MEMBER REPORT FOR ZSECTIONLIPPED SECTION

Design checks for AISI S100-12 as per provision ASD

PROJECT DETAILS

Project Name:
Project ID:
Company:
Designer:
Client:
Project Notes:
Project Units: Imperial

General member design information

Section Name: 12Z52.75x070
Shape: Z-Section w/ Lips

Dimensions:
Height, \( h = 12 \) in
Thickness, \( t = 0.07 \) in
Top Flange Width, \( TFw = 2.75 \) in
Bottom Flange Width, \( BFw = 2.75 \) in
Lip Depth, \( d = 0.93 \) in
Fillet Radius, \( r = 0.188 \) in

Properties:
Area, \( A = 1.33 \) in²
Moment of Inertia about the z-axis, \( I_z = 27.9 \) in⁴
Moment of Inertia about the Y-Axis, \( I_y = 1.02 \) in⁴
Plastic Section Modulus about the z-axis, \( Z_z = 5.446 \) in³
Plastic Section Modulus about the Y-Axis, \( Z_y = 0.959 \) in³
Torsion Constant, \( J = 0.00217 \) in⁴
Warping Constant, \( lw = 56 \) in⁶

Material properties:
Material Name: Structural Steel
Modulus of Elasticity, \( E = 29007.547 \) ksi
Yield Strength, \( F_y = 37.71 \) ksi
Ultimate Tensile Strength, \( F_u = 59.465 \) ksi

Design Parameters:
Design Method: ASD

Flexural Buckling parameters:
Effective length factor for flexural buckling about Z-Axis, \( K_z = 1 \)
Effective length factor for flexural buckling about Y-Axis, \( K_y = 1 \)
Member length for flexural buckling, \( L = 137.795 \) in
Length between braced points, \( L_b = 137.795 \) in

Lateral Torsional Buckling parameters:
Coefficient for lateral-torsional buckling, \( C_t = 1 \)
End moment coefficient in interaction formula, \( C_{TF} = 1.0 \)
Design Internal Forces

Load Case:
Name = Worst Case Load Combination
Type = User Define

For check axial strength:
Absolute Maximum Axial Force, $P = 0.004$ kip

For check flexural strength about Z-Axis:
Absolute Maximum Major Bending Moment, $M_z = 0.191$ kip-in

For check flexural strength about Y-Axis:
Absolute Maximum Major Bending Moment, $M_y = 0.025$ kip-in

For check shear strength Y-Axis:
Absolute Maximum Shear Force, $V_x = 0.006$ kip

For check shear strength Z-Axis:
Absolute Maximum Shear Force, $V_y = 0$ kip

For check interaction of combined compression and bending strength:
Axial Force, $P = 0.004$ kip
Z-Axis Bending Moment, $M_z = 0.191$ kip-in
Y-Axis Bending Moment, $M_y = 0.025$ kip-in

For check interaction of combined bending and shear strength:
Z-Axis Bending Moment, $M_z = 0.191$ kip-in
Y-Axis Bending Moment, $M_y = 0.025$ kip-in
Shear Force, $V_y = 0.006$ kip
Shear Force, $V_x = 0$ kip

BENDING CAPACITY CHECK

Bending about Y-Axis

$$M_{sy} = S_p F_p$$

$$M_{sy} = (0.602) (37.71) = 22.701 \text{ kip-in}$$

Allowable Flexural Strength $= \frac{M_{sy}}{\Omega_b} = \frac{22.701}{1.67} = 13.593 \text{ kip-in}$

Calculate Nominal flexural strength about Y-Axis ($M_{sy}$)

$$\frac{M_{sy}}{\text{Allowable Flexural Strength}} = 0.025 \frac{13.593}{0.002} = 0.025 < 1.0$$

Bending about Z-Axis

$$M_{sz} = S_p F_p$$

$$M_{sz} = (4.231) (37.71) = 154.851 \text{ kip-in}$$

Calculate Nominal flexural strength about Z-Axis ($M_{sz}$)

Allowable Flexural Strength $= \frac{M_{sz}}{\Omega_b} = \frac{154.851}{1.67} = 92.725 \text{ kip-in}$

$$\frac{M_{sz}}{\text{Allowable Flexural Strength}} = 0.191 \frac{92.725}{0.002} = 0.191 < 1.0$$
\[
\lambda_c = \sqrt{\frac{F_g}{F_e}} - \sqrt{\frac{37.71}{30.06}^{1.12}}
\]

