass virzienā),
  - konstante **4** (J) (-x ass negatīvā virzienā).

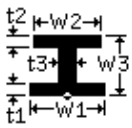
Papildus iespējas
- Materiāla šķūde
- Lielas deformācijas elementā

3D sija modelēšana ar Beam189 palīdzību



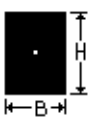
L = 5 [m]
q = 15 [kN/m]

Dubult-T profila šķērsgriezums GOST 8239-89 Nr.20Б1



W1 = 0.1 [m]
W2 = 0.1 [m]
W3 = 0.2 [m]
t1 = 0.008 [m]
t2 = 0.008 [m]
t3 = 0.0055 [m]

Ekvivālenta taisnstūra profila šķērsgriezums



H = 0.2 [m]
I = 0.0000194 [m^4]
A = 0.0028 [m^2]

Elementa tipa definēšana – BEAM 3

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

(2) Add...

(3) Beam
2D elastic 3

(4) OK

Materiāla īpašību definēšana

(1) Preprocessor/
Material Props/
Material Models

(2) Material Model Number

Structural
Linear
Elastic
Isotropic

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

PRXY = 0.3 *Puasona koeficients*

OK

Šķērsgriezuma profila definēšana

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

(2) Add...

(3) OK

(4) AREA 0.0028
IZZ 0.00001943
HEIGHT 0.2

OK

Koordinātu mezglu definēšana

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

(2) NPT X, Y, Z
1 0 0 0
2 5 0 0

Apply
OK

Līnijas definēšana

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

(3) OK

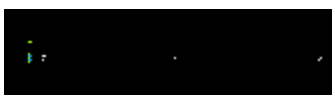
(2) Savienot punktu Nr.1 ar punktu Nr.2

Galīgo elementu izmēru definēšana

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

(2) NDIV 6

(3) OK

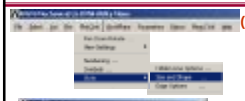


Sijas dalījums galīgos elementos

(1) Preprocessor/
Meshing/
Mesh/
Lines/

(2) Pick All

Sijas izometriskā skata izveide



(1) PlotCtrls/ Style/ Size and Shape/

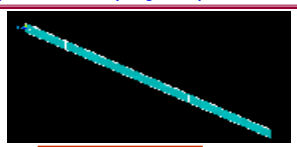
(2) Display of element
On

(4) OK

(3) OK

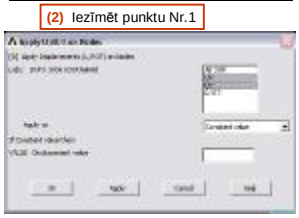
Elementa nostiprinājuma definēšana (*Mezgls Nr.1*)

(1) Preprocessor/
Loads/
Define Loads/
Apply/
Structural/
Displacement/
On Nodes



(2) Iezīmēt punktu Nr.1

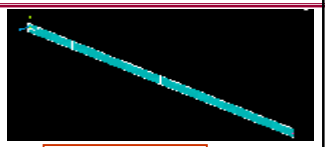
(3) OK



(4) UX, UY (5) Apply

Elementa nostiprinājuma definēšana (*Mezgls Nr.2*)

(1) Preprocessor/
Loads/
Define Loads/
Apply/
Structural/
Displacement/
On Nodes



(2) Iezīmēt punktu Nr.2

(3) OK

(4) UY (5) Apply

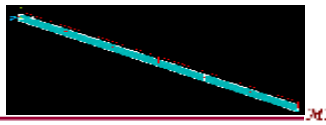
Sijas vienmērīgi izkliedētas slodzes definēšana

(1) Preprocessor/
Loads/
Define Loads/
Apply/
Structural/
Pressure/
On Beams

(3) LKEY = 1
VALI = 15000 [N/m]
VALJ = 15000 [N/m]

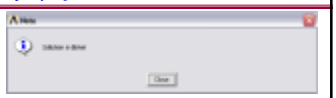
(4) OK

(2) Pick All



Sija aprēķins

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



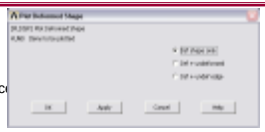
(2) Close

(3) Close

Sijas deformētā stāvokļa grafiska izveide

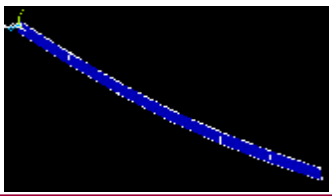
(1) General Postproc/
Plot Rezults/
Deformed Shape/

