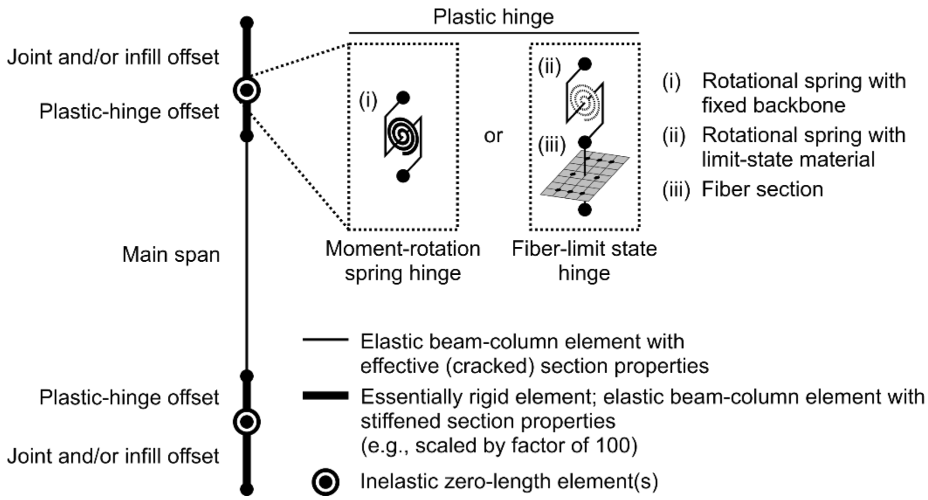
COMMAND FOR “ASCE 41 RC COLUMN LIMIT CURVE”

limitCurve Rotation $curveTag $eleTag $dofl $dofv $iNodeTag $jNodeTag $fpc $fyt $Ag $rhot $thetay $VColOE $Kunload -$VyE

DOCUMENTATION

Parameter	Description
curveTag	Unique tag of limit curve
eleTag	Tag of zero-length element associated with hinge
dofl	Lateral degree of freedom (used to determine shear demand)
dofv	Vertical degree of freedom (used to determine axial load)
iNodeTag	Tag of node “i” of hinge (used to determine total hinge rotation)
jNodeTag	Tag of node “j” of hinge (used to determine total hinge rotation)
fpc	Concrete compressive strength (ksi)
fyt	Transverse steel yield stress (ksi)
Ag	Gross area of concrete (in.^{2})
rhot	Transverse steel reinforcement ratio
thetay	Yield rotation of hinge (rad)
VColOE	Shear capacity of column (k)
Kunload	Unloading stiffness of hinge (k-in./rad; see note below)
$VyE	Plastic shear demand (k; if not used, shear demand is determined at each step instead)



ASCE 41-17 TARGETED MODELING PARAMETERS

Table 10-8. Modeling Parameters and Numerical Acceptance Criteria for Nonlinear Procedures—Reinforced Concrete Columns Other Than Circular with Spiral Reinforcement or Seismic Hoops as Defined in ACI 318

Modeling Parameters	**Acceptance Criteria**		
	Plastic Rotation Angle (radians)		
	Performance Level		
Plastic Rotation Angles, *a* and *b* (radians) **Residual Strength Ratio, *c***	**IO**	**LS**	**CP**
Columns not controlled by inadequate development or splicing along the clear height[a]			
$a = \left(0.042 - 0.043\frac{N_{UD}}{A_g f'_{cE}} + 0.63\rho_t - 0.023\frac{V_{yE}}{V_{ColOE}}\right) \geq 0.0$	$0.15\,a$ ≤ 0.005	$0.5\,b^{b}$	$0.7\,b^{b}$
For $\frac{N_{UD}}{A_g f'_{cE}} \leq 0.5 \left\{ b = \frac{0.5}{5 + \frac{N_{UD}}{0.8 A_g f'_{cE}} \frac{1}{\rho_t} \frac{f'_{cE}}{f_{ytE}}} - 0.01 \geq a^{a} \right.$			
$c = 0.24 - 0.4\frac{N_{UD}}{A_g f'_{cE}} \geq 0.0$			
Columns controlled by inadequate development or splicing along the clear height[c]			
$a = \left(\frac{1}{8}\frac{\rho_t f_{ytE}}{\rho_l f_{ylE}}\right) \begin{matrix} \geq 0.0 \\ \leq 0.025^{d} \end{matrix}$	0.0	$0.5\,b$	$0.7\,b$
$b = \left(0.012 - 0.085\frac{N_{UD}}{A_g f'_{cE}} + 12\rho_t^{\,e}\right) \begin{matrix} \geq 0.0 \\ \geq a \\ \leq 0.06 \end{matrix}$			
$c = 0.15 + 36\rho_t \leq 0.4$			

