IDEALIZE LOAD-DISPLACEMENT CURVE - CYCLIC LOADING

This software uses the energy equivalence method to **idealize** the load-displacement curves for **cyclic loading tests**. The yield displacement (Δ_y) and corresponding load (i.e., F_y) of a RC column is determined according to the procedure described by Sezen and Moehle (2004) as shown in **Figure 1.**

"Sezen, H., and Moehle, J. P., 2004, "Strength and Deformation Capacity of Reinforced Concrete Columns with Limited Ductility," Proceeding of the 13th World Conference on Earthquake Engineering, v. 279, pp. 1-15".

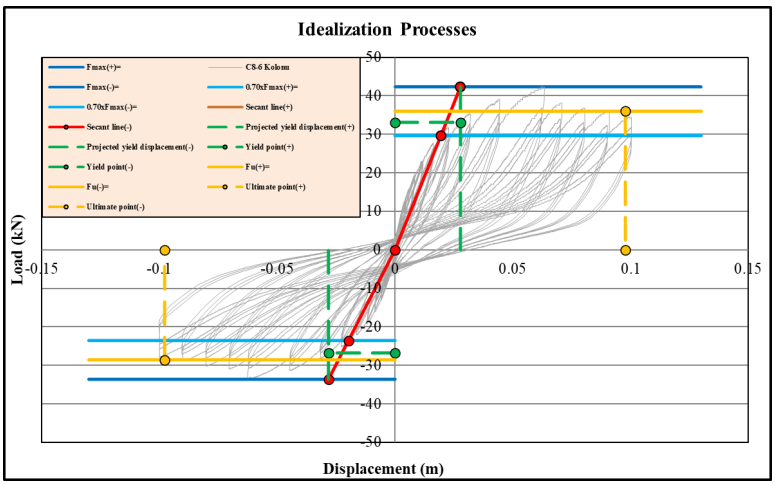

Figure 1: Idealized load-displacement curves based on Sezen and Moehle (2004).

- In this method, the ultimate load (**Fu**) is obtained when the given set of three cycles drop to 85% of the maximum lateral load.

- **Cumulative energy dissipation capacity:** The cumulative energy dissipation capacity of a RC column is determined using Eq. (1) and **Figure 2**.

$$E = \Sigma_{i=1}^{n} E_i, \qquad (1)$$

where ***E*** is the sum of all hysteretic loops, and E_i is calculated from the energy dissipated at each positive and negative cyclic loop. In Eq. (1), the total dissipated energy of the tested RC column is determined by the sum of all loading cycles until the lateral force of the member is reduced to 85% of the maximum load.

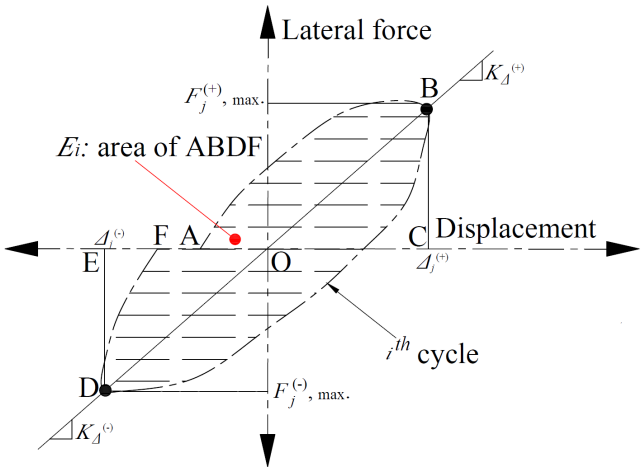

Figure 2: Schematic for energy dissipation capacity and stiffness.

- **Stiffness degradation:** The stiffness of a RC column is calculated according to procedure described by Sun et al. (2008).

  "Sun, Z.; Si, B.; Wang, D.; and Guo, X., 2008, "Experimental Research and Finite Element Analysis of Bridge Piers Failed in Flexure-Shear Modes," Earthquake Engineering and Engineering Vibration, V. 7, No. 4, pp. 403-414".

$$K_\Delta = \frac{K_\Delta^+ + K_\Delta^-}{2} \quad \textbf{(2)}$$

$$K_\Delta^+ = \sum_{j=1}^{3} F_{j,max}^+ / \sum_{j=1}^{3} \Delta_j^+ , K_\Delta^- = \sum_{j=1}^{3} F_{j,max}^- / \sum_{j=1}^{3} \Delta_j^- , \quad \textbf{(3)}$$

where $F_{j,max}$ and Δ_j are the maximum lateral load within a cycle and its corresponding displacement, respectively (refer to Figure 3).

- **Energy based ductility index:** The energy-based ductility index ($\mu_E = \frac{E_u}{E_y}$) of a RC column is defined as the ratio of the **cumulative energy dissipation** to the **cumulative dissipated energy at the yield strength**.