

OpenSees: Static, Cyclic, and Dynamic Analysis Examples

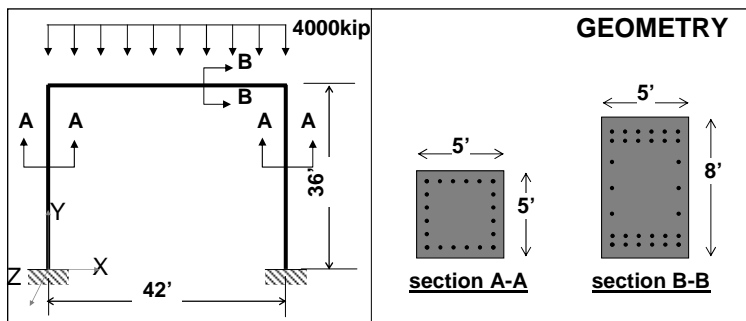
Frank McKenna

OpenSees and NEESgrid Simulation
Component Users Workshop
Sept 2-3, 2004



Model: (same as last presentation)

- Reinforced-Concrete Portal Frame
- start with ALL elastic elements
- use kip, inch and sec as basic units



source [example.tcl](#)

Gravity Load Analysis

```
# first source in the model
source example.tcl

# create analysis & perform analysis
constraints transformation
numberer RCM
system BandGeneral
test NormDispIncr 1.0e-6 6 2
algorithm Newton
integrator LoadControl 0.1
analysis Static
analyze 10

# look at what happened to node 3
print node 3
```

* We will call this file example1.tcl for future examples

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Cyclic Lateral Load Analysis

```
# first source in the model and do gravity load analysis
source example1.tcl

# set gravity loads constant & reset time in domain
loadConst -time 0.0

# create load pattern for lateral loads
pattern Plain 2 Linear {
  load 3 200.0 0.0 0.0
  load 4 200.0 0.0 0.0
}

# do some cyclic analysis
foreach {numSteps stepSize} {10 0.1 10 -0.1 10 -0.1 10 0.1 10 0.1} {
  integrator LoadControl $stepSize
  analyze $numSteps

  set time [getTime]
  set disp [nodeDisp 3 1]
  puts "Time: $time Displacement $disp"
}
```

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Transient Analysis - Uniform Excitation

```
# first source in the model and do gravity load analysis
source example1.tcl

# set gravity loads constant & reset time in domain
loadConst -time -0.01

# create load pattern
set motion IELC180
source READSMDFile.tcl
ReadSMDFile $motion.AT2 $motion.acc dt
set accelSeries "Path -filePath $motion.acc -dt $dt -factor 386.4"
pattern UniformExcitation 2 1 -accel $accelSeries

# set damping factors
rayleigh 0.0 0.0 0.0 0.0 0.0

# create the analysis
wipeAnalysis
System ProfileSPD
Test NormDispIncr 1.0e-16 10
Algorithm Newton
Integrator Newmark 0.5 0.25
Analysis Transient

# create a recorder
recorder Node -time -file example3.out -node 3 -dof 1 disp

analyze 4000 $dt
```

