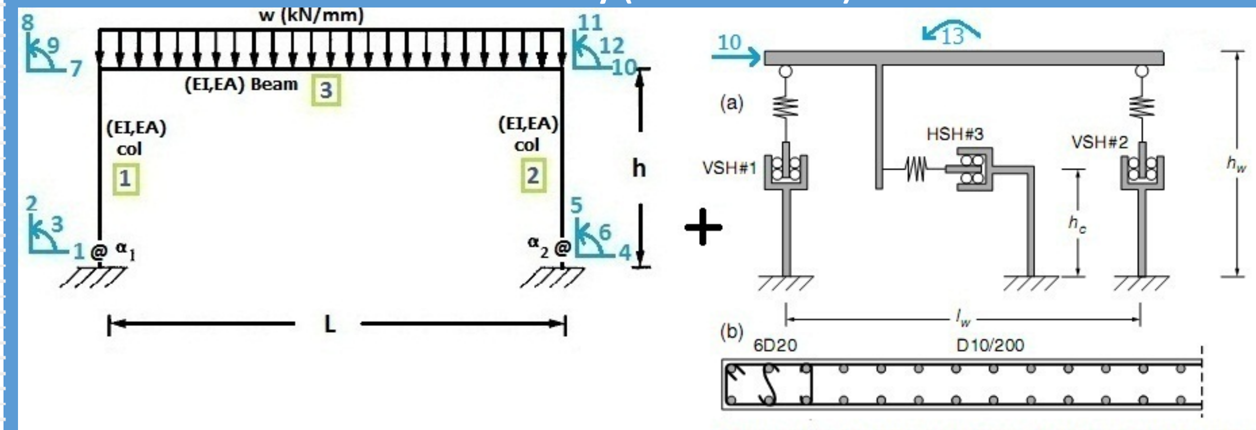
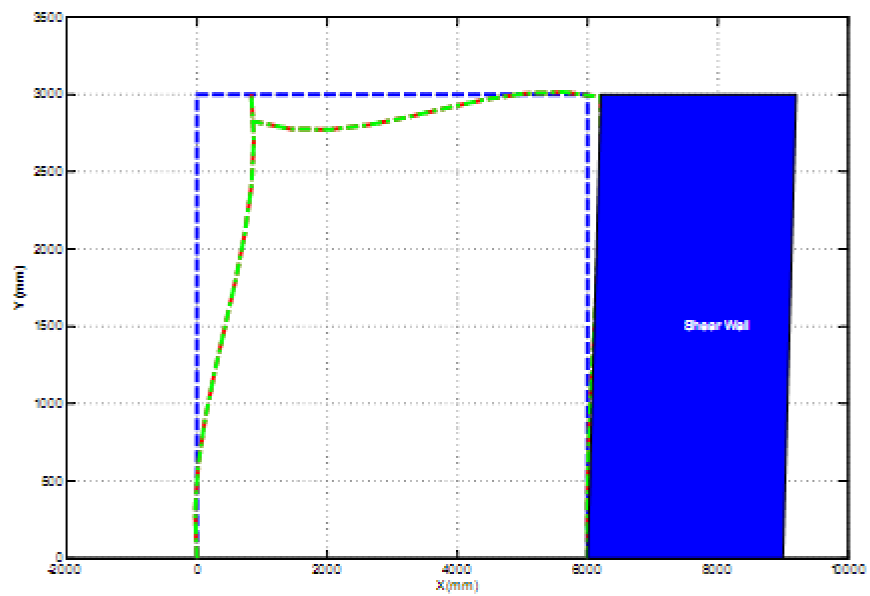
>> IN THE NAME OF GOD <<

Pushover 1st and 2nd order Analysis Interaction of Concrete Shear wall with Steel Frame Nonlinear Semi Rigid Conection Frame subjected to lateral load Small Deflection Theory (Force Control) in MATLAB