Notes: ρ_t shall not be taken as greater than 0.0175 in any case nor greater than 0.0075 when ties are not adequately anchored in the core. Equations in the table are not valid for columns with ρ_t smaller than 0.0005.

V_{yE}/V_{ColOE} shall not be taken as less than 0.2.

N_{UD} shall be the maximum compressive axial load accounting for the effects of lateral forces as described in Eq. (7-34). Alternatively, it shall be permitted to evaluate N_{UD} based on a limit-state analysis.

[a] b shall be reduced linearly for $N_{UD}/(A_g f'_{cE}) > 0.5$ from its value at $N_{UD}/(A_g f'_{cE}) = 0.5$ to zero at $N_{UD}/(A_g f'_{cE}) = 0.7$ but shall not be smaller than a.

[b] $N_{UD}/(A_g f'_{cE})$ shall not be taken as smaller than 0.1.

[c] Columns are considered to be controlled by inadequate development or splices where the calculated steel stress at the splice exceeds the steel stress specified by Eq. (10-1a) or (10-1b). Modeling parameter for columns controlled by inadequate development or splicing shall never exceed those of columns not controlled by inadequate development or splicing.

[d] a for columns controlled by inadequate development or splicing shall be taken as zero if the splice region is not crossed by at least two tie groups over its length.

[e] ρ_t shall not be taken as greater than 0.0075.

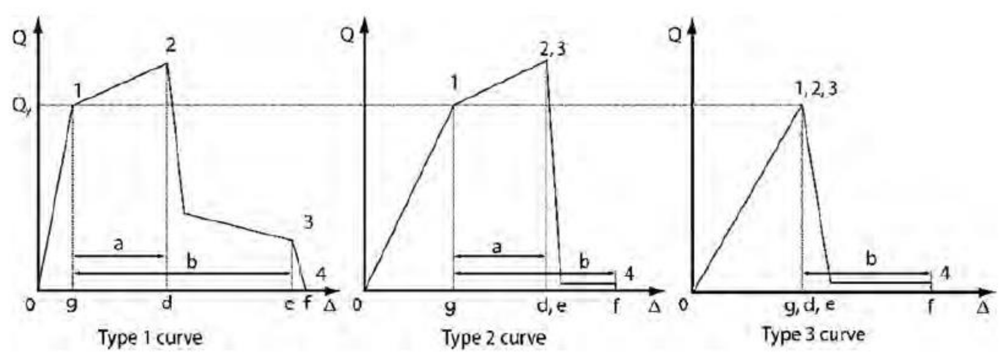


Figure 7-4. Component Force Versus Deformation Curves

Notes:

1. Only secondary component actions permitted between points 2 and 4.
2. The force, Q, after point 3 diminishes to approximately zero.

