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1  # #####
2  # SE 201B: NONLINEAR STRUCTURAL ANALYSIS
3  # NONLINEAR FIBER SECTION ANALYSIS
4  # #####
5
6  #Always start with
7  wipe; # Clear memory of all past model definitions
8  model BasicBuilder -ndm 3 -ndf 6; # Define the model builder, ndm=#dimension, ndf=#dofs
9
10 # -----
11 # DEFINE NODES
12 # -----
13 set nodeTag1 1;
14 set nodeTag2 2;
15
16 node $nodeTag1      0. 0. 0.;
17 node $nodeTag2      0. 0. 0.;
18
19 # -----
20 # DEFINE CONSTRAINTS
21 # -----
22 fix $nodeTag1      1 1 1 1 1 1; # Pin
23 fix $nodeTag2      0 1 1 1 0 0; # Roller
24
25 # -----
26 # DEFINE MATERIAL
27 # -----
28
29 # Define unconfined concrete material parameters
30 set fpc            [expr -32.5*$MPa]
31 set Ec            [expr 27000.0*$MPa]
32 set epsc0         [expr 2.0*$fpc/$Ec]
33 set ft            [expr 1.9*$MPa]
34 set lambda        0.25
35 set Ets           [expr 0.1*$Ec]
36 set fpcU          [expr 0.2*$fpc]
37 set epsU          -0.004
38
39 # Define confined concrete material parameters
40 set fpcc           [expr -47.9*$MPa]
41 set Ecc           [expr 27000.0*$MPa]
42 set epscc0        [expr 2.0*$fpcc/$Ecc]
43 set ftc           [expr 1.9*$MPa]
44 set lambdac       0.25
45 set Etsc          [expr 0.1*$Ecc]
46 set fpccU         [expr 0.85*$fpcc]
47 set epscU         -0.0276
48
49 # Define steel material parameters
50 set fy            [expr 455.0*$MPa]
51 set Es            [expr 215000.0*$MPa]
52 set b            0.01
53 set R0           20.0
54 set cR1          0.925
55 set cR2          0.15
56 set a1           0.0
57 set a2           1.0
58 set a3           0.0
59 set a4           1.0
60 set sigInit      0.0
61
62 set matTagConcCover 1
63 set matTagConcCore  2
64 set matTagSteel     3
65 set modelnum 1.0
66
67 # Unconfined concrete:
68 uniaxialMaterial Concrete02 $matTagConcCover $fpc $epsc0 $fpcU $epsU $lambda $ft $Ets
69

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70 # Confined concrete:
71 uniaxialMaterial Concrete02 $matTagConcCore $fpcc $epscc0 $fpccU $epscU $lambdac $ftc
  $EtsC
72
73 # Reinforcing steel:
74 uniaxialMaterial Steel02 $matTagSteel $fy $Es $b $R0 $cR1 $cR2 $a1 $a2 $a3 $a4
  $sigInit
75
76 #puts $modelExportFileID "uniaxialMaterial Concrete02 $matTagConcCore $fpcc $epscc0
  $fpccU $epscU $lambdac $ftc $EtsC"
77 #puts $modelExportFileID "uniaxialMaterial Concrete02 $matTagConcCover $fpc $epscc0
  $fpcU $epsU $lambda $ft $Ets"
78 #puts $modelExportFileID "uniaxialMaterial Steel02 $matTagSteel $fy $Es $b $R0
  $cR1 $cR2 $a1 $a2 $a3 $a4 $sigInit"
79
80 # -----
81 # DEFINE SECTION
82 # -----
83 set colWidth [expr 400.*$mm]
84 set colDepth [expr 400.*$mm]
85 set colArea [expr $colWidth * $colDepth]
86 set cover [expr 40.*$mm]
87 set dB [expr 20.*$mm]
88 set As [expr 314.159*$mm2]
89 set y1 [expr $colDepth/2.0]
90 set z1 [expr $colWidth/2.0]
91 set totNumBars 8
92
93 set secTag 4
94 set fiberA 40