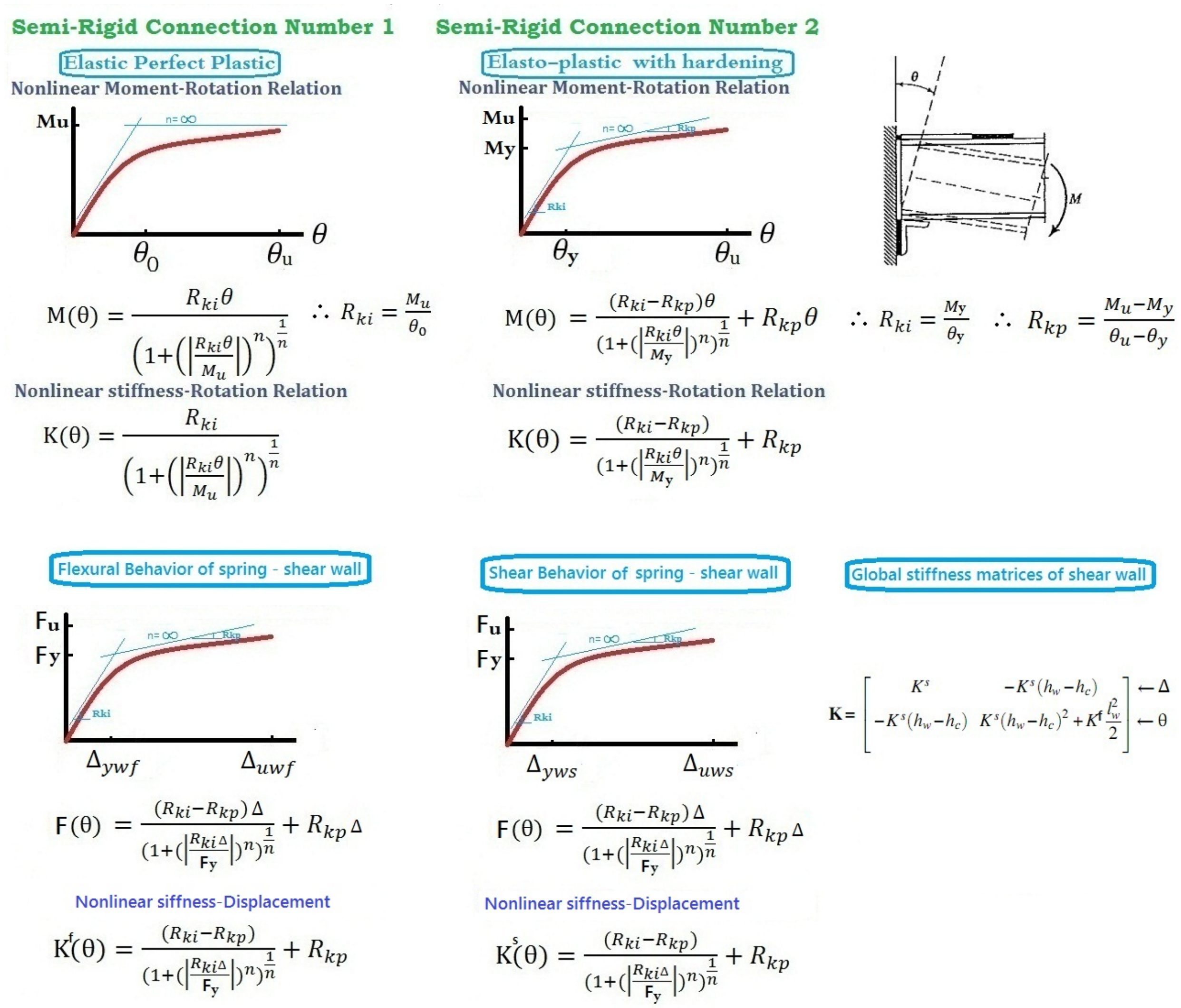


Numerical model: (a) Basic information; (b) Sectional parameters.

This program is written by Salar Delavar Ghashghaei – Date of Publication: March/26/2017
E-mail: salar.d.ghashghaei@gmail.com



Figure(1) Deformed shape model in MATLAB



Figure(2) Nonlinear behavior of columns connection and concrete shear wall

Define Parameters:

```
% Define Parameters in mm,kN
W=.005; % [kN/mm] % Distributed load Value (+ : Down)
h= 3000; % [mm] % column length
L = 6000; % [mm] % beam length
bw = 3000; % [mm] width of shear wall
Lw = 3000; % [mm] Length of shear wall
Ew = 200; % [kN/mm^2] modulus of elasticity of shear wall
EIc = 200*100^4/12; % [kN.mm^2] column
EAc = 200*10000; % [kN]
EIb = 200*50^4/12; % [kN.mm^2] beam
EAb = 200*(50)^2; % [kN]
m = 2000; % number of calculation (Load Steps)
itermax = 400;% maximum number of iterations
tolerance = 1e-9; % specified tolerance for convergence
u = zeros(9,1);% initial guess value
P3 =0; % [kN.mm] Moment [DOF (3)]
P6 =0; % [kN.mm] Moment [DOF (6)]
P7=50; % [kN] Horizontal Force [DOF (7)] Incremantal Loading
P8=-.5*W*L; % [kN] Vertical Force [DOF (8)]
```

```
P9 =-(W*L^2)/12; % [kN.mm] Moment [DOF (9)]
P10=0; % [kN] Horizental Force [DOF (10)]
P11=-.5*W*L; % [kN] Vertical Force [DOF (11)]
P12=+(W*L^2)/12; % [kN.mm] Moment [DOF (12)]
lanXc=0;lanYc=1;
lanXb=1;lanYb=0;
%% Nonlinear Rotational Spring of columns
tyc=.08; % Yield rotaion
Myc=40e+3; % Yield moment
tuc=.25;  % Ultimate rotation
Muc=1.25*Myc;  % Ultimate moment
nc = 5; % Moment-rotation shape parameter
Rkic=Myc/tyc;
Rkpc=(Muc-Myc)/(tuc-tyc);
%% Nonlinear Displacement Spring of Shear Wall - Flexural Behavior
hw=h;Iw= bw*(Lw^3)/12;As=(2*Iw)/Lw^2;aw=(2*Iw)/(bw*Lw^3);
dywf=15; % Yield displacement
Fywf=20e+3; % Yield Shear Force
duwf=30;  % Ultimate displacement
Fuwf=25e+3;  % Ultimate Shear Force
nwf = 5; % Shear Force-displacement shape parameter
Rkiwf=Fywf/dywf;
Rkpwf=(Fuwf-Fywf)/(duwf-dywf);
%% Nonlinear Displacement Spring of Shear Wall - Shear Behavior
hc = hw/3; % [mm]
dyws=5; % Yield displacement
Fyws=20e+3; % Yield Shear Force
duws=50;  % Ultimate displacement
Fuws=30e+3;  % Ultimate Shear Force
nws = 5; % Shear Force-displacement shape parameter
Rkiws=Fyws/dyws;
Rkpws=(Fuws-Fyws)/(duws-dyws);
```