Transient Analysis - MultiSupport Excitation

```
# first source in the model and do gravity load analysis
source example1.tcl

# set gravity loads constant & reset time in domain
loadConst -time -0.01

# remove some sp constraints
remove sp 0
remove sp 3

# create load pattern
set motion IELC180
source READSMDFile.tcl
ReadSMDFile $motion.DT2 $motion.disp dt
set dispSeries "Path -filePath $motion.disp -dt $dt -factor 0.3937"
pattern MultiSupport 2 {
    groundMotion 5 Plain -disp $dispSeries
    imposedMotion 1 1 5
    imposedMotion 2 1 5
}

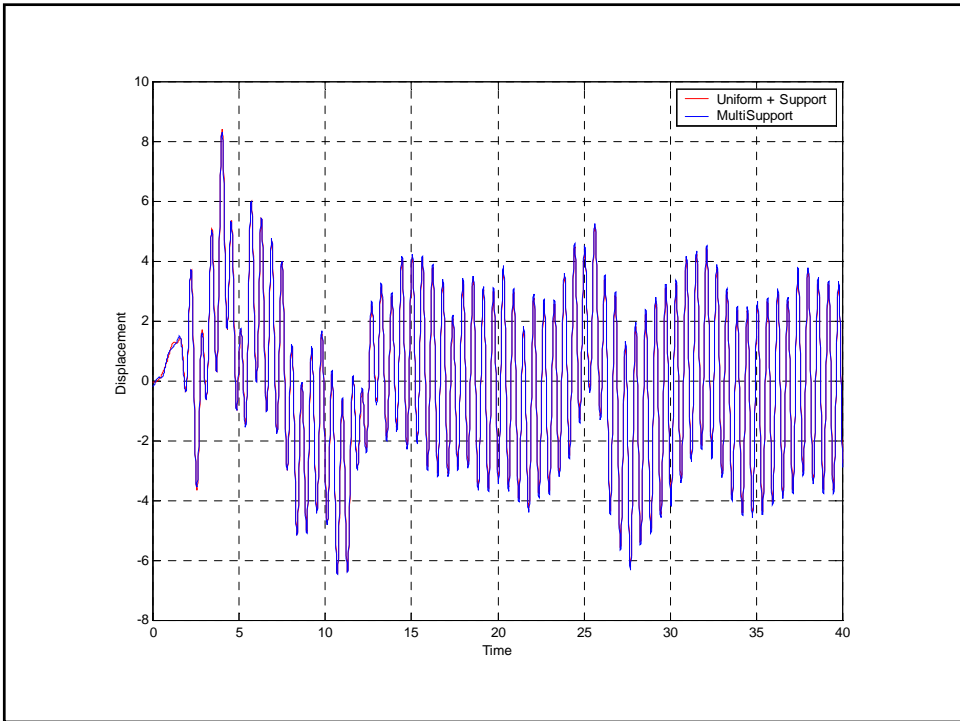
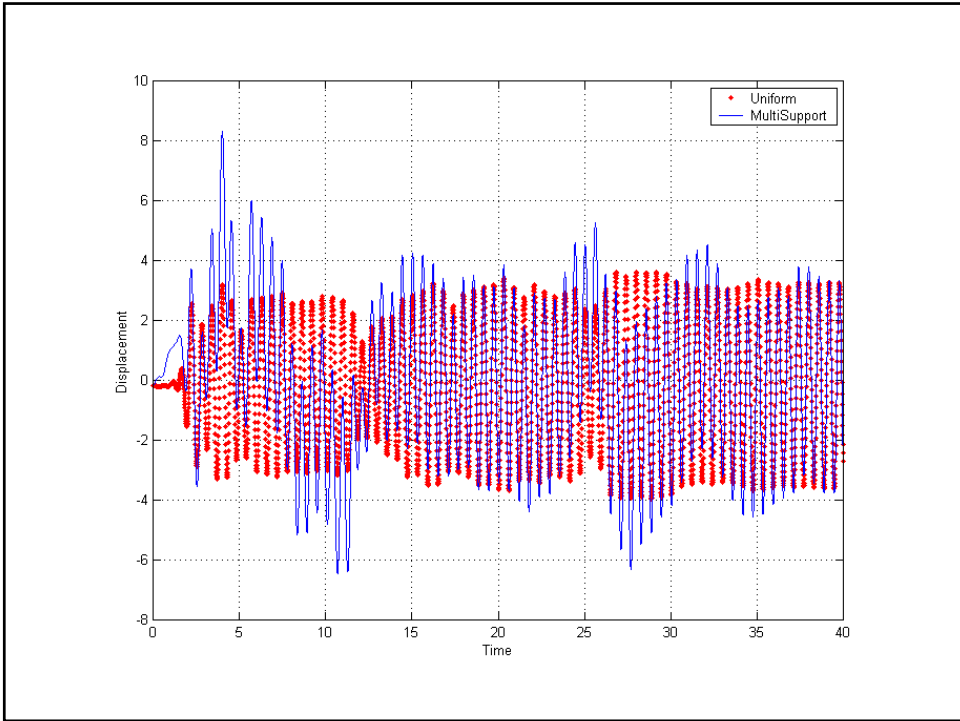
# set damping factors
rayleigh 0.0 0.0 0.0 0.0 0.0

# create a recorder
recorder Node -time -file example4.out -node 3 -dof 1 disp

# set damping factors
rayleigh 0.0 0.0 0.0 0.0 0.0

# create the analysis
wipeAnalysis
system ProfileSPD
test NormDispIncr 1.0e-16 10
algorithm Newton
integrator Newmark 0.5 0.25
analysis Transient

analyze 4000 $dt
```



Parameter Study - Response Spectra

```
source READSMDFile.tcl
modelBuilder BasicBuilder -ndm 1 -ndf 1

# set a bunch of parameters
set PI 3.14159265
set g 386.4
set TnMin 0.1; #min period
set TnMax 2.0; #max period
set TnIncr 0.1; #period incr
set M 1.0; #mass
set A 1.0; #area
set L 1.0; #length
set motion ELCENTRO
set outFileFilename spectrum.dat

# open output file
set outFileID [open $outFileFilename w]

#create accel series
ReadSMDFile $motion.AT2 $motion.acc dt
set accelSeries "Path -filePath $motion.acc \
-dt $dt -factor $g"

# loop over period range
set Tn $TnMin
while {$Tn <= $TnMax} {
  wipe
  set w [expr 2.0 * $PI / $Tn]
  set K [expr $w * $w * $M]
  set E [expr $k * $l / $A

  node 1 0.0
  node 2 $l -mass $M
  fix 1 1
  uniaxialMaterial Elastic 1 $E
  element truss 1 1 2 $A 1
  pattern UniformExcitation 2 1 -accel $accelSeries
  rayleigh 0.0 0.0 0.0 0.0 0.0

  recorder EnvelopeNode -file envelope.out -node 2 -dof 1 disp
  system ProfileSPD
  test NormDispIncr 1.0e-16 10
  algorithm Newton
  integrator Newmark 0.5 0.25
  analysis Transient
  analyze 2000 $dt

  if [catch {open envelope.out r} inFileID]
    puts puts "ERROR - could not open file"

  set min [gets $inFileID]
  set max [gets $inFileID]
  set absMax [gets $inFileID]
  close $inFileID
  puts $outFileID "$Tn $absmax"
  set Tn [expr $Tn + $TnIncr]
}
close $outFileID
```

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.