

LAMPIRAN

Lampiran 1. Program OpenSees - Model *Slender Shearwall*

```
#####
# Shear Wall Slender Model
# Author: Ryan Wijaya
# Units: kN, m, sec
#####

#####
# Script
#####

wipe

# Define Model Builder
# model BasicBuilder -ndm $ndm -ndf $ndf
model BasicBuilder -ndm 2 -ndf 3; #Dua Dimensi Tiga DOF

#####
# Model Geometry
#####

set B 0.0; #Bentang Model
set H 10.0; #Tinggi Model

# Additional Tags
set a1 [expr 0.0]; #Sumbu x
set a2 [expr $a1+$B]; #Sumbu x
set b1 [expr 0.0]; #Sumbu y
set b2 [expr $b1+$H]; #Sumbu y

# Node's Tags
set N1 1; #Node 1
set N2 2; #Node 2

# Define Nodes
# node $nodeTag (ndm $coords) <-mass (ndf $MassValues)>
node $N1 $a1 $b1; #Node Dasar
node $N2 $a1 $b2; #Node Puncak

#####
# Restraints
#####

# fix $nodeTag (ndf $ConstrValues)
fix $N1 1 1 1; #Jepit

#####
# Materials
#####

# Material's Tags
set NConc1 1; #Beton Normal Confined
set NConc2 2; #Beton Normal Unconfined
set HSS 3; #High-Strength Steel
```

```

# Parameters for NConc
# Confined
set fpc1 -30000.0; #Kuat tekan (kN/m2)
set epsc01 -0.004; #Regangan pada kuat tekan maksimum
set fpcu1 [expr 0.1*$fpc1]; #Tegangan residu beton (10%-30% dari fpc)
set epsU1 -0.015; #Regangan pada tegangan residu
# Unconfined
set fpc2 -28000.0; #Kuat tekan (kN/m2)
set epsc02 -0.002; #Regangan pada kuat tekan maksimum
set fpcu2 [expr 0.1*$fpc2]; #Tegangan residu beton (10%-30% dari fpc)
set epsU2 -0.006; #Regangan pada tegangan residu
# Steel
set fy 420000.0; #tegangan leleh (kN/m2)
set E0 200000000.0; #Modulus Baja (kN/m2)
set p 0.01; #strainhardening ratio

# Define Materials
# Concrete01
# uniaxialMaterial Concrete01 $matTag $fpc $epsc0 $fpcu $epsU
uniaxialMaterial Concrete01 $NConc1 $fpc1 $epsc01 $fpcu1 $epsU1; #Confined
uniaxialMaterial Concrete01 $NConc2 $fpc2 $epsc02 $fpcu2 $epsU2; #Unconfined
# uniaxialMaterial Steel01 $matTag $fy $E $b
uniaxialMaterial Steel01 $HSS $fy $E0 $p; #High-Strength Steel

#####
# Sections
#####

# Section's Tag
set Fiber 1;

# Shear Wall Dimension
set d 3.0; #depth
set w 0.2; #width
set c 0.04; #selimut beton
set Cvz [expr $d/2];
set Crz [expr $w/2];
set Cry [expr $Cvz-$Crz];
set Crz [expr $Cvz-$Crz];

# Additional Parameters
set nfIJC 10; #jumlah subdivisi IJ daerah confined
set nfJKC 10; #jumlah subdivisi JK daerah confined
set nfIJU1 10; #jumlah subdivisi IJ daerah unconfined bagian atas dan bawah
set nfJKU1 2; #jumlah subdivisi JK daerah unconfined bagian atas dan bawah
set nfIJU2 2; #jumlah subdivisi IJ daerah unconfined bagian kiri dan kanan
set nfJKU2 10; #jumlah subdivisi JK daerah unconfined bagian kiri dan kanan
# set nBTOP 2; #jumlah tulangan longitudinal bagian atas
# set nBBOT 2; #jumlah tulangan longitudinal bagian bawah
set nBINT 48; #jumlah tulangan longitudinal bagian tengah kiri dan kanan
set nBMID 2;
set dB 0.019; #diameter tulangan
set areaBar [expr 3.14*0.25*$dB*$dB]; #luas tulangan