Analysis Report:

```
###################################
#       First-order Nonlinear Analysis      #
###################################
 (+)It is converged in 2 iterations for increment 1
(+)It is converged in 2 iterations for increment 2
(+)It is converged in 2 iterations for increment 3
(+)It is converged in 2 iterations for increment 4
(+)It is converged in 3 iterations for increment 5
(+)It is converged in 3 iterations for increment 6
(+)It is converged in 3 iterations for increment 7
(+)It is converged in 3 iterations for increment 8
(+)It is converged in 3 iterations for increment 9
(+)It is converged in 3 iterations for increment 10
.
.
.
(+)It is converged in 15 iterations for increment 1045
(+)It is converged in 15 iterations for increment 1046
(+)It is converged in 15 iterations for increment 1047
(+)It is converged in 15 iterations for increment 1048
(+)It is converged in 15 iterations for increment 1049
(+)It is converged in 15 iterations for increment 1050
(+)It is converged in 15 iterations for increment 1051
(+)It is converged in 15 iterations for increment 1052
(+)It is converged in 15 iterations for increment 1053
(+)It is converged in 15 iterations for increment 1054
    ## spring at support reached to Ultimate Rotation ##
```

```
####################################
#       Second-order Nonlinear Analysis       #
####################################
(+)It is converged in 2 iterations for increment 1
(+)It is converged in 2 iterations for increment 2
(+)It is converged in 2 iterations for increment 3
(+)It is converged in 2 iterations for increment 4
(+)It is converged in 3 iterations for increment 5
(+)It is converged in 3 iterations for increment 6
(+)It is converged in 3 iterations for increment 7
(+)It is converged in 3 iterations for increment 8
(+)It is converged in 3 iterations for increment 9
(+)It is converged in 3 iterations for increment 10
.
.
.
(+)It is converged in 15 iterations for increment 1045
