

```

        element forceBeamColumn 2      $N_B0      $N_B1      $NI      $Kolom
$PDTransCol;

# Beam elements of the MRF
#element nonlinearBeamColumn $eleTag  $iNode      $jNode      $numIntgrPts
$secTag      $transfTag
        element forceBeamColumn 3      $N_A1      $N_B1      $NI      $Balok
$LTransBea;

#####
# GRAVITY LOADS
#####

#timeSeries "LinearDefault":      tsTag      cFactor
timeSeries Linear      1      -factor +1.00000E+00

#Distributed loads
set DL      80; # 80 kN/m = 80000 N/mm
set CL      100; # 100 kN = 100000 N

#pattern PatternType $PatternID TimeSeriesType
pattern Plain      1      1      {
#load $nodeTag (ndf $LoadValues)
load $N_A1 0 [expr -$CL] 0;
load $N_B1 0 [expr -$CL] 0;

#eleload -ele $eleTag1 <$eleTag2 ...> -type -beamUniform $WY <$Wx>
eleload -ele 3 -type -beamUniform [expr -$DL];
}

#####
# MASSES
#####

set mass1 200; # 1 tonf = 9806.65 N

# Assign mass to nodes
#mass $nodeTag (ndf $massValues)
mass $N_A1 [expr $mass1/2] 0 0;
mass $N_B1 [expr $mass1/2] 0 0;

```

```

#### MODEL K2 ####

#####
# SET UP OF WORKSPACE
#####

wipe

# Define model builder
# http://opensees.berkeley.edu/wiki/index.php/Model_command
# model BasicBuilder -ndm $ndm <-ndf $ndf>
# model BasicBuilder -ndm 2 -ndf 3; #ndm: spatial dimension; ndf: DoF per node
#                               #2 dimensions, 3 DOF per node

#####
# GLOBAL GEOMETRY
#####

set Span 6.0;      # bentang dalam mm
set Storey 2.0;    # tinggi tingkat dalam mm

# Main grid lines
# Axes in span
set x1 [expr 0.0];
set x2 [expr $x1+$Span];
# Axes in storey
set z0 [expr 0.0];
set z1 [expr $z0+$Storey];

#####
# DEFINITION OF NODES
#####

#Assigning node tags to variables to facilitate the manipulation of models
set N_A0 1;
set N_B0 2;
set N_A1 3;
set N_B1 4;

#node $nodeTag (ndm $coords) <-mass (ndf $massValues)>
node $N_A0 $x1 $z0;
node $N_B0 $x2 $z0;
node $N_A1 $x1 $z1;
node $N_B1 $x2 $z1;

#####
# RESTRAINTS
#####

#fix $nodeTag (ndf $constrValues)

```

```

fix      $N_A0      1 1 1;
fix      $N_B0      1 1 1;

#####
# CONSTRAINTS
#####

#####
# MATERIALS
#####

# Definition of materials IDs
set C_unconf 1;
set C_conf 2;
set R_steel 3;
set CFRP 4;
set noCFRP 5;
set CFRP1 6;

### Material ###
# balok & kolom (tanpa cfrp)
set fc_1 -25000; #f'c in compression for unconfined concrete
set fc_2 -30000; #f'c in compression for confined concrete
set epsc -0.002; #strain at maximum stress in compression
set fu_1 [expr $fc_1*0.2]; #ultimate stress for unconfined concrete
set fu_2 [expr $fc_2*0.2]; #ultimate stress for confined concrete
set epsu -0.01; #strain at ultimate stress in compression
set lambda 0.05; #ratio between reloading stiffness and initial stiffness
in compression
set ft_1 [expr $fc_1*-0.1]; #maximum stress in tension for unconfined
concrete
set ft_2 [expr $fc_2*-0.1]; #maximum stress in tension for confined
concrete
set Et_1 [expr $ft_1/0.002]; #Elastic modulus in tension for unconfined
concrete
set Et_2 [expr $ft_2/0.002]; #Elastic modulus in tension for confined
concrete
# E in compression is calculated automatically depending on other material
properties

# Tulangan
set fy 42000; #fy for reinforcing steel
set Es 210000000; #E for reinforcing steel
set b 0.005; #strain hardening ratio
set R0 25; #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

