Seismic Design of Steel Structures
Homework #5 **Due: May 7, 2018**

1. Read the latest US seismic steel building provisions for the BRB (AISC 341-10 Seismic Provisions for Structural Steel Building), please show how to calculate the design maximum tensile and compressive axial forces in a BRB. And discuss the meaning of various parameters.

2. See Fig.1, consider the length and the averaged cross sectional area of the combined connection-transition segment at each end of the BRB are 0.25 and 1.6, repectively times those of the BRB core segment. Please plot the best estimates of the relationship between ε_{core} and θ, from 0.0 to 0.03 radians, when the frame deforms from the (A) elastic into the (B) inelastic ranges, where ε_{core} is the axial strain of the BRB steel core and θ is the inter-story drift. Assume A572 GR 50 steel ($Fy=3.5t/cm^2$) is elastic-perfect plastic material. Assume the angle of the brace Φ is 30 degree.

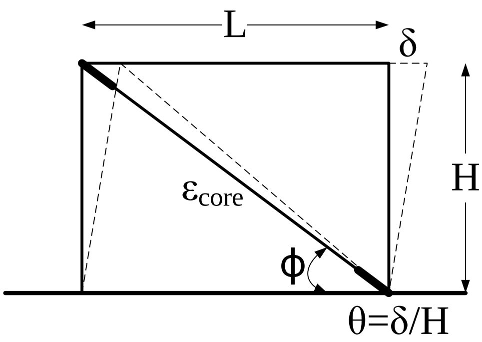

Figure1

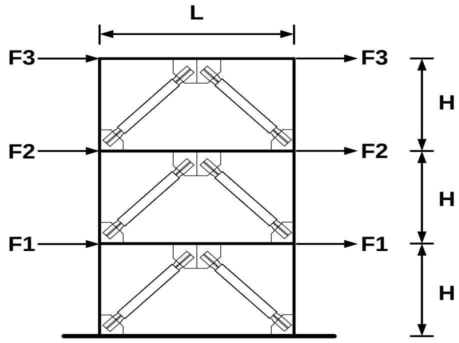

Figure 2

3. Figure 2 shows the distribution of design lateral forces of the BRBF(L=8.0m, H=4.0m). Where the LRFD-level seismic lateral forces, $2xF_3=2x120t$, $2xF_2=2x80t$ and$2xF_1=2x40t$. Assume the material of brace and beam are SN490 ($Fy=3.3t/cm^2$), and the stress should be no greater than $0.9F_y$ in the BRB core section. Please calculate the required cross-sectional area (Ac) of the energy dissipation core segment in the first story BRB. Assume all lateral forces are resisted by BRBs. The beam will have to transfer the horizontal force component of the BRB axial forces, it also needs to resist the unbalanced load components from the peak compression and tension BRBs. Please calculate the maximum axial force and the moment demands on the lowest floor beam using LRFD procedure. (Without the presence of gravity load, compute the column maximum axial compressive and tensile forces in the lowest story.)

4. The variation of cross-sectional areas along the length of the BRB is shown in Figure 3, where L_{wp} = 7.0m, L_c = 4.2m, L_j= 2.4m and assume A_t = 1.3A_c, A_j= 1.6A_c. What is the effective stiffness K_{eff} in terms of EA_c/L_{wp}? If we need to use L_{wp} (distance of work-point to work-point) and K_{eff} in an analytical model with just one truss element to represent the BRB, please explain how to assign the material elastic modulus, yield stress and effective cross sectional area of the BRB. If the nominal yield capacity of the BRB is Py=3000kN (SN490, Fy=3.3t/cm^2), the length of steel casing (square hollow structural section, HSS) is 5.0meter. Please select the smallest square hollow structural section (HSS) for the WES-BRB.

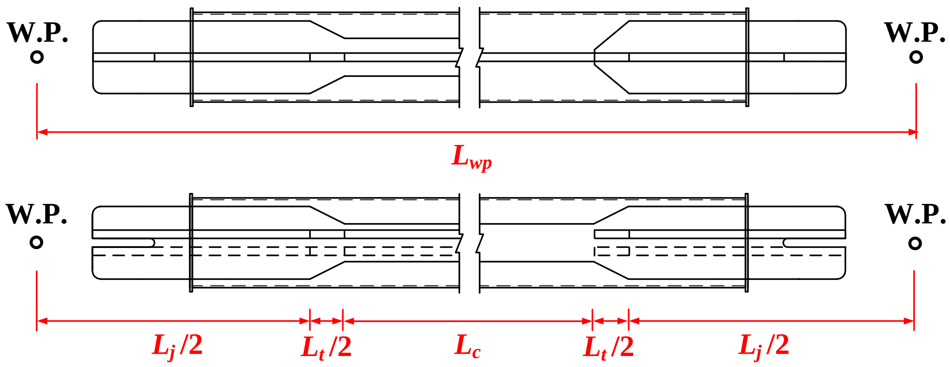

Figure 3