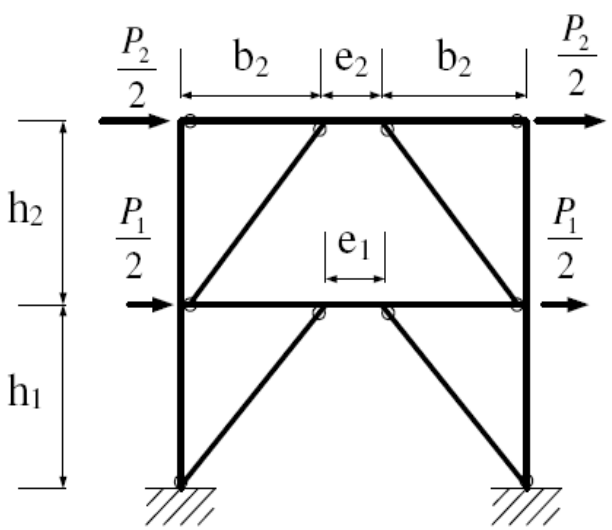
**Seismic Resistant Design of Steel Structures**
**Homework#4** **Due 4/30/2018**




The link lengths, e1=e2=1.3m. The beam segment, b2=3.5m.
The story height, h1=h2=3.5m.
The upper beam is H500×300×12×24mm, and the lower beam H500×300×$t_w$×$t_f$ mm. All member ends are pin connections. The LRFD seismic lateral forces, P2=200 tons, P1=100 tons. Assume all beams, columns are SN490B (Fy=3.3 t/cm$^2$). Braces is A500B (Fy=3.5 t/cm$^2$). Assume beam segments outside the link are laterally supported at every 1.75 meters. Check the b/t ratios of the sections as you proceed.

(1) Assume column base is pin connected, all lateral forces are resisted by the braces, check the shear force in the upper link by hand calculation to see if it exceeds the limit. Is the link in the upper floor beam a shear or flexural link?
(2) Check the capacity design of the upper beam segment outside the link and report the demand-to-capacity ratio (DCR) of the beam segment outside the link.
(3) Design the $t_f$ and $t_w$ for the lower beam so that it meets the requirements for a shear link and with a length no greater than $1.3M_p/V_p$. Check the DCR of the lower beam segment outside the link.
(4) Select two different square hollow structural sections (HSS) for the braces in the upper and lower stories. Show DCRs and all the calculations to meet the capacity design requirements.
(5) If the column size is H350×350×15×32mm. Assume all the columns are laterally supported at the floor level, apply strain hardening factor of 1.1 for link and check the DCR in the column.
(6) Construct the PISA3D model, apply the stated lateral forces and compute the elastic inter-story drift. Apply the $C_d$ factor (prescribed in AISC 2005), estimate the inelastic link deformational demands and size the link web stiffeners for the upper and lower links.
(7) Apply proper material model for the link so that the link can yield in shear and bending accordingly. Keep the stated lateral load pattern unchanged but apply cyclic roof drift for ±0.005, ±0.01, ±0.015, ±0.020 and ±0.025 radians, two cycles each. Properly specify the strain hardening control parameters so that at the ±0.025 radians story deformation, the strain hardened shear strength is between 1.3~1.4$V_p$. Plot the cyclic lateral shear force versus lateral drift, link shear versus link rotation relationships for both floors. Mark the LRFD lateral

shear force and the link shear yield strength in the plots.
(8) Change the column base and all the beam-to-column connections from pin to rigid, but keep all the braces pin-ended. Repeat Items 6 and 7.
(9) Discuss the $\Omega_o$ factors you observed in Items 7 and 8.
(10) Discuss your experience in constructing the analytical models. Upload your .ipt files for your PISA3D analytical models. Include your full name in the .ipt file name.