```

```

# Definition of Concrete02 material
#uniaxialMaterial Concrete02 $matTag $fpc $epsc0 $fpcu $epsU $lambda $ft
$Ets
uniaxialMaterial Concrete02 $C_unconf $fc_1 $epsc $fu_1 $epsu $lambda $ft_1
$Et_1;
uniaxialMaterial Concrete02 $C_conf $fc_2 $epsc $fu_2 $epsu $lambda $ft_2
$Et_2;

# Definition of Steel02 steel
#uniaxialMaterial Steel02 $matTag $Fy $E $b $R0 $cR1 $cR2 <$a1 $a2 $a3 $a4
$sigInit>
uniaxialMaterial Steel02 $R_steel $fy $Es $b $R0 $cR1 $cR2;

# CFRP
#### DATA ####
set fc0 $fc_2;
set Ec [expr 4730 * (sqrt(-$fc0))];
set ec0 $epsc;
set lambda1 0.05
## Dimenso Kolom
set b 0.5; # lebar kolom
set h 0.5; # tinggi kolom
set r 0.05; # selimut beton

set pi [expr acos(-1.0)];

set n 2; # banyak lapis CFRP
set tfrp [expr 0.000166 * $n]; # total tebal CFRP
set Efrp 230000000.0; # modulus elastis CFRP
set efrp 0.015; # strain rupture CFRP

set R 0.015; # radius sudut
set Psc 0.02; # rasio tulangan longitudinal
set Ag [expr $b*$h - (4 - $pi) * pow($R,2)]; # luas penampang total
dikurangi sudut tidak efektif
set D [expr 2*$b*$h / ($b + $h)]; # dimensi efektif kolom

# untuk fcU
set ki 3.3;
# koefisien efektivitas penahanan CFRP
set ks [expr 1 - (pow($b - 2*$R,2) + pow($h - 2*$R,2) / 3 * $Ag) - ($Psc / 1 -
$Psc)]; # Koefisien efisiensi penahanan penampang tak bundar
set fi [expr 2 * $Efrp * $efrp * $tfrp / $D];
set fi [expr $ks * $fi];
# Lateral confinement pressure efektif, dihitung dari properti CFRP

# untuk ecU
set ke 0.5; # efisiensi penahanan CFRP
#set Pfrp [expr 2 * $tfrp / $b]; # untuk penampang persegi
set Pfrp [expr (2*(2*($b-2*$R)+($pi*$R))*$tfrp)/((pow($b,2)) - (4 -
$pi)*pow($R,2))];

```

```

## data yang masuk ke dalam FRPconfinedconcrete02
## uniaxialMaterial('FRPConfinedConcrete02', matTag, fc0, Ec, ec0, <'-JacketC',
tfrp, Efrp, erup, R>, <'-Ultimate', fcu, ecu>, ft, Ets, Unit)
    set fcu      [expr $fc0 * (1 + $ki * $ks * $fI/abs($fc0))];      #
ultimate stress dari FRP confined concrete (fcu > fc0)
    set ecu      [expr $ec0 * (1 + $ke * $Pfrp * $Efrp/abs($fc0))];  #
ultimate strain dari FRP confined concrete
    set ft       [expr 0.632 * sqrt(-$fc0)];                        # kekuatan
tarik unconfined concrete
    set Ets      [expr 0.05*$Ec];
                                # kekakuan pelunakan tarik
    set Unit     1;
    set fcu_3    [expr $fcu * 0.2];
    set ft_3     [expr $fcu * -0.1]; #maksimum stress
    set Et_3     [expr $ft_3/0.002]; # modulus elastis in tension

puts "n      = $n"
puts "tfrp   = $tfrp"
puts "Ag     = $Ag"
puts "D      = $D"
puts "ks     = $ks"
puts "fi     = $fi"
puts "fI     = $fI"
puts "Pfrp   = $Pfrp"

puts "fcu    = $fcu"
puts "ecu    = $ecu"
puts "ft     = $ft"
puts "Ets    = $Ets"

# Definition of FRPConfinedConcrete02
    #uniaxialMaterial('FRPConfinedConcrete02', matTag, fc0, Ec, ec0, <'-JacketC',
tfrp, Efrp, erup, R>, <'-Ultimate', fcu, ecu>, ft, Ets, Unit)
    #uniaxialMaterial FRPConfinedConcrete02 $noCFRP $fc0 $ec0 $Ec $ft $Ets $Unit;
    #uniaxialMaterial FRPConfinedConcrete02 $CFRP $fc0 $ec0 $Ec -Ultimate $fcu $ecu
$ft $Ets $Unit;

    uniaxialMaterial Concrete02 $CFRP1 $fcu $ec0 $fcu_3 $ecu $lambda1 $ft_3
$Et_3;

#####
# SECTIONS
#####

# Define sections IDs
    set Kolom 1;
    set Balok 2;