(1) General Postproc
Plot Rezults/
Control Plot/
Nodal Solu/



(2) Def shape only

(3) OK

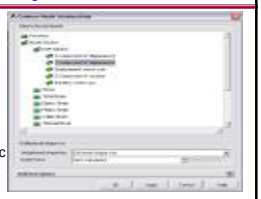


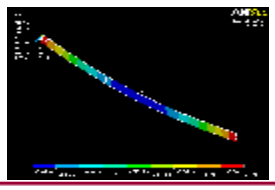
Sijas pārvietojumi Y-ass virzienā grafiska izveide

(1) General Postproc
Plot Rezults/
Control Plot/
Nodal Solu/

(2) Nodal Solution
DOF Solution
Y-Components of displac

(3) OK



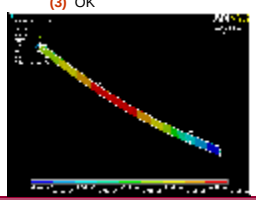


Ekvivalento spriegumu sadalījumu sijā grafiska izveide

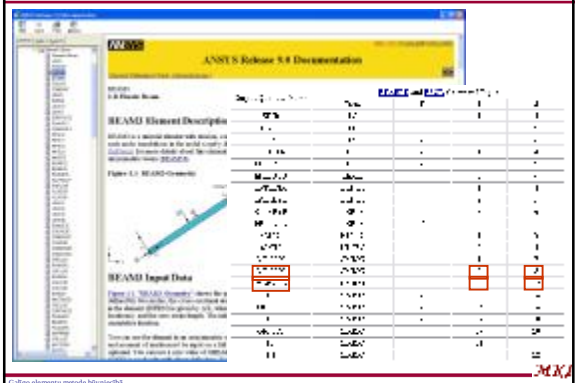
(1) General Postproc
Plot Rezults/
Control Plot/
Nodal Solu/

(2) Nodal Solution
DOF Solution
Stress
von Mises stress

(3) OK

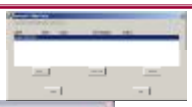


Elementa BEAM 3 – piepūļu skaitlisko vērtību definēšana



Momenta piepūļu skaitlisko vērtību definēšana

(1) General Postproc/
Element Table/
Define Table/



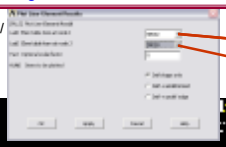
(2) Add..

(3) By sequence num
SMISC
6
Apply

(4) By sequence num
SMISC
12
OK

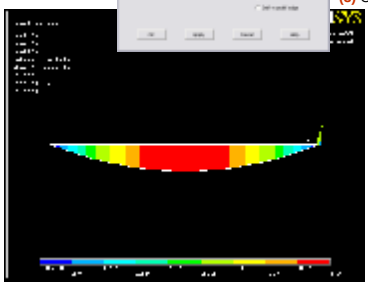
Momentu epīras grafiska izveide

(1) General Postproc/
Plot Resukts/
Controur Plot/
Line Elem Res



(2)
SMIS6
SMIS12

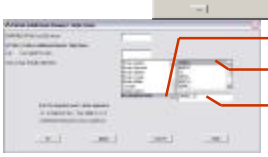
(3) Ok



Šķērsspēka piepūļu skaitlisko vērtību definēšana

(1) General Postproc/
Element Table/
Define Table/

(2) Add..