(+)It is converged in 15 iterations for increment 1046
(+)It is converged in 15 iterations for increment 1047
(+)It is converged in 15 iterations for increment 1048
(+)It is converged in 15 iterations for increment 1049
(+)It is converged in 15 iterations for increment 1050
(+)It is converged in 15 iterations for increment 1051
(+)It is converged in 15 iterations for increment 1052
(+)It is converged in 15 iterations for increment 1053
(+)It is converged in 15 iterations for increment 1054
    ## spring at support reached to Ultimate Rotation ##
====================== Result =======================
=== 1st-order Nonlinear ==+== 2nd-order Nonlinear =====
Disp.(D7) Base Shear(D1+D4) Disp.(D7) Base Shear(D1+D4)
=====================================================
 (mm)       (kN)        (mm)        (kN)
-------------------------------------------------------
 1.0e+004 *

      0        0        0        0
   0.0483   3.3045   0.0483   3.3046
   0.0834   5.2700   0.0834   5.2700

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+-----------------------------------------------------------------------------------------------+
 Semi-Rigid Column Connection Ductility Rito is:  3.235
 1st-order Nonlinear Ductility Rito is (Du/Dy):  1.727
 2nd-order Nonlinear Ductility Rito is (Du/Dy): 1.727
 1st-order Nonlinear Over Strength Ratio is (Fu/Fy):  1.595
 2nd-order Nonlinear Over Strength Ratio is (Fu/Fy): 1.595
 1st-order Nonlinear Initial Strucural stiffness is (Ke): 68.418 [kN/mm]
 1st-order Nonlinear Tangent Strucural stiffness is (Kt): 55.986 [kN/mm]
 2nd-order Nonlinear Initial Strucural stiffness is (Ke): 68.412 [kN/mm]
 2nd-order Nonlinear Tangent Strucural stiffness is (Kt): 55.980 [kN/mm]
+-----------------------------------------------------------------------------------------------+
```
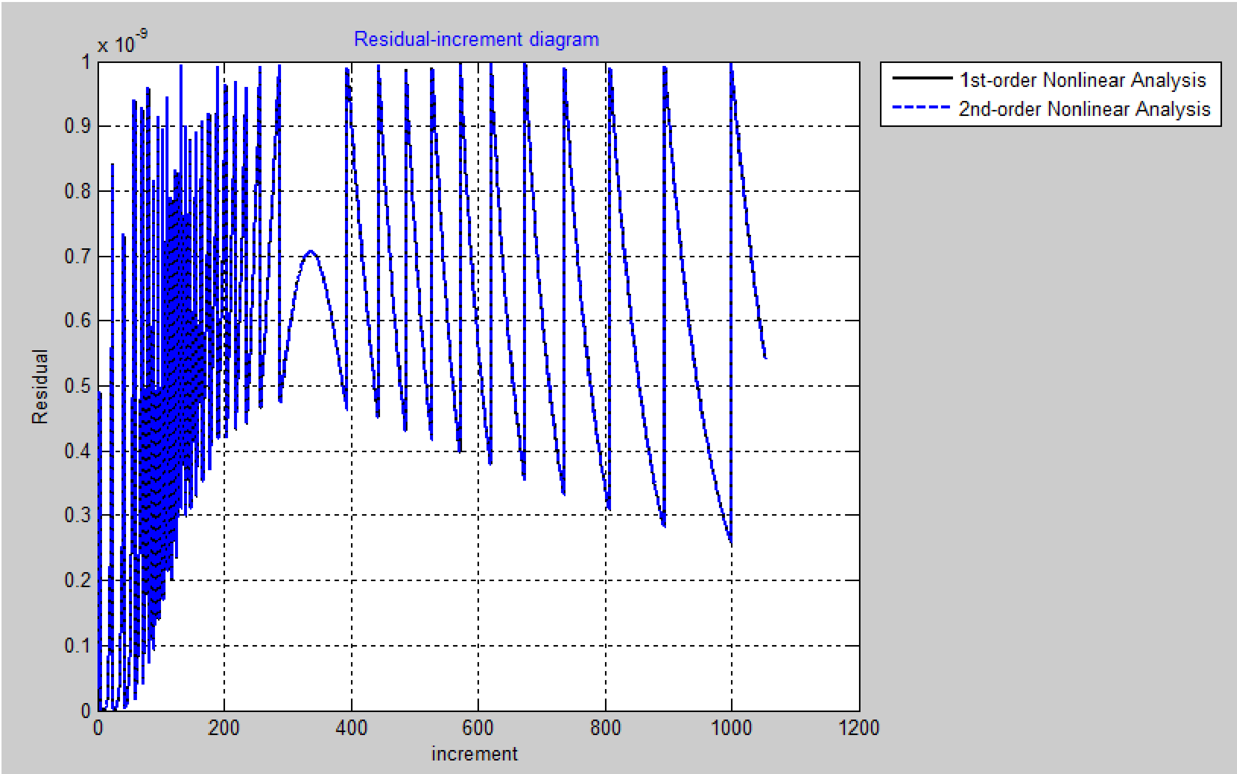
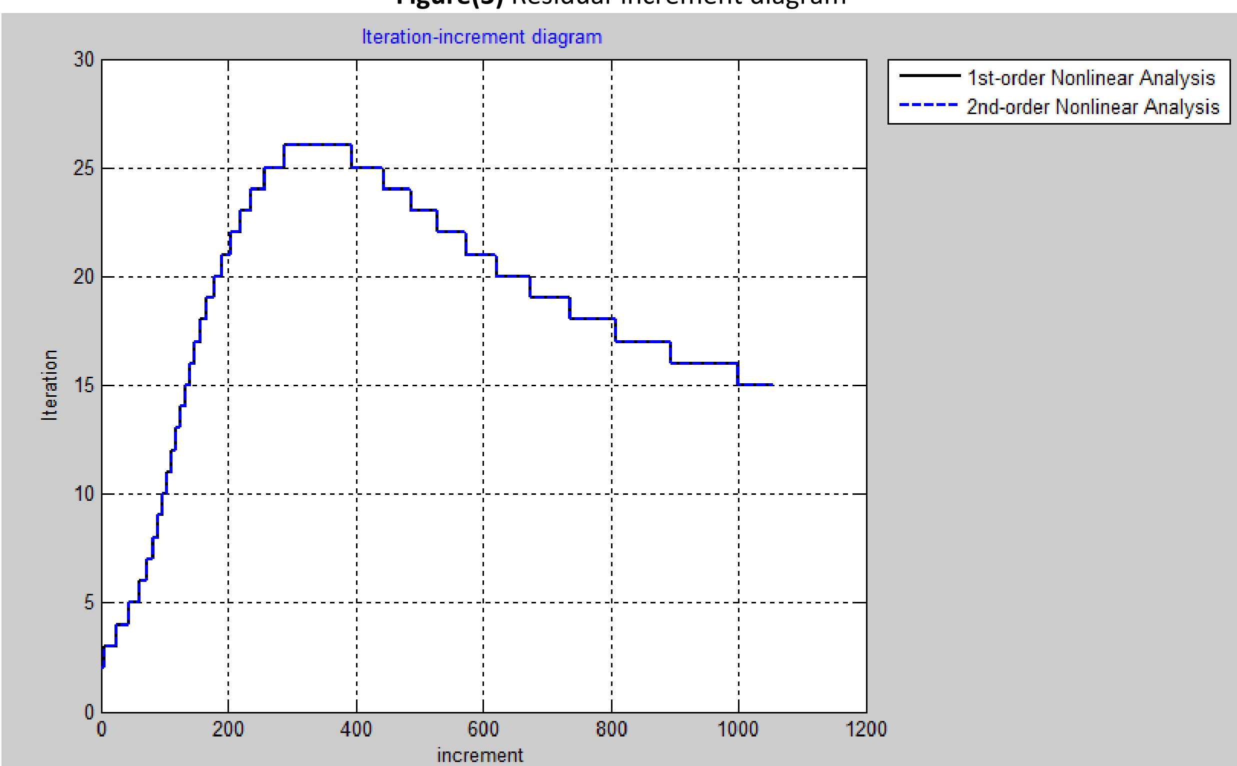
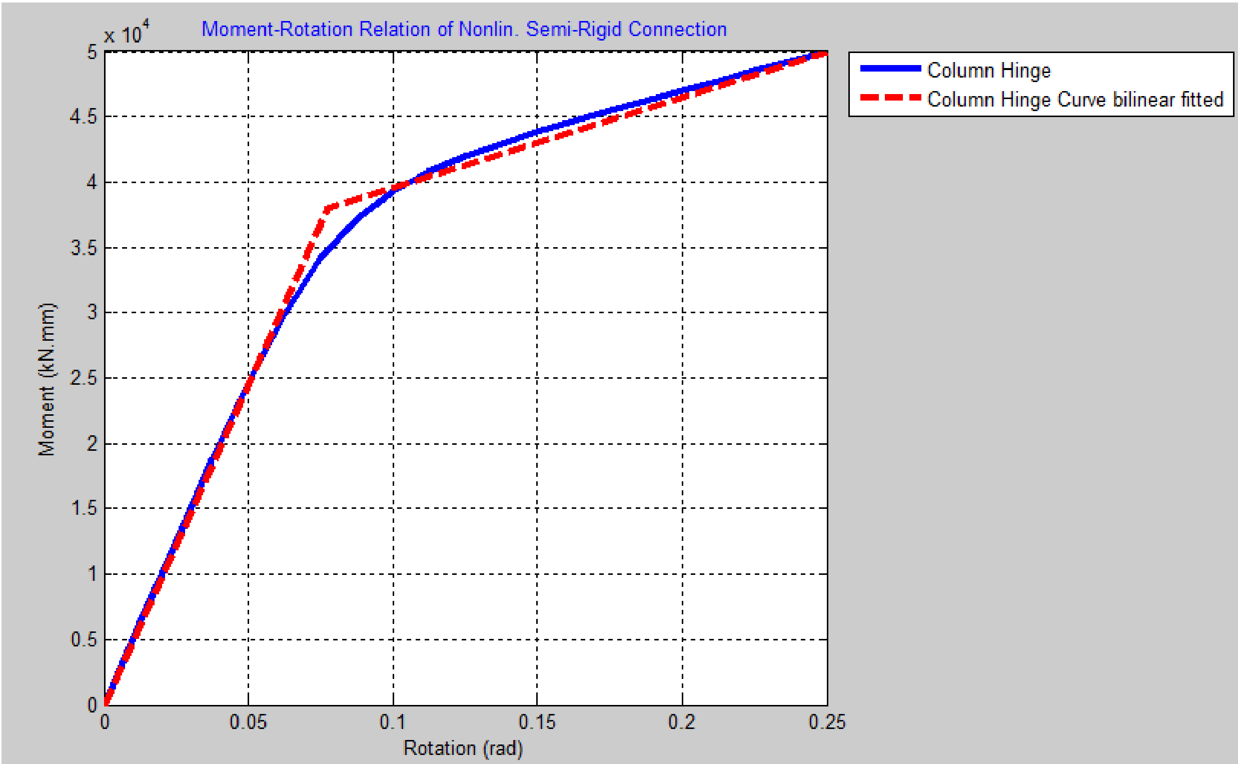