```

```

# Fiber Section

section Fiber $Fiber {
  # patch quadr $matTag $numSubdivIJ $numSubdivJK $yI $zI $yJ $zJ $yK $zK $yL $zL
  patch quadr $NConc1 $nfIJC $nfJKC -$Cry $Crz -$Cry -$Crz $Cry -$Crz $Cry $Crz; #Confined
  patch quadr $NConc2 $nfIJU2 $nfJKU2 -$Cvy $Cvz -$Cry $Crz $Cry $Crz $Cvy $Cvz; #Unconfined kiri
  patch quadr $NConc2 $nfIJU2 $nfJKU2 -$Cry -$Crz -$Cvy -$Cvz $Cvy -$Cvz $Cry -$Crz; #Unconfined kanan
  patch quadr $NConc2 $nfIJU1 $nfJKU1 -$Cvy $Cvz -$Cvy -$Cvz -$Cry -$Crz -$Cry $Crz; #Unconfined bawah
  patch quadr $NConc2 $nfIJU1 $nfJKU1 $Cry $Crz $Cry -$Crz $Cvy -$Cvz $Cvy $Cvz; #Unconfined atas
  # layer straight $matTag $numBars $areaBar $yStart $zStart $yEnd $zEnd
  layer straight $HSS [expr $nBINT/2] $areaBar -$Cry $Crz $Cry $Crz; #Kiri
  layer straight $HSS [expr $nBINT/2] $areaBar -$Cry -$Crz $Cry -$Crz; #Kanan
  layer straight $HSS $nBMID $areaBar -$Cry 0 $Cry 0; #Tengah
}

#####
# Element
#####

# Transformation Tag
set LNtrans 1
# set PDtrans 1

# Define Transformation
geomTransf Linear $LNtrans; #P-Delta tidak dihitung
# geomTransf PDelta $PDtrans; #P-Delta dihitung

# Define Number of Integrations
set NOI 3;

# Define Elements
# element nonlinearBeamColumn $eleTag $iNode $jNode $numIntgrPts $secTag $transfTag
element nonlinearBeamColumn 1 $N1 $N2 $NOI $Fiber $LNtrans;

#####
# Gravity Loads
#####

# timeSeries "LinearDefault": TSTag cFactor
timeSeries Linear 1 -factor +1.000E+00

# Distributed Loads
set CL 100; #Beban Terpusat

# pattern PatternType $PatternID TimeSeriesType
pattern Plain 1 1 {
  # Load $nodeTag (ndf $LoadValues)
  load $N2 0 [expr -$CL] 0;
}

#####
# Masses
#####

set mass 500; #tonf

# Assign Mass
# mass $nodeTag (ndf $massValues)
mass $N2 $mass 0 0;

```

Lampiran 2. Program OpenSees - Analisis *Gravity Slender Shearwall*

```
#####
# Start Analysis
#####

initialize

puts "Gravity Analysis Succesfull"

#####
# Recorders
#####

# Node Recorder "Reactions": filename <nodeTags dof respType
recorder Node -file GravityReactionSWL.out -time -node $N1 -dof 1 2 3 reaction

#####
# Analysis
#####

# Constraint Handler
constraints Plain
# DOF Numberer
numberer RCM
# System
system BandGeneral
# Convergence Test
test NormDispIncr +1.000E-003 100 0 2;
# Algorithm
algorithm Newton
# Integrator
# integrator LoadControl $lambda <$numIter $minlambda $maxlambda>
integrator LoadControl +0.1
# Analysis Type
analysis Static

# Record initial state of model
record

#Analysis Model
analyze 10

# Reset
# -----
setTime 0.0
loadConst
remove recorders
wipeAnalysis
```

