```
# ##########################################################################################
# SE 201B: NONLINEAR STRUCTURAL ANALYSIS
# NONLINEAR FIBER SECTION ANALYSIS
# ##########################################################################################

#Always start with
wipe; # Clear memory of all past model definitions
model BasicBuilder -ndm 2 -ndf 3; # Define the model builder, ndm=#dimension, ndf=#dofs

# ------------------------------------------------------------------------------------------
# DEFINE NODES
# ------------------------------------------------------------------------------------------
set nodeTag1 1;
set nodeTag2 2;

node $nodeTag1       0. 0.;
node $nodeTag2       0. 0.;

# puts $modelExportFileID "node $nodeTag1       0. 0.;"
# puts $modelExportFileID "node $nodeTag2       0. 0.;"

# ------------------------------------------------------------------------------------------
# DEFINE CONSTRAINTS
# ------------------------------------------------------------------------------------------
fix $nodeTag1        1 1 1; # Pin
fix $nodeTag2        0 1 0; # Roller

# ------------------------------------------------------------------------------------------
# DEFINE MATERIAL
# ------------------------------------------------------------------------------------------

# Define unconfined concrete material parameters
set fpc              [expr -32.5*$MPa]
set Ec               [expr 27000.0*$MPa]
set epsc0            [expr 2.0*$fpc/$Ec]
set ft               [expr 1.9*$MPa]
set lambda           0.25
set Ets              [expr 0.1*$Ec]
set fpcU             [expr 0.2*$fpc]
set epsU             -0.004

# Define confined concrete material parameters
set fpcc             [expr -47.9*$MPa]
set Ecc              [expr 27000.0*$MPa]
set epscc0           [expr 2.0*$fpcc/$Ecc]
set ftc              [expr 1.9*$MPa]
set lambdac          0.25
set Etsc             [expr 0.1*$Ecc]
set fpccU            [expr 0.85*$fpcc]
set epscU            -0.0276

# Define steel material parameters
set fy               [expr 455.0*$MPa]
set Es               [expr 215000.0*$MPa]
set b                0.01
set R0               20.0
set cR1              0.925
set cR2              0.15
set a1               0.0
set a2               1.0
set a3               0.0
set a4               1.0
set sigInit          0.0

set matTagConcCover 1
set matTagConcCore  2
set matTagSteel     3
set modelnum 2.0

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```
70  # Unconfined concrete:
71  uniaxialMaterial Concrete01 $matTagConcCover  $fpc $epsc0 $fpcU $epsU
72
73  # Confined concrete:
74  uniaxialMaterial Concrete01 $matTagConcCore   $fpcc $epscc0 $fpccU $epscU
75
76  # Reinforcing steel:
77  uniaxialMaterial Steel01    $matTagSteel      $fy $Es $b $a1 $a2 $a3 $a4
78
79  # puts $modelExportFileID "uniaxialMaterial Concrete01 $matTagConcCover  $fpc $epsc0
    $fpcU $epsU"
80  # puts $modelExportFileID "uniaxialMaterial Concrete01 $matTagConcCore   $fpcc $epscc0
    $fpccU $epscU"
81  # puts $modelExportFileID "uniaxialMaterial Steel01    $matTagSteel      $fy $Es $b $a1
    $a2 $a3 $a4"
82
83
84  # ------------------------------------------------------------------------------
85  # DEFINE SECTION
86  # ------------------------------------------------------------------------------
87  set colWidth    [expr 400.*$mm]
88  set colDepth    [expr 400.*$mm]
89  set colArea     [expr $colWidth * $colDepth]
90  set cover       [expr 40.*$mm]
91  set dB          [expr 20.*$mm]
92  set As          [expr 314.*$mm2]
93  set y1          [expr $colDepth/2.0]
94  set z1          [expr $colWidth/2.0]
95  set totNumBars  8
96
97  set secTag 3