DEGENKOLB TESTING

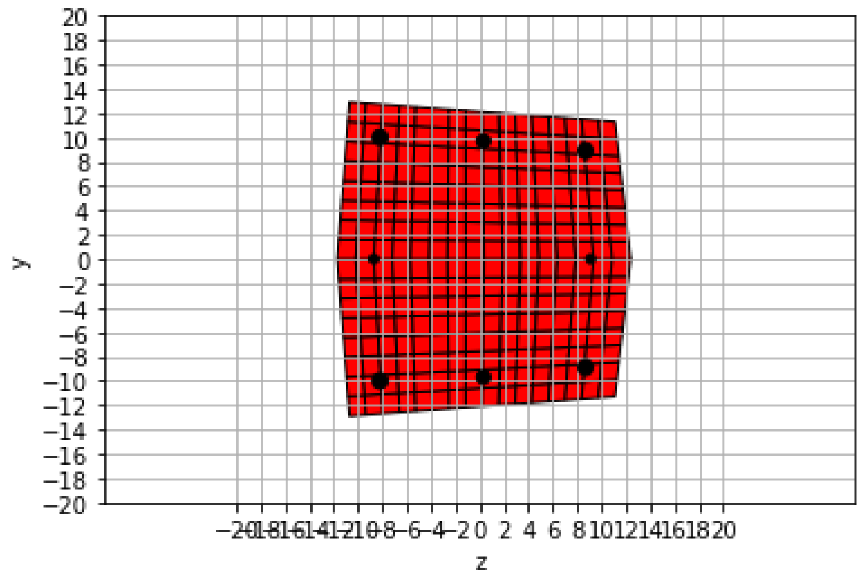


Figure 1: Section of 6’-3” tall cantilever column under investigation.

In figures 2-4, the envelope of the Perform3D response represents the behavior prescribed by ASCE 41-17.

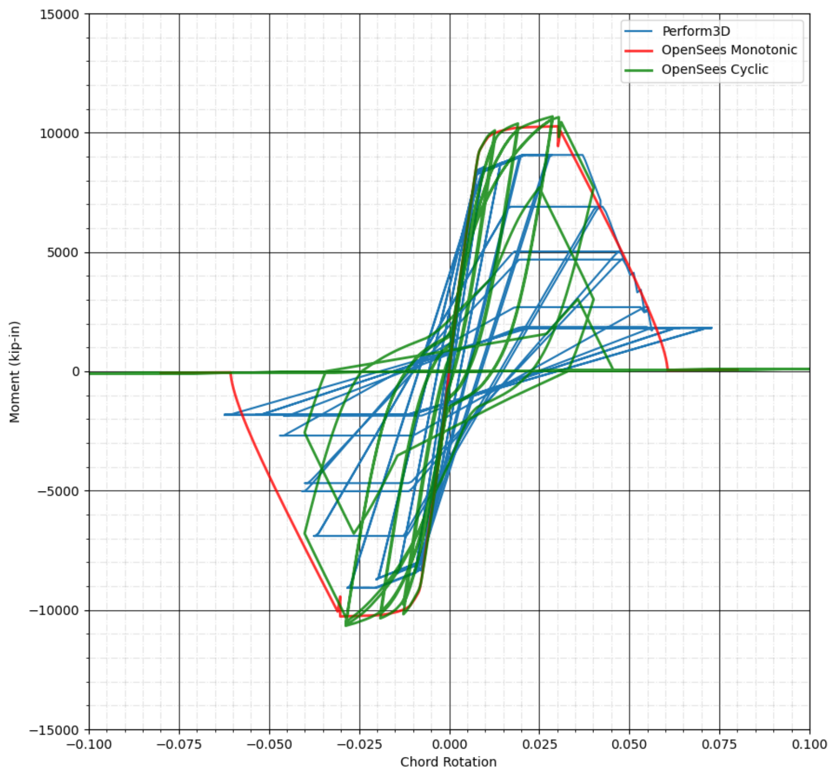


Figure 2: Flexural response at 0.1Agf'c axial load.