Lampiran 3. Program OpenSees - Analisis *Time History Slender Shearwall*

```
#####
# Start Analysis
#####

initialize

puts "Time History Analysis"

#####
# Recorders
#####

set k 1; #Groundmotion tag
set j 1; #Scaling tag

# Node Recorder "Reactions": filename <nodeTags dof respType
recorder Node -file TimeHistorySWSL_ReactX.out -time -node $N1 -dof 1 reaction
recorder Node -file TimeHistoryStoreysSWSL_DispX.out -time -node $N2 -dof 1 disp
recorder Element -file TimeHistorySWSL_GLBForce.out -time -ele 1 globalForce
recorder Element -file TimeHistorySWSL_Rotation.out -time -ele 1 chordRotation

|
#####
# Ground Motion
#####

set lambda 10; #Faktor skala akselerasi
set dt 0.005
set numstep 8000
# Define Time Series
# TimeSeries "TimeSeries01": -dt $dt -filePath Namefile -factor $factor
set TimeSeries01 "Series -dt $dt -filePath accImpVall03.txt -factor $lambda"

#####
# Analysis
#####

# Convergence Test
test NormDispIncr +1.000E-02 100 0 0;
# Load Pattern
pattern UniformExcitation $patternTag $dir -accel $tsTag
pattern UniformExcitation 3 1 -accel $TimeSeries01;
# Constraint Handler
constraints Transformation
# Integrator
# integrator Newmark $gamma $beta
integrator Newmark +5.000E-01 +2.500E-01
# Rayleigh Damping
# rayleigh $alphaM $betaK $betaKinit $betaKcomm
rayleigh 0.0 0.0 0.0 0.0;
```

```

# Algorithm
algorithm Newton
# DOF Numberer
numberer RCM
# System
system BandGeneral

# Analysis Type
analysis Transient

set begin [clock clicks -milliseconds];

# Intial Variables Before Starting Dynamic Analysis
set ok 0;
set t 0;
set startTime [clock clicks -milliseconds];
set finalt [expr [getTime]+[expr $numstep*$dt]];
set DtAnalysis $dt; #nilai dt bisa diturunkan jika gagal
puts "Analysis_1 k $k j $j lambda $lambda Dt $DtAnalysis Tol +1.000E-02 Algoritma Newton"
while {$ok == 0 && $t <= $finalt} {
    set ok [analyze 1 $DtAnalysis]
    set t [getTime]
    # Update the time
    set currentTime [getTime]
}
set finishTime [clock clicks -milliseconds];
set timeSeconds [expr ($finishTime-$startTime)/1000];
set timeMinutes [expr $timeSeconds/60];
set timeHours [expr $timeSeconds/3600];
set timeMinutes [expr ($timeMinutes-$timeHours*60)];
set timeSeconds [expr ($timeSeconds-$timeMinutes*60-$timeHours*3600)];
if {$ok == 0} {
    puts "Analysis k $k j $j lambda $lambda Success";
    puts "Time in hours-min-sec: $timeHours:$timeMinutes:$timeSeconds"
} else {
    puts "Analysis k $k j $j lambda $lambda Failed";
    puts "Time in hours-min-sec: $timeHours:$timeMinutes:$timeSeconds"
}
puts "StartTime: $startTime"
puts "FinishTime: $finishTime"
# Clean up
wipe

```

Lampiran 4. Program OpenSees - Run *Time History Slender Shearwall*

```
#####  
# Run TimeHistory  
#####  
  
source ModelSWSL.tcl  
source A_GravitySWSL.tcl  
source A_TimeHistorySWSL.tcl
```



