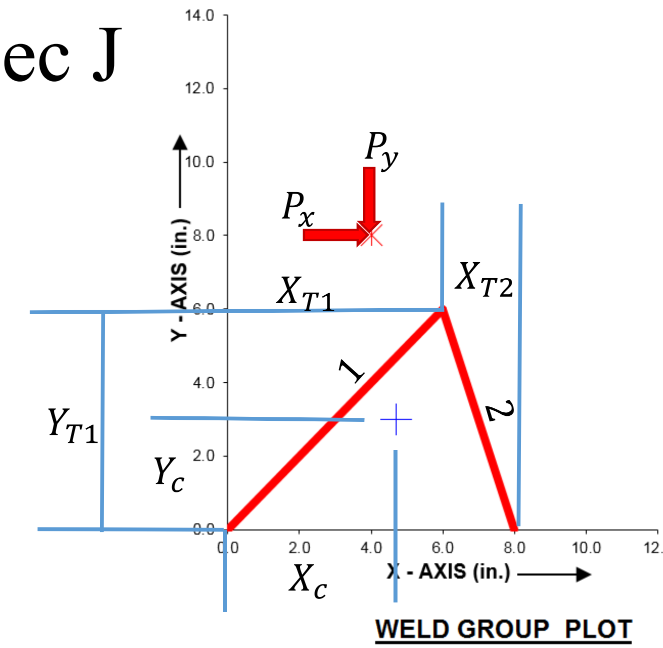
Welded Connection Design – AISC Spec J

General Elastic Method for Any Weld Group w/ Same Size Welds



General Elastic Method (as adopted from Alex Tomanovich)

1) Identify Weld Group Main Parameters

- L_{wt} = total length of weld group
- Centroid of Weld Group
  - $X_c = \frac{\sum X_c}{L_{wt}}$ when $X_c = (X_{mid,indv})(L_{w,indv})$
  - $Y_c = \frac{\sum Y_c}{L_{wt}}$ when $Y_c = (Y_{mid,indv})(L_{w,indv})$
- Calculate I_x, I_y, J
  - $I_x = (\sum I_{x0}) - L_{wt}(Y_c)^2 \rightarrow I_{xo1} = \frac{(L_1)(Y_{T\,1})^2}{12} + L_1(Y_{mid,1})^2$ continue for each weld
  - $I_y = (\sum I_{y0}) - L_{wt}(X_c)^2 \rightarrow I_{yo1} = \frac{(L_1)(X_{T\,1})^2}{12} + L_1(X_{mid,1})^2$ continue for each weld
  - $J = I_x + I_y$

2a) Moment Summations about CG (for each point loaded)

- **USE RIGHT HAND RULE CENTERED ON THE CG_{weld}!!!!**

$M_{xfrom(P_y)} = (Z_{load\ point} - Z_{CG_{weld}})(P_y)$

$M_{xfrom(P_z)} = (Y_{load\ point} - Y_{CG_{weld}})(P_z)$

$M_{yfrom(P_x)} = (Z_{load\ point} - Z_{CG_{weld}})(P_x)$

$M_{yfrom(P_z)} = (X_{load\ point} - X_{CG_{weld}})(P_z)$

$M_{zfrom(P_x)} = (Y_{load\ point} - Y_{CG_{weld}})(P_x)$

$M_{zfrom(P_y)} = (X_{load\ point} - X_{CG_{weld}})(P_y)$

2b) Loads Transformed for Effects @ CG of Weld Group

Notation $M_{xfrom(P_y)}$ indicates moment about x-axis caused by P_y.

- $\sum P_x = Applied\ P_x$
- $\sum P_y = Applied\ P_y$
- $\sum P_z = Applied\ P_z$
- $\sum M_x = Applied M_x + M_{xfrom(P_y)} + M_{xfrom(P_z)}$
- $\sum M_y = Applied M_y + M_{yfrom(P_x)} + M_{yfrom(P_z)}$
- $\sum M_z = Applied M_z + M_{zfrom(P_x)} + M_{zfrom(P_y)}$

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Elastic Method General Algorithm

General Elastic Method (as adopted from Alex Tomanovich)

3) Weld Forces @ Individual Points (Weld Ends): The forces are dependent on Cx & Cy, as measured from CG_{weld}

BE AWARE OF THE MOMENT ORIENTATION AND RIGHT HAND RULE!!!

- $f_z = \frac{\sum P_z}{L_{wt}} + \frac{(\sum M_x)(C_{y1b})}{I_x} + \frac{(\sum M_y)(C_{x1b})}{I_y}$
- $f_{vy} = \frac{\sum P_y}{L_{wt}} + \frac{(\sum M_z)(C_{x1b})}{J}$
- $f_{vx} = \frac{\sum P_x}{L_{wt}} + \frac{(\sum M_z)(C_{y1b})}{J}$ (e.g. positive moment about Z will produce force in negative X if C_{y1b} is positive)
- $f_{resultant} = \sqrt{(f_z)^2 + (f_{vy})^2 + (f_{vx})^2}$ $\frac{Force}{Unit\ Length}$ ➔ Usually $\frac{Kips}{in}$

4) Weld Requirements and Base Metal Check

- Fillet weld size required (in 16ths of an inch) = $\frac{f_{resultant}}{0.75*w*(0.6F_{EXX})*(unit\ length)} = \frac{f_{resultant}}{1.392\ ^k/_{in}/_{16th}}$ for LRFD.
  - If using ASD, substitute $0.928^k/_{in}/_{16th}$ for $1.392\ ^k/_{in}/_{16th}$
- Base Metal Shear Allowable
  - LRFD: $\emptyset R_n = (1.00)(0.6)(F_{ybase})(Base\ Metal\ Thickness)$ ➔ ______ $^{force}/_{unit\ length}$ usually $\frac{Kips}{inch}$
  - Refer to AISC Spec. J4
  - $R_n = 0.6F_yA_{gv}$ $w/\ \emptyset = 1.00\ or\ \Omega = 1.5\ (This\ is\ where\ 0.4F_y\ for\ ASD\ comes\ from)$