```

```

# Define dimensions
set Rebar_25 [expr $pi*0.025*0.025/4]; # area baja tulangan 25mm
set Rebar_16 [expr $pi*0.016*0.016/4]; # Luas penampang 1 tulangan
D16 (mm2)

set h_col 0.5;
set b_col 0.5;
set r_col 0.05;

set b_beam 0.3; # lebar balok
set h_beam 0.6; # tinggi balok
set r_beam 0.05; # selimut balok

# Load procedure
source BuildRCrectSection.tcl

# Build section
#BuildRCrectSection $ColSecTag $HSec $BSec $coverH $coverB $IDconcCore
$IDconcCover $IDSteel $numBarsTop $barAreaTop $numBarsBot $barAreaBot
$numBarsIntTot $barAreaInt $nfCoreY $nfCoreZ $nfCoverY $nfCoverZ
BuildRCrectSection $Balok $h_beam $b_beam $r_beam $r_beam $C_conf
$C_unconf $R_steel 3 $Rebar_25 3 $Rebar_25 4
$Rebar_25 8 8 8 8
BuildRCrectSection $Kolom $h_col $b_col $r_col $r_col $C_conf
$C_unconf $R_steel 4 $Rebar_16 4 $Rebar_16 4
$Rebar_16 8 8 8 8

#####
# ELEMENTS
#####

# Definition of transformation IDs
set PDTransCol 1; # untuk kolom
set LTransBea 2; # untuk balok

# Definition of transformation
#geomTransf PDelta $transfTag
geomTransf PDelta $PDTransCol
geomTransf Linear $LTransBea

# Definition of number of integration points
set NI 5; #Maximum number = 10

# Column elements of the MRF
#element nonlinearBeamColumn $eleTag $iNode $jNode $numIntgrPts
$secTag $transfTag
element forceBeamColumn 1 $N_A0 $N_A1 $NI $Kolom
$PDTransCol;

```

```

        element forceBeamColumn 2      $N_B0      $N_B1      $NI      $Kolom
$PDTransCol;

# Beam elements of the MRF
#element nonlinearBeamColumn $eleTag  $iNode      $jNode      $numIntgrPts
$secTag      $transfTag
element forceBeamColumn 3      $N_A1      $N_B1      $NI      $Balok
$LTransBea;

#####
# GRAVITY LOADS
#####

#timeSeries "LinearDefault":      tsTag      cFactor
timeSeries Linear      1      -factor +1.00000E+00

#Distributed loads
set DL      80; # 80 kN/m = 80000 N/mm
set CL      100; # 100 kN = 100000 N

#pattern PatternType $PatternID TimeSeriesType
pattern Plain      1      1      {
#load $nodeTag (ndf $LoadValues)
load $N_A1 0 [expr -$CL] 0;
load $N_B1 0 [expr -$CL] 0;

#eleload -ele $eleTag1 <$eleTag2 ...> -type -beamUniform $WY <$Wx>
eleload -ele 3 -type -beamUniform [expr -$DL];
}

#####
# MASSES
#####

set mass1 200; # 1 tonf = 9806.65 N

# Assign mass to nodes
#mass $nodeTag (ndf $massValues)
mass $N_A1 [expr $mass1/2] 0 0;
mass $N_B1 [expr $mass1/2] 0 0;