Plot:



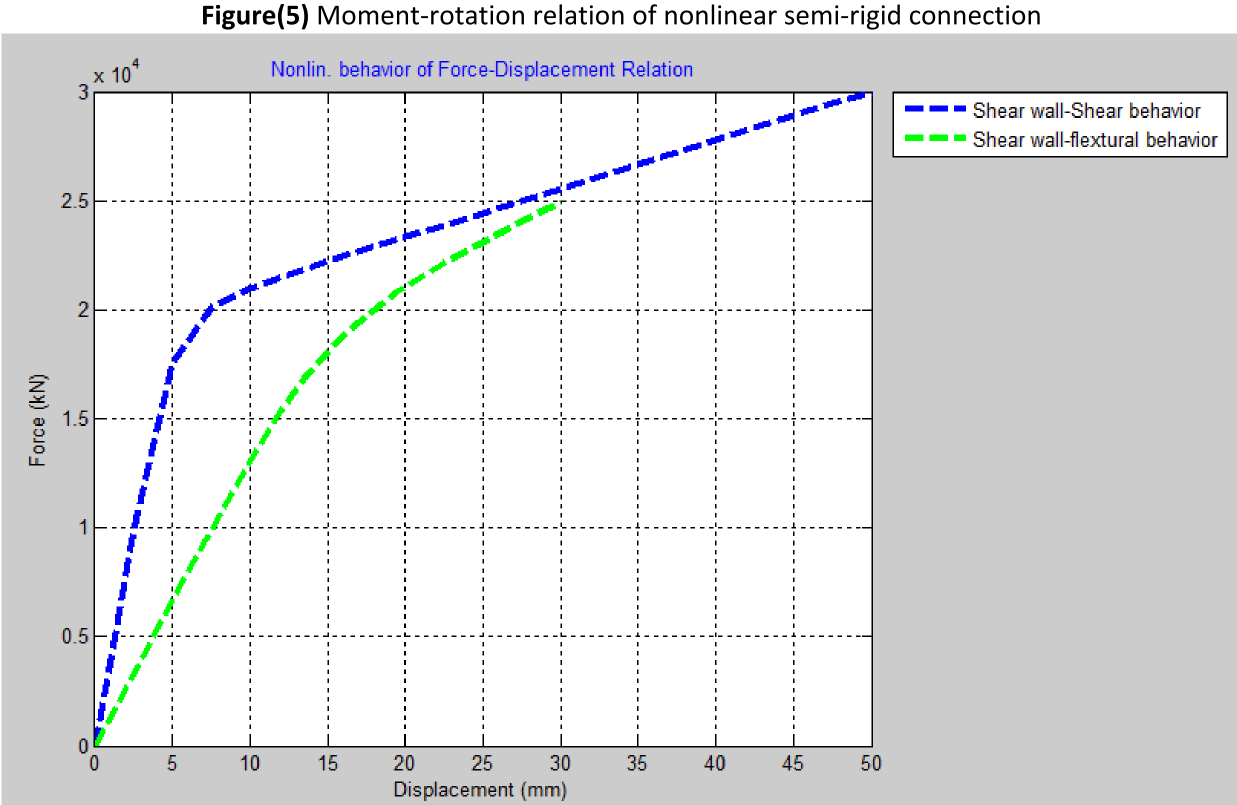
Figure(3) Residual-increment diagram



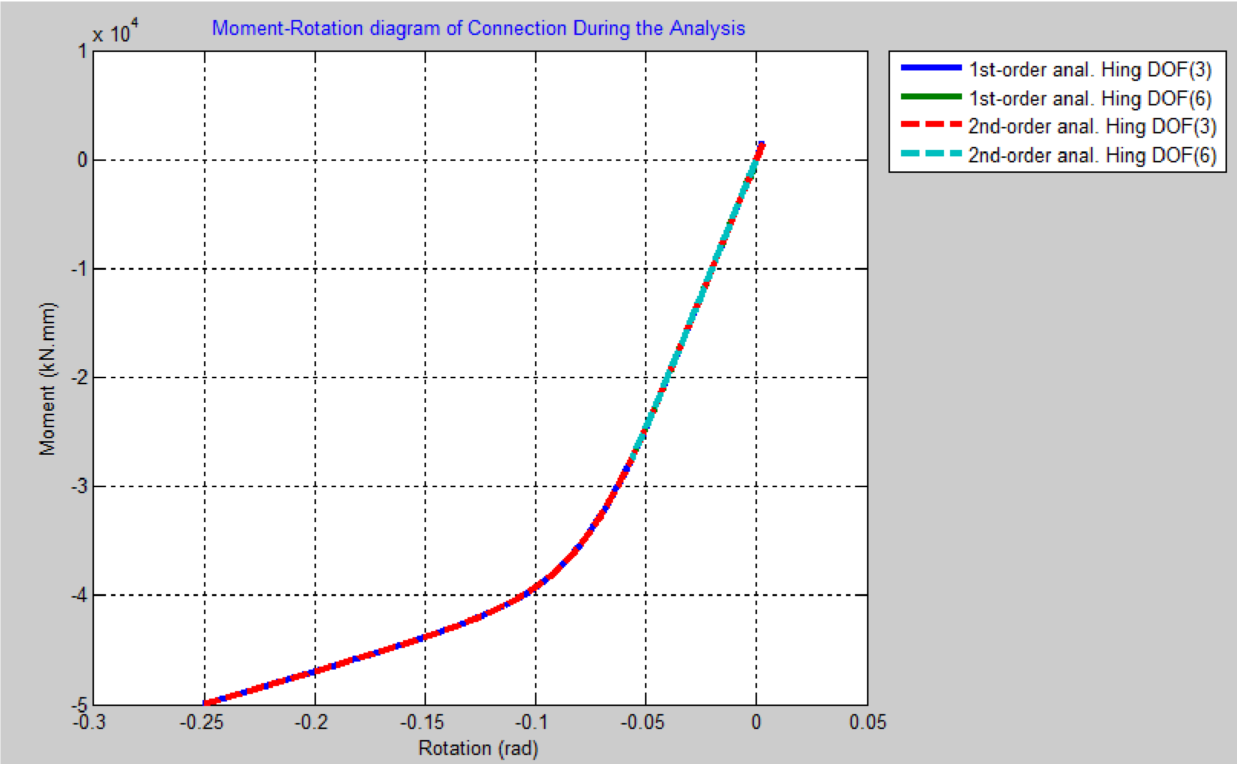
