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## ***Investigating Deterioration Effect of Hysteresis Loops in Nonlinear Static Analysis of Intermediate RC Moment Frame***

G. Ghodrati Amiri; B. Mohebi; H. Hamidi Jamnani

### ***ABSTRACT***

This research investigates the effect of stiffness degradation, strength deterioration and pinching behavior of hysteresis loops in static nonlinear analysis. One of the inefficiencies of static nonlinear analysis is that nonlinear behavior of structural elements due to cyclic deformations is approximately considered in the analysis, and only one quarter of a full hysteretic loop is considered. For investigating the effect of this inefficiency in analysis results, three intermediate concrete moment frames from regular RC structures are selected. The performed procedures in FEMA-356 and proposed plastic hinges in this guideline are utilized for performing static nonlinear analysis. A coefficient for consideration of stiffness degradation and strength deterioration is proposed by FEMA-356 in nonlinear static analysis. This coefficient for intermediate RC

Email: [ghodrati@iust.ac.ir](mailto:ghodrati@iust.ac.ir) :

Email: [mohebi@iust.ac.ir](mailto:mohebi@iust.ac.ir) :

Email: [civ\\_hamidi@yahoo.com](mailto:civ_hamidi@yahoo.com) :

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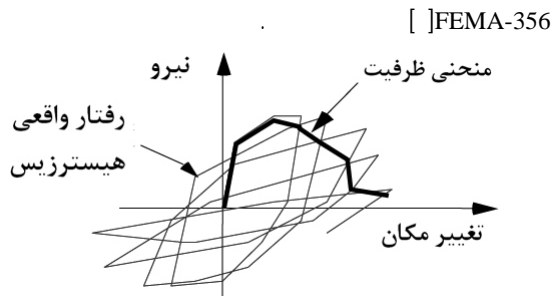
moment frames is equal to unity. For calculation of this coefficient, in this paper, the nonlinear dynamic analysis is used. Clough and Takeda Hysteretic loops and a hysteretic loop that considers effects of severe stiffness degradation, strength deterioration and pinching are assumed in nonlinear dynamic analysis. Comparing final results lead to conclusion that revealed the value of this coefficient is obtained 25% more than the value proposed by FEMA-356.

**KEYWORDS**

Nonlinear static analysis, Hysteresis loops, Nonlinear dynamic analysis, Stiffness degradation, strength deterioration.

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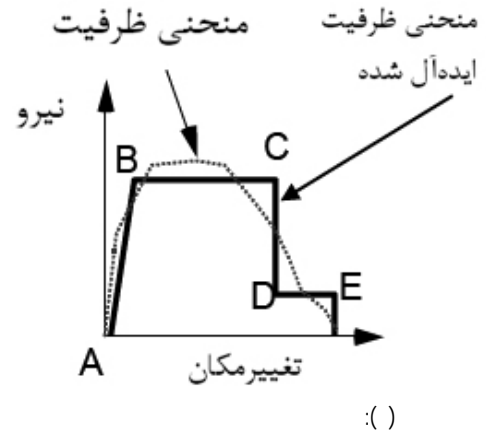


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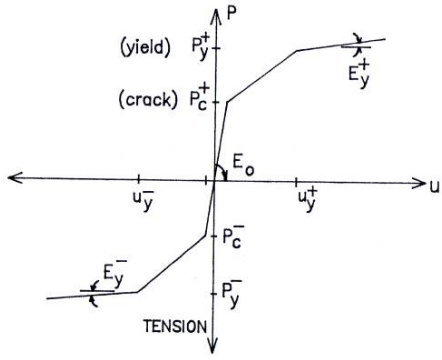
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$\beta$

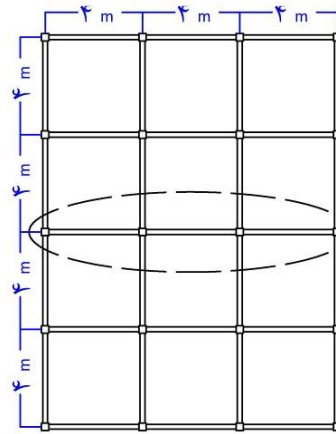
$$\frac{d\delta_m}{\delta_u}$$

$$\frac{dE}{\delta_u P_y}$$

$$\beta = \frac{d\delta_m / \delta_u}{dE / (\delta_u P_y)} = \frac{d\delta_m}{dE / P_y}$$

$\gamma P_y$

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kg/m

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$\alpha$

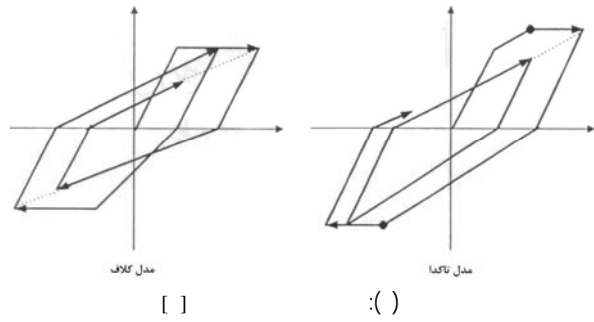
$\gamma$

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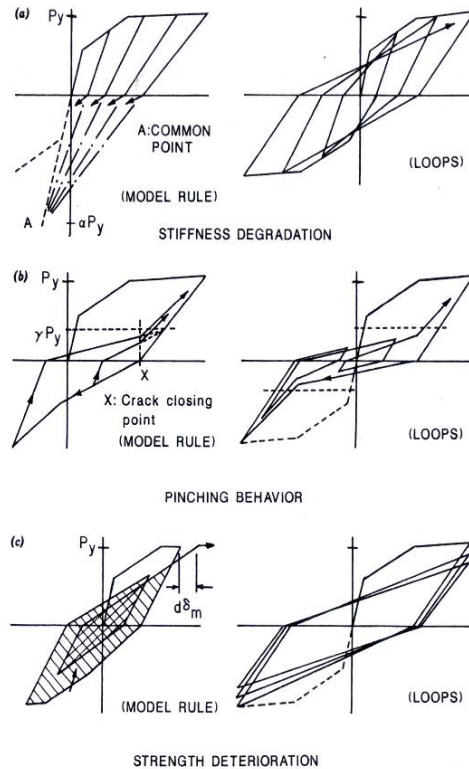
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$\alpha, \beta, \gamma$  ( )