Lampiran 5. Program OpenSees - Model *Squat Shearwall*

```
#####
# Shear Wall Skuat Model
# Author: Ryan Wijaya
# Units: kN, m, sec
#####

#####
# Script
#####

wipe

# Define Model Builder
# model BasicBuilder -ndm $ndm -ndf $ndf
model BasicBuilder -ndm 2 -ndf 3; #Dua Dimensi Tiga DOF

#####
# Model Geometry
#####

set B 0.0; #Bentang Model
set H 4.0; #Tinggi Model

# Additional Tags
set a1 [expr 0.0]; #Sumbu x
set a2 [expr $a1+$B]; #Sumbu x
set b1 [expr 0.0]; #Sumbu y
set b2 [expr $b1+$H]; #Sumbu y

# Node's Tags
set N1 1; #Node 1
set N2 2; #Node 2

# Define Nodes
# node $nodeTag (ndm $coords) <-mass (ndf $MassValues)>
node $N1 $a1 $b1; #Node Dasar
node $N2 $a1 $b2; #Node Puncak

#####
# Restraints
#####

# fix $nodeTag (ndf $ConstrValues)
fix $N1 1 1 1; #Jepit

#####
# Materials
#####

# Material's Tags
set NConc1 1; #Beton Normal Confined
set NConc2 2; #Beton Normal Unconfined
set HSS 3; #High-Strength Steel
```

```

# Parameters for NConc
# Confined
set fpc1 -18000.0; #Kuat tekan (kN/m2)
set epsc01 -0.004; #Regangan pada kuat tekan maksimum
set fpcu1 [expr 0.1*fpc1]; #Tegangan residu beton (10%-30% dari fpc)
set epsU1 -0.015; #Regangan pada tegangan residu
# set ft1 [expr $fpc1*-0.1];
# set Et1 [expr $ft1/0.002];
# set lambda1 0.1;
# Unconfined
set fpc2 -16800.0; #Kuat tekan (kN/m2)
set epsc02 -0.002; #Regangan pada kuat tekan maksimum
set fpcu2 [expr 0.1*fpc2]; #Tegangan residu beton (10%-30% dari fpc)
set epsU2 -0.006; #Regangan pada tegangan residu
# set ft2 [expr $fpc2*-0.1];
# set Et2 [expr $ft2/0.002];
# set lambda2 $lambda1
# Steel
set fy 420000.0; #tegangan leleh (kN/m2)
set E0 200000000.0; #Modulus Baja (kN/m2)
set p 0.01; #strainhardening ratio
# set R0 20; #smoothness of the elastic-to-plastic transition
# set cR1 0.925; #smoothness of the elastic-to-plastic transition
# set cR2 0.15; #smoothness of the elastic-to-plastic transition

# Define Materials
# Concrete01
# uniaxialMaterial Concrete01 $matTag $fpc $epsc0 $fpcu $epsU
uniaxialMaterial Concrete01 $NConc1 $fpc1 $epsc01 $fpcu1 $epsU1; #Confined
uniaxialMaterial Concrete01 $NConc2 $fpc2 $epsc02 $fpcu2 $epsU2; #Unconfined
# uniaxialMaterial Steel01 $matTag $fy $E $b
uniaxialMaterial Steel01 $HSS $fy $E0 $p; #High-Strength Steel

#####
# Sections
#####

# Section's Tag
set Fiber 1;

# Shear Wall Dimension
set d 3.0; #depth
set w 0.2; #width
set c 0.04; #selimut beton
set CvY [expr $d/2];
set CvZ [expr $w/2];
set CrY [expr $CvY-$c];
set CrZ [expr $CvZ-$c];

# Additional Parameters
set nFIJC 10; #jumlah subdivisi IJ daerah confined
set nFJKC 10; #jumlah subdivisi JK daerah confined
set nFIJU1 10; #jumlah subdivisi IJ daerah unconfined bagian atas dan bawah
set nFJKU1 2; #jumlah subdivisi JK daerah unconfined bagian atas dan bawah
set nFIJU2 2; #jumlah subdivisi IJ daerah unconfined bagian kiri dan kanan
set nFJKU2 10; #jumlah subdivisi JK daerah unconfined bagian kiri dan kanan
set nBTOP 2; #jumlah tulangan longitudinal bagian atas
set nBBOT 2; #jumlah tulangan longitudinal bagian bawah
set nBINT 46; #jumlah tulangan longitudinal bagian tengah kiri dan kanan
set dB 0.019; #diameter tulangan
set areaBar [expr 3.14*0.25*$dB*$dB]; #luas tulangan