```

```
#####
# START ANALYSIS
#####

initialize

puts "ooo Analysis: Gravity ooo"

#####
# SET RECORDERS
#####

# Node Recorder "Reactions":   fileName   <nodeTag>   dof   respType
recorder Node -file Gravity_Model.out -time -node $N_A0 $N_B0 -dof 1 2 3
reaction

#####
# ANALYSIS OPTIONS
#####

# Constraint Handler
constraints Transformation
# DOF Numberer
numberer RCM
# System of Equations
system BandGeneral
# Convergence Test
test NormDispIncr +1.000000E-006 100 0 2;
# Solution Algorithm
algorithm Newton
# Integrator
#integrator LoadControl $lambda <$numIter $minLambda $maxLambda>
integrator LoadControl +0.1
# Analysis Type
analysis Static

# Record initial state of model
record

# Analyze model
analyze 10

# Reset for next analysis case
# -----
setTime 0.0
loadConst -time 0.0
remove loadPattern 1
wipeAnalysis
```

```
#####
# START ANALYSIS
#####

puts "ooo Analysis: Pushover ooo"

#####
# SET RECORDERS
#####

# Global behaviour
recorder Node -file Pushover_Horizontal_Reactions.out -time -node $N_A0 $N_B0 -dof
1 reaction
recorder Node -file Pushover_Storey_Displacement.out -time -node $N_B1 -dof 1 disp

# Local behavior
recorder Element -file Pushover_Column_GlbForc.out -time -ele 1 2 globalForce
recorder Element -file Pushover_Column_ChordRot.out -time -ele 1 2
chordRotation

#####
# ANALYSIS
#####

set tStart [clock clicks -milliseconds]

# Apply lateral load based on first mode shape in x direction (EC8-1)
set phil 1
# pattern PatternType $PatternID TimeSeriesType
pattern Plain 2 1 {
    # load $nodeTag (ndf $LoadValues)
    load $N_A1 [expr $mass1*$phil] 0.0 0.0 ;# Reduced load magnitude for debugging
    load $N_B1 [expr $mass1*$phil] 0.0 0.0 ;# Reduced load magnitude for debugging
}

# Define step parameters
set step +1.000000E-05;
set numbersteps 1000;

# Constraint Handler
constraints Transformation
# DOF Numberer
numberer RCM
# System of Equations
system BandGeneral
# Convergence Test
test NormDispIncr 0.00001 100
#algorithm NewtonLineSearch <-type $typeSearch> <-tol $tol> <-maxIter $maxIter>
<-minEta $minEta> <-maxEta $maxEta>
```

```

algorithm NewtonLineSearch -type Bisection -tol +8E-1 -maxIter 1000 -minEta 1E-1
-maxEta 1E1 pFlag 1
#integrator DisplacementControl $node $dof $incr <$numIter $?Umin $?Umax>
100 +5.000000E-08 +5.000000E-06
integrator DisplacementControl $N_A1 1 $step

# Analysis Type
analysis Static

# Record initial state of model
record

# Analyze model
# Analyze model
puts "Memulai analisis pushover..."
set ok_pushover [analyze $numbersteps]
if {$ok_pushover != 0} {
    puts "Analisis pushover gagal pada suatu titik."
} else {
    puts "Analisis pushover berhasil diselesaikan."
}

# Stop timing of this analysis sequence
set tStop [clock clicks -milliseconds]
puts "o Time taken: [expr ($tStop-$tStart)/1000.0] sec"

# Reset for next analysis sequence
wipe

```

```
#####  
# ASSEMBLES MODEL + ANALYSIS  
#####  
  
source K.tcl                # Diganti sesuai yang dianalisis (K, K1, K2)  
source Analysis_Gravity.tcl  
source Analysis_Pushover.tcl
```




```

#          |   o       o   |   |
#          | o o o o o |   | coverH
#          |-----|   |
#          |-----Bsec-----|
#          |---| coverB |---|
#
#          y
#          ^
#          |
#
#          \   cover   /
#          \---Top---/
#          |c|         |c|
#          |o|         |o|
#          |v|         |v| HSec
#          |e|         |e|
#          |r|         |r|
#          /---Bot---\
#          /   cover   \
#          /-----\
#          Bsec
#
# Notes
#   The core concrete ends at the NA of the reinforcement
#   The center of the section is at (0,0) in the local axis system
#
#   set coverY [expr $HSec/2.0];           # The distance from the section
#   z-axis to the edge of the cover concrete -- outer edge of cover concrete
#   set coverZ [expr $BSec/2.0];           # The distance from the section
#   y-axis to the edge of the cover concrete -- outer edge of cover concrete
#   set coreY [expr $coverY-$coverH];       # The distance from the
#   section z-axis to the edge of the core concrete -- edge of the core concrete/inner
#   edge of cover concrete
#   set coreZ [expr $coverZ-$coverB];       # The distance from the
#   section y-axis to the edge of the core concrete -- edge of the core concrete/inner
#   edge of cover concrete
#   set numBarsInt [expr $numBarsIntTot/2]; # number of intermediate bars per
#   side
#
# Define the fiber section
section Fiber $id -GJ 1000000000 {
  # Define the core patch
  patch quadr $coreID $nfCoreZ $nfCoreY -$coreY $coreZ -$coreY
  -$coreZ $coreY -$coreZ $coreY $coreZ
  # Define the four cover patches
  patch quadr $coverID 2 $nfCoverY -$coverY $coverZ -$coreY $coreZ
  $coreY $coreZ $coverY $coverZ