Figure(4) Iteration-increment diagram



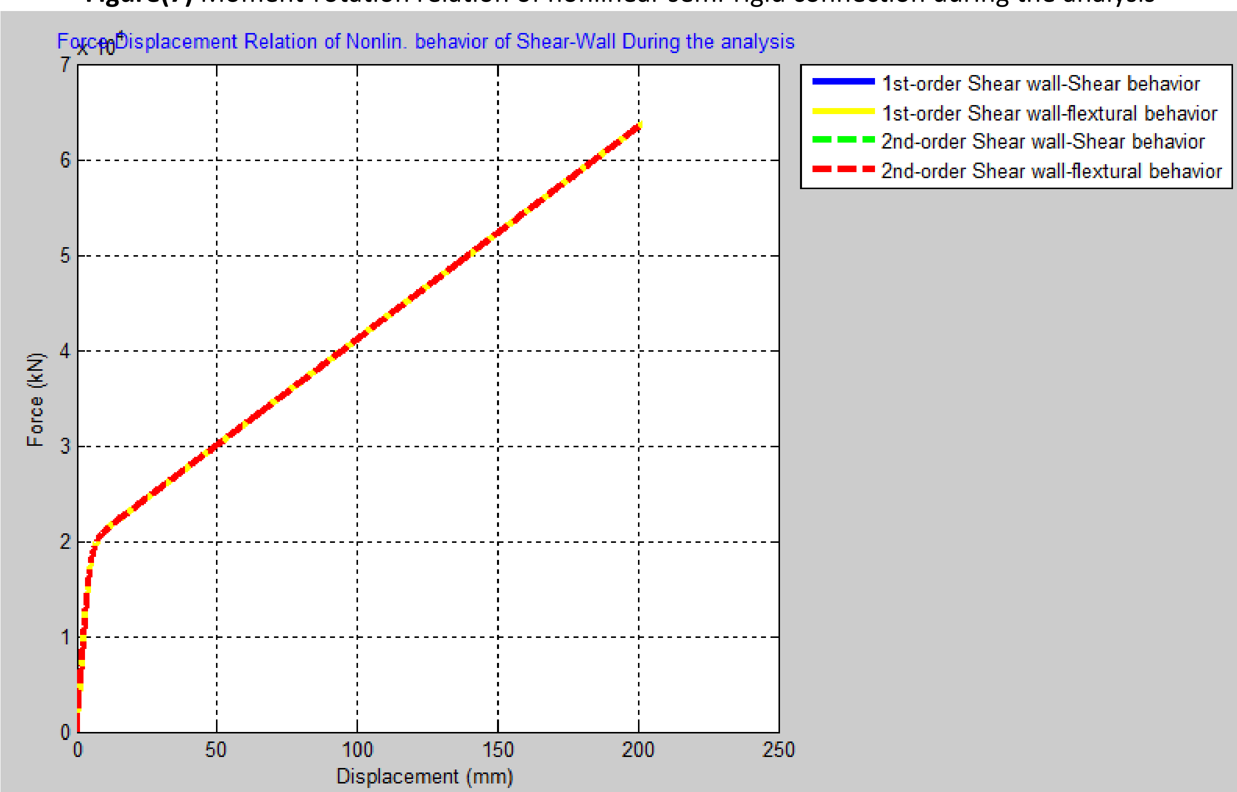
Figure(5) Moment-rotation relation of nonlinear semi-rigid connection