```

```

# Fiber Section

section Fiber $Fiber {
  # patch quadr $matTag $numSubdivIJ $numSubdivJK $yI $zI $yJ $zJ $yK $zK $yL $zL
  patch quadr $NConc1 $nfIJC $nfJKC -$Cry $Crz -$Cry -$Crz $Cry -$Crz $Cry $Crz; #Confined
  patch quadr $NConc2 $nfIJU2 $nfJKU2 -$Cvy $Cvz -$Cry $Crz $Cry $Crz $Cvy $Cvz; #Unconfined kiri
  patch quadr $NConc2 $nfIJU2 $nfJKU2 -$Cry -$Crz -$Cvy -$Cvz $Cvy -$Cvz $Cry -$Crz; #Unconfined kanan
  patch quadr $NConc2 $nfIJU1 $nfJKU1 -$Cvy $Cvz -$Cvy -$Cvz -$Cry -$Crz -$Cry $Crz; #Unconfined bawah
  patch quadr $NConc2 $nfIJU1 $nfJKU1 $Cry $Crz $Cry -$Crz $Cvy -$Cvz $Cvy $Cvz; #Unconfined atas
  # layer straight $matTag $numBars $areaBar $yStart $zStart $yEnd $zEnd
  layer straight $HSS [expr $nBINT/2] $areaBar -$Cry $Crz $Cry $Crz; #Tengah Kiri
  layer straight $HSS [expr $nBINT/2] $areaBar -$Cry -$Crz $Cry -$Crz; #Tengah Kanan
  layer straight $HSS $nBTOP $areaBar $Cry $Crz $Cry -$Crz; #Atas
  layer straight $HSS $nBBOT $areaBar -$Cry $Crz -$Cry -$Crz; #Bawah
}

#####
# Element
#####

# Trasformation Tag
set LNtrans 1
# set PDtrans 1

# Define Transformation
geomTransf Linear $LNtrans; #P-Delta tidak dihitung
# geomTransf PDelta $PDtrans; #P-Delta dihitung

# Define Number of Integrations
set NoI 3;

# Define Elements
# element nonlinearBeamColumn $eleTag $iNode $jNode $numIntgrPts $secTag $transfTag
element nonlinearBeamColumn 1 $N1 $N2 $NoI $Fiber $LNtrans;

#####
# Gravity Loads
#####

# timeSeries "LinearDefault": TSTag cFactor
timeSeries Linear 1 -factor +1.000E+00

# Distributed Loads
set CL 100; #Beban Terpusat

# pattern PatternType $PatternID TimeSeriesType
pattern Plain 1 1 {
  # Load $nodeTag (ndf $LoadValues)
  load $N2 0 [expr -$CL] 0;
}

#####
# Masses
#####

set mass 500; #tonf

# Assign Mass
# mass $nodeTag (ndf $massValues)
mass $N2 $mass 0 0;

```

Lampiran 6. Program OpenSees - Analisis *Gravity Squat Shearwall*

```
#####
# Start Analysis
#####

initialize

puts "Gravity Analysis"

#####
# Recorders
#####

# Node Recorder "Reactions": filename <nodeTags dof respType
recorder Node -file GravityReactionSWS.out -time -node $N1 -dof 1 2 3 reaction

#####
# Analysis
#####

# Constraint Handler
constraints Plain
# DOF Numberer
numberer RCM
# System
system BandGeneral
# Convergence Test
test NormDispIncr +1.000E-003 100 0 2;
# Algorithm
algorithm Newton
# Integrator
# integrator LoadControl $lambda <$numIter $minlambda $maxlambda>
integrator LoadControl +0.1
# Analysis Type
analysis Static

# Record initial state of model
record

#Analysis Model
analyze 10

# Reset
# -----
setTime 0.0
loadConst
remove recorders
wipeAnalysis
```