(3) By sequence num

SMISC

2

Apply

(4) By sequence num

SMISC

8

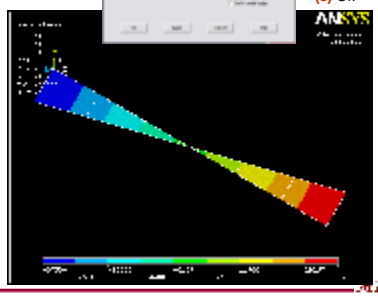
OK

Šķērsspēka epīras grafiska izveide

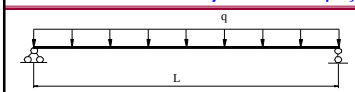
(1) General Postproc/
Plot Resukts/
Controur Plot/
Line Elem Res

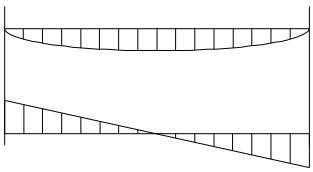
(2)
SMIS2
SMIS8

(3) Ok



Sijas analītiskais aprēķins





$$M_{max} = \frac{gl^2}{8} = \frac{15000 \cdot 25}{8} = 46875[N \cdot m]$$

$$Q_{max} = \frac{ql}{2} = \frac{15000 \cdot 5}{2} = 37500[N]$$

$$d = w_{max} = \frac{5qL^4}{384EI} = \frac{5 \cdot 15 \times 10^3 \cdot 5^4}{384 \cdot 2.1 \times 10^{11} \cdot 1943 \times 10^{-8}} = 0.0299[m]$$

$$s = \frac{M}{W} = \frac{46875}{194.3 \times 10^{-6}} = 241.2 \times 10^6 [Pa]$$

Rezultātu salīdzināšana

	UY [m]	M [Nm]	Q [N]	σ x10⁶ [Pa]
Analītiskais aprēķins	0.0299	46875	37500	241.2
ANSYS	0.0299	46875	37500	241
|Δ| [%]	**0**	**0**	**0**	**0.1**

Log fail

```
!* Elementa tipa izvele
!*
ET,1,BEAM3
!*
!* Materiala ipasibu definesana (Pa)
!*
MPTEMP,,,,,,,,
MPTEMP,1,0
MPDATA,EX,1,,2.1e11
MPDATA,PRXY,1,,0.3
!*
!* Skersgriezuma parametru definesana (m)
!*
R,1,0.0028,1.943e-5,0.2, , , ,
!*
!* Koordinatu mezglu punktu definesana
!*
K,1,0,0,0,
K,2,5,0,0,
!*
!* Koordinatu mezglu punktu svienosana ar taisnu liniju
!*
LSTR,      1,      2
!*
!* Dalijums galigos elementos
!*
LESIZE,ALL, , ,6, ,1, , ,1,
LMESH,       1
!*
!*
/SHRINK,0
/ESHAPE,1.0
/EFACET,1
/RATIO,1,1,1
/CFORMAT,32,0
/REPLOT
!*
!* 3D skats
!*
/VIEW,1,1,1,1
/ANG,1
/REP,FAST
FLST,2,1,1,ORDE,1
FITEM,2,1
!*
!* Elementa nostiprinajuma definēšana (Mezgls Nr.1)
!*
/GO
D,P51X, , , , , ,UX,UY, , , ,
FLST,2,1,1,ORDE,1
FITEM,2,2
!*
!* Elementa nostiprinajuma definēšana (Mezgls Nr.2)
!*
/GO
D,P51X, , , , , ,UY, , , , ,
FLST,2,6,2,ORDE,2
FITEM,2,1
```


Log fail

```
!*
!* Sijas slogošana
!*
FITEM,2,-6
SFBEAM,P51X,1,PRES,15000,15000, , , , ,
FINISH
/SOL
/STATUS,SOLU
SOLVE
!*
!* Sijas aprekins
!*
FINISH
/POST1
PLDISP,0
!*
!* Parvietojumi pa Y asi
!*
/EFACET,1
PLNSOL, U,Y, 0,1.0
!*
!* Momenta epīras
!*
/EFACET,1
PLNSOL, S,EQV, 0,1.0
AVPRIN,0, ,
ETABLE, ,SMISC, 6
!*
AVPRIN,0, ,
ETABLE, ,SMISC, 12
!*
!*
PLLS,SMIS6,SMIS12,1,0
!*
!* Šķērsspēķas epīras
!*
AVPRIN,0, ,
ETABLE, ,SMISC, 2
!*
AVPRIN,0, ,
ETABLE, ,SMISC, 8
!*
!*
PLLS,SMIS2,SMIS8,1,0
```