Calculate Slenderness factor \((\lambda_c)\)

\[
F_g = (0.658^{1.37}) (F_e)
\]

\[
F_e = (0.658^{1.37}) (37.71)
\]

Calculate Nominal Buckling Stress \((F_{nc})\)

\[
P_s = A_e F_{nc} = 0.828 (22.306) = 18.478 \text{ kip}
\]

Calculate Nominal Flexural-Torsional Buckling Strength \((P_{nc})\)

\[
\begin{align*}
\text{Allowable Strength} \cdot \frac{P_{nc}}{\Omega_e} & = \frac{18.478}{1.8} = 10.265 \text{ kip} \\
\end{align*}
\]

Calculate the allowable Flexural-Torsional Buckling strength \((P_s)\)

\[
\begin{align*}
P & = \frac{0.004}{10.265} = 0 \leq 1.0
\end{align*}
\]

DISTORTIONAL BUCKLING STRENGTH CHECK (BENDING)

\[
F_d = \frac{1}{\beta} \frac{h_{fle} + h_{opw} + h}{h_{fle} + h_{opw}} = 1.00 \frac{0.2724087 + 0.2601159 + 0.00000}{0.0102690 + 0.0035508} = 38.422 \text{ ksi}
\]

Calculate Distortional Buckling Stress \((F_d)\)

\[
\lambda_b = \sqrt{M_d/M_{tot}} = \sqrt{175.352/178.663} = 0.991
\]

Calculate Slenderness factor \((\lambda_b)\)

\[
M_a = \left(1 - 0.22 \left( \frac{M_{tot}}{M_d} \right)^{0.5} \right) \left( \frac{M_{tot}}{M_d} \right)^{0.5} = \left(1 - 0.22 \left( \frac{178.663}{175.352} \right)^{0.5} \right) \left( \frac{178.663}{175.352} \right)^{0.5} = 137.694 \text{ kip-in}
\]

\[
M_d = S_y F_d = 4.65 (37.71) = 175.352 \text{ kip-in}
\]

\[
M_{tot} = S_y F_d = 4.65 (38.422) = 178.663 \text{ kip-in}
\]

Calculate Nominal Bending Strength for Distortional Buckling \((M_a)\)

\[
\text{Allowable Strength} \cdot \frac{M_a}{\Omega_b} = \frac{137.694}{1.67} = 82.451 \text{ kip-in}
\]

Calculate Allowable Distortional Buckling Strength \((M_a)\)

\[
\frac{M}{\text{Capacity}} = \frac{0.191}{82.451} = 0.002 < 1.0
\]

DISTORTIONAL BUCKLING STRENGTH CHECK (COMPRESSION)
### Task 1: Reading/Understanding

- Initial Reading/Understanding:
  - Initial step to understand the context.

- Gradual Reading/Understanding:
  - Breaking down the information into manageable parts.

### Task 2: Comprehending and Relating

- Comprehending and Relating:
  - Connecting the pieces of information to form a coherent understanding.

### Task 3: Visualizing

- Visualizing:
  - Creating mental images related to the tasks.

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### Task 4: Synthesizing

- Synthesizing:
  - Integrating the information into a single, cohesive understanding.

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### Task 5: Dealing with Ambiguity

- Dealing with Ambiguity:
  - Addressing any uncertainties or unclear parts of the tasks.

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### Task 6: Problem-Solving

- Problem-Solving:
  - Applying logical reasoning to resolve issues or find solutions.

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### Task 7: Decision-Making

- Decision-Making:
  - Making choices based on the information gathered and analyzed.

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### Task 8: Monitoring

- Monitoring:
  - Keeping track of progress and any changes in the tasks.

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### Task 9: Revising

- Revising:
  - Reviewing the completed tasks to ensure accuracy and completeness.

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### Task 10: Reviewing

- Reviewing:
  - Evaluating the effectiveness of the tasks and identifying areas for improvement.

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### Task 11: Reflecting

- Reflecting:
  - Considering the outcomes and learning from the experience.

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### Task 12: Evaluating

- Evaluating:
  - Assessing the quality and impact of the tasks.

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### Task 13: Improving

- Improving:
  - Enhancing the methods and tools used in the tasks.

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### Task 14: Optimizing

- Optimizing:
  - Maximizing efficiency and effectiveness in the tasks.

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### Task 15: Finalizing

- Finalizing:
  - Concluding the tasks with a thorough review and final adjustments.