Lampiran 7. Program OpenSees - Analisis *Time History Squat Shearwall*

```
#####
# Start Analysis
#####

initialize

puts "Time History Analysis"

#####
# Recorders
#####

set k 1; #Groundmotion tag
set j 1; #Scaling tag

# Node Recorder "Reactions": filename <nodeTags dof respType
recorder Node -file TimeHistory_ReactX.out -time -node $N1 -dof 1 reaction
recorder Node -file TimeHistoryStorey_Dispx.out -time -node $N2 -dof 1 disp
recorder Element -file TimeHistory_GLBForce.out -time -ele 1 globalForce
recorder Element -file TimeHistory_Rotation.out -time -ele 1 chordRotation

#####
# Ground Motion
#####

set lambda 10; #Faktor skala akselerasi
set dt 0.005
set numstep 8000
# Define Time Series
# TimeSeries "TimeSeries01": -dt $dt -filePath Namefile -factor $factor
set TimeSeries01 "Series -dt $dt -filePath accImpVall03.txt -factor $lambda"

#####
# Analysis
#####

# Convergence Test
test NormDispIncr +1.000E-02 100 0 0;
# Load Pattern
# pattern UniformExcitation $patternTag $dir -accel $tsTag
pattern UniformExcitation 3 1 -accel $TimeSeries01;
# Constraint Handler
constraints Transformation
# Integrator
# integrator Newmark $gamma $beta
integrator Newmark +5.000E-01 +2.500E-01
# Rayleigh Damping
# rayleigh $alphaM $betaK $betaKinit $betaKcomm
rayleigh 0.0 0.0 0.0 0.0;
# Algorithm
algorithm Newton
# DOF Numberer
numberer RCM
# System
system BandGeneral
```

```

# Analysis Type
analysis Transient

set begin [clock clicks -milliseconds];

# Intial Variables Before Starting Dynamic Analysis
set ok 0;
set t 0;
set startTime [clock clicks -milliseconds];
set finalt [expr [getTime]+[expr $numstep*$dt]];
set DtAnalysis $dt; #nilai dt bisa diturunkan jika gagal
puts "Analysis_1 k $k j $j lambda $lambda Dt $DtAnalysis Tol +1.000E-02 Algoritma Newton"
while {$ok == 0 && $t <= $finalt} {
    set ok [analyze 1 $DtAnalysis]
    set t [getTime]
    # Update the time
    set currentTime [getTime]
}
set finishTime [clock clicks -milliseconds];
set timeSeconds [expr ($finishTime-$startTime)/1000];
set timeMinutes [expr $timeSeconds/60];
set timeHours [expr $timeSeconds/3600];
set timeMinutes [expr ($timeMinutes-$timeHours*60)];
set timeSeconds [expr ($timeSeconds-$timeMinutes*60-$timeHours*3600)];
if {$ok == 0} {
    puts "Analysis k $k j $j lambda $lambda Success";
    puts "Time in hours-min-sec: $timeHours:$timeMinutes:$timeSeconds"
} else {
    puts "Analysis k $k j $j lambda $lambda Failed";
    puts "Time in hours-min-sec: $timeHours:$timeMinutes:$timeSeconds"
}
puts "StartTime: $startTime"
puts "FinishTime: $finishTime"
# Clean up
wipe

```

Lampiran 8. Program OpenSees - Run *Time History Squat Shearwall*

```
#####  
# Run TimeHistory  
#####  
  
source ModelSWS.tcl  
source A_GravitySWS.tcl  
source A_TimeHistorySWS.tcl
```