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$$\dot{U}_{t+\Delta t} = \dot{U}_t + [(1-\delta)\ddot{U}_t + \delta\ddot{U}_{t+\Delta t}]\Delta t \quad ( )$$

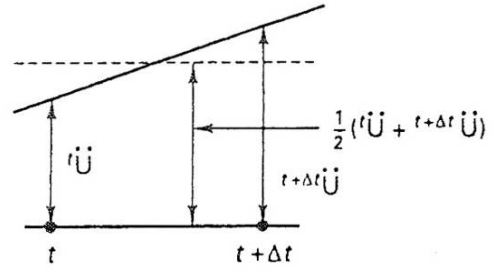
$$U_{t+\Delta t} = U_t + \dot{U}_t \Delta t + \left[ \left( \frac{1}{2} - \alpha \right) \ddot{U}_t + \alpha \ddot{U}_{t+\Delta t} \right] \Delta t^2 \quad ( )$$

$$\delta = \frac{1}{\gamma}$$

$$\alpha = \frac{1}{6}$$

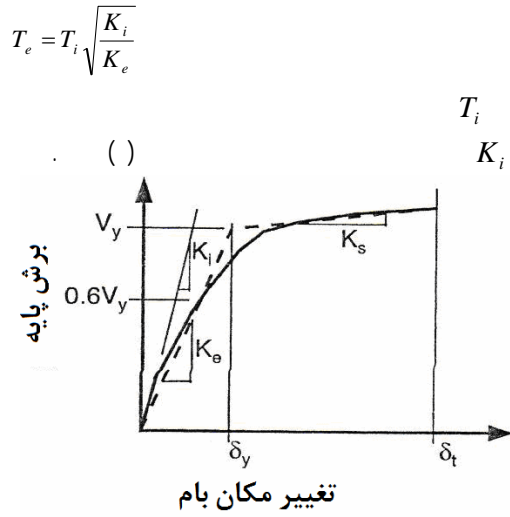
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$$\alpha = \frac{1}{6} \quad \delta = \frac{1}{\gamma}$$



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$$\delta_t = C_0 C_1 C_2 C_3 S_a \frac{T_e^2}{4\pi^2} g \quad ( )$$

$T_e$

$S_a$

$C_0$

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$C_1$

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$T_0$  )  $T_e > T_0$

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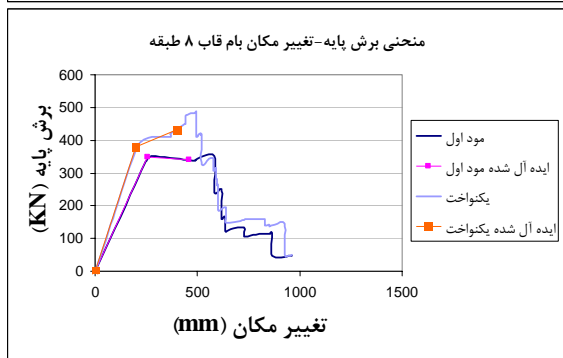
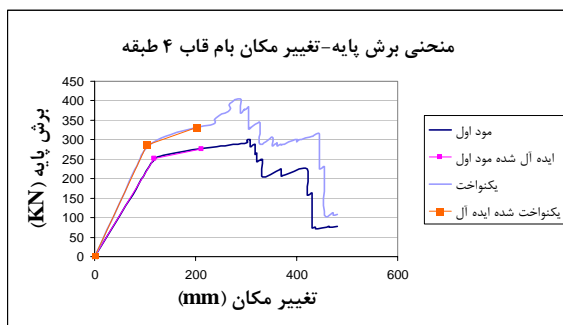
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C<sub>3</sub>

P-Δ

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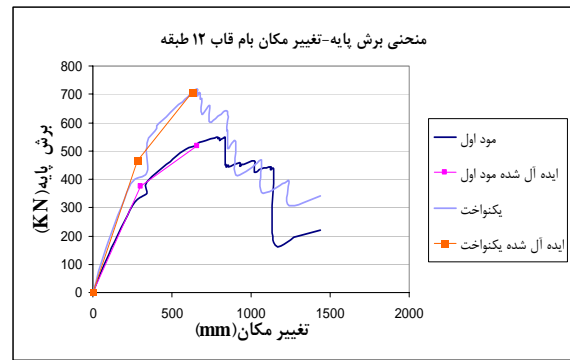
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	Clough	Takeda	Severe	Clough	Takeda	Severe	Clough	Takeda	Severe
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Kocaeli	/	/	/	/	/	/	/	/	/
Lomap	/	/	/	/	/	/	/	/	/
Northridge	/	/	/	/	/	/	/	/	/
Palm Springs	/	/	/	/	/	/	/	/	/
Capemendocino	/	/	/	/	/	/	/	/	/
Superestiti hills	/	/		/	/	/	/	/	/
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