SLang - the Next Generation

Tutorial

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0.1 Simple finite element analysis

A simple frame consisting of 4 beam elements as sketched in Fig. **??** is analyzed. The steps required to perform the analysis are shown in the following *SLangTNG*-script
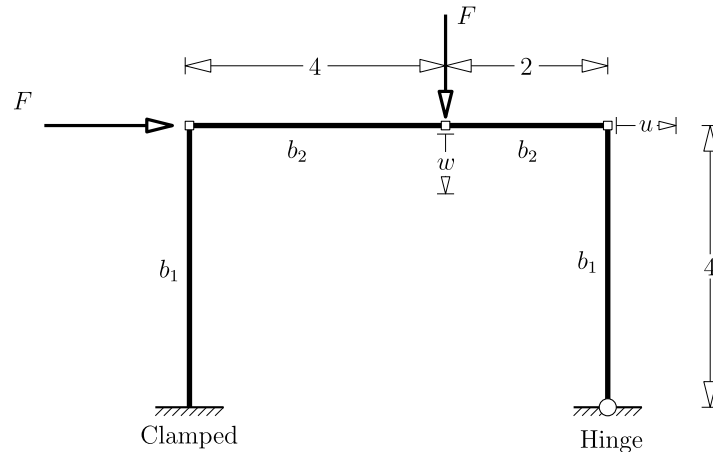

Figure 1: Simple frame

```
1  −−[[
2  SLangTNG
3  Simple  test  example  for  Finite  Element  analysis
4  (c)  2009  Christian  Bucher ,  CMSD–VUT
5  −−]]
6
7  −−  Create  new  structure
8    struct=tngfem.TNGStructure ("frame")
9
10 −−  Define  node  IDs  and  coordinates
11   nodes  =  tmath.ReadMatrix ({
12     {11,  0,  0,  0},
13     {12,  0,  4,  0},
14     {13,  4,  4,  0},
15     {14,  6,  4,  0},
16     {15,  6,  0,  0},
17     {16,  10,  0,  0}
18   })
19   struct:AddNodes (nodes)
20
21 −−  Define  support  conditions  and  fix  reference  node  16
22   struct:GetNode (11):SetAvailDof (0,  0,  0,  0,  0,  0)
23   struct:GetNode (15):SetAvailDof (0,  0,  0,  0,  0,  1)
24   struct:GetNode (16):SetAvailDof (0,  0,  0,  0,  0,  0)
25 −−  Define  cross  sections
26   b1  =  0.3
27   b2  =  0.2
28   struct:AddSection (1,  "RECT",  0,  b1,  b1)
29   struct:AddSection (2,  "RECT",  0,  b2,  b2)
30
31 −−  Define  material
32   struct:AddMaterial (8,  "LINEAR_ELASTIC",  2.1e11 ,  .3,  7850)
33
34 −−  Define  elements
35   struct:AddElement (1,  "RECT",  8,  1,  11,  12,  16)
36   struct:AddElement (2,  "RECT",  8,  2,  12,  13,  16)
37   struct:AddElement (3,  "RECT",  8,  2,  13,  14,  16)
38   struct:AddElement (4,  "RECT",  8,  1,  14,  15,  16)
39
40 −−  Find  global  DOFs  and  assemble  stiffness
41   nd=struct:GlobalDof ()
42   struct:Print ()
43   K=struct:SparseStiffness ()
44
```

```
45  --- Construct a load vector
46    local F1=struct:GetAllDisplacements()
47    F = 10000
48  --- DOF 0 of second node
49    node = 1; dof = 0
50    F1[{node,dof}] = F
51  --- DOF 1 of third node
52    node = 2; dof = 1
53    F1[{node,dof}] = F
54  --- Convert to a vector containing only active DOF's
55    FA=struct:ToDofDisplacements(F1)
56
57  --- Solve for displacements and assign to structure
58    U=K:Solve(FA)
59    U1=struct:ToAllDisplacements(U)
60    print("U1", U1)
61    struct:SetAllDisplacements(U1)
62
63  --- Get displacements u and w
64    u = U1[{3, 0}]
65    w = U1[{2, 1}]
66    print("u", u, "w", w)
67
68  --- Draw the structure (scale deformations by factor 1000)
69    ww = tnggraphics.TNGVisualize(800, 100, 600, 600, "Deformed Structure")
70    ww:Lighting(true)
71    ww:Perspective(true)
72    ww:SetAngles(10,30,0)
73    ww:Draw(struct, 1000)
74    ww:File("structure.pdf")
```
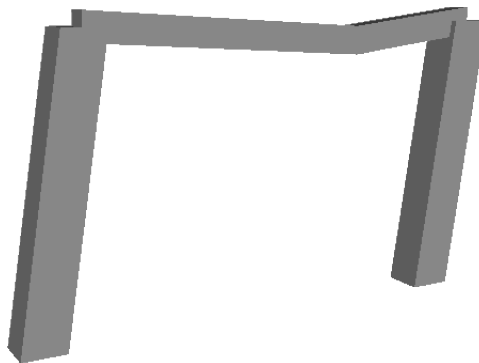

Figure 2: Deformed structure