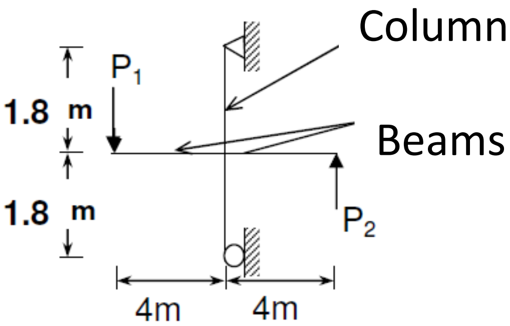
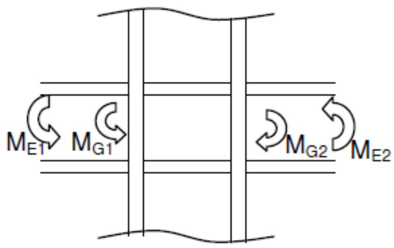
Seismic Design of Steel Structures Homework # 2 Due 3/26 /2018

(1) Read the reference paper "Experimental Investigation of Dogboned Moment Connection (Engelhardt, et al.1998)". Try deriving the following equation:

$$C \geq \frac{Z}{2t_f\left(d - t_f\right)}\left[1 - \frac{\alpha(L - a - 0.5b)}{\beta L}\right]$$

where L=3800mm is the cantilever beam clear span, β is the strain hardening factor and the meaning of other parameters can be found in the stated reference paper. Assume the beam section is H600×250×14 ×26mm, if we want to let the moment demand in the column face is smaller than αM_p and assume $\beta = 1.15$, please design the size of "C" (to the full mm) in the above equation for $\alpha = 0.90$, and calculate the C/b_f ratio.





(2) Please consider the conditions in the figures (M_G and M_E are due to gravity and earthquake loads respectively) and the current Taiwanese seismic steel building codes which require to consider the demand of $\sum M_p$ from the two beams on the panel zone (PZ). Design the PZ doubler plate thickness (up to full mm), using the above requirement, LRFD method and consider the capacity of the PZ as $0.6F_yd_ct_p$. Column is H400×400×20×32mm (SN490, Fy=3.3 t/cm^2), beam is H600×250×14×26mm (A36, Fy=2.5t/cm^2), $\phi = 1.0$.

(3) If we want to design the PZ using the 2010 AISC seismic steel building codes which consider the demand as the sum of two amplified beam moment capacity $\sum 1.1R_yM_p$. Consider the overstrength factor R_y=1.5 for A36 steel. Please design the PZ doubler plate thickness (up to full mm) using the LRFD method, PZ strength at $4.0\gamma_y$ and $\phi = 1.0$.

(4) In Problem (2), assume P1=P2=120 kN. If E=200 GPa, please answer the following two questions: (4a) Consider member center-to-center line dimensions and neglect the PZ deformation, please compute the total elastic flexural displacement (mm) in the P_1 direction. Compute the beams and column deformation contributions (percentages) to the total displacement at the cantilever end.

(4b) Consider PZ deformation for Problems 2, calculate the total displacement (mm) in the P1 direction. Calculate the elastic deformation contributions (in terms of percentage) of the PZ, the column and the beams to the total cantilever end displacement. Discuss your findings with that computed in Problem (4a).

(5) Indicate if you have neglected the shear deformation of the beams and column in the calculations.