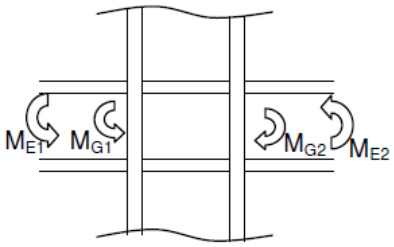
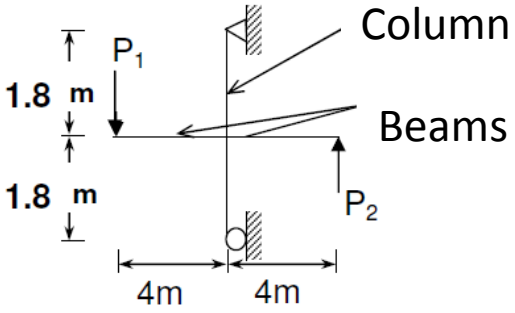
Seismic Design of Steel Structures Homework # 3 **Due 4/16/2018**





This beam-to-column connection subassembly has been adopted in HW#2. In this HW#3, you are required to construct three PISA3D models (Models A, B and C). Please compute the PZ elastic stiffness and the PZ yield strength for the two different PZ designs, Taiwanese and US PZs you did in Item (2) and (3), respectively in Homework#2. Assume $P_1=P_2=120$ kN. (1) If E = 200 GPa, please answer the following two questions:

(1a) Consider member center-to-center line dimensions and neglect the PZ deformation, please construct PISA3D Model A (without PZ and rigid member end zone), compute the total elastic displacement (mm) in the P_1 direction. Compute the beams and column contributions (percentages) in the total deformation at the cantilever end.

(1b) Consider the PZ deformation in both two PZ designs, construct the PISA3D Model B and C using member rigid end zones, a joint element placed between the double nodes at the beam-to-column joint. Apply suitable elastic stiffness and PZ strength for both Models B and C, compute the total elastic displacements (mm) in the P_1 direction. Calculate the contributions (percentages) of the PZ, the column and the beams to the cantilever end displacement from Models B and C. Tabulate your results and discuss your findings from the responses of Models A, B and C.

(2) For the beam-to-column moment connection tested as shown in the article SW2.pdf, construct the PISA3D model and compare your analytical results with the test results given in SW2.xls as suggested in the following:

(2a) Calculate PZ stiffness and yield strength using twice the column plate thickness before constructing analytical model. Apply joint element between the double nodes at the beam-to-column juncture, beam-column element and rigid end offsets for the column and the beam members in your model. Assume column ends are pin-supported. Properly specify beam and column sectional properties, using bi-linear stress vs. strain material model for all elements, apply cyclic displacement history according to the test data SW2.xls. Compare the analytical results with the test by plotting the total beam deformation versus cantilever beam force relationships. Also compare the analytical PZ, column, beam rotational components versus beam force relationships with the test results.

(2b) Repeat 2a, but using the plastic hardening material model for all elements. Make sure you try changing the hardening parameters and report the best selections of hardening properties.

(2c) Discuss your experience gained from the exercise in (2a) and (2b).