98  set fiberA 20
99  set fiberB 5
100 set fiberC 20
101
102 section Fiber $secTag -GJ $Ubig {
103     #
        ------------------------------------------------------------------------------
104     # Create rectangular patches
105     #
        ------------------------------------------------------------------------------
106     # Cover concrete
107     patch rect $matTagConcCover $fiberA 1 [expr $cover - $y1] [expr -$z1] [expr $y1 -
        $cover] [expr $cover - $z1]
108     patch rect $matTagConcCover $fiberA 1 [expr $cover - $y1] [expr $z1 - $cover] [expr
        $y1 - $cover] [expr $z1]
109     patch rect $matTagConcCover $fiberB 1 [expr -$y1] [expr -$z1] [expr $cover - $y1]
        [expr $z1]
110     patch rect $matTagConcCover $fiberB 1 [expr $y1 - $cover] [expr -$z1] [expr $y1]
        [expr $z1]
111     # Core concrete
112     patch rect $matTagConcCore $fiberC 1 [expr $cover - $y1] [expr $cover - $z1] [expr
        $y1 - $cover] [expr $z1 - $cover]
113     #
        ------------------------------------------------------------------------------
114     # Create straight layers
115     #
        ------------------------------------------------------------------------------
116     # Reinforcing steel
117     layer straight $matTagSteel 3 $As [expr $y1 - $cover] [expr $z1 - $cover] [expr $y1
        - $cover] [expr $cover - $z1]
118     layer straight $matTagSteel 2 $As 0 [expr $cover - $z1] 0 [expr $z1 - $cover]
119     layer straight $matTagSteel 3 $As [expr $cover - $y1] [expr $cover - $z1] [expr
        $cover - $y1] [expr $z1 - $cover]
120 }
121
122
123 # puts $modelExportFileID "section Fiber $secTag -GJ $Ubig {
124     # #
```

```
        # ------------------------------------------------------------------------------------
        # # Create rectangular patches
        # #
        # ------------------------------------------------------------------------------------
        # # Cover concrete
        # patch rect $matTagConcCover $fiberA 1 [expr $cover - $y1] [expr -$z1] [expr $y1 - $cover] [expr $cover - $z1]
        # patch rect $matTagConcCover $fiberA 1 [expr $cover - $y1] [expr $z1 - $cover] [expr $y1 - $cover] [expr $z1]
        # patch rect $matTagConcCover $fiberB 1 [expr -$y1] [expr -$z1] [expr $cover - $y1] [expr $z1]
        # patch rect $matTagConcCover $fiberB 1 [expr $y1 - $cover] [expr -$z1] [expr $y1] [expr $z1]
        # # Core concrete
        # patch rect $matTagConcCore $fiberC 1 [expr $cover - $y1] [expr $cover - $z1] [expr $y1 - $cover] [expr $z1 - $cover]
        # #
        # ------------------------------------------------------------------------------------
        # # Create straight layers
        # #
        # ------------------------------------------------------------------------------------
        # # Reinforcing steel
        # layer straight $matTagSteel 3 $As [expr $y1 - $cover] [expr $z1 - $cover] [expr $y1 - $cover] [expr $cover - $z1]
        # layer straight $matTagSteel 2 $As 0 [expr $cover - $z1] 0 [expr $z1 - $cover]
        # layer straight $matTagSteel 3 $As [expr $cover - $y1] [expr $cover - $z1] [expr $cover - $y1] [expr $z1 - $cover]
    # }"

    # ------------------------------------------------------------------------------------
    # DEFINE ELEMENT
    # ------------------------------------------------------------------------------------
    set eleTag 1
    set secTag 3
    element zeroLengthSection $eleTag $nodeTag1 $nodeTag2 $secTag -orient 1 0 0 0 1 0
    # puts $modelExportFileID "element zeroLengthSection $eleTag $nodeTag1 $nodeTag2 $secTag -orient 1 0 0 0 1 0"
    # close $modelExportFileID

    set controlNode $nodeTag2
```