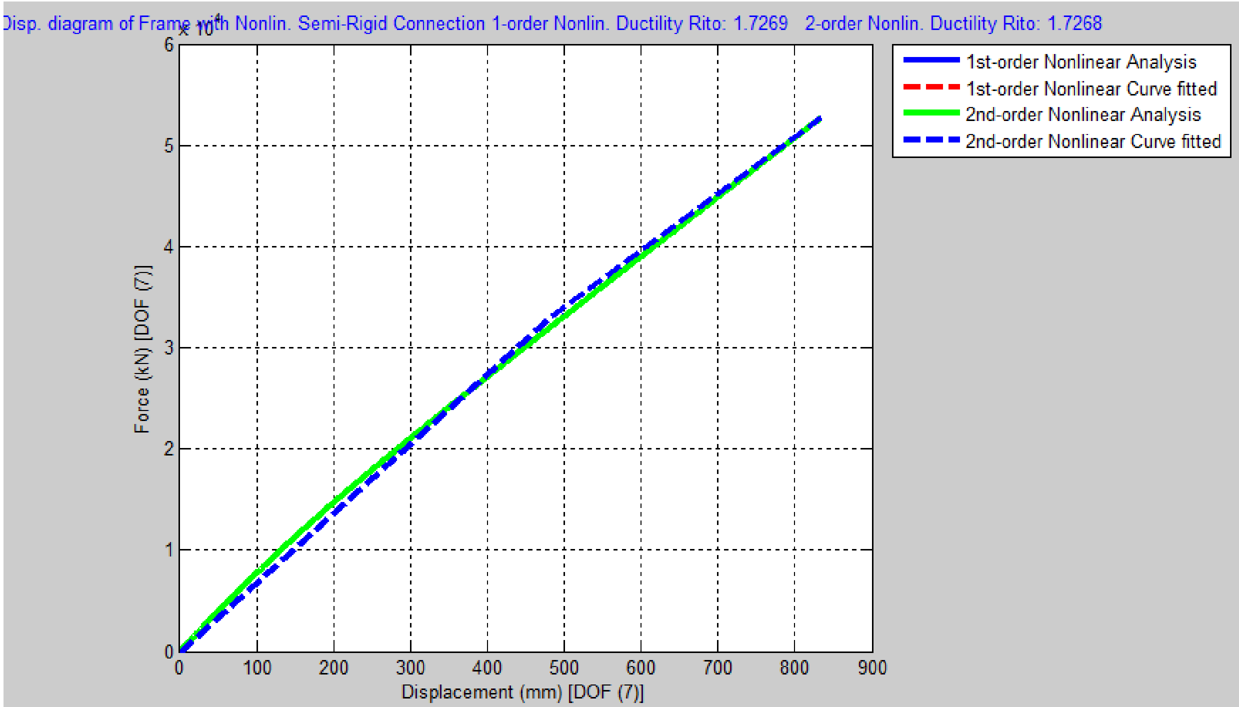
Figure(6) Force-displacement diagram of shear wall, shear and flextural behavior