```

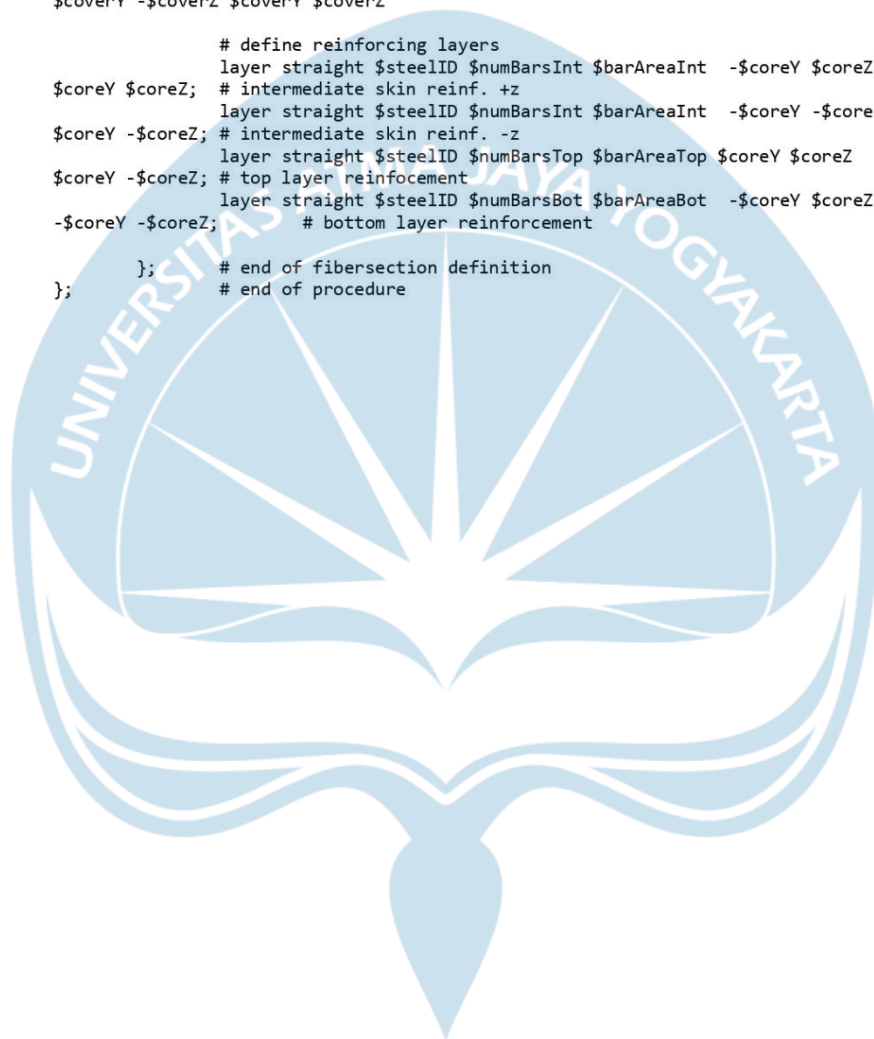
```

        patch quadr $coverID 2 $nfCoverY -$coreY -$coreZ -$coverY -$coverZ
$coverY -$coverZ $coreY -$coreZ
        patch quadr $coverID $nfCoverZ 2 -$coverY $coverZ -$coverY -$coverZ
-$coreY -$coreZ -$coreY $coreZ
        patch quadr $coverID $nfCoverZ 2 $coreY $coreZ $coreY -$coreZ
$coverY -$coverZ $coverY $coverZ

        # define reinforcing layers
        layer straight $steelID $numBarsInt $barAreaInt -$coreY $coreZ
$coreY $coreZ; # intermediate skin reinf. +z
        layer straight $steelID $numBarsInt $barAreaInt -$coreY -$coreZ
$coreY -$coreZ; # intermediate skin reinf. -z
        layer straight $steelID $numBarsTop $barAreaTop $coreY $coreZ
$coreY -$coreZ; # top layer reinforcement
        layer straight $steelID $numBarsBot $barAreaBot -$coreY $coreZ
-$coreY -$coreZ; # bottom layer reinforcement

    }; # end of fibersection definition
}; # end of procedure

```



ORIGINALITY REPORT

9%

SIMILARITY INDEX

8%

INTERNET SOURCES

2%

PUBLICATIONS

4%

STUDENT PAPERS

PRIMARY SOURCES

1

e-journal.uajy.ac.id

Internet Source

2%

2

repository.usd.ac.id

Internet Source

<1%

3

dspace.uii.ac.id

Internet Source

<1%

4

Submitted to Rektorat (ADM)

Student Paper

<1%

5

www.pu.go.id

Internet Source

<1%

6

docplayer.info

Internet Source

<1%

7

repository.unsri.ac.id

Internet Source

<1%

8

www.neliti.com

Internet Source

<1%

9

Submitted to Universitas Andalas

Student Paper

<1%

10

Submitted to Heriot-Watt University

Student Paper

<1 %

11

hdl.handle.net

Internet Source

<1 %

12

simdos.unud.ac.id

Internet Source

<1 %

13

N. Septian, G. Turuallo, I.K. Sulendra. "Kinerja Portal Struktur Gedung Tahan Gempa dengan Sistem Ganda Menggunakan Metode Pushover Analysis", REKONSTRUKSI TADULAKO: Civil Engineering Journal on Research and Development, 2022

Publication

<1 %

14

Submitted to Universitas Pendidikan Indonesia

Student Paper

<1 %

15

etd.repository.ugm.ac.id

Internet Source

<1 %

16

digilib.unhas.ac.id

Internet Source

<1 %

17

www.site3k.net

Internet Source

<1 %

18

Submitted to Universitas Pertamina

Student Paper

<1 %

etd.lib.metu.edu.tr

19

Internet Source

<1 %

20

fis.cld.bz

Internet Source

<1 %

21

repository.untag-sby.ac.id

Internet Source

<1 %

22

www.oaepublish.com

Internet Source

<1 %

23

Submitted to Universitas Brawijaya

Student Paper

<1 %

24

Submitted to Universitas Islam Indonesia

Student Paper

<1 %

25

ascelibrary.org

Internet Source

<1 %

26

documents.mx

Internet Source

<1 %

27

repo.palcomtech.ac.id

Internet Source

<1 %

28

repository.umi.ac.id

Internet Source

<1 %

29

www.readbag.com

Internet Source

<1 %

30

Muhammad Ryan Iskandar, Fajar Purwoko.
"PERILAKU KOLOM BETON RINGAN AKIBAT

<1 %

31	tel.archives-ouvertes.fr Internet Source	<1 %
32	ejournal.unsri.ac.id Internet Source	<1 %
33	eprints.uny.ac.id Internet Source	<1 %
34	repository.eka-prasetya.ac.id Internet Source	<1 %
35	www.ce.ntu.edu.tw Internet Source	<1 %
36	123dok.com Internet Source	<1 %
37	Nadian Ernaningtyas, Sri Budi Wahjuningsih, Sri Haryati. "Substitusi Wortel (<i>Daucus carota</i> L.) dan Tepung Mocaf (Modified Cassava Flour) Terhadap Sifat Fisikokimia Dan Organoleptik Mie Kering", Jurnal Teknologi Pangan dan Hasil Pertanian, 2020 Publication	<1 %
38	etd.aau.edu.et Internet Source	<1 %
39	id.scribd.com Internet Source	<1 %

40

repository.usu.ac.id

Internet Source

<1 %

41

repository.widyatama.ac.id

Internet Source

<1 %

42

scholar.unand.ac.id

Internet Source

<1 %

43

www.researchgate.net

Internet Source

<1 %

44

core.ac.uk

Internet Source

<1 %

Exclude quotes

Off

Exclude matches

Off

Exclude bibliography

On