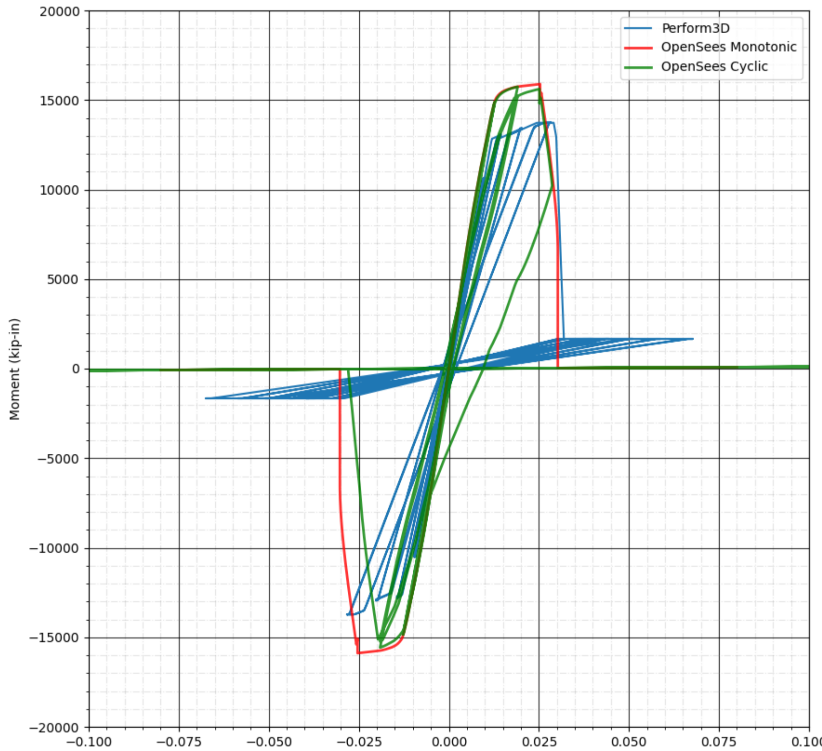


Figure 3: Flexural response at 0.3Agf'c axial load.

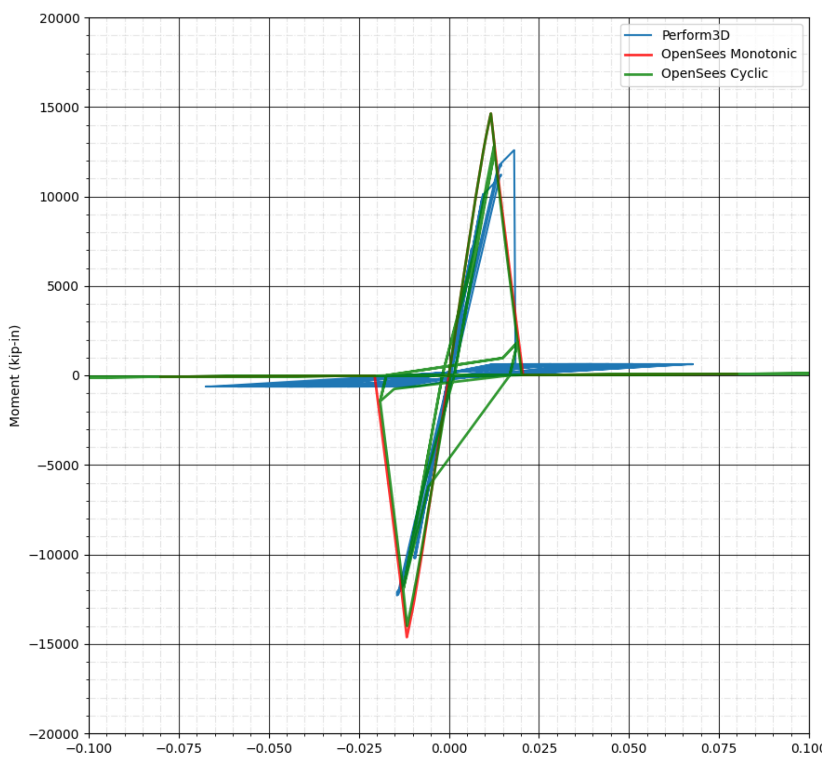


Figure 4: Flexural response at 0.6Agf'c axial load.