95 set fiberB 5
96 set fiberC 40
97
98 section Fiber $secTag -GJ $Ubig {
99 #
100 # Create rectangular patches
101 #
102 # Cover concrete
103 patch rect $matTagConcCover $fiberA $fiberB [expr $cover - $y1] [expr -$z1] [expr
  $y1 - $cover] [expr $cover - $z1]
104 patch rect $matTagConcCover $fiberA $fiberB [expr $cover - $y1] [expr $z1 - $cover]
  [expr $y1 - $cover] [expr $z1]
105 patch rect $matTagConcCover $fiberB [expr $fiberA+2*$fiberB] [expr -$y1] [expr
  -$z1] [expr $cover - $y1] [expr $z1]
106 patch rect $matTagConcCover $fiberB [expr $fiberA+2*$fiberB] [expr $y1 - $cover]
  [expr -$z1] [expr $y1] [expr $z1]
107 # Core concrete
108 patch rect $matTagConcCore $fiberC $fiberC [expr $cover - $y1] [expr $cover - $z1]
  [expr $y1 - $cover] [expr $z1 - $cover]
109 #
110 # Create straight layers
111 #
112 # Reinforcing steel
113 layer straight $matTagSteel 3 $As [expr $y1 - $cover] [expr $z1 - $cover] [expr $y1
  - $cover] [expr $cover - $z1]
114 layer straight $matTagSteel 2 $As 0 [expr $cover - $z1] 0 [expr $z1 - $cover]
115 layer straight $matTagSteel 3 $As [expr $cover - $y1] [expr $cover - $z1] [expr
  $cover - $y1] [expr $z1 - $cover]
116 }
117
118
119 # puts $modelExportFileID "section Fiber $secTag -GJ $Ubig {
120 # #
121 # # Create rectangular patches

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122      # #
123      # # Cover concrete
124      # patch rect $matTagConcCover $fiberA $fiberB [expr $cover - $y1] [expr -$z1] [expr
125      $y1 - $cover] [expr $cover - $z1]
126      # patch rect $matTagConcCover $fiberA $fiberB [expr $cover - $y1] [expr $z1 -
127      $cover] [expr $y1 - $cover] [expr $z1]
128      # patch rect $matTagConcCover $fiberB $fiberA [expr -$y1] [expr -$z1] [expr $cover
129      - $y1] [expr $z1]
130      # patch rect $matTagConcCover $fiberB $fiberA [expr $y1 - $cover] [expr -$z1] [expr
131      $y1] [expr $z1]
132      # # Core concrete
133      # patch rect $matTagConcCore $fiberC $fiberC [expr $cover - $y1] [expr $cover -
134      $z1] [expr $y1 - $cover] [expr $z1 - $cover]
135      # #
136
137      # # Create straight layers
138      # #
139
140      # # Reinforcing steel
141      # layer straight $matTagSteel 3 $As [expr $y1 - $cover] [expr $z1 - $cover] [expr
142      $y1 - $cover] [expr $cover - $z1]
143      # layer straight $matTagSteel 2 $As 0 [expr $cover - $z1] 0 [expr $z1 - $cover]
144      # layer straight $matTagSteel 3 $As [expr $cover - $y1] [expr $cover - $z1] [expr
145      $cover - $y1] [expr $z1 - $cover]
146      # }"
147
148      # -----
149      # DEFINE ELEMENT
150      # -----
151      set eleTag 1
152      set secTag 4
153      element zeroLengthSection $eleTag $nodeTag1 $nodeTag2 $secTag -orient 1 0 0 0 1 0
154      # puts $modelExportFileID "element zeroLengthSection $eleTag $nodeTag1 $nodeTag2
155      $secTag -orient 1 0 0 0 1 0"
156      # close $modelExportFileID
157
158      set controlNode $nodeTag2

```