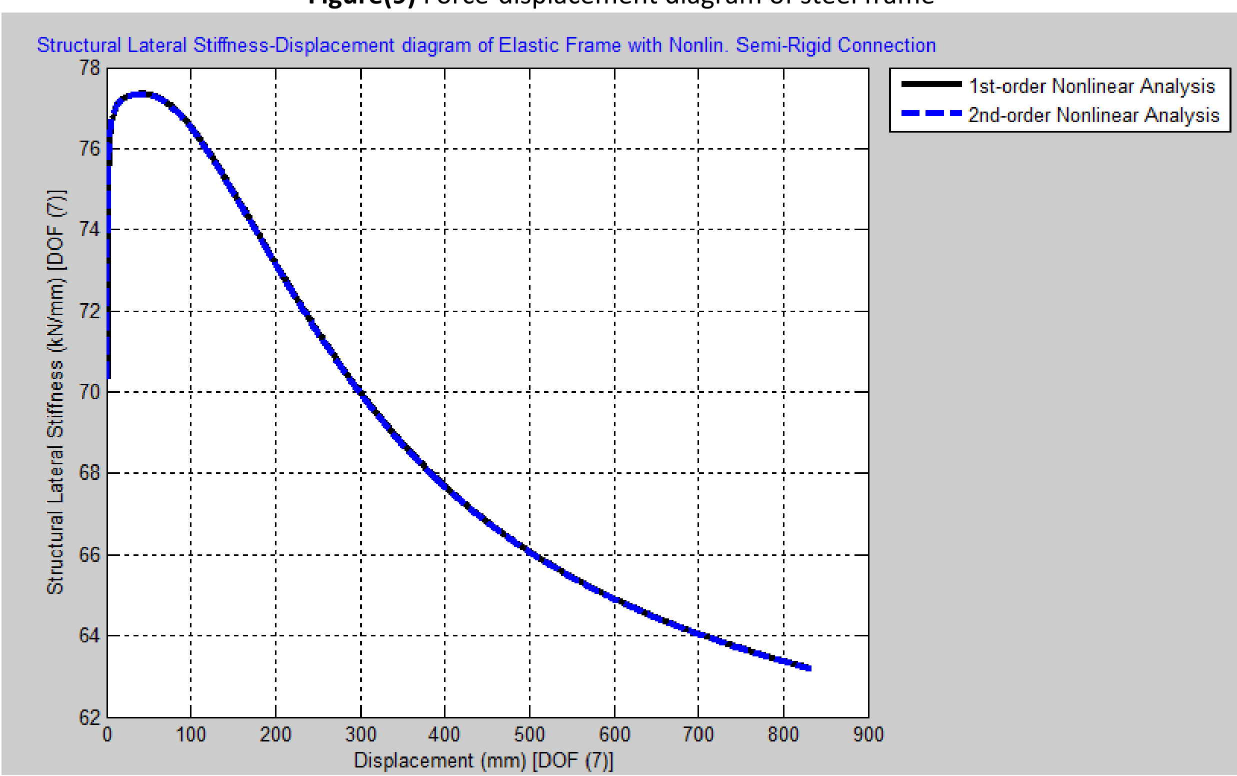
Figure(7) Moment-rotation relation of nonlinear semi-rigid connection during the analysis



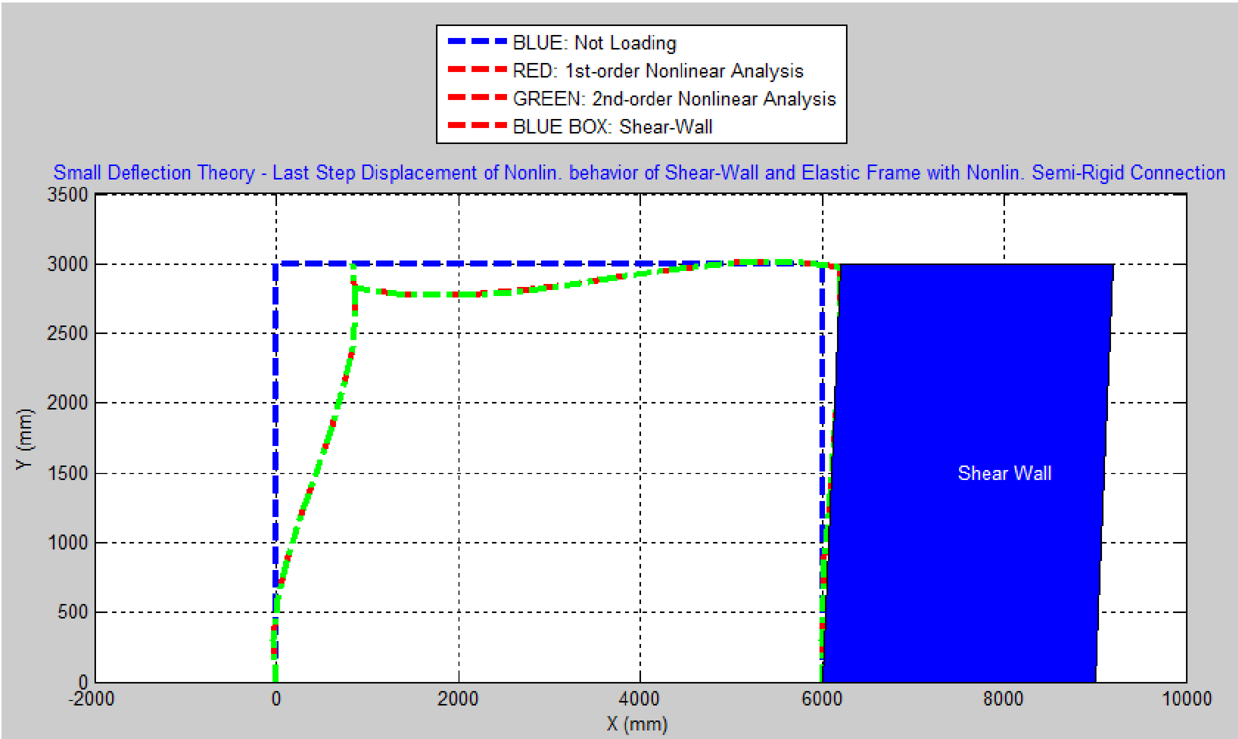
Figure(8) Force-displacement diagram of shear wall, shear and flextural behavior during the analysis



Figure(9) Force-displacement diagram of steel frame



Figure(10) Structural lateral stiffness-displacement diagram of steel frame



Figure(11) Last step deformation of steel frame